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SERVICE MANUAL

Workmaster™ 50 / Workmaster™ 60 / Workmaster™ 70
Tier 4B (final)
Tractor

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NEW HOLLAND AGRICULTURE

https://truckmanualshub.com/

SERVICE MANUAL

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

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Link Product / Engine

Product	Market Product	Engine
Workmaster™ 50 Compact tractor, 2WD, 50 HP, TIER 4B (FINAL)	North America	R 753 IE4
Workmaster™ 50 Compact tractor, 4WD, 50 HP, TIER 4B (FINAL)	North America	R 753 IE4
Workmaster™ 60 Compact tractor, 2WD, 60 HP, TIER4B (FINAL)	North America	R 753 IE4
Workmaster™ 60 Compact tractor, 4WD, 60 HP, TIER 4B (FINAL)	North America	R 753 IE4
Workmaster™ 70 Compact tractor, 2WD, TIER 4B (FINAL)	North America	R 753 IE4
Workmaster™ 70 Compact tractor, 4WD, 70 HP, TIER 4B (FINAL)	North America	R 753 IE4

https://truckmanualshub.com/

Contents

INTRODUCTION

Engine 10

[10.001] Engine and crankcase 10.1

[10.103] Crankshaft and flywheel 10.2

[10.202] Air cleaners and lines 10.3

[10.206] Fuel filters 10.4

[10.216] Fuel tanks 10.5

[10.310] Aftercooler 10.6

[10.400] Engine cooling system 10.7

Clutch 18

[18.100] Clutch mechanical release control 18.1

[18.110] Clutch and components 18.2

Transmission 21

[21.114] Mechanical transmission 21.1

[21.130] Mechanical transmission external controls 21.2

[21.140] Mechanical transmission internal components 21.3

[21.145] Gearbox internal components 21.4

[21.200] Dropbox 21.5

Four-Wheel Drive (4WD) system 23

[23.314] Drive shaft 23.1

Front axle system 25

[25.100] Powered front axle 25.1

[25.102] Front bevel gear set and differential 25.2

[25.108] Final drive hub, steering knuckles, and shafts 25.3

[25.310] Final drives 25.4

[25.400] Non-powered front axle 25.5

Rear axle system 27
[27.100] Powered rear axle 27.1
[27.106] Rear bevel gear set and differential 27.2
[27.120] Planetary and final drives 27.3
Power Take-Off (PTO) 31
[31.101] Rear mechanical control 31.1
[31.110] One-speed rear Power Take-Off (PTO) 31.2
[31.114] Two-speed rear Power Take-Off (PTO) 31.3
Brakes and controls 33
[33.120] Mechanical service brakes 33.1
Hydraulic systems 35
[35.000] Hydraulic systems 35.1
[35.100] Main lift system 35.2
[35.104] Fixed displacement pump 35.3
[35.204] Remote control valves 35.4
[35.300] Reservoir, cooler, and filters 35.5
[35.355] Hydraulic hand control 35.6
[35.359] Main control valve 35.7
Steering 41
[41.101] Steering control 41.1
[41.200] Hydraulic control components 41.2
[41.206] Pump 41.3
[41.216] Cylinders 41.4
Wheels 44
[44.511] Front wheels 44.1
[44.520] Rear wheels 44.2
Electrical systems 55
[55.000] Electrical system 55.1

[55.024] Transmission control system 55.2
[55.048] Rear Power Take-Off (PTO) control system 55.3
[55.100] Harnesses and connectors 55.4
[55.201] Engine starting system 55.5
[55.301] Alternator 55.6
[55.302] Battery 55.7
[55.404] External lighting 55.8
[55.405] External lighting switches and relays 55.9
[55.408] Warning indicators, alarms, and instruments 55.10
[55.512] Cab controls 55.11
[55.DTC] FAULT CODES 55.12
Platform, cab, bodywork, and decals 90
[90.100] Engine hood and panels 90.1
[90.110] Operator platform less cab 90.2
[90.116] Fenders and guards 90.3
[90.118] Protections and footboards 90.4

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https://truckmanualshub.com/

INTRODUCTION

https://truckmanualshub.com/

Contents

INTRODUCTION

Foreword 3
Foreword Ecology and the environment 4
Advice 5
International symbols 6
Safety rules 7
Basic instructions hardware 11
General specification - Biodiesel Fuels 12

Foreword

This repair manual provides the technical information needed to properly service the model tractors. Use this manual in conjunction with the operator's manual for complete operation, adjustment, and maintenance information

On NEW HOLLAND equipment, left and right are determined by standing behind the unit, looking in the direction of travel.

Foreword Ecology and the environment

Soil, air, and water are vital factors of agriculture and life in general. When legislation does not yet rule the treatment of some of the substances which are required by advanced technology, common sense should govern the use and disposal of products of a chemical and petrochemical nature.

NOTICE: *The following are recommendations which may be of assistance:*

- Become acquainted with and ensure that you understand the relative legislation applicable to your country.
- Where no legislation exists, obtain information from suppliers of oils, filters, batteries, fuels, antifreeze, cleaning agents, etc., with regard to their effect on man and nature and how to safely store, use and dispose of these substances.
- Agricultural consultants will, in many cases, be able to help you as well.

Helpful hints

- Avoid filling tanks using cans or inappropriate pressurized fuel delivery systems which may cause considerable spillage.
- In general, avoid skin contact with all fuels, oils, acids, solvents, etc. Most of them contain substances which may be harmful to your health.
- Modern oils contain additives. Do not burn contaminated fuels and or waste oils in ordinary heating systems.
- Avoid spillage when draining off used engine coolant mixtures, engine, gearbox and hydraulic oils, brake fluids, etc. Do not mix drained brake fluids or fuels with lubricants. Store them safely until they can be disposed of in a proper way to comply with local legislation and available resources.
- Modern coolant mixtures, i.e. antifreeze and other additives, should be replaced every two years. They should not be allowed to get into the soil but should be collected and disposed of properly.
- Do not open the air-conditioning system yourself. It contains gases which should not be released into the atmosphere. Your NEW HOLLAND dealer or air conditioning specialist has a special extractor for this purpose and will have to recharge the system properly.
- Repair any leaks or defects in the engine cooling or hydraulic system immediately.
- Do not increase the pressure in a pressurized circuit as this may lead to a component failure.
- Protect hoses during welding as penetrating weld splatter may burn a hole or weaken them, allowing the loss of oils, coolant, etc.

Advice

CALIFORNIA
PROPOSITION 65 WARNING

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Battery post, terminals and related accessories contain lead and lead compounds.

Wash hands after handling

BT09A213 1

International symbols

As a guide to the operation of the machine, various universal symbols have been utilized on the instruments, controls, switches, and fuse box. The symbols are shown below with an indication of their meaning.


Thermostart starting aid


Alternator charge


Fuel level


Automatic Fuel shut-off


Engine speed (rev/min x 100)


Hours recorded


Engine oil pressure


Engine coolant temperature


Coolant level


Tractor lights


Headlamp main beam


Headlamp dipped beam


Work lamps


Stop lamps


Horn


Radio

KAM
Keep alive memory


Turn signals



Turn signals -one trailer



Turn signals -two trailers


Front wind-screen wash/wipe


Rear wind-screen wash/wipe


Heater temp-erature control


Heater fan


Air conditioner


Air filter blocked


Parking brake


Brake fluid level


Trailer brake


Roof beacon


Warning ! Corrosive substance


PTO

N
Transmission in neutral


Creeper gears


Slow or low setting


Fast or high setting


Ground speed


Differential lock


Rear axle oil tem-perature


Transmission oil pressure


FWD engaged


FWD dis-engaged


Warning!


Hazard warning lights


Variable control


Pressurised! Open carefully


Position Control


Draft Control


Accessory socket


Implement socket


%age slip


Hitch raise (rear)


Hitch lower (rear)


Hitch height limit (rear)


Hitch height limit (front)


Hitch dis-abled


Hydraulic and transmission filters


Remote valve extend


Remote valve retract


Remote valve float


Malfunction! See Operator's Manual


Malfunction! (alter-native symbol)

Safety rules

PRECAUTIONARY STATEMENTS

Personal Safety

Throughout this manual and on machine signs, you will find precautionary statements ("DANGER", "WARNING", and "CAUTION") followed by specific instructions. These precautions are intended for the personal safety of you and those working with you. Please take the time to read them.

Machine Safety

The precautionary statement ("IMPORTANT") is followed by specific instructions. This statement is intended for machine safety.

NOTICE: *The word "IMPORTANT" is used to inform the reader of something they need to know to prevent minor machine damage if a certain procedure is not followed.*

Information

NOTE: *Instructions used to identify and present supplementary information.*

Legal obligations

This machine may be equipped with special guarding or other devices in compliance with local legislation. Some of these require active use by the operator. Therefore, check local legislation on the usage of this machine.

Accident prevention

Most accidents or injuries that occur in workshops are the result of a non compliance to simple and fundamental safety regulations. In most case, accidents can be avoided by foreseeing possible causes and consequently acting with the necessary caution and care.

Accidents may occur with all types of machines, regardless of how well the machine in question was designed and built.

A careful and informed service technician is the best guarantee against accidents.

Decisive awareness of the most basic safety rule is normally sufficient to avoid many serious accident.

Safety requirements for fluid power systems and components - Hydraulics (European standard PR EM 982)

⚠ WARNING

Avoid injury!
Before you start any work on the unit:
• Park the unit on a hard, level surface.
• Apply the parking brake.
• Completely lower the attachments.
• Relieve all the hydraulic system pressure.
• Shut down the engine.
• Remove the ignition key.
• Secure the unit with wheel chocks.
• Turn the battery isolator switch to the OFF position.
Failure to comply could result in death or serious injury.

W1371A

Flexible hose assemblies must not be constructed from hoses which have been previously used as part of a hose assembly.
Do not weld hydraulic piping.
When flexible hoses or piping are damaged, replace them immediately.
It is forbidden to modify a hydraulic accumulator by machining, welding or any other means.

Before removing hydraulic accumulators for servicing, the liquid pressure in the accumulators must be reduced to zero.
Pressure check on hydraulic accumulators shall be carried out by method recommended by the accumulator manufacturer.
Care must be taken not to exceed the maximum allowable pressure of the accumulator. After any check or adjustment there must be no leakage of gas.

Safety rules

A careful operator is the best operator. Most accidents can be avoided by observing certain precautions. To help prevent accidents, read and take the following precautions before operating this tractor. Equipment should be operated only by those who are responsible and instructed to do so.

The tractor

1. Read the Operator's Manual carefully before using the tractor. Lack of operating knowledge can lead to accidents.
2. Use an approved roll bar and seat belt for safe operation. Overturning a tractor without a roll bar can result in death or injury. If your tractor is not equipped with a roll bar and seat belt, see your NEW HOLLAND Dealer.
3. Always use the seat belt. The only instance when the seat belt should not be used is if the roll bar has been removed from the tractor or folding ROPS is in down position.
4. If a front end loader is to be installed, always use a FOPS (Falling Object Protective Structure) canopy to avoid injury from falling objects.
5. Use the handrails and step plates when getting on and off the tractor to prevent falls. Keep steps and platform cleared of mud and debris.
6. Do not permit anyone but the operator to ride on the tractor. There is no safe place for extra riders.
7. Keep all safety decals clean of dirt and grime, and replace all missing, illegible, or damaged safety decals. See the list of decals in the Decal section of this manual.

Servicing the tractor

1. The cooling system operates under pressure which is controlled by the radiator cap. It is dangerous to remove the cap while the system is hot. Always turn the cap slowly to the first stop and allow pressure to escape before removing the cap entirely.
2. Keep any type of open flame away from the tractor and do not smoke while refuelling. Wait for the engine to cool before refueling.
3. Keep the tractor and equipment, particularly brakes and steering, maintained in a reliable and satisfactory condition to ensure your safety and comply with legal requirements.
4. Keep open flame or cold weather starting aids away from the battery to prevent fires or explosions. Use jumper cables according to instructions to prevent sparks which could cause explosion.
5. Stop the engine before performing any service on the tractor.
6. Escaping hydraulic/diesel fluid under pressure can penetrate the skin causing serious injury. If fluid is injected into the skin, obtain medical attention immediately or gangrene may result.
   - Do not use your hand to check for leaks.
   - Use a piece of cardboard or paper to search for leaks.
   - Stop the engine and relieve pressure before connecting or disconnecting lines.
   - Tighten all connections before starting the engine or pressurizing lines.
7. Do not modify or permit anyone else to modify or alter this tractor or any of its components or functions without first consulting a NEW HOLLAND Dealer.
8. The fuel oil in the injection system is under high pressure and can penetrate the skin. Unqualified persons should not remove or attempt to adjust a pump, injector, nozzle, or any other part of the fuel injection system. Failure to follow these instructions can result in serious injury.
9. Continuous long-term contact with used engine oil may cause skin cancer. Avoid prolonged contact with used engine oil. Wash skin promptly with soap and water.

10. Some components of your tractor, such as gaskets and friction surfaces (brake linings, clutch linings, etc.) may contain asbestos. Breathing asbestos dust is dangerous to your health. You are advised to have any maintenance or repair on such components carried out by an authorized NEW HOLLAND Dealer. However, if service operations are to be undertaken on parts that contain asbestos, the essential precautions listed below must be observed:
    - Work out of doors or in a well ventilated area.
    - Dust found on the tractor or produced during work on the tractor should be removed by extraction, not by blowing.
    - Dust waste should be dampened, placed in a sealed container, and marked to ensure safe disposal.
    - If any cutting, drilling, etc. is attempted on materials containing asbestos, the item should be dampened and only hand tools or low speed power tools used.

Operating the tractor

1. Before starting the tractor, apply the parking brake, place the PTO lever in the 'OFF' position, the lift control lever in the down position, the remote control valve levers in the neutral position, and the transmission in neutral.
2. Always sit in the tractor seat when starting the engine or operating controls. Do not start the engine or operate controls while standing beside the tractor.
3. Do not bypass the neutral start switches. Consult your NEW HOLLAND Dealer if your neutral start controls malfunction. Use jumper cables only in the recommended manner. Improper use can result in tractor runaway.
4. Avoid accidental contact with the gear shift lever while the engine is running, as this can cause unexpected tractor movement.
5. Before getting off the tractor, disengage the PTO, turn the engine off, and apply the parking brake. Never get off the tractor while it is in motion.
6. Do not park the tractor on a steep incline.
7. Do not operate the tractor engine in an enclosed building without adequate ventilation. Exhaust fumes can cause death or illness.
8. If the power steering or engine ceases operating, stop the tractor immediately.
9. Pull only from the drawbar or the lower link drawbar in the down position. Use only a drawbar pin that locks in place. Pulling from the tractor rear axle or any point above the axle may cause the tractor to upset.
10. If the front end of the tractor tends to rise when heavy implements are attached to the three-point hitch, install front end or front wheel weights. Do not operate the tractor with a light front end.
11. Always set the hydraulic selector lever in position control when attaching or transporting equipment. Ensure hydraulic couplers are properly mounted and will disconnect safely in case of accidental detachment of implement
12. Do not leave equipment in the raised position.
13. Use the flasher/turn signal lights and Slow Moving Vehicle (SMV) signs when traveling on public roads both day and night (unless prohibited by law).
14. When operating at night, adjust lights to prevent blinding oncoming drivers.

Driving the tractor

1. Watch where you are going, especially at row ends, on roads, around trees and low hanging obstacles.
2. To avoid upsets, drive the tractor with care and at a safe speed. Use extra caution when operating over rough ground, when crossing ditches or slopes, and when turning corners.
3. To provide two-wheel braking, lock tractor brake pedals together when transporting on roads.
4. Do not coast or free wheel down hills. Use the same gear when going downhill as is used when going uphill.
5. Any towed vehicle with a total weight exceeding that of the towing tractor should be equipped with brakes for safe operation.
6. If the tractor becomes stuck or the tires become frozen to the ground, back up the tractor to prevent upset.
7. Always check overhead clearance, especially when transporting the tractor.
8. When operating at night, adjust lights to prevent blinding oncoming drivers.

Operating the Power Take-Off (PTO)

1. When operating PTO driven equipment, shut off the engine and wait until the PTO stops before getting off the tractor and disconnecting the equipment.
2. Do not wear loose clothing when operating the power take-off or when near rotating equipment.
3. When operating stationary PTO driven equipment, always place all gear shift levers in neutral position.
4. To avoid injury, do not clean, adjust, unclog, or service PTO driven equipment when the tractor engine is running.
5. Ensure the PTO master shield is installed at all times. Always replace the PTO shield cap when the PTO is not in use.

Diesel fuel

1. Under no circumstances should gasoline, alcohol, or blended fuels be added to diesel fuel. These combinations can create an increased fire or explosive hazard. Such blends are more explosive than pure gasoline in a closed container such as a fuel tank.
2. Never remove the fuel cap or refuel with the engine running or hot.
3. Do not smoke while refueling or when standing near fuel.
4. Maintain control of the fuel filler pipe nozzle when filling the tank.
5. Do not fill the fuel tank to capacity. Allow room for expansion.
6. Wipe up spilled fuel immediately.
7. Always tighten the fuel tank cap securely.
8. If the original fuel tank cap is lost, replace it with a NEW HOLLAND approved cap. A non-approved, proprietary cap may not be safe.
9. Keep equipment clean and properly maintained.
10. Do not drive equipment near open fires.
11. Never use fuel for cleaning purposes.
12. Arrange fuel purchases so that winter grade fuels are not held over and used in the spring.

Safety Frame or Roll Over Protective Structure (ROPS)

Your NEW HOLLAND tractor is equipped with a safety frame. It must be maintained in a serviceable condition. Be careful when driving through doorways or working in confined spaces with low headroom.

Under no circumstances should you:

- Modify, drill, or alter the safety frame in any way. Doing so may render you liable to legal prosecution.
- Attempt to straighten or weld any part of the main frame or retaining brackets which have suffered damage. Doing so may weaken the structure and endanger your safety.
- Secure any parts on the main frame or attach your safety frame with anything other than the special high tensile bolts and nuts specified.
- Attach chains or ropes to the main frame for pulling purposes.
- Take unnecessary risks even though your safety frame affords you the maximum protection possible.

Basic instructions hardware

General

Your tractor has been built using metric hardware.

NOTE: *Be sure to use the hardware specified when using tapped holes, as trying to install a metric bolt in an inch thread, or an inch bolt in a metric thread, will damage the thread.*

Certain hardware must be tightened to specific torque specifications. If specific torque specifications are not noted, tighten the hardware to the standard torque chart specification listed in this manual.

Plating

Hardware used on NEW HOLLAND balers is plated with zinc chromate (gold color). Gold colored hardware has different torquing requirements from unplated or zinc plated (silver color) hardware because of the difference in the coefficient of friction of the plating material. The torque charts in this manual list the correct specifications for gold, silver, and unplated bolts.

Nut tightening

Whenever possible, the nut should be tightened, not the head of the bolt. When tightening using the bolt head, the clamp load can be lost because some of the torque applied twists the bolt instead of tensioning (stretching) it. The tension on the bolt is what holds the joint together.

Approximately 90% of the torque applied during assembly goes to overcoming friction between the parts. The other 10% is used to tension (stretch) the bolt. After assembly, the frictional forces disappear, which is the basis for the saying 'If it does not fail during assembly, it will not fail in service.' The bolt may later fail due to other factors, but not from being over tightened.

Locknuts

Most locknuts are coated with a special lubricant that is dry to the touch. Anytime a locknut is used, a lower than normal torque is required. Refer to the torque charts in this manual for specific values.

Jam nuts

When using a jam nut to lock a regular nut, the jam nut should be installed first and tightened to one half the recommended torque, then held in place while installing a regular nut to the recommended torque.

Thread lubrication

The addition of antiseize compound, Molykote, oil, graphite, or any other lubricant to a bolt decreases the friction between it and a nut. This makes it necessary to reduce the recommended torque to prevent over tensioning of the bolt. When using the torque charts in this manual, decrease the value by 20% whenever a lubricant is used.

General specification - Biodiesel Fuels

Fatty Acid Methyl Ester Biodiesel (Biodiesel Fuel) consists of a family of fuels derived from vegetable oils treated with methyl esters.

NOTICE: *Biodiesel Fuel blends are approved for your engine only if they comply with* ***EN14214*** *Specification Standards or* ***ASTM D6751****.*

NOTICE: *It is imperative that you check which blend is approved for your engine with your NEW HOLLAND dealer. Be aware that the use of Biodiesel Fuel that does not comply with the Standards mentioned above could lead to severe damage to the engine and fuel system of your machine. The use of fuels that are not approved may void NEW HOLLAND Warranty coverage.*

Biodiesel Fuel Usage Conditions

NOTICE: *The Biodiesel Fuel must meet the fuel Specification mentioned above.*

Biodiesel Fuel must be purchased from a trusted supplier that understands the product and maintains good fuel quality. Biodiesel Fuel must be pre-blended by the supplier. Mixing Biodiesel Fuels on-site can result incorrect mixture that can lead to problems with both engine and fuel system.

Engine performance is affected by the use of Biodiesel Fuel. There may be up to **12 %** reduction in power or torque depending on the blend used.

NOTICE: *DO NOT modify the engine and/or injection pump settings to recover the reduced performance.*

The reduced power must be accepted if using any Biodiesel Fuel blend.

Some modification may be required to allow your engine to run Biodiesel Fuel. Consult you dealer for complete information on these modifications.

Biodiesel Fuel has a higher cloud point than Diesel Fuel.

NOTICE: *The use of high Biodiesel Fuel blends are not recommended in cold weather conditions.*

With Biodiesel Fuels, it may be necessary to change the engine oil, engine oil filter and fuel filter elements more frequently than with Diesel Fuels. Biodiesel Fuel can remove rust and particles from the inside of on-site fuel storage tanks that would normally adhere to the sides of the tank. Like particle deposits that commonly occur with Diesel Fuel, these particles can become trapped by the machine fuel filters, causing blockage and shortening filter life. In cold weather, this is more likely to happen. Consult your NEW HOLLAND dealer for information on cold weather operation and proper maintenance intervals when using any Biodiesel Fuel blend.

When handling Biodiesel Fuel, care must be taken not to allow water into the fuel supply. Biodiesel Fuel will actually attract moisture from the atmosphere.

Fuel tanks must be kept as full as possible to limit the amount of air and water vapors in them. It may be necessary to drain the fuel filter water tap more frequently.

Potential oxidation and stability could be a problem with the fuel stored in the machine.

NOTICE: *Machines must not be stored for more than three months with Biodiesel Fuel blends in the fuel system.*

If long storage periods are necessary, the engine must run on Diesel Fuel for 20 hours to flush the Biodiesel Fuel out of the engine fuel system prior to storage.

NOTICE: *Biodiesel Fuel must not be stored in on-site storage tanks for more than three months.*

Any spillage of Biodiesel Fuel must be cleaned up immediately before it can cause damage to the environment and the paint finish of the machine.

Before using Biodiesel Fuel blends you should consult with your dealer to receive full information about the approved blend for your machine and any detailed conditions of its usage.

NOTICE: *Be aware that not fulfilling the requirements and conditions of Biodiesel Fuel usage will void your machine's NEW HOLLAND Warranty coverage.*

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SERVICE MANUAL

Engine

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Engine - 10

[10.001] Engine and crankcase 10.1

[10.103] Crankshaft and flywheel..... 10.2

[10.202] Air cleaners and lines 10.3

[10.206] Fuel filters 10.4

[10.216] Fuel tanks 10.5

[10.310] Aftercooler..... 10.6

[10.400] Engine cooling system 10.7

https://truckmanualshub.com/

Engine - 10

Engine and crankcase - 001

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Engine - 10

Engine and crankcase - 001

SERVICE

Engine
Remove 3
Install 15

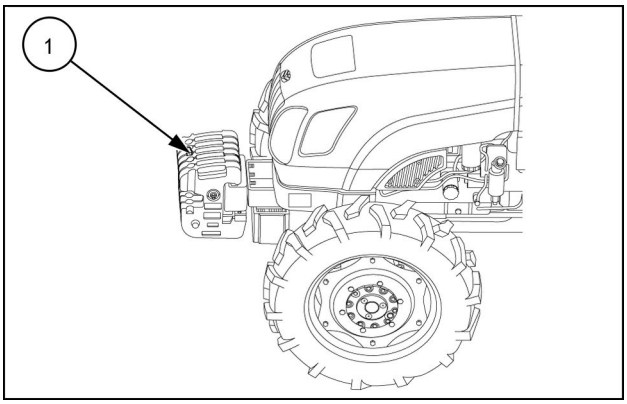
Engine - Remove

⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

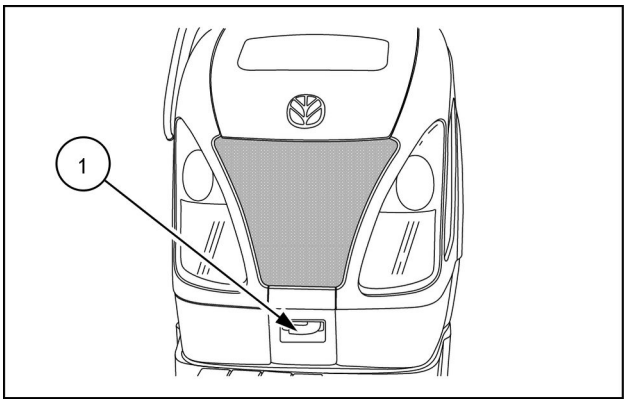
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1. Remove the front weights **(1)**.



GNIL14TR00829AA 1

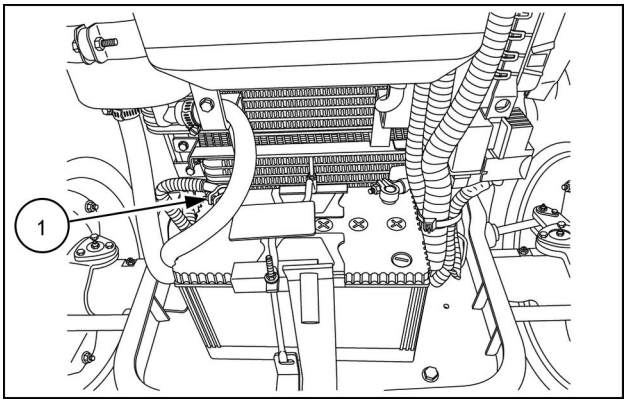
2. Slide the lock **(1)** to right, hold and raise the hood.



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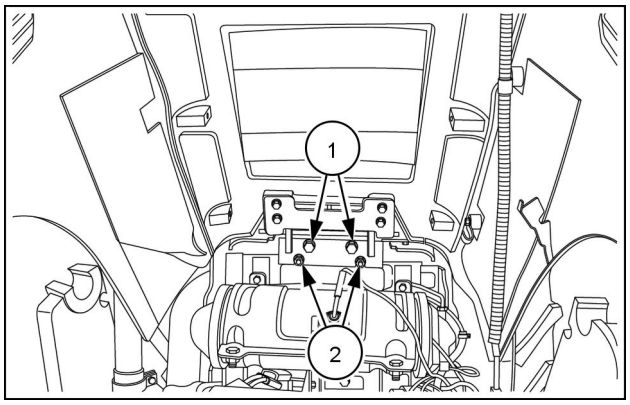
3. Disconnect the battery terminals.

NOTE: *Always disconnect the negative cable **(1)** first.*



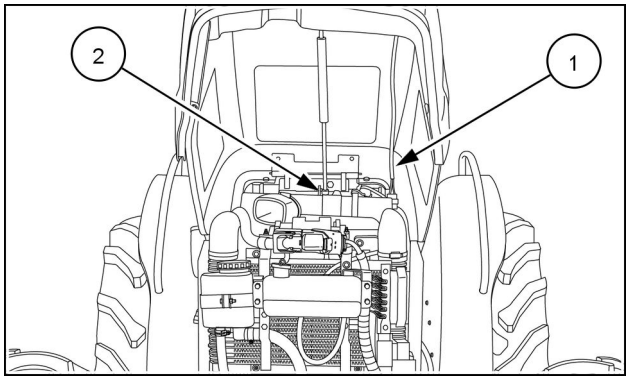
GNIL14TR00784AA 3

4. Unscrew the hood mounting bracket bolts **(1)** and nuts **(2)** from engine frame.



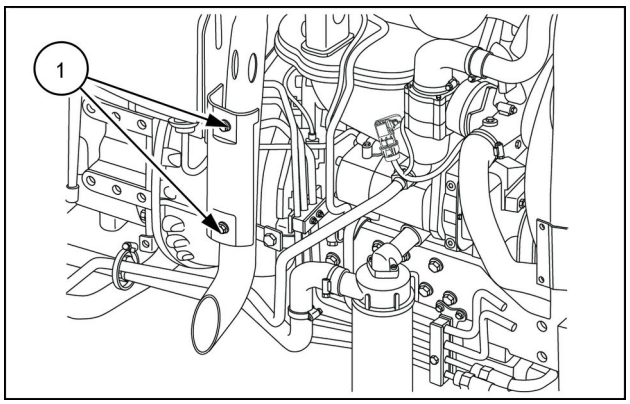
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5. Disconnect headlight and horn harness connection **(1)**.
6. Unscrew gas strut bolt **(2)** and remove the front hood.



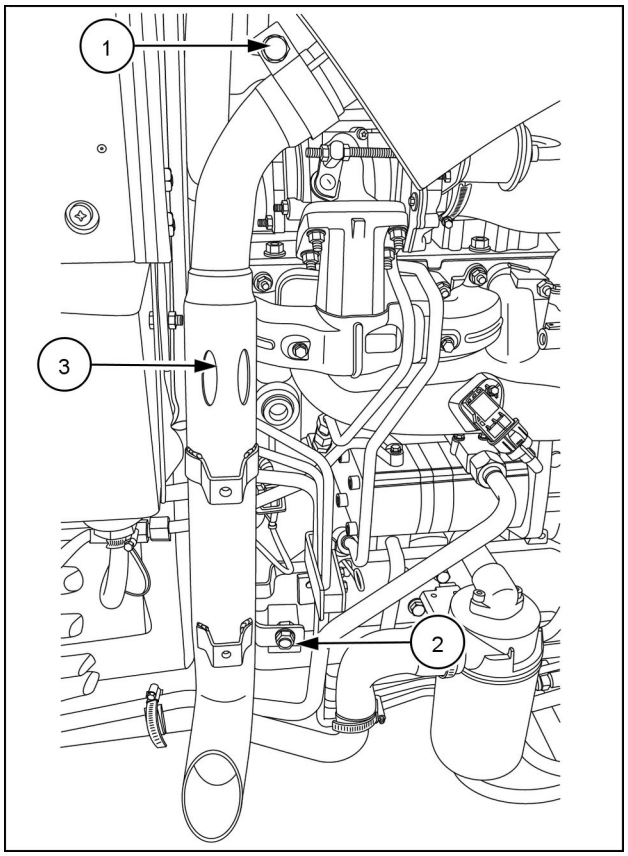
GNIL14TR00822AA 5

7. Loosen the bolts **(1)** and remove the silencer guard.



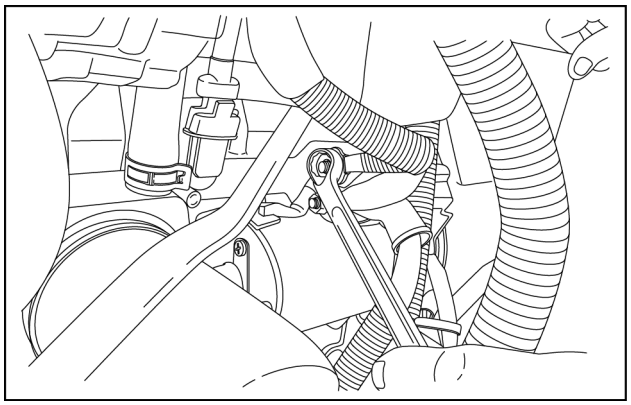
GNIL14TR00631AA 6

8. Loosen the silencer mounting bolts **(1)** and **(2)**.
9. Remove the silencer **(3)**.



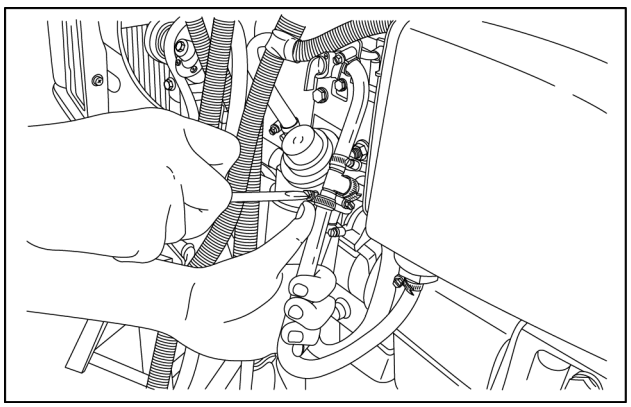
GNIL14TR00611AA 7

10. Disconnect the electric connection **(1)** to starter motor.



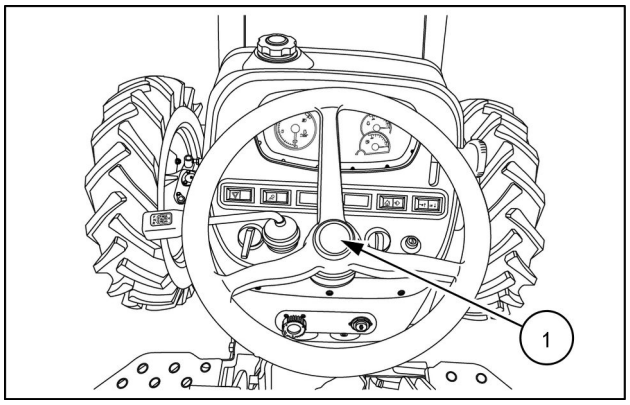
GNIL14TR00713AA 8

11. Disconnect the fuel supply and return lines.



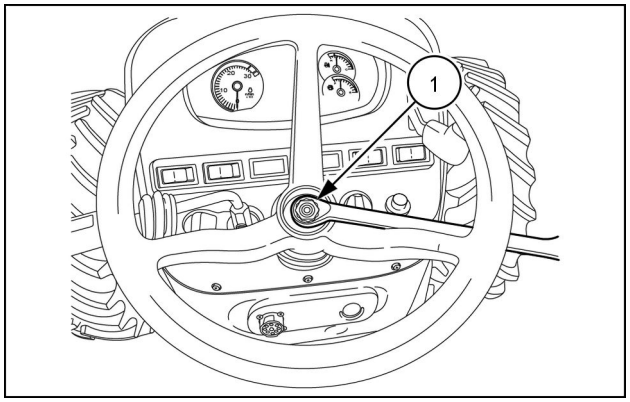
GNIL14TR00712AA 9

12. Remove the steering wheel cover **(1)**.



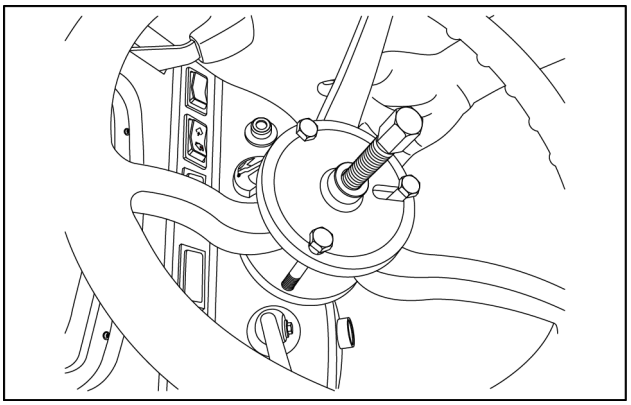
GNIL14TR00512AA 10

13. Remove the steering wheel securing nut **(1)**.



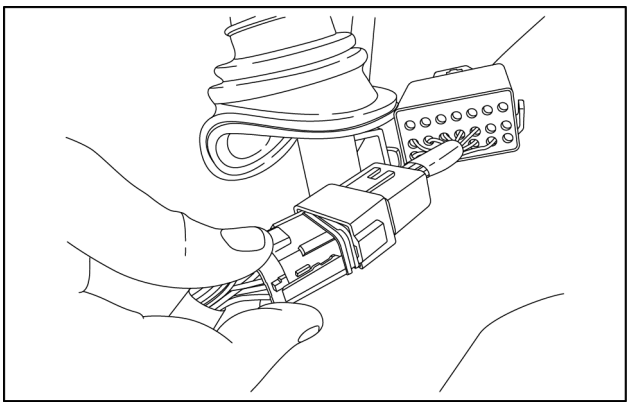
GNIL14TR00846AA 11

14. Remove the steering wheel using tool number **380001672**, and **380003008**.



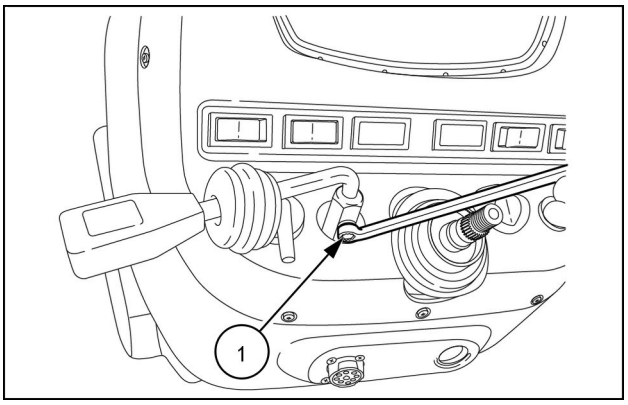
GNIL14TR00704AA 12

15. Disconnect the wiring **(1)** on the steering column.



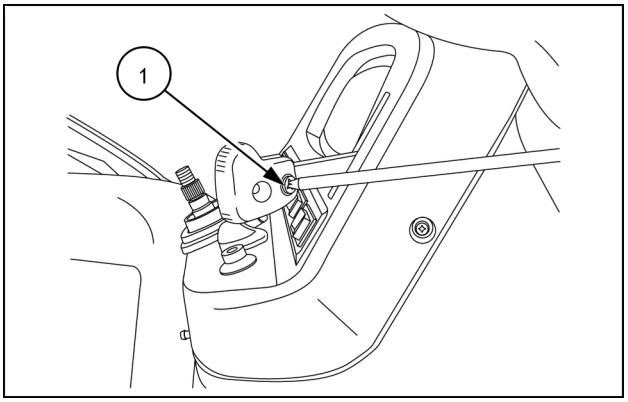
GNIL14TR00711AA 13

16. Loosen the bolt **(1)** and remove the shuttle lever.



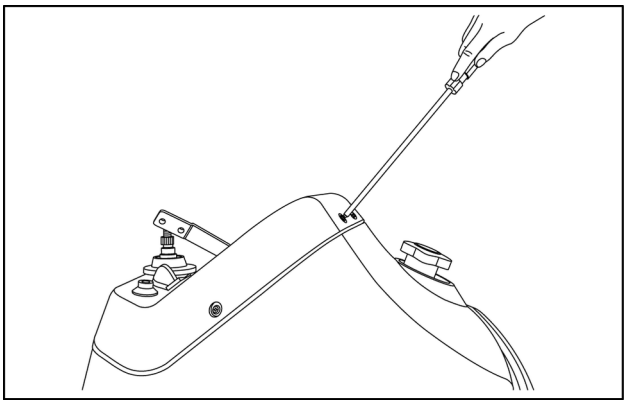
GNIL14TR00705AA 14

17. Loosen the screw **(1)** and remove the hand throttle knob.



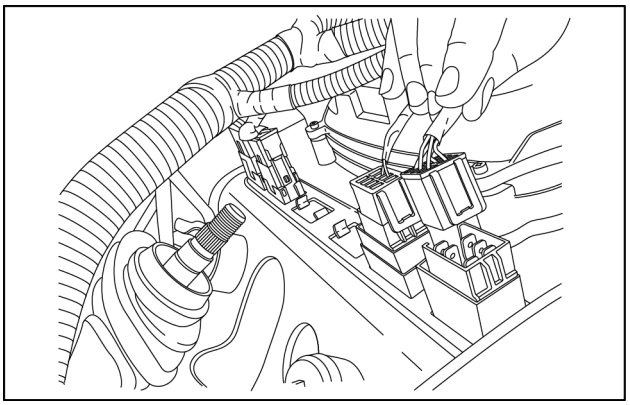
GNIL14TR00706AA 15

18. Unscrew all the screws securing instrument panel to the rear hood.



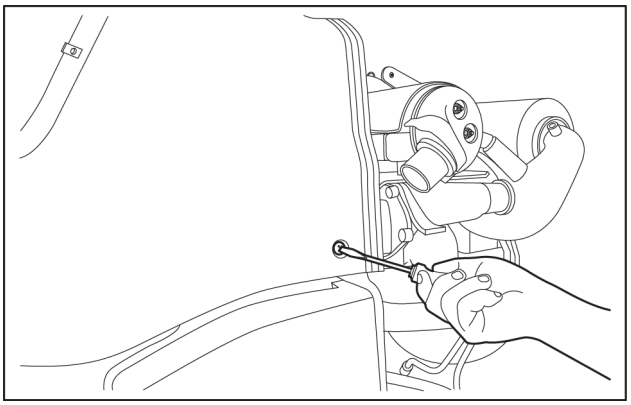
GNIL14TR00707AA 16

19. Pull out the instrument panel from the rear hood.
20. Disconnect all the wirings of the instrument cluster.



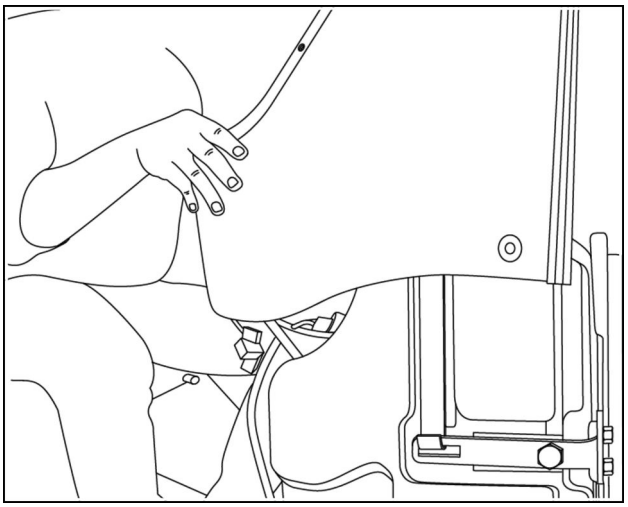
GNIL14TR00714AA 17

21. Remove pull to stop knob and then centre panel. Unscrew all rear hood securing bolts and screws on rear hood.



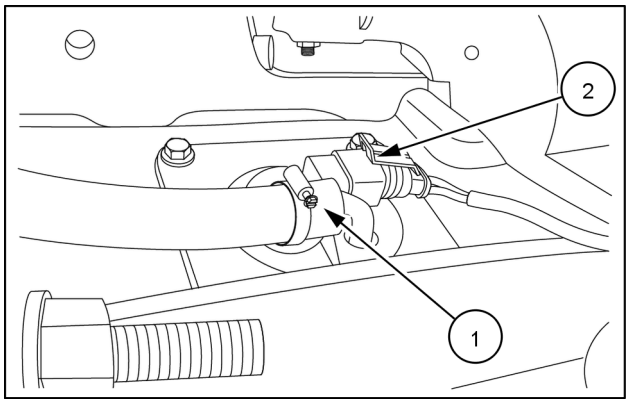
GNIL14TR00849AA 18

22. Lift and remove the rear hood.



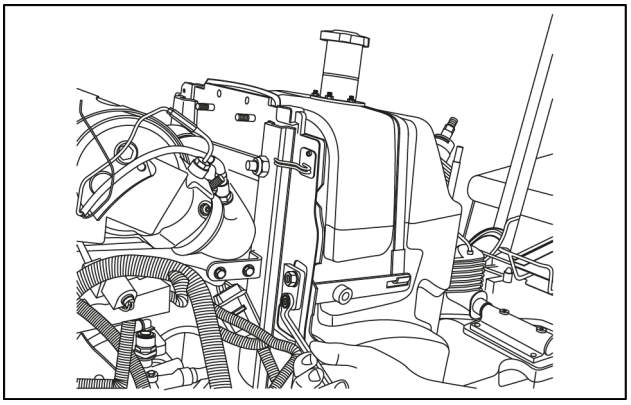
GNIL14TR00715AA 19

23. Disconnect the diesel overflow pipe **(1)** on the fuel tank.
24. Disconnect the fuel sensor electric connection **(2)**.



GNIL14TR00719AA 20

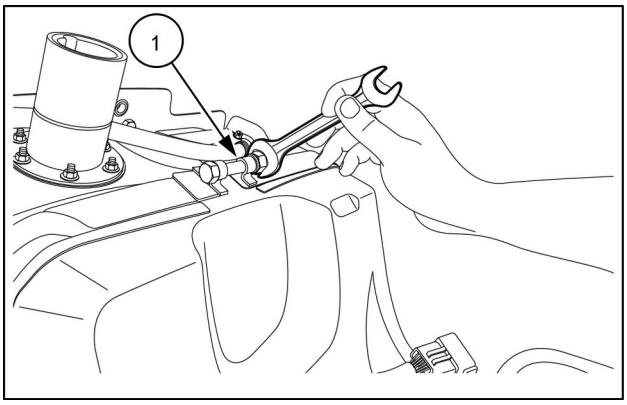
25. Loosen the bolts and remove the bracket that holds the fuel tank strap.



GNIL14TR00852AA 21

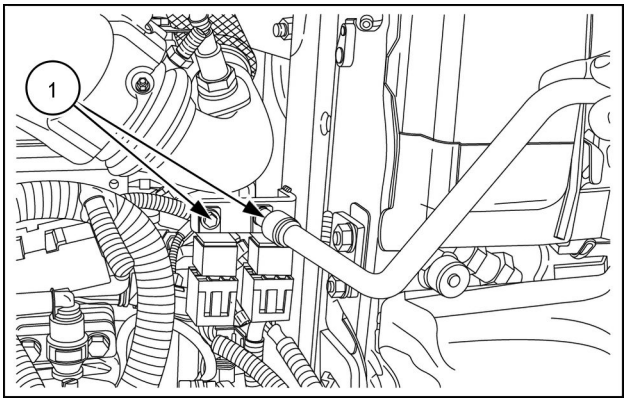
26. Loosen the bolts **(1)** and release the fuel tank strap.

NOTE: *It is advisable to drain diesel from fuel tank if tank is more than half filled.*



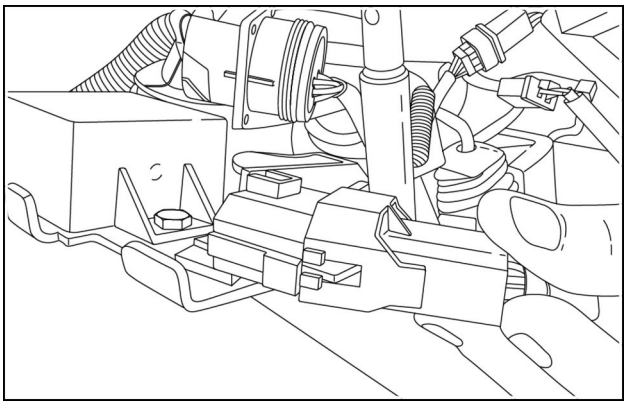
GNIL14TR00709AA 22

27. Loosen the bolts **(1)** and remove the wiring couplers at the rear of fuel tank.



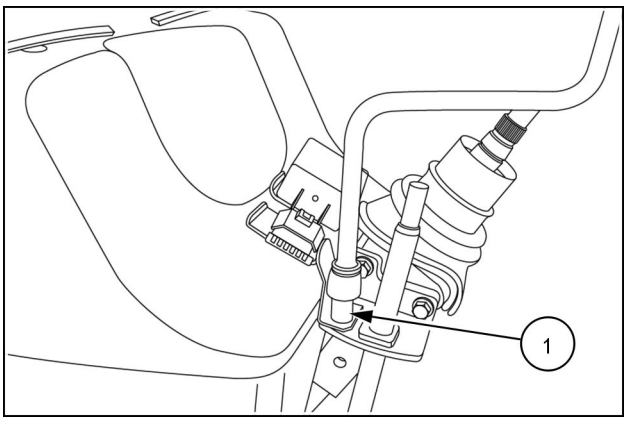
GNIL14TR00851AA 23

28. Disconnect the wiring from the adaptor under the rear hood.



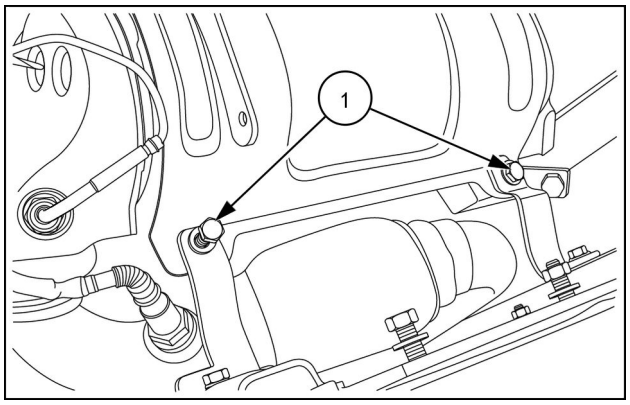
GNIL14TR00855AA 24

29. Remove the bolts **(1)**.
30. Remove the adaptor.
31. Remove the fuel tank.



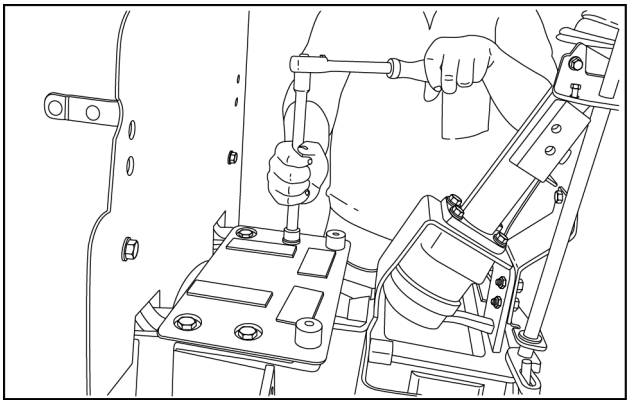
GNIL14TR00727AA 25

32. Loosen the bolts **(1)** securing cover of the SCR (Selective Catalytic Reduction) assembly to the fuel tank support plate.



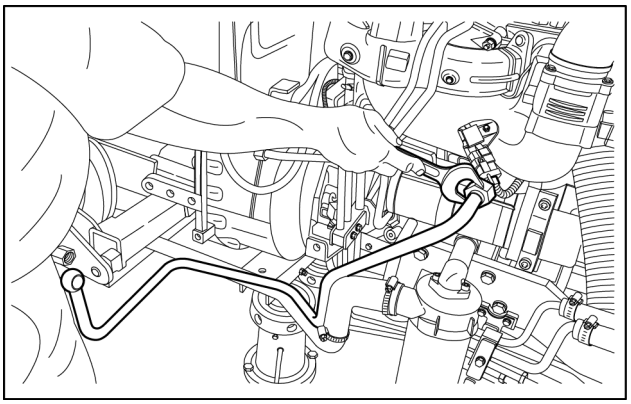
GNIL14TR00857AA 26

33. Remove all the bolts securing the fuel tank base plate to the clutch housing.
34. Remove the fuel tank base plate.



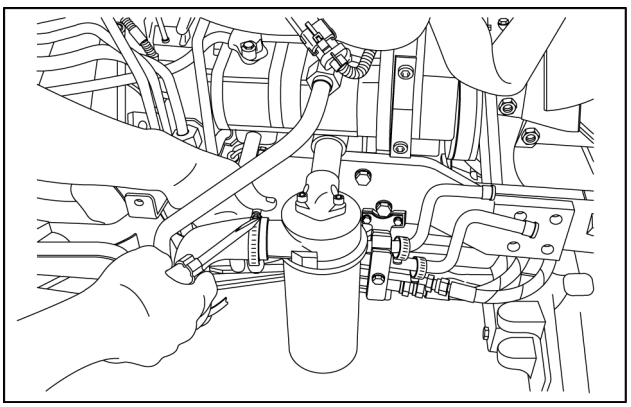
GNIL14TR00850AA 27

35. Disconnect the hydraulic line between the pump and the mid mount valve.



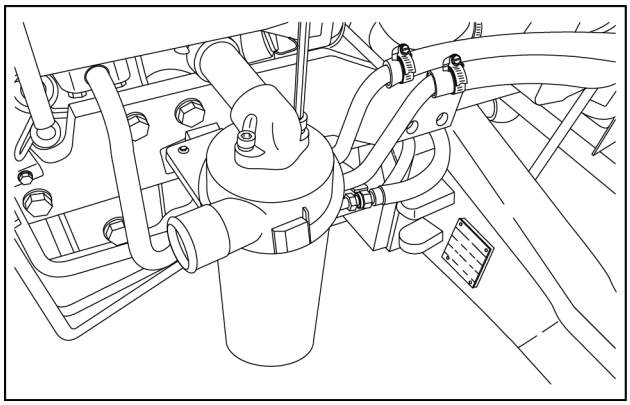
GNIL14TR00783AA 28

36. Loosen the clamp and remove the suction pipe from the hydraulic filter.



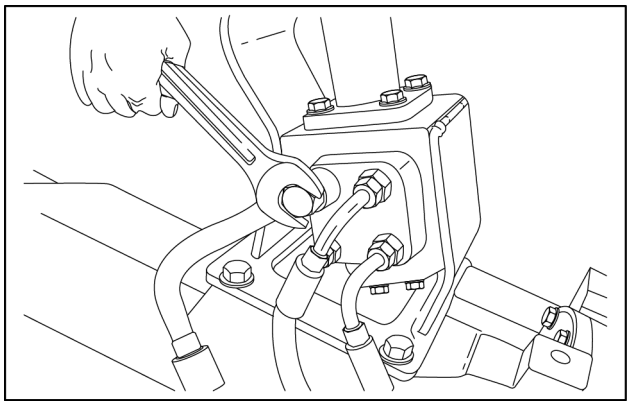
GNIL14TR00725AA 29

37. Loosen the set screws and remove the hydraulic filter.



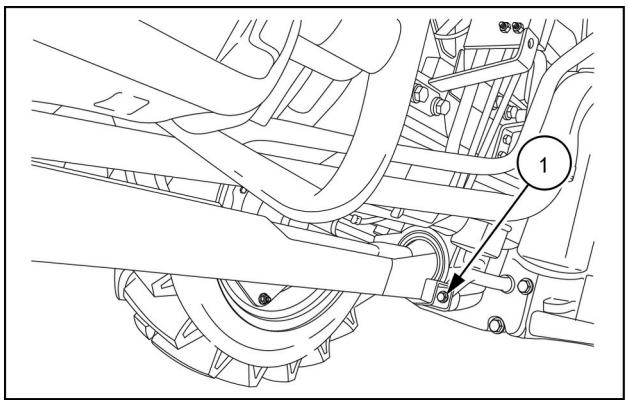
GNIL14TR00728AA 30

38. Disconnect the power steering hoses on the steering motor.



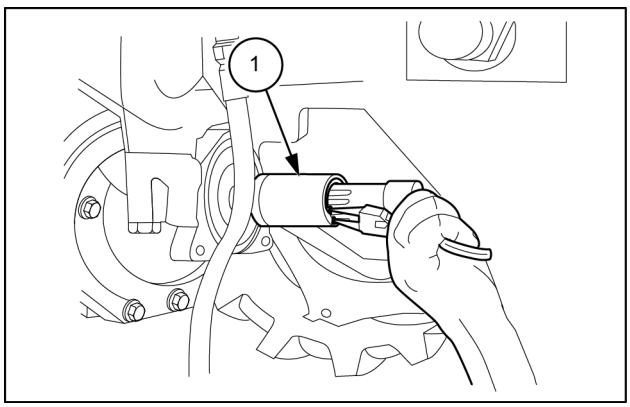
GNIL14TR00740AA 31

39. Loosen the bolts **(1)** of the 4WD shaft cover.



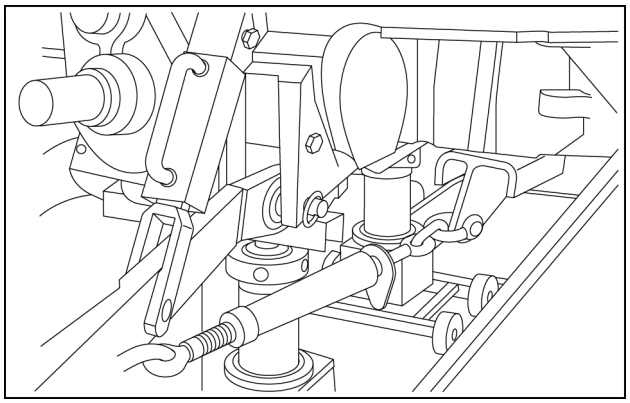
GNIL14TR00823AA 32

40. Remove the circlip and slide the coupler **(1)** backward.



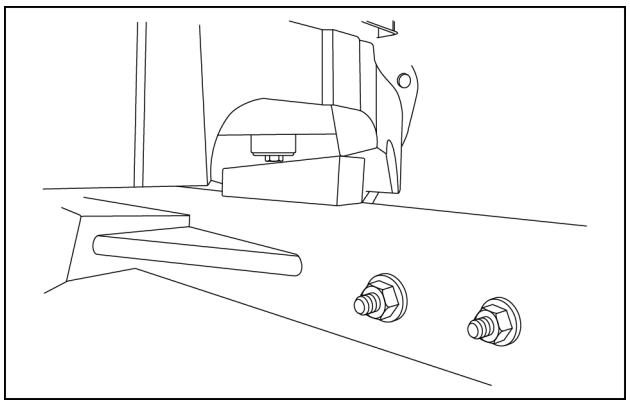
GNIL14TR04359AB 33

41. Position splitting trolley, special tool number 292320, with engine supports in position.
42. Block front wheels at the front and back using suitable wedges.



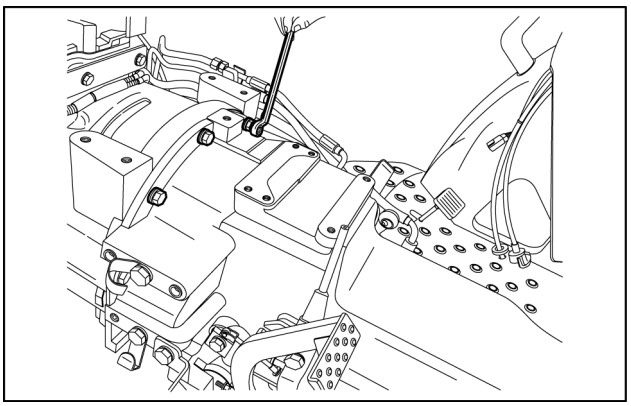
GNIL14TR04779AA 34

43. Support the engine at the back of the front axle.
44. Position wedges between axle and support to prevent articulation.



GNIL14TR04781AA 35

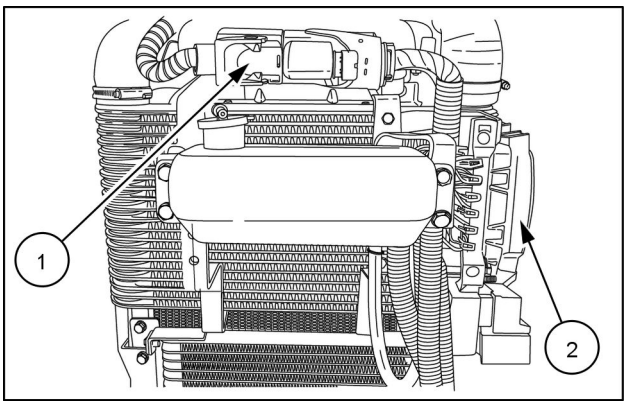
45. Loosen the bolts securing the engine to the centre housing.
46. Wheel the centre housing and rear wheels away from the engine.



GNIL14TR00753AA 36

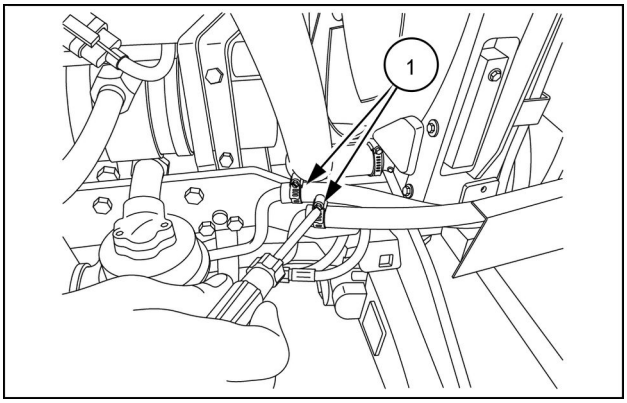
Separating front axle from engine
With engine previously separated from centre housing

47. Remove the electrical couplers **(1)** from Engine Control Unit (ECU) and **(2)** for rear lamps, flasher unit, fuse box etc.



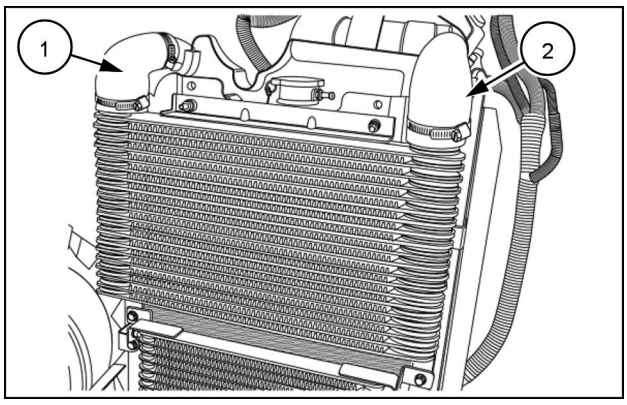
GNIL14TR00757AA 37

48. Disconnect the steering hoses **(1)**.



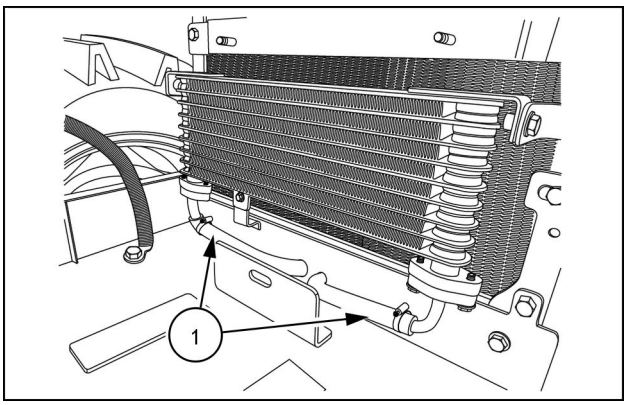
GNIL14TR00758AA 38

49. Disconnect the hoses **(1)** from the intercooler.



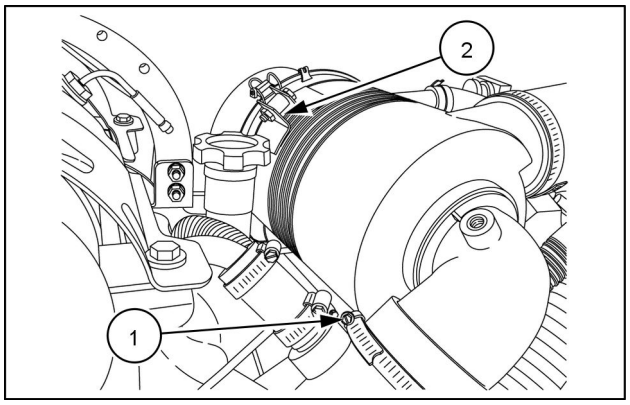
GNIL14TR00702AA 39

50. Disconnect the pipes **(1)** from the fuel cooler.



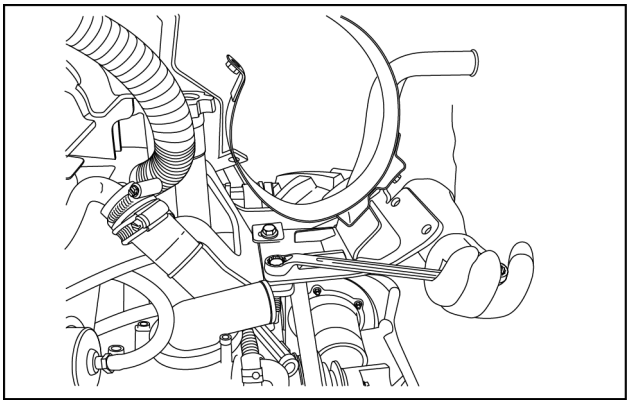
GNIL14TR00703AA 40

51. Loosen the clamp **(1)** on the air inlet hose.
52. Loosen the bolt **(2)** and remove the air cleaner assembly.



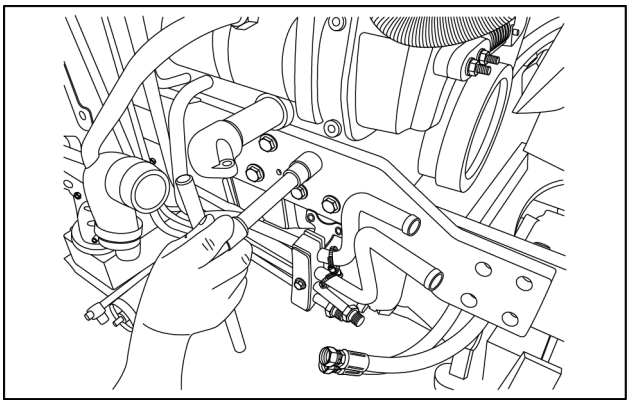
GNIL14TR00720AA 41

53. Loosen the bolts and remove the air cleaner mounting bracket.



GNIL14TR00860AA 42

54. Support the front axle at the front bracket.
55. Support the engine using a suitable hoist.
56. Remove the buckle up bolts and set screws between the engine and front axle support. Carefully lift the engine from the front axle support.
57. Make sure that all the wires and tubes are disconnected. Place the engine on a suitable stand for repair.



GNIL14TR00755AA 43

Engine - Install

For installation, follow the reverse order of removal.
See **Instrument cluster - Install (55.408)** for the installation of the instrument cluster.

https://truckmanualshub.com/

Index

Engine - 10

Engine and crankcase - 001

Engine - Install 15
Engine - Remove 3

https://truckmanualshub.com/

Engine - 10

Crankshaft and flywheel - 103

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Engine - 10

Crankshaft and flywheel - 103

SERVICE

Engine flywheel
Remove 3
Inspect 5

Engine flywheel - Remove

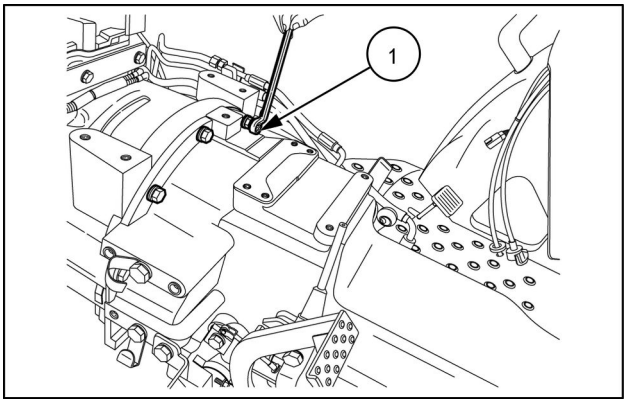
⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

W0208A

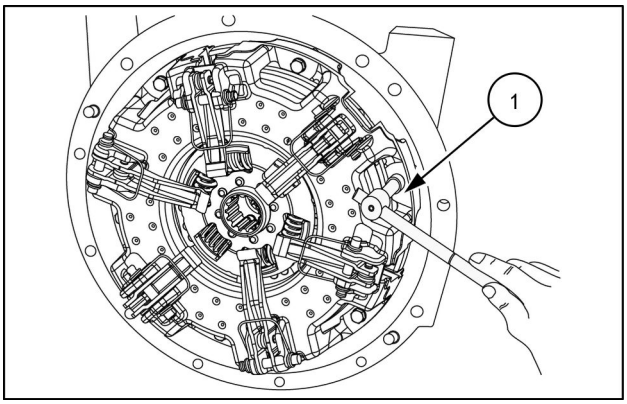
It is necessary to split the tractor between engine and transmission housing to gain access to the clutch. See engine removal section.

1. Remove the bolts **(1)**. Separate the transmission housing from engine.



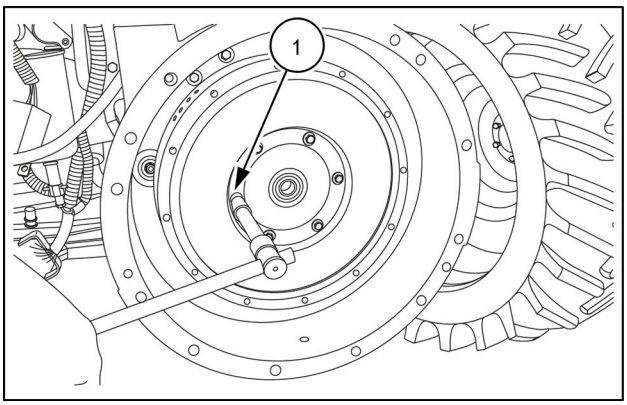
GNIL14TR00753AA 1

2. Remove the bolts **(1)** which retains the clutch assembly to the engine fly wheel and slacken the two remaining bolts.



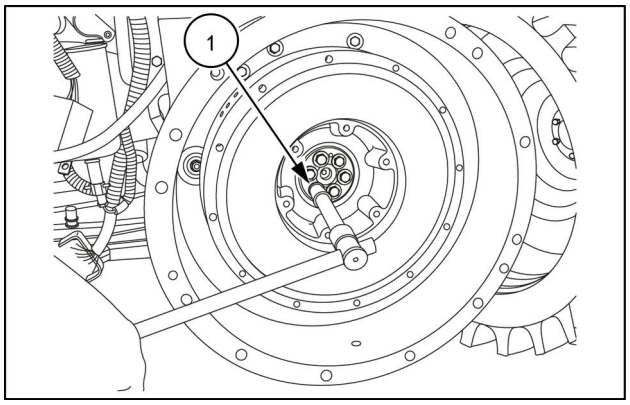
GNIL14TR00754AA 2

3. Insert centralizing pin special tool number **380000612** in clutch plate shaft seats back off the two remaining bolts and remove assembly completely. Retrieve Power Take-Off (PTO) clutch disc.
4. Remove the bolts **(1)** and retrieve the pilot bearing assembly.



GNIL14TR00769AA 3

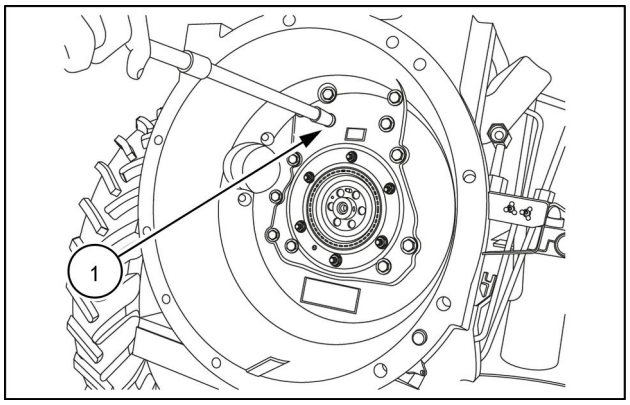
5. Remove the bolts **(1)** and take out the flywheel from the main clutch housing.



GNIL14TR00770AA 4

Clutch housing separation from the engine (if necessary)

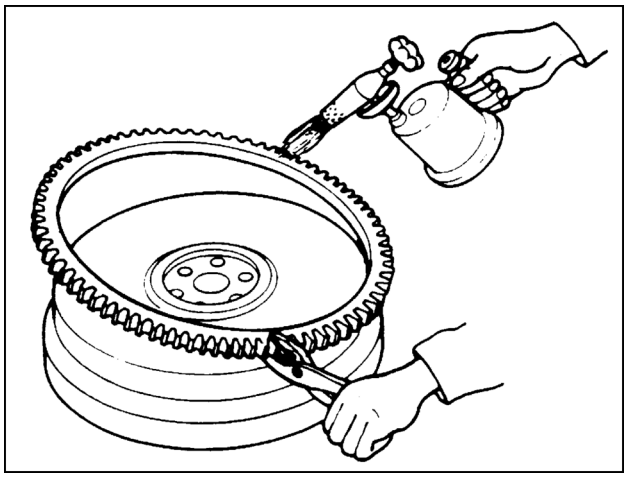
6. Place a suitable support. Remove the bolts **(1)** and separate the clutch housing.



GNIL14TR00771AA 5

Engine flywheel - Inspect

1. Inspect the ring gear for cracked, broken, chipped, or worn gear teeth. If found damaged, replace the ring gear.
2. If necessary, remove the starter ring gear using a hammer and chisel to crack the ring gear.
3. To reinstall a new ring gear, heat the new ring gear to **120 - 150 °C** (**245 - 300 °F**) from the inside only. Be careful not to overheat the ring gear teeth. Use a temperature sensitive crayon to mark the inside of the ring gear. Quench the ring gear quickly to obtain a good shrink fit onto the flywheel.



20093403 1

https://truckmanualshub.com/

Index

Engine - 10

Crankshaft and flywheel - 103

Engine flywheel - Inspect 5
Engine flywheel - Remove 3

https://truckmanualshub.com/

Engine - 10

Air cleaners and lines - 202

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Engine - 10

Air cleaners and lines - 202

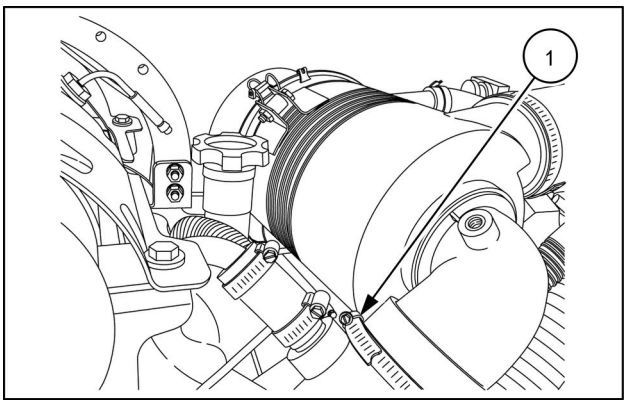
SERVICE

Air cleaner
Remove 3
Disassemble 4
Inspect 5
Cleaning 6
Replace 7
Assemble 8

Air cleaner - Remove

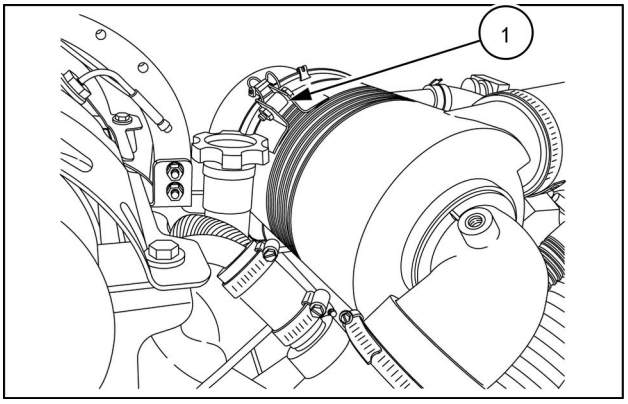
NOTE: *It is not necessary to remove the complete air cleaner body, as described below, to service the air cleaner elements.*

1. Lift the front hood.
2. Loosen the clamp **(1)** of air cleaner hose. Remove the air cleaner hose.



GNIL14TR00720AA 1

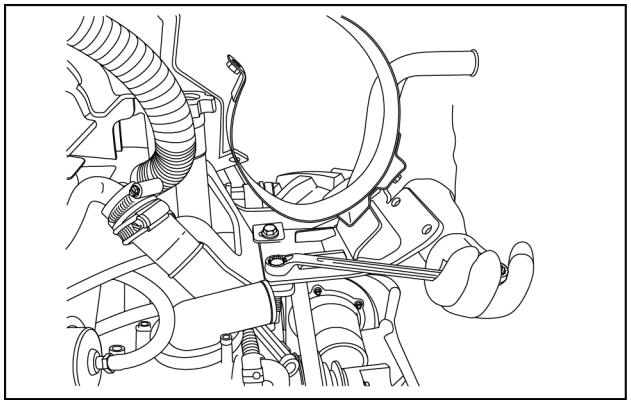
3. Loosen the bolt of the air cleaner securing clamp. **(1)**.
4. Remove the air cleaner assembly.



GNIL14TR00720AA 2

Air cleaner mounting bracket removal

5. Loosen the bolts and remove the air cleaner mounting bracket.

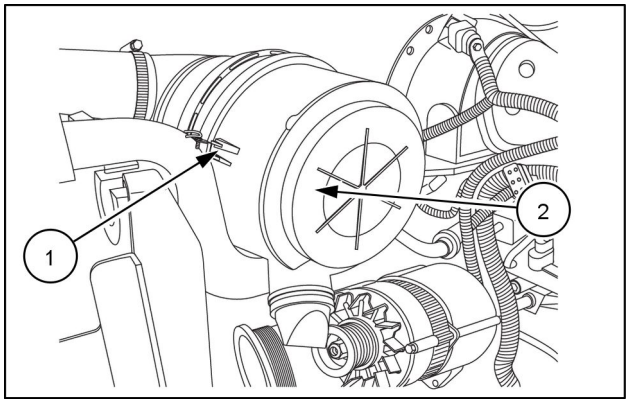


GNIL14TR00722AA 3

Air cleaner - Disassemble

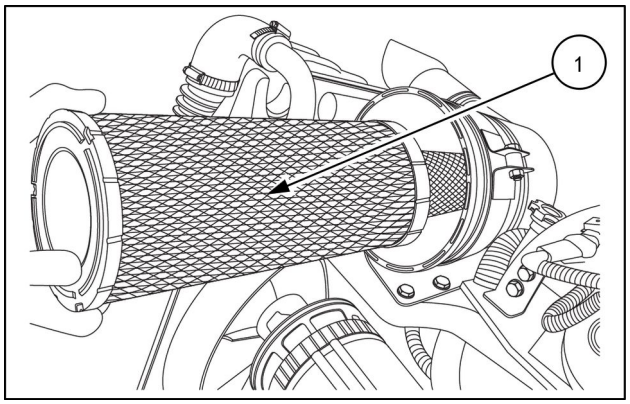
NOTE: *The air cleaner assembly can be serviced on the tractor. It is not necessary to remove the complete assembly from the tractor.*

1. Release the locking clips **(1)** and remove the air cleaner cover **(2)**.



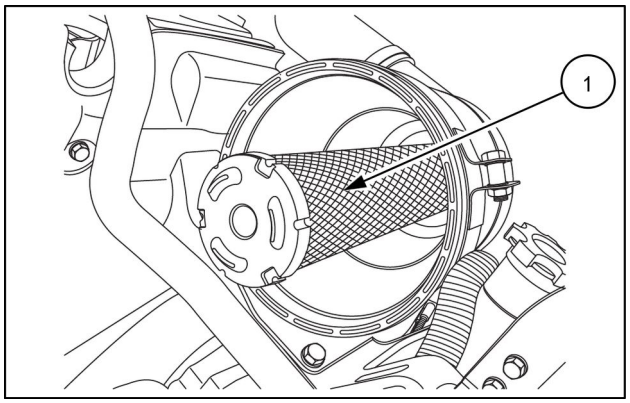
GNIL14TR00721AA 1

2. Remove the air cleaner outer element **(1)**.



GNIL14TR00723AA 2

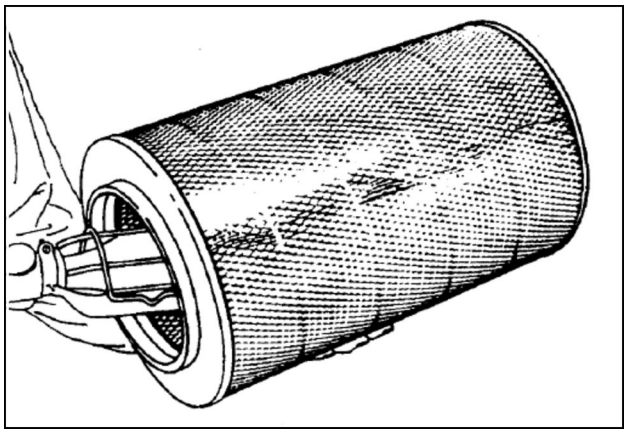
3. Remove the inner element **(1)**.



GNIL14TR00724AA 3

Air cleaner - Inspect

1. Examine the element for damage by placing a light inside the element.. Discard the element if pin pricks of light can be seen or there are areas where paper appears thin.
2. Check the element material for bunching, metal casing for distortion and rubber gasket for damage. Discard the filter element if damaged.
3. Clean the inside of the air cleaner housing using a damp, lint free cloth on a probe. Do not damage the inner filter element. Ensure that the inner end of the housing is clean and smooth. This ensures good seating of the rubber seal on the element.
4. Install the cleaned outer element or new outer element. Gently push it inside the housing in clockwise direction.
5. While fitting back the cover, make sure that the dust cup/ejector is facing downward.
6. Check all the air intake hoses for damage and replace as necessary. Check clamps for tightness.



GNIL14TR02103AA 1

Air cleaner - Cleaning

⚠ WARNING

Chemical hazard!
Stop the fan before you open the lid. Avoid exposure to airborne chemicals. Dust and fumes will be exhausted if you open the tank lid while the tank is pressurized. Chemicals may cause eye, skin, or breathing problems. Wear a face mask, gloves, and goggles.
Failure to comply could result in death or serious injury.

W1307A

1. Clean the outer element using either method **(A)** or **(B)**, depending on the elements condition.

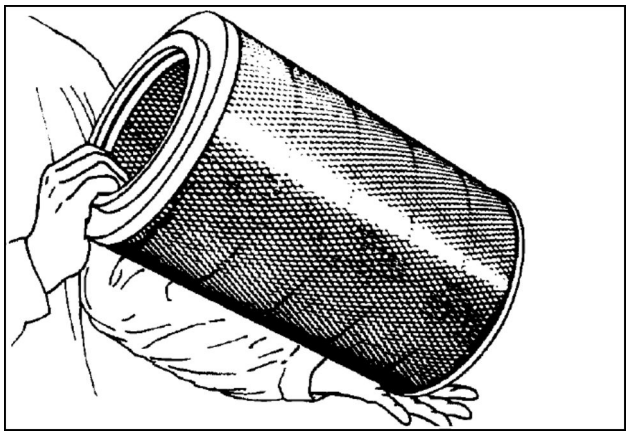
NOTE: *An outer element may be dry cleaned (methods A or B). Every **300 h** or when warning bulb glows (whichever is earlier).*
*Outer element to be replaced after 3 times of cleaning by method B or maximum **900 h**.*
*Inner element should be replaced after three outer element replacements or every **2700 h** whichever is earlier.*

NOTE: *Clean the air filters in a well ventilated room with a provision to artificially throw out the dusty air. If it is not available, it is advised to do the cleaning outdoors, but never in an unventilated room.*

Method A

Lightly tap the element against the palm. Continue till the accumulated dust comes out completely.

NOTE: *Do not tap the element against a hard surface. This will damage the element.*

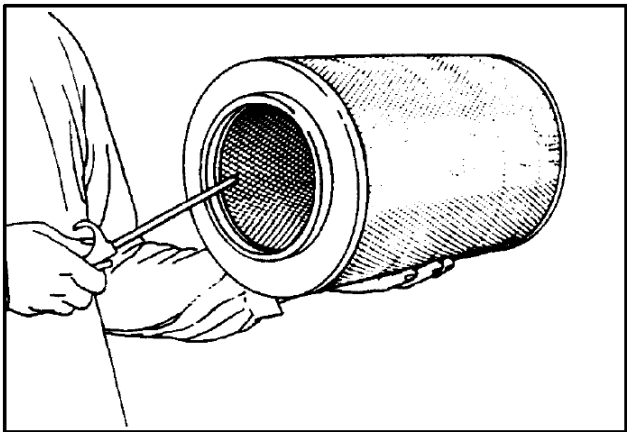


GNIL14TR02100AA 1

Method B

Using compressed air, not exceeding **1.3 bar**, insert the air nozzle inside the element.

NOTE: *Hold the nozzle at a safe distance from the element. Blow the dust from the inside, through the element, to the outside.*
Never blow air from outside to inside.



GNIL14TR02101AA 2

Air cleaner - Replace

1. The inner element to be removed only at the time of replacement. It should never be cleaned. The inner element should be replaced after three outer element replacements or **2700 h** whichever is earlier.
2. Follow the similar instructions of removing and fitting outer element from casting to replace inner element.

Air cleaner - Assemble

Fitment

For assembly, follow the reverse order of disassembly. Clean the interior of the air filter housing using a clean cloth.

https://truckmanualshub.com/

Index

Engine - 10

Air cleaners and lines - 202

Air cleaner - Assemble 8
Air cleaner - Cleaning 6
Air cleaner - Disassemble 4
Air cleaner - Inspect 5
Air cleaner - Remove 3
Air cleaner - Replace 7

https://truckmanualshub.com/

https://truckmanualshub.com/

Engine - 10

Fuel filters - 206

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Engine - 10

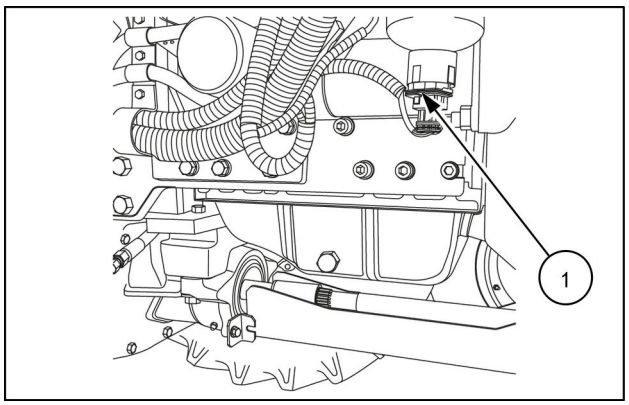
Fuel filters - 206

SERVICE

Pre-filter
Remove 3
Install 4

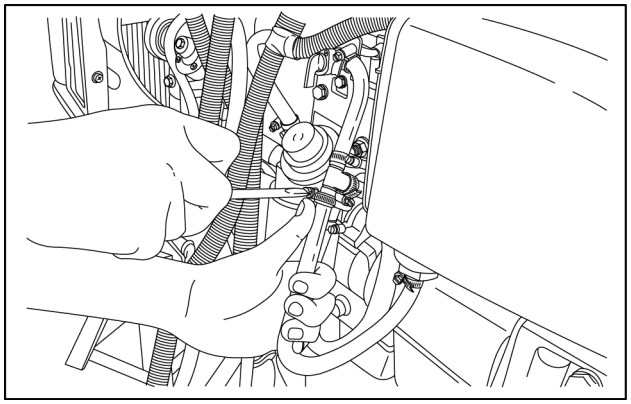
Pre-filter - Remove

1. Lift the front hood.
2. Remove the electrical connections on the fuel prefilter.



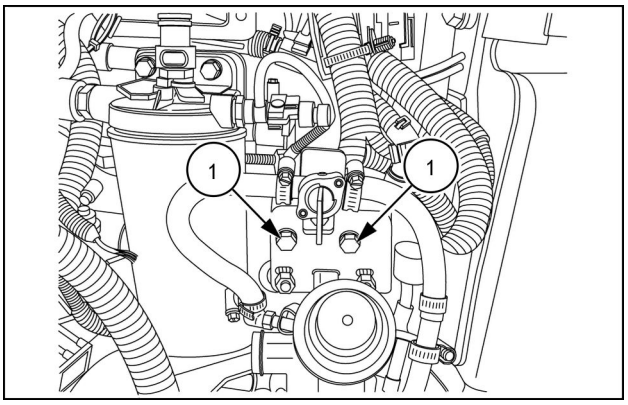
GNIL14TR00737AA 1

3. Disconnect all the fuel lines on the fuel prefilter.



GNIL14TR00712AA 2

4. Loosen the bolts **(1)** and remove the fuel prefilter.



GNIL14TR00862AA 3

Pre-filter - Install

For installation, follow the reverse order of removal.

https://truckmanualshub.com/

Index

Engine - 10

Fuel filters - 206

Pre-filter - Install 4
Pre-filter - Remove 3

https://truckmanualshub.com/

https://truckmanualshub.com/

Engine - 10

Fuel tanks - 216

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Engine - 10

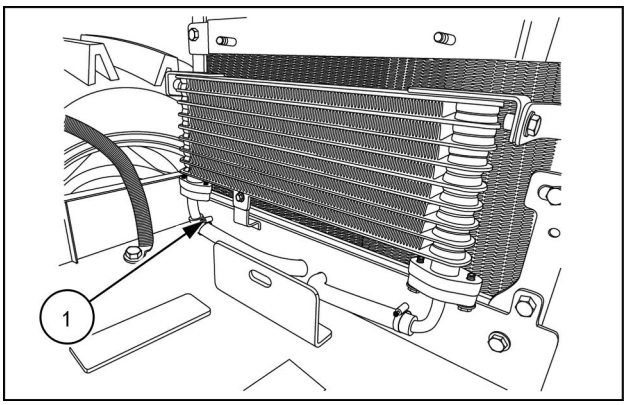
Fuel tanks - 216

SERVICE

Fuel cooler
Remove 3
Install 4

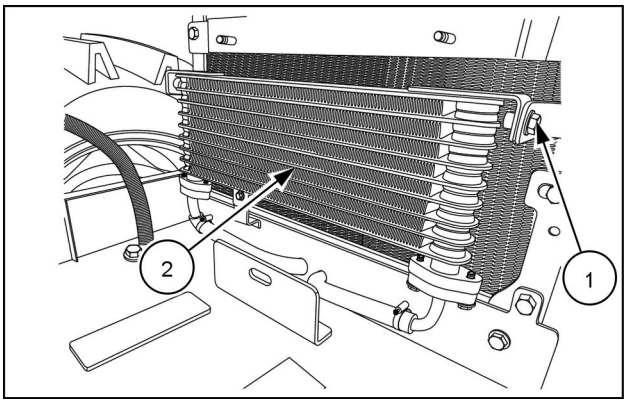
Fuel cooler - Remove

1. Lift the front hood.
2. Remove the battery. See **Battery - Remove (55.302)**.
3. Disconnect the fuel pipes **(1)** on the fuel cooler.



GNIL14TR00703AA 1

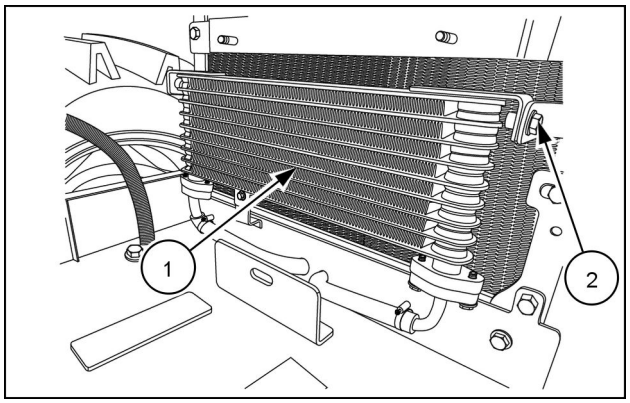
4. 1. Loosen all the bolts **(1)**.
   2. Remove the fuel cooler **(2)**.



GNIL14TR00703AA 2

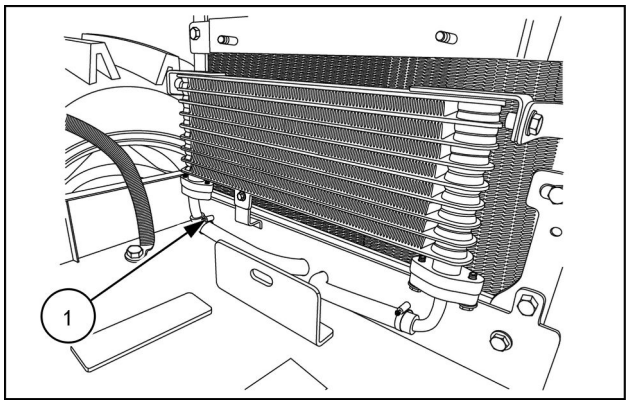
Fuel cooler - Install

1. Install the fuel cooler **(1)** and tighten the bolts **(2)**.



GNIL14TR00703AA 1

2. Connect the fuel pipes **(1)** on the fuel cooler.



GNIL14TR00703AA 2

3. Install the battery. See **Battery - Install (55.302)**.

https://truckmanualshub.com/

Index

Engine - 10

Fuel tanks - 216

Fuel cooler - Install 4
Fuel cooler - Remove 3

https://truckmanualshub.com/

https://truckmanualshub.com/

Engine - 10

Aftercooler - 310

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Engine - 10

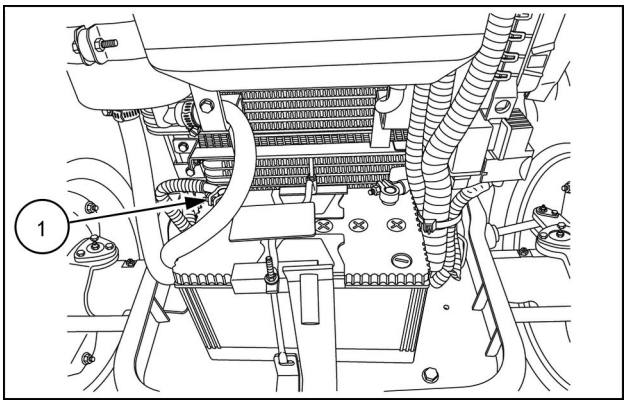
Aftercooler - 310

SERVICE

Aftercooler
Remove 3
Install 5

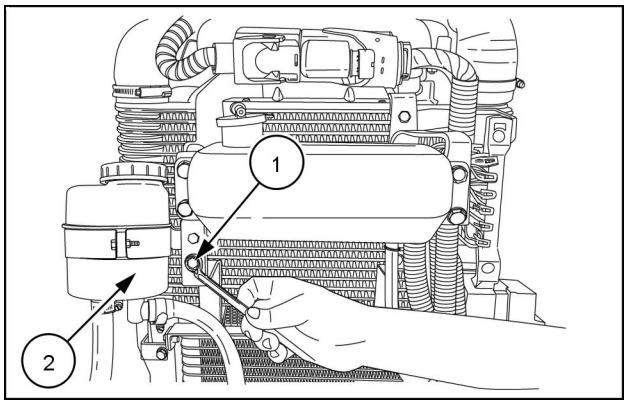
Aftercooler - Remove

1. 1. Lift the front hood.
   2. Disconnect the negative terminal **(1)** of the battery.



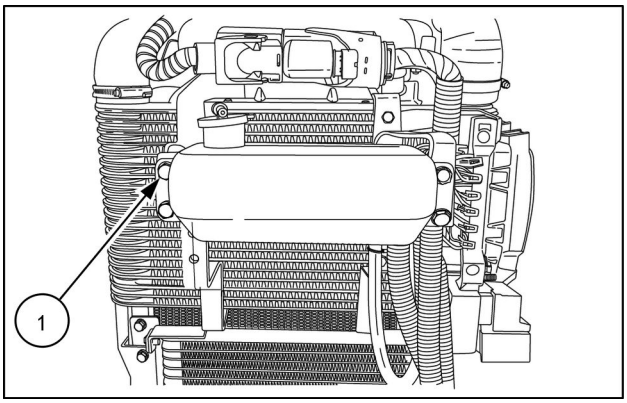
GNIL14TR00784AA 1

2. 1. Loosen the bolt **(1)**.
   2. Remove the steering oil reservoir **(2)**.



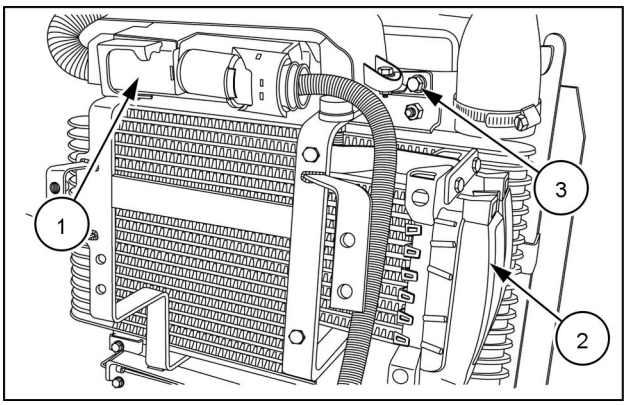
GNIL14TR00759AA 2

3. 1. Disconnect the hose from the radiator coolant reservoir.
   2. Loosen the bolts **(1)** and remove the coolant reservoir.



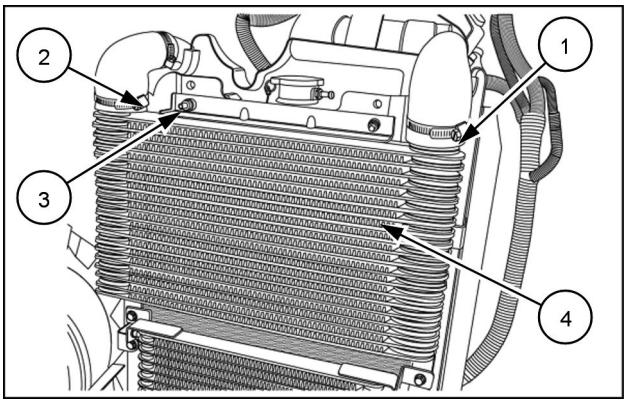
GNIL14TR00757AA 3

4. 1. Remove the electrical couplers on the Engine Control Unit (ECU) bracket **(1)** and the fuse box **(2)**.
   2. Loosen the bolts **(3)** and remove the ECU bracket.



GNIL14TR00762AA 4

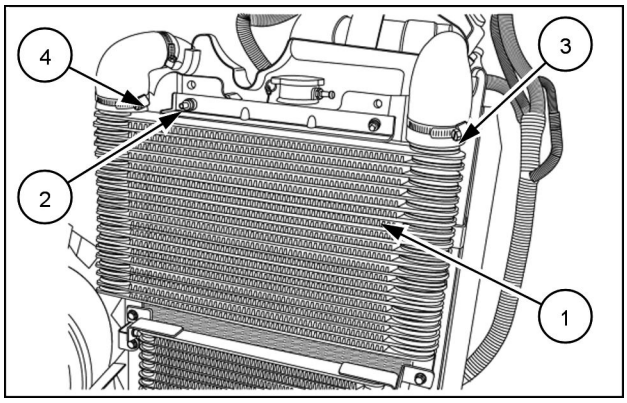
5. 1. Remove the inlet **(1)** and the outlet hoses **(2)** of the after cooler.
   2. Loosen and remove the mounting bolts **(3)** and remove the after cooler **(4)**.



GNIL14TR00702AA 5

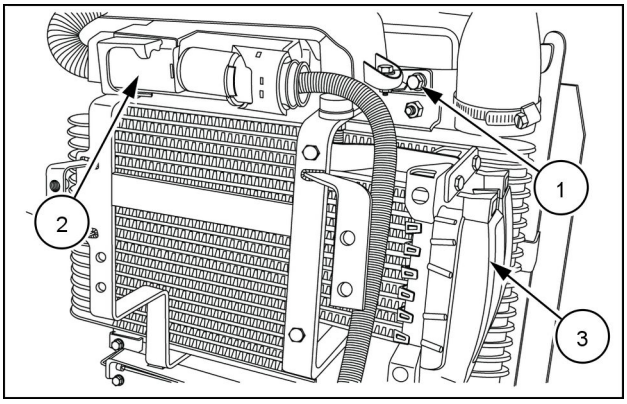
Aftercooler - Install

1. 1. Install the after cooler **(1)** on the mounting bracket and tighten the bolts **(2)**.
   2. Connect the inlet hose **(3)** and outlet hose **(4)** of the radiator.



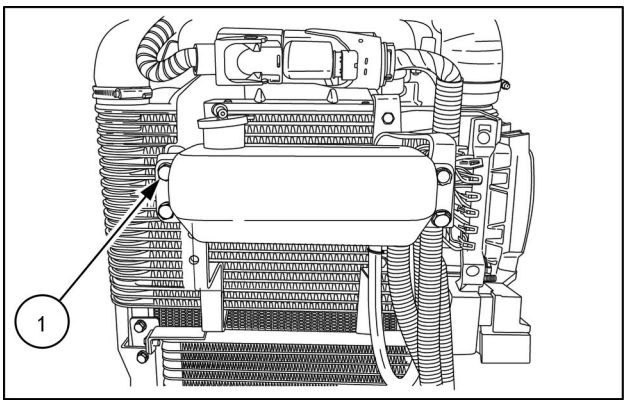
GNIL14TR00702AA 1

2. 1. Install the Engine Control Unit (ECU) and tighten the bolts **(1)**.
   2. Connect the electrical couplers on the ECU **(1)** and fuse box.



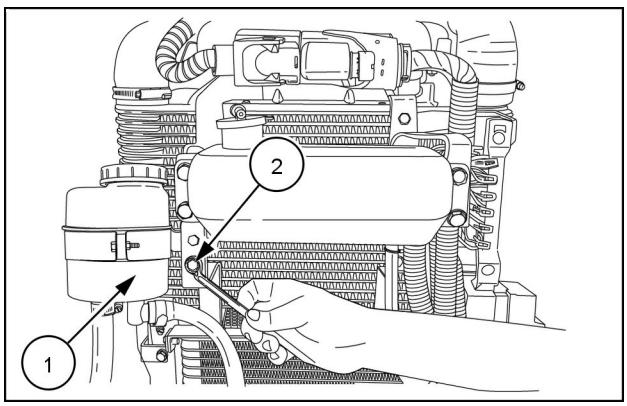
GNIL14TR00762AA 2

3. 1. Install the radiator coolant reservoir and tighten the bolts **(1)**.
   2. Connect the hoses to the radiator coolant reservoir.



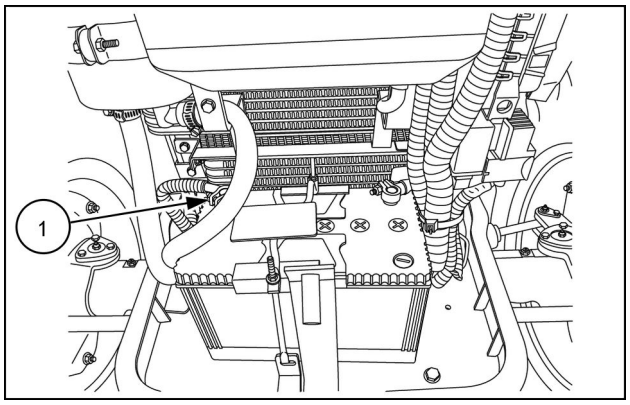
GNIL14TR00757AA 3

4. Install the steering oil reservoir **(1)** and tighten the bolt **(2)**.



GNIL14TR00759AA 4

5. Connect the negative terminal **(1)** of the battery.



GNIL14TR00784AA 5

https://truckmanualshub.com/

Index

Engine - 10

Aftercooler - 310

Aftercooler - Install 5
Aftercooler - Remove 3

https://truckmanualshub.com/

https://truckmanualshub.com/

Engine - 10

Engine cooling system - 400

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Engine - 10

Engine cooling system - 400

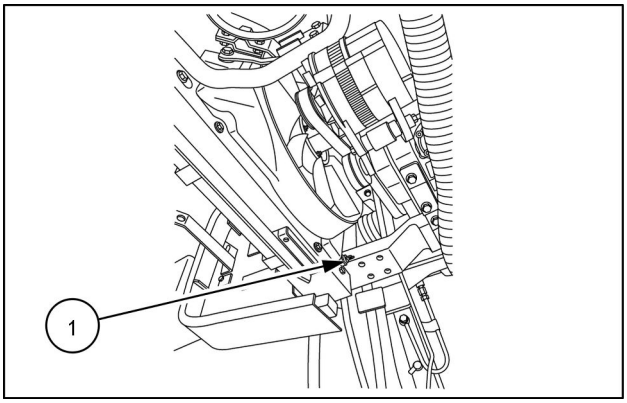
SERVICE

Radiator
Remove 3
Install 5

Radiator - Remove

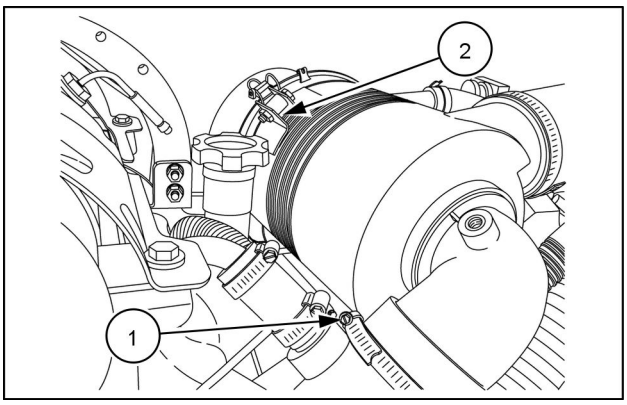
1. Lift the front hood.
2. Disconnect the wiring couplers on the ECU (Engine Control Unit) bracket and fuse box. Remove the ECU Bracket, steering oil reservoir, intercooler and fuel cooler. See **Aftercooler - Remove (10.310)** and **Fuel cooler - Remove (10.216)**.
3. Remove the cock **(1)** and drain the coolant from the radiator.

NOTE: *Remove the radiator cap to assist draining.*



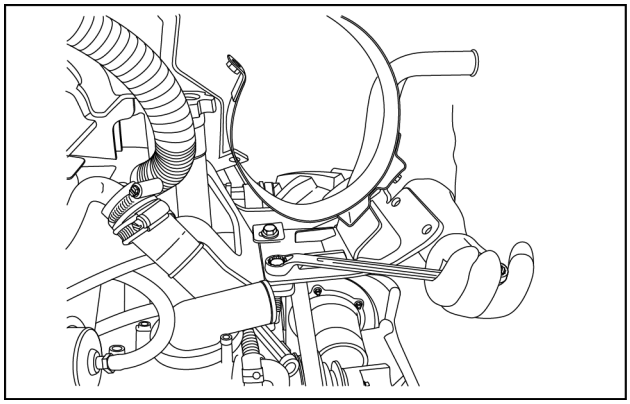
GNIL14TR00760AA 1

4. Loosen the clamp **(1)** on the air inlet hose. Remove the bolts securing the air cleaner **(2)** to the radiator.



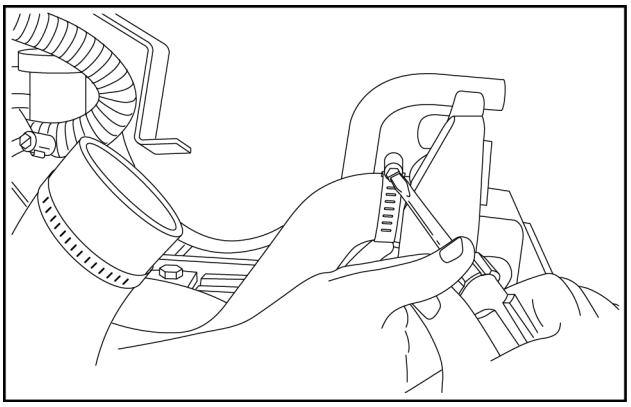
GNIL14TR00720AA 2

5. Loosen the bolts and remove the air cleaner mounting bracket.



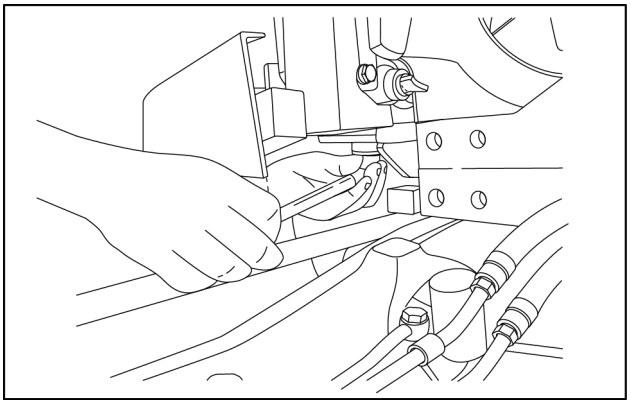
GNIL14TR00860AA 3

6. Remove all the hoses from the radiator



GNIL14TR00717AA 4

7. Loosen and remove all the radiator mounting bolts. Remove the radiator from the tractor.



GNIL14TR00761AA 5

Radiator - Install

For installation, follow the reverse order of removal.

https://truckmanualshub.com/

Index

Engine - 10

Engine cooling system - 400

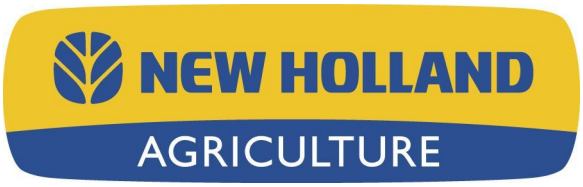
Radiator - Install 5
Radiator - Remove 3

https://truckmanualshub.com/

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SERVICE - Technical Publications & Tools



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https://truckmanualshub.com/

SERVICE MANUAL

Clutch

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Clutch - 18

[18.100] Clutch mechanical release control 18.1

[18.110] Clutch and components 18.2

https://truckmanualshub.com/

Clutch - 18

Clutch mechanical release control - 100

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Clutch - 18

Clutch mechanical release control - 100

SERVICE

Clutch mechanical release control
Remove 3
Install 7
Adjust 8

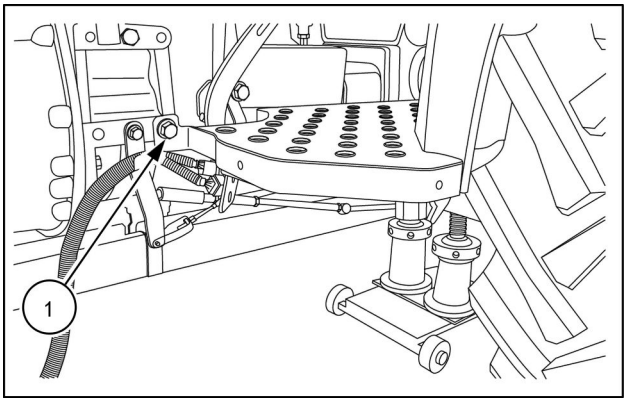
Clutch mechanical release control - Remove

⚠ CAUTION

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in minor or moderate injury.

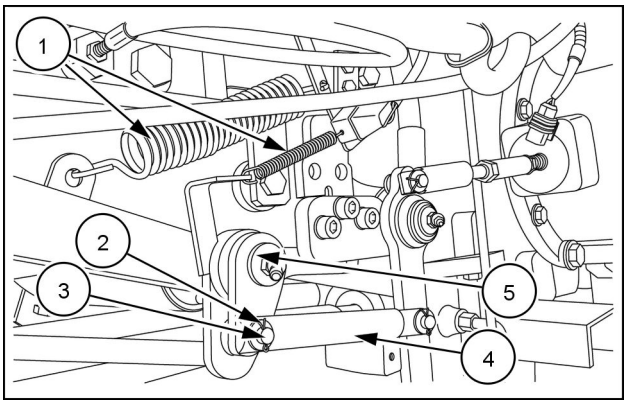
C0145A

1. Remove all foot platform bolts, and remove the left-hand side footboard. See **Protections and footboards - Remove (90.118)**.



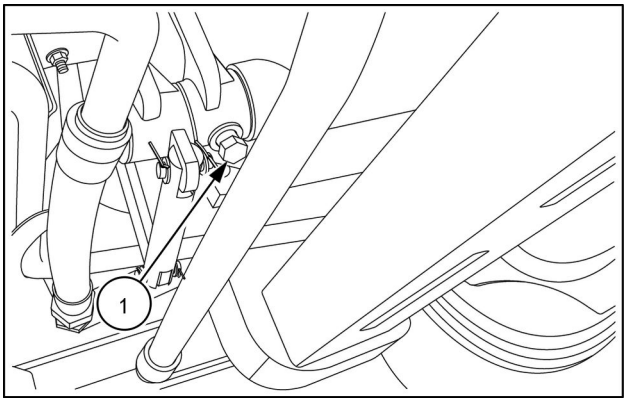
GNIL14TR00767AA 1

2. Remove clutch pedal spring **(1)**.
3. Remove the split pin **(2)**
4. Remove the roll pin **(3)**.
5. Disconnect the linkage **(4)**.
6. Remove the circlip **(5)**.



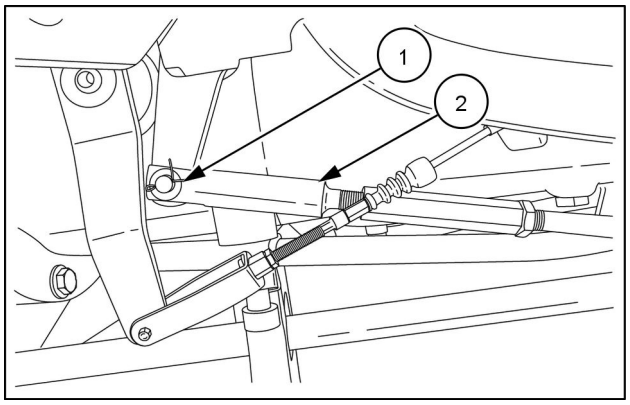
GNIL14TR00766AA 2

7. Loosen the lock screw **(1)**.



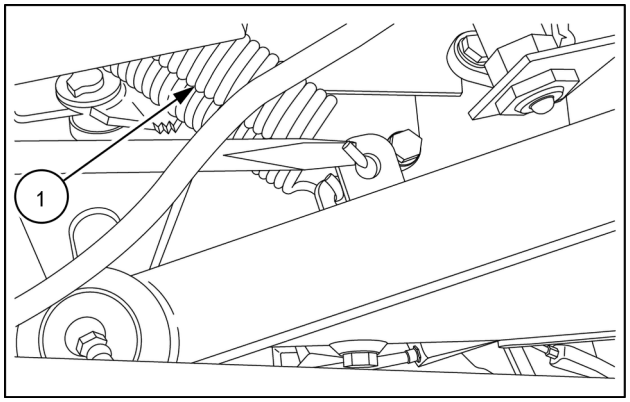
GNIL14TR00812AA 3

8. Remove split pin **(1)**.
9. Disconnect linkage **(2)** from clutch cross shaft.



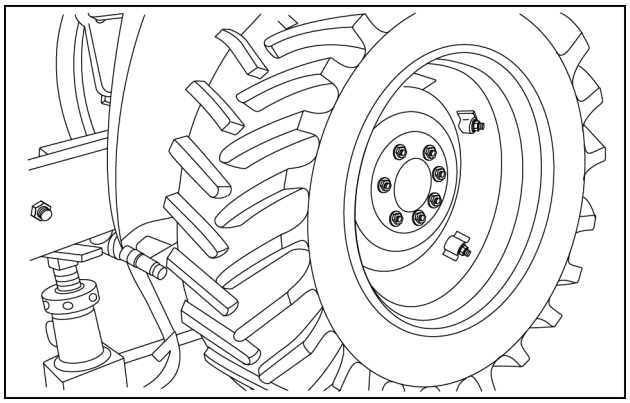
GNIL14TR00781AA 4

10. Similarly remove brake pedal spring **(2)** and disconnect all the linkages.



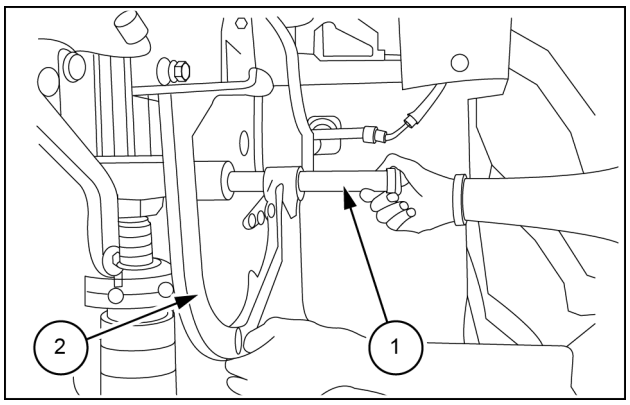
GNIL14TR00782AA 5

11. Jack-up rear left-hand side of tractor and remove left-hand side rear wheel.



GNIL14TR04667AB 6

12. Pull out clutch or brake pedal support rod **(1)** from the rear axle housing.
13. Retrieve clutch pedal **(2)** from the support shaft.

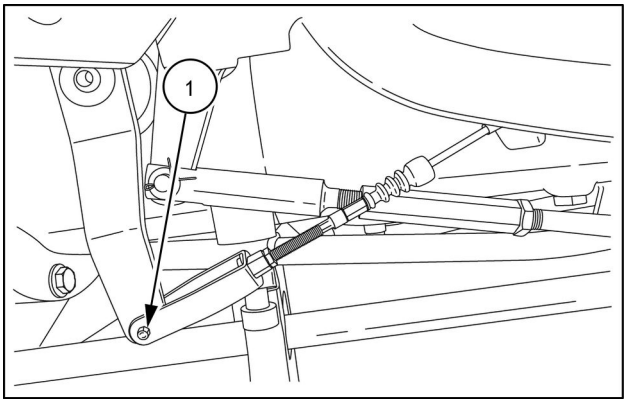


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Power Take-Off (PTO) clutch lever removal

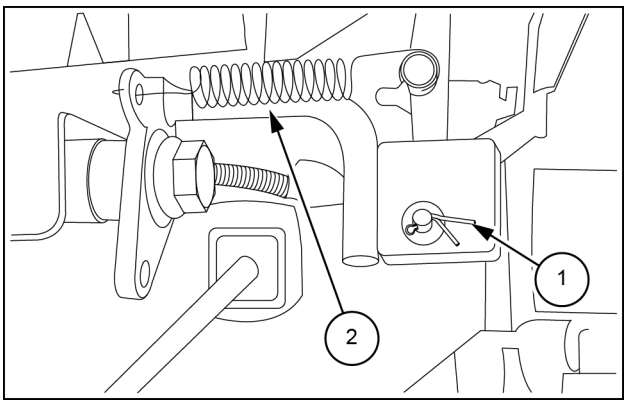
To remove the Power Take-Off (PTO) clutch lever **(1)** proceed as follows:-

1. Remove pin **(1)** by releasing lock plate and disconnect linkage between Power Take-Off (PTO) clutch lever and Power Take-Off (PTO) clutch cross shaft.



GNIL14TR00781AA 8

2. Remove the split pin lock **(1)** take out the pin and remove hand lever from the mounting bracket.
3. Remove bolt **(2)** from the housing to take out the levers with the bracket.

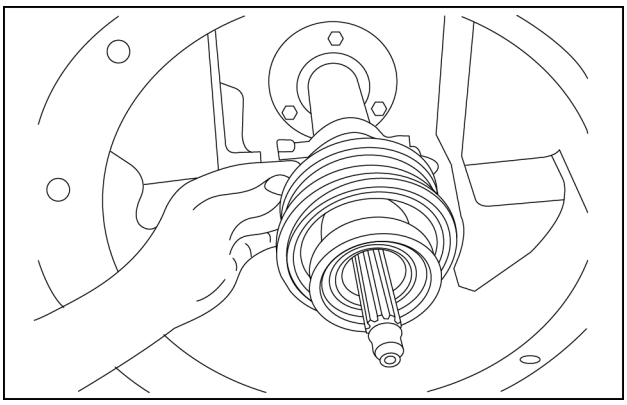


GNIL14TR04671AB 9

Cross shafts removal

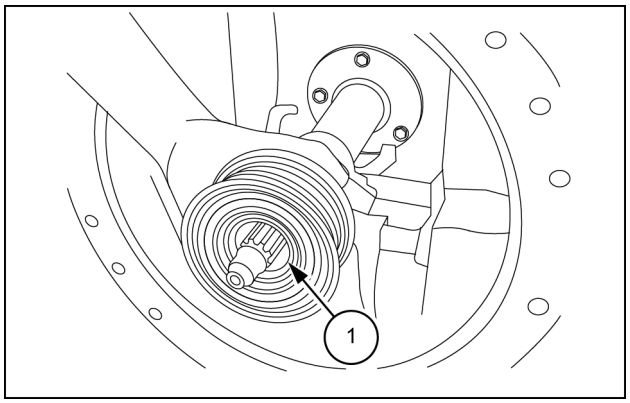
To remove cross shafts clutch housing has to be split between engine flywheel housing and transmission housing.

1. Remove clips **(1)** from both the forks and release bearings and take out release bearings.



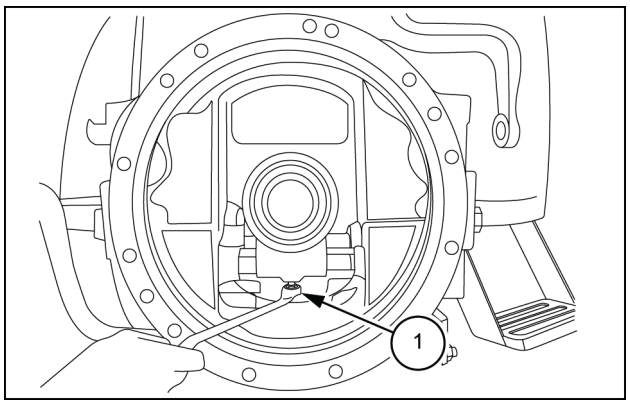
GNIL14TR04673AB 10

2. Slide out both transmission and Power Take-Off (PTO) clutch release bearings **(1)** and **(2)** from the shaft.



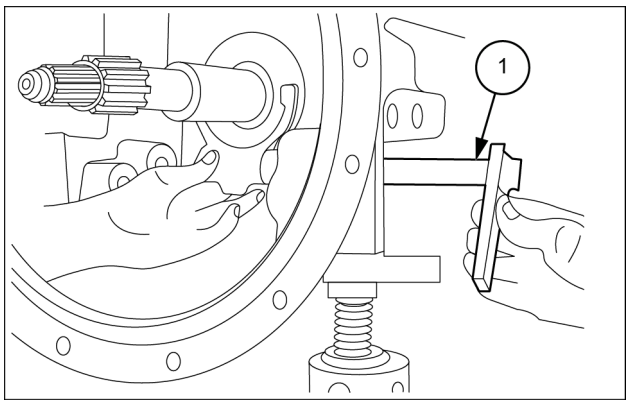
GNIL14TR04674AB 11

3. Loosen the Power Take-Off (PTO) clutch fork lock screw **(1)**.



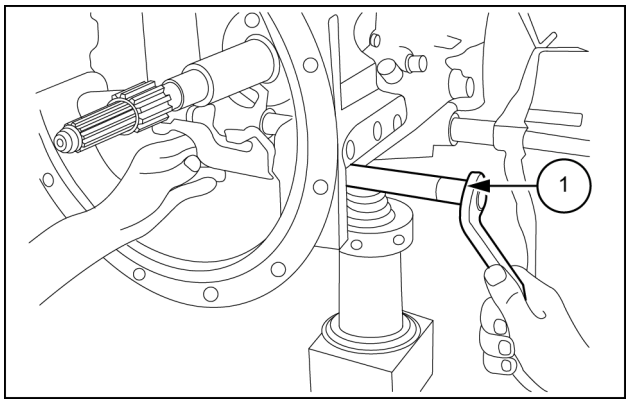
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4. Pull out the Power Take-Off (PTO) cross shaft **(1)** from left hand-side of transmission housing and retrieve fork from the housing.



GNIL14TR04677AB 13

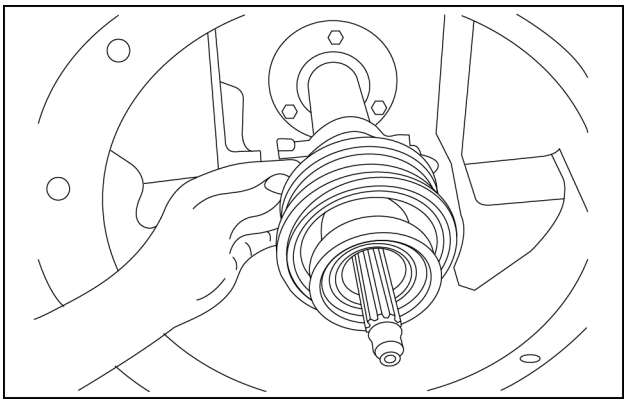
5. Loosen the transmission clutch fork screw.
6. Pull out the Transmission clutch cross shaft **(1)** from left-hand side of the transmission housing and retrieve fork from the housing.



GNIL14TR04676AB 14

Clutch mechanical release control - Install

Reassemble the clutch mechanical release control. Take care of the following:

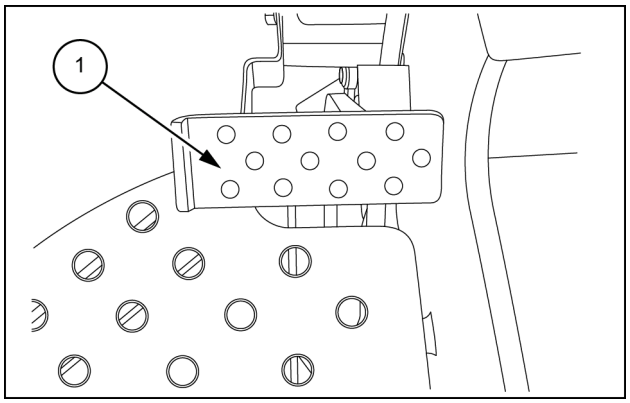


GNIL14TR04673AB 1

1. Reassembly follows the disassembly procedure in reverse.
2. Make sure that the lock clips are properly seated on the clutch release forks.
3. Comply with tightening torques indicated. See **Clutch - Torque (18.110)**.
4. Apply **LOCTITE® 243™** sealant to clutch release fork lock-screw and left-hand side brake pedal lock-screw before tightening.
5. Thoroughly clean and degrease mating surfaces of engine and transmission housing. Apply a bead of liquid gasket of approximately **2.000 mm** (**0.079 in**) of diameter. Buckle up the transmission housing and the engine.

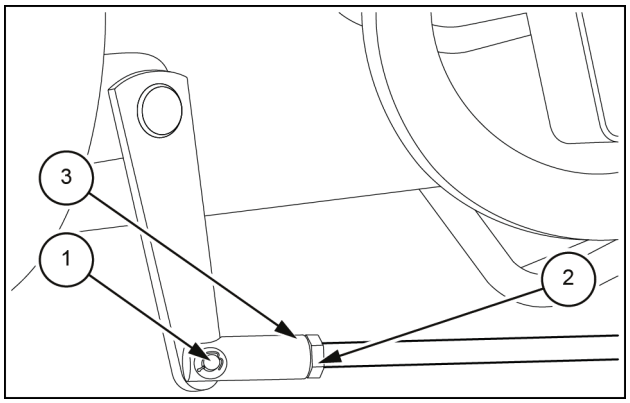
Clutch mechanical release control - Adjust

Clutch pedal free play should be **30.00 - 45.00 mm** (**1.18 - 1.77 in**). To adjust the clutch pedal free play proceed as follows:



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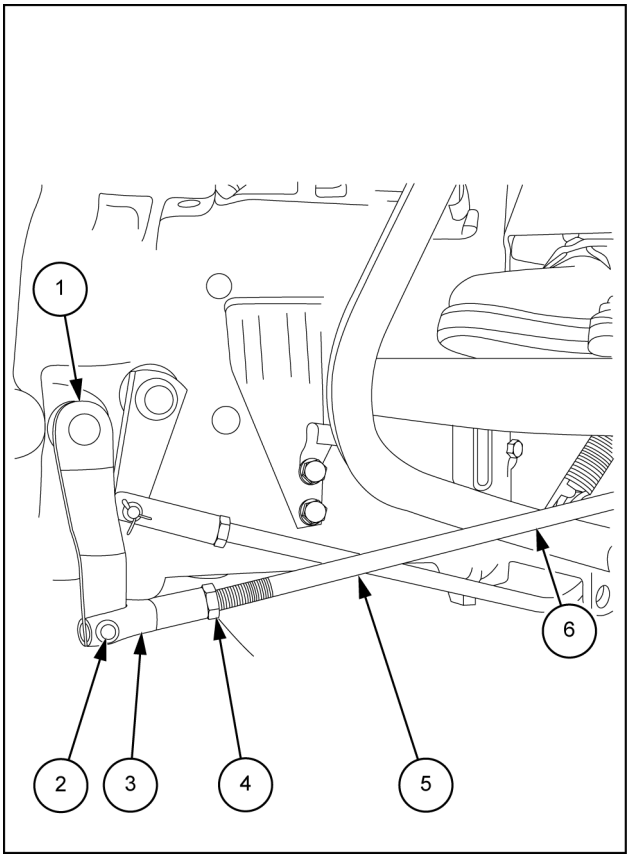
1. Remove the split pin **(1)** and disconnect the linkage.
2. Loosen the lock nut **(2)**.
3. Rotate the yoke **(3)** clockwise to reduce the play and anti-clockwise to increase the play.
4. Connect the linkage back to the cross shaft.



GNIL14TR04688AB 2

Power Take-Off (PTO) clutch lever free play (double speed)

1. Remove the pin **(2)**, fork **(3)** and rod **(5)** separately.
2. Keep lever **(1)** at the right most position such that the bearing just touches the clutch fingers.
3. Insert rod **(5)** into fork **(6)** and tight the threads up to **15.00 mm** (**0.59 in**).
4. Keep end of lever **(7)** at **30.00 - 35.00 mm** (**1.18 - 1.38 in**) from edge as shown in figure.
5. Keep the rod in static position and insert fork **(3)** into rod **(5)**.
6. Match the hole of fork **(3)** with hole of lever **(1)**. Keep the lever in initial position.
7. Insert pin **(2)** in matching holes and lock lever **(1)**.



GNIL14TR04690FB 3

8. Now tight the nut **(4)** to lock the fork.
9. We can see the play of lever **(7)** between edge A and end of lever at **30.00 - 35.00 mm** (**1.18 - 1.38 in**) from edge A. This is the free play of Power Take-Off (PTO) clutch lever.

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Index

Clutch - 18

Clutch mechanical release control - 100

Clutch mechanical release control - Adjust 8
Clutch mechanical release control - Install 7
Clutch mechanical release control - Remove 3

https://truckmanualshub.com/

Clutch - 18

Clutch and components - 110

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

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Contents

Clutch - 18

Clutch and components - 110

TECHNICAL DATA

Clutch
General specification . . . 3
Torque . . . 3
Special tools . . . 4
Sealing . . . 4

FUNCTIONAL DATA

Clutch
Dynamic description . . . 6
Sectional view . . . 7

SERVICE

Clutch
Remove . . . 9
Disassemble . . . 10
Inspect . . . 13
Assemble . . . 15
Adjust . . . 16
Service instruction . . . 17

Clutch control mechanism
Remove . . . 18

DIAGNOSTIC

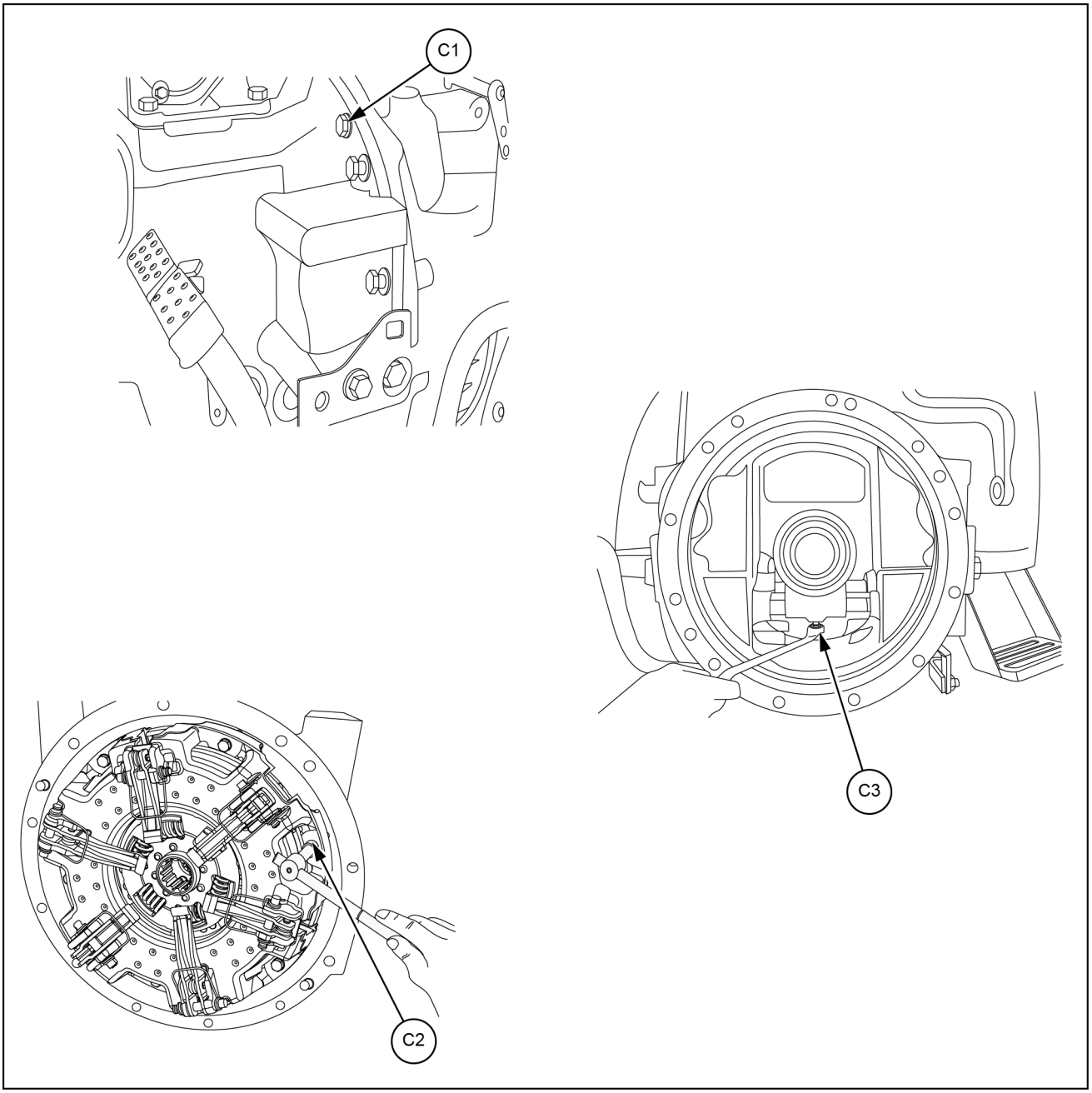
Clutch
Troubleshooting . . . 20

Clutch - General specification

Type	Dry plate torsion springs
Control	Mechanical pedal for transmission Hand lever for PTO
Release mechanism	Diaphragm type
Plate material	Cerametallic
Plate thickness	**7.50 - 8.10 mm** (**0.30 - 0.32 in**)
Plate with pressure springs	Tangential springs

Clutch - Torque

Description	Thread Size (mm)	Torque
Transmission housing to flywheel housing buckle up bolts **(C1)**	M12 X 1.25	**7.00 kgf** (**15.43 lbf**)
Clutch assembly mounting bolts **(C2)**	M8 X 1	**2.60 kgf** (**5.73 lbf**)
Bolts, release fork **(C3)**	M16 X 1.5	**16.00 kgf** (**35.27 lbf**)



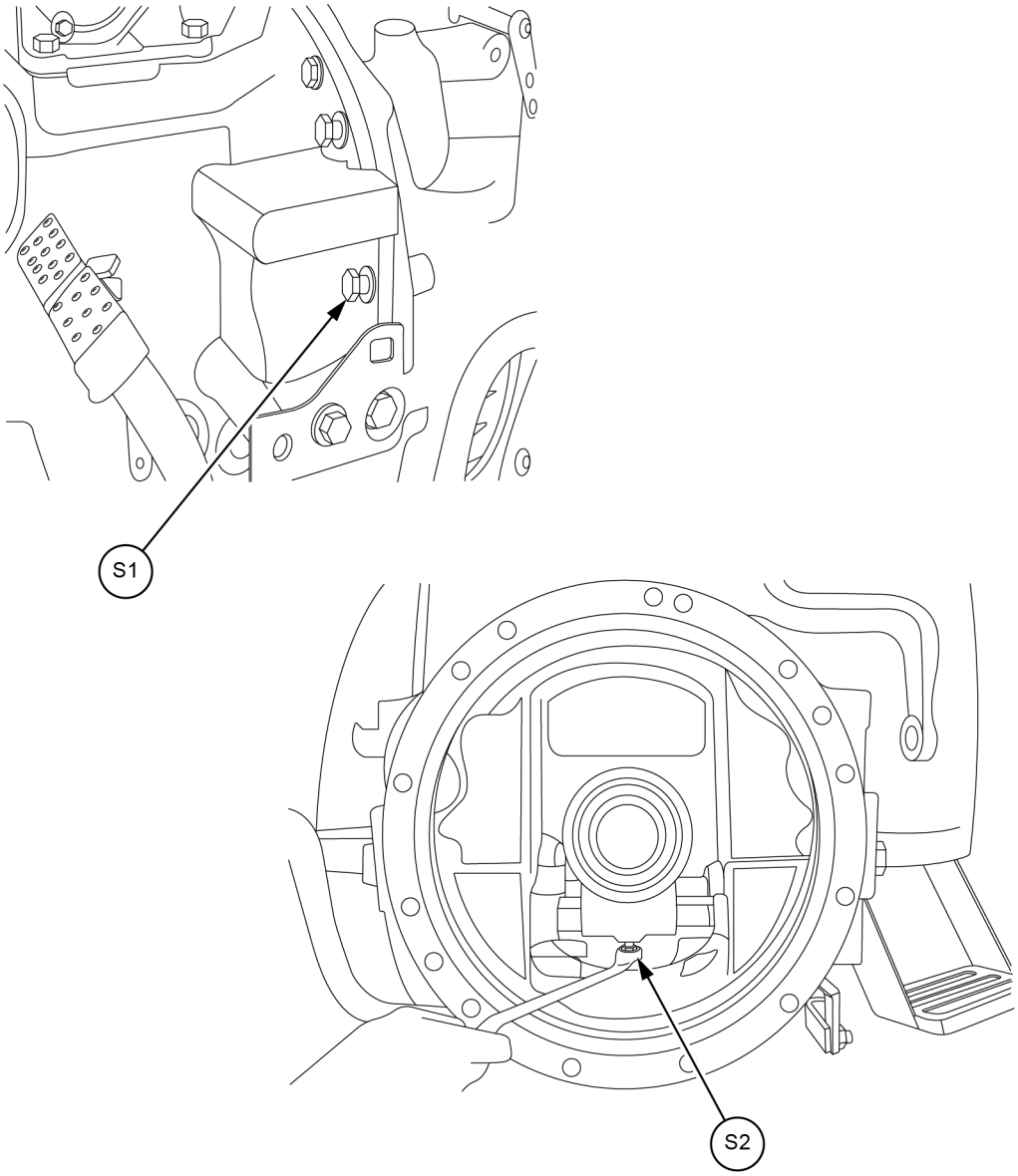
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Clutch - Special tools

Tool Description	Tool Number
Clutch centralizer and finger height setting gauge	**380000612**
Clutch finger height adjusting wrench (set of three)	**380000256**
Installer, oil seal in clutch housing	84261387
Installer, oil seal in hollow shaft	84261388

Clutch - Sealing

Operation description	Sealant specification
Engine to transmission buckle up **(S1)**	**LOCTITE® 518™**
Bolts, release fork **(S2)**	**LOCTITE® 243™**



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Clutch - Dynamic description

The clutch system is double clutch mechanical type. It includes two dry clutch discs with non-asbestos, organic material pads. One clutch disc is to connect transmission to engine and another for connecting PTO directly to engine, independent of transmission.

The clutch is located in front of the transmission. The transmission (main) clutch is operated by means of foot pedal and PTO clutch is operated by hand lever located on right side below rear hood panel. The clutch system is composed of the clutch housing, clutch pressure plate, disc ring, clutch release fingers, clutch release bearings and clutch discs.

OPERATION

When both the clutches are engaged, the PTO clutch pressure plate pushes the PTO clutch disc against engine flywheel and transmission pressure plate pushes the clutch housing by the spring action of dish ring.

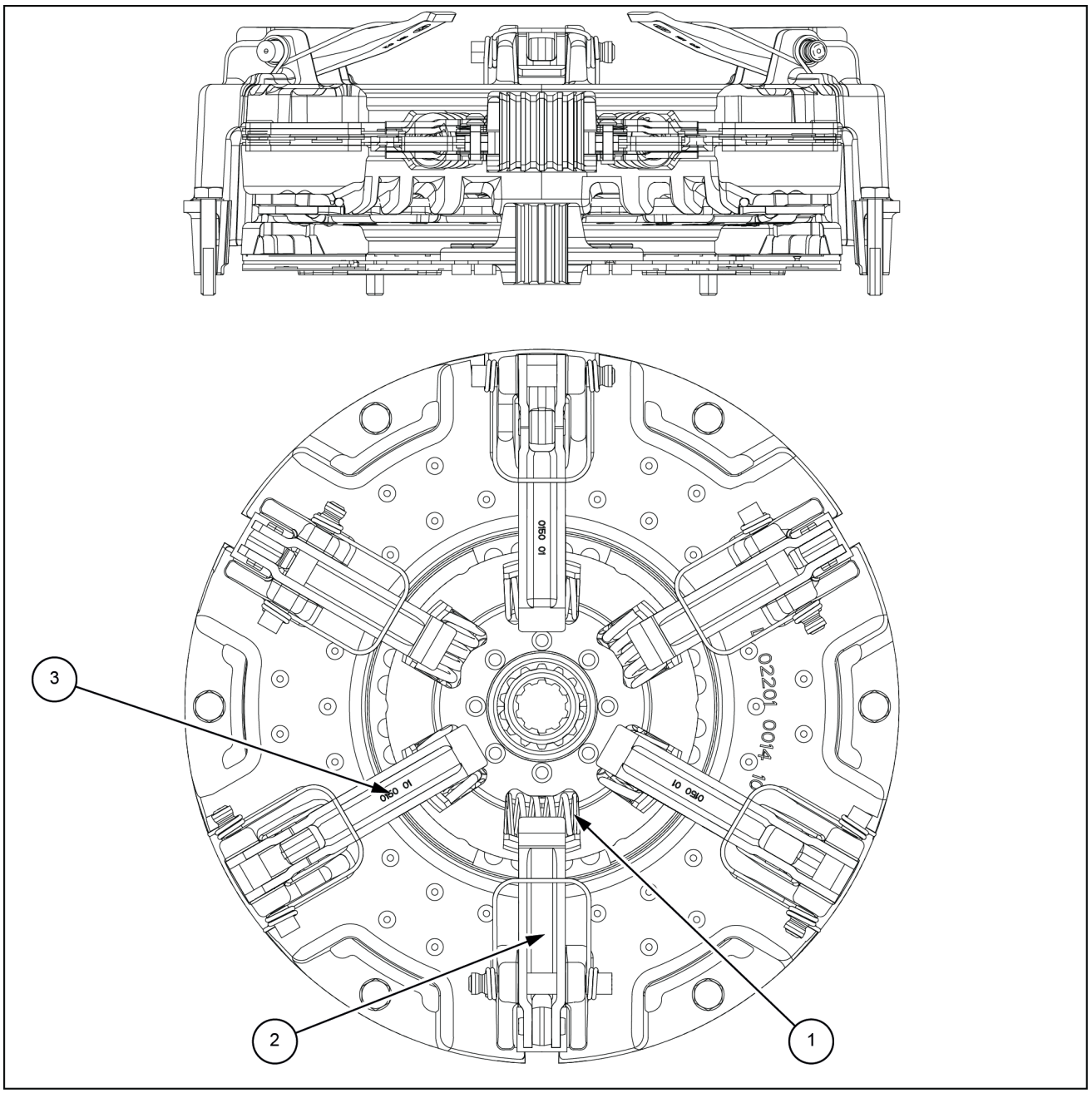
The friction between the clutch disc, flywheel and clutch housing transmits the engine power to the transmission drive shaft and PTO drive shaft independently.

The clutch pedal is connected to the main clutch release bearing by means of mechanical linkage components.

When the clutch pedal is pressed, the clutch release bearing moves forward and discharges the main clutch fingers. Consequently, the clutch pressure plate backs off and releases the clutch disc from the clutch housing. The transfer of engine power to the transmission is stopped.

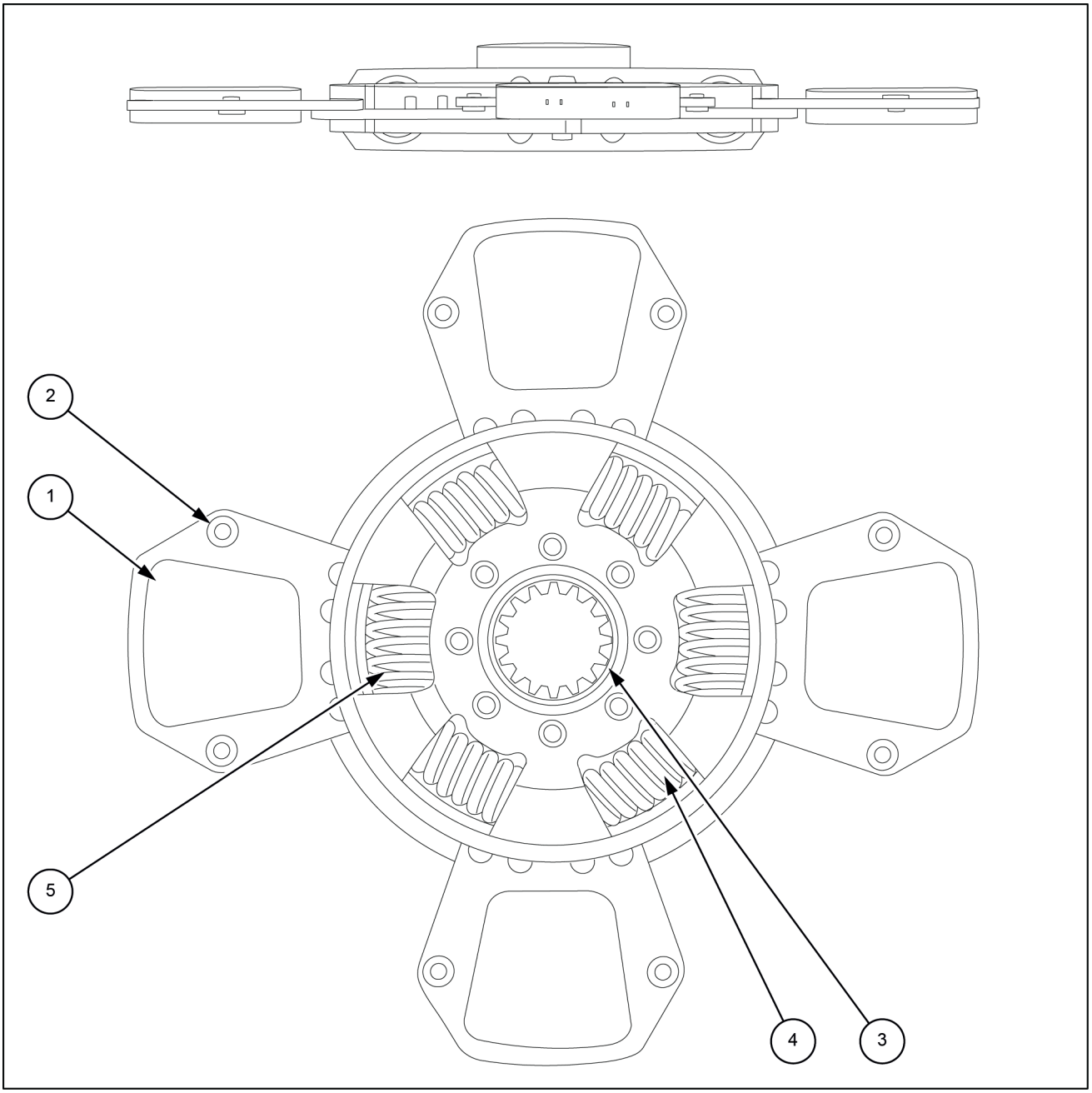
When the clutch pedal is released, the main clutch release bearing disengages the main clutch finger which acts on the clutch pressure plate and causes the clutch housing, main clutch discs and pressure plates to come in contact. The flow of power from the engine and transmission is re-established. Similarly PTO clutch is engaged and disengaged independent of transmission clutch by operating PTO clutch control lever.

Clutch - Sectional view



GNIL14TR00802GA 1

(1) — Damper springs
(2) — Transmission clutch release fingers
(3) — Power Take-Off (PTO) clutch release fingers



GNIL14TR00803GA 2

(1) – Clutch facing
(2) – Facing rivet
(3) – Hub
(4) – Idle damper spring
(\5) – Main damper spring

Clutch - Remove

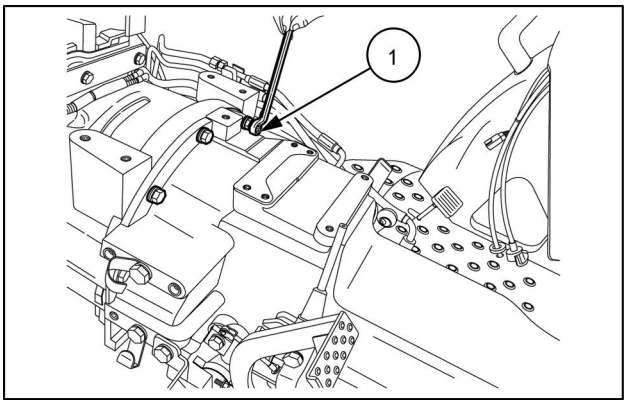
⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

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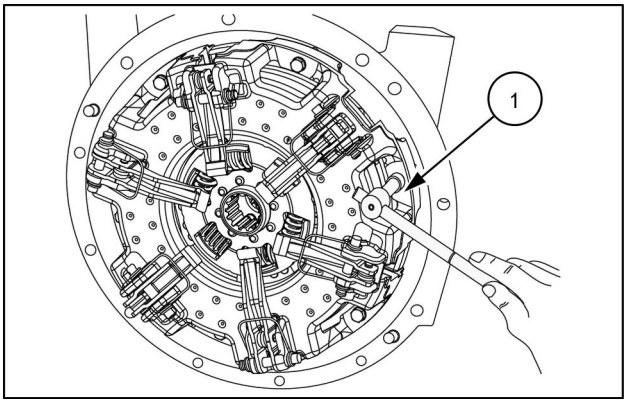
It is necessary to split the tractor between engine and transmission housing to gain access to the clutch.

1. Remove the bolts **(1)**.
2. Separate the transmission housing from engine. See engine removal section.



GNIL14TR00753AA 1

3. Remove the bolts **(1)** which retains the clutch assembly to the engine fly wheel and slacken the two remaining bolts.



GNIL14TR00754AA 2

4. Insert centralizing pin special tool number **380000612** in clutch plate shaft seats back off the two remaining bolts.
5. Remove the assembly completely.
6. Retrieve the Power Take-Off (PTO) clutch disc.

Clutch - Disassemble

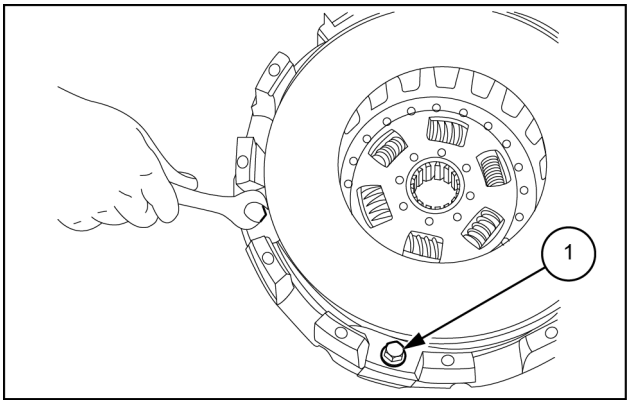
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Failure to comply could result in death or serious injury.

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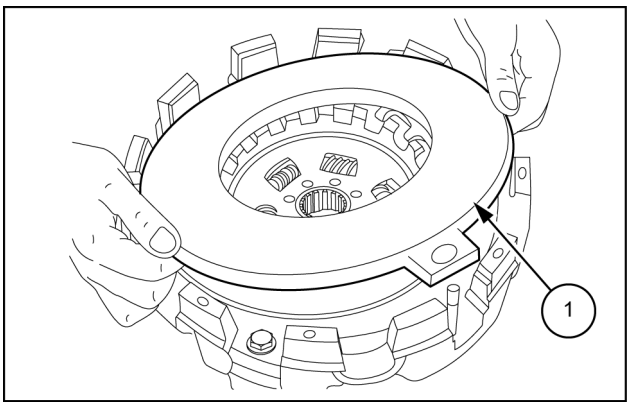
1. Remove the clutch assembly from the tractor as described earlier in this section. See **Clutch - Remove (18.110)**.
2. Loosen the Power Take-Off (PTO) clutch release lever locknuts **(1)**.

NOTICE: *Since the locknuts are under the load of disk ring, loosen all these gradually and evenly by rotating 1/4 to 1/2 turns.*



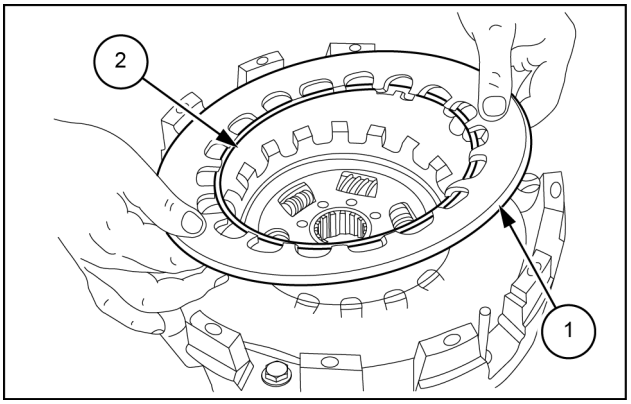
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3. Remove Power Take-Off (PTO) pressure plate **(1)**.



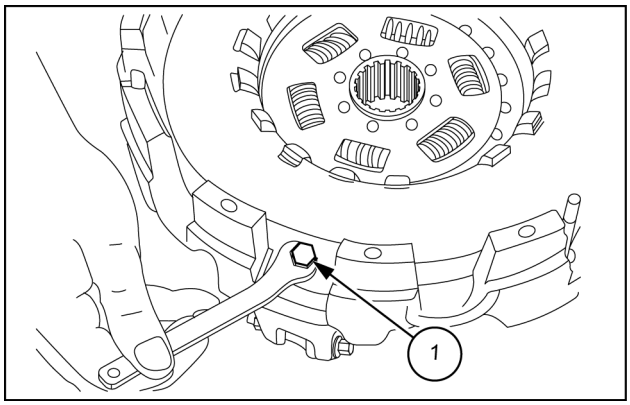
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4. Remove disk ring **(1)** and lock ring **(2)**.



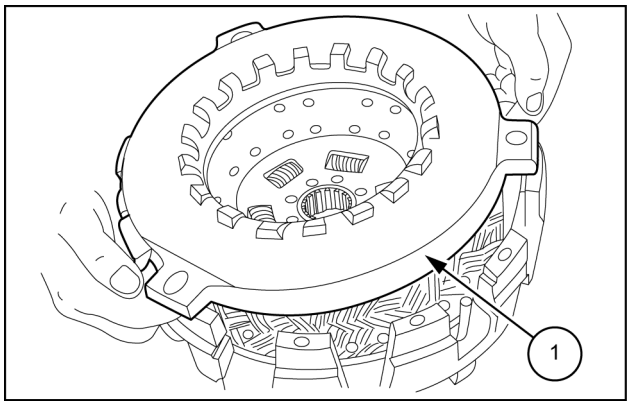
GNIL14TR04697AB 3

5. Loosen lock nut **(1)**.



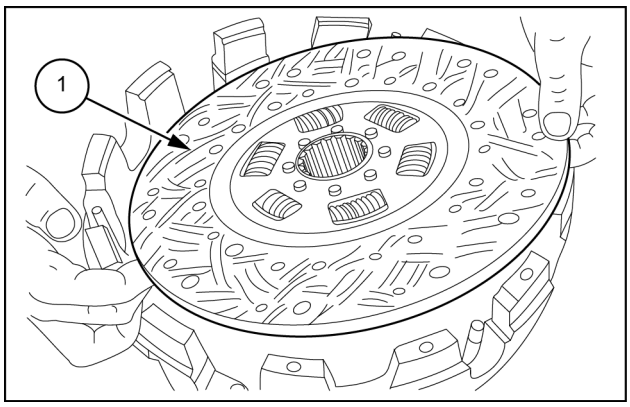
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6. Remove transmission clutch pressure plate **(1)**.



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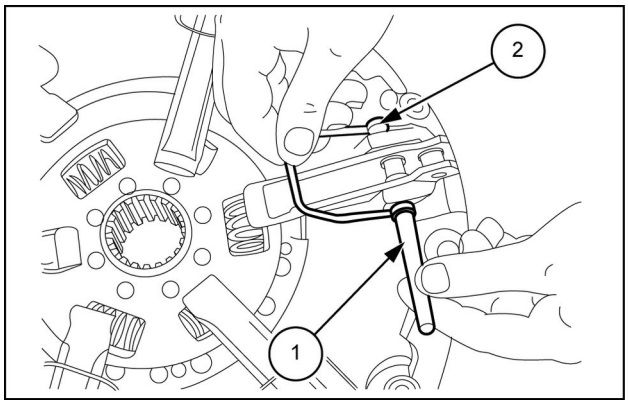
7. Remove transmission clutch disc **(1)** from the housing.



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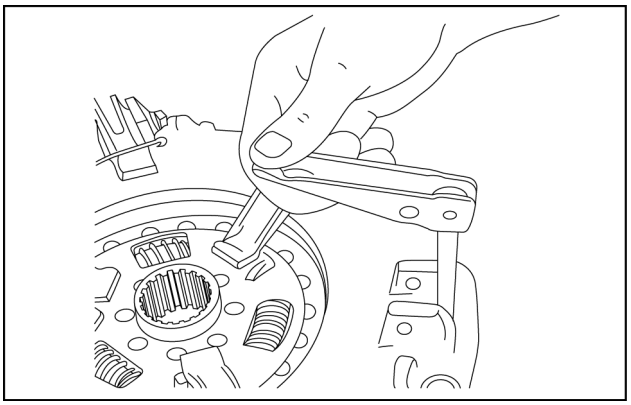
Release fingers disassembly

8. Push out the pin **(1)** from the housing and retrieve the spring **(2)**.



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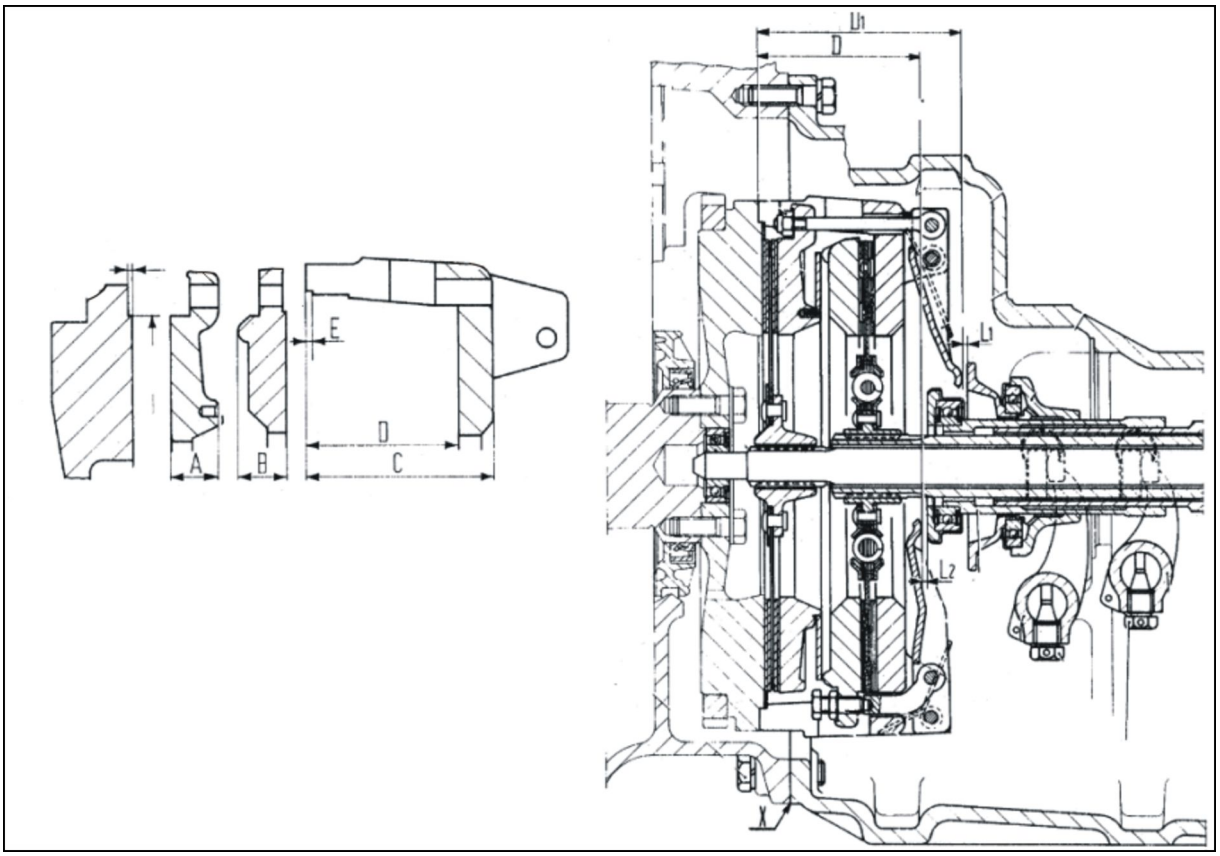
9. Remove release fingers from the housing.



GNIL14TR04703AA 8

Clutch - Inspect

1. Check clutch driven discs for wear and replace if rivets **(2)** are near or flush with top facing.
2. Discs are also to be replaced if the organic facings are found to be soaked with oil.
3. Check condition of clutch housing and pressure plate friction surfaces. If necessary dress noting that dimensions of pressure plates and clutch housing must not be reduced below the limits described below otherwise replace as necessary.



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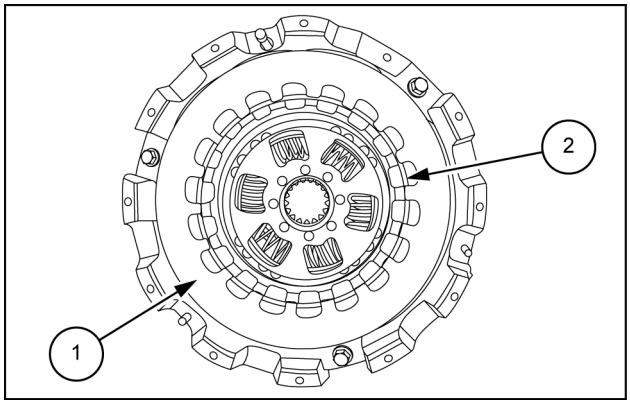
See **1**.

- Fly wheel **(1)** under cut - ‘A’ = **2.000 mm** (**0.079 in**)
- Power Take-Off (PTO) clutch pressure plate **(2)** thickness - ‘B’ = **22.000 mm** (**0.866 in**)
- Transmission clutch pressure plate **(3)** thickness - ‘C’ = **24.000 mm** (**0.945 in**)
- Clutch housing under cut -‘E’ = **2.500 mm** (**0.098 in**)
- Dressing allowance - ‘F’ = **70.000 - 70.150 mm** (**2.760 - 2.760 in**)
- Calculate dimension ‘F’ as follows
  F=A+B+C+S1+S2+P
  Where,
  S1 = Power Take-Off (PTO) clutch disc thickness
  S2 = Transmission clutch disc thickness
  P = Spring dimensions to restore original load = **4.500 mm** (**0.180 in**) (fixed)
- Check that value ‘F’ is equal to **69.850 - 70.150 mm** (**2.750 - 2.760 in**)
- In restoring value ‘F’ check that clutch housing thickness ‘E’ does not fall below **17.000 mm** (**0.670 in**) i.e. D-F = E ≥ **17.000 mm** (**0.670 in**)
- Check that the undercut ‘E’ on clutch housing is deeper than **2.500 mm** (**0.098 in**) and restore as necessary.
- If necessary, dress friction face on flywheel and restore external undercut ‘A’ of **2.000 mm** (**0.079 in**).

Clutch - Assemble

Re-assembly follows disassembly procedure in reverse order. See **Clutch - Disassemble (18.110)** .

1. Position disc springs **(1)** correctly and lock-ring **(2)** on transmission pressure plates as shown in **1**.



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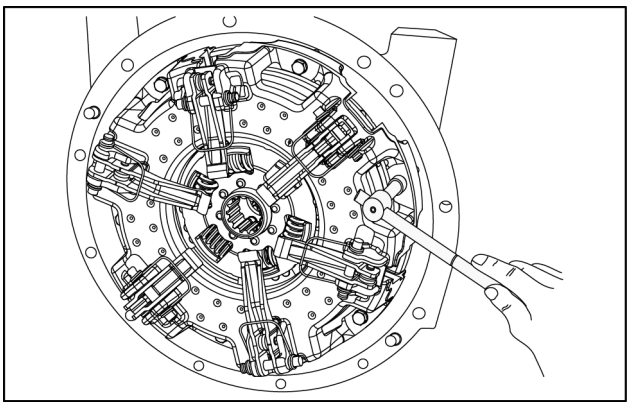
2. Use special tool number **380000612**, and centralize the clutch discs.
3. Install the clutch assembly on flywheel.
4. Adjust the release fingers as described under clutch release finger settings. See **Clutch - Adjust (18.110)**.

Clutch - Adjust

For correct function of clutch release mechanism, the release fingers must be set at the distances D - **96 mm** (**4 in**) and D1 - **121 mm** (**5 in**) relative to flywheel face for transmission clutch and Power Take-Off (PTO) clutch respectively.

Follow the below described procedure to obtain these settings.

1. Install the clutch assembly on engine flywheel.



GNIL14TR00754AA 1

2. Insert centralizer pin, special tool number **380000612**, along with fingers height setting gauge drive shaft seats ensuring that end is in contact with flywheel housing.
3. First set Power Take-Off (PTO) release fingers by using height setting gauge as shown in figure. Gap between gauge and finger should be between **0.30 mm** (**0.01 in**). Use feeler gauge to check the gap.
4. Use special tool no. 9971365. Rotate the locknut and set the gap.
5. Similarly set the height setting gauge as shown in the figure **(b)** to set transmission clutch release fingers. The gap between fingers and gauge should be **0.30 mm** (**0.01 in**).
6. Use special tool number 9971365. Loosen the locknut and rotating screws and adjust the gap.

Clutch - Service instruction

⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

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Important points to be taken into account while replacing clutch:

1. Check the condition of spigot bearing replace if necessary.
2. Check the condition of the oil seals on the engine and transmission sides for leaks and replace if necessary.
3. Check the flywheel face is free from scores and cracks. When machining the surface, follow specified tolerances.

NOTE: *Machine the bolting surface to the same amount of the running surface, to maintain original clamp loads.*
Always use suitable tools to align holes. Do not use hands or fingers.

4. Make sure that the alignment of the clutch cover to the flywheel is correct. Use special tool number **380000612** for alignment.
5. Make sure that the clutch cover is secured to the flywheel evenly and sequentially. Use new spring washers.
6. After an initial running-in period, any variation lever height will correct itself.
7. Before fitting check the clutch plate for lateral runout.
8. Make sure that the clutch plate is fitted the correct way. Observe the direction as indicated on the driven plate.
9. Check the gearbox input shaft for damage. Only non-metallic based high melting point grease should be used to lubricate the splines and release bearing guide sleeve.
10. Check the release bearing guide sleeve for wear and replace if necessary.
11. After applying the grease to the gearbox input shaft, guide the clutch driven plate on to the shaft and remove the surplus grease.
12. Make sure that the alignment between the engine and transmission/clutch housing is correct. Make sure that the locating dowels are fit and secure.
13. Carefully guide the input shaft into the clutch hub splines. Do not allow the weight of the transmission to hang on the hub of the driven plate. This will prevent irreparable damage to the segments and associated cushion springs.
14. Make sure that the adjustment of clutch pedal free play is correct.

Clutch control mechanism - Remove

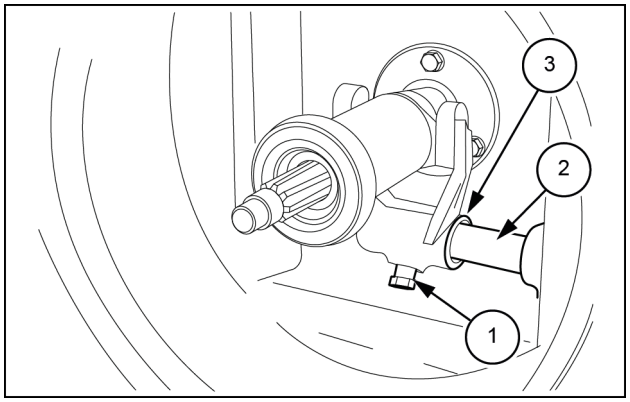
⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

W0208A

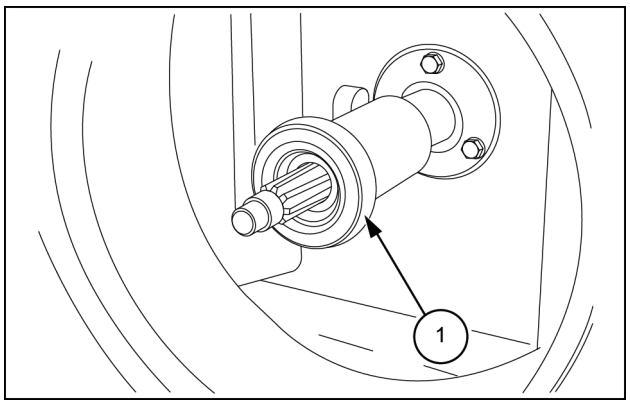
It is necessary to split the tractor between engine and transmission housing to gain access to the clutch.

1. Loosen the set screw **(1)** from fork.
2. Pull out the cross shaft **(2)**.
3. Remove clutch release fork **(3)**.



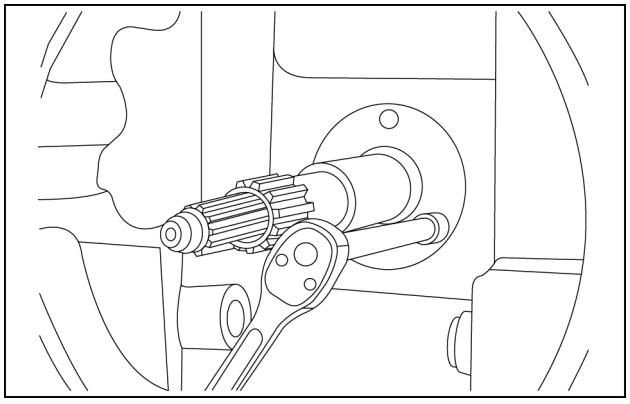
GNIL14TR04679AB 1

4. Slide out the clutch release bearing **(1)**.



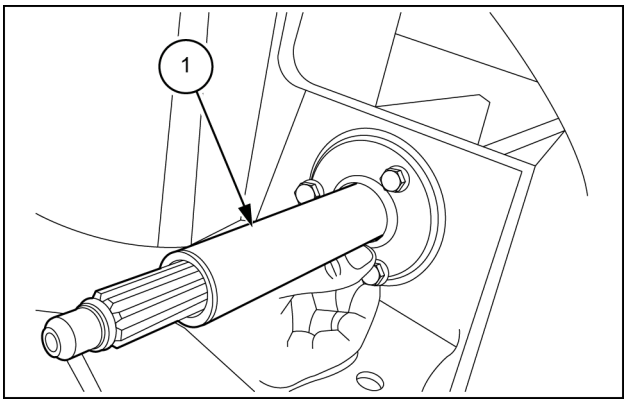
GNIL14TR04680AB 2

5. Loosen the bolts 3 numbers as shown in figure.



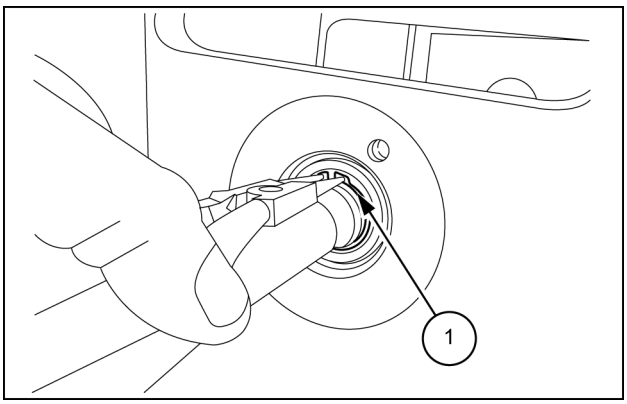
GNIL14TR04681AA 3

6. Unscrew bolts as shown in figure and remove top cover **(1)**.



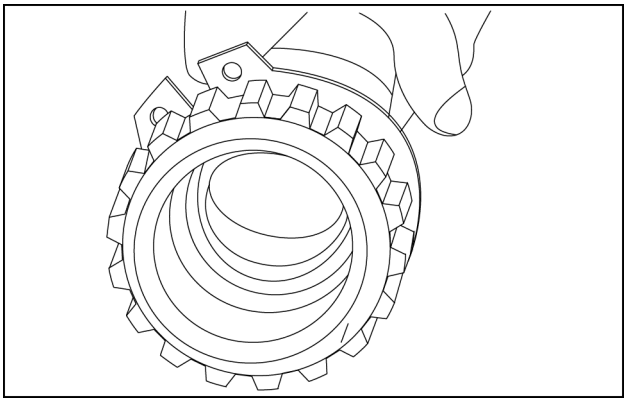
GNIL14TR04682AB 4

7. Remove lock **(1)** as shown in figure. Use plastic hammer to push out the shaft. The shaft will come out toward gearbox side. Retrieve bearing.



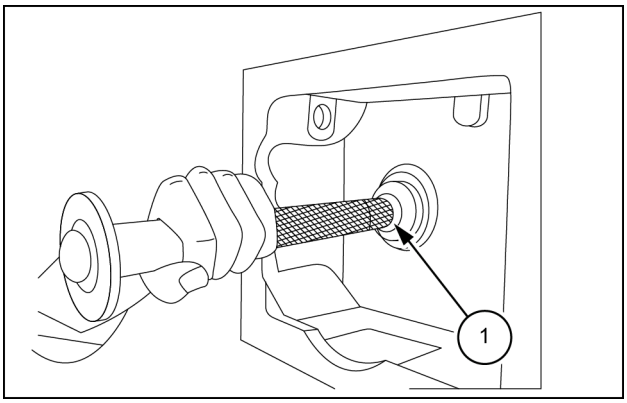
GNIL14TR04683AB 5

8. To remove shaft **(2)** toward the clutch side, remove circlip lock **(1)**. Retrieve bearing and seal.



GNIL14TR04684AA 6

9. Use special tool number 84261387 and install the seal **(1)**.



GNIL14TR04685AB 7

Clutch - Troubleshooting

Problem	Possible Cause	Correction
Clutch slips	Clutch disc, pressure plate and/or flywheel wear.	Replace clutch disc; replace clutch if necessary and grind the flywheel.
	Damaged or bent or broken fingers.	Replace finger assembly.
	Oil or grease on friction material.	Replace clutch disc; repair leak of lubricant in to clutch housing; thoroughly clean friction surfaces.
Clutch grabs	Stiff external control linkage.	Check and lubricate linkage pivot points.
	Warped clutch disc.	Replace clutch disc.
	Clutch disc with damaged damper springs or loose hub.	Replace clutch disc.
	Oil or grease on friction material.	Replace clutch disc; repair leak of lubricant in to clutch housing; thoroughly clean friction surfaces.
	Finger springs broken.	Replace finger springs.
Clutch fails to disconnect and drags	Warped clutch disc.	Replace clutch disc.
	Damaged clutch release bearing.	Replace clutch release bearing.
	Damaged finger spring.	Replace finger springs.
Clutch noise at engagement and / or disengagement	Warped clutch disc.	Replace clutch disc.
	Damaged clutch disc damper springs.	Replace clutch disc.
	Excess backlash on clutch disc to hub meshing splines.	Replace clutch disc and shaft, as necessary.
Clutch noise at disengagement	Worn clutch release bearing.	Replace bearing.
Clutch control pedal hardness	Hard pedal.	Check and lubricate linkage.
	Broken or disconnected clutch return spring.	Repalce or hook-up clutch return spring.

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Index

Clutch - 18

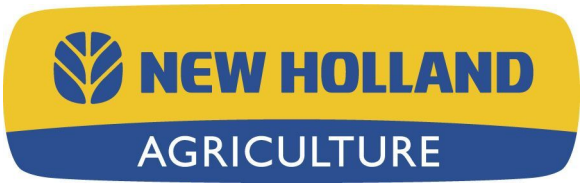
Clutch and components - 110

Clutch - Adjust 16
Clutch - Assemble 15
Clutch - Disassemble 10
Clutch - Dynamic description 6
Clutch - General specification 3
Clutch - Inspect 13
Clutch - Remove 9
Clutch - Sealing 4
Clutch - Sectional view 7
Clutch - Service instruction 17
Clutch - Special tools 4
Clutch - Torque 3
Clutch - Troubleshooting 20
Clutch control mechanism - Remove 18

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SERVICE - Technical Publications & Tools



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SERVICE MANUAL

Transmission

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Transmission - 21

[21.114] Mechanical transmission 21.1

[21.130] Mechanical transmission external controls..... 21.2

[21.140] Mechanical transmission internal components..... 21.3

[21.145] Gearbox internal components..... 21.4

[21.200] Dropbox 21.5

https://truckmanualshub.com/

Transmission - 21

Mechanical transmission - 114

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Transmission - 21

Mechanical transmission - 114

TECHNICAL DATA

Mechanical transmission
General specification 3
Torque 3
Sealing 5
Special tools 6

FUNCTIONAL DATA

Mechanical transmission
Sectional view 7
Overview 9

SERVICE

Mechanical transmission
Drive shaft - Service instruction 12
Remove 14
Disassemble – Intermediate plate 18
Inspect – Intermediate plate 21
Assemble – Intermediate plate 22
Install 25

DIAGNOSTIC

Mechanical transmission
Troubleshooting 29

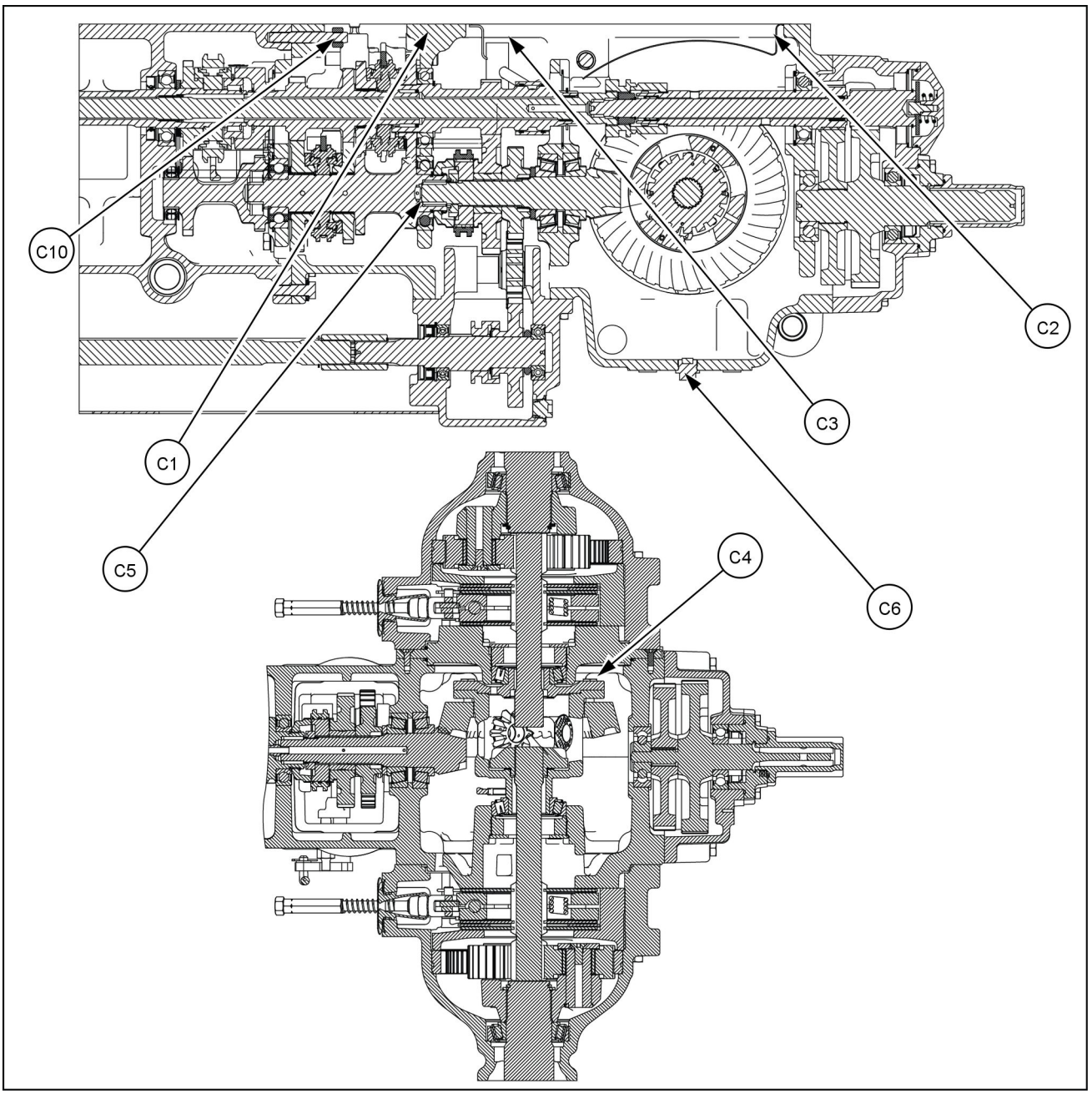
Mechanical transmission - General specification

Gear box type	Constant mesh
Range gears	Constant mesh
Forward-reverse	Mechanical Synchromesh Shuttle
Lubrication	
Transmission oil capacity	APGL4SAE 20W30 **23 L** (**6 US gal**) for 2WD (Two Wheel Drive) and **25.0 L** (**6.6 US gal**) for 4WD (Four Wheel Drive)

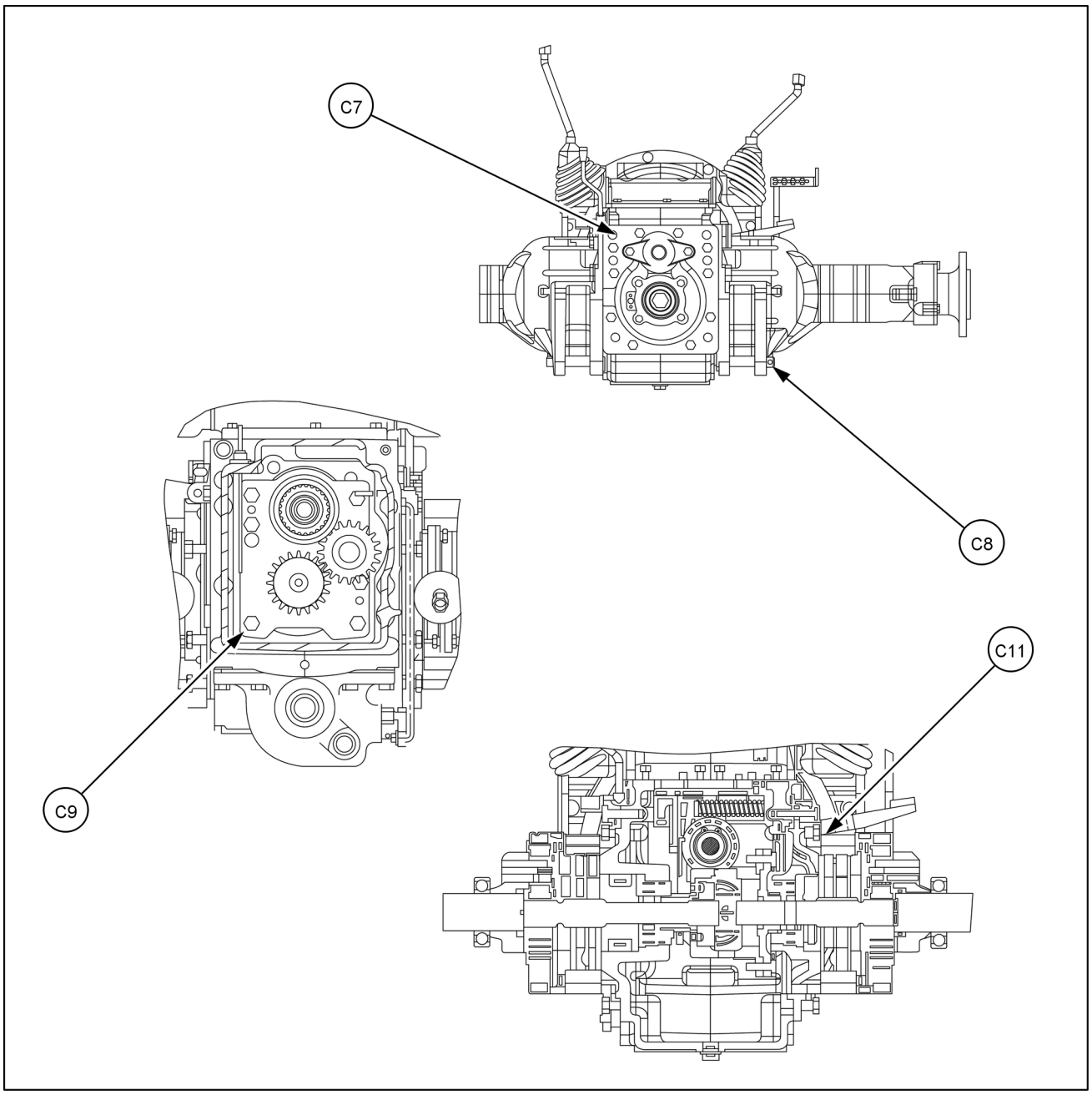
Rear Tire Size	**13.6-28**	**14.9-28**
Gear	**2600 RPM**	**2600 RPM**
FL1	2.56	2.73
FL2	3.86	4.11
FL3	5.69	6.07
FL4	7.83	8.34
FH1	10.03	10.68
FH2	15.10	16.09
FH3	22.29	23.75
FH4	30.67	32.68
RL1	2.70	2.88
RL2	4.07	4.34
RL3	6.01	6.41
RL4	8.27	8.82
RH1	10.59	11.29
RH2	15.96	17.00
RH3	23.56	25.10
RH4	32.40	34.53

Mechanical transmission - Torque

Description	**Thread size**	**Torque**
Gear shift lever cover bolts **(C1)**	M8	**2.5 kgf** (**5.5 lbf**)
Hydraulic housing on transmission retainer bolts **(C2)**	M10 x 1.25	**6.0 kgf** (**13.2 lbf**)
Hydraulic housing on transmission retainer bolts **(C3)**	M12 x 1.25	**10.0 kgf** (**22.0 lbf**)
Crown wheel bolts **(C4)**	M10	**6.0 kgf** (**13.2 lbf**)
Pinion lock nut **(C5)**	M35	**30.0 kgf** (**66.1 lbf**)
Drain plug **(C6)**	M22	**4.5 kgf** (**9.9 lbf**)
Power Take-Off (PTO) cover bolts **(C7)**	M12 x 1.25	**9.0 kgf** (**19.8 lbf**)
Rear axle to transmission housing attaching bolts **(C8)**	M12 x 1.25	**10.0 kgf** (**22.0 lbf**)
Front cover bolts **(C9)**	M12 x 1.25	**10.0 kgf** (**22.0 lbf**)
Transmission housing to centre housing attaching bolts **(C10)**	M12 x 1.25	**9.0 kgf** (**19.8 lbf**)
Differential lock pedal screw **(C11)**	M10 x 1.25	**6.0 kgf** (**13.2 lbf**)



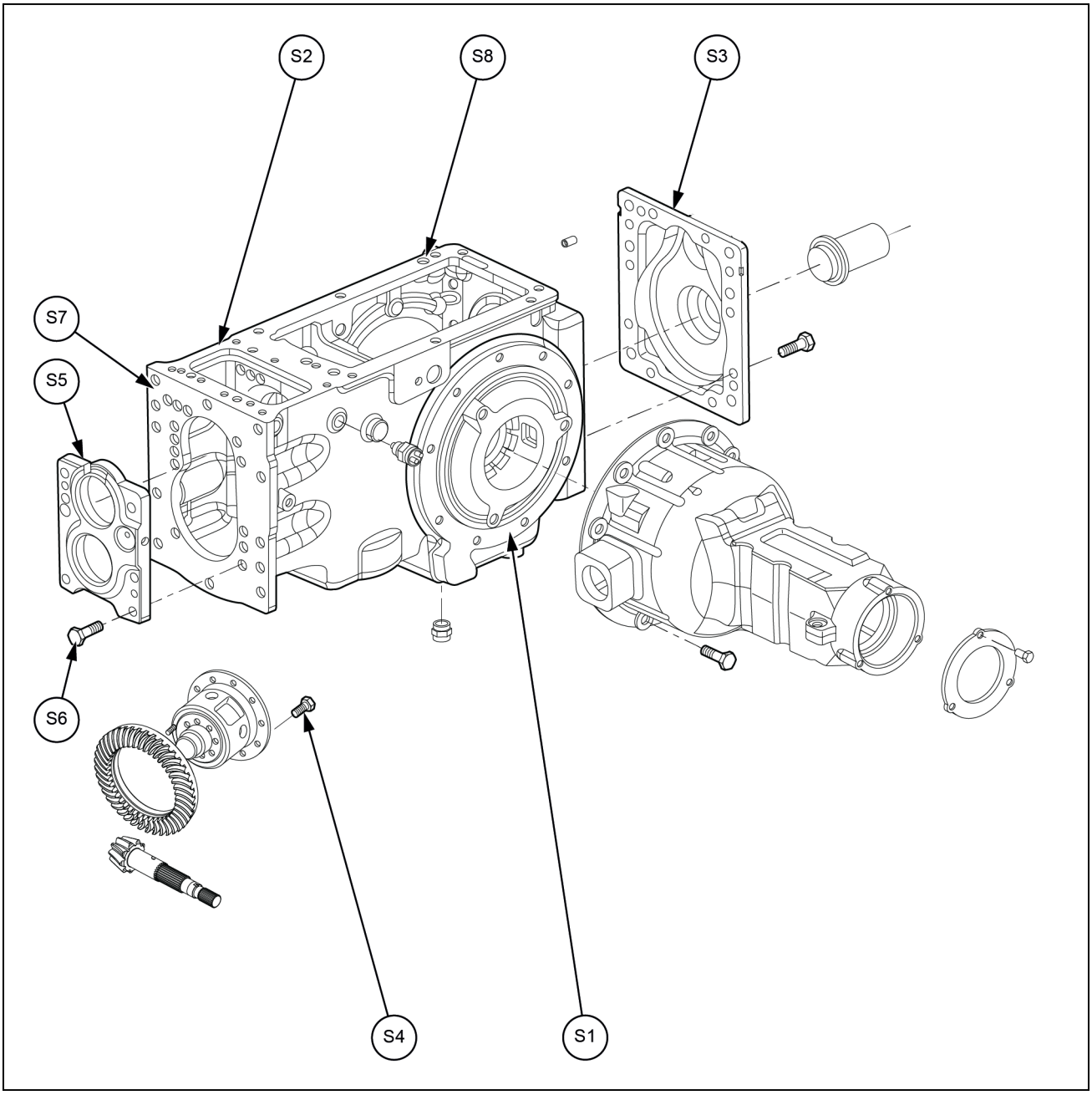
GNIL14TR00824GA 1



GNIL14TR00828GA 2

Mechanical transmission - Sealing

Description	Sealant specification
Rear axle to transmission housing **(S1)**	**LOCTITE® 518™**
Gear shift lever cover **(S2)**	**LOCTITE® 518™**
Power Take-Off (PTO) cover plate **(S3)**	**LOCTITE® 518™**
Crown wheel bolts **(S4)**	**LOCTITE® 243™**
Front cover plate **(S5)**	**LOCTITE® 518™**
Front cover bolts **(S6)**	**LOCTITE® 243™**
Transmission to centre housing **(S7)**	**LOCTITE® 518™**
Lift housing to transmission housing **(S8)**	**LOCTITE® 518™**

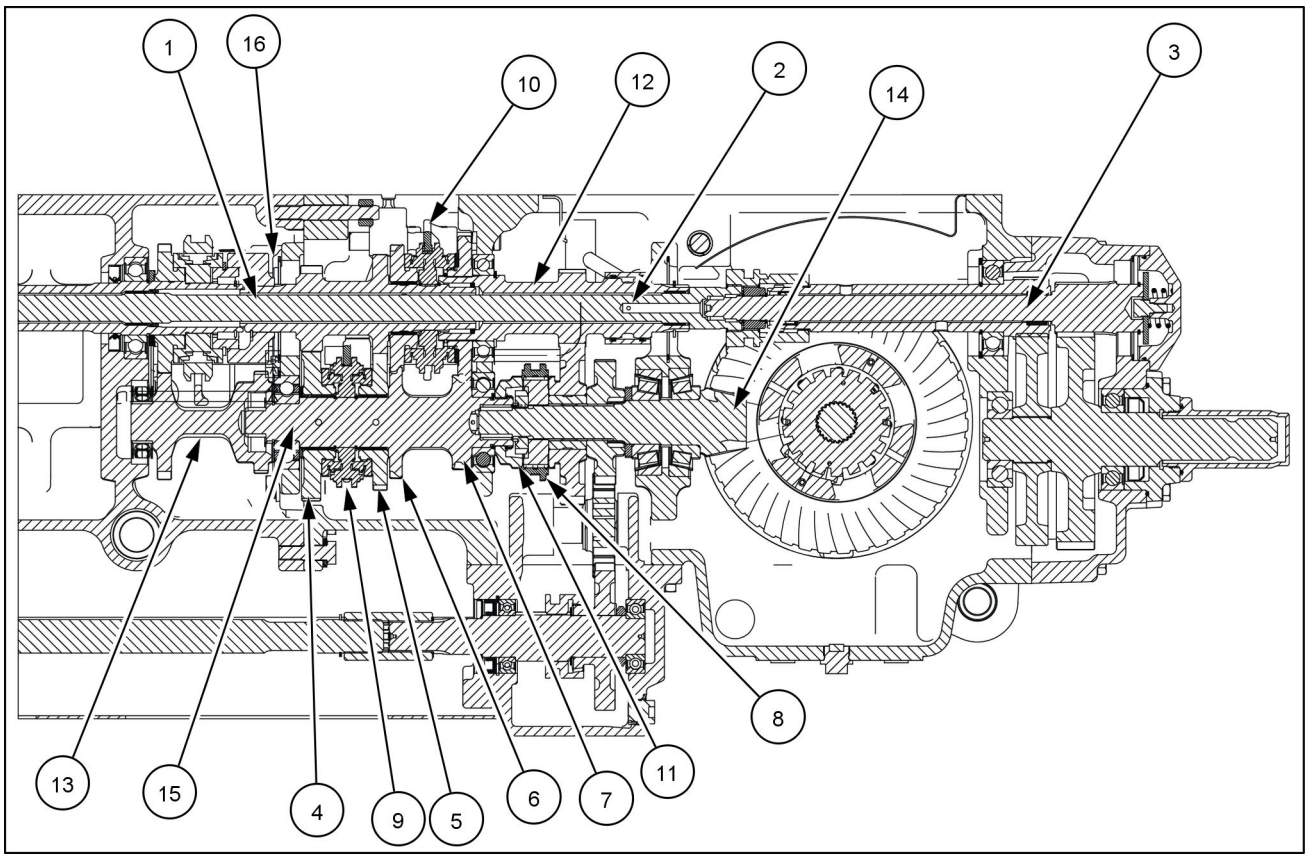


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Mechanical transmission - Special tools

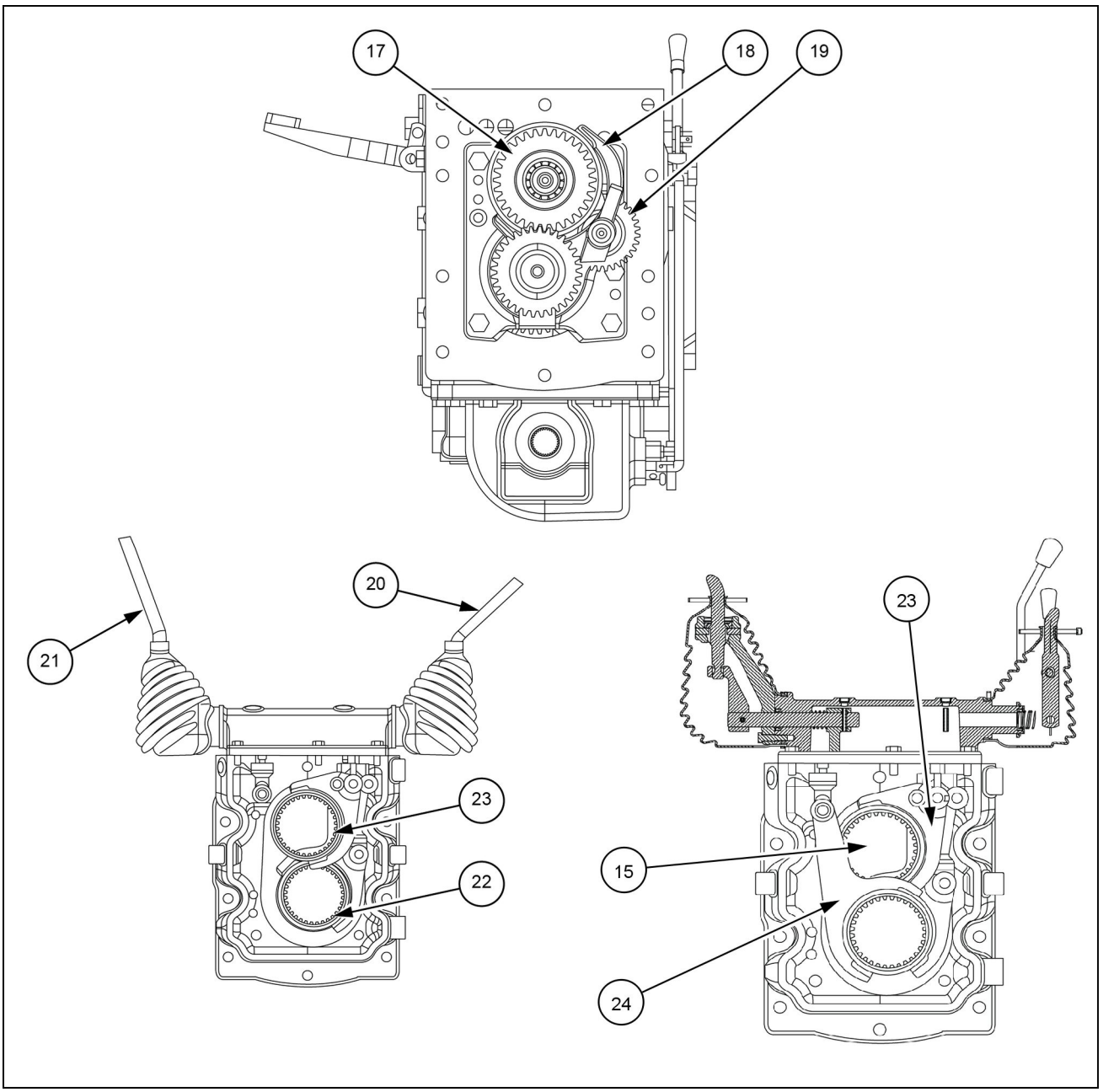
Tool description	Tool number
Socket pinion check nut	84261389
Yoke and spreader	291051 and 291052
Pinion locking tool	**380002985**
Mandrel with extension	9971381
Special snap ring remover	84261393

Mechanical transmission - Sectional view



GNIL14TR00826FA 1

1. Drive shaft
2. Range shaft
3. Power Take-Off (PTO) input shaft
4. 1st gear
5. 2nd gear
6. 3rd gear
7. 4th gear
8. Low gear on pinion shaft
9. 1st - 2nd Synchrokit
10. 3rd - 4th Synchrokit
11. Hi - Lo gear coupler
12. Low gear on range shaft
13. Cluster gear
14. Pinion shaft
15. Driven shaft
16. Reverse gear



GNIL14TR00827GA 2

17. Reverse drive gear
18. Range gear shift fork
19. Reverse intermediate gear
20. Hi-Lo gear shift lever
21. Range gear shift lever
22. 1st - 2nd gear shift fork
23. 3rd - 4th gear shift fork
24. Hi - Lo gear shift fork

Mechanical transmission - Overview

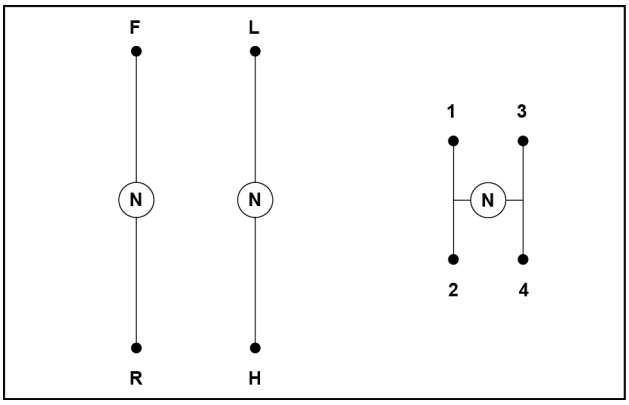
8+8 Synchro shuttle

The transmission has eight forward and eight reverse gears.

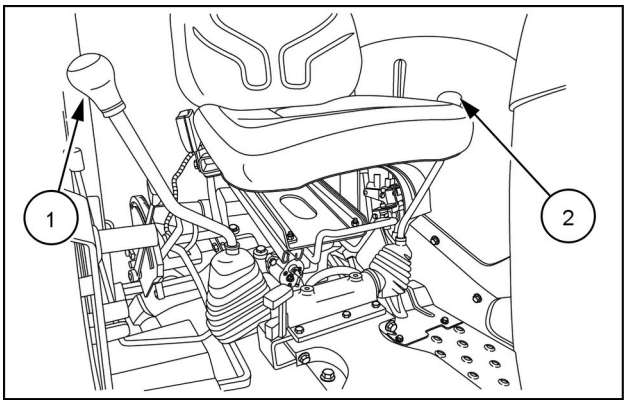
⚠ WARNING

Avoid injury! Always do the following before lubricating, maintaining, or servicing the machine.
1. Disengage all drives.
2. Engage parking brake.
3. Lower all attachments to the ground, or raise and engage all safety locks.
4. Shut off engine.
5. Remove key from key switch.
6. Switch off battery key, if installed.
7. Wait for all machine movement to stop.
Failure to comply could result in death or serious injury.

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GNIL14TR00513AC 1



GNIL14TR00785AA 2

To select any one of the four forward gears or one reverse gear use the main gearshift lever **(1)**. To select the high range or low range, which gives double the number of available gears use Hi-Low selector lever **(2)**.

To change gear range, depress the clutch pedal. Stop the tractor and move the Hi-Low selector lever backward (for high) or forward (for low).

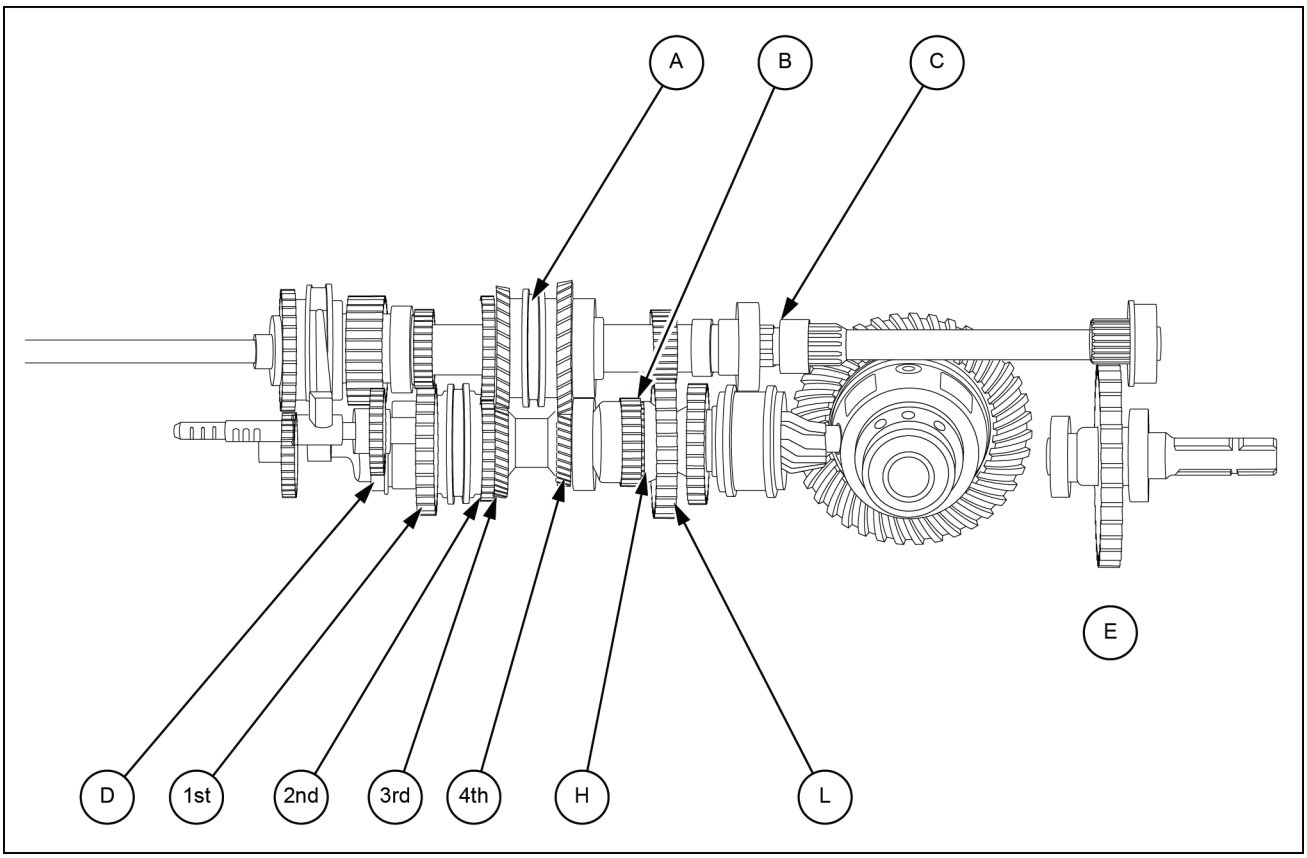
To change the gears in the selected range, depress the clutch pedal and shift main gear lever in the normal way

To select reverse gear **(R)**, first stop the tractor.

NOTE: *A safety start switch prevents operation of the starter motor unless the transmission range lever is in neutral position **(N)**.*

NOTE: *If it is necessary to tow the tractor, the Hi-Low selector and both main gearshift levers must be in neutral.*

The transmission has an input shaft called drive shaft **(1)**, range shaft **(2)**, driven shaft **(16)** and pinion shaft **(15)**. 1st **(4)**, 2nd **(5)** gears are integral part of the drive shaft. 3rd **(6)**, 4th **(7)** gears are integral part of driven shaft. All gears of input shaft and driven shaft are constant mesh. High gear is assembled in driven shaft while, low gear **(8)** is fitted on the pinion shaft. Low drive gear **(12)** is part of the range shaft and is in constant mesh with low gear on the pinion shaft.



GNIL14TR04107FB 3

A	Main gear lever (1st/2nd & 3rd/4th)	E	PTO 540
B	Range selector lever (H/L)	H	High
C	PTO Coupler	L	Low
D	Reverse		

The speeds are shifted by meshing gears 1st **(4)**, 2nd **(5)**, 3rd **(6)**, and 4th **(7)** in succession with the gearbox driven shaft. This is done by means of gear couplers **(9)** and **(10)**. If coupler **(9)** is shifted, say to the left, its internal teeth will connect additional gear ring of 1st gear **(4)** with toothed bushings secured on the driven shaft. As a result, 1st gear **(4)** will rotate together with the driven shaft and transmit rotation to pinion shaft via range shaft **(2)**. When gear coupler **(9)** is shifted to the right, the driven shaft will become rigidly connected with 2nd gear **(5)** having a larger number of teeth than 1st gear. As a consequence, the pinion shaft will rotate faster than the previous speed.

Similarly by shifting gear coupler **(10)** to left pinion shaft is driven by 3rd gear **(6)** via range shaft and by shifting to right pinion shaft is driven by 4th gear **(7)** via range shaft and speed of the pinion shaft varies according to the number of teeth on the gears **(6)** and **(7)**.

Range gear can be selected by shifting the range gear coupler **(11)** to left or right. For getting high range, shifting coupler to left engages cluster gear directly to pinion shaft and pinion shaft receives the rotation from any one of the gears 1st, 2nd, 3rd and 4th depending on the position of gear couplers **(9)** and **(10)** through driven shaft **(16)** and range shaft **(2)**.

For low gear range coupler **(11)** have to be shifted to right and pinion shaft receives rotation via driven shaft **(16)** and range shaft **(2)**. Since gear **(12)** has less number of gears teeth, as a consequence, the pinion shaft will rotate slower than high range.

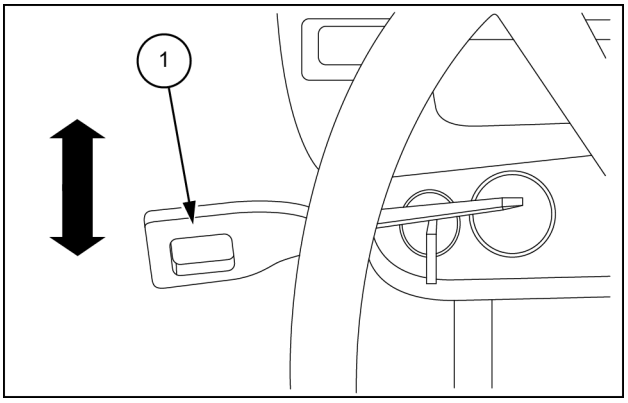
For high gear range coupler **(11)** have to be shifted to the left and pinion shaft receives a rotation directly from driven shaft **(16)**.

For engaging reverse gear, shift reverse gear fork to right, power flow is from input shaft via drive shaft to reverse drive **(14)** gear **(18)** acts as intermediate gear between reverse drive gear **(14)** and reverse gear **(13)** and changes the direction of rotation of pinion shaft. Depending on the position of range gear coupler **(11)** high reverse or low reverse are obtained.

8 + 8 Synchro shuttle

The synchro shuttle transmission is ideal for application which require frequent changes of direction. The operator has to press clutch pedal and move shuttle lever to change direction of travel. Shift lever **(1)** to front for forward and rear to get reverse direction.

NOTE: *The shuttle lever must be in the neutral (middle) position to activate the safety start system, which allows the engine to start.*

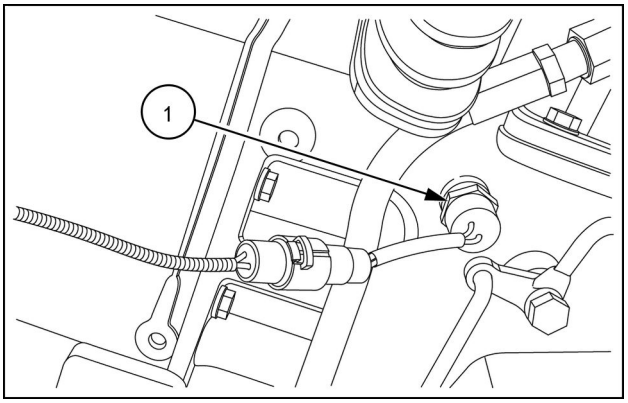


GNIL14TR04110AB 4

Transmission range safety switch

The transmission range safety switch **(1)** is a single-pole, single-throw, switch located along the left side of the transmission. The switch is activated by the range shift lever. When the range is in neutral, the switch is closed to allow current to flow to the neutral start relay.

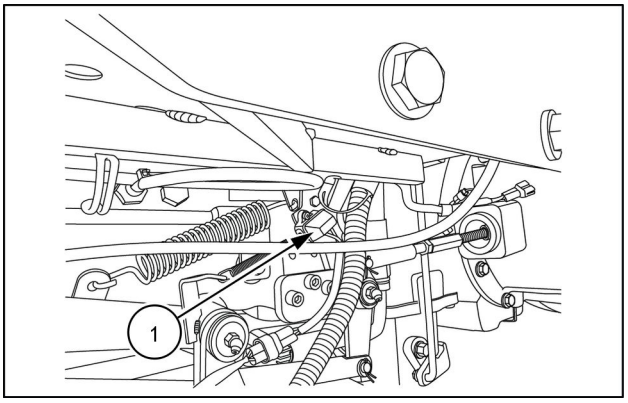
NOTE: *The range shift rail operates the safety switch. Notches in the shift rail accept the balk pin, extending the plunger in the safety switch, when the range lever is in the neutral position. This completes the circuit and allows the tractor to start.*



GNIL14TR00870AA 5

Transmission clutch safety switch

The transmission clutch safety switch **(1)** is a single throw-style switch, located underneath the left side platform of the tractor. The switch is activated by the clutch pedal. When clutch pedal is depressed, the switch closes completing the circuit.



GNIL14TR00796AA 6

Drive shaft - Service instruction

NOTE: *Please read this carefully before starting assembly or disassembly operations.*

Precaution at flange and tool ends

While hammering at flange and tool ends during removal or installation, attention must be paid to the various phases. Functioning and integrity of tool as well as various components must not be endangered.

Reassembling methods

Adequate holding equipment should be used for reassembling group.

Lifting system will be necessary for reconnecting, disassembling and reassembling the ring gear or for holding the gear box.

Use cross section drawings to ease assembly and disassembly operations.

Recommendations regarding lubrication

It is very important to use proper lubricants and to maintain a constant level of correct lubrication.
Right operational temperature is to be maintained.

Shaft seals

Respect the following recommendations during seal and gasket assembly:

- Clean shaft very carefully and ensure that the part in contact with the rings is not damaged, cut or out of roundness.
- Assemble the seals so that the lips is fitted towards the oil side.
- Lubricate seal lips (use oil) and fill 3/4 of seal cavity with grease.
- Use appropriate driver. Do not use a hammer directly on the seals.
- Do not damage the seals while assembling the shaft.

O-ring

Lubricate adequately before inserting them at the right place so as to avoid rolling while assembling shaft.

Adjusting shims

Use appropriate adjusting shims and measure each one separately.
Complete group measurement or stamping on the shim is not always reliable check.

Bearings

Use correct pullers for bearings removal.
Clean, lubricate and inspect well before reassembling the bearings.
The spiral elastic pins do not need such adjustment.

Sealing

Use sealants as specified. ensure that parts to be sealed are clean, dry and grease free.

Oil drain

Before disassembly oil should be drained out from the group.

⚠ WARNING
Disposal of used oil must be done according to the laws.

Cleaning

1. All parts in motion (gears, bearings, etc) are to be washed accurately with parts cleaning solution.
2. Petrol and watery alkaline solutions are to be avoided.
3. Do not wash with stream or hot water as it will be very difficult to eliminate surface humidity.
4. Dry all parts with a rag or air jet to avoid scratching from abrasive residuals.
5. All surfaces should be covered with lubricant so as to protect it from future oxidation.

Inspections

1. Examine accurately that all bearings, external rings which may be still stuck in their position pivot pins on which rolls rotate and replace those which are worn out or damaged.
2. Gears should not be damaged and teeth should not be excessively worn. Smoothness of the teeth should not be deteriorated.
3. Control all grooves. Assure that they are not worn out or damaged.
4. Replace damaged parts with original spare parts.
5. After disassembly, replace seals on rotating shaft.

Mechanical transmission - Remove

⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

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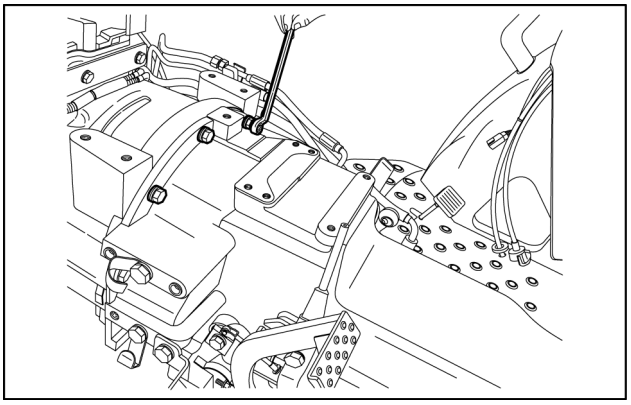
⚠ DANGER

Heavy objects!
Lift and handle all heavy components using lifting equipment with adequate capacity. Always support units or parts with suitable slings or hooks. Make sure the work area is clear of all bystanders.
Failure to comply will result in death or serious injury.

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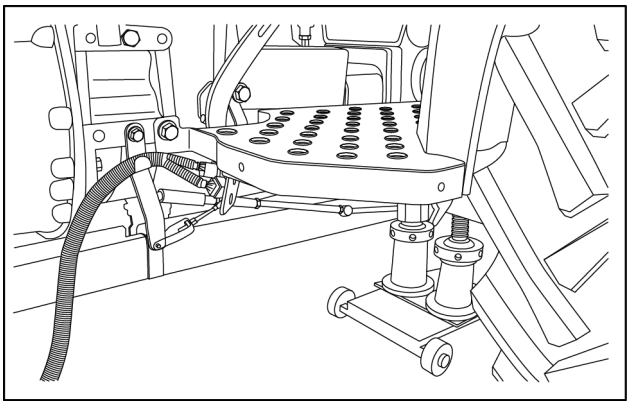
NOTE: *To remove the transmission housing from the tractor, tractor has to be split at clutch and transmission housing. Fenders, hydraulic housing, three point linkage, rear tires and final drive housing have to be removed from the tractor.*

1. Loosen the bolts and remove the transmission assembly from the tractor. See engine removal section.



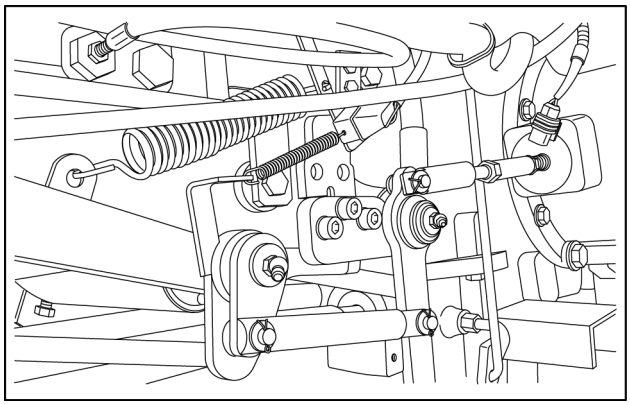
GNIL14TR00753AA 1

2. Loosen bolts securing foot boards on left-hand side and right-hand side fenders. Disconnect all the wirings. See **Protections and footboards - Remove (90.118)**.



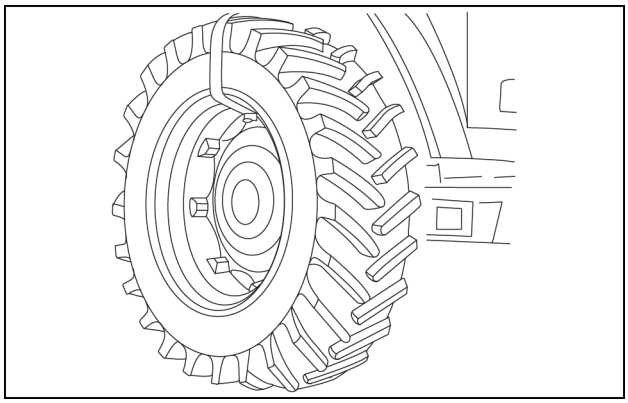
GNIL14TR00767AA 2

3. Disconnect the clutch linkages and the brake linkages.



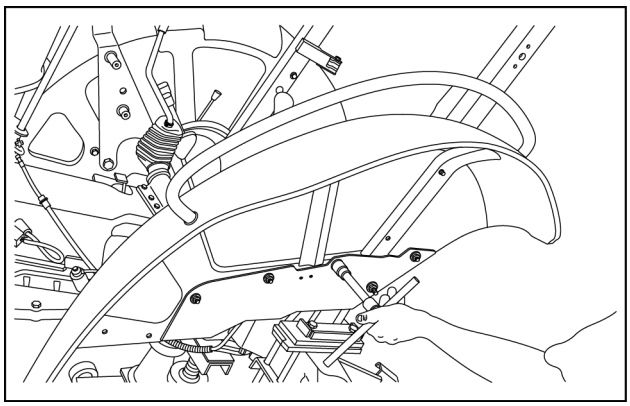
GNIL14TR00766AA 3

4. Remove both the left-hand and right-hand side wheels.



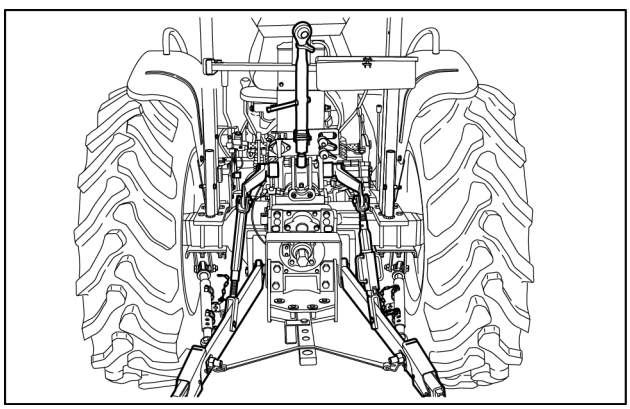
GNIL14TR04016AB 4

5. Loosen the bolts **(1)** and remove fenders from both sides.
   Drain oil from transmission housing.



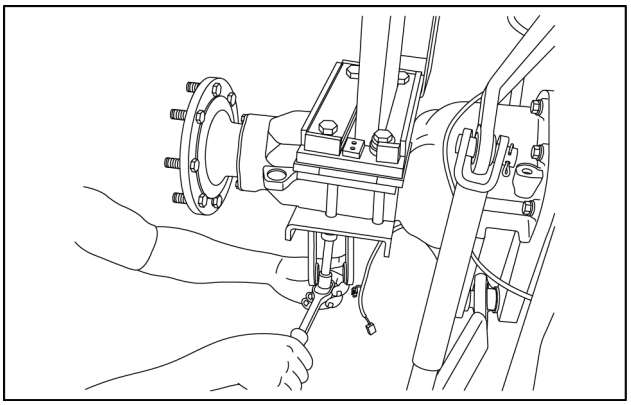
GNIL14TR00790AA 5

6. Disconnect all the hydraulic lines.
7. Remove three point linkages from the tractor.



GNIL14TR00562AA 6

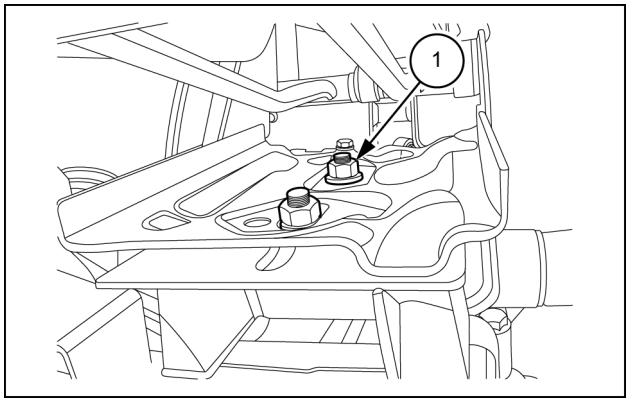
8. Remove the ROPS (Roll Over Protection Structure) from the tractor.



GNIL14TR00865AA 7

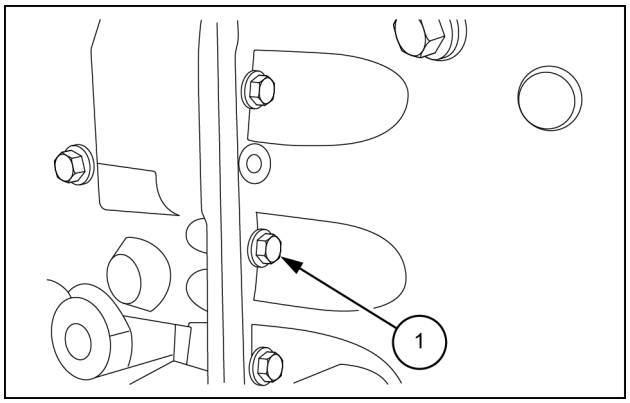
9. Place splitting trolley (special tool number: 292320) **(1)** under the tractor. Place a suitable stand under both side of the final drive housing.

10. Loosen the bolts **(1)**, disconnect the wiring and remove operator's seat.



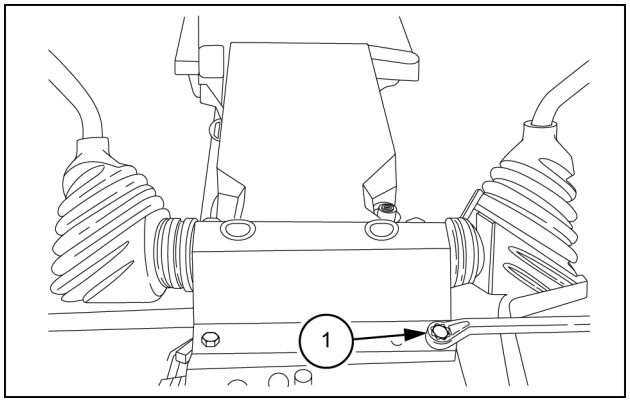
GNIL14TR04021AB 8

11. Loosen the transmission and centre housing coupling bolts **(1)**. Use a suitable hoist and lift the assembly.



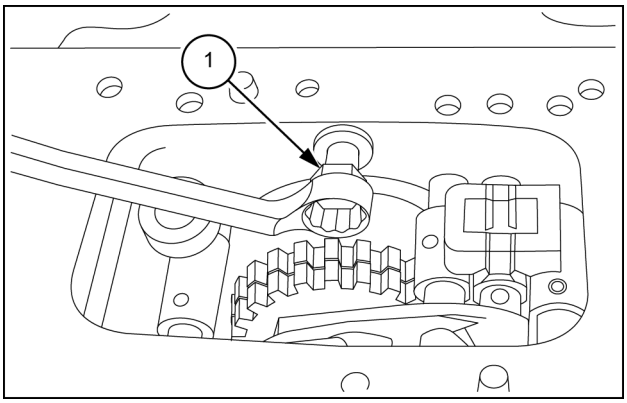
GNIL14TR04022AB 9

12. Loosen bolts **(1)** and remove top cover along with gearshift levers.



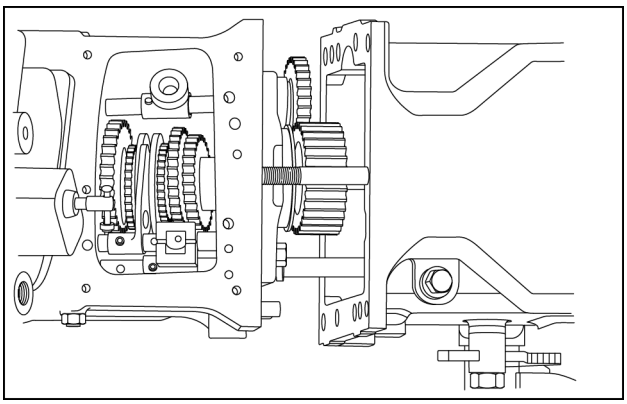
GNIL14TR04124AB 10

13. Loosen the bolt **(1)** as shown in figure before separating the transmission housing from clutch housing.



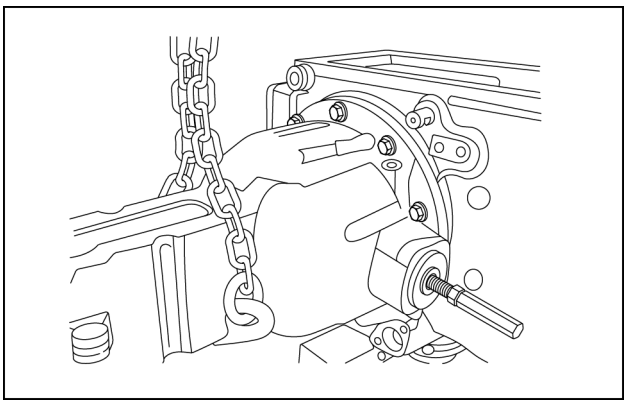
GNIL14TR04024AB 11

14. Separate the clutch and transmission housing.



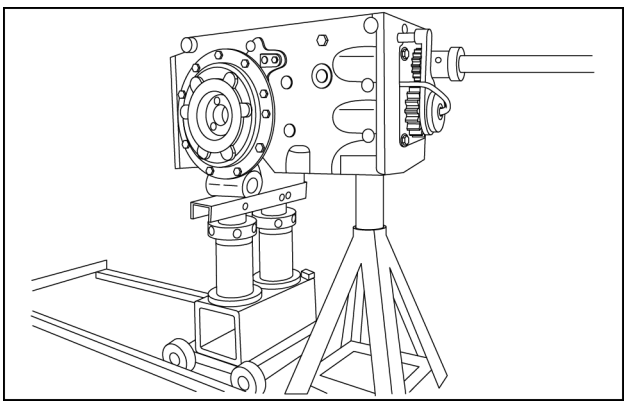
GNIL14TR04128AA 12

15. Wrap chain or nylon rope on the final drive housing and connect it to a hoist. Loosen the attaching bolts and remove the final drive housing.
16. Repeat for the final drive housing on the other side.
17. Loosen the bolts securing hydraulic housing on transmission housing and lift the housing using suitable hoist.



GNIL14TR04026AA 13

18. Place transmission housing on a suitable stand.



GNIL14TR04027AA 14

Mechanical transmission - Disassemble – Intermediate plate

⚠ WARNING

Heavy objects!
Lift and handle all heavy components using lifting equipment with adequate capacity. Always support units or parts with suitable slings or hooks. Make sure the work area is clear of all bystanders. Failure to comply could result in death or serious injury.

W0398A

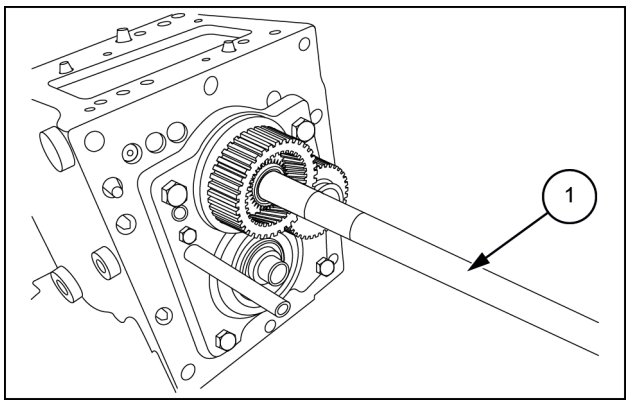
⚠ CAUTION

Pinch hazard!
Always use suitable tools to align mating parts. DO NOT use your hand or fingers. Failure to comply could result in minor or moderate injury.

C0044A

To remove the intermediate plate and reverse gear.

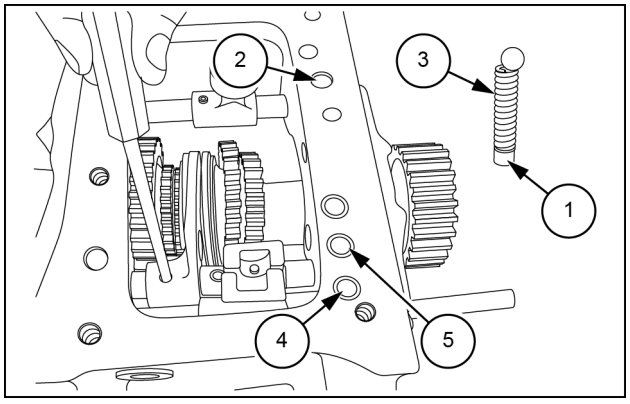
1. Remove Power Take-Off (PTO) shaft **(1)**.



GNIL14TR04150AB 1

2. Remove all roll pins from gear rails to make dismantling easy. Remove the springs and balls.

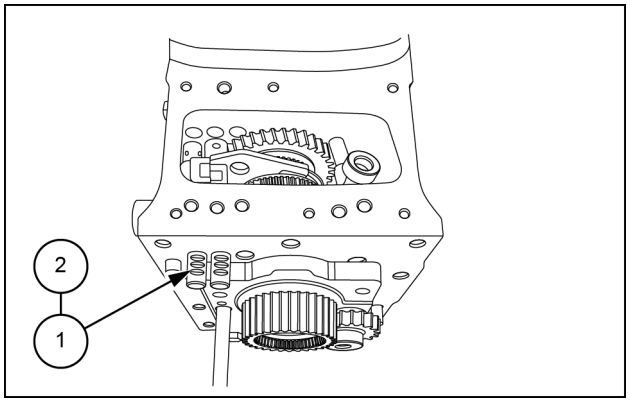
NOTE: *Remove plug **(1)**, from housing as shown at **(2)**, from where Hi/Low rail passes, retrieve spring and ball **(3)** of Hi/Low rail. Retrieve balls and springs from location **(4)** and **(5)**.*



GNIL14TR04132AB 2

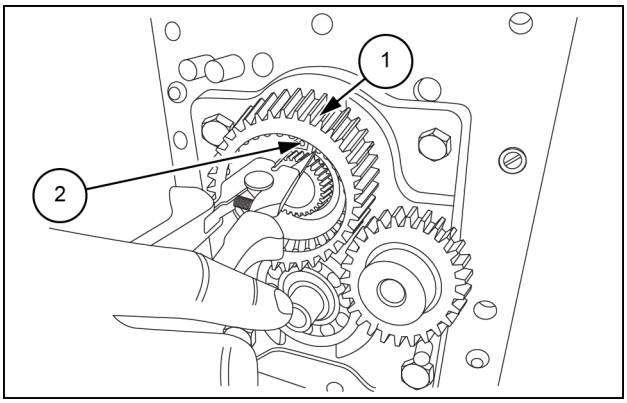
3. Remove the springs **(1)** and balls **(2)**, with the help of a magnetic tool.
4. Remove all the rails and take out gates, forks.

NOTE: *Bring all the gears neutral position to remove rails and retrieve balls from crown side.*



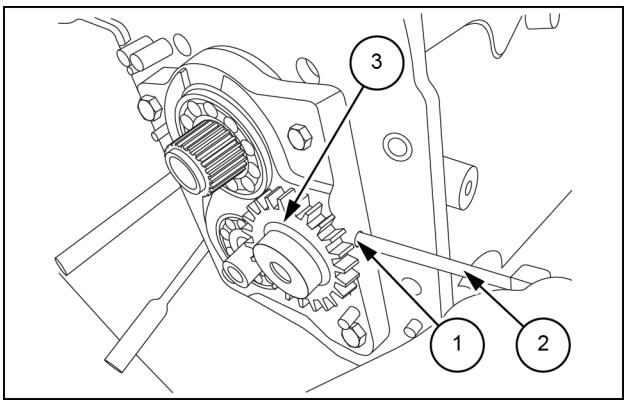
GNIL14TR04133AB 3

5. Remove the snap ring **(2)** securing the reverse drive gear.
6. Remove the reverse drive gear **(1)** from drive shaft.



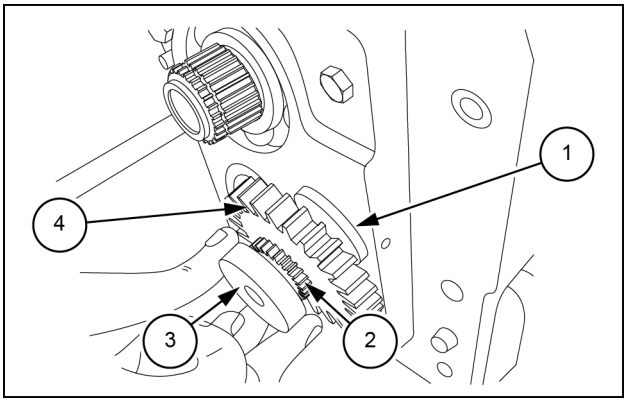
GNIL14TR04147AB 4

7. Unscrew the reverse intermediate gear shaft locking screw **(1)** with a screw driver **(2)**.
8. Remove the idler gear **(3)**.



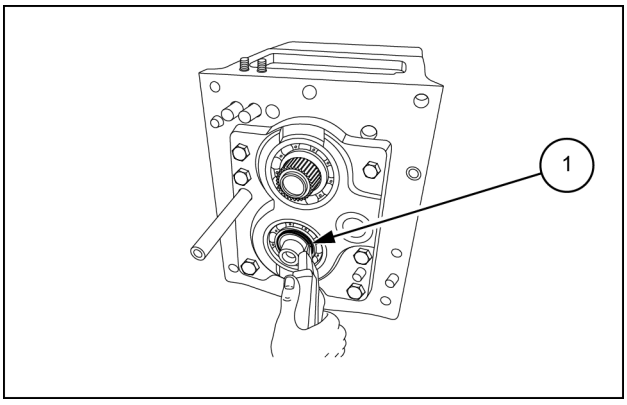
GNIL14TR04135AB 5

9. Remove the spacer **(1)**, needle bearing **(2)**, and reverse intermediate gear pin **(3)**, along with reverse intermediate gear **(4)**.



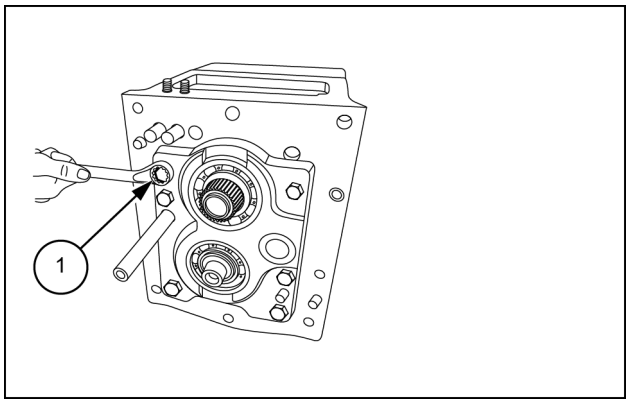
GNIL14TR04136AB 6

10. Remove the snap ring **(1)** securing the driven shaft bearing.



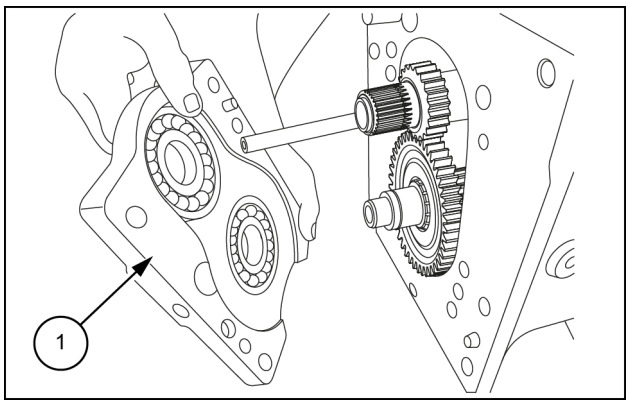
GNIL14TR04137AB 7

11. Remove all the bolts **(1)** securing the intermediate plate.



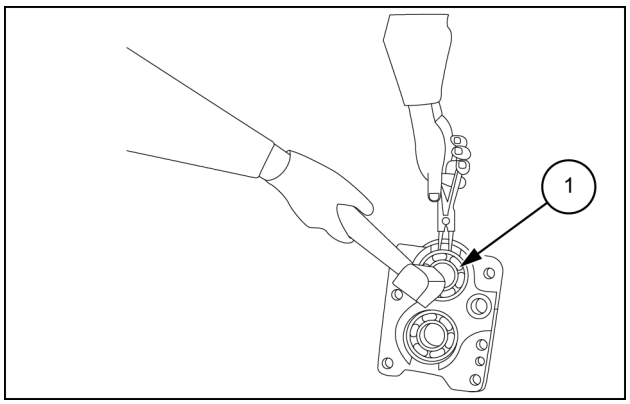
GNIL14TR04138AB 8

12. Remove the intermediate plate **(1)** along with the bearings.



GNIL14TR04139AB 9

13. Remove the ball bearings from the intermediate plate by expanding the retaining rings **(1)**.



GNIL14TR04140AB 10

Mechanical transmission - Inspect – Intermediate plate

Clean and inspect the shift fork, shift rail, coupler, hub, bearings, and gears for excessive wear and/or damage. Replace if necessary.

Mechanical transmission - Assemble – Intermediate plate

⚠ WARNING

Heavy objects!
Lift and handle all heavy components using lifting equipment with adequate capacity. Always support units or parts with suitable slings or hooks. Make sure the work area is clear of all bystanders. Failure to comply could result in death or serious injury.

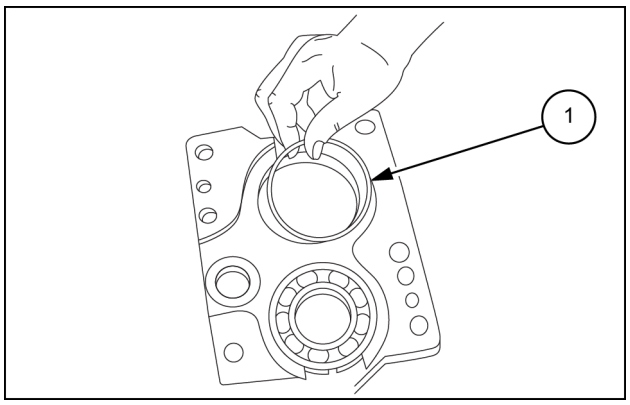
W0398A

⚠ CAUTION

Pinch hazard!
Always use suitable tools to align mating parts. DO NOT use your hand or fingers. Failure to comply could result in minor or moderate injury.

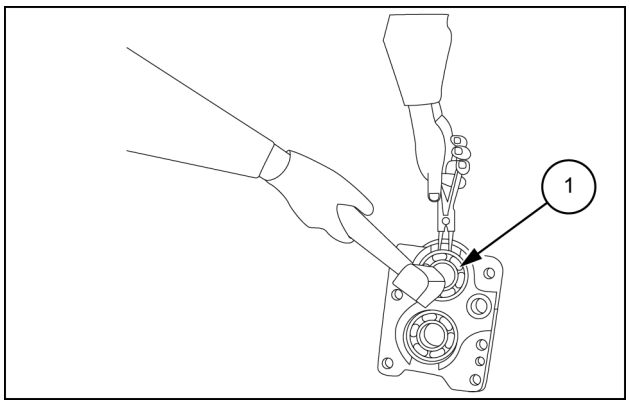
C0044A

1. Install the retaining rings **(1)** into the intermediate plate.



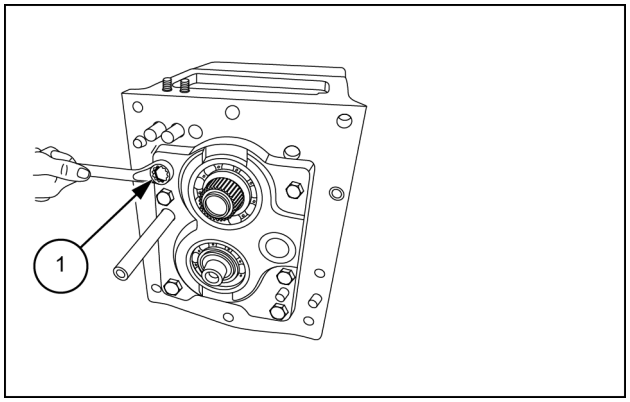
GNIL14TR04141AB 1

2. Expand the retaining ring **(1)** and insert the bearing. Use a hammer to drive the bearing in until the retaining ring locks into the groove on the bearing.
3. Install the intermediate plate on the front of the transmission housing.



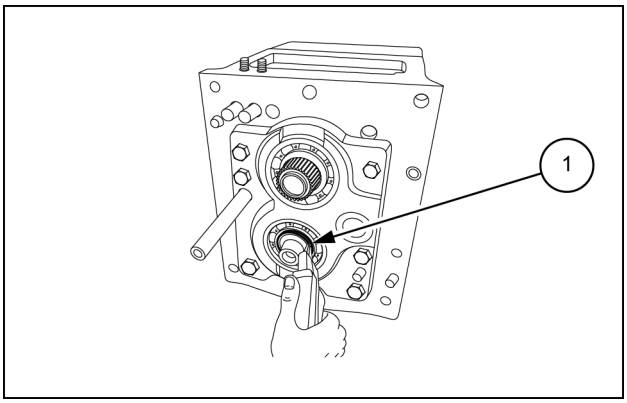
GNIL14TR04142AB 2

4. Secure the intermediate plate with the bolts **(1)** that were removed during disassembly.



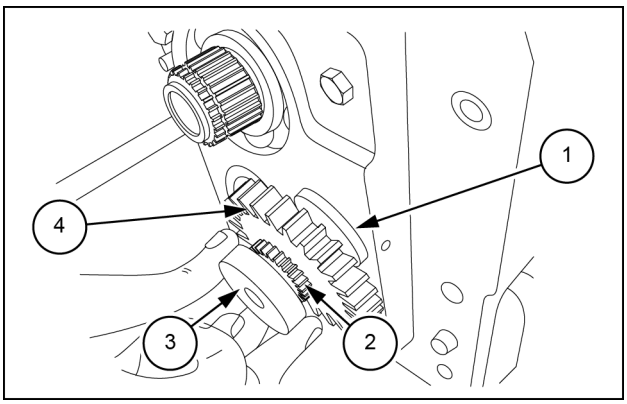
GNIL14TR04143AB 3

5. Secure the driven shaft bearing with the snap ring **(1)**.



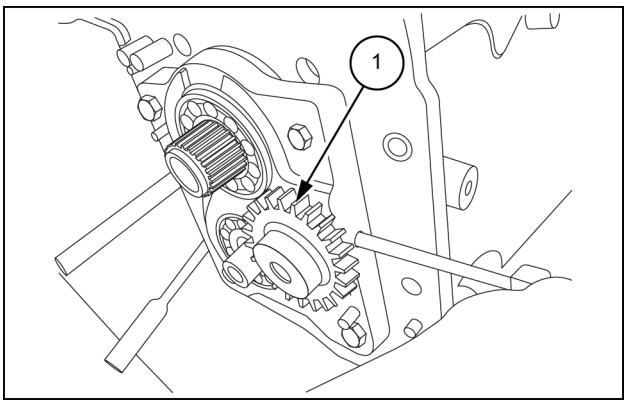
GNIL14TR04144AB 4

6. Install the spacer **(1)**, needle bearing **(2)** and reverse intermediate gear pin **(3)** along with the reverse intermediate gear **(4)**.



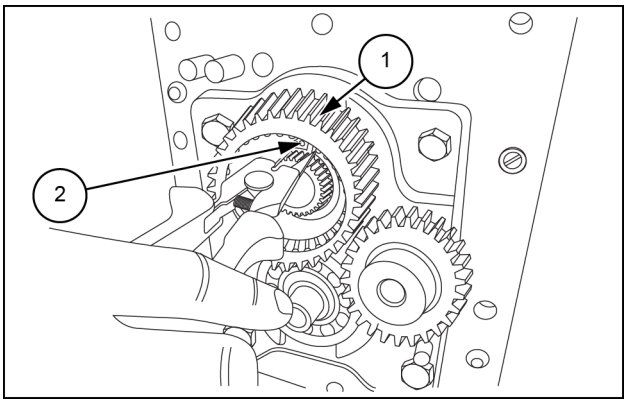
GNIL14TR04145AB 5

7. Use thread locker **LOCTITE® 243™** for locking reverse intermediate gear **(1)** shaft screw.



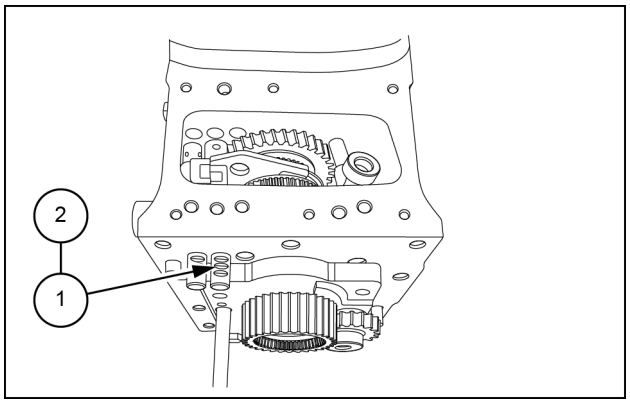
GNIL14TR04146AB 6

8. Install the reverse drive gear **(1)** onto the drive shaft.
9. Secure the reverse drive gear **(1)** with the snap ring **(2)**.



GNIL14TR04147AB 7

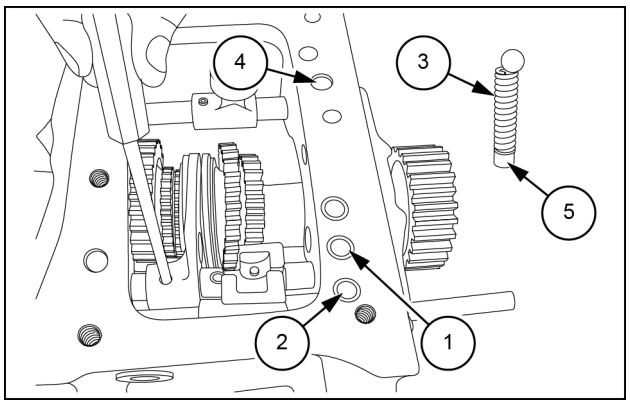
10. Install all the shift rails shift gates and shift forks after installing the springs **(1)** and detent balls **(2)**.



GNIL14TR04148AB 8

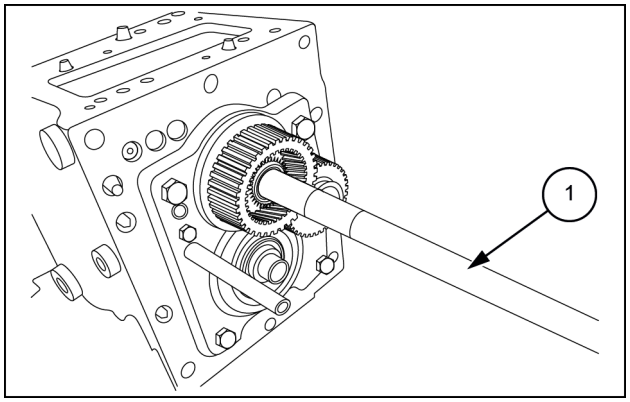
11. Install all roll pins to shift rails along with springs and detent balls.

NOTE: *Install the detent balls and springs where shown **(1)** and **(2)**. Insert the Hi/Low rail detent ball and spring **(3)** where shown **(4)**. Install the plug **(5)** above the Hi/Low rail detent ball and spring at **(4)**.*



GNIL14TR04149AB 9

12. Install the Power Take-Off (PTO) shaft **(1)**.

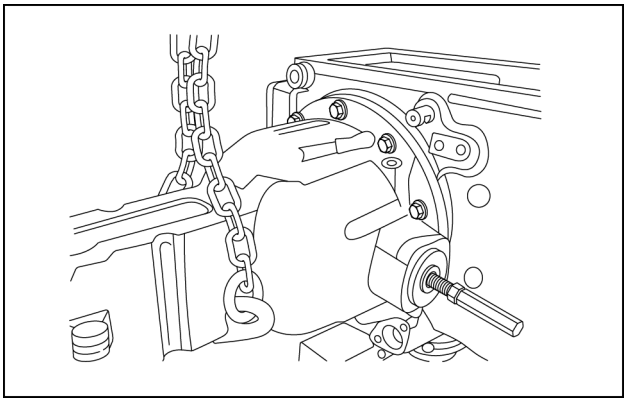


GNIL14TR04150AB 10

Mechanical transmission - Install

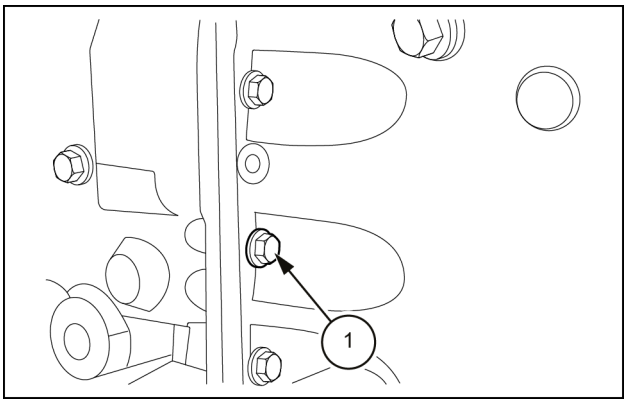
NOTE: *Before assembling housings covers and support, thoroughly clean and degrease mating surfaces and apply a* ***2.000 mm*** *(****0.079 in****) bead of* ***LOCTITE® 518™*** *sealant.*

1. Use a suitable lifting device to lift and install the final drive housing.
2. Install the final drive housing onto the transmission housing. Secure the final drive housing with the bolts from removal. Torque the M12 bolts to **98.00 N·m** (**867.37 lb in**).
3. Repeat procedure for other side.



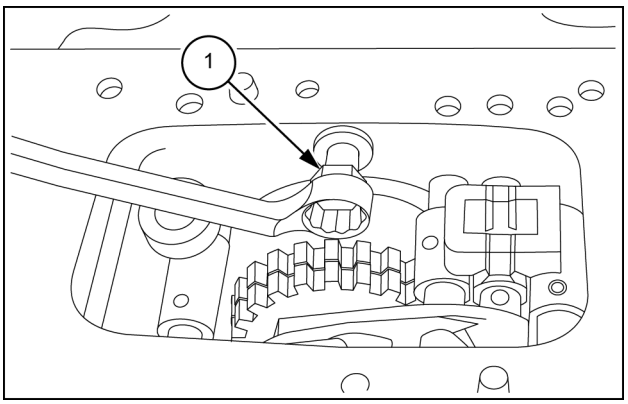
GNIL14TR04129AA 1

4. Using a suitable lifting device, install the hydraulic housing onto the rear of the transmission housing.
5. Remove the complete transmission assembly from the stand using a suitable device.
6. Attach the transmission housing to the clutch housing and secure with the M12 attaching bolts **(1)** from removal. Torque the bolts to **88.00 N·m** (**778.87 lb in**)



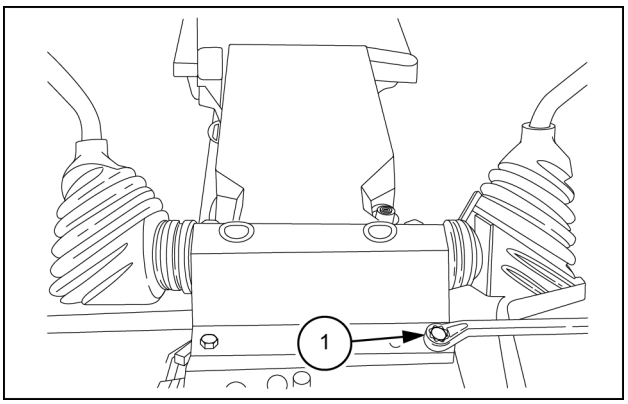
GNIL14TR04152AB 2

7. Attach the clutch housing to the transmission housing by installing the bolt **(1)**.



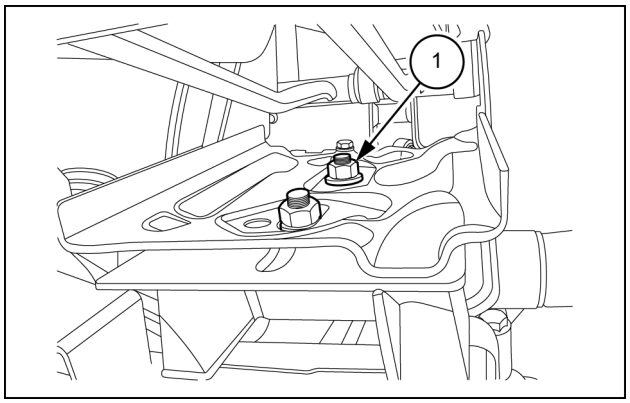
GNIL14TR04153AB 3

8. Install the M8 x 20 gear box cover bolts **(1)** securing cover. Torque the bolts to **24.50 N·m** (**216.84 lb in**).



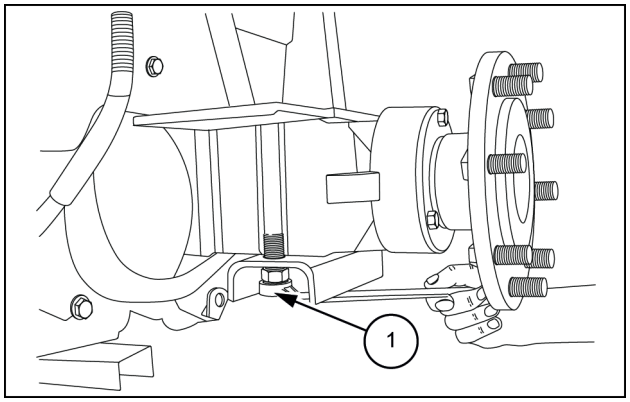
GNIL14TR04124AB 4

9. Install the operator's seat onto the hydraulic housing. Connect the wiring.



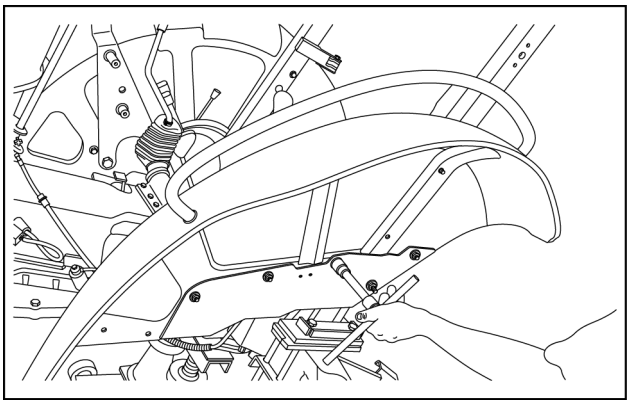
GNIL14TR04021AB 5

10. Connect all the hydraulic lines.
11. Install the ROPS to the axle housings. Secure using the bolts and nuts **(1)**.



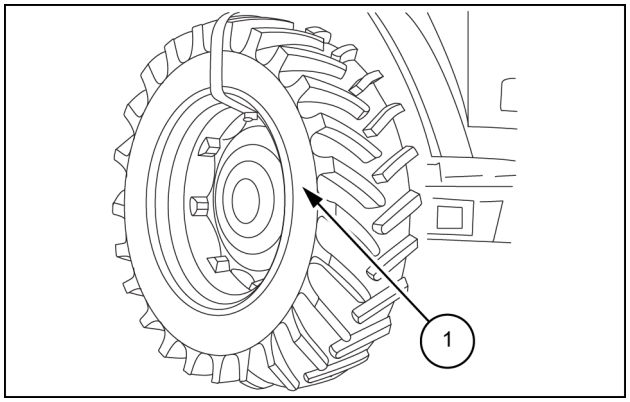
GNIL14TR04017AB 6

12. Install the rear fenders **(1)**.



GNIL14TR00790AA 7

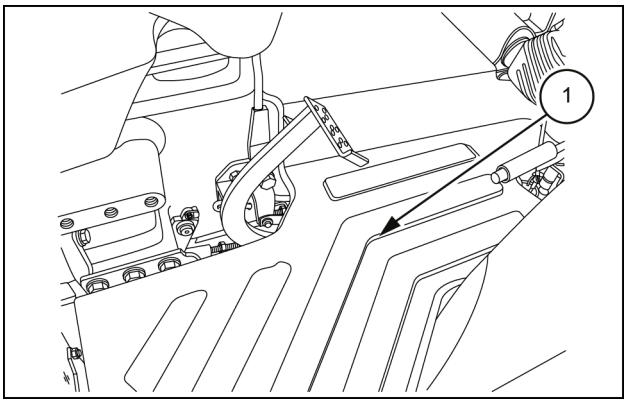
13. Install both left-hand and right-hand side wheels **(1)**.



GNIL14TR04159AB 8

14. Remove the jack stands **(1)** and splitting trolley **(2)**.
15. Install the three point linkages **(1)** to the tractor.

16. Secure the footrest **(1)** to the fender and transmission housing.

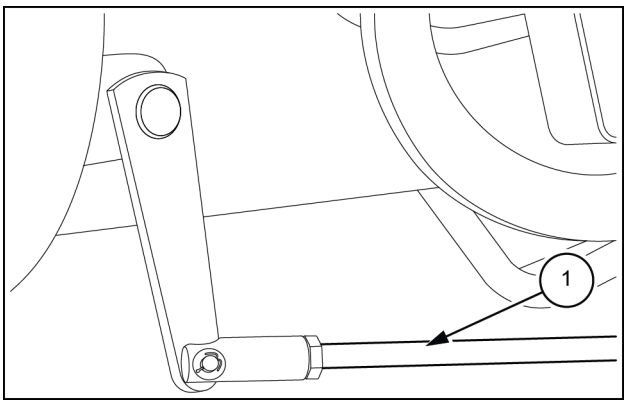


GNIL14TR04162AB 9

17. Connect the clutch linkage **(1)**.

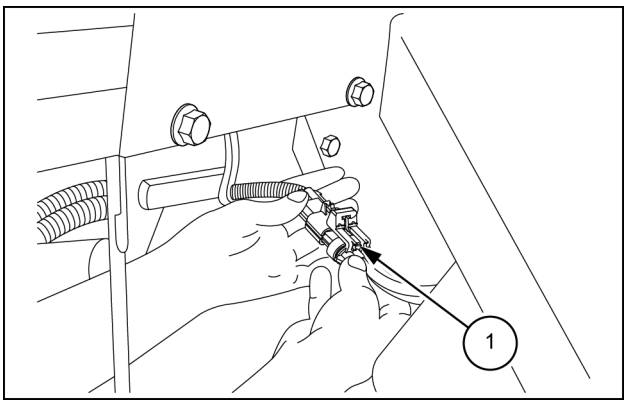
NOTE: *Check the clutch pedal free play and adjust as necessary.*

NOTE: *Connect the brake linkage rods to the brake pedals.*



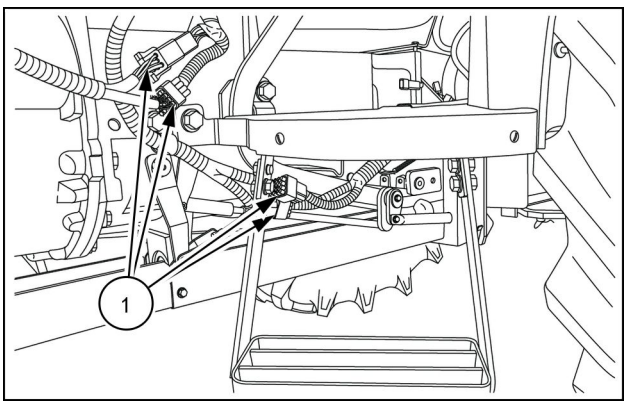
GNIL14TR04164AB 10

18. Connect the wire harness connector **(1)** between left-hand and right-hand side fenders.



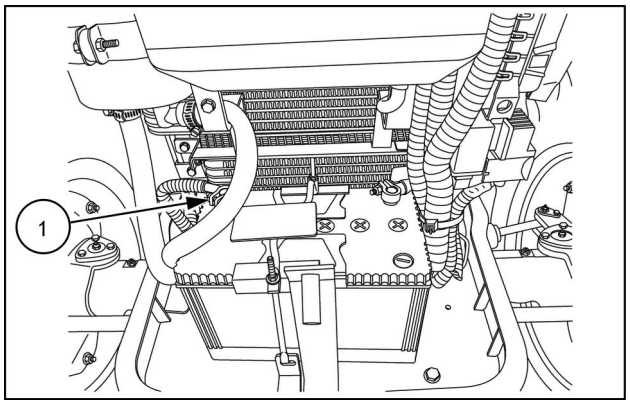
GNIL14TR04165AB 11

19. Connect the electrical couplings **(1)**.

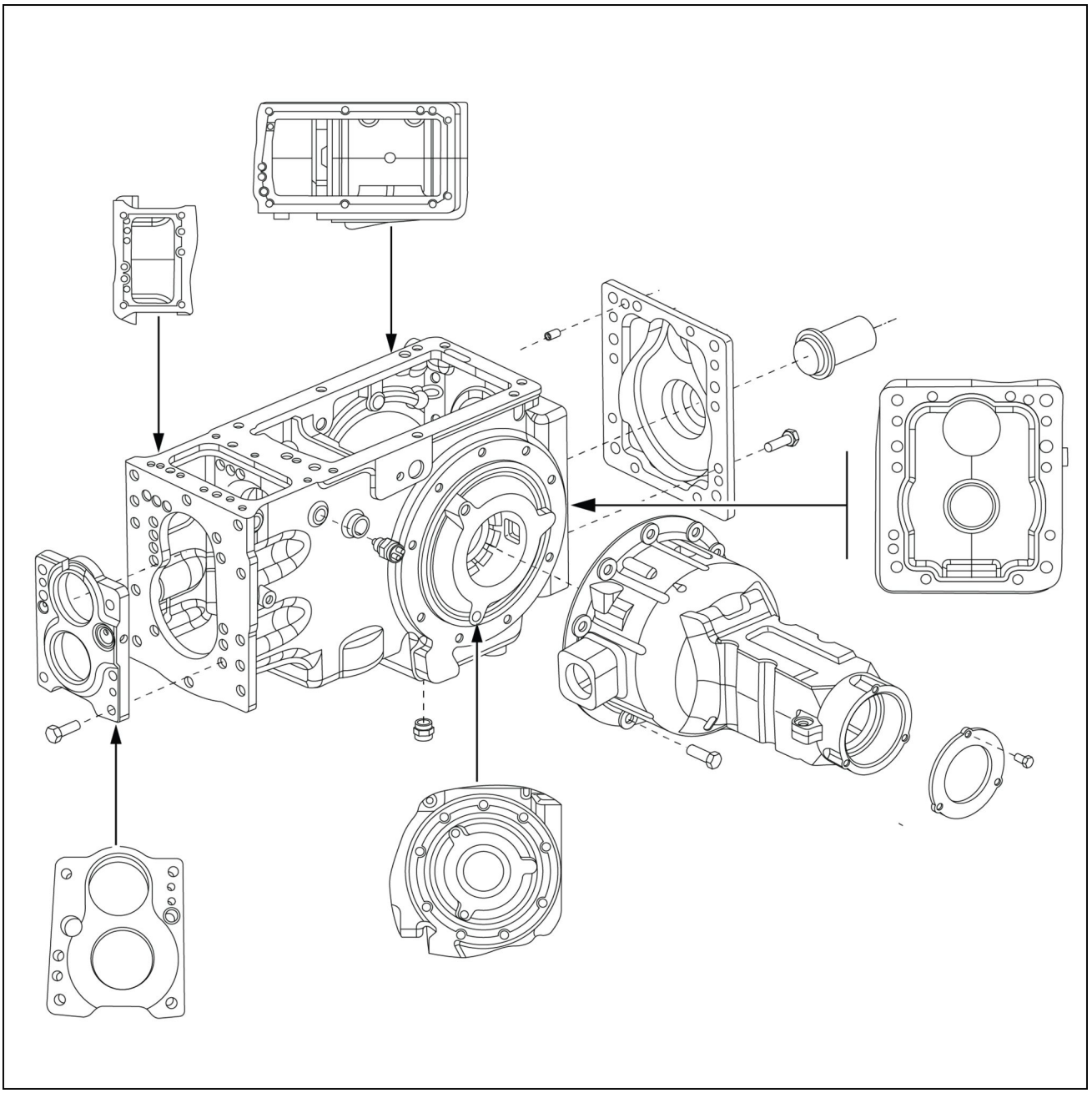


GNIL14TR00797AA 12

20. Connect the negative battery cable **(1)** to the negative battery terminal.



GNIL14TR00784AA 13



GNIL14TR04168GB 14

Mechanical transmission - Troubleshooting

Problem	Possible Cause	Correction
Noisy operation with range in neutral and main lever engaged	Input and output shaft support bearing mis-adjusted.	Remove transmission housing and adjust bearings.
	Failed or defective inner component.	Remove housing, overhaul transmission and replace faulty parts.
	Internal component seizure due to poor lubrication.	Overhaul transmission and top up oil to correct level.
Noisy operation with tractor stationery, idling engine and transmission in neutral	Faulty clutch plate springs.	Replace clutch plates.
Self disengagement of speed, range gears	External linkage and levers mis-adjusted.	Adjust correctly.
	Failed control rail retaining springs.	Replace springs.
	Partial engagement travel.	Correct reasons for problem and restore full travel.
Difficult engagement of speed and range gears	External levers mis-adjusted.	Adjust correctly.
	External levers stiff or seized.	Check pivot points and correct.
	Internal control items (rails, forks and sleeves) slide with difficulty.	Overhaul control items.

https://truckmanualshub.com/

Index

Transmission - 21

Mechanical transmission - 114

Drive shaft - Service instruction 12
Mechanical transmission - Assemble – Intermediate plate 22
Mechanical transmission - Disassemble – Intermediate plate 18
Mechanical transmission - General specification 3
Mechanical transmission - Inspect – Intermediate plate 21
Mechanical transmission - Install 25
Mechanical transmission - Overview 9
Mechanical transmission - Remove 14
Mechanical transmission - Sealing 5
Mechanical transmission - Sectional view 7
Mechanical transmission - Special tools 6
Mechanical transmission - Torque 3
Mechanical transmission - Troubleshooting 29

https://truckmanualshub.com/

Transmission - 21

Mechanical transmission external controls - 130

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Transmission - 21

Mechanical transmission external controls - 130

SERVICE

Mechanical transmission external controls
Remove 3
Adjust 4
Transmission control levers
Disassemble 5
Install 8

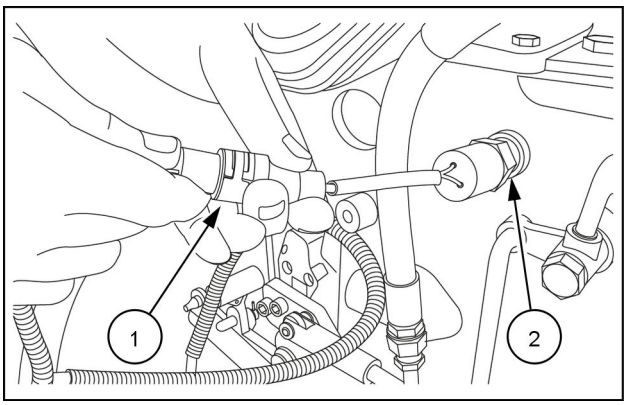
Mechanical transmission external controls - Remove

Transmission range safety switch

1. Disconnect the negative (-) battery terminal.
2. Disconnect the transmission range safety switch **(1)** from the tractor wire harness.

NOTE: *Switch is protected with a rubber boot.*

3. Unscrew the switch **(2) 1** with sealing washer from the transmission housing.

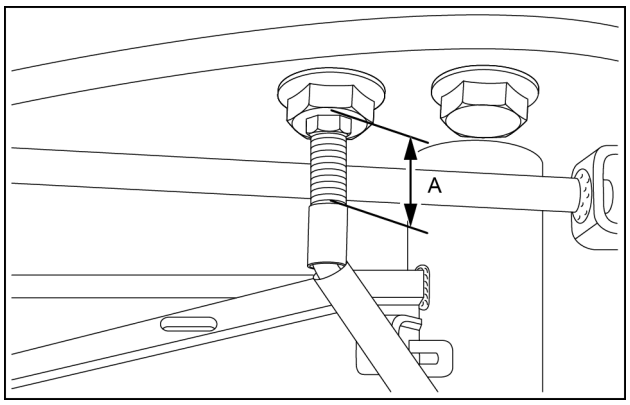


GNIL14TR00793AA 1

Mechanical transmission external controls - Adjust

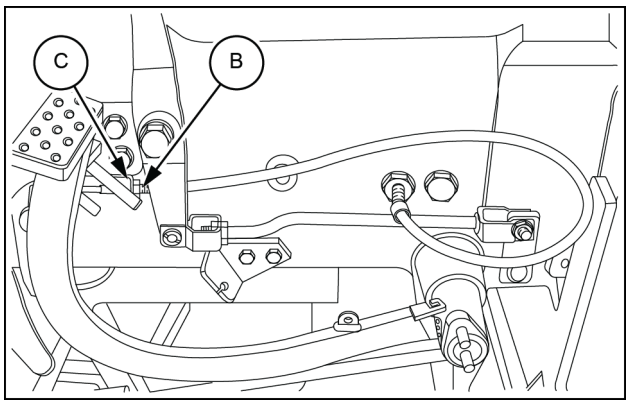
Shuttle interlock cable

1. Measure dimension **(A)** at cable end as shown in figure **1**. (Top of nut to bottom of threads). The desired length of **(A)** is approximately **26.000 mm** (**1.024 in**), adjust if required.



GNIL14TR04225AB 1

2. At the opposite cable end, count the number of visible threads **(B)**, there should be 6 or 7. Thread length can be changed by adjusting the nuts on either side of cable mounting bracket **(C)**.
3. Adjust the nuts so that the shuttle lever starts to move when clutch pedal is depressed beyond free play **50.00 - 55.00 mm** (**1.97 - 2.17 in**) from rest) and then tighten.



GNIL14TR04226AB 2

Transmission control levers - Disassemble

⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

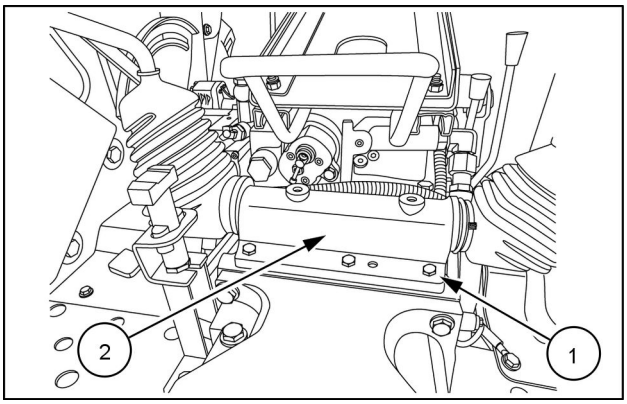
W0208A

⚠ CAUTION

Pinch hazard!
Always use suitable tools to align mating parts. DO NOT use your hand or fingers.
Failure to comply could result in minor or moderate injury.

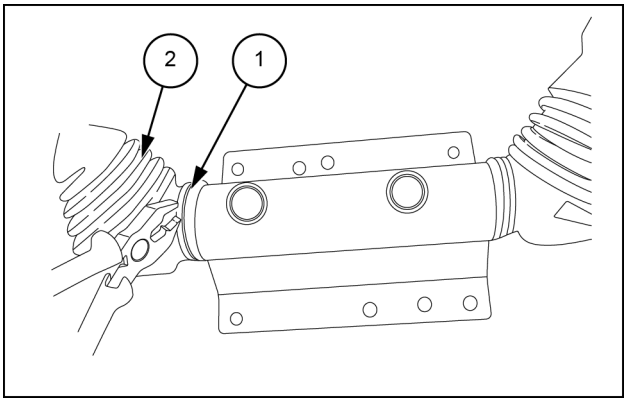
C0044A

1. Loosen the bolts **(1)** and remove the top cover **(2)** from the transmission housing.



GNIL14TR00804AA 1

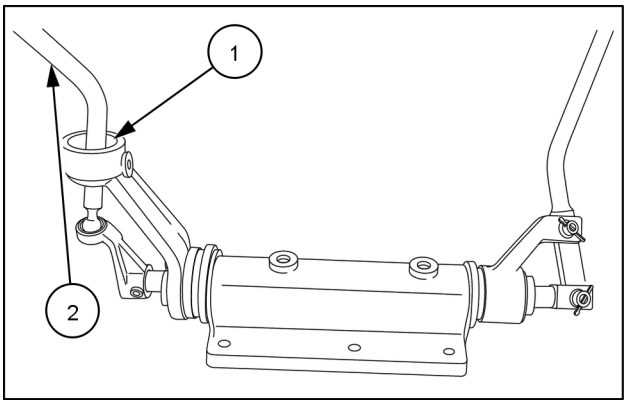
2. Remove the circlip **(1)**. Remove the gear lever rubber boot **(2)**.



GNIL14TR04091AB 2

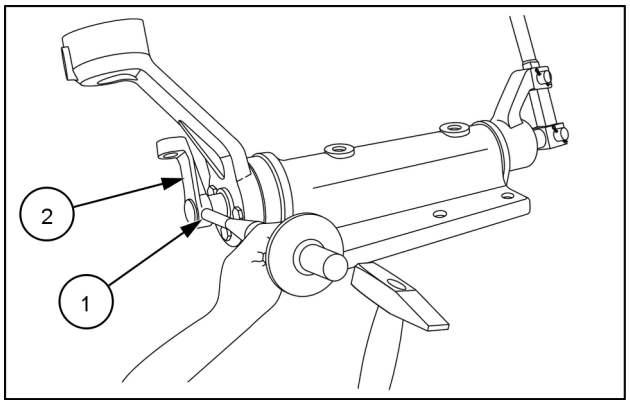
Main gear selector lever

3. Remove the circlip **(1)** on the transmission main lever. Remove the transmission main gear selector lever **(2)**.



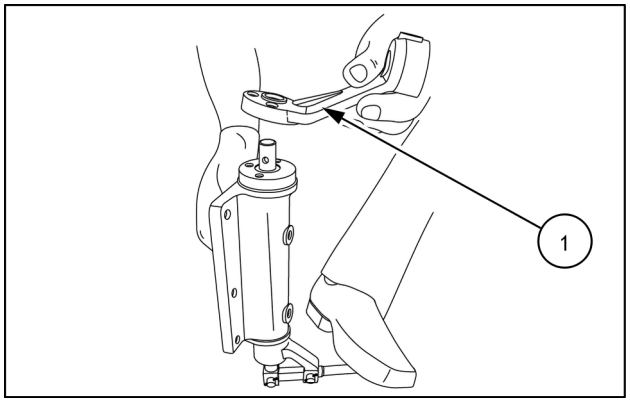
GNIL14TR00805AA 3

4. Remove the roll pin **(1)** and remove the linkage **(2)**.



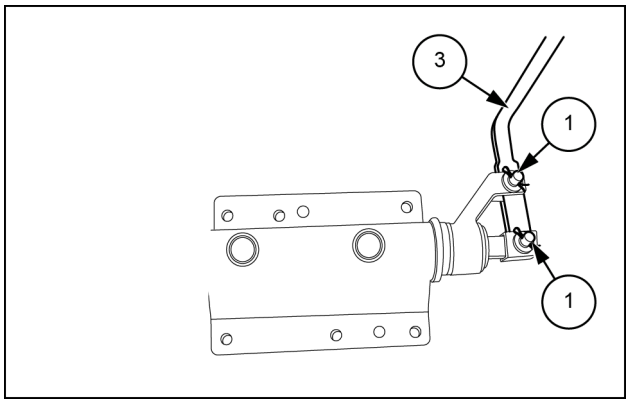
GNIL14TR00807AA 4

5. Loosen the bolt and remove the yoke **(1)**.



GNIL14TR00809AA 5

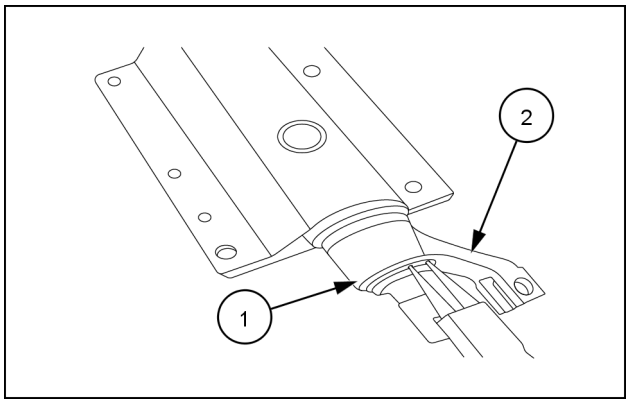
6. Remove the split pins **(1)** and take out pin **(2)** to remove range gear selector lever **(3)**.



GNIL14TR04092AB 6

Range gear selector lever

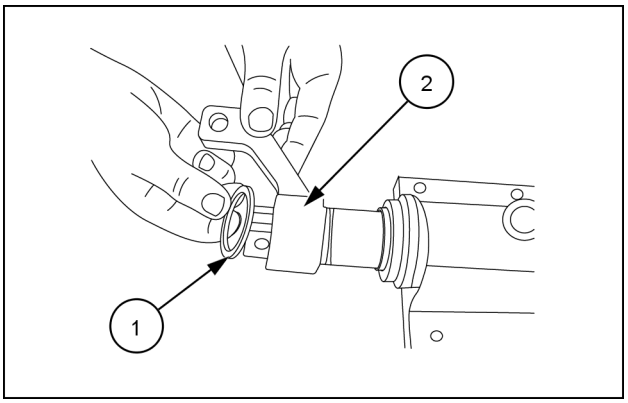
7. Remove the circlip lock **(1)** from the yoke **(2)**.



GNIL14TR04093AB 7

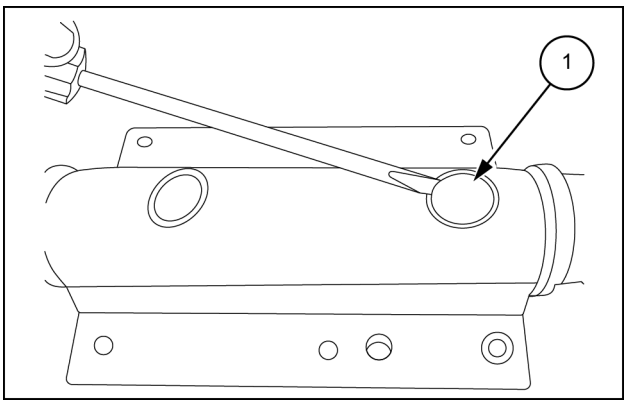
8. Remove the washer **(1)** and linkage **(2)**.

NOTE: *Take out springs 2 numbers from the range lever.*



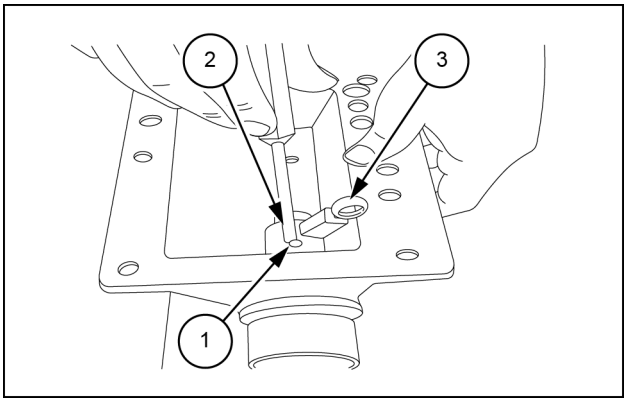
GNIL14TR04094AB 8

9. Remove the expansion plug **(1)** from the shifter cover housing as shown.



GNIL14TR04095AB 9

10. Remove the roll pin **(1)** from the shaft **(2)**. Remove the fork **(3)**.

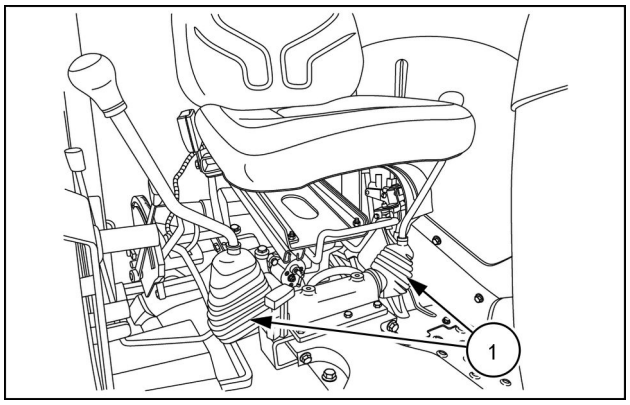


GNIL14TR04096AB 10

Transmission control levers - Install

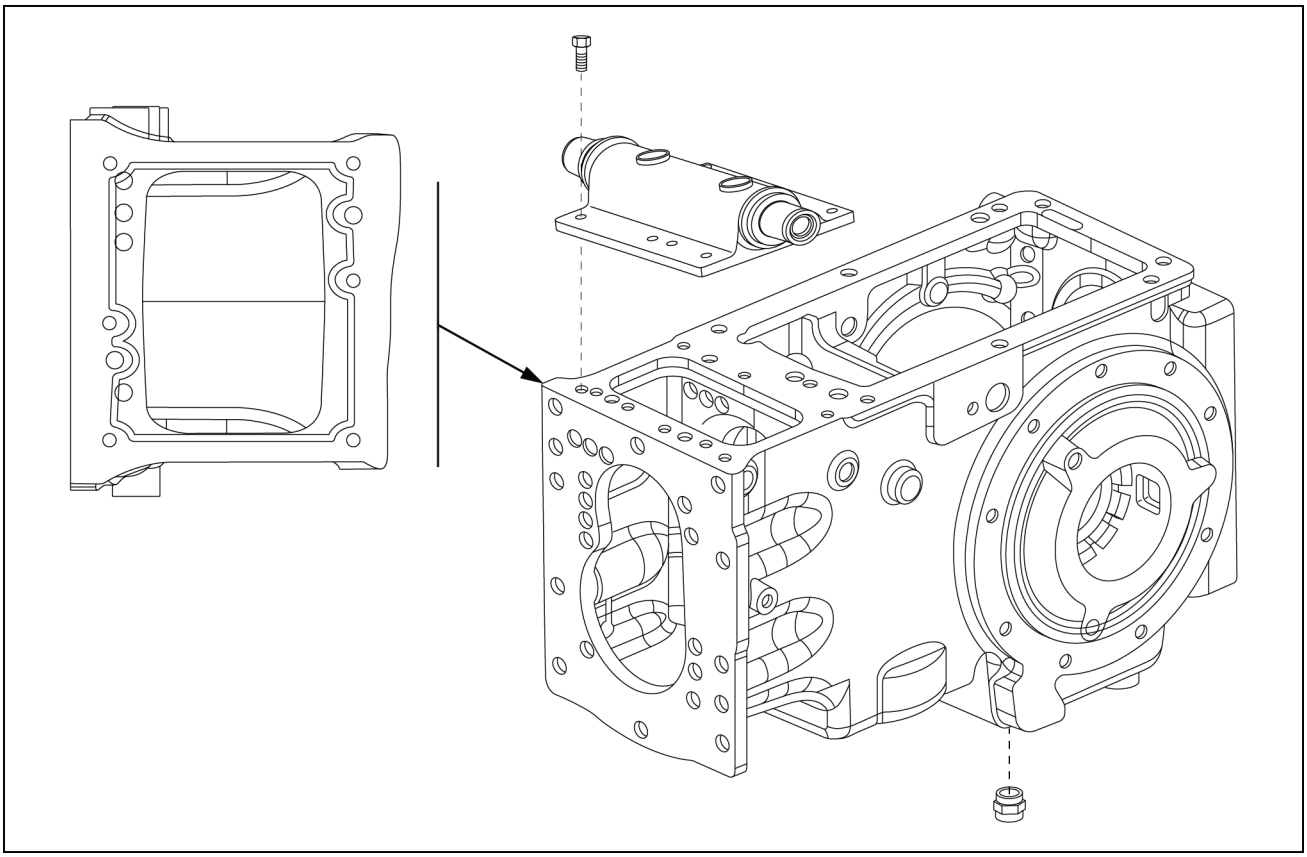
Assemble the levers in the cover plate and reinstall the cover plate on the transmission housing. Observe the following.

1. Inspect the rubber boot **(1)** for cracks or damage, replace if necessary.
2. Reinstallation follows the removal procedure in reverse, from step 7 back to step 1.



GNIL14TR00785AA 1

3. Before fixing cover plate, thoroughly clean and degrease mating surface and apply a **2.000 mm** (**0.079 in**) bead of sealant following the pattern shown in **2**
4. Torque the bolts to the correct value.



GNIL14TR04099FB 2

https://truckmanualshub.com/

Index

Transmission - 21

Mechanical transmission external controls - 130

Mechanical transmission external controls - Adjust 4
Mechanical transmission external controls - Remove 3
Transmission control levers - Disassemble 5
Transmission control levers - Install 8

https://truckmanualshub.com/

https://truckmanualshub.com/

Transmission - 21

Mechanical transmission internal components - 140

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Transmission - 21

Mechanical transmission internal components - 140

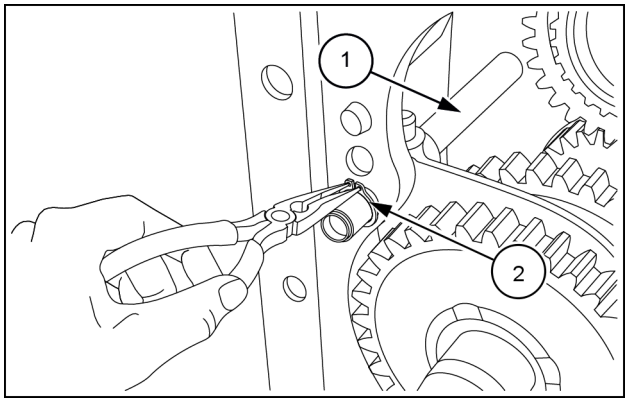
SERVICE

Transmission internal parts
Install Transmission rails and fork 3

Transmission internal parts - Install Transmission rails and fork

To install the shift rail and shift forks follow the procedure as mentioned below.

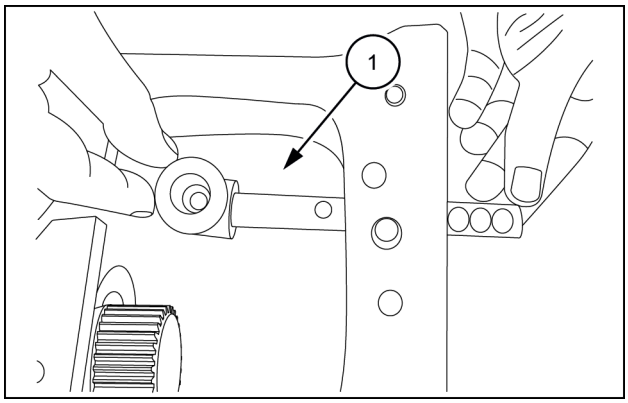
1. Insert the bottom shift rail, **(1)**, and 1st/2nd gearshift fork. Insert the snap ring, **(2)**, on the bottom shift rail and ensure it sits on the seat in housing.



GNIL14TR04227AB 1

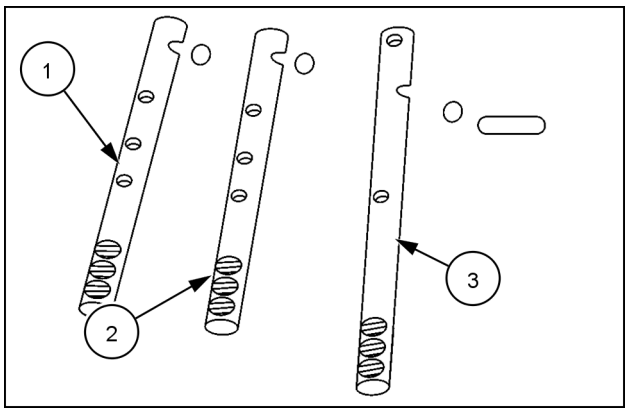
2. The Hi/low shift rail, **(1)**, shift fork, and shift gate should be installed after the pinion and crown settings.

NOTE: *Keep grooves of rails upward to make easy fitment of balls and springs.*



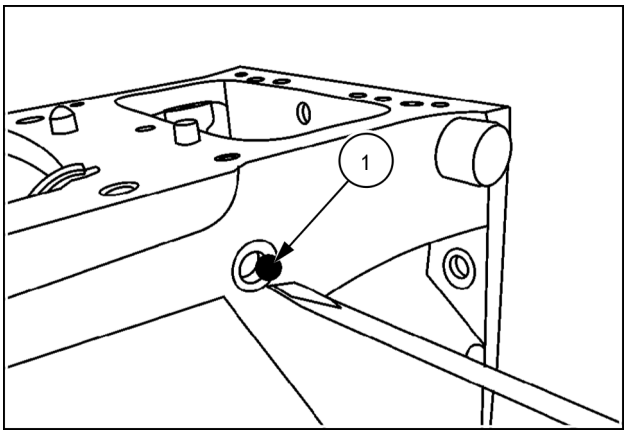
GNIL14TR04228AB 2

3. Transmission shift rails can be identified by referring to Figure **3**.To fit rails 1st/2nd **(1)** and 3rd/4th **(2)** rails are similar. After fitting range shaft and drive shaft fit fork for 3rd/4th and insert reverse rail **(3)**, passing through fork of 3rd/4th gear.



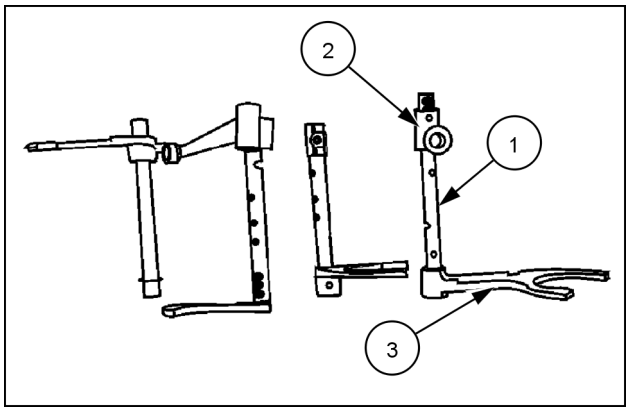
200900174 3

4. After fitting reverse rail insert ball **(1)**, applying some grease in the housing.



20097886 4

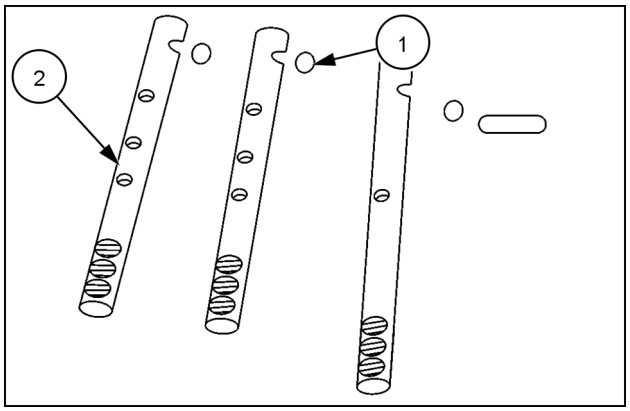
5. Insert the rail **(1)**, of 3rd/4th with gate **(2)**, passing through fork **(3)**, of 3rd/4th gear as shown in **5**.
   Insert gate of 1st/2nd rail shaft on the notch of 1st/2nd gear fork.



200900175 5

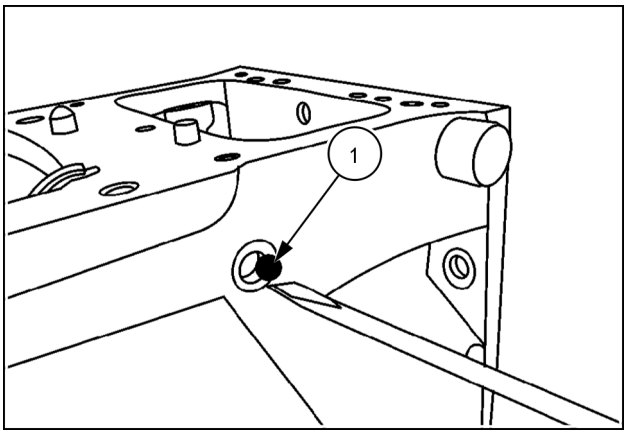
6. Insert the ball **(1)**, applying some grease in housing after removing bolt as shown in **4**.
7. Insert the 1st/2nd rail **(2)**, passing thru gate as shown in **5**.

NOTE: *Keep grooves of rails upward to make easy fitment of balls and springs.*



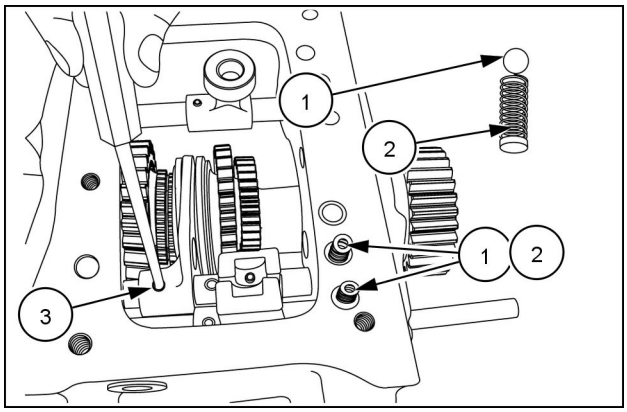
200900174 6

8. Insert the ball and pin **(1)**, after removing neutral safety switch for Hi/Lo rail then fit neutral safety switch and tighten it.



20097886 7

9. After fitting reverse rail insert ball **(1)**, applying some grease in the housing as such it sits in groove given on reverse rail.
10. Insert the balls **(1)** and springs **(2)** of the rails. Insert plug above the spring of Hi/Lo rail. Fit roll pins **(3)**, in all rails and gates.



20099991 8

Index

Transmission - 21

Mechanical transmission internal components - 140

Transmission internal parts - Install Transmission rails and fork 3

https://truckmanualshub.com/

Transmission - 21

Gearbox internal components - 145

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Transmission - 21

Gearbox internal components - 145

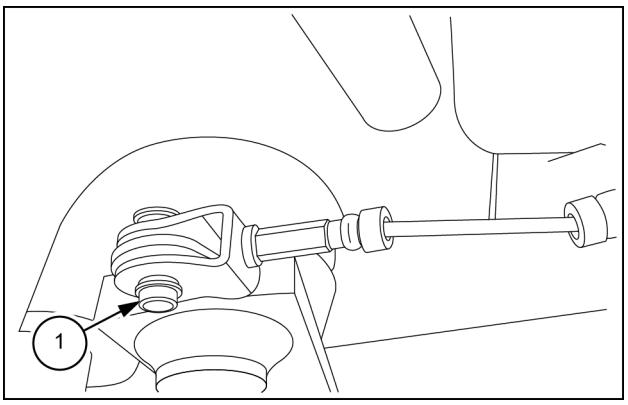
SERVICE

Gearbox internal components
Remove . . . 3
Inspect . . . 7
Install . . . 8
Drive shaft
Remove . . . 14
Disassemble . . . 17
Inspect . . . 18
Driven shaft
Remove . . . 19
Disassemble . . . 21
Inspect . . . 22
Install Transmission drive and driven shafts . . . 23

Gearbox internal components - Remove

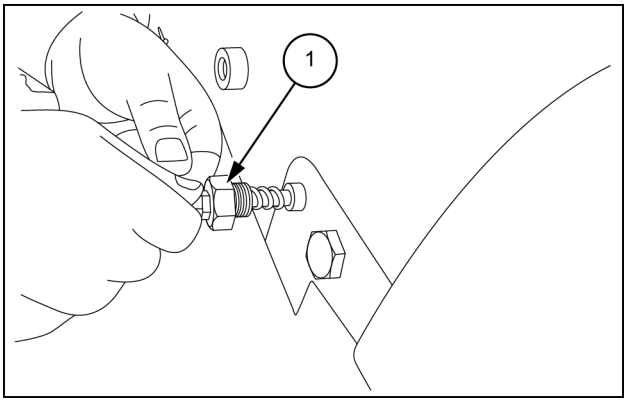
Transmission synchronizer kit and cluster gear

1. Remove the split pins to release the link.
2. Remove the circlip lock **(1)**.



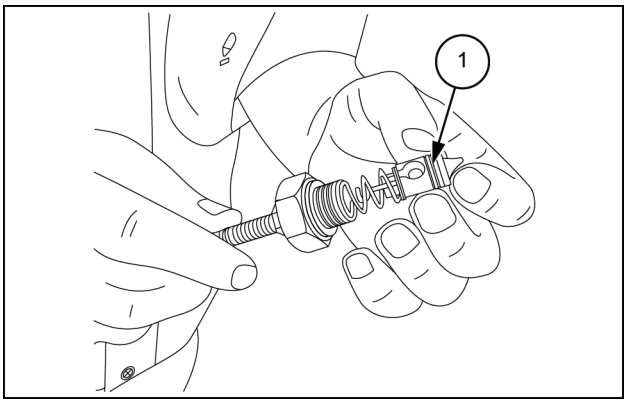
GNIL14TR04196AB 1

3. Remove the shuttle wire **(1)** as shown.



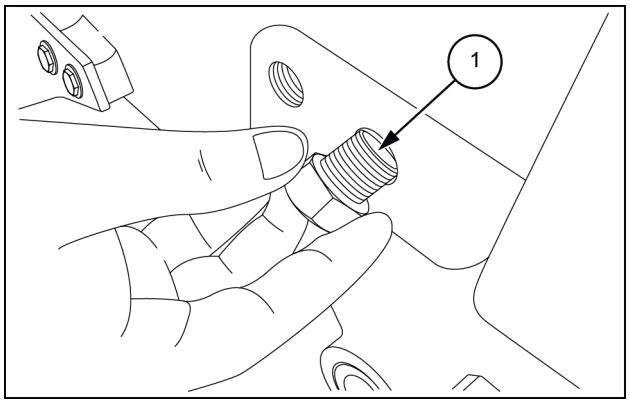
GNIL14TR04197AB 2

4. Collect the spring and the pin **(1)** as shown.



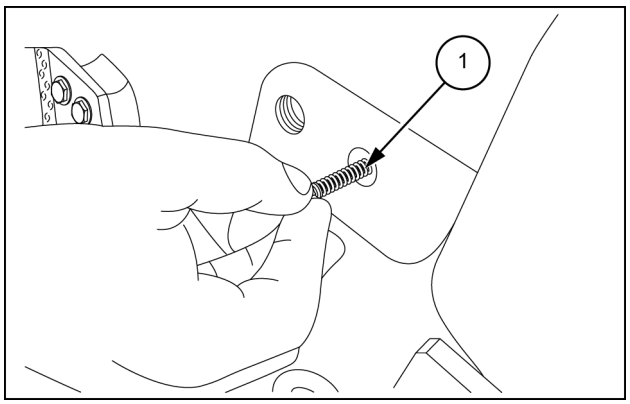
GNIL14TR04198AB 3

5. Remove the shuttle detent bolt from the left-hand side of the clutch housing.



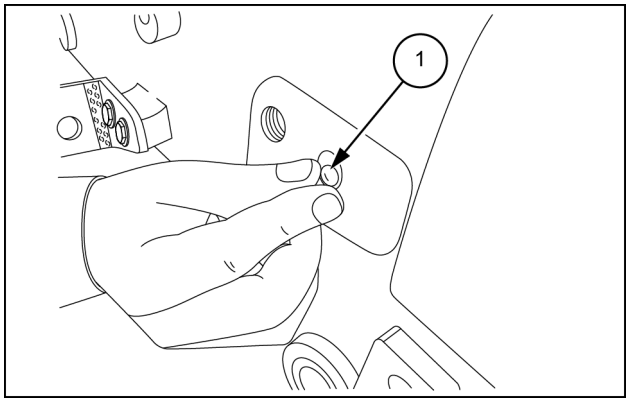
GNIL14TR04199AB 4

6. Remove the spring **(1)** from the hole in the clutch housing.



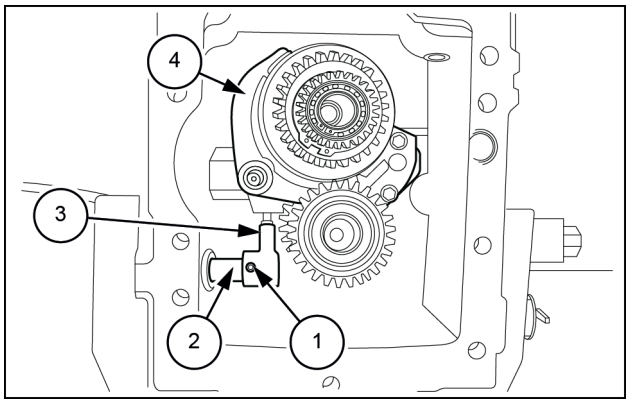
GNIL14TR04200AB 5

7. Remove the detent ball **(1)** from the hole in the clutch housing.



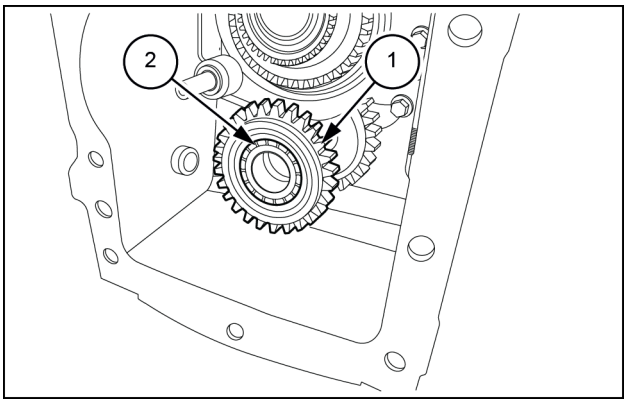
GNIL14TR04201AB 6

8. Remove the roll pin **(1)** aligning the shaft link rod **(2)** and lever link rod **(3)**.
9. Slide the shaft link rod **(2)** out from the lever link rod **(3)** and remove the shaft link rod **(2)** from the cluster housing.
10. Remove the lever link rod **(3)** from the shift fork **(4)**.
11. Remove the O-rings from the shaft link rod **(2)**.



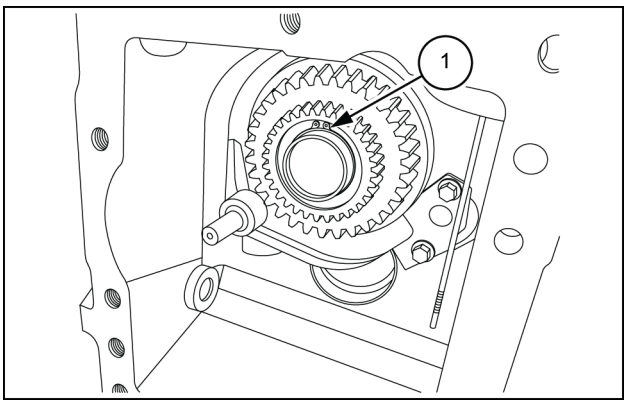
GNIL14TR04202AB 7

12. Remove the cluster gear shaft **(1)** from the ball bearing.
13. Remove the ball bearing **(2)** from the cluster gear shaft **(1)**.



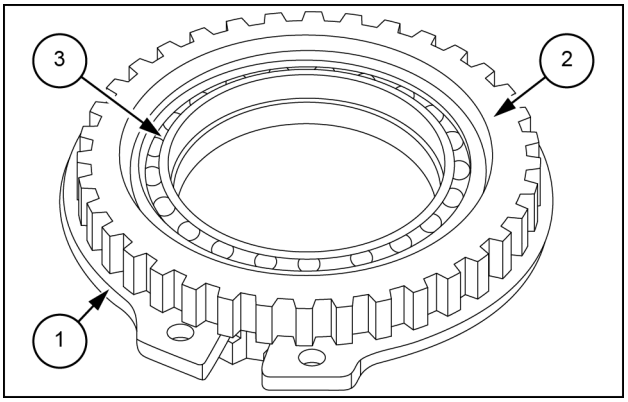
GNIL14TR04203AB 8

14. Remove the external circlip **(1)** from the groove of the input shaft.
15. Remove the shuttle coupler gear assembly from the input shaft.



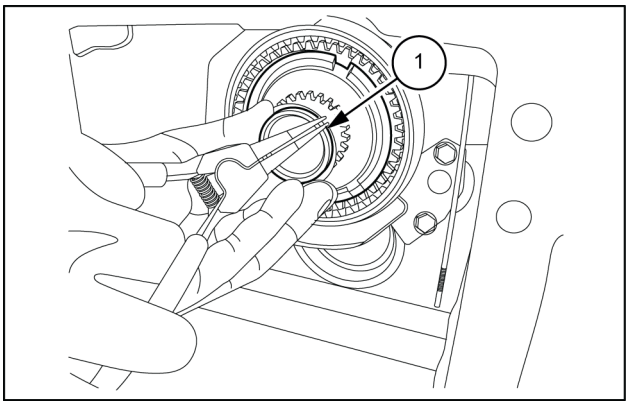
GNIL14TR04204AB 9

16. Remove the external retaining ring **(1)** from the groove of coupler shuttle gear **(2)**.
17. Remove the ball bearing **(3)** inside the coupler shuttle gear **(2)**.



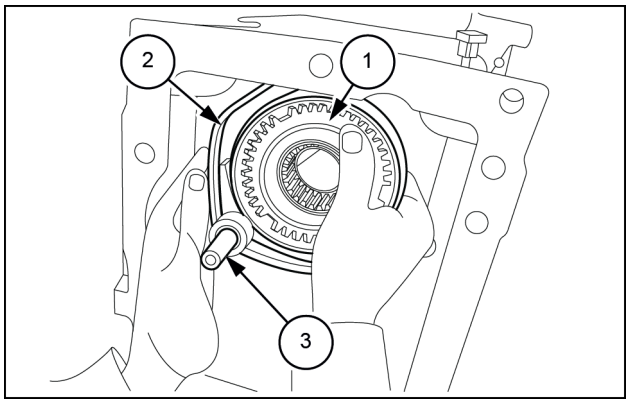
GNIL14TR04205AB 10

18. Remove the snap ring **(1)** from the groove of the input shaft.



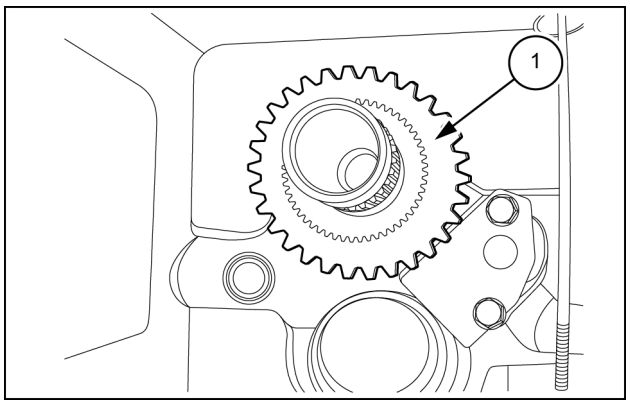
GNIL14TR04206AB 11

19. Remove the synchronizer kit **(1)** shift fork **(2)** and rail **(3)**.



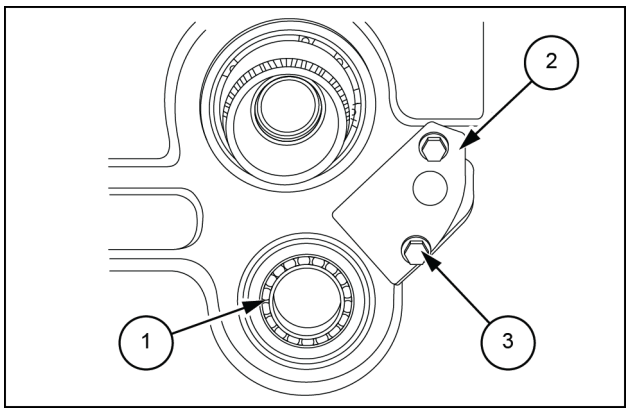
GNIL14TR04207AB 12

20. Remove the reverse gear **(1)**.



GNIL14TR04208AB 13

21. Remove the ball bearing **(1)** from the rear of the clutch housing.
22. Remove the oil trench plate **(2)** from the housing surface by loosening the M8 bolts and washers **(3)**.



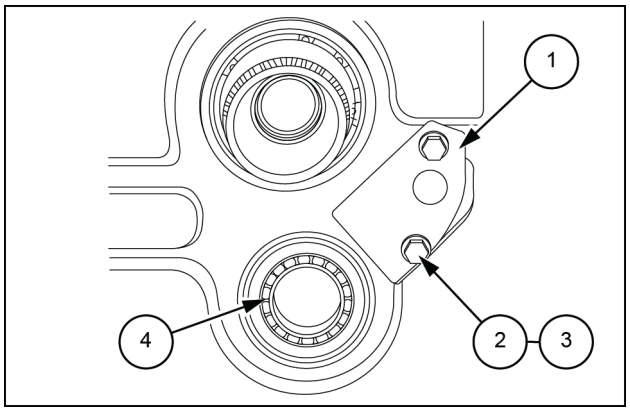
GNIL14TR04209AB 14

Gearbox internal components - Inspect

1. Wash all parts in a suitable cleaning solution and allow to air dry.
2. Inspect the bearings for excess wear, score marks , discoloration from overheating or other damage. Rotate the bearings by hand and check for any roughness. Replace as necessary.
3. Inspect the synchronizer gears and cluster gear shaft for excess wear, chipped gear teeth, cracks or any other damage. Replace as necessary.
4. Inspect the shift fork for wear or damage. Replace as necessary.
5. Inspect the detent grooves in the shift rail for excess wear. Replace as necessary.
6. Check the detent spring for wear or weak spring tension. Replace as necessary.

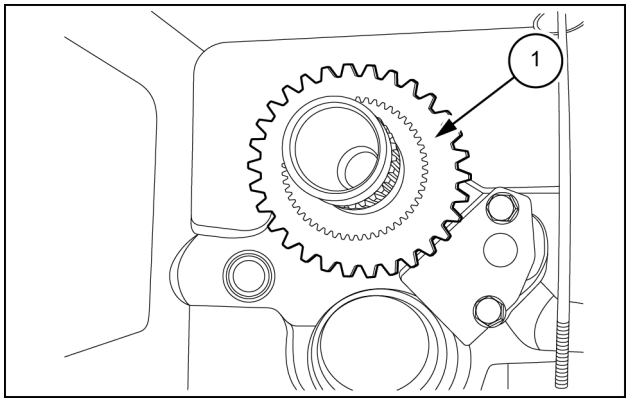
Gearbox internal components - Install

1. Place the oil trench plate **(1)** on the housing surface and tighten the bolts **(2)** with washer **(3)** to **25.5 N·m** (**18.8 lb ft**).
2. Install the ball bearing **(4)** from the rear of the clutch housing.



GNIL14TR04210AB 1

3. Install the reverse gear **(1)** over the input shaft spacer.

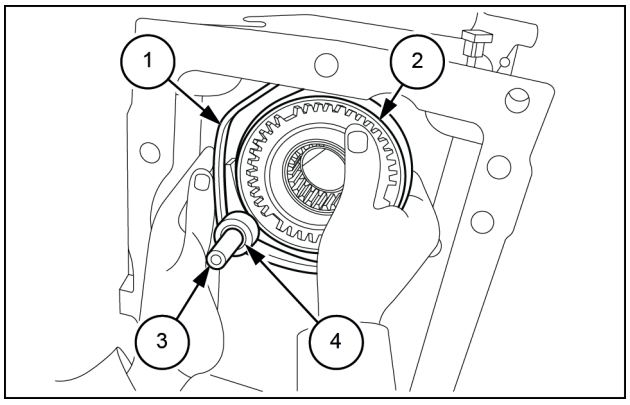


GNIL14TR04211AB 2

4. Install the shift fork **(1)** onto the synchronizer **(2)**.
5. Insert the shift rail **(3)** through the shift fork **(1)**.

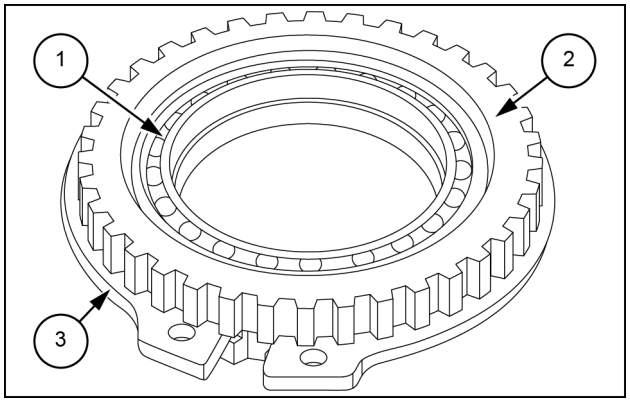
NOTE: *Secure the spring and detent ball against the groove on the shift rail by installing the shuttle detent bolt on the left-hand side of the clutch housing.*

6. Install roll pin **(4)** after aligning the hole of the shift fork **(1)** and shift rail **(3)**.
7. Install the synchronizer kit **(1)** onto the spline of the input shaft.
8. Secure the synchronizer on the input shaft with the external retaining ring **(2)**.



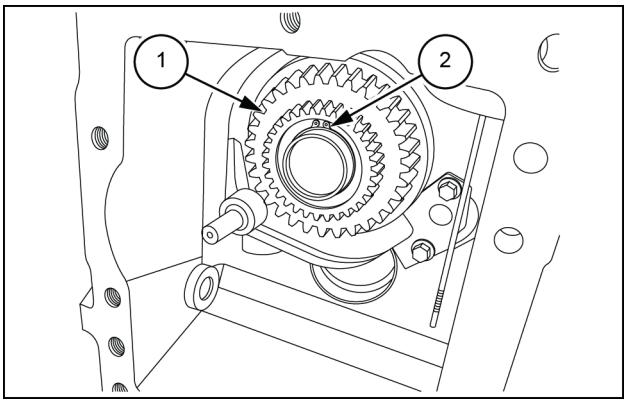
GNIL14TR04212AB 3

9. Press the ball bearing **(1)** inside the coupler shuttle gear **(2)**.
10. Attach the external snap ring **(3)** onto the groove of coupler shuttle gear **(2)**.



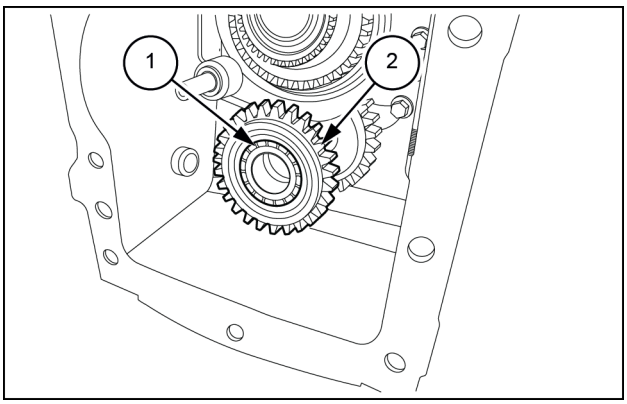
GNIL14TR04214AB 4

11. Install the shuttle coupler gear assembly **(1)** over the input shaft.
12. Secure the shuttle coupler gear on the input shaft with the external snap ring **(2)**.



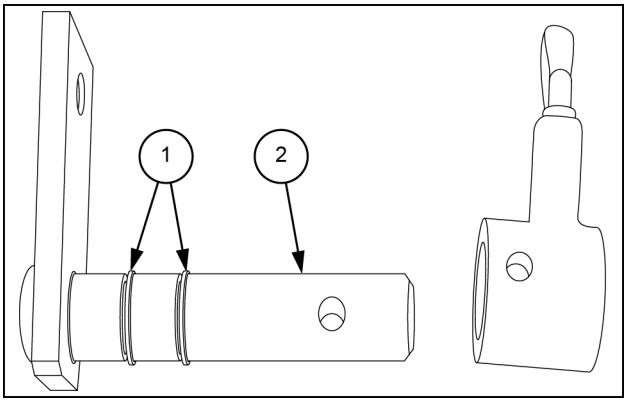
GNIL14TR04215AB 5

13. Press the ball bearing **(1)** into the cluster gear shaft **(2)**.
14. Install the cluster gear shaft **(2)** into the ball bearing installed from step 2.



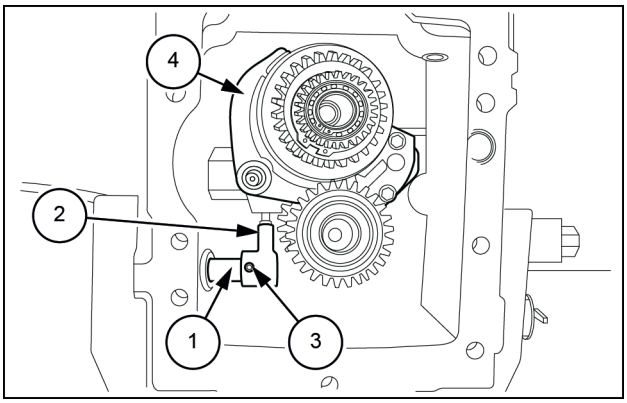
GNIL14TR04216AB 6

15. Apply petroleum jelly to the O-rings **(1)**.
16. Insert the O-rings in the grooves on the shaft link rod **(2)**.



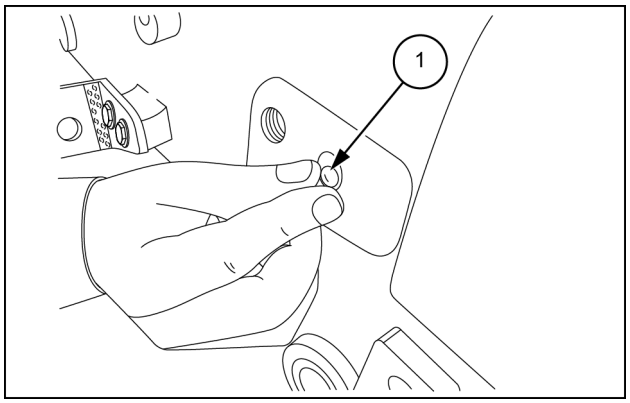
GNIL14TR04217AB 7

17. Insert the shaft link rod **(1)** through the hole in the clutch housing.
18. Insert the lever link rod **(2)** in the shift fork **(4)**.
19. Slide the shaft link rod **(1)** into the lever link rod **(2)**.
20. Align the holes in the shaft link rod **(1)** with the holes in the lever link rod **(2)**. Secure using the roll pin **(3)**.



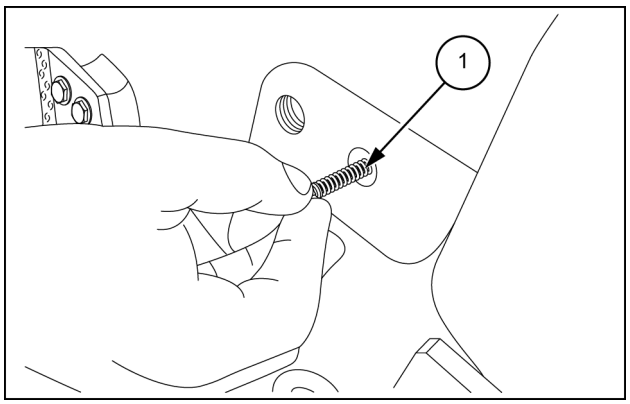
GNIL14TR04218AB 8

21. Insert the detent ball **(1)** in front of the spring.



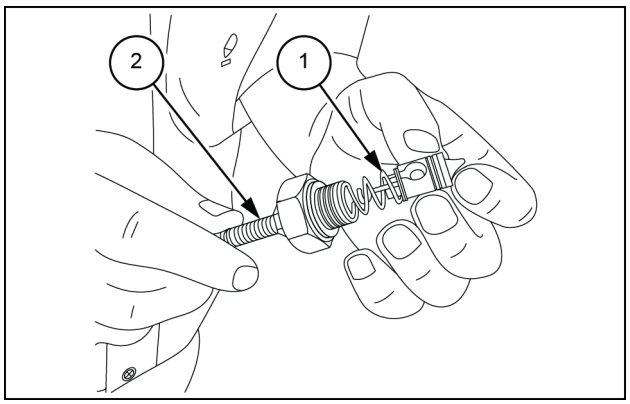
GNIL14TR04219AB 9

22. Insert the spring **(1)** into the clutch housing.
23. Install the shuttle detent bolt to the left-hand side of the clutch housing.



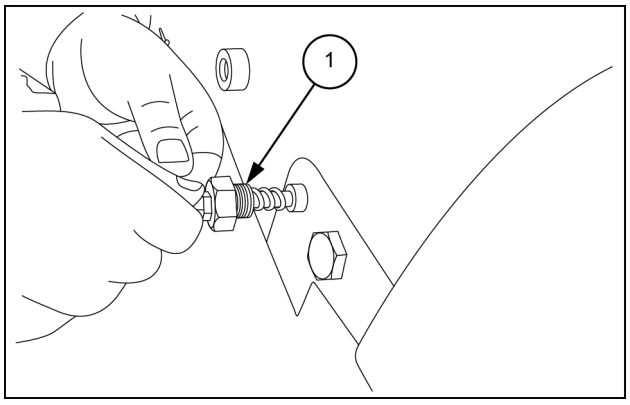
GNIL14TR04220AB 10

24. Insert the pin and spring **(1)** to shuttle cable **(2)**.



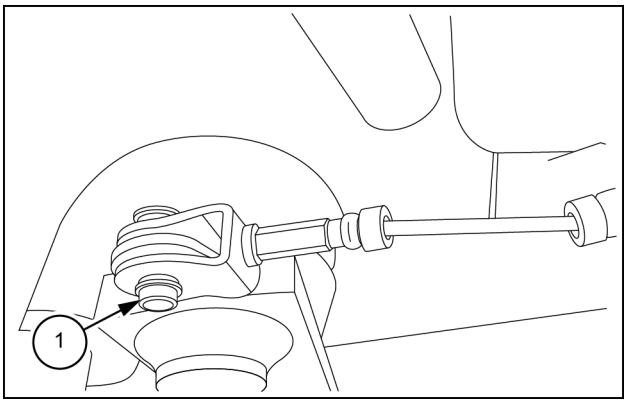
GNIL14TR04221AB 11

25. Insert the shuttle cable **(1)** through the hole on the left-hand side of the clutch housing.



GNIL14TR04222AB 12

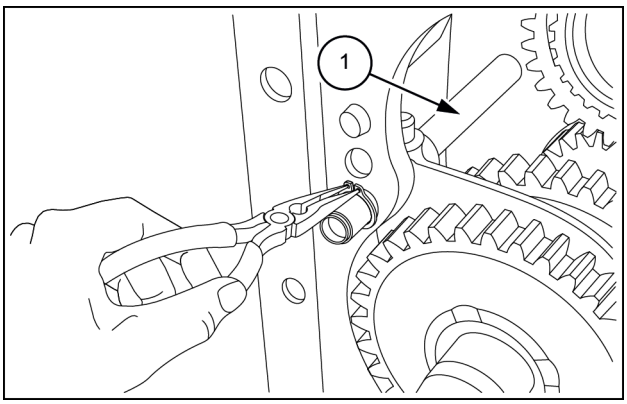
26. Attach the cable on the linkage and secure with the snap ring **(1)**.
27. Attach the linkage to the shaft link rod. Secure using the pin and cotter pin.



GNIL14TR04223AB 13

Synchro shuttle rails and fork

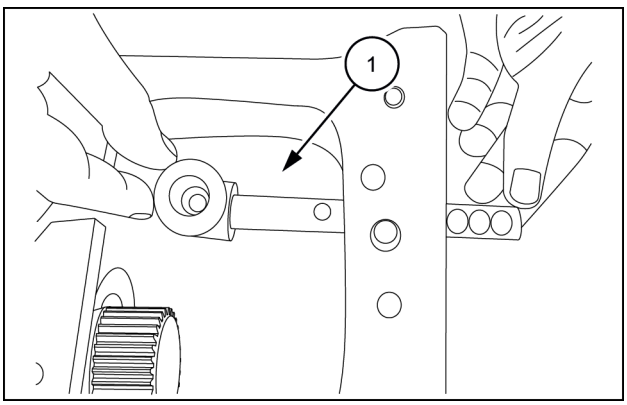
28. To install the shift rail and shift forks follow the procedure as mentioned below.
29. Insert shuttler rail.
30. Insert the bottom shift rail **(1)** and 1st/2nd gearshift fork. Insert the snap ring **(2)** on the bottom shift rail and ensure it sits on the seat in housing.



GNIL14TR04227AB 14

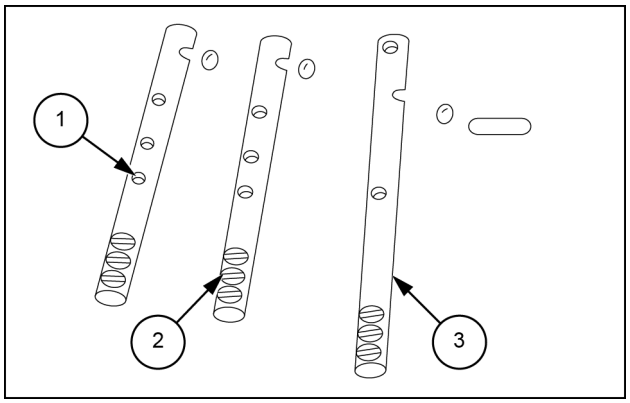
31. The Hi/Low shift rail **(1)** shift fork and shift gate should be installed after the pinion and crown settings.

NOTE: *Keep grooves of rails upward to make easy fitment of balls and springs.*



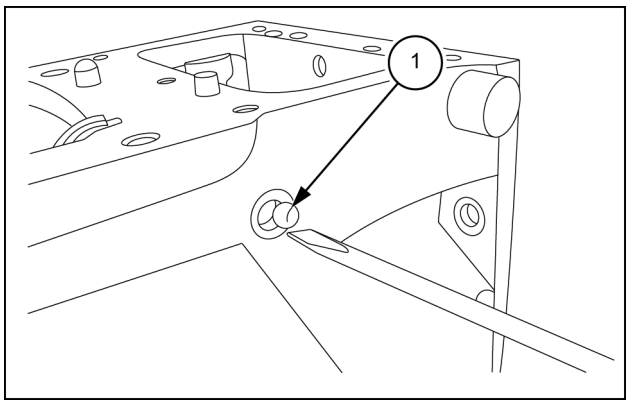
GNIL14TR04228AB 15

32. Transmission shift rails can be identified by referring to figure **3**. To fit rails 1st/2nd **(1)** and 3rd/4th **(2)** rails are similar. After fitting range shaft and drive shaft fit fork for 3rd/4th and insert reverse rail **(3)**, passing through fork of 3rd/4th gear.



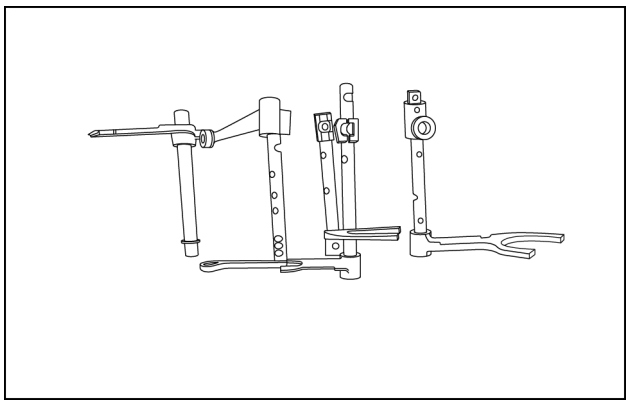
GNIL14TR04229AB 16

33. After fitting reverse rail insert ball **(1)**, applying some grease in the housing.



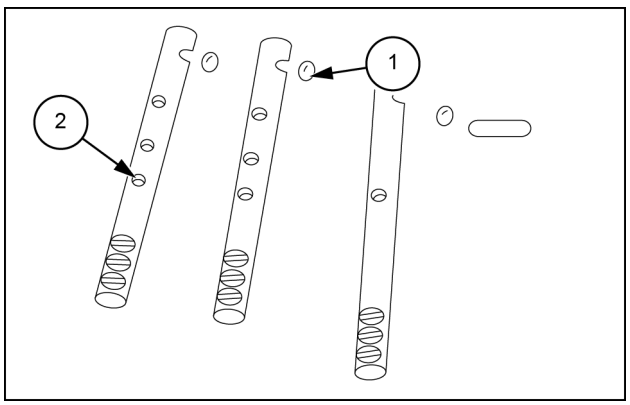
GNIL14TR04230AB 17

34. Insert the rail **(1)** of 3rd/4th with gate **(2)** passing through fork **(3)** of 3rd/4th gear as shown in figure **18**.



GNIL14TR04231AA 18

35. Insert gate of 1st/2nd rail shaft on the notch of 1st/ 2nd gear fork.
36. Insert the ball **(1)** applying some grease in housing after removing bolt as shown in figure **17**.

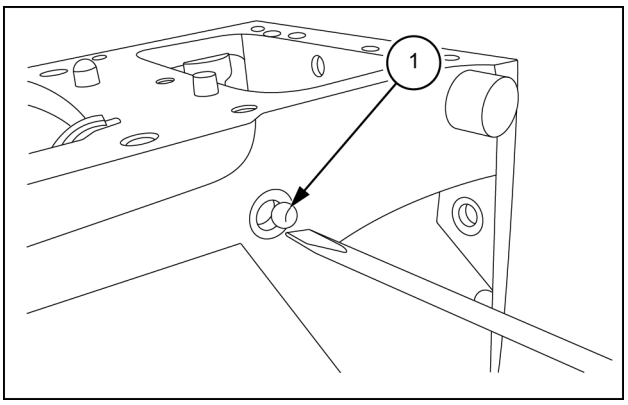


GNIL14TR04232AB 19

37. Insert the 1st/2nd rail **(2)** passing thru gate as shown in figure **18**.

NOTE: *Keep grooves of rails upward to make easy fitment of balls and springs.*

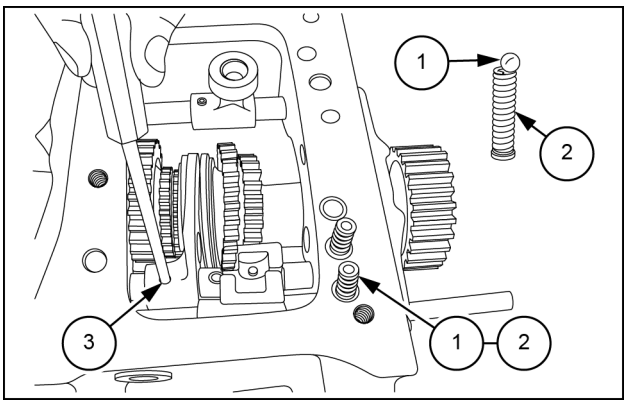
38. Insert the ball and pin **(1)** after removing neutral safety switch for Hi/Low rail then fit neutral safety switch and tighten it.



GNIL14TR04230AB 20

39. After fitting reverse rail insert ball **(1)** applying some grease in the housing as such it sits in groove given on reverse rail.

40. Insert the balls **(1)** and springs **(2)** of the rails. Insert plug above the spring of Hi/Low rail. Fit roll pins **(3)** in all rails and gates.

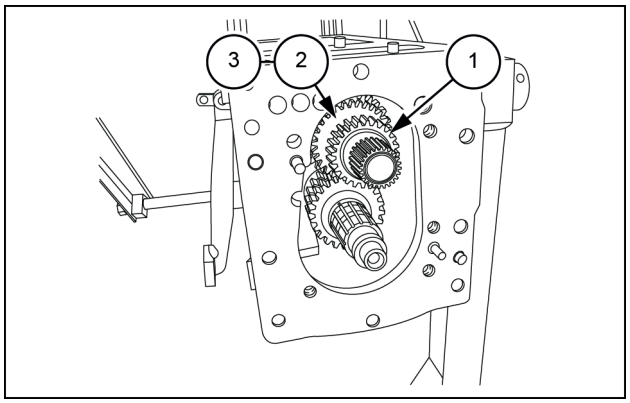


GNIL14TR04234AB 21

Drive shaft - Remove

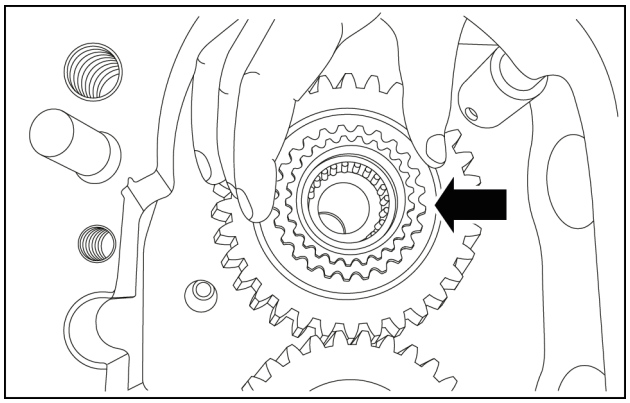
1. Remove the drive shaft **(1)** 3rd gear drive gear **(2)** and 3rd/4th gear coupler **(3)** as a assembly from the transmission housing.

NOTE: *1st and 2nd gear are a integral part of the drive shaft.*



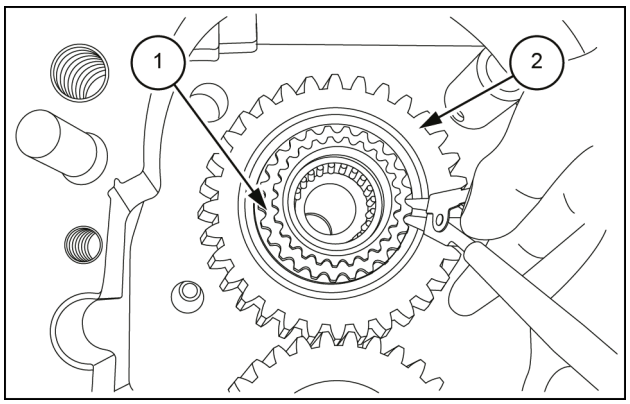
GNIL14TR04174AB 1

2. Remove shims.



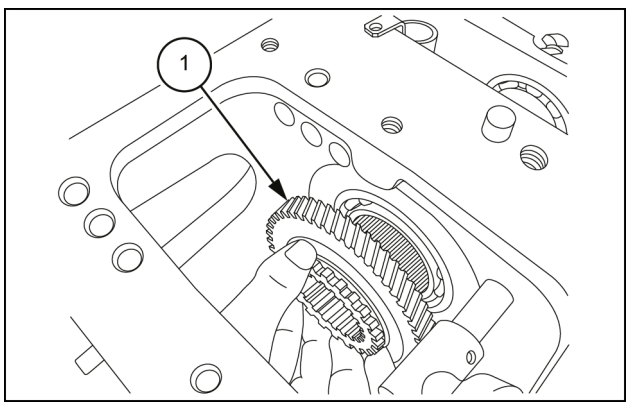
GNIL14TR04175AB 2

3. Remove the snap ring **(1)** securing the 4th gear drive gear **(2)** on the range shaft.



GNIL14TR04176AB 3

4. Remove the 4th gear drive gear **(1)** from the range shaft.

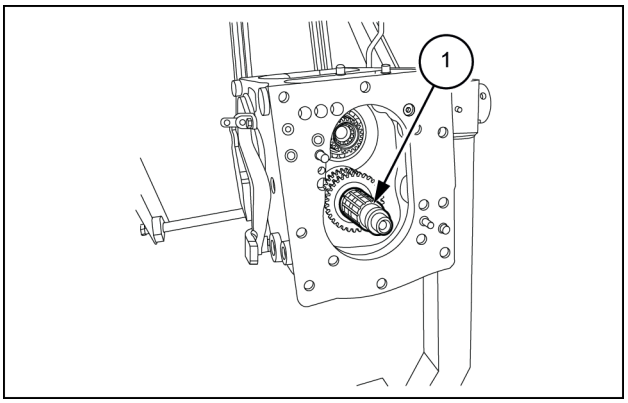


GNIL14TR04177AB 4

5. Remove the driven shaft **(1)** from the housing.

NOTE: *3rd and 4th gears are a integral part of the driven shaft.*

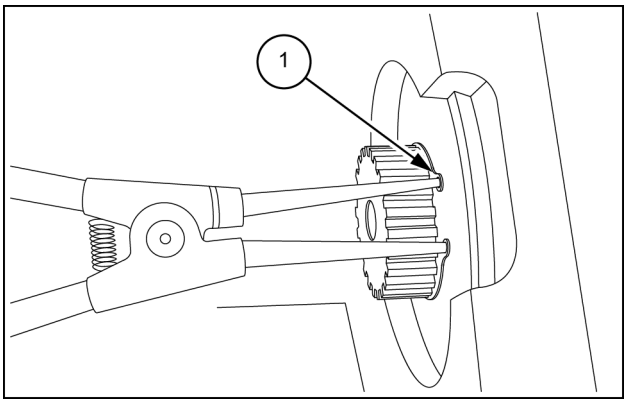
6. Clean and inspect the gears and hub for excess wear, chipped gear teeth, cracks or any other damage. Replace as necessary.
7. Inspect the shift fork for wear or damage. Replace as necessary.
8. Inspect the shift rail for wear or damage. Replace as necessary.



GNIL14TR04178A 5

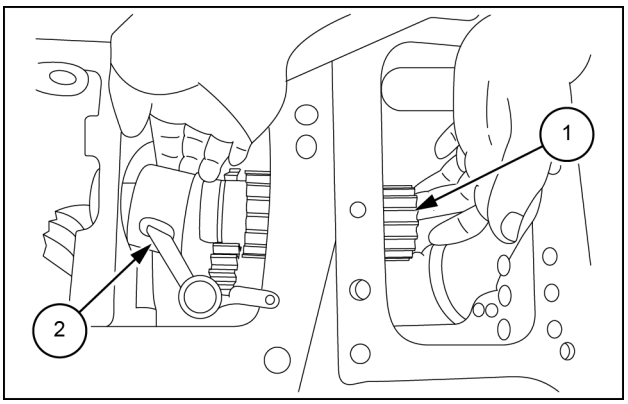
Range shaft removal

9. Remove the circlip lock **(1)** of the range shaft.



GNIL14TR04065AB 6

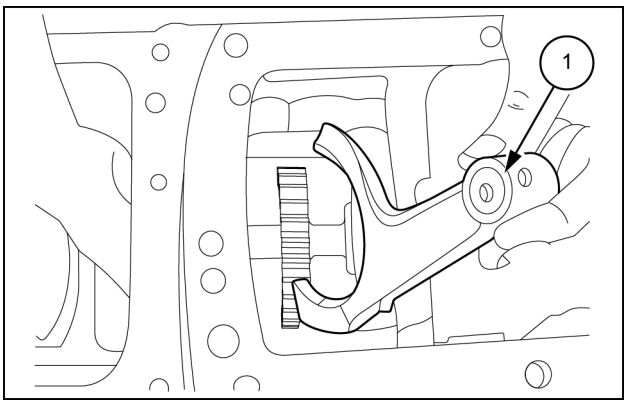
10. Remove the range shaft **(1)** from the housing. Remove the oil feeder cup **(2)** from the shaft as shown.



GNIL14TR04066AB 7

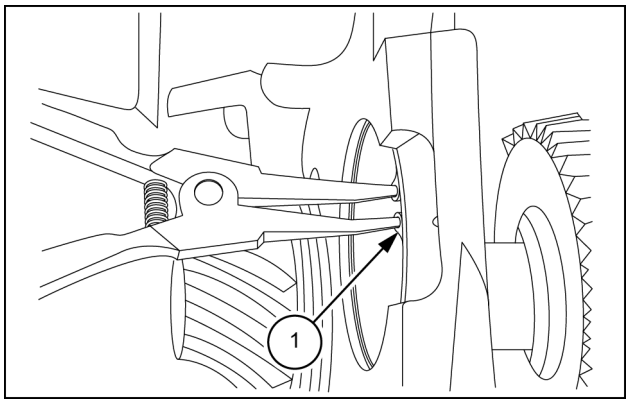
11. After removing the high low rail take out high low fork **(1)**.

NOTE: *It is required to take out the spacer **(2)**, spring and ball of high low rail shaft from the housing.*



GNIL14TR04067AB 8

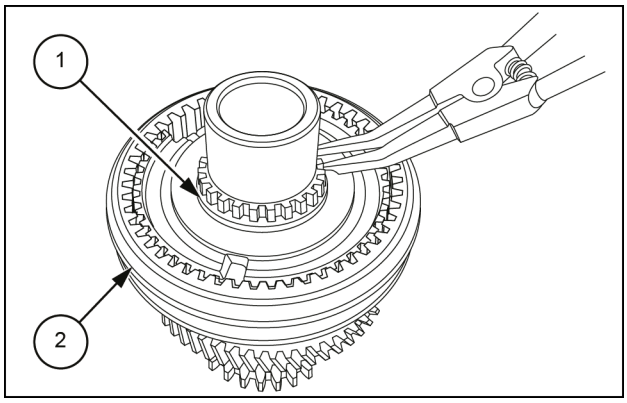
12. Remove the range shaft. Remove the snap ring **(1)** of range shaft bearing. Remove the range shaft bearing.



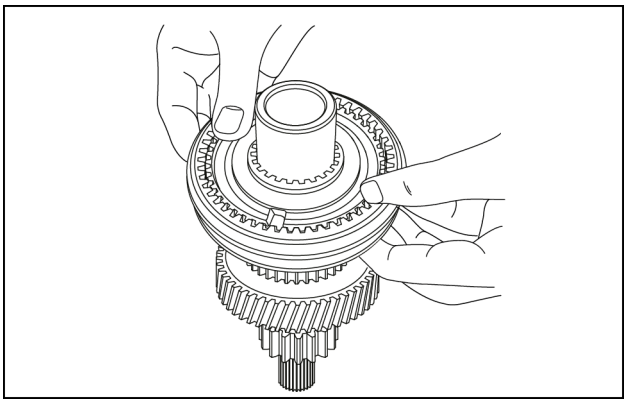
GNIL14TR04068AB 9

Drive shaft - Disassemble

1. Remove the snap ring **(1)** from the drive shaft to remove the hub along with coupler.



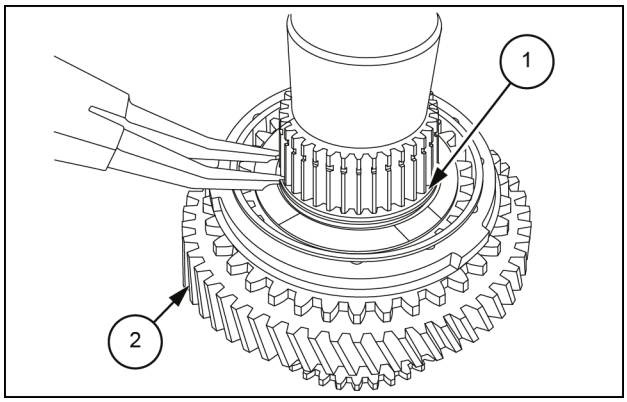
GNIL14TR04179AB 1



GNIL14TR04180AA 2

2. Remove the snap ring **(1)** from the drive shaft. Remove the 3rd drive gear **(2)**.

NOTE: *1st and 2nd gear are a integral part of the drive shaft.*



GNIL14TR04181AB 3

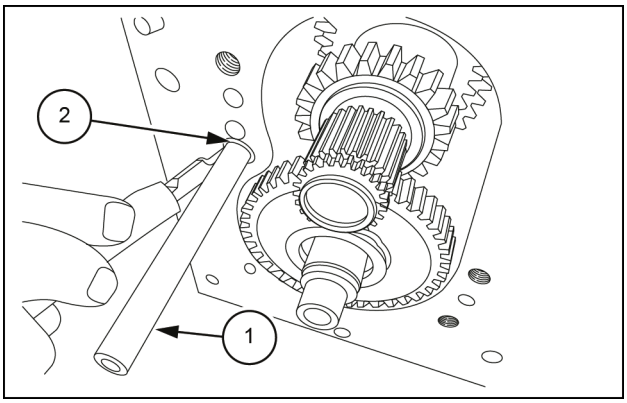
Drive shaft - Inspect

1. Wash all parts in a suitable cleaning solution and allow to air-dry.
2. Inspect all gears for excess wear chipped gear teeth cracks or any other damage. Replace as necessary.
3. Inspect the gear coupler and synchromesh drive shaft for any cracks or damage. Replace as necessary.

Driven shaft - Remove

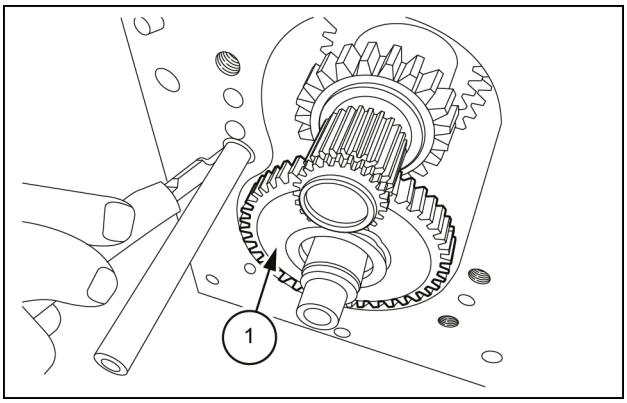
1. Remove the bottom shift rail **(1)**.

NOTE: *The bottom shift rail has a M12 plug* ***(2)*** *that must be removed from the front of the housing.*



GNIL14TR04169AB 1

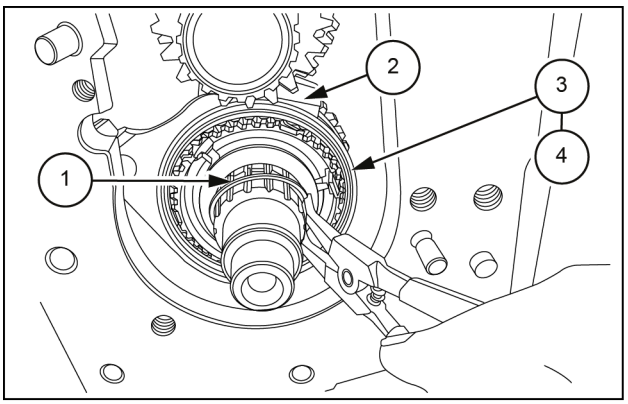
2. Remove the 1st gear **(1)** off the synchromesh driven shaft.



GNIL14TR04170AB 2

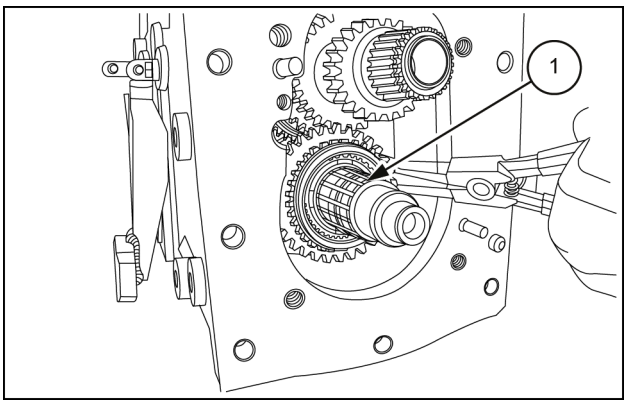
3. Remove the snap ring **(1)** from the driven shaft. Take out the 1st/2nd gear shift fork **(2)**, the 1st/2nd gear coupler **(3)**, and the hub **(4)** of the driven shaft.

NOTE: *Keep the face of the hub with the cut towards the pinion side.*



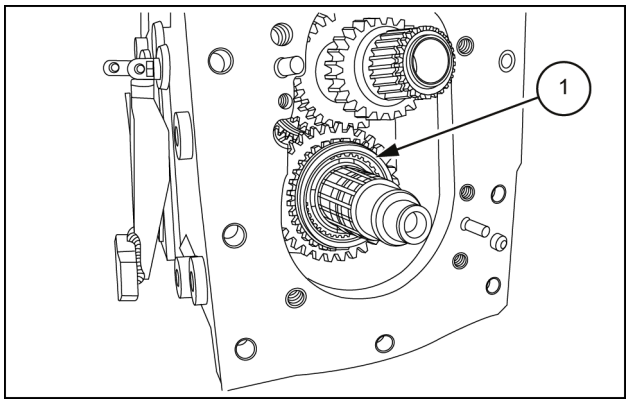
GNIL14TR00867AA 3

4. Remove the snap ring **(1)** that secures the 2nd gear.



GNIL14TR04172AB 4

5. Remove the 2nd gear **(1)** from driven shaft.

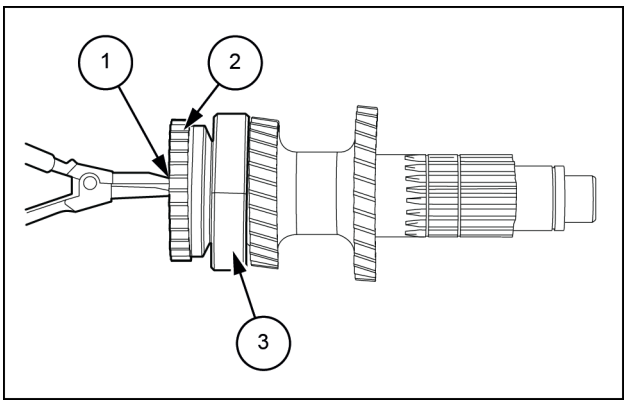


GNIL14TR04173AB 5

Driven shaft - Disassemble

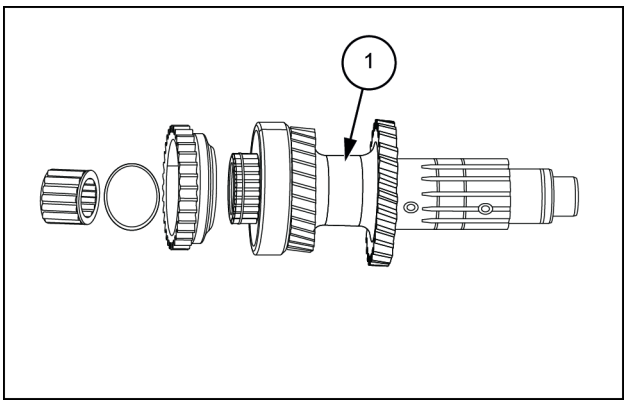
Dismantling on bench

1. Remove the snap ring **(1)** to remove the high gear **(2)** and bearing **(3)** from the synchromesh driven shaft.



GNIL14TR04182AB 1

NOTE: *3rd and 4th gear are a integral part of the driven shaft* ***(1)****.*



GNIL14TR04183AB 2

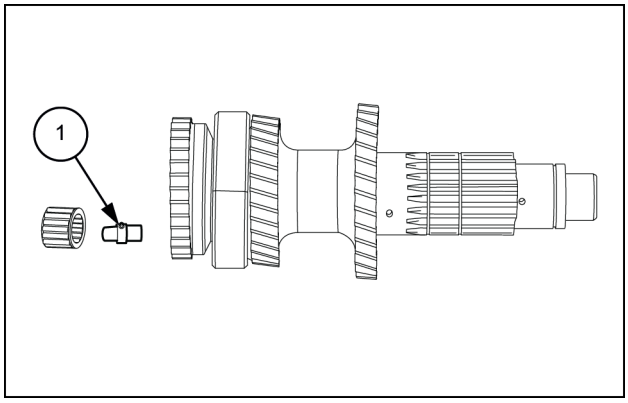
Driven shaft - Inspect

1. Wash all parts in a suitable cleaning solution and allow to air dry.
2. Inspect the bearing for excess wear, score marks, discoloration from overheating or other damage. Rotate the bearing by hand and check for any roughness while turning. Replace as necessary.
3. Inspect all the gears and driven shaft for excess wear chipped gear teeth cracks or any other damage. Replace as necessary.
4. Inspect synchronizer ring spring loaded poppet valve dog for wear.

Driven shaft - Install Transmission drive and driven shafts

NOTE: *Before assembly carefully check gears needle bearing snap rings etc. and replace if found faulty.*

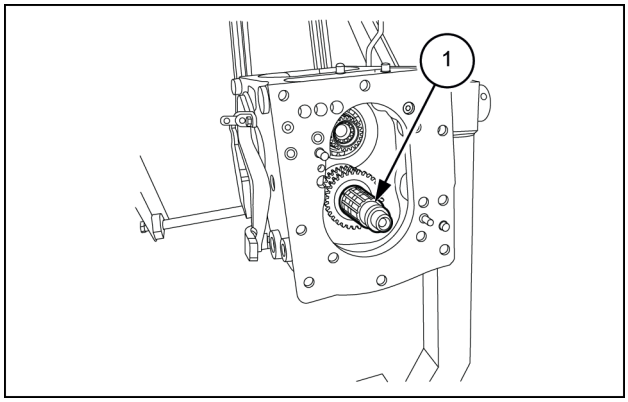
1. Fit the oil connector **(1)** between driven shaft and pinion keeping larger diameter towards driven shaft before fitting driven shaft on pinion.



GNIL14TR04184AB 1

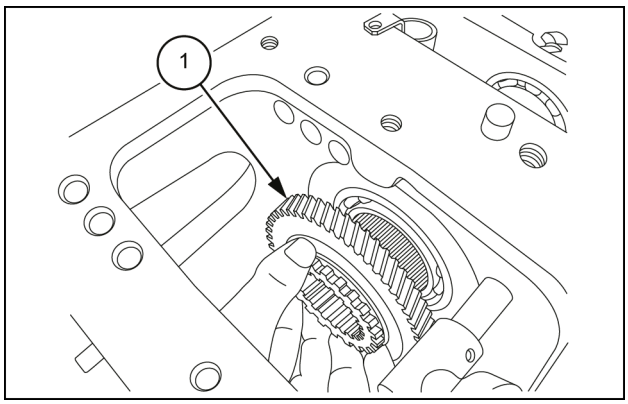
2. Install the driven shaft **(1)** into the housing.

NOTE: *3rd and 4th gears are a integral part of the driven shaft.*



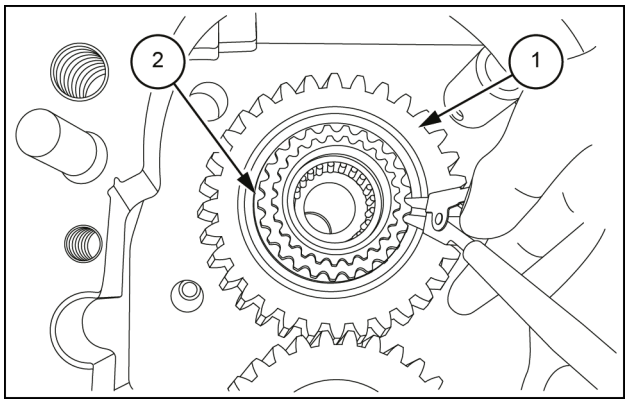
GNIL14TR04185AB 2

3. Install the 4th gear drive gear **(1)** onto the range shaft.



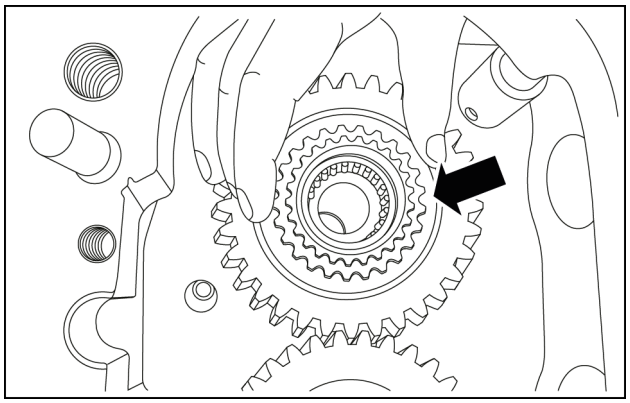
GNIL14TR04186AB 3

4. Secure the 4th gear drive gear **(1)** with the snap ring **(2)**.



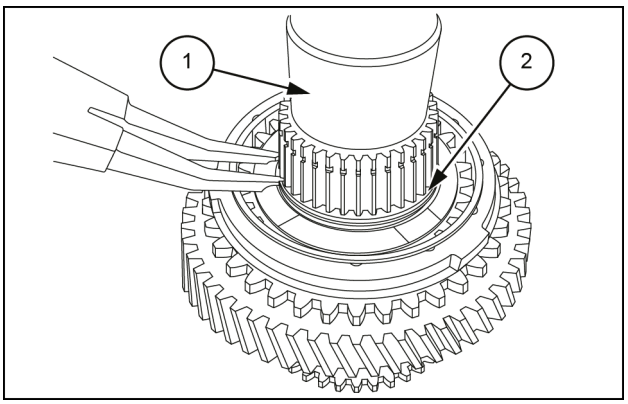
GNIL14TR04187AB 4

5. Install shims and synchronizer ring on the 4th gear.



GNIL14TR04188AB 5

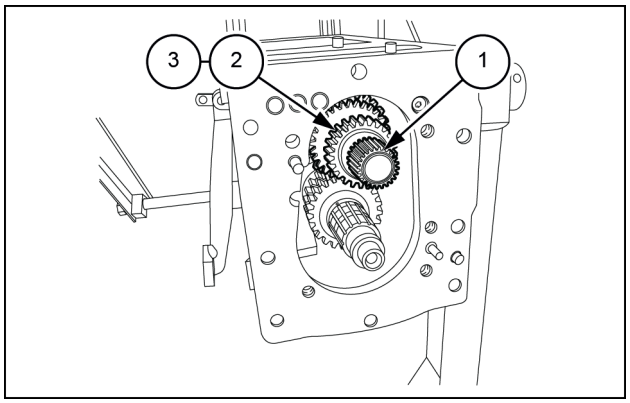
6. Instal 3rd gear with synchronizer on drive shaft **(1)** and retain with snap ring **(2)**.



GNIL14TR04189AB 6

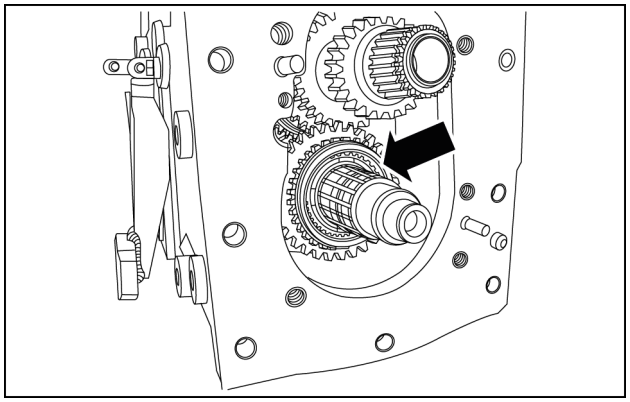
7. Install the synchromesh drive shaft **(1)** in assembled form which includes the drive shaft 3rd gear drive gear **(2)** and 3rd / 4th gear coupler **(3)**.

NOTE: *1st and 2nd gear are a integral part of the drive shaft.*



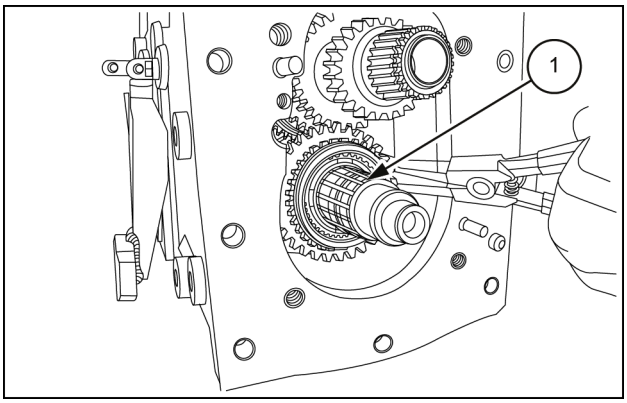
GNIL14TR04190A 7

8. Install synchronizer ring.



GNIL14TR04191AB 8

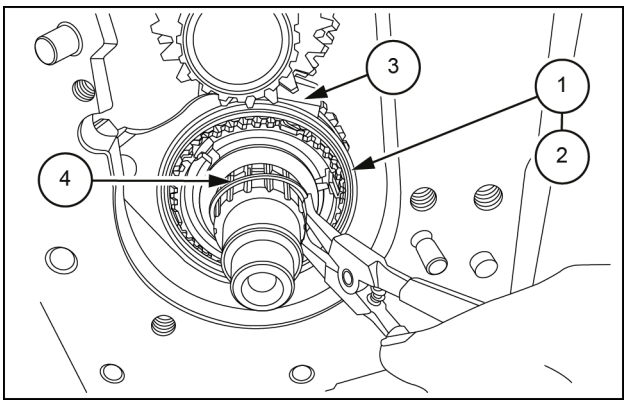
9. Install 2nd gear onto the synchromesh driven shaft and secure 2nd gear with a snap ring **(1)**.



GNIL14TR04192AB 9

10. Install the hub **(1)** 1st/2nd gear coupler **(2)** onto the driven shaft and insert the shift fork **(3)** onto the coupler. Secure the hub with the snap ring **(4)**.

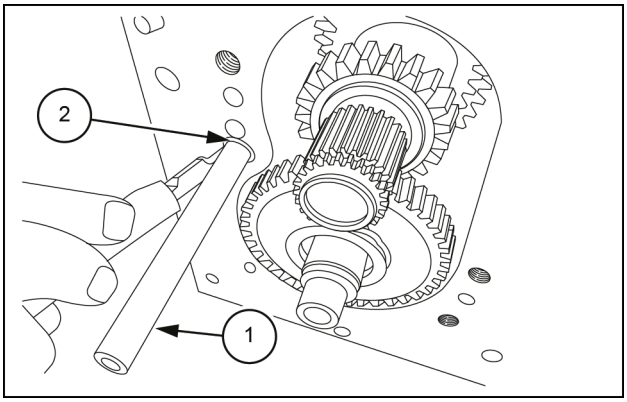
NOTE: *Keep the face of the hub with the cut towards the pinion side.*



GNIL14TR04193AB 10

11. Secure the shift fork in place by inserting the bottom shift rail **(1)**.

NOTE: *Insert the M12 plug* ***(2)*** *for the shift rail into the housing.*



GNIL14TR04194AB 11

https://truckmanualshub.com/

Index

Transmission - 21

Gearbox internal components - 145

Drive shaft - Disassemble 17
Drive shaft - Inspect 18
Drive shaft - Remove 14
Driven shaft - Disassemble 21
Driven shaft - Inspect 22
Driven shaft - Install Transmission drive and driven shafts 23
Driven shaft - Remove 19
Gearbox internal components - Inspect 7
Gearbox internal components - Install 8
Gearbox internal components - Remove 3

https://truckmanualshub.com/

Transmission - 21

Dropbox - 200

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Transmission - 21

Dropbox - 200

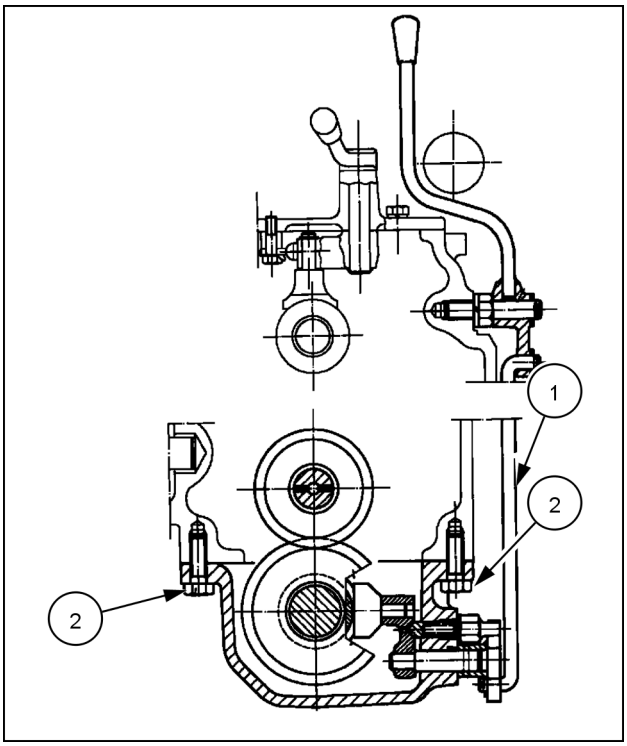
SERVICE

Dropbox
- Remove 3
- Disassemble 4
- Assemble 5
- Install 6

Dropbox - Remove

1. After removing the drive shaft, drain the oil from the tractor transmission. See **Drive shaft - Remove (23.314)** for the drive shaft removal.
2. Detach the hand lever vertical rod **(1)** from the drop box control lever.
3. Remove the mounting bolts **(2)** and remove the drop box assembly.

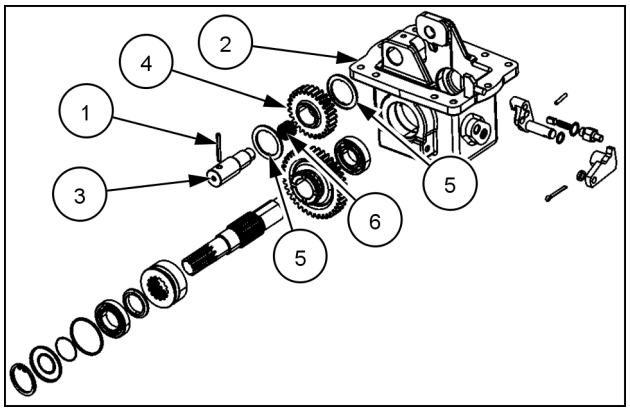
NOTE: *Drain the oil from the drop box by removing the drain plug on the drop box.*



20097721 1

Dropbox - Disassemble

1. Use a punch to remove the roll pin **(1)** from the drop box **(2)** and idler gear shaft **(3)**.
2. Push the idler gear shaft **(3)**, forward out of the drop box **(2)** and remove the idler gear **(4)**, spacers **(5)**, and needle bearing **(6)** from the drop box.
3. Check the idler gear shaft, idler gear, spacers, and needle bearing for any wear or damage. Replace as necessary.

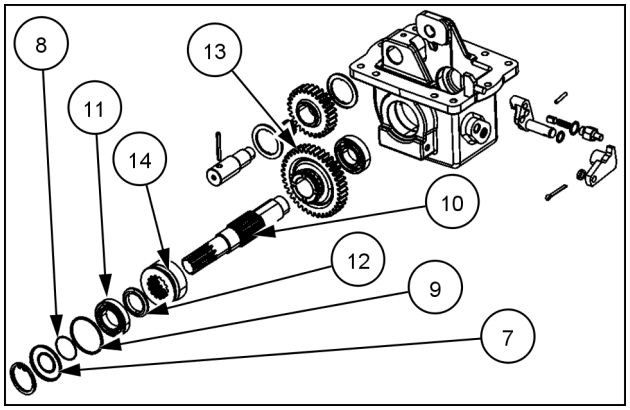


200900126 1

4. Remove the following :-
   - Dust seal disc **(7)**.
   - Shaft seal **(8)**.
   - Retaining ring **(9)**.
   - Output shaft **(10)**, with bearing **(11)**, and dust excluder **(12)**.

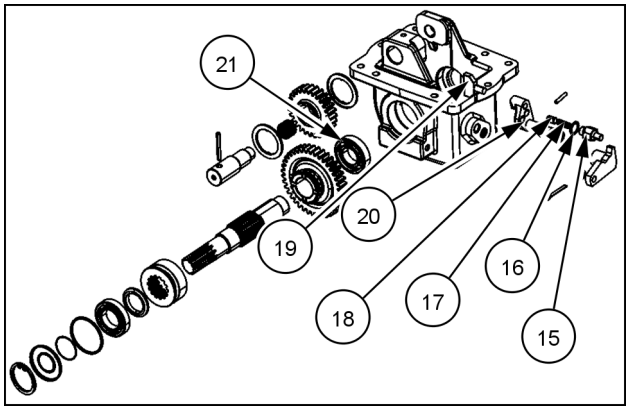
NOTE: *Drill a 1/8 inch hole on each side of the dust seal **(7)** and shaft seal **(8)** and insert sheet metal screws into the holes to pull the parts from the case bore.*

5. Remove the output shaft gear **(13)**, and splined coupler **(14)**, from the case.



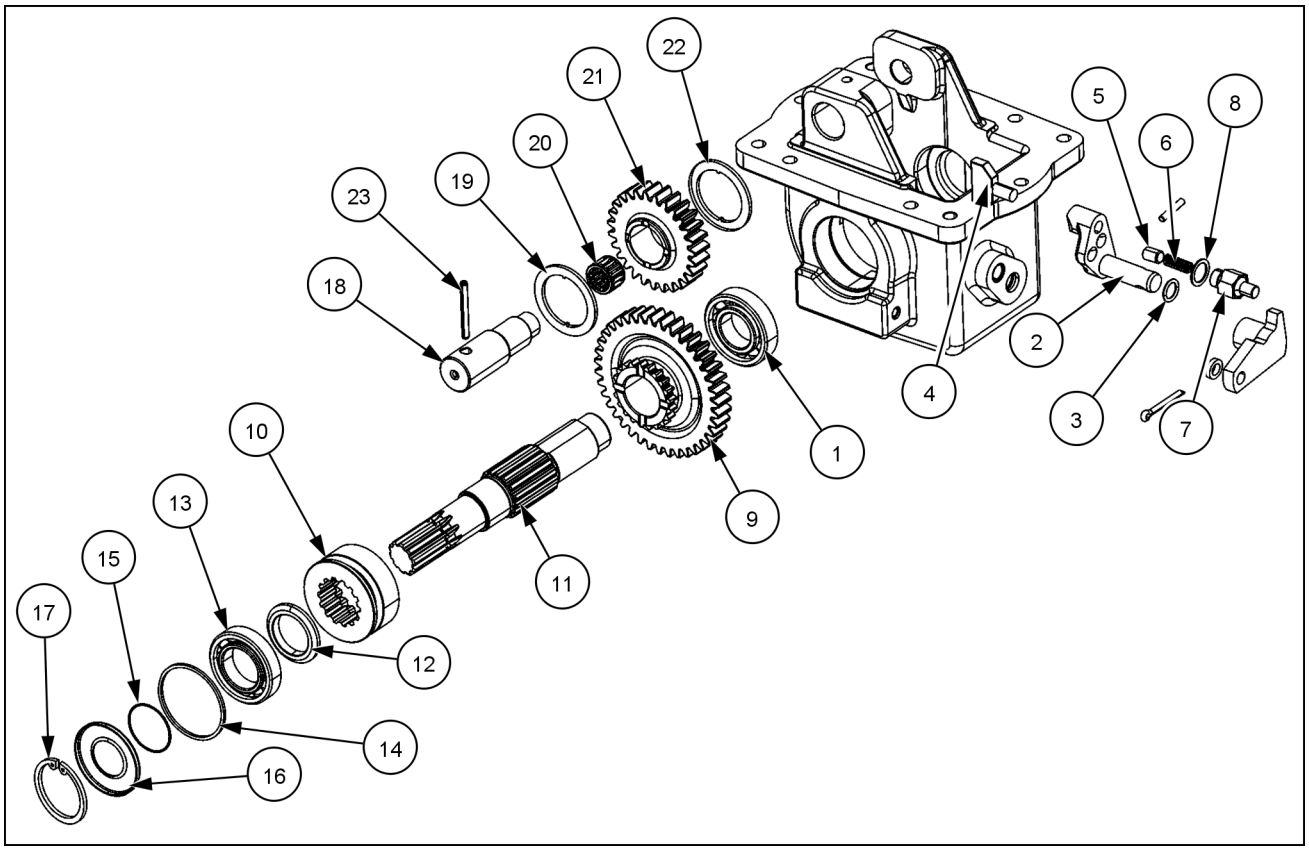
200900126 2

6. To remove shift lever :-
   - Unscrew the plug **(15)** with sealing washer **(16)**.
   - Remove detent plunger spring **(17)**.
   - Remove detent plunger **(18)**.
   - Remove pad **(19)**.
   - Remove Inner change lever **(20)** from case.
7. To remove rear bearing **(21)** use a slide hammer puller.



200900126 3

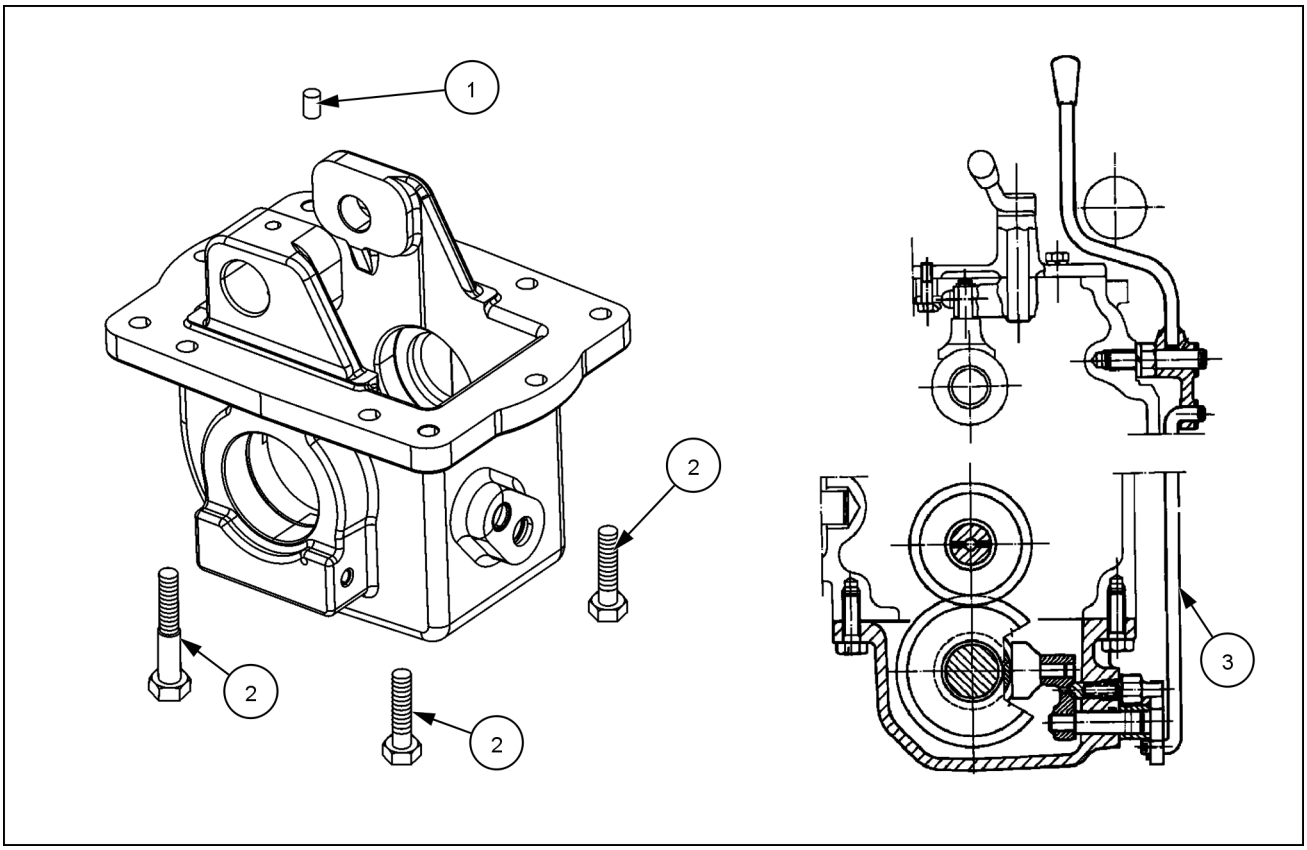
Dropbox - Assemble



200900125 1

1. Install rear bearing **(1)** into the drop box.
2. Install inner change lever **(2)** with O-ring **(3)** into the drop box.
3. Install pad **(4)** onto the changing lever.
4. Install detent plunger **(5)**, plunger spring **(6)**, plug **(7)** with sealing washer **(8)**.
5. Place output shaft gear **(9)** and splined coupler **(10)** into the drop box.
6. Slide output shaft **(11)** through the coupler, gear and into the rear bearing. Seat shaft fully into rear bearing.
7. Install the dust excluder **(12)** and the front bearing **(13)** onto the output shaft.
8. Install retaining ring **(14)** into the groove in the drop box.
9. Install shaft seal **(15)** and dust seal disc **(16)** into the drop box.
10. Install retaining ring **(17)** onto the output shaft.
11. Slide the idler gear shaft **(18)** into the front of the transfer box and slide the spacer **(19)**, needle bearing **(20)**, idler gear **(21)**, and spacer **(22)** onto the shaft.
12. Secure the idler gear shaft **(18)** by using a punch to drive the roll pin **(23)** into the shaft and drop box.

Dropbox - Install



200900127 1

1. Make sure that the two locating dowel pins **(1)** are installed in the drop box.
2. Place a bead of gasket eliminator 518 onto the mounting surface of the transfer box.
3. Install transfer box assembly onto the tractor using eight M10 x 30 **(2)** mounting bolts.
4. Torque bolts to **49.0 - 62.8 N·m** (**36.1 - 46.3 lb ft**).
5. Attach the vertical hand lever rod **(3)** onto the drop box lever.
6. Refill transmission with oil.

https://truckmanualshub.com/

Index

Transmission - 21

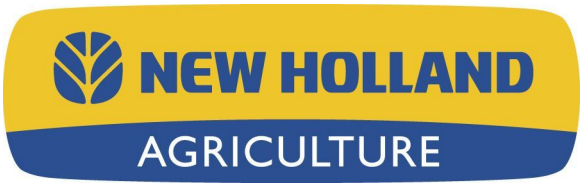
Dropbox - 200

Dropbox - Assemble 5
Dropbox - Disassemble 4
Dropbox - Install 6
Dropbox - Remove 3

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https://truckmanualshub.com/

SERVICE MANUAL

Four-Wheel Drive (4WD) system

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Four-Wheel Drive (4WD) system - 23

[23.314] Drive shaft 23.1

https://truckmanualshub.com/

Four-Wheel Drive (4WD) system - 23

Drive shaft - 314

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Four-Wheel Drive (4WD) system - 23

Drive shaft - 314

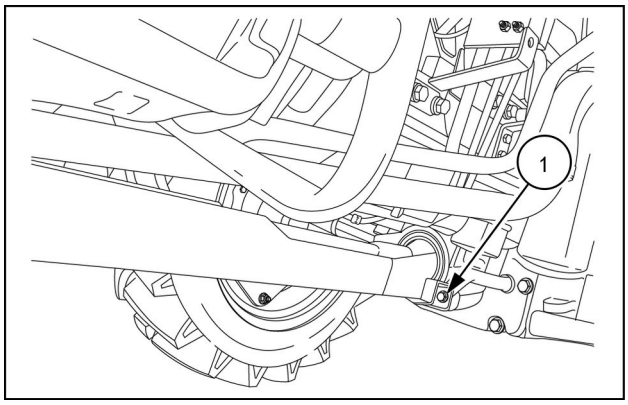
SERVICE

Drive shaft
Remove 3
Install 4

Drive shaft - Remove

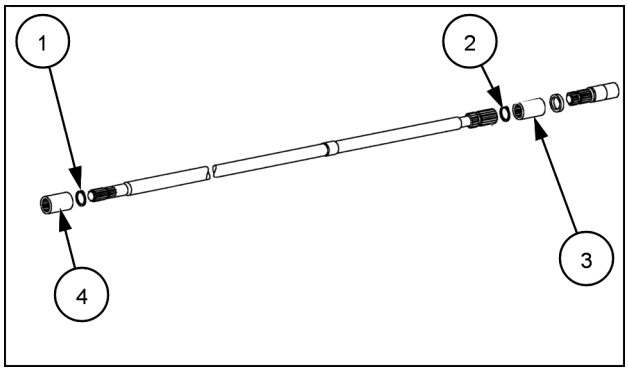
1. Loosen the bolts **(1)** on both the ends of the Four-Wheel Drive (4WD) shaft guard and remove the 4WD shaft guard.

NOTE: *The drive shaft guard can be separated into two sections.*



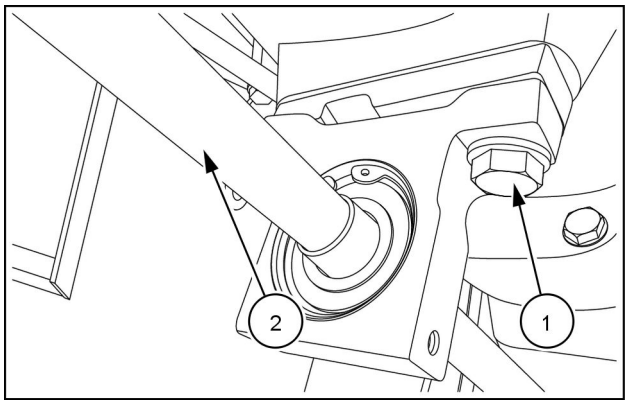
GNIL14TR00823AA 1

2. Unseat the retaining rings **(1)** and **(2)**. Slide the splined couplers **(3)** and **(4)** toward the center mounting bracket of the 4WD shaft.



GNIL15TR01128FA 2

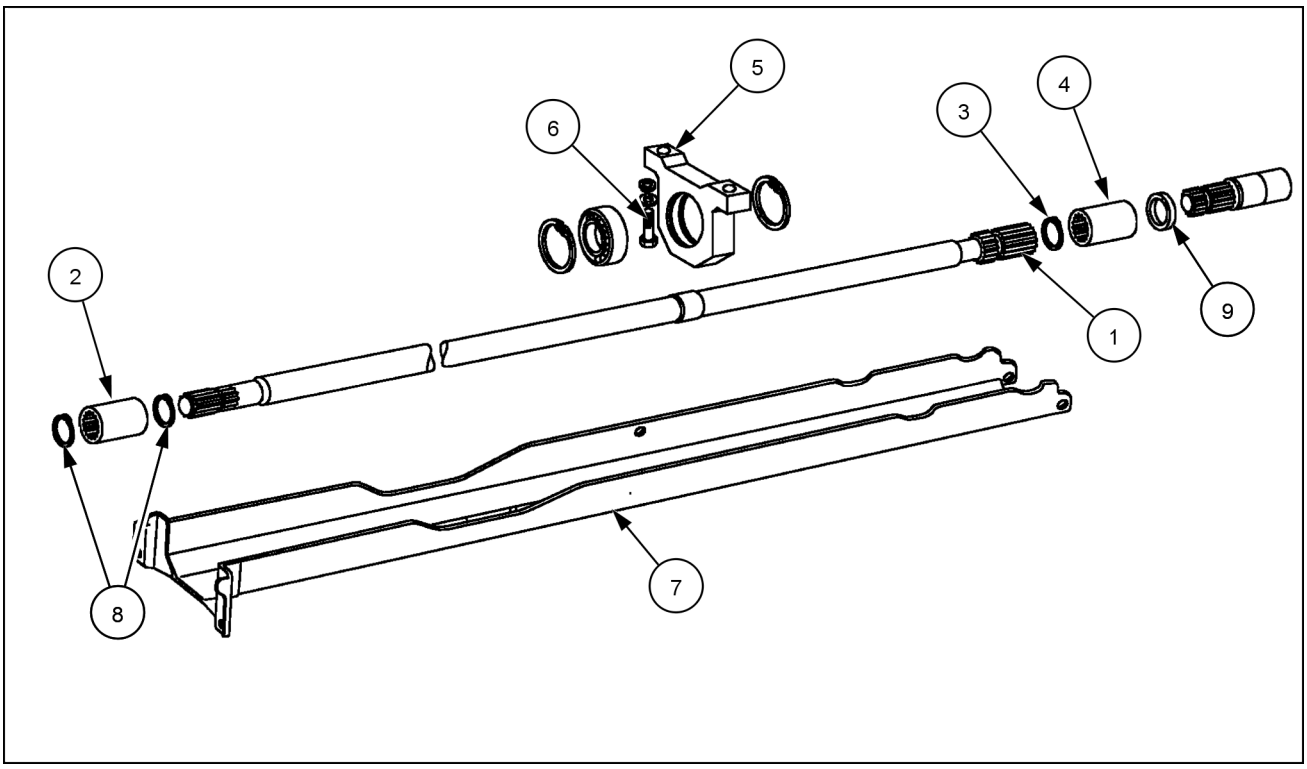
3. Remove the two mounting bolts **(1)** from center mounting bracket of the 4WD shaft.
4. Remove the 4WD shaft **(2)**.



GNIL15TR01129AA 3

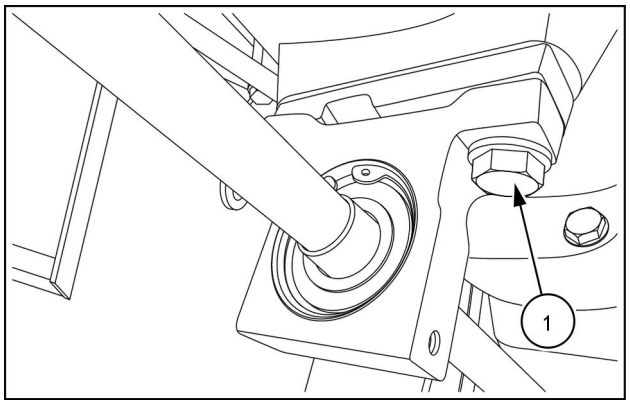
5. Inspect splines of shaft, coupler and condition of bore of center support housing for wear or damage.

Drive shaft - Install



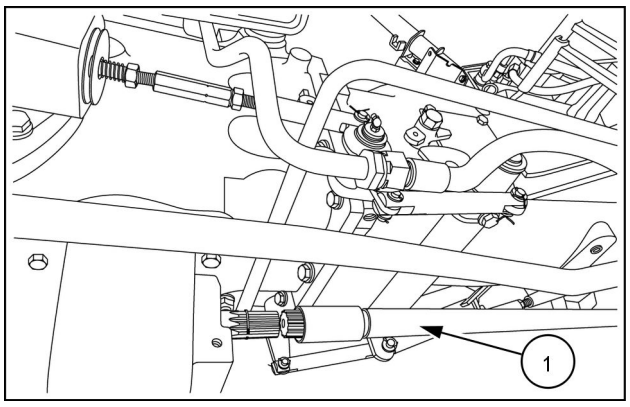
GNIL15TR01128FA 1

1. Tighten the bolts **(1)** on the center mounting bracket of the Four-Wheel Drive (4WD) shaft.



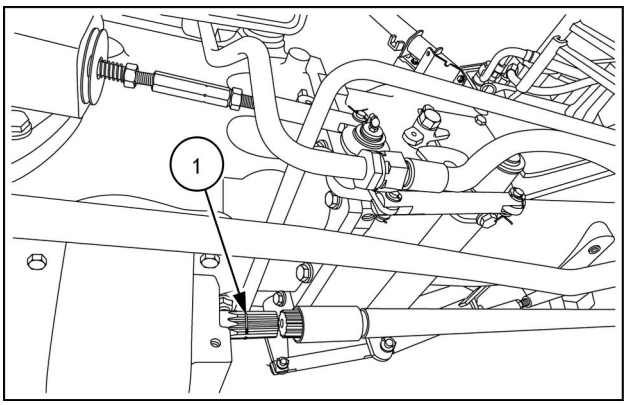
GNIL15TR01129AA 2

2. Engage the spline coupler **(2)**, figure **1**, on the Power Take-Off (PTO) shaft of the front axle and the 4WD shaft.
3. Push the 4WD shaft **(1)** toward the front axle.



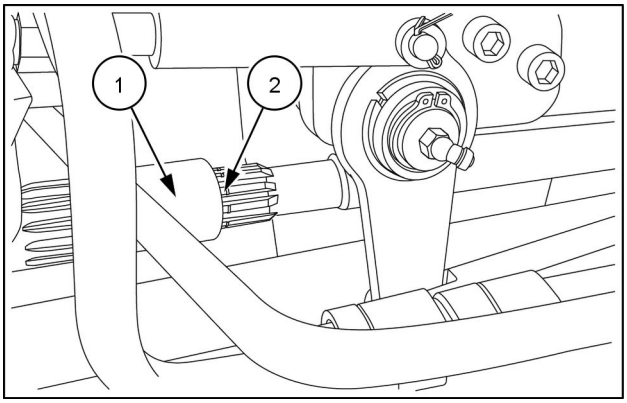
GNIL15TR01130AA 3

4. Seat the retaining rings **(8)**, figure **1**, on the front axle PTO shaft and 4WD shaft.
5. Seat the retaining ring **(1)** on the PTO shaft of the drop box.



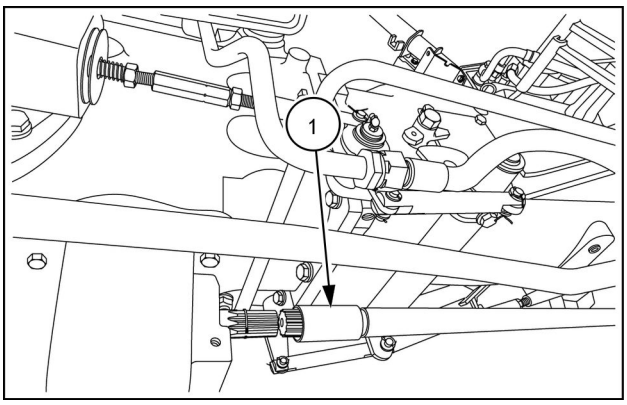
GNIL15TR01130AA 4

6. Slide the spline coupler **(1)** toward the drop box.
7. Measure the gap **(2)** on the 4WD shaft between retaining ring groove and sleeve face.



GNIL15TR01131AA 5

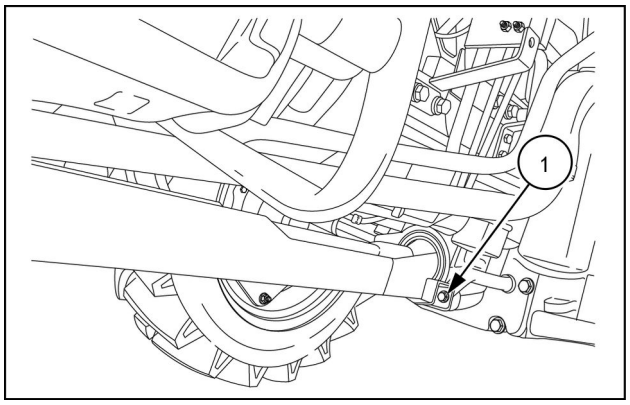
8. Slide the spline coupler **(1)** away from the drop box.



GNIL15TR01130AA 6

9. Insert suitable shim or combination of shims **(9)**, figure **1**, on the drop box PTO shaft to make up for the gap. Maintain a free play of **0.3 mm**.
10. Slide the spline coupler toward the drop box and seat the retaining ring **(3)**, figure **1**.

11. Fit the drive shaft guard and tighten the bolts **(1)** on both the ends.



GNIL14TR00823AA 7

https://truckmanualshub.com/

Index

Four-Wheel Drive (4WD) system - 23

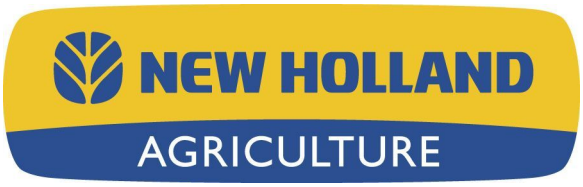
Drive shaft - 314

Drive shaft - Install 4
Drive shaft - Remove 3

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https://truckmanualshub.com/

SERVICE MANUAL

Front axle system

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Front axle system - 25

[25.100] Powered front axle 25.1

[25.102] Front bevel gear set and differential 25.2

[25.108] Final drive hub, steering knuckles, and shafts 25.3

[25.310] Final drives 25.4

[25.400] Non-powered front axle 25.5

https://truckmanualshub.com/

Front axle system - 25

Powered front axle - 100

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Front axle system - 25

Powered front axle - 100

TECHNICAL DATA

Four-Wheel Drive (4WD) axle

General specification 3
Torque 5
Special tools 6

FUNCTIONAL DATA

Four-Wheel Drive (4WD) axle

Overview 8
Sectional view 9

SERVICE

Four-Wheel Drive (4WD) axle

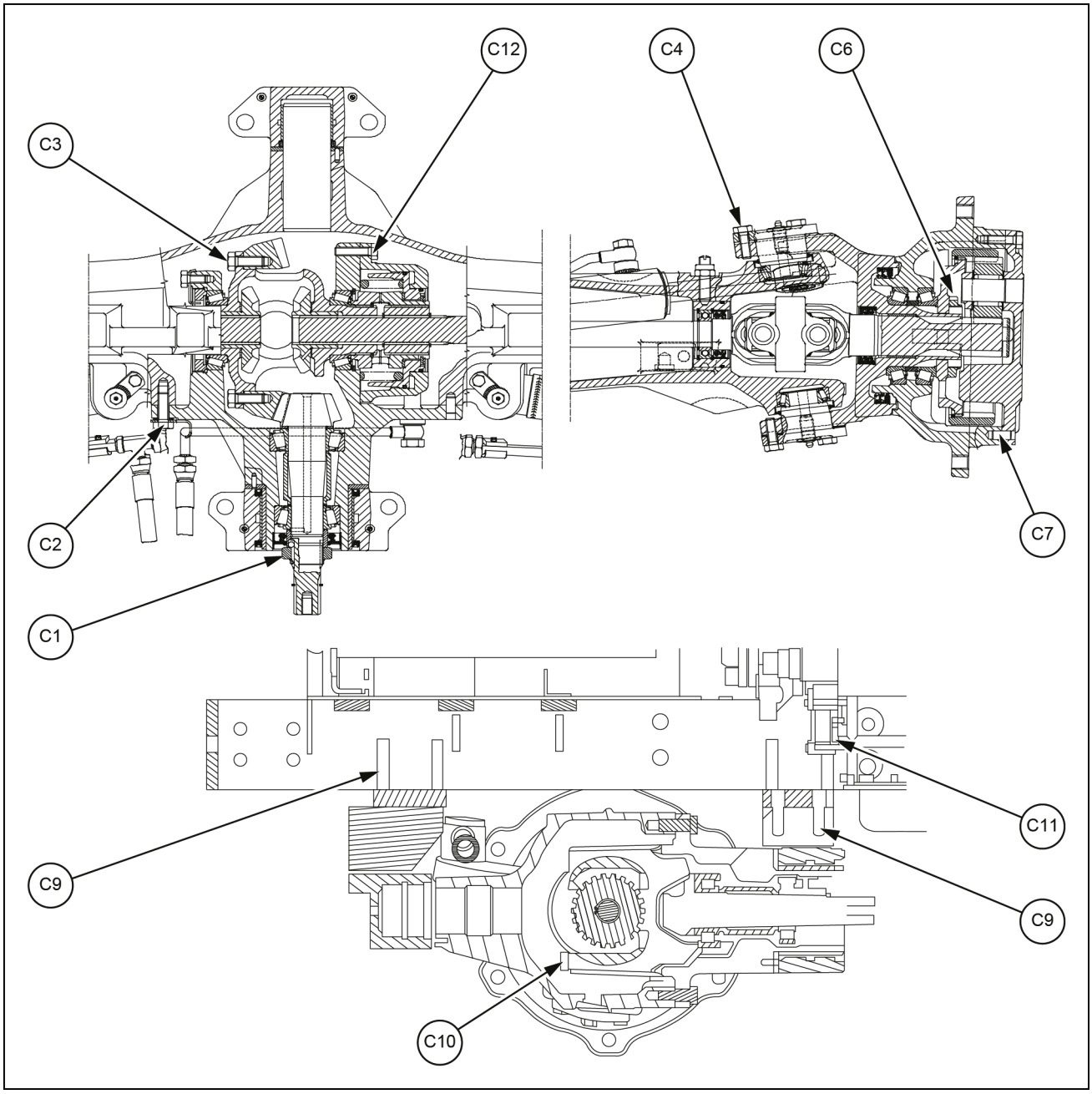
Remove 12
Remove 15
Install 18
Disassemble 19
Inspect 25
Assemble 26
Adjust 27
Toe in adjust 30

Four-Wheel Drive (4WD) axle - General specification

Axle class	Class 1
Unrestricted (static) axle capacity	**2400.0 kg** (**5291.1 lb**)
Bevel gear pair - differential	
Pinion-ring gear ratio	9/38 = 1:4.2
Backlash between bevel gear pair	**0.15 mm** (**0.006 in**) - **0.20 mm** (**0.008 in**)
Bevel drive and differential	
• Thickness of pinion bearing adjustment shim	**2.5 mm** (**0.0984 in**) - **2.55 mm** (**0.1004 in**) - **2.6 mm** (**0.1024 in**) - **2.65 mm** (**0.1043 in**) - **2.7 mm** (**0.1063 in**) - **2.75 mm** (**0.1083 in**) - **2.8 mm** (**0.1102 in**) - **2.85 mm** (**0.1122 in**) - **2.9 mm** (**0.1142 in**) - **2.95 mm** (**0.1161 in**) - **3.00 mm** (**0.1181 in**) - **3.05 mm** (**0.1201 in**) - **3.10 mm** (**0.1220 in**) - **3.15 mm** (**0.1240 in**) - **3.2 mm** (**0.1260 in**) - **3.25 mm** (**0.1280 in**) - **3.3 mm** (**0.1299 in**) - **3.35 mm** (**0.1319 in**) - **3.4 mm** (**0.1339 in**) - **3.4 mm** (**0.1339 in**) - **3.4 mm** (**0.1339 in**) - **3.4 mm** (**0.1339 in**) - **3.4 mm** (**0.1339 in**) - **3.4 mm** (**0.1339 in**) - **3.4 mm** (**0.1339 in**) - **3.4 mm** (**0.1339 in**) - **3.4 mm** (**0.1339 in**) - **3.4 mm** (**0.1339 in**) - **3.4 mm** (**0.1339 in**) - **3.4 mm** (**0.1339 in**) - **3.4 mm** (**0.1339 in**) - **3.4 mm** (**0.1339 in**) - **3.45 mm** (**0.1358 in**) - **3.5 mm** (**0.1378 in**) - **3.55 mm** (**0.1398 in**) - **3.6 mm** (**0.1417 in**) - **3.65 mm** (**0.1437 in**) - **3.7 mm** (**0.1457 in**)
• Thickness of crown wheel position adjustment shim	**2.5 mm** (**0.0984 in**) - **2.6 mm** (**0.1024 in**) - **2.7 mm** (**0.1063 in**) - **2.8 mm** (**0.1102 in**) - **2.9 mm** (**0.1142 in**) - **3.00 mm** (**0.1181 in**) - **3.1 mm** (**0.1220 in**) - **3.2 mm** (**0.1260 in**) - **3.3 mm** (**0.1299 in**) - **3.4 mm** (**0.1339 in**) - **3.5 mm** (**0.1378 in**) - **3.6 mm** (**0.1417 in**) - **3.7 mm** (**0.1457 in**)
• Clearance between sides of planet and side pinion teeth	**0.15 mm** (**0.006 in**)
• Thickness of planet pinion thrust washers	**1.470 mm** (**0.058 in**) - **1.530 mm** (**0.060 in**)
• Thickness of side gear thrust washers	**1.50 mm** (**0.059 in**) to **1.60 mm** (**0.063 in**)
• Diameter of cross pin for planet pinions	**21.939 mm** (**0.8637 in**) - **21.960 mm** (**0.8646 in**)
• Side diameter cross pin bore diameter	**22.040 mm** (**0.8677 in**) to **22.061 mm** (**0.8685 in**)
• Clearance between cross pin and bores	**0.80 mm** (**0.0315 in**) - **0.122 mm** (**0.0048 in**)
• Diameter of outer axle shafts and corresponding bushings	**37.961 mm** (**1.4945 in**) - **38.000 mm** (**1.4961 in**)
• Inside diameter of installed bushings	**38.080 mm** (**1.4992 in**) – **38.119 mm** (**1.5007 in**)
• Clearance between axle shafts and bushings	**0.080 mm** (**0.0031 in**) - **0.158 mm** (**0.0062 in**)
• Type of differential lock	LSD
Axle Shafts and Steering Knuckles	
• Diameter of outer axle shafts and corresponding bushings	**29.914 mm** (**0.0031 in**) - **29.935 mm** (**1.1785 in**)
• Inside diameter of installed front bushings	**30.050 mm** (**1.1831 in**) - **30.105 mm** (**1.1852 in**)
• Clearance between pin and bushings	**0.115 mm** (**0.0045 in**) - **0.191 mm** (**0.0075 in**)
• Interference fit between bushings and respective bores	**0.064 mm** (**0.0025 in**) - **0.129 mm** (**0.0051 in**)
• Thickness of steering knuckle bearing adjuster plates	**0.10 mm** (**0.0039 in**) - **0.15 mm** (**0.0059 in**) - **0.20 mm** (**0.0079 in**) - **0.25 mm** (**0.0098 in**) - **0.30 mm** (**0.0118 in**)
Planetary final drives	
• Reduction ratio	**15 mm** (**0.5906 in**):(**19 mm** (**0.7480 in**)+ **54 mm** (**2.1260 in**)) = 1:4.87
• Driven gear thrust washer thickness	**0.77 mm** (**0.0303 in**) - **0.83 mm** (**0.0327 in**)
Axle pivot	

• Pivoting angle/oscillation (on either side)	**11 °**
• Center pivot and support end float	**0.3 mm** (**0.0118 in**) - **1.1 mm** (**0.0433 in**)
• Maximum wear clearance	**2 mm** (**0.0787 in**)
• Center pivot diameter	**52.652 mm** (**2.0729 in**) - **52.671 mm** (**2.0737 in**)
• Center pivot front bushing fitted	**52.720 mm** (**2.0756 in**) - **52.790 mm** (**2.0783 in**)
• Center pivot working clearance in bushing	**0.049 mm** (**0.0019 in**) - **0.138 mm** (**2.0783 in**)
• Rear bevel pinion carrier spigot	**99.040 mm** (**3.8992 in**) - **99.72 mm** (**3.9260 in**)
• Rear bushing fitted	**99.146 mm** (**3.9034 in**) - **99.221 mm** (**3.9063 in**)
• Spigot fitted clearance in bushing	**0.074 mm** (**0.0029 in**) - **0.181 mm** (**0.0071 in**)
Axle front and rear thrust washer thickness	**4.95 mm** (**0.1949 in**) - **5.00 mm** (**0.1969 in**)
Turning radius	
• Turning radius with brakes	**4200.0 mm** (**165.4 in**)
• Turning radius without brakes	**4850.0 mm** (**190.9 in**)
Turnaround diameter	
• Turnaround diameter with brakes	**8720.0 mm** (**343.3 in**)
• Turnaround diameter without brakes	**10020.0 mm** (**394.5 in**)
Maximum axle steering angle	**62 °**
Camber angle	**1 °**
Caster angle	**2 °**
Tire sizes	
• Front 4WD	9.5 x 24 R4 12.5x18
• Rear 4WD	14.9 x 28 R4 18.4x24

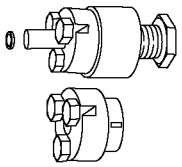
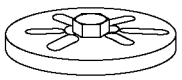
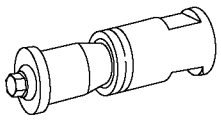
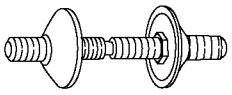
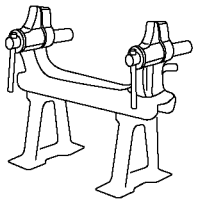
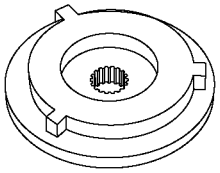
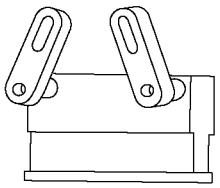
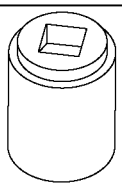
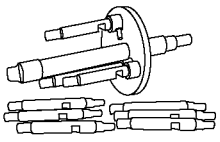
Four-Wheel Drive (4WD) axle - Torque



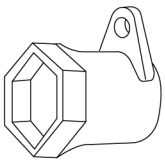
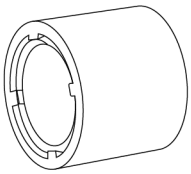
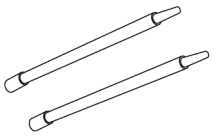
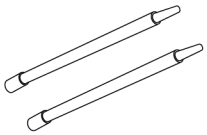
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Description	Thread size	Torque
Lock ring, bevel pinion **(C1)**	M35 x 1.5	**294 N·m** (**217 lb ft**)
Bolt, differential case to axle casing **(C2)**	M12 x 1.25	**113 N·m** (**83 lb ft**)
Bolt, ring gear to differential case **(C3)**	M12 x 1.25	**127 N·m** (**94 lb ft**)
Bolt, king pin **(C4)**	M10 x 1.25	**64 N·m** (**47 lb ft**)
Steering knuckle bolt **(C5)**	M10 x 1.25	**64 N·m** (**47 lb ft**)
Wheel hub bearings lock nut **(C6)**	M45 x 1.5	**392 N·m** (**289 lb ft**)
Bolt, planetary final drive housing **(C7)**	M10 x 1.25	**64 N·m** (**47 lb ft**)
Bolt, wheel disc to hub **(C8)**	M16 x 1.5	**193 N·m** (**142 lb ft**)
Nut for rim to disc securing bolt	M16 x 1.5	**193 N·m** (**142 lb ft**)
Front axle front and rear pivot support bolt **(C9)**	M18 x 1.5	**280 N·m** (**207 lb ft**)
Differential cage support cap bolt **(C10)**	M12 x 1.25	**113 N·m** (**83 lb ft**)
Front axle support to engine retaining bolt **(C11)**	M18 x 1.5	**314 N·m** (**232 lb ft**)

Four-Wheel Drive (4WD) axle - Special tools

Tool number	Cross over tool number	Image	Description	Tractor series also used on
380000234*	292161		Front axle pivot bearing outer ring removal tool	TL and TM
380000235*	292220		Measurement of rolling torque of front axle bearing	TL and TM
380000248*	NH01326 or 293391		Pinion Bearing preload adjustment tool	40 / TS / 60/ TM / TN / TL
380000249*	NH01296 or 293400		Universal gauge for positioning of front bevel drive pinion	40 / TS / 60 / TM
380000251*	2934460 or 99322215		Front axle overhaul stand	TM
380000252*	NH01320 or 293544		Wrench for differential case bearing threaded adjustment nut	40 / TS / 60 / TM / TN / TL
380000255*	293743		Overhaul support for front axle differential case	TL and TM
380000257*	NH01321 or 293782		Front bevel drive pinion lock key wrench	40 / TS / 60 / TM / TN / TL
380000265*	NH01286 or 293857		Front axle king pin removal tool	40 / TS / 60 / TM / TN / TL

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Tool number	Cross over tool number	Image	Description	Tractor series also used on
380000268*	NH01289 or 293878		Pinion shaft spanner	40 / TS / 60/TM/ TL
380000295*	NH01319 or 295030		Wrench for front axle wheel hub bearing retaining nut	40 /TS/60 / TM / TN / TL
380002813*	NA		Dowel studs (set of 2) (M10 x 1.25 x 100), fine thread for front axle cover removal	TN
380002814*	NA		Dowel studs (set of 2) (M10 x 1.25 x 100), fine thread for front axle differential cover removal	TN

Four-Wheel Drive (4WD) axle - Overview

The tractor has a centrally pivoting front axle with the pivot and the drive shaft coaxial with the longitudinal axis of the tractor. The drive shaft has no universal joints.

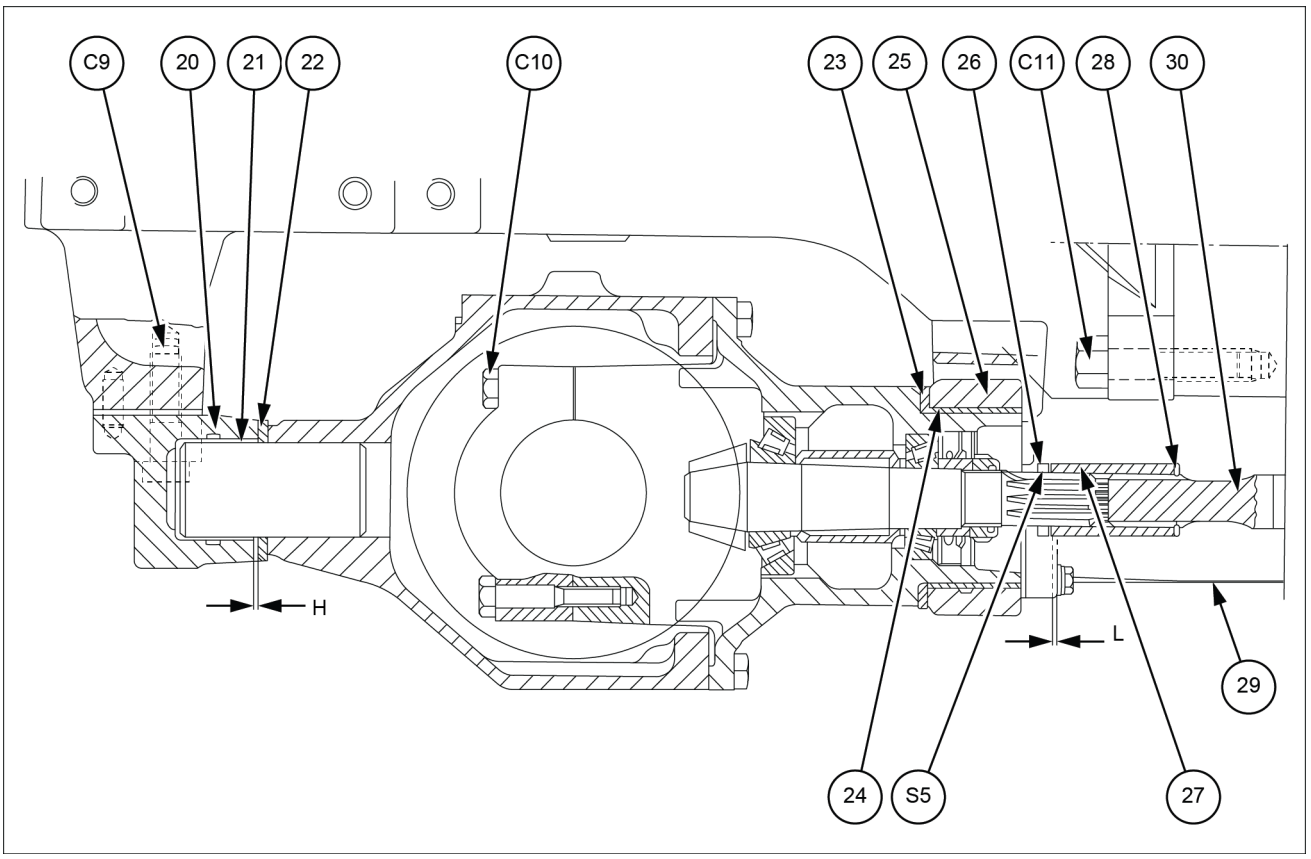
The differential has two planet pinions; drive is transmitted to lateral epicyclic final drive units (installed on the wheel hubs) through universal joints which require no maintenance.

Front to rear axle ratio

NOTE: *On tractors equipped with FWD (Front Wheel Drive) the front to rear axle ratio is critical and must be maintained for safe and efficient use of the tractor. This ratio applies to all available tire options. Following is a list of problems that may occur if the front to rear axle ratio is not maintained:*

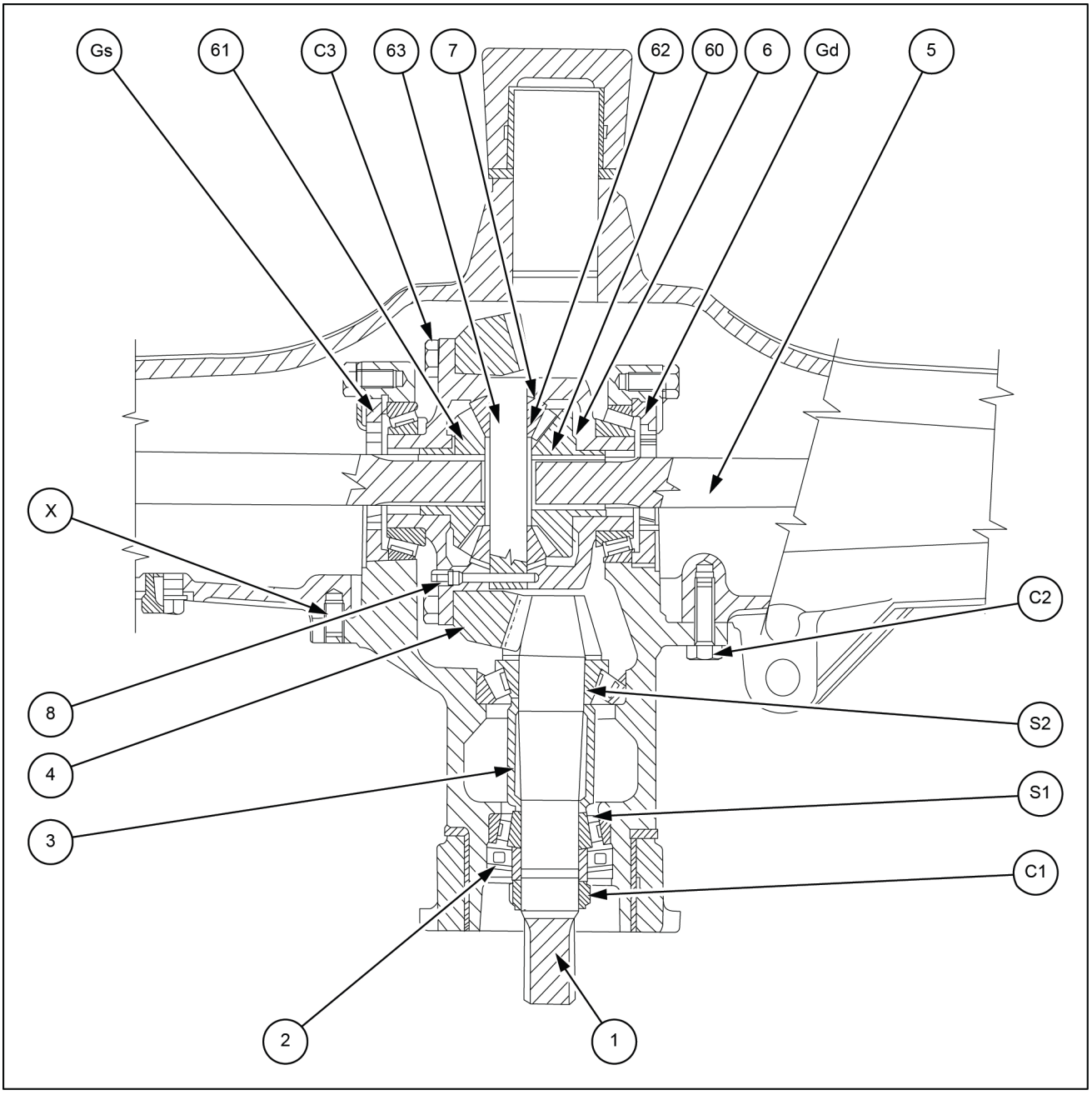
- Engine will lug down or stall when operating on hard surfaces.
- The front wheel drive lever will not remain in the engaged position, or is difficult to disengage.
- Failure of the drive line gears.
- Failure of the front axle, ring and pinion gears.
- Premature tire wear.

Four-Wheel Drive (4WD) axle - Sectional view



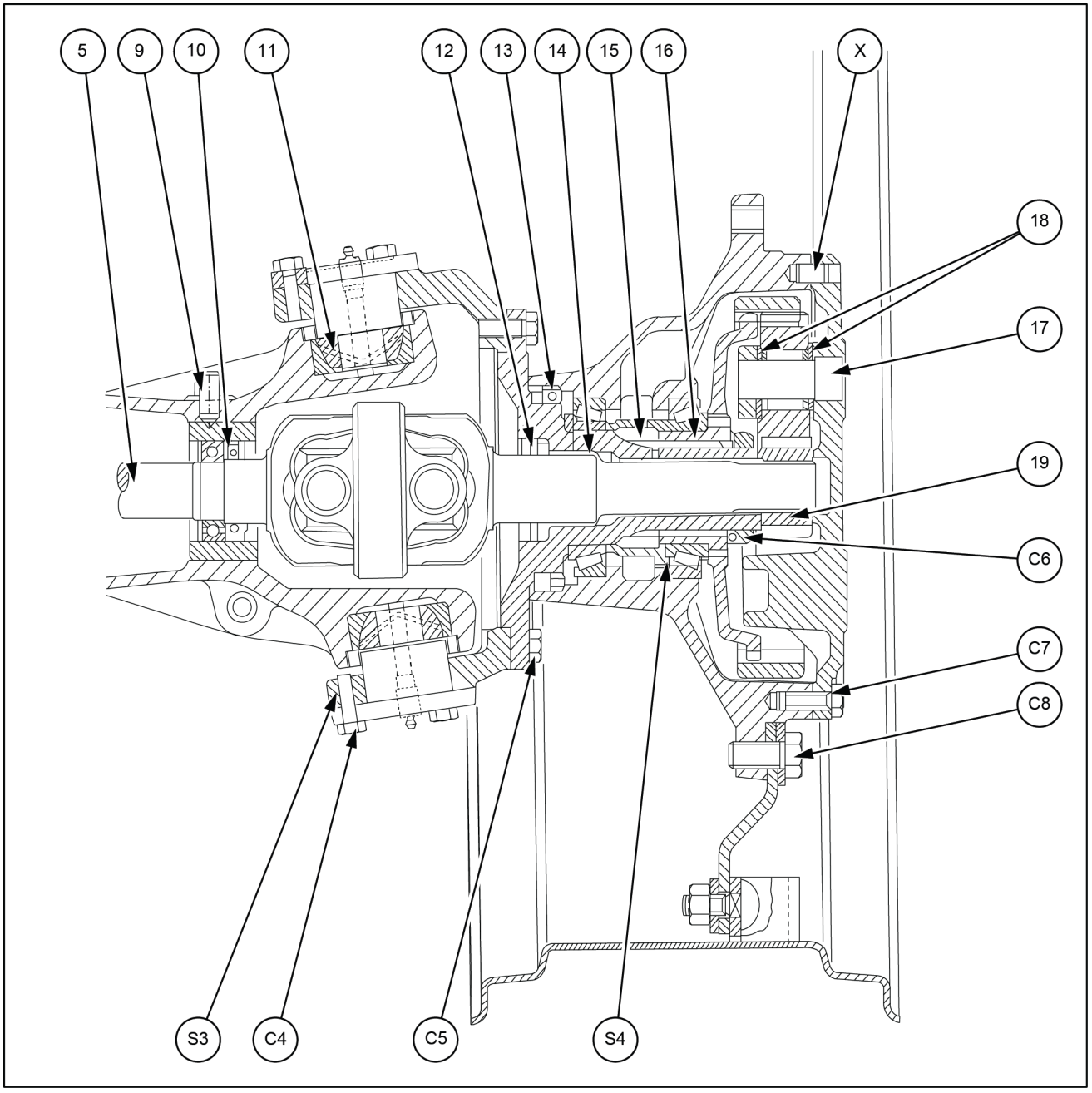
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H **1.000 mm** (**0.039 in**)
L **1.000 - 1.500 mm** (**0.039 - 0.059 in**)
S5 Sleeve position shim
C9 Axle pivot support bolt
C10 Differential bearing cap bolt
C11 Bolt securing front axle support to engine
20. Front axle pivot support
21. Front bushing
22. Front thrust washer
23 Rear thrust washer
24. Rear bushing
25. Rear axle pivot support
26. Retaining rings
27. Front splined sleeve
28. Retaining rings
29. Drive shaft guard
30. Drive shaft



GNIL14TR04351GB 2

X	**0.500 - 1.000 mm** (**0.020 - 0.039 in**)	4.	Ring gear
S1	Bevel pinion bearing shim	5.	Axle shaft with universal joint
S2	Bevel pinion position shim	6.	Side gear washers
C1	Bevel pinion bearing lock ring	7.	Differential pinion washers
C2	Differential carrier bolt	8.	Differential pinion journal bolt
C3	Ring gear bolt	60.	Side gear
Gd, Gs	Right-hand side and left-hand side differential bearing lock ring	61.	Side gear
1.	Bevel pinion	62.	Differential pinion
2.	Seal	63.	Differential pinion journal
3.	Bevel pinion bearing spacer		



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S3	King pin bearing shim	11.	King pin bearing
S4	Wheel hub bearing shims	12.	Seal
C4	King pin bearing bolt	13.	Seal
C5	Steering knuckle bolt	14.	Axle shaft bushing
C6	Wheel hub bearing lock ring	15	Spacer
C7	Final drive housing bolt	16.	Thrust washers
C8	Wheel hub bolt	17.	Planet wheel journals
9.	Bearing carrier bolt	18.	Planet wheel shims
10.	Seal	19.	Sun gear

Four-Wheel Drive (4WD) axle - Remove

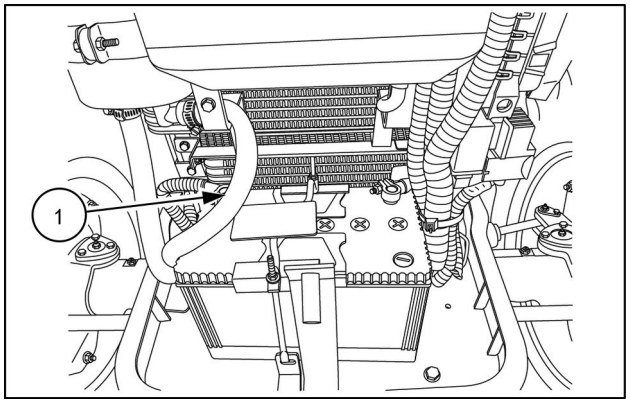
⚠ WARNING

Heavy objects!
Lift and handle all heavy components using lifting equipment with adequate capacity. Always support units or parts with suitable slings or hooks. Make sure the work area is clear of all bystanders. Failure to comply could result in death or serious injury.

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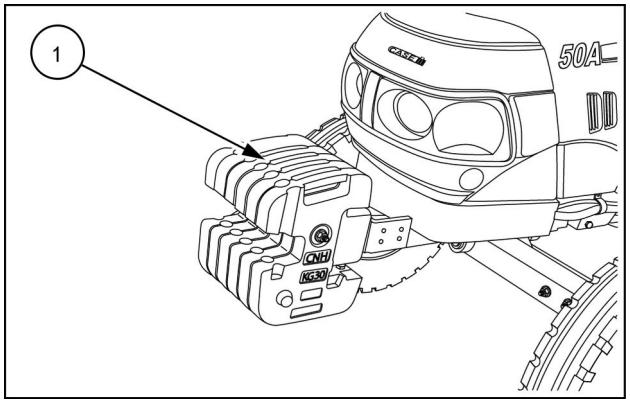
NOTE: *The front axle assembly can be removed from the tractor either with or without previously removing the drive shaft. The description below refers to removal of the front axle with the drive shaft installed on the tractor.*

1. Disconnect the negative battery terminal **(1)**.



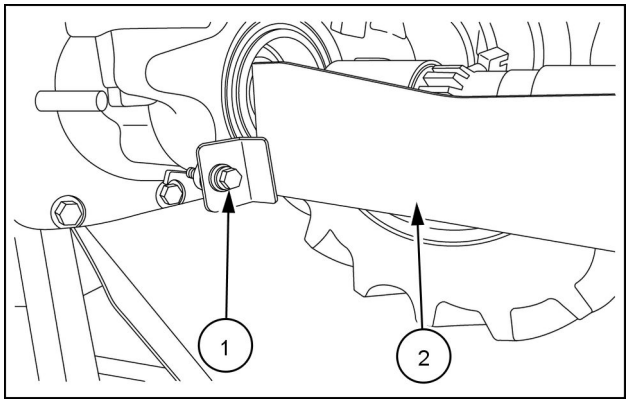
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2. Remove the front weights **(1)**.



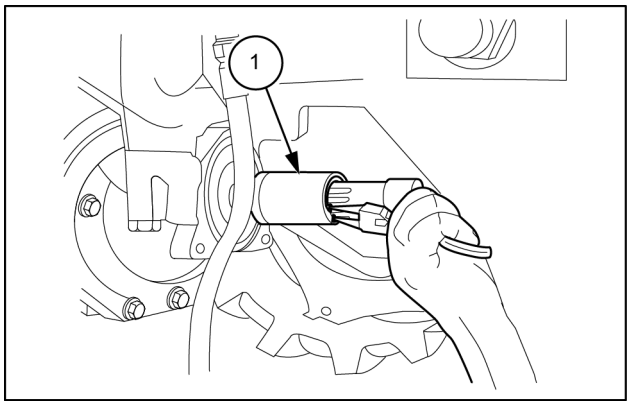
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3. Remove the bolts **(1)**, and remove the drive shaft guards **(2)**.



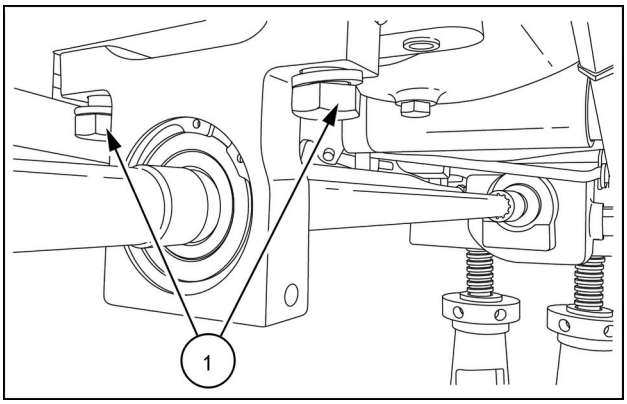
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4. Remove the snap ring **(1)** from the front and rear of the drive shaft.



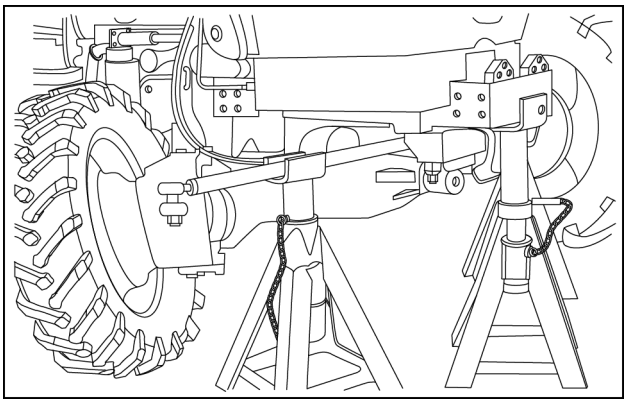
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5. Remove the bolts **(1)** from the drive shaft support bearing.
6. Remove the drive shaft from the front axle input shaft and drop box output shaft by sliding the two couplers onto the drive shaft.



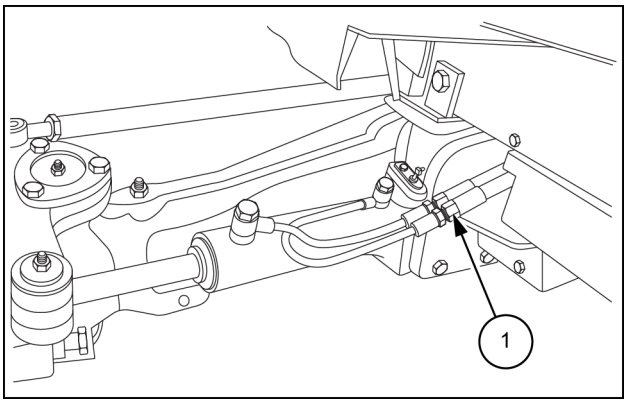
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7. Attach nylon slings around the front axle and attach them to a hoist.
8. Lift the tractor with the hoist and place a stand under the lower portion of the front axle.



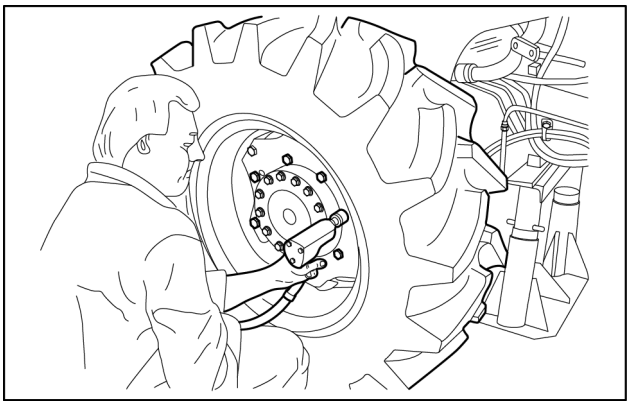
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9. Remove the power steering hoses **(1)** from the power steering tubes.



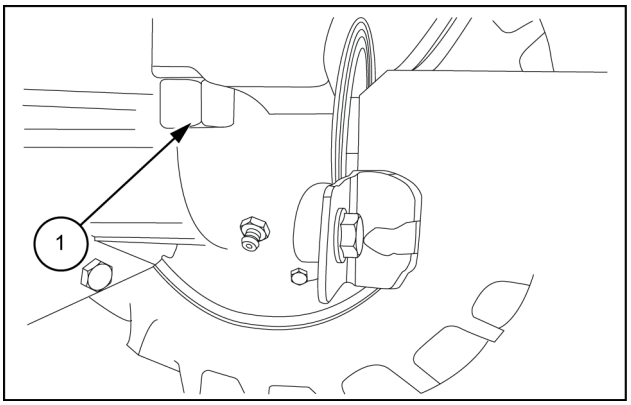
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10. Remove the front wheels.



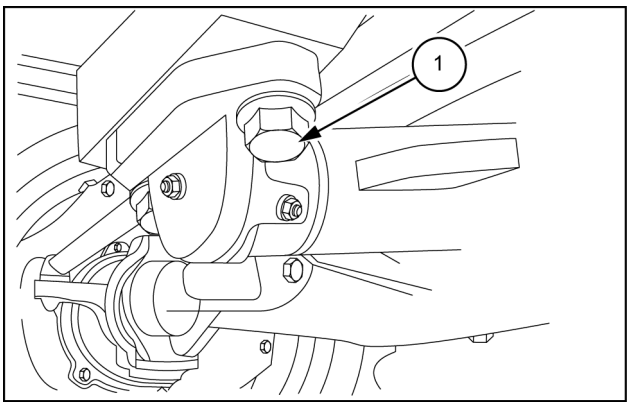
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11. Remove the front axle rear support retaining bolts **(1)**.



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12. Remove the front axle front support retaining bolts **(1)**.
13. Using a hoist and nylon cables (one for each side) detach the front axle from the tractor.



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Four-Wheel Drive (4WD) axle - Remove

⚠ WARNING

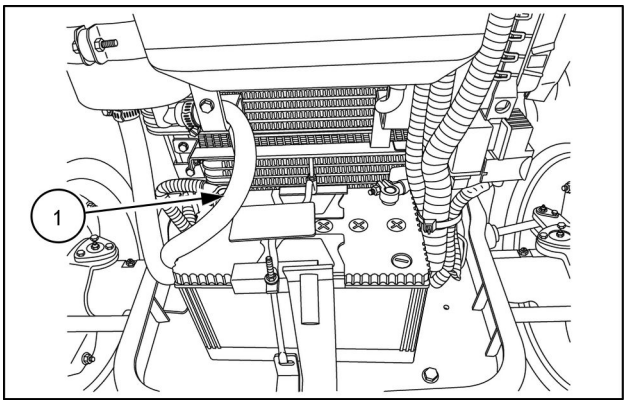
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Lift and handle all heavy components using lifting equipment with adequate capacity. Always support units or parts with suitable slings or hooks. Make sure the work area is clear of all bystanders. Failure to comply could result in death or serious injury.

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Proceed as follows:

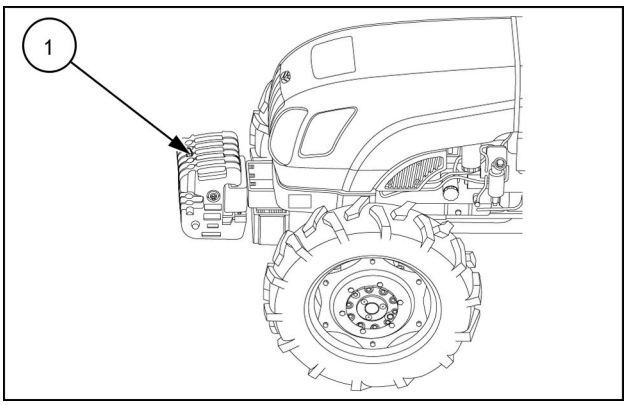
NOTE: *The front axle assembly can be removed from the tractor either with or without previously removing the drive shaft. The description below refers to removal of the front axle with the drive shaft installed on the tractor.*

1. Disconnect the negative battery lead **(1)**.



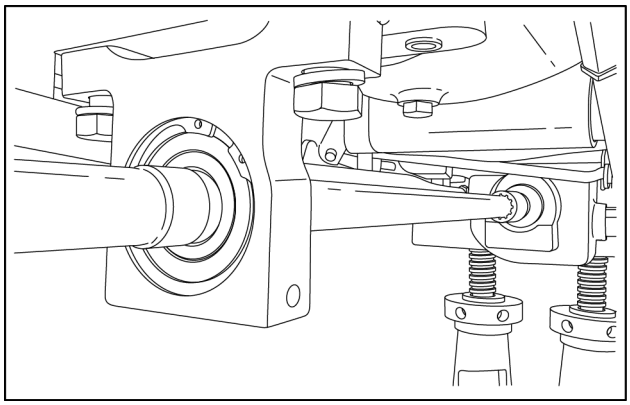
GNIL14TR00784AA 1

2. remove the front weights **(1)**.



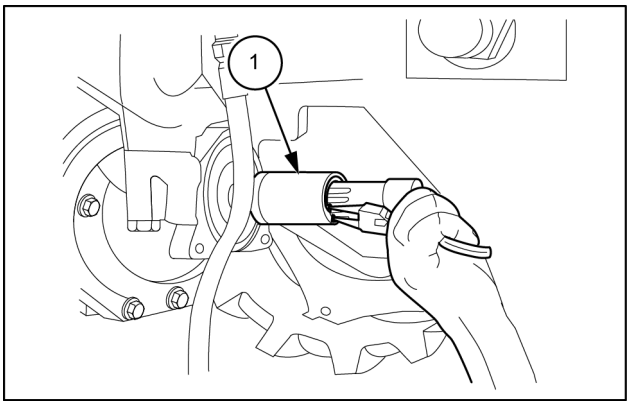
GNIL14TR00829AA 2

3. Remove the bolts **(1)**, and remove the drive shaft guards **(2)**.



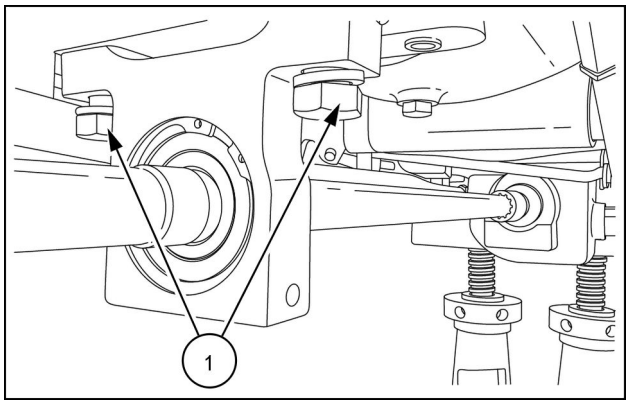
GNIL14TR00859AA 3

4. Remove the snap ring **(1)** from the front and rear of the drive shaft.



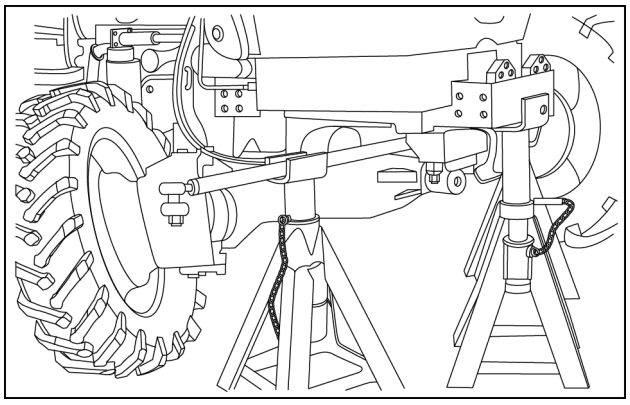
GNIL14TR04359AB 4

5. Remove the bolts **(1)** from the drive shaft support bearing.
6. Remove the drive shaft from the front axle input shaft and drop box output shaft by sliding the two couplers onto the drive shaft.



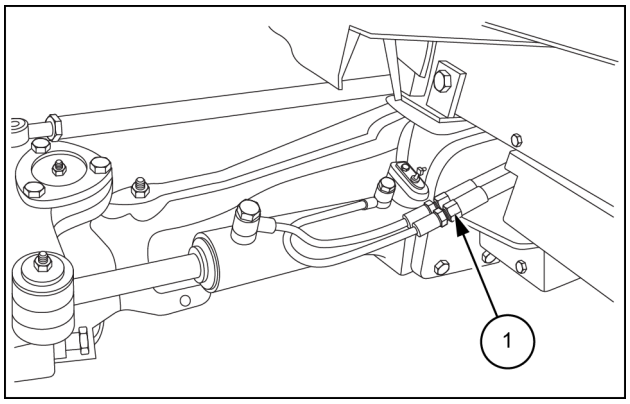
GNIL14TR00859AA 5

7. Attach nylon slings around the front axle and attach them to a hoist.
8. Lift the tractor with the hoist and place a stand under the lower portion of the front axle.



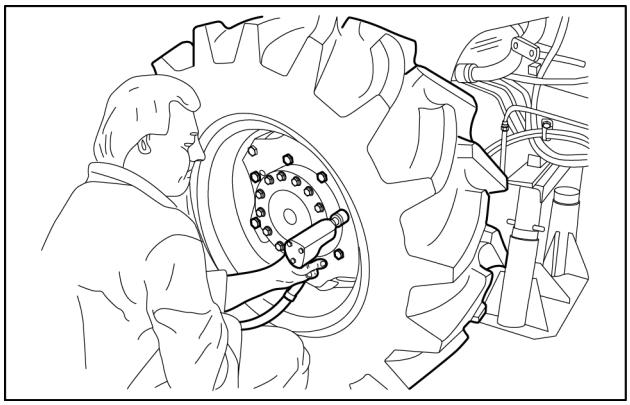
GNIL14TR04361AA 6

9. Remove the power steering hoses **(1)** from the power steering tubes.



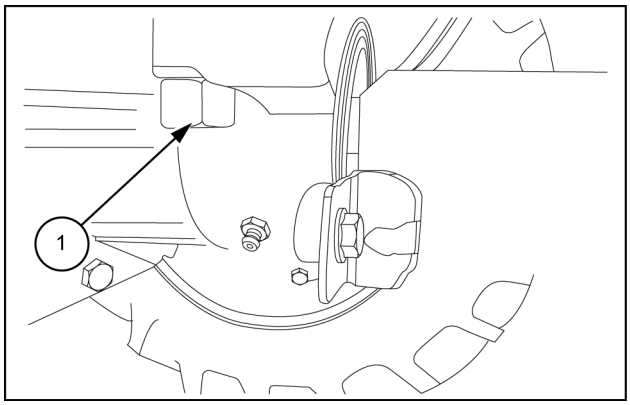
GNIL14TR04362AB 7

10. Remove the front wheels.



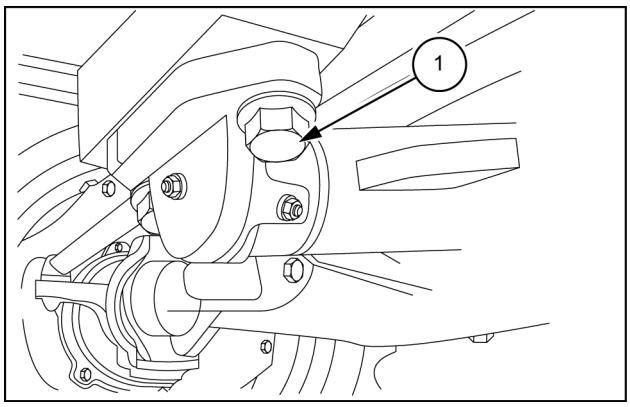
GNIL14TR04363AA 8

11. Remove the front axle rear support retaining bolts **(1)**.



GNIL14TR04364AB 9

12. 1. Remove the front axle front support retaining bolts **(1)**.
    2. Using a hoist and nylon cables (one for each side) detach the front axle from the tractor.



GNIL14TR04365AB 10

Four-Wheel Drive (4WD) axle - Install

⚠ CAUTION

Pinch hazard!
Always use suitable tools to align mating parts.
DO NOT use your hand or fingers.
Failure to comply could result in minor or moderate injury.

C0044A

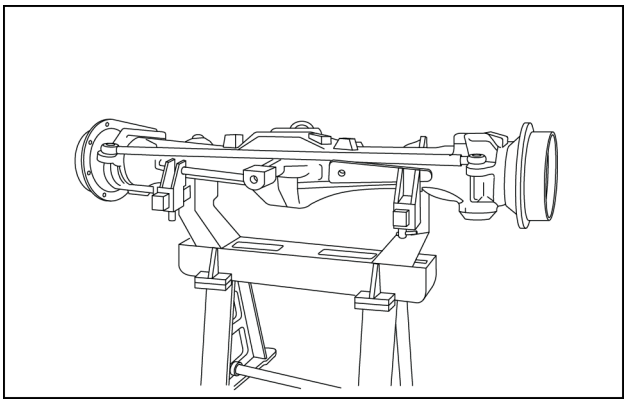
1. Refit the front axle following the instructions below.
   - Install the axle and bolt the front and rear supports in position.
   - Reconnect the power steering hoses.
   - Install the front wheels.
   - Raise the front of the tractor using the hoist.
   - Remove the fixed stand.
   - Detach the nylon cables.
   - Reconnect the drive shaft and install the drive shaft guard.
   - Attach a nylon cable to the front weights, lift, install to the tractor and secure with the locking screws.
   - Reconnect the negative battery lead.
   - See the **Four-Wheel Drive (4WD) axle - Torque (25.100)**.

Four-Wheel Drive (4WD) axle - Disassemble

⚠ WARNING

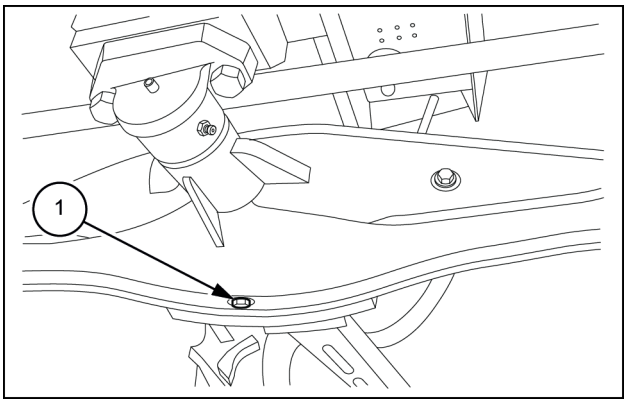
Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

W0208A



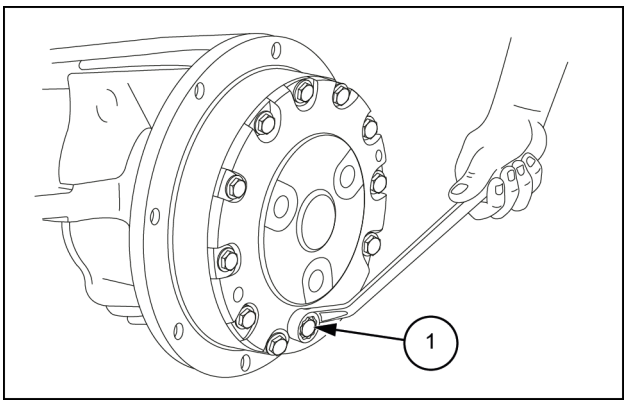
GNIL14TR04367AA 1

1. Remove plug **(1)** and drain the oil from the axle casing.



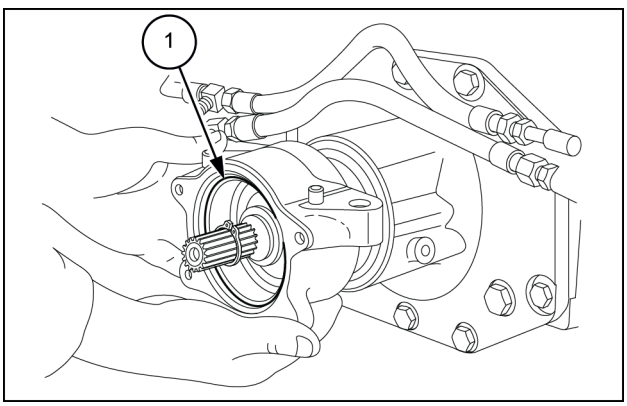
GNIL14TR04368AB 2

2. To drain the final drive oil, remove plug **(1)** on the left-hand final drive casing.
3. Repeat the same operation on the right-hand side casing.



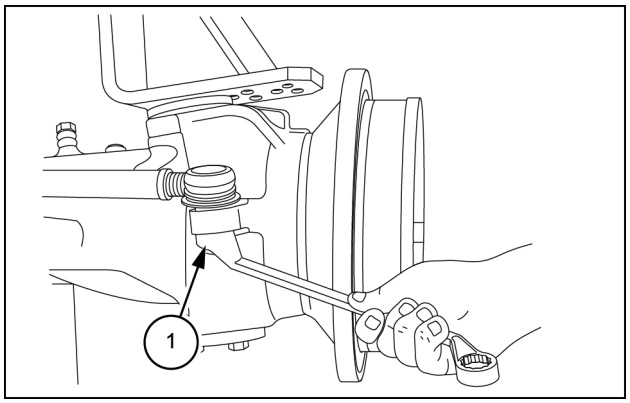
GNIL14TR04369AB 3

4. Remove the rear support **(1)** off the front axle.
5. Remove the front support and the thrust washer.



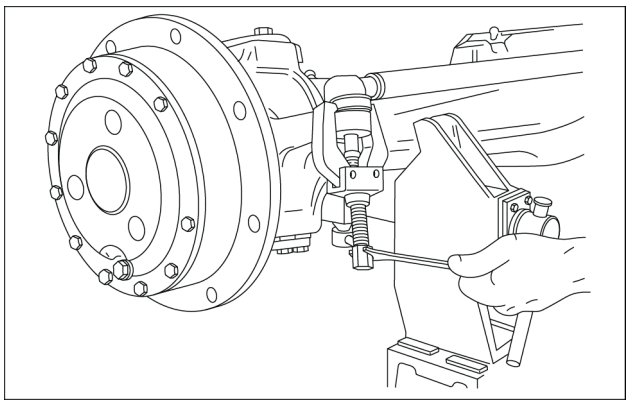
GNIL14TR04370AB 4

6. Remove the tie rod retaining nuts **(1)**.



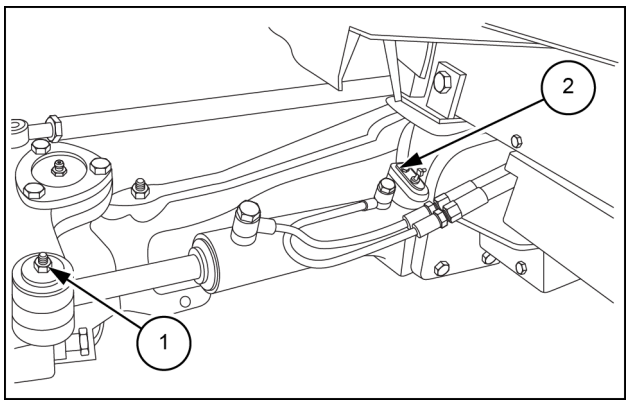
GNIL14TR04371AB 5

7. Using a removal tool, remove the tie rod ends from their bores in the stub axle housing.



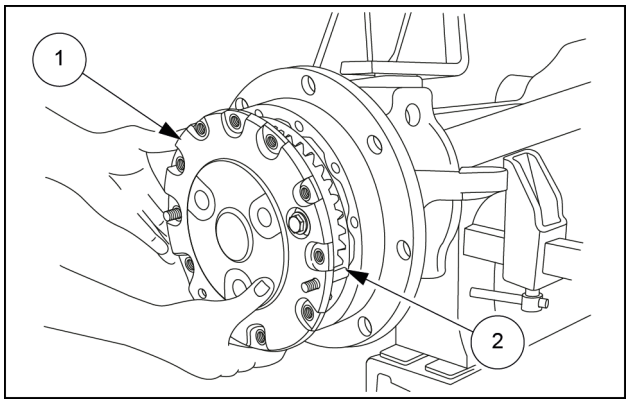
GNIL14TR04372AA 6

8. Remove the snap ring from the bottom of the cylinder rod pivot pin **(1)**
9. Remove the pin retaining bolt **(2)** from the pin. Remove the pins and detach the cylinder.



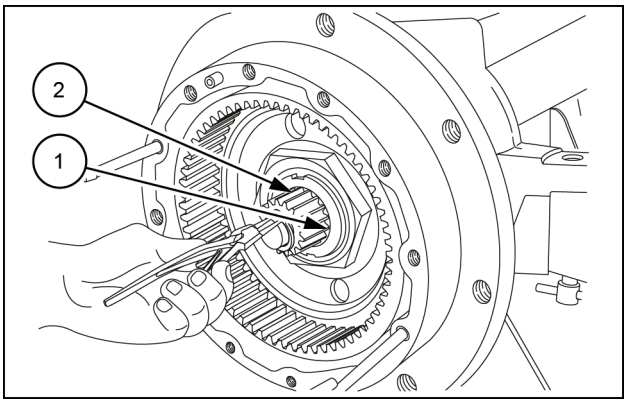
GNIL14TR04373AB 7

10. Unscrew the retaining bolts off the left-hand final drive casing cover **(1)**.
11. Screw in the two M10 x 100 dowels tool no 380002813 **(2)**.
12. Using a slide hammer puller screwed into the oil drain plug.
13. Detach the cover **(1)** from the casing.



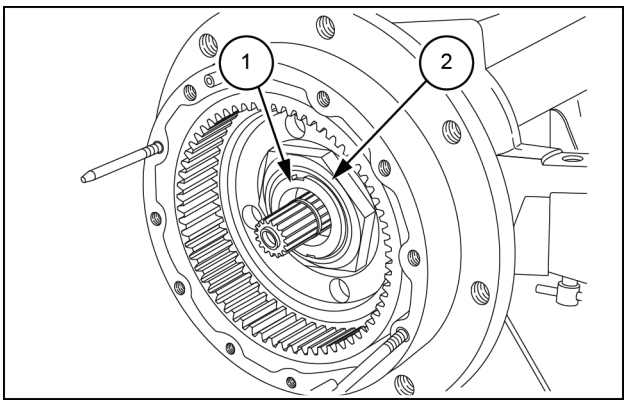
GNIL14TR04374AB 8

14. Remove the snap ring **(1)**.
15. Remove the driving gear **(2)**.



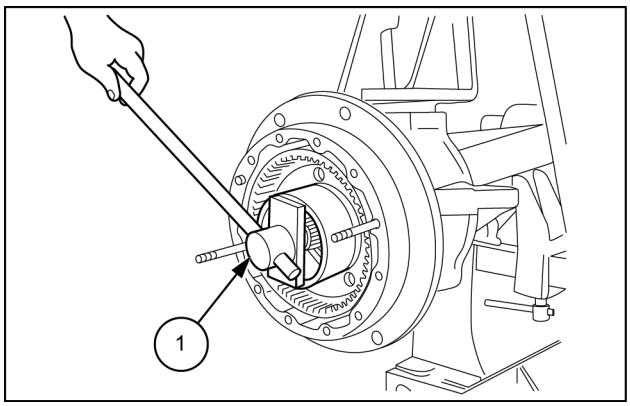
GNIL14TR04375AB 9

16. Remove the staking **(1)** on the wheel hub bearing lock ring **(2)**.



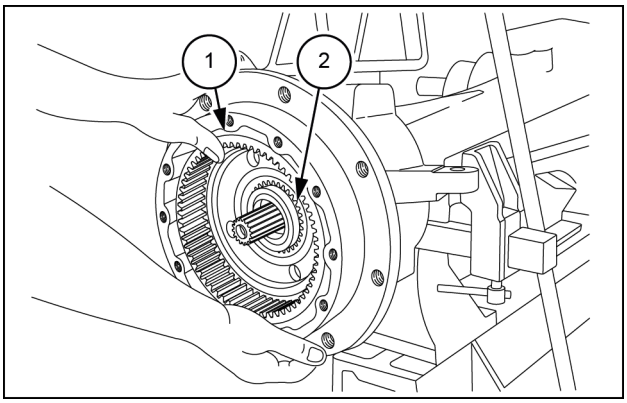
GNIL14TR04377AB 10

17. Remove the wheel hub bearing lock ring using tool no **380000295 (1)**.



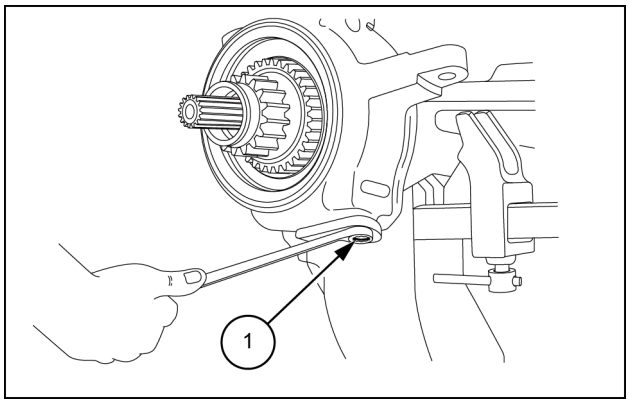
GNIL14TR04378AB 11

18. Remove the wheel hub **(1)** with the ring gear **(2)**.



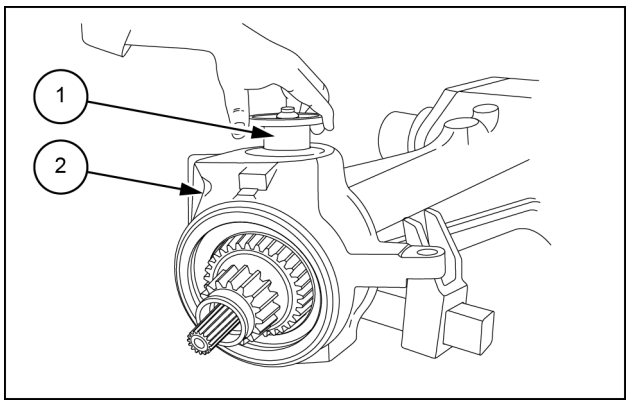
GNIL14TR04379AB 12

19. Remove the retaining bolts **(1)** of the lower pivot pin of the stub axle housing.
20. Remove the lower pivot pin and the relative adjustment shims.



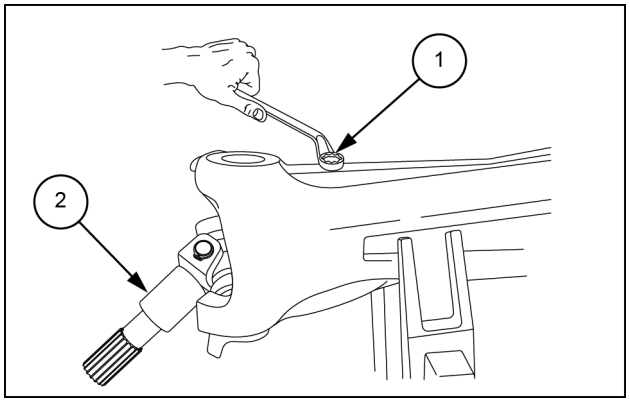
GNIL14TR04380AB 13

21. Remove the retaining bolts of the upper pivot pin.
22. Remove the upper pivot pin **(1)**.
23. Remove the stub axle housing **(2)**.



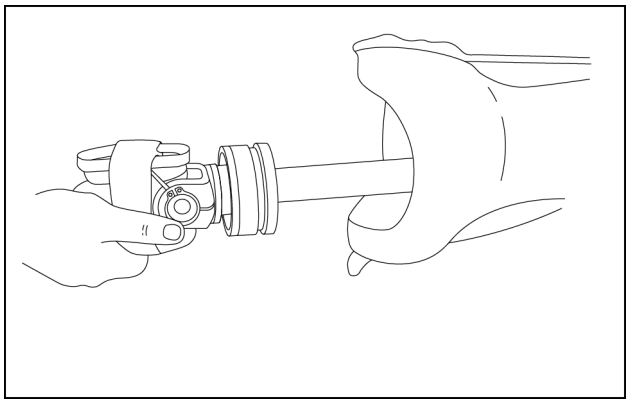
GNIL14TR04381AB 14

24. Remove the retaining bolt **(1)** of the axle shaft **(2)**.



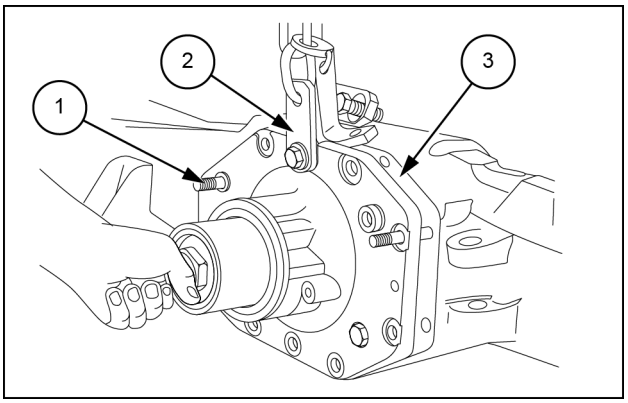
GNIL14TR04382AB 15

25. Using a pry bar, pull the axle shaft out of the casing.
26. To disassemble the right-hand final drive unit, repeat the above steps **[Invalid Reference]** to **[Invalid Reference]**.



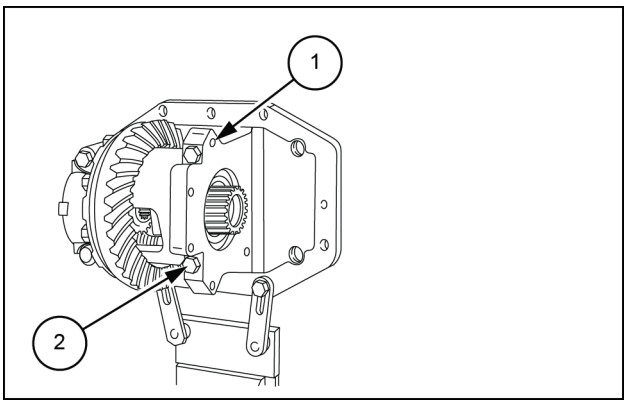
GNIL14TR04383AA 16

27. Remove the bolts fixing the bevel drive-differential support to the axle casing.
28. Screw in the M12 x 100 dowels, tool no 380002814 **(1)**.
29. Remove the remaining bolts and separate the bevel drive-differential support from the axle casing.
30. Attach a chain **(2)** to the support and take up the weight with the hoist.
31. Remove the bevel drive-differential support **(3)** from the axle casing.



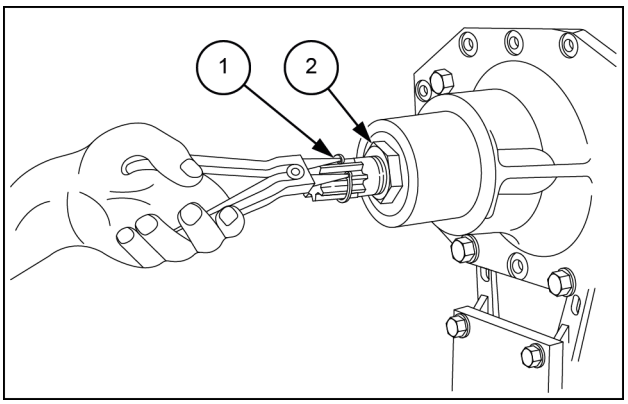
GNIL14TR04384AB 17

32. Remove the two bolts **(1)** from the two ring gear differential support caps **(2)**.
33. Remove the crown wheel-differential assembly from the housing.



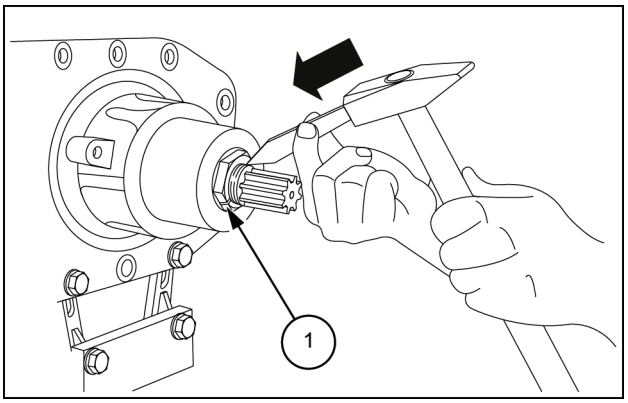
GNIL14TR04385AB 18

34. Remove the snap ring **(1)** from the splined shaft **(2)**.



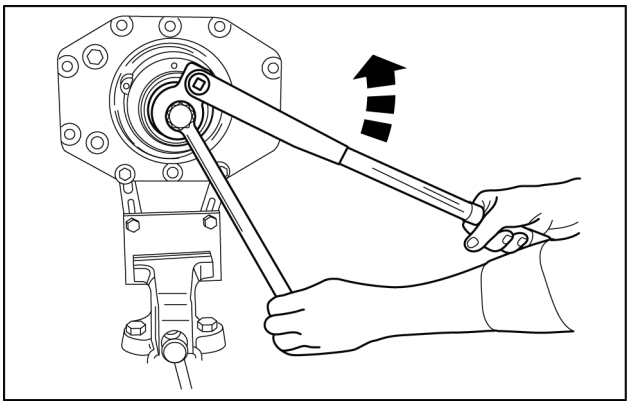
GNIL14TR04386AB 19

35. Straighten the locking tab on the splined shaft lock nut **(1)**.



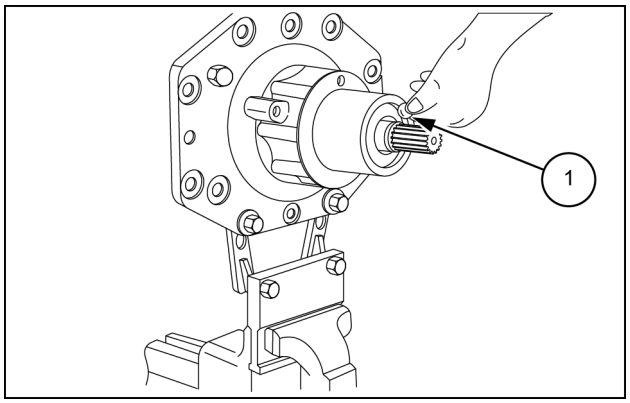
GNIL14TR04387AB 20

36. Remove the nut using wrench, tool no **380000268 (1)**, while holding the bevel drive pinion shaft against rotation with wrench, tool no **380000257**.



GNIL14TR04388AB 21

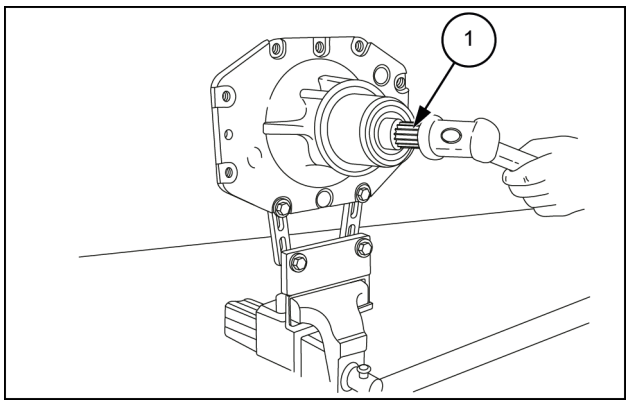
37. Remove the splined shaft detent ball **(1)**.



GNIL14TR04389AB 22

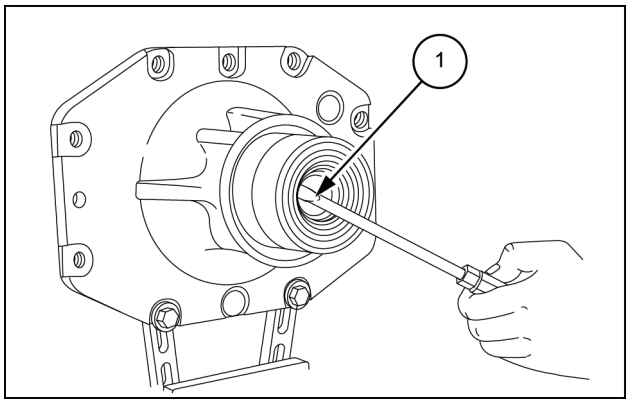
38. Remove the bevel drive pinion shaft **(1)** from the rear of the casing and remove the spacer, the adjustment shims and the bearing.

NOTE: *Observe the quantity and the size of the shims removed from the pinion shaft.*



GNIL14TR04390AB 23

39. Using a screwdriver, remove the dust seal, seal ring **(1)** and rear bearing.



GNIL14TR04391AB 24

Four-Wheel Drive (4WD) axle - Inspect

1. Wash all parts in a suitable solvent and allow to air dry.
2. Inspect the gears for excess wear or damage. Replace as necessary.
3. Check all the bearings for wear or roughness. Rotate the bearings by hand and replace if necessary.
4. Inspect the axle shafts and pinion shaft for wear or damage. Replace if necessary.
5. Inspect the front axle housing for any damage. Replace if necessary.

Four-Wheel Drive (4WD) axle - Assemble

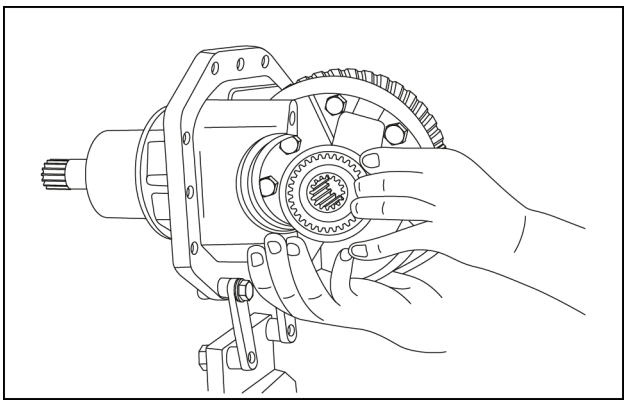
1. Reassemble the front axle. Adhere to the following instructions:
   - See **Four-Wheel Drive (4WD) axle - Torque (25.100)**.
   - Install the rear bearing, the seal, the dust seal, the adjustment shims, the spacer and the bevel drive pinion shaft complete with front bearing.
   - Position the detent ball, screw in the bevel drive pinion lock nut and secure in position by staking. Finally, replace the snap ring.
   - Install the ring gear differential assembly, the support caps and tighten the relative bolts.
   - Install the bevel drive-differential housing on the front axle casing.
   - Install the axle shaft and relative bolt.
   - Install the stub axle, the adjustment shims, the upper and lower pivot pins.
   - Install the wheel hub, the ring gear of the final drive unit and the lock ring and tighten to the prescribed torque value, while simultaneously turning the wheel hub to ensure that the bearings are correctly seated.
   - Install the securing and stop snap rings, the driving gear and the cover of the final drive unit.
   - Install the pins, washers, spacers and steering cylinders.
   - Install the track rod, the front and rear supports and the oil drain plugs.

Four-Wheel Drive (4WD) axle - Adjust

Adjustment of the ring gear bearings and checking the backlash between the pinion and ring gear

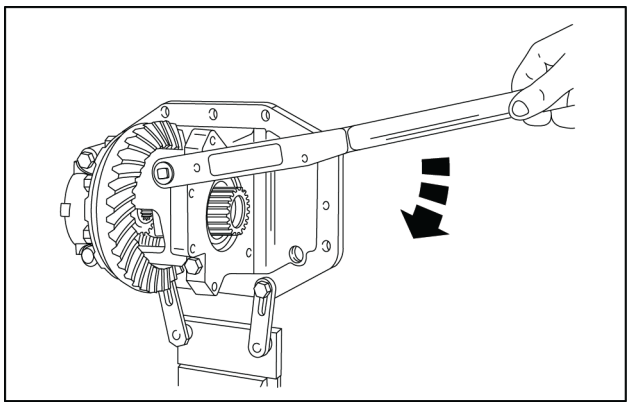
Proceed as follows.

1. Install the differential assembly complete with ring gear and inner ring gear bearing rings in the bevel drive/ differential housing.



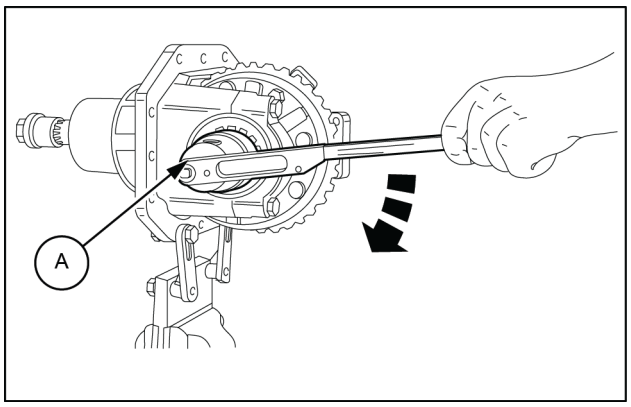
GNIL14TR04392AA 1

2. Insert the outer bearing rings in the differential housing. Install the differential support caps. Torque the bolts to **59 N·m** (**44 lb ft**), then loosen and re-tighten to a torque of **20 N·m** (**15 lb ft**).



GNIL14TR04399AB 2

3. With the bearings lubricated, rotate the ring gear and at the same time tighten the threaded adjustment ring using wrench, tool no **380000252 (A)** to a torque of **39 - 59 N·m** (**29 - 44 lb ft**) to take up the axial play between the components.

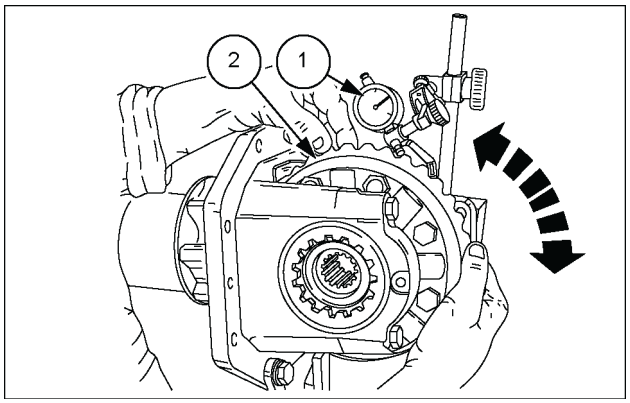


GNIL14TR04393AB 3

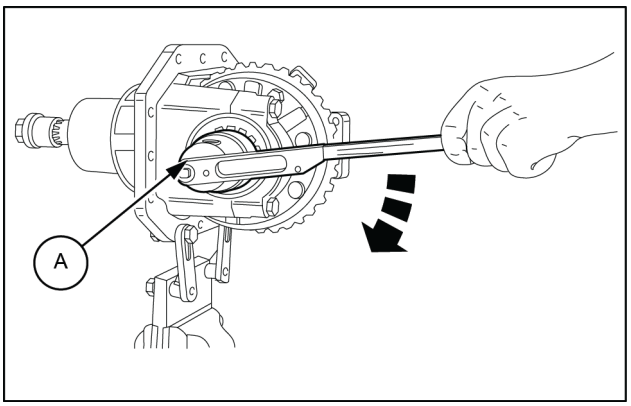
4. Measure the backlash between pinion and ring gear, using a dial gauge **(1)** perpendicular to the outer edge of a tooth on the ring gear **(2)**.

5. Repeat the measurement in two other positions 120° apart and compare the average of the three values (Gm) with the prescribed normal backlash specification of **0.18 mm** (**0.007 in**) - **0.23 mm** (**0.009 in**) average value **0.20 mm** (**0.008 in**).
   If the measured backlash exceeds the prescribed value, adjust the threaded adjustment rings by screwing one of the rings in and the other out by the same amount to correct the axial preload and thus obtain the prescribed backlash.

6. With a dial gauge positioned perpendicular to the outside edge of one of the ring gear teeth, check that the backlash between the pinion and ring gear is within the tolerance limits of **0.18 mm** (**0.007 in**) - **0.23 mm** (**0.009 in**).



NDIL14TR00427AB 4



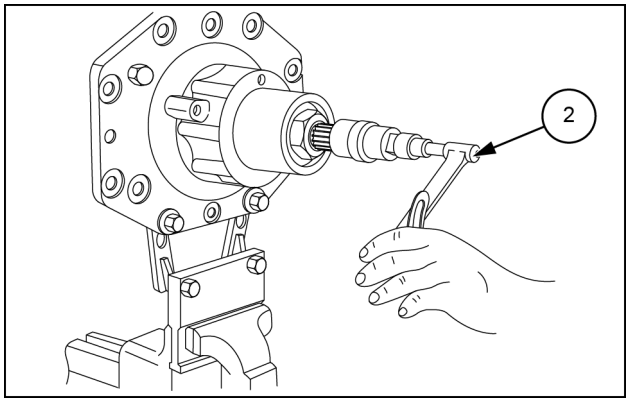
GNIL14TR04393AB 5

7. Using a wrench, tool number **380000252 (A)** turn the threaded adjustment ring and check, using torque wrench **(2)** that the combined rolling resistance torque of the ring gear and pinion bearings is:
   A2 = A1 + **1.0 N·m** (**0.74 lb ft**) to **1.5 N·m** (**1.11 lb ft**).
   where:
   A2 = combined ring gear/pinion rolling resistance torque
   A1 = rolling resistance torque of pinion only as measured previously
   1.0 N·m (**0.74 lb ft**) to **1.5 N·m** (**1.11 lb ft**) = rolling resistance torque of crown wheel only measured at the end of the pinion using wrench, tool number **380000257** and a torque wrench.

8. Tighten the cap bolts see figure in **Four-Wheel Drive (4WD) axle - Torque (25.100)** to a torque of **113 N·m** (**83 lb ft**).

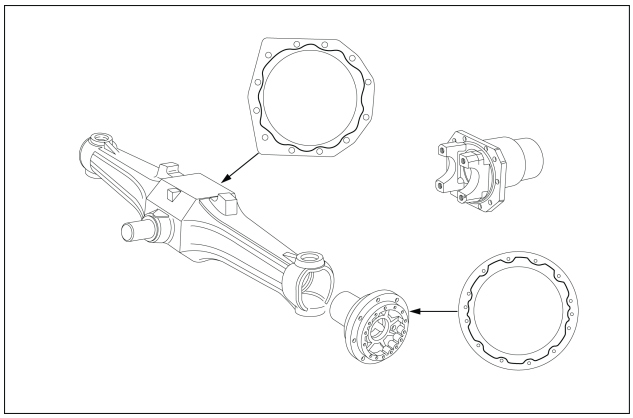
9. Install the safety plate, screwing the threaded adjustment ring in or out up to the nearest notch.

10. Attach the bevel drive/differential to the axle casing after having carefully cleaned and degreased the mating surfaces and applied a bead of gasket eliminator **LOCTITE® 518**, approx. **2 mm** (**0.08 in**) wide along the line shown in the figure.



GNIL14TR04397AB 6

11. Gasket eliminator **LOCTITE® 518** application diagram for assembly of bevel drive unit and epicyclic final drive unit.



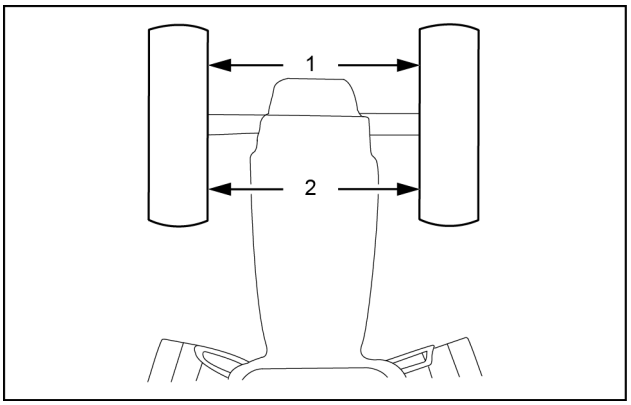
GNIL14TR04394AB 7

Four-Wheel Drive (4WD) axle - Toe in adjust

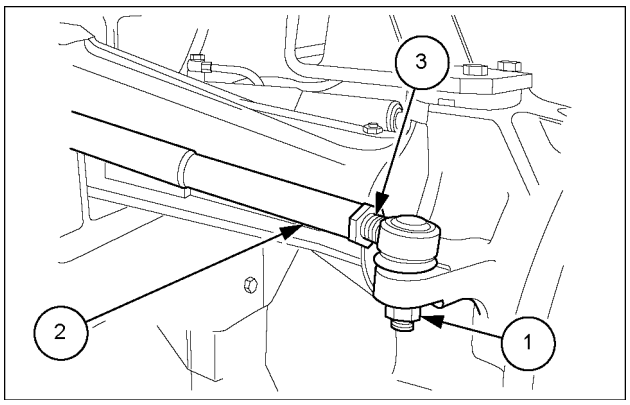
When travelling forward in a straight path, the wheels of four-wheel drive tractors must be parallel to the longitudinal axis of the tractor, alternatively a slight toe-in of the front wheels is permissible up to a maximum of **6 mm** (**0.24 in**) as measured at the edges of the wheel rims.
To check the exact value of the toe-in setting of four-wheel drive tractors, proceed as follows.

1. Inflate the front tires to the prescribed pressure.
2. Position the steering at the straight ahead position (along the longitudinal axis of the tractor).
3. Check that the wheels are parallel to the longitudinal axis of the tractor.
4. Make a chalk mark on the front inside edges of both wheel rims, at the height of the wheel hub centers. Measure the distance **(1)** between the chalk marks.
5. Move the tractor forward to turn both front wheels through **180 °**The chalk marks will now be measure between the rear inside edges of the wheel rims at the height of the wheel hub centers. Now measure the distance **(2)** checking that this new measurement is equal to or greater than the distance **(1)** by a maximum or **6 mm** (**0.24 in**).
   The rotation of the wheels through **180 °** is necessary to eliminate the effect of wear, misalignment or distortion of the wheel rims on the measurements obtained.
6. If it is necessary to correct the wheel alignment, remove nut **(1)** and pull the tie rod end out of its housing. Loosen the locknut **(2)** and screw the tie rod end **(3)** in or out to increase or decrease the distance **(2)**.
   Reposition the tie rod end in its housing and re-check alignment.
   After having adjusted the toe in to within the prescribed limits, tighten locknut **(2)** to a torque of **180 N·m** (**133 lb ft**) and nut **(1)** to **100 N·m** (**74 lb ft**).

NOTE: *The self-locking nut **(1)**, must be replaced each time it is removed or partially unscrewed.*



GNIL14TR04416AB 1



GNIL14TR04400AB 2

https://truckmanualshub.com/

Index

Front axle system - 25

Powered front axle - 100

Four-Wheel Drive (4WD) axle - Adjust 27
Four-Wheel Drive (4WD) axle - Assemble 26
Four-Wheel Drive (4WD) axle - Disassemble 19
Four-Wheel Drive (4WD) axle - General specification 3
Four-Wheel Drive (4WD) axle - Inspect 25
Four-Wheel Drive (4WD) axle - Install 18
Four-Wheel Drive (4WD) axle - Overview 8
Four-Wheel Drive (4WD) axle - Remove 12
Four-Wheel Drive (4WD) axle - Remove 15
Four-Wheel Drive (4WD) axle - Sectional view 9
Four-Wheel Drive (4WD) axle - Special tools 6
Four-Wheel Drive (4WD) axle - Toe in adjust 30
Four-Wheel Drive (4WD) axle - Torque 5

https://truckmanualshub.com/

https://truckmanualshub.com/

Front axle system - 25

Front bevel gear set and differential - 102

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Front axle system - 25

Front bevel gear set and differential - 102

SERVICE

Differential
Adjust - 4WD Front axle 3

Differential - Adjust - 4WD Front axle

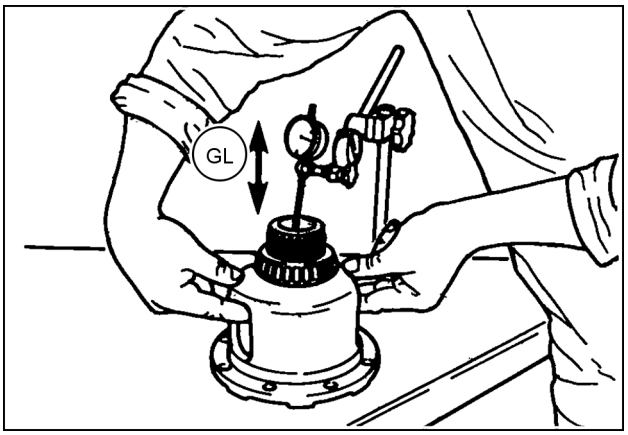
Prior operation:
Four-Wheel Drive (4WD) axle - Disassemble (25.100).

End play adjustment

In case of differential assembly overhaul it is necessary to adjust the backlash between the teeth of the planet pinions and side gears.

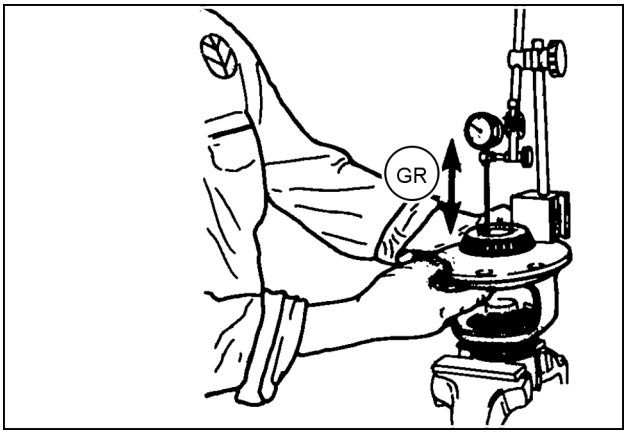
Proceed as follows:

1. Thoroughly clean the components of the differential to remove any traces of oil which would otherwise prevent accurate backlash measurement.
2. Install the two side gears without thrust washers.
3. Install the planet pinions complete with thrust washers and pins and screw the pin retaining bolts in by a few turns to hold the pins in place.
4. Position a dial gauge on the differential housing.
5. Move the left-hand side gear to bring it into full contact with the planet pinion and then push it up against the differential housing, reading the end play (GL) on the dial gauge.



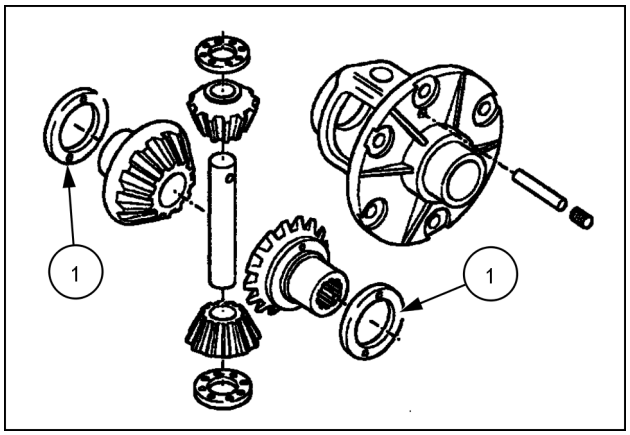
20097712 1

6. Repeat the above operations to measure the end play on the right-hand side gear (GR).
   The end play should be **0.25 mm** (**0.010 in**). Therefore the shims to be inserted in the differential housing are given by:
   Shim (left) = GL - **0.25 mm** (**0.010 in**) for the left-hand side gear.
   Shim (right) = GR - **0.25 mm** (**0.010 in**) for the right-hand side gear.



20097713 2

7. Install shims, **(1)**, as near as possible to the calculated value. Use a dial gauge and following the procedure described above, check that the end float of the left and right-hand side gears is approximately **0.25 mm** (**0.010 in**).



20097714 3

Differential side gear shim sizes

Available shim sizes mm (inches)	
1.0 mm (**0.039 in**)	**1.6 mm** (**0.063 in**)
1.1 mm (**0.043 in**)	**1.7 mm** (**0.067 in**)
1.2 mm (**0.047 in**)	**1.8 mm** (**0.071 in**)
1.3 mm (**0.051 in**)	**1.9 mm** (**0.075 in**)
1.4 mm (**0.055 in**)	**2.0 mm** (**0.039 in**)
1.5 mm (**0.059 in**)	

https://truckmanualshub.com/

Index

Front axle system - 25

Front bevel gear set and differential - 102

Differential - Adjust - 4WD Front axle 3

https://truckmanualshub.com/

https://truckmanualshub.com/

Front axle system - 25

Final drive hub, steering knuckles, and shafts - 108

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Front axle system - 25

Final drive hub, steering knuckles, and shafts - 108

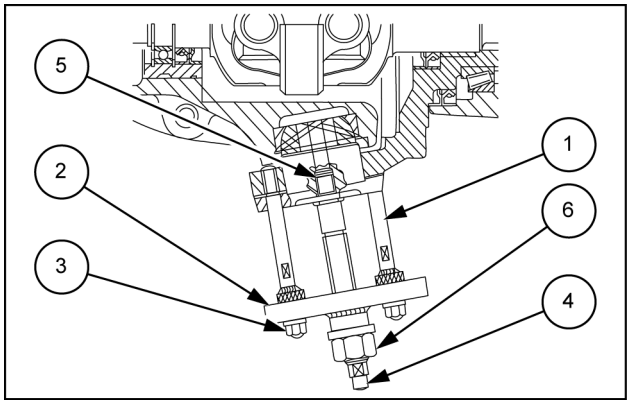
SERVICE

Steering knuckle and king pin
Remove 3
Adjust (Stub Axle) 4
Wheel hub
Adjust (4WD) – Front Axle 6

Steering knuckle and king pin - Remove

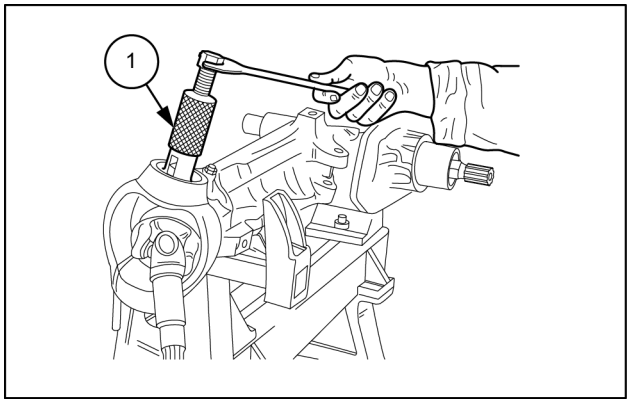
In the event that the steering knuckle pins prove difficult to remove, proceed as follows.

1. Remove the grease nipples and the steering knuckle pin retaining bolts.
2. Install the bolts **(1)** using tool number **380000265**.
3. Install the plate **(2)** from the tool and retain it to the three bolts with nuts **(3)**.
4. Install the central tie bolt **(4)** screwing it fully into the grease nipple bore on the pin **(5)**.
5. Screw in the nut **(6)** to drive the pin out of its bore.



GNIL14TR04428AB 1

6. Using extractor tool, tool number **380000234 (1)**, remove the steering knuckle bearings.



GNIL14TR04429AB 2

NOTE: *Re-install the steering knuckle bearings using a suitable drift.*

Steering knuckle and king pin - Adjust (Stub Axle)

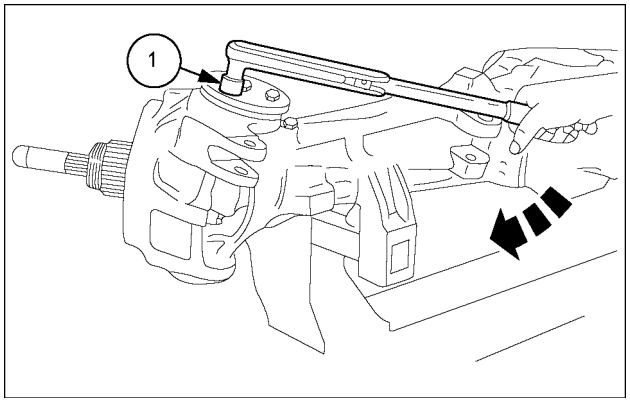
⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

W0208A

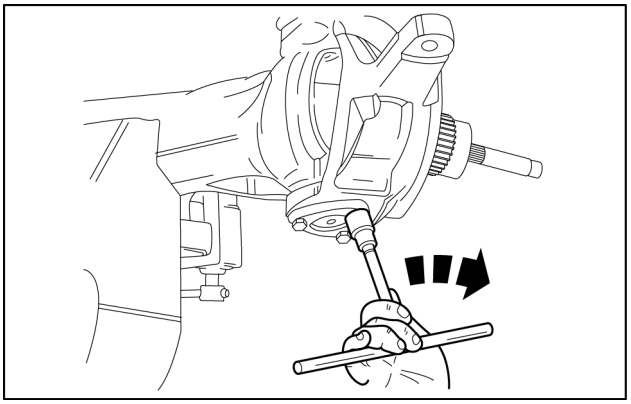
Install the front axle on a stand and proceed as follows.

1. Smear grease on the outer races of the bearings and fit the upper cover, without the adjustment plate, but with tool number **380000235 (1)**. Tighten the retaining bolts to a torque value of **64 N·m** (**47 lb ft**).



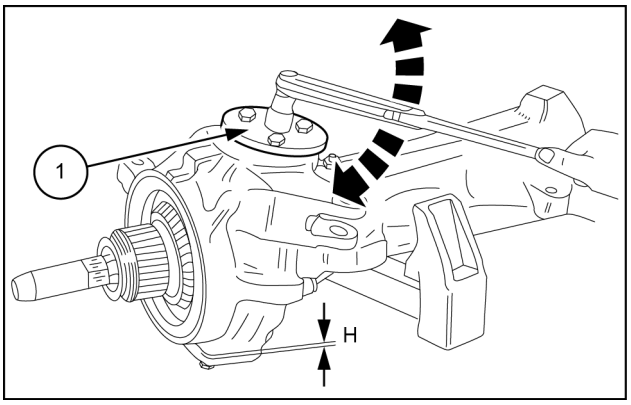
GNIL14TR04412AB 1

2. Install the lower cover without adjustment plate, lubricate the three retaining bolts with oil.
3. Gradually tighten the lower cover bolts in sequence, while simultaneously rotating the casing to allow the excess grease to escape.



GNIL14TR04413AA 2

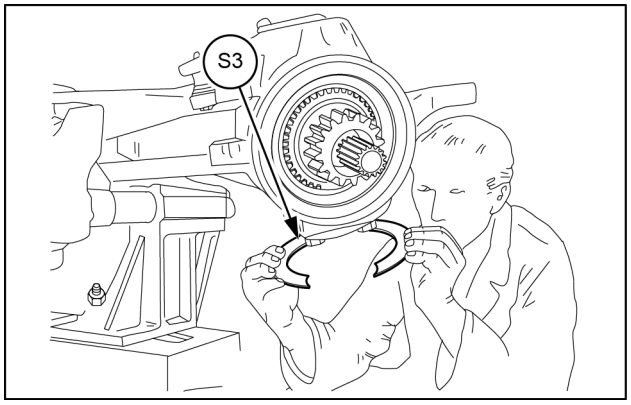
4. Using a torque wrench, tool number **380000235 (1)**, check that the torque required to rotate the casing is **2.9 N·m** (**25.7 lb in**) without considering the peak starting value. If not, adjust by way of the lower cover bolts.
5. Measure the gap (H) created between the low cover and the casing in correspondence with the three bolts.



GNIL14TR04414AB 3

6. Calculate the average of the three values measured. The total thickness of the adjustment shims to be fitted under the lower cover is to be calculated as follows:
   S3= H
   If necessary, round up the value to the next **0.05 mm** (**0.002 in**).

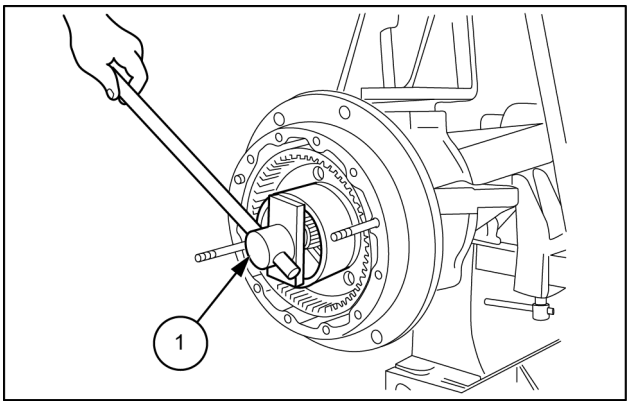
7. Partially unscrew the bolts of the lower cover, insert the shims and tighten the bolts to a torque value of **64 N·m** (**47 lb ft**).
8. After having rotated the casing a few times to allow the components to bed down, check that the torque necessary to rotate the casing is **2.9 N·m** (**25.7 lb in**) - **7.8 N·m** (**69 lb in**), without considering the initial peak torque.
9. If the torque value measured is greater than the prescribed value, increase the thickness of the shims, if the measured value is less than the prescribed value, reduce the thickness of the shims.
10. Install the grease nipples in the upper and lower covers and grease the assembly.



GNIL14TR04415AB 4

Wheel hub - Adjust (4WD) – Front Axle

1. Proceed as follows:
   - Install wheel hub and fixed gear unit onto the steering knuckle.
   - Using a torque wrench and lock ring wrench, tool number 380000295, progressively tighten the lock ring to **147 - 196 N·m** (**108 - 145 lb ft**). While tightening the lock ring, rotate the hub to seat the bearings.
   - Fully loosen the lock ring and retighten to **392 N·m** (**289 lb ft**) while rotating hub.
   - Secure the lock ring by bending over a lock washer tab (if necessary, further tighten the lock ring to align a slot with the tab).
   - Turn the hub by hand to check for excessive play or binding.



GNIL14TR04378AB 1

https://truckmanualshub.com/

Index

Front axle system - 25

Final drive hub, steering knuckles, and shafts - 108

Steering knuckle and king pin - Adjust (Stub Axle) 4
Steering knuckle and king pin - Remove 3
Wheel hub - Adjust (4WD) – Front Axle 6

https://truckmanualshub.com/

https://truckmanualshub.com/

Front axle system - 25

Final drives - 310

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Front axle system - 25

Final drives - 310

SERVICE

Final drive driving pinion
Preload – (4WD) Front Axle 3
Adjust – (4WD) Front Axle 5

Final drive driving pinion - Preload – (4WD) Front Axle

⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

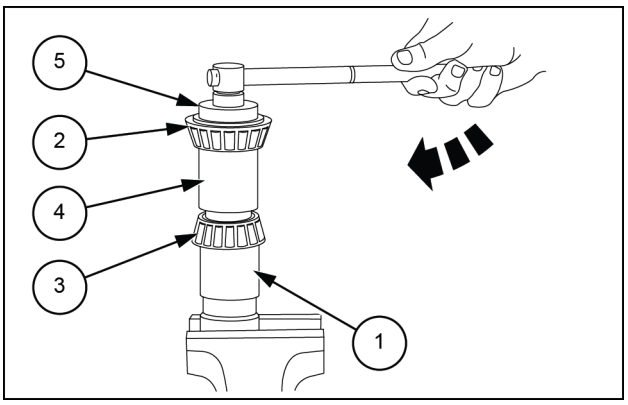
W0208A

Adjustment of the preload of the pinion shaft bearings

Proceed as follows:

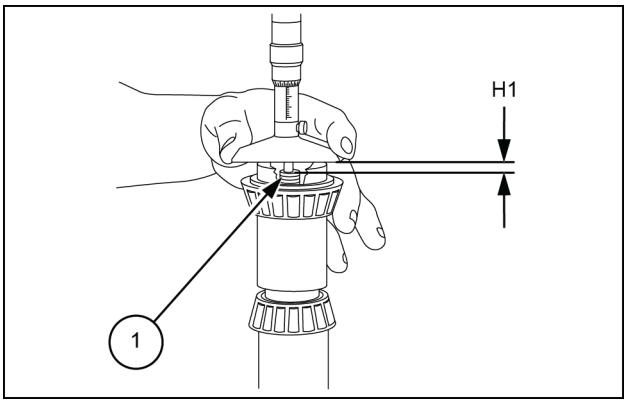
1. Clamp tool number **380000248 (1)** in the vice. Install bearings **(2)**, **(3)** and the bearing spacer **(4)** and tighten the nut of the tool fully home.

NOTE: *Install the **10 mm** (**0.394 in**) thick spacer between tool number **380000248 (1)** and the bearing **(2)**.*



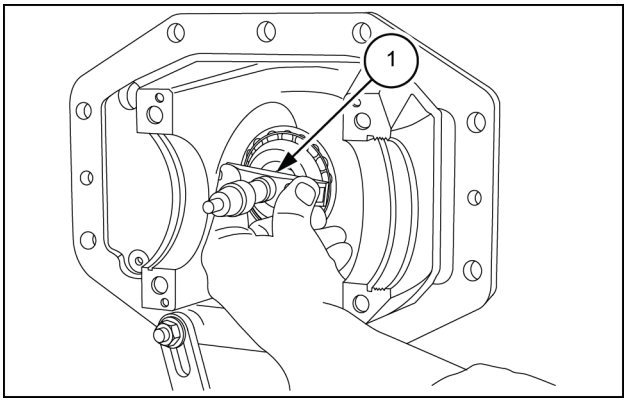
GNIL14TR04419AB 1

2. Using a micrometer, measure distance **(H1)** between the upper surface and the pin of tool number **380000248 (1)**.
3. Disassemble the above parts, lubricate the bearings with oil and then re-assemble the parts, excluding the bearing spacer, in the bevel drive-differential housing, complete with outer bearing races, held in place with tool number 380000255.



GNIL14TR04420AB 2

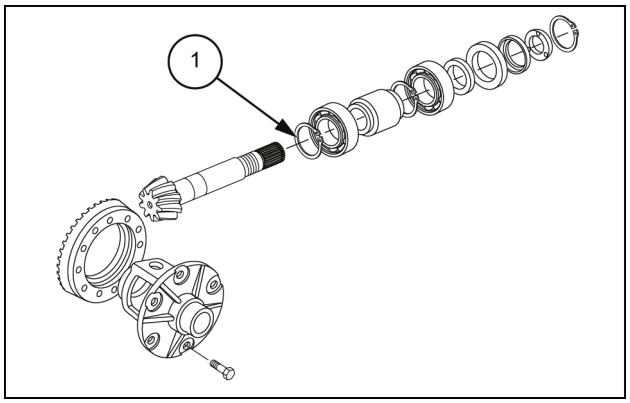
4. Tighten the nut of tool number 380000255 **(1)**, while turning the tool to ensure that the bearings are seated correctly.
5. Using a micrometer, measure the distance **(H2)** between the upper surface and the pin of the tool.
6. The thickness of the adjustment shim required is given by:
   Shim = H2 - H1 + **0.05 mm** (**0.002 in**)



GNIL14TR04421AB 3

If necessary, round the value thus obtained up to the nearest **0.05 mm** (**0.002 in**).
Pinion positioning shim **(1)** is located between pinion gear and front bearing.

NOTE: *On completing the adjustment, do not remove the adjustment tool from the bevel drive-differential housing: leave in place for adjustment of the drive pinion position.*



GNIL14TR04422AB 4

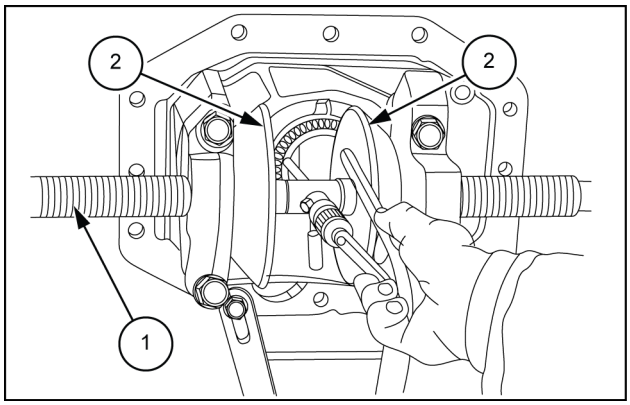
Available shim sizes	
0.5 mm (**0.020 in**)	**2.7 mm** (**0.106 in**)
2.5 mm (**0.098 in**)	**2.8 mm** (**0.110 in**)
2.6 mm (**0.102 in**)	**2.9 mm** (**0.114 in**)

Final drive driving pinion - Adjust – (4WD) Front Axle

Determining the thickness of the drive pinion position adjustment shim

Proceed as follows.

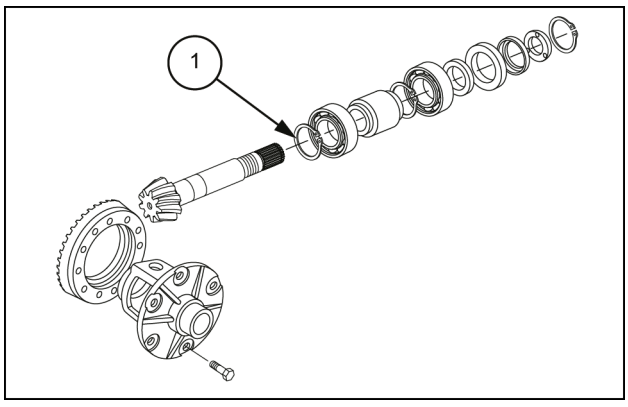
1. Install tool number **380000249 (1)** in the bevel drive-differential housing complete with outer bearing rings, ring gear bearings adjustment ring, ring gear bearings adjustment shim, circlip and differential support caps.
2. Screw the cones **(2)** of tool number **380000249 (1)** in or out in order to orientate the micrometer shaft inline with the inner bearing ring while eliminating the end play between the cones and the outer rings of the ring gear bearings.
3. Adjust the micrometer so that the shaft is in contact with inner bearing race and measure the distance (H3) thus obtained.



GNIL14TR04423AB 1

4. Determine the correct distance (H5) between the ring gear axis and the large diameter base of the pinion:
   H5 =H4 ± C
   where:
   H4 = **95 mm** (**3.74 in**) nominal distance between the ring gear axis and the large diameter base of the pinion.
   C= correction value stamped on pinion preceded by a + or - sign, (if other than 0), to be added to or subtracted from the nominal distance (H4) according to the sign.
5. The thickness of the adjustment shim will be given by:
   Shim = H3 - H5
   where:
   H3 = the distance measured using the micrometer.
   H5 = corrected nominal distance between the crown wheel axis and the large diameter base of the pinion.
6. Remove tool number **380000248** and tool number **380000249** from bevel drive housing.
7. Install the drive pinion complete with: inner bearing races, spacer and adjustment shims of the previously determined thickness.

   Pinion bearing preload shim **(1)** is located between spacer and rear bearing.

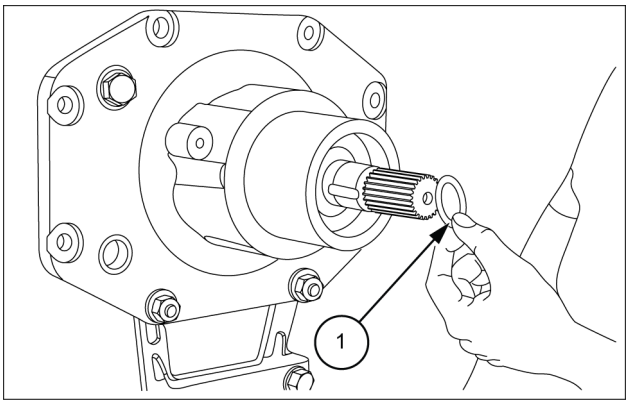


GNIL14TR04424AB 2

Available shim sizes	
0.5 mm (**0.020 in**)	**2.75 mm** (**0.108 in**)
2.5 mm (**0.098 in**)	**2.8 mm** (**0.110 in**)
2.55 mm (**0.100 in**)	**2.85 mm** (**0.112 in**)

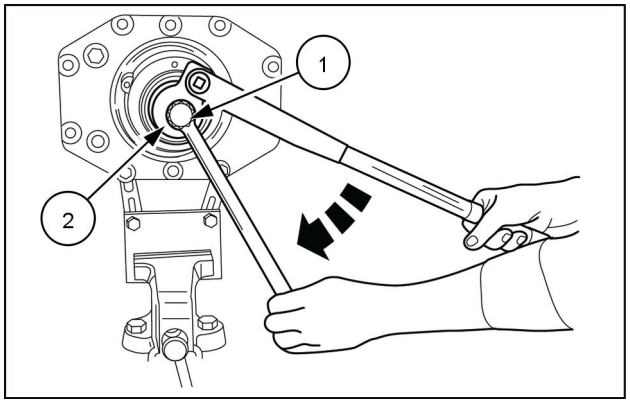
Available shim sizes	
2.6 mm (**0.102 in**)	**2.9 mm** (**0.114 in**)
2.65 mm (**0.104 in**)	**2.95 mm** (**0.116 in**)
2.7 mm (**0.106 in**)	

8. Install the O-ring seal **(1)** on the drive pinion shaft.
9. Then insert the spacer and then the detent ball, after having carefully lubricated the outer surface.



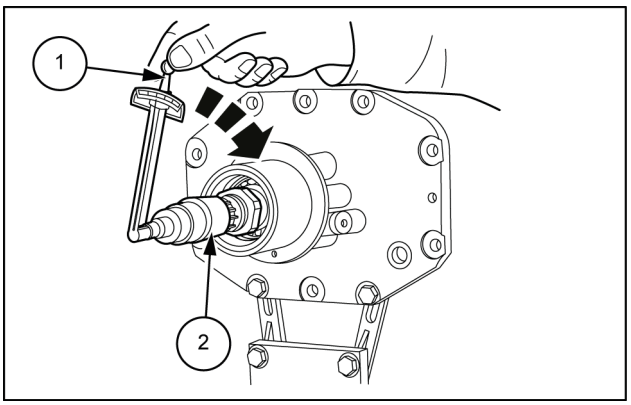
GNIL14TR04425AB 3

10. Install the pinion lock tool, tool number **380000257 (1)**.
11. Install wrench, tool number **380000268** on the threaded adjustment ring.
12. Using a wrench on the pinion lock tool **(1)**, hold the pinion against rotation, and using a torque wrench positioned exactly as shown in the figure on the threaded adjustment ring wrench **(2)**, tighten the adjustment ring to a torque value of **294 N·m** (**217 lb ft**) while simultaneously rotating the pinion shaft to ensure that the bearings are seated correctly.



GNIL14TR04430AB 4

13. With a torque wrench **(1)** on the pinion lock tool, tool number **380000257 (2)**, check that the pinion rolling torque, without oil seal and relative dust seal ring is **0 N·m** (**0 lb in**) - **0.2 N·m** (**1.8 lb in**).
    If the rolling torque is less than the prescribed value, install a thinner adjustment shim shown in Figure **2**, if the torque is greater than the prescribed value, install a thicker adjustment shim.
14. Unscrew the threaded adjustment ring and install the oil seal and the dust seal ring. Tighten the threaded ring to a torque of **294 N·m** (**217 lb ft**), while simultaneously rotating the pinion shaft to ensure that the bearings are seated correctly.
15. With a inch/pound torque wrench **(1)** on the pinion lock tool number **380000257 (2)**, check that the pinion rolling torque with the oil seal and relative dust seal ring is **0.5 N·m** (**4.4 lb in**) - **1 N·m** (**9 lb in**).
    Finally, carefully stake the threaded ring and fit the circlip on the drive pinion shaft.



GNIL14TR04355AB 5

https://truckmanualshub.com/

Index

Front axle system - 25

Final drives - 310

Final drive driving pinion - Adjust – (4WD) Front Axle 5
Final drive driving pinion - Preload – (4WD) Front Axle 3

https://truckmanualshub.com/

https://truckmanualshub.com/

Front axle system - 25

Non-powered front axle - 400

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Front axle system - 25

Non-powered front axle - 400

TECHNICAL DATA

Non-powered front axle
General specification . . . 3
Torque . . . 3
Special tools . . . 4
Sealing . . . 4

FUNCTIONAL DATA

Non-powered front axle
Overview . . . 5
Sectional view . . . 6

SERVICE

Non-powered front axle
Remove . . . 8
Install . . . 10
Front axle
Remove – Spindle Assembly . . . 11
Overhaul – Spindle Assembly . . . 13
Install – Spindle assembly . . . 14
Axle wheel hub
Remove . . . 15
Install . . . 17

DIAGNOSTIC

Non-powered front axle
Troubleshooting . . . 18

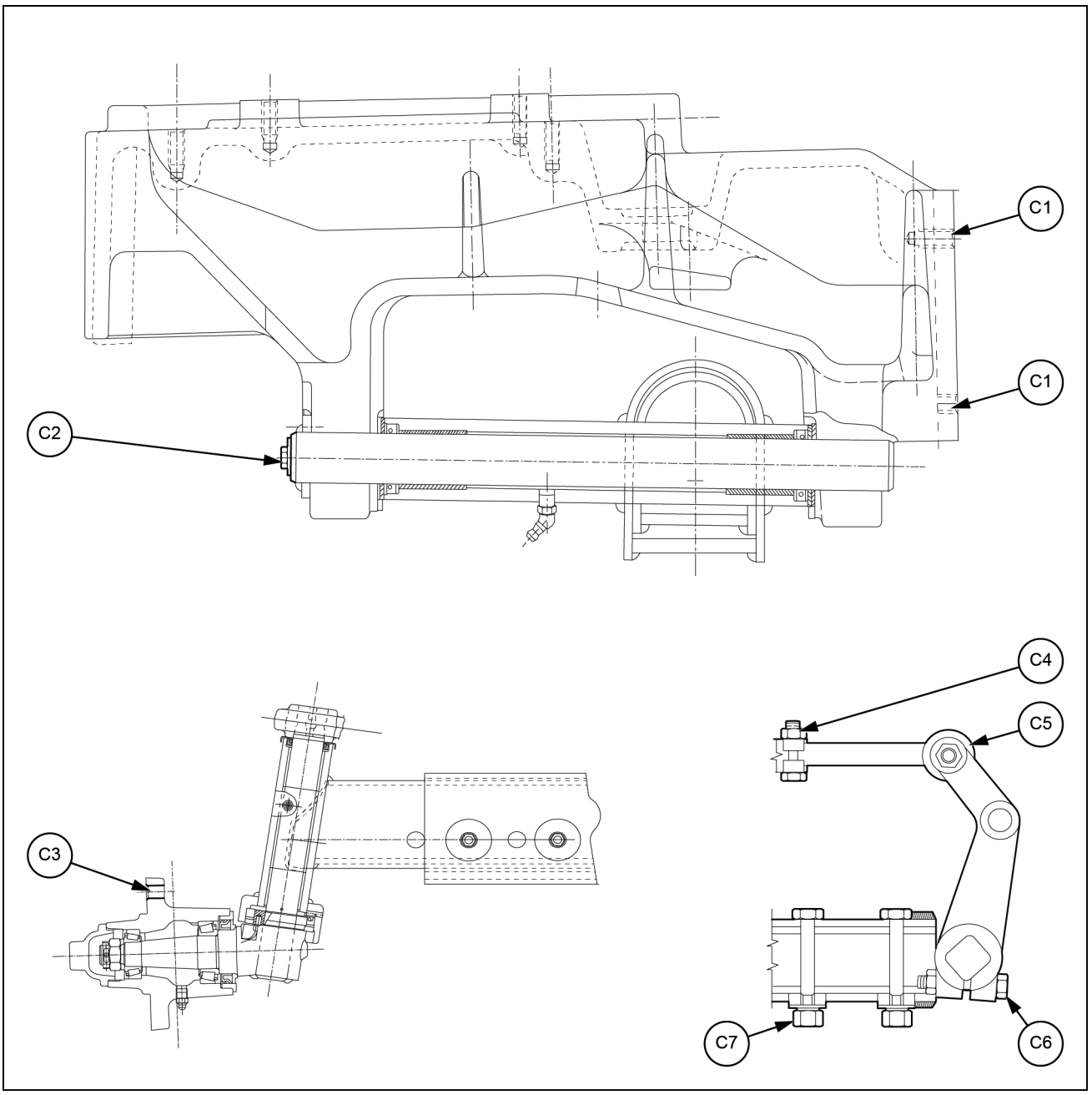
Non-powered front axle - General specification

Type	Centrally pivoted U-type centre beam without telescopic outer section
Wheel camber	**2 °** corresponding to approx. **15.00 mm** (**0.59 in**) with **406.40 mm** (**16.00 in**) rims
Wheel toe-in	**0.000 - 5.000 mm** (**0.000 - 0.197 in**)
Swivel pin assembly	
Swivel pin **(3)** diameter at the bushes	**29.967 mm** (**1.180 in**) / **30.000 mm** (**1.181 in**)
Press-fit bush **(4)** inner diameter	**30.140 mm** (**1.187 in**) / **30.060 mm** (**1.183 in**)
Swivel pin to bush clearance	**0.060 - 0.173 mm** (**0.002 - 0.007 in**)
Axle pivot pin assembly	
Pivot pin **(9)** diameter	**29.967 mm** (**1.180 in**) / **30.000 mm** (**1.181 in**)
Press-fit bush **(4)** inner diameter	**30.140 mm** (**1.187 in**) / **30.060 mm** (**1.183 in**)
Pivot pin to bush clearance	**0.060 - 0.173 mm** (**0.002 - 0.007 in**)

2WD Dished In	**7.50 - 16**
AC	**1424.0 mm** (**56.1 in**)
BD	**1524.0 mm** (**60.0 in**)
CE	**1624.0 mm** (**63.9 in**)
DF	**1724.0 mm** (**67.9 in**)
EG	**1824.0 mm** (**71.8 in**)
FH	**1924.0 mm** (**75.7 in**)
2WD Dished Out	
AC	**1472.0 mm** (**58.0 in**)
BD	**1572.0 mm** (**61.9 in**)
CE	**1672.0 mm** (**65.8 in**)
DF	**1772.0 mm** (**69.8 in**)
EG	**1872.0 mm** (**73.7 in**)
FH	**1972.0 mm** (**77.6 in**)

Non-powered front axle - Torque

Description	Thread size	Torque
Bolt, front axle carrier to engine **(C1)**	M16 x 2	**22.00 kgf** (**48.50 lbf**)
Bolt, axle pivot **(C2)**	M10 x 1.25	**6.00 kgf** (**13.23 lbf**)
Bolt, wheel to hub **(C3)**	M14 x 1.5	**15.00 kgf** (**33.07 lbf**)
Nut, track/drag link, ball joint **(C4)**	M10 x 1	**2.50 kgf** (**5.51 lbf**)
Nut, track/ drag link, ball joint **(C5)**	M14 x 1.5	**10.00 kgf** (**22.05 lbf**)
Nut, right-hand side and left-hand side control lever **(C6)**	M12 x 1.25	**9.00 kgf** (**19.84 lbf**)
Axle extension securing bolts **(C7)**	M16 x 1.5	**11.80 kgf** (**26.01 lbf**)



GNIL14TR04431GB 1

Non-powered front axle - Special tools

Tool description	Tool number
Slide hammer for centre pin	**380001545**
Adapter for slide hammer	290793

Non-powered front axle - Sealing

Operation description	Specification
Front wheel hub sleeve	**LOCTITE® 638™**
King pin thrust washer	**LOCTITE® 638™**

Non-powered front axle - Overview

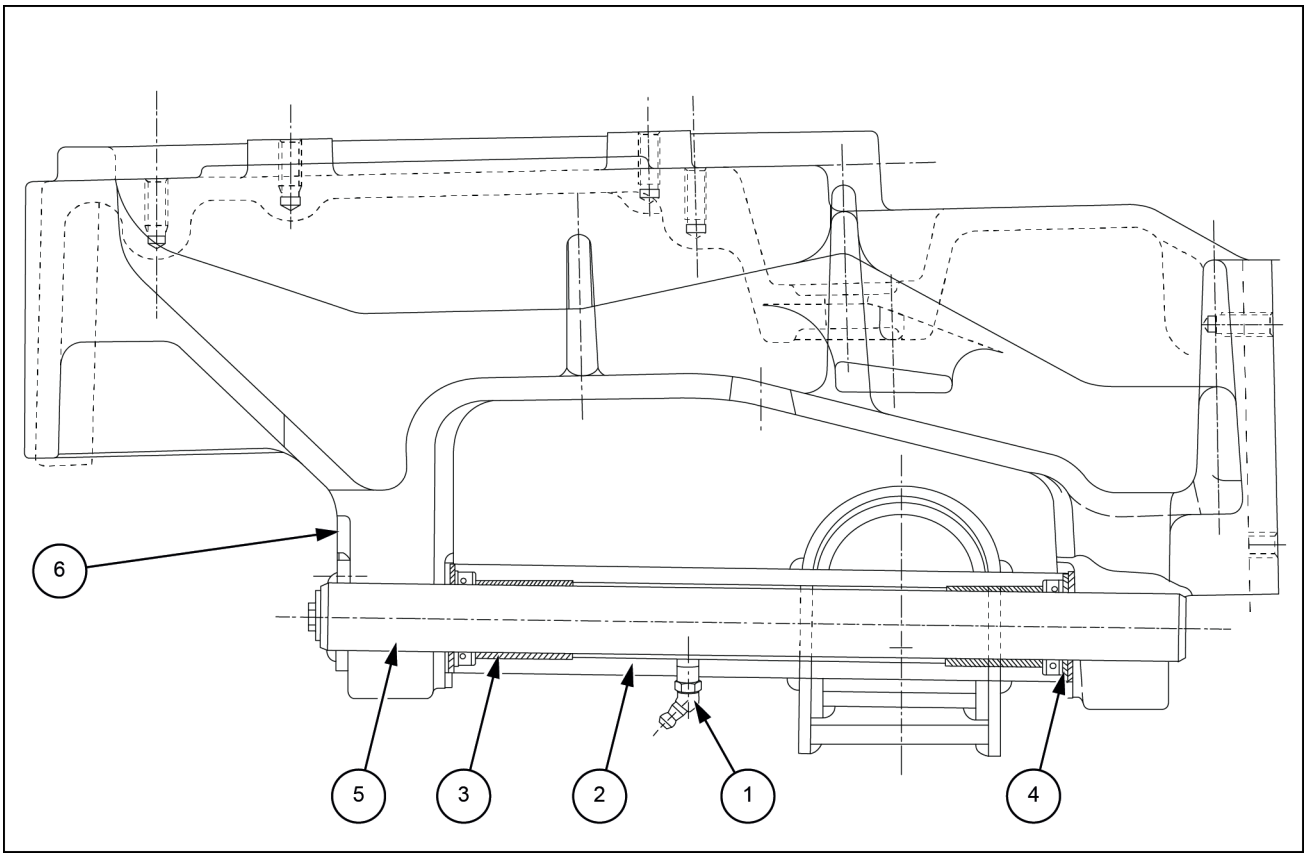
The adjustable front axle is composed of a reversed U-type centre beam with telescopic sections at each end.

A number of holes at **50.00 mm** (**2.00 in**) intervals are provided in the telescopic sections for track width adjustment purpose. Adjustment of the front wheel track width is affected by extending or retracting both ends of the axle equally.

The centre beam is attached to the front axle carrier by means of a single pivot which allows oscillation on both sides.

The front axle is controlled by mechanical steering through swivel pin control lever. The two swivel pins are connected by telescopic track control rod, which contain adjustment for toe-in.

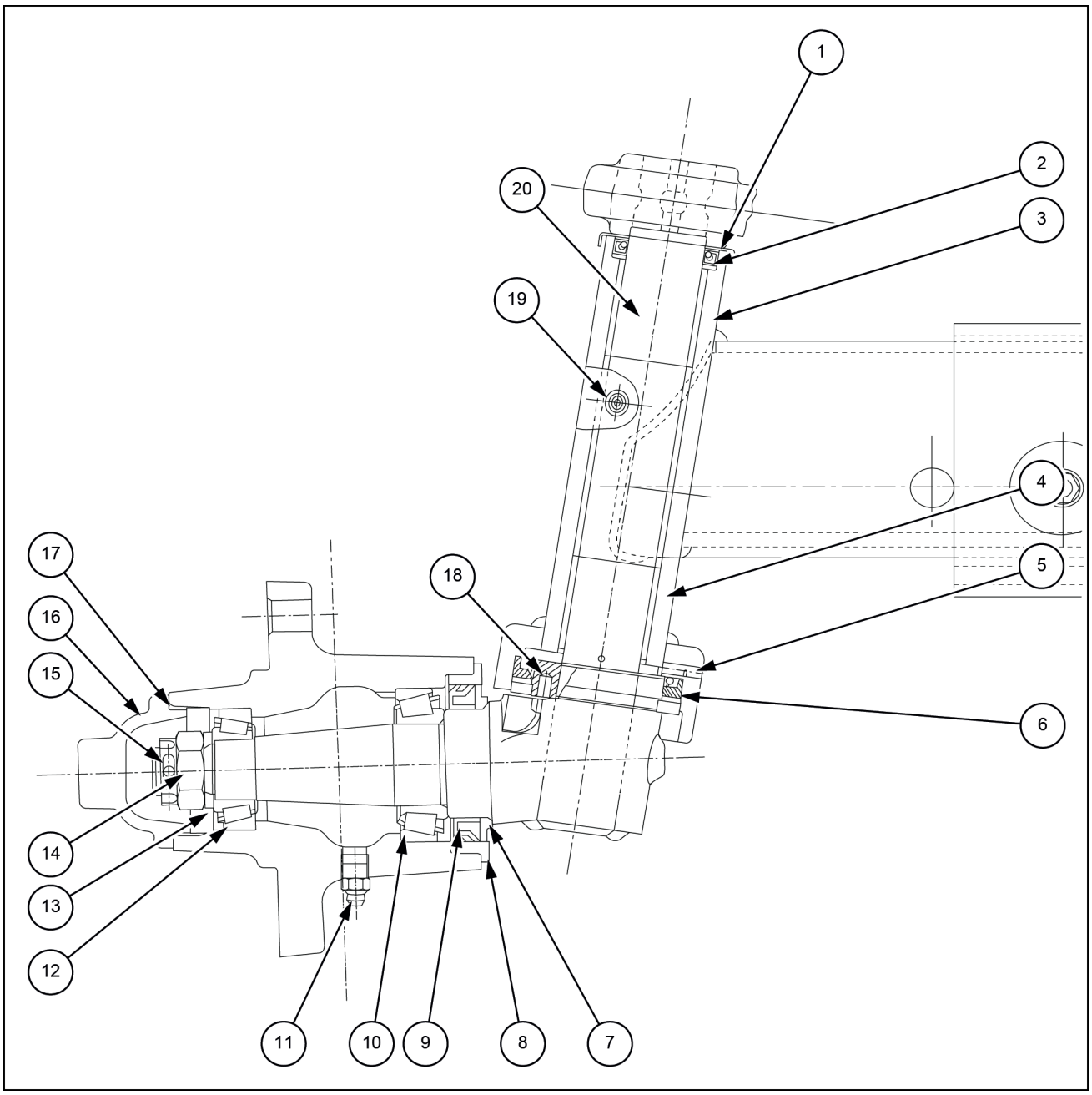
Non-powered front axle - Sectional view



GNIL14TR04432FB 1

Front axle support

1. Grease fitting
2. Axle centre beam
3. Axle pivot pin bushings
4. Thrust washers
5. Axle pivot pin
6. Front axle carrier



GNIL14TR04433GB 2

Stub assembly

1. Dust cover
2. Oil seal
3. Bush upper
4. Bush lower
5. Thrust washer
6. Seal
7. Dust cover
8. Bush (sleeve)
9. Seal
10. Bearing
11. Grease nipple
12. Bearing
13. Thrust washer
14. Castle nut
15. Split pin
16. Dust cover
17. O-ring
18. Thrust washer pin
19. Grease nipple
20. King pin

Non-powered front axle - Remove

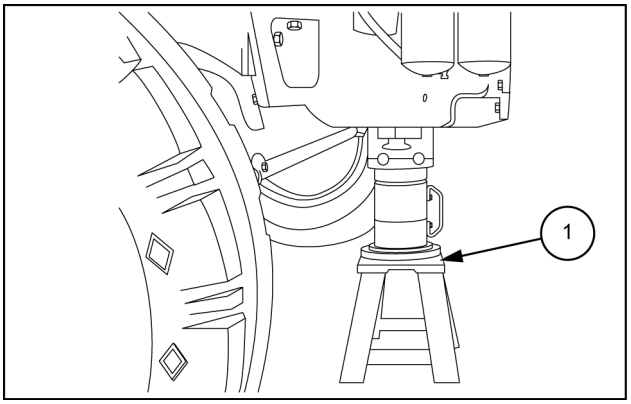
⚠ DANGER

Heavy objects!
Lift and handle all heavy components using lifting equipment with adequate capacity. Always support units or parts with suitable slings or hooks. Make sure the work area is clear of all bystanders. Failure to comply will result in death or serious injury.

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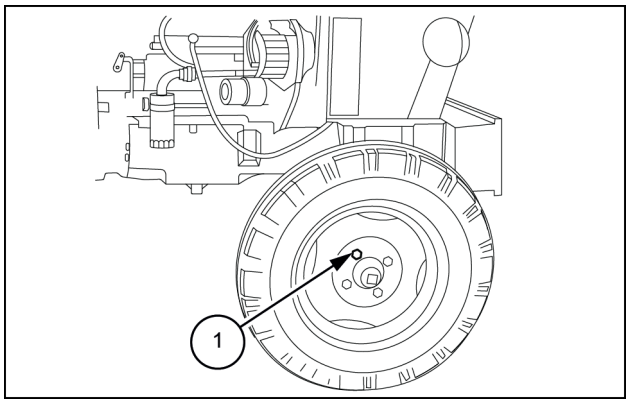
Remove the front axle assembly from the tractor as follows:

1. Open and raise front hood.
2. Disconnect the negative cable from the battery and insulate.
3. Safely block rear wheels.
4. Remove front weights and weight support, where fitted.
5. Jack up front tractor and place a stationary stand **(1)** under the sump.



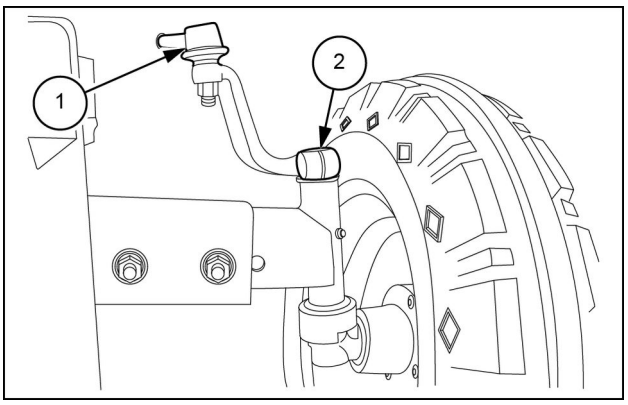
GNIL14TR04434AB 1

6. Loosen retaining bolts **(1)** and remove the front wheels.



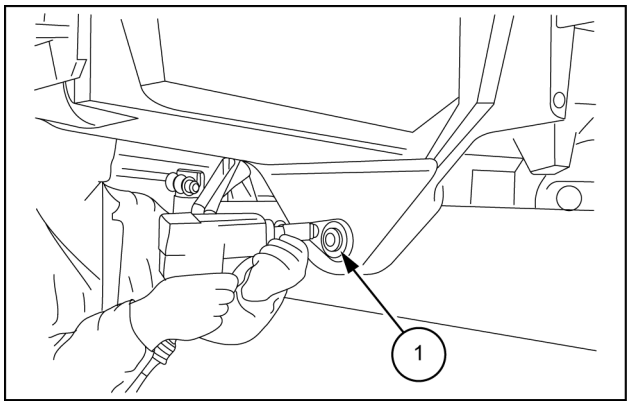
GNIL14TR04435AB 2

7. Remove knuckle joint nut **(1)** and disconnect drag link **(2)** from control lever.



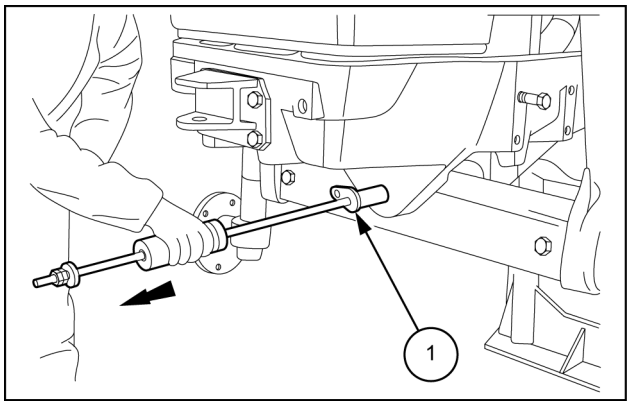
GNIL14TR04436AB 3

8. Remove the axle pivot pin locking bolt **(1)**.



GNIL14TR04437AB 4

11. Using a slide puller (special tool number 292927) with tool no. **380001545** withdraw the pivot pin **(1)**.
10. Recover thrust washers and shims provided between axle carrier and centre beam.
11. Remove front axle from tractor using a hoist.



GNIL14TR04438AB 5

Non-powered front axle - Install

Reinstall the front axle assembly to carrier observing the following:

1. Reassembly follows disassembly procedure in reverse, refer to **Non-powered front axle - Remove (25.400)**.

⚠ CAUTION

Pinch hazard!
Always use suitable tools to align mating parts.
DO NOT use your hand or fingers.
Failure to comply could result in minor or moderate injury.

C0044A

2. Check the pivot pin play. It should not exceed **0.25 mm** (**0.01 in**). If play is more, add shims between axle carrier and centre beam.
3. Check for correct toe-in setting. See “front wheel setting tests” for details.
4. Tighten all fasteners to correct torques.

Front axle - Remove – Spindle Assembly

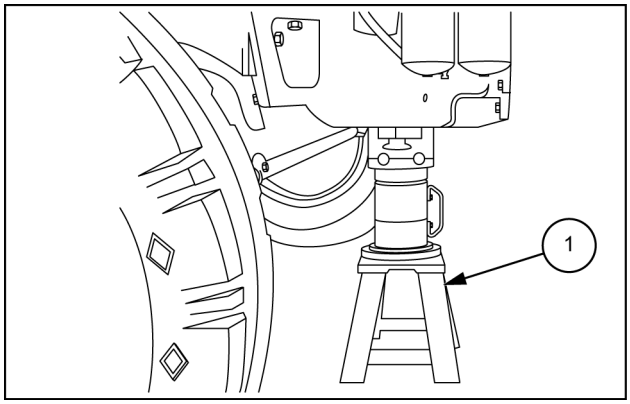
⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

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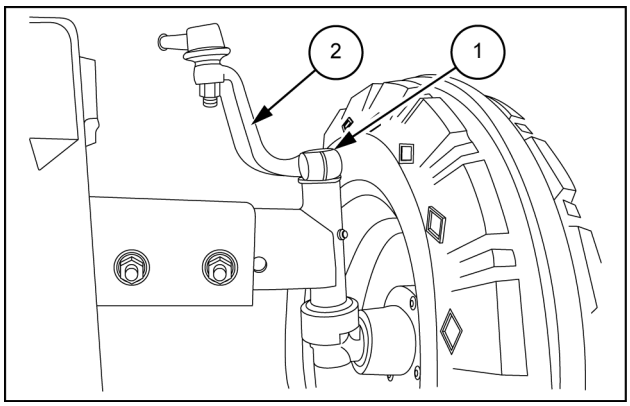
Swivel pins can be removed and overhauled with the front axle on the tractor proceed as follows for each wheel:

1. Safely block rear wheels.
2. Jack up front tractor and place a stationary stand **(1)** under the sump.
3. Loosen retaining bolts and remove front wheels.



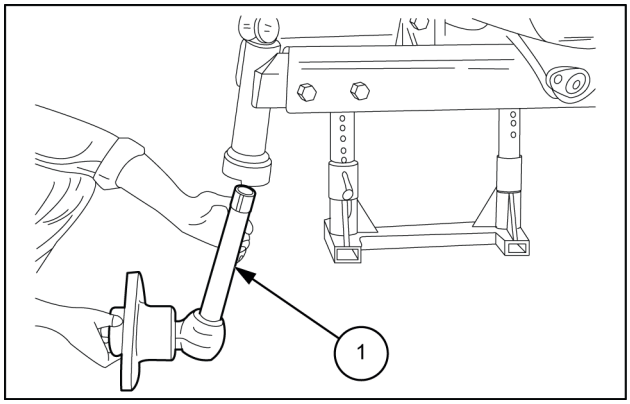
GNIL14TR04449AB 1

4. Remove swivel pin control lever retaining bolt **(1)**.
5. Slide out the control lever **(2)** from the spindle assembly.



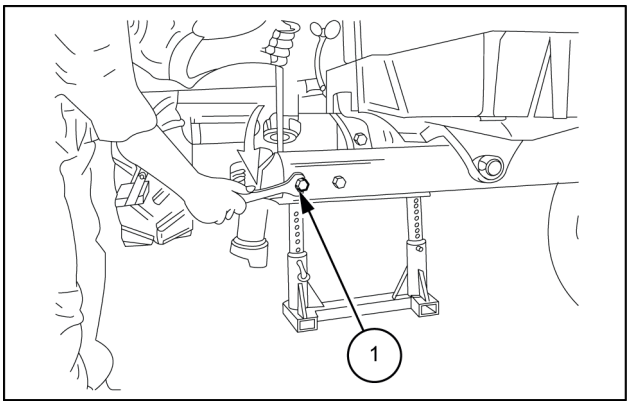
GNIL14TR04450AB 2

6. Pull out the swivel axle and hub assembly **(1)** from axle outer section.



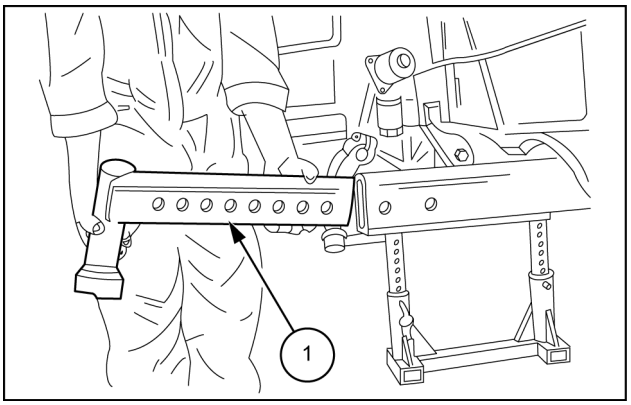
GNIL14TR04451AB 3

7. Remove the axle outer section **(1)** attaching bolts.



GNIL14TR04452AB 4

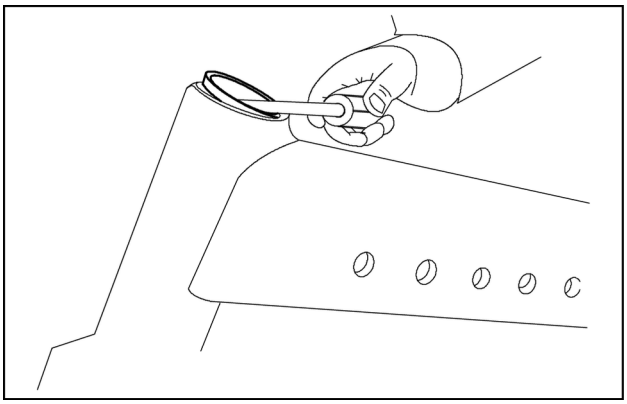
8. Remove the axle outer section **(1)**.



GNIL14TR04453AB 5

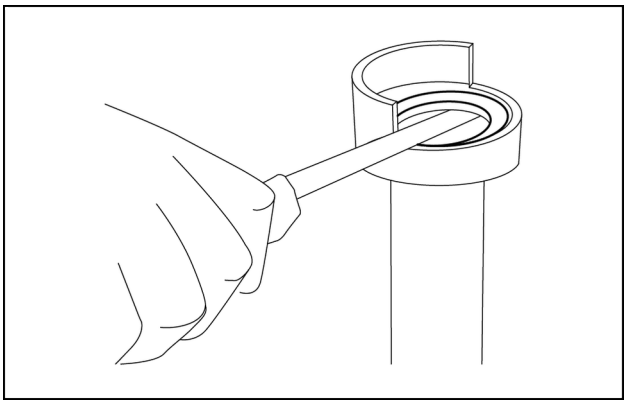
Front axle - Overhaul – Spindle Assembly

1. Fix the axle outer section in a vice and remove the upper seal using suitable tool.



GNIL14TR04454AA 1

2. Remove the bottom seal using suitable tool and recover thrust washer.
3. Check the swivel bearing bushes for wear. See specifications in **Non-powered front axle - General specification (25.400)**. If bushes require replacement, remove the bushes using suitable tool.
4. Using a suitable drift install new bushings on the axle outer section.
5. Check the swivel pin for wear. If required replace new spindle.
6. Ream the new bushings to suit the swivel pin.

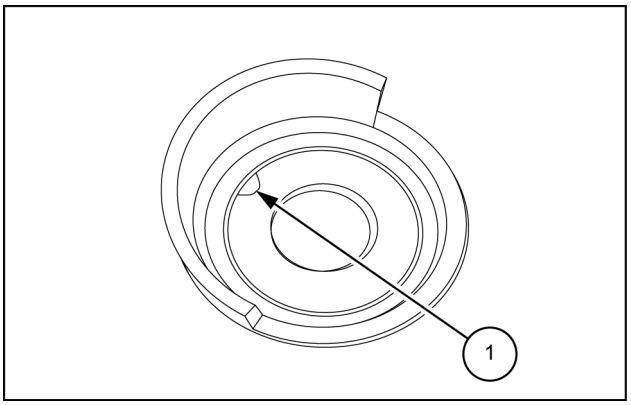


GNIL14TR04455AA 2

Front axle - Install – Spindle assembly

Reinstall the spindle assembly to the front axle following the disassembly procedure in reverse.

NOTE: *Make sure that the slot* ***(1)*** *in the thrust washer fits on the notch provided on the axle outer section.*



GNIL14TR04456AB 1

Axle wheel hub - Remove

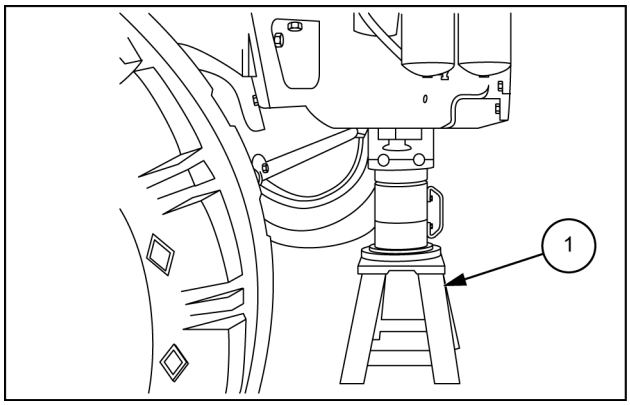
⚠ WARNING

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Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

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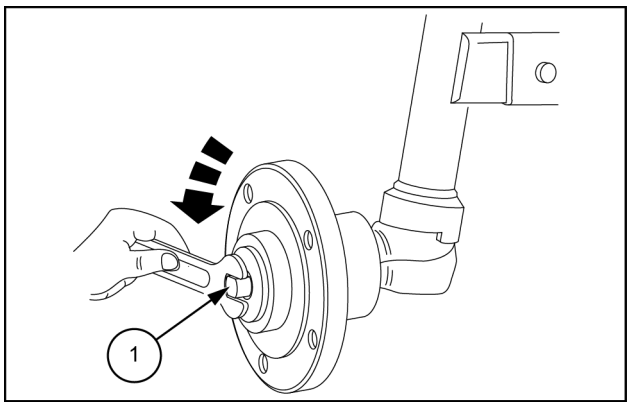
Wheel hubs can be removed with the front axle on the tractor. Proceed as follows for each hub.

1. Safely block rear wheels.
2. Jack up front tractor and place a stationary stand **(1)** under the sump.
3. Loosen retaining bolts and remove front wheels.



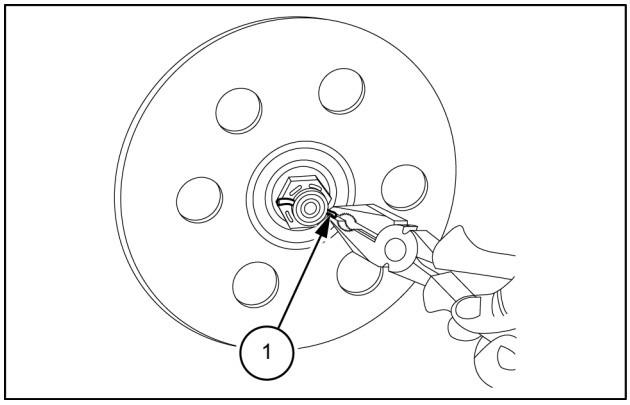
GNIL14TR04439AB 1

4. Remove wheel hub bearing grease cup **(1)**.



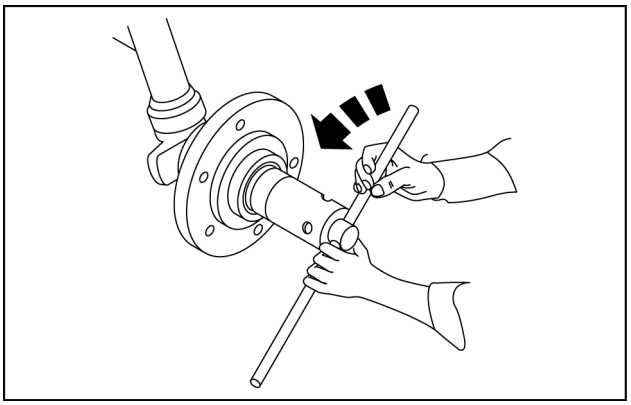
GNIL14TR04440AB 2

5. Remove split pin **(1)**.



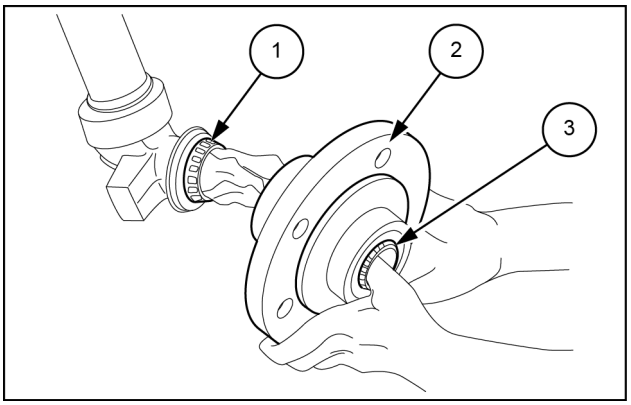
GNIL14TR04441AB 3

6. Using the socket spanner loosen the wheel hub bearing. Adjust castle nut.



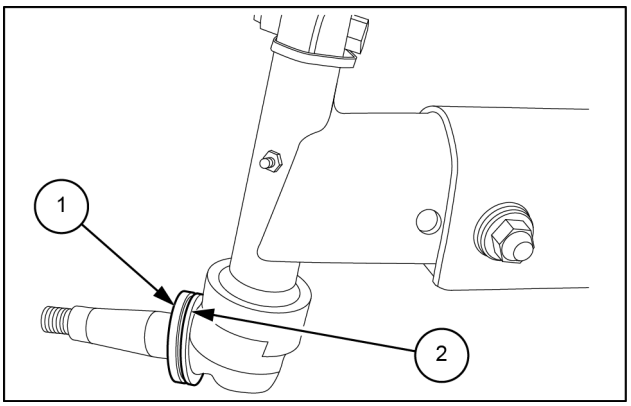
GNIL14TR04442AA 4

7. Remove wheel hub **(2)** and recover bearing **(1)** and **(3)**.



GNIL14TR04443AB 5

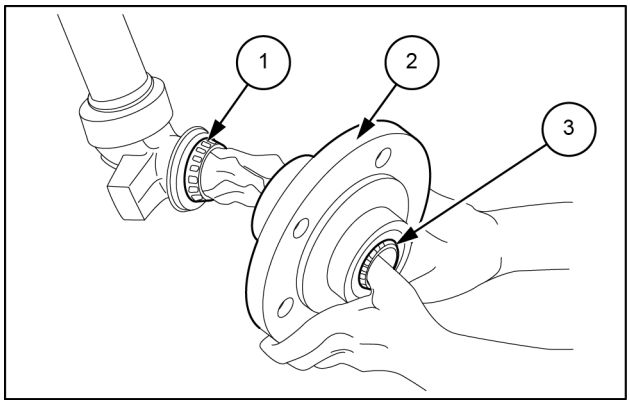
8. Remove seal **(1)** and nyloc ring **(2)** using suitable tool.



GNIL14TR04444AB 6

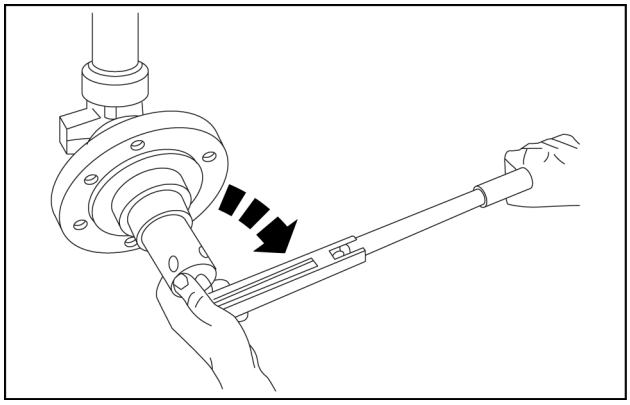
Axle wheel hub - Install

1. Replace faulty seals and worn bearing using suitable pullers and drifts.
2. Fill the wheel hub with specified grease.
3. Re-assemble the wheel hub **(2)** complete with the bearings **(1)** and **(3)**.



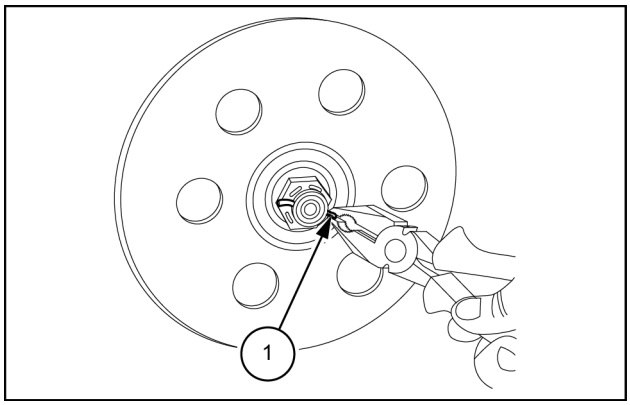
GNIL14TR04445AB 1

4. Using a torque wrench and socket spanner **(1)** tighten the castle nut while turning the wheel hub **(1)** to settle the bearing. Tighten the nut until wheel hub gets slightly tight to rotate.
5. Loosen the castle nut and torque it again to **9.8 N·m** (**7.2 lb ft**) continuing to turn the wheel hub.



GNIL14TR04446AA 2

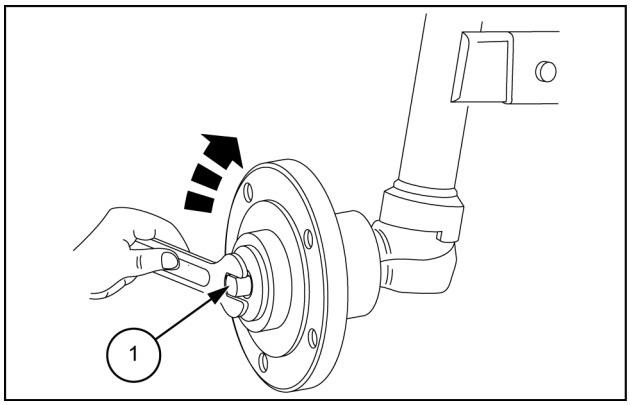
6. Insert split pin **(1)**.



GNIL14TR04447AB 3

7. Reassemble the wheel hub dust cap **(1)**.

NOTE: *Check the O-ring provided on the dust cap for any cut or damage. If required replace the O-ring.*



GNIL14TR04448AB 4

Non-powered front axle - Troubleshooting

Problem	Possible Cause	Correction
Premature tire wear	Wrong inflation pressure	Inflate tyres to correct pressure refer to values suggested in the operator's manual. Always comply with values specified by the tire manufacture
	Wrong front wheel toe-in	Adjust toe-in (see the procedure explained in this section under adjustment)
Poor tractor stability	Wrong inflation pressure	Inflate tyres to correct pressure

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Index

Front axle system - 25

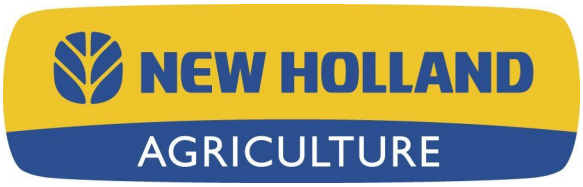
Non-powered front axle - 400

Axle wheel hub - Install 17
Axle wheel hub - Remove 15
Front axle - Install – Spindle assembly 14
Front axle - Overhaul – Spindle Assembly 13
Front axle - Remove – Spindle Assembly 11
Non-powered front axle - General specification 3
Non-powered front axle - Install 10
Non-powered front axle - Overview 5
Non-powered front axle - Remove 8
Non-powered front axle - Sealing 4
Non-powered front axle - Sectional view 6
Non-powered front axle - Special tools 4
Non-powered front axle - Torque 3
Non-powered front axle - Troubleshooting 18

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SERVICE - Technical Publications & Tools



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SERVICE MANUAL

Rear axle system

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Rear axle system - 27

[27.100] Powered rear axle 27.1

[27.106] Rear bevel gear set and differential 27.2

[27.120] Planetary and final drives 27.3

https://truckmanualshub.com/

Rear axle system - 27

Powered rear axle - 100

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Rear axle system - 27

Powered rear axle - 100

FUNCTIONAL DATA

Powered rear axle
Overview 3

Powered rear axle - Overview

The rear axle assembly transfers drive from the transmission to the planet drive through a bevel pinion and crown wheel coupling. The bevel gears are spiral type and are supported by tapered roller bearings.

The differential is fitted with four planetary and two side gears and mechanical lock. The differential lock is dog clutch type and operated by foot pedal located below operator’s seat at right hand side.

The planetary reduction gear set is controlled by the bevel pinion and crown wheel output half - shaft, which also controls the brakes.

Planetary helps in improving traction and increasing brakes life. It also gives more ground clearance and it is sealed against water and dust.

In this cascade arrangement half axle is fitted into two side gears which rotates the planetary gears through a ring gear, resulting into reduction of speed, that turn is transferred to rear axle.

https://truckmanualshub.com/

Index

Rear axle system - 27

Powered rear axle - 100

Powered rear axle - Overview 3

https://truckmanualshub.com/

Rear axle system - 27

Rear bevel gear set and differential - 106

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Rear axle system - 27

Rear bevel gear set and differential - 106

TECHNICAL DATA

Rear bevel gear set and differential
General specification . . . 3
Torque . . . 3
Special tools . . . 4
Sealing . . . 4

FUNCTIONAL DATA

Rear bevel gear set and differential
Sectional view . . . 6

SERVICE

Rear bevel gear set and differential
Remove . . . 7
Install . . . 12
Differential
Disassemble . . . 14
Inspect . . . 17
Assemble . . . 18
Backlash . . . 19
Bevel pinion
Remove . . . 21
Install . . . 24

DIAGNOSTIC

Rear bevel gear set and differential
Troubleshooting . . . 25

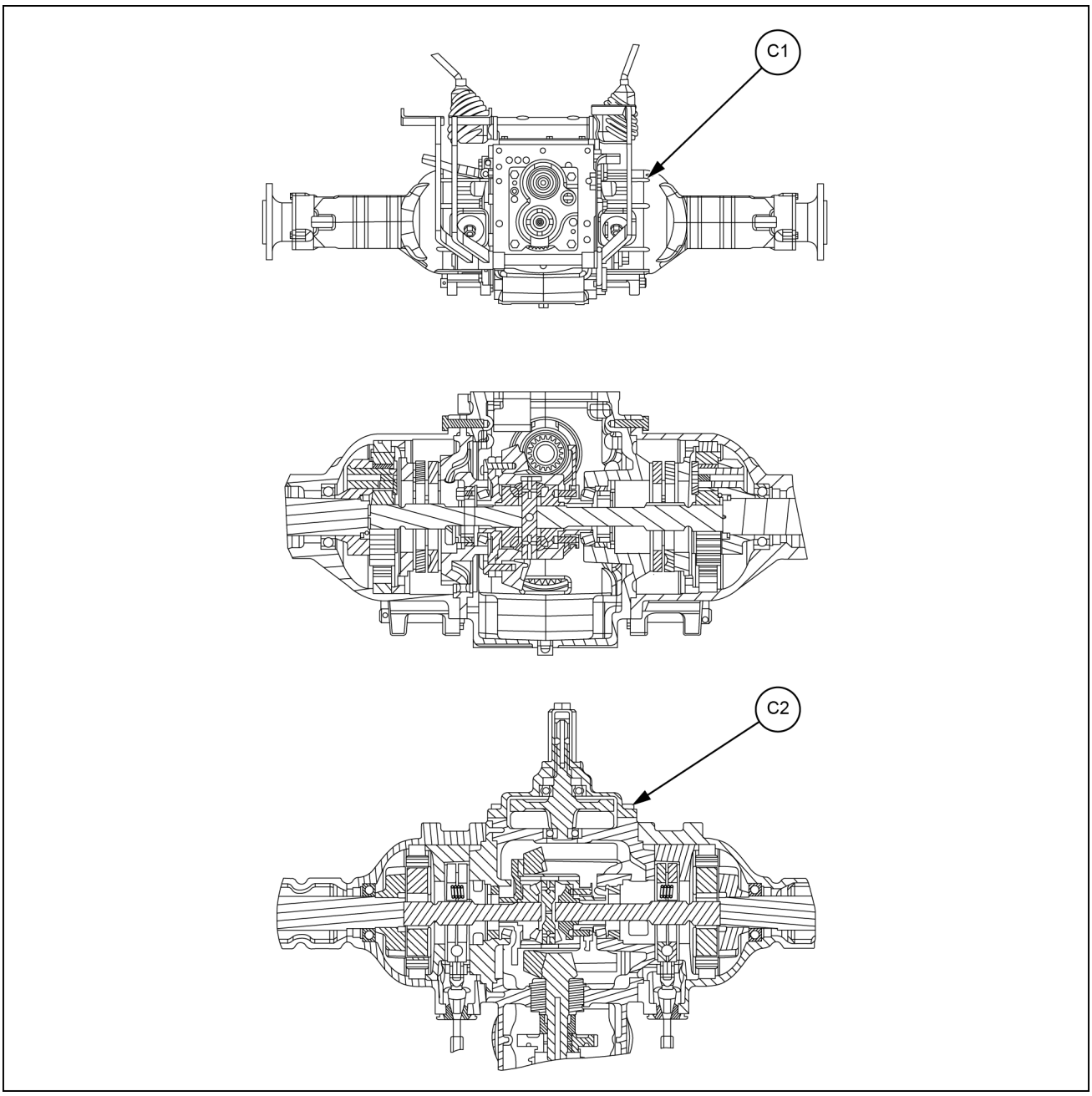
Rear bevel gear set and differential - General specification

Pinion to crown wheel and differential

Pinion and crown wheel ratio	
Pinion to crown wheel backlash	**0.180 mm** (**0.007 in**) - **0.230 mm** (**0.009 in**)
Differential	4 pin
Differential lock control type	Mechanical operated with foot pedal
Differential lock free spring length	**106.000 mm** (**4.170 in**)
Compressed spring length, under a load of **365000.0 Kg/cm²** (**5191520.3 psi**)	**82.000 mm** (**3.230 in**)
Side gear to differential gear backlash	**0.100 mm** (**0.004 in**) - **0.250 mm** (**0.010 in**)
Differential gear pin diameter	**21.960 mm** (**0.865 in**) - **21.939 mm** (**0.864 in**)
Bore diameter on differential gears for pin	**22.098 mm** (**0.870 in**) - **22.065 mm** (**0.869 in**)
Bore diameter on differential case for pin	**22.020 mm** (**0.867 in**) - **22.000 mm** (**0.866 in**)
Pin to differential gear clearance	**0.159 mm** (**0.006 in**) - **0.040 mm** (**0.002 in**)
Pin to differential case clearance	**0.082 mm** (**0.003 in**) - **0.040 mm** (**0.002 in**)

Rear bevel gear set and differential - Torque

Description	Thread size	Torque
Rear axle to transmission housing attaching bolts **(C1)**	M12 x 1.25	**10 kgf** (**22 lbf**)
Power Take-Off (PTO) cover bolts **(C2)**	M12	**10 kgf** (**22 lbf**)
Ring gear bolts **(C3)***	M10	**6 kgf** (**13 lbf**)
Drain plug **(C4)**	M22	**4.5 kgf** (**10 lbf**)



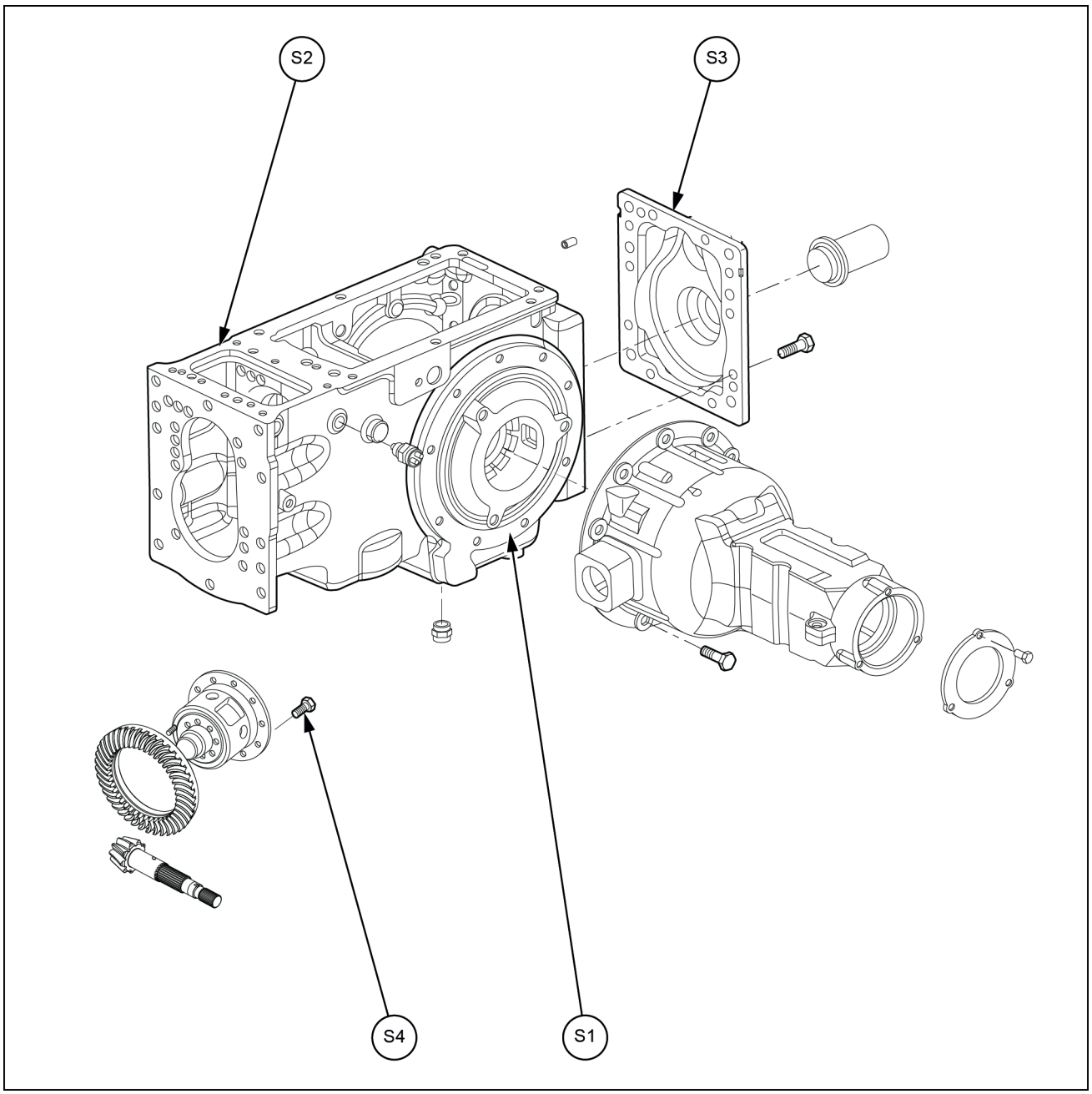
GNIL14TR04239GB 1

Rear bevel gear set and differential - Special tools

Tool description	Tool number
Differential plate check nut tightening tool	**9971349**
Installer oil seal wheel side (heavy duty)	84261386
Set screw socket **6.000 mm** (**0.236 in**)	84261394
Yoke and spreader	291051 and 291052

Rear bevel gear set and differential - Sealing

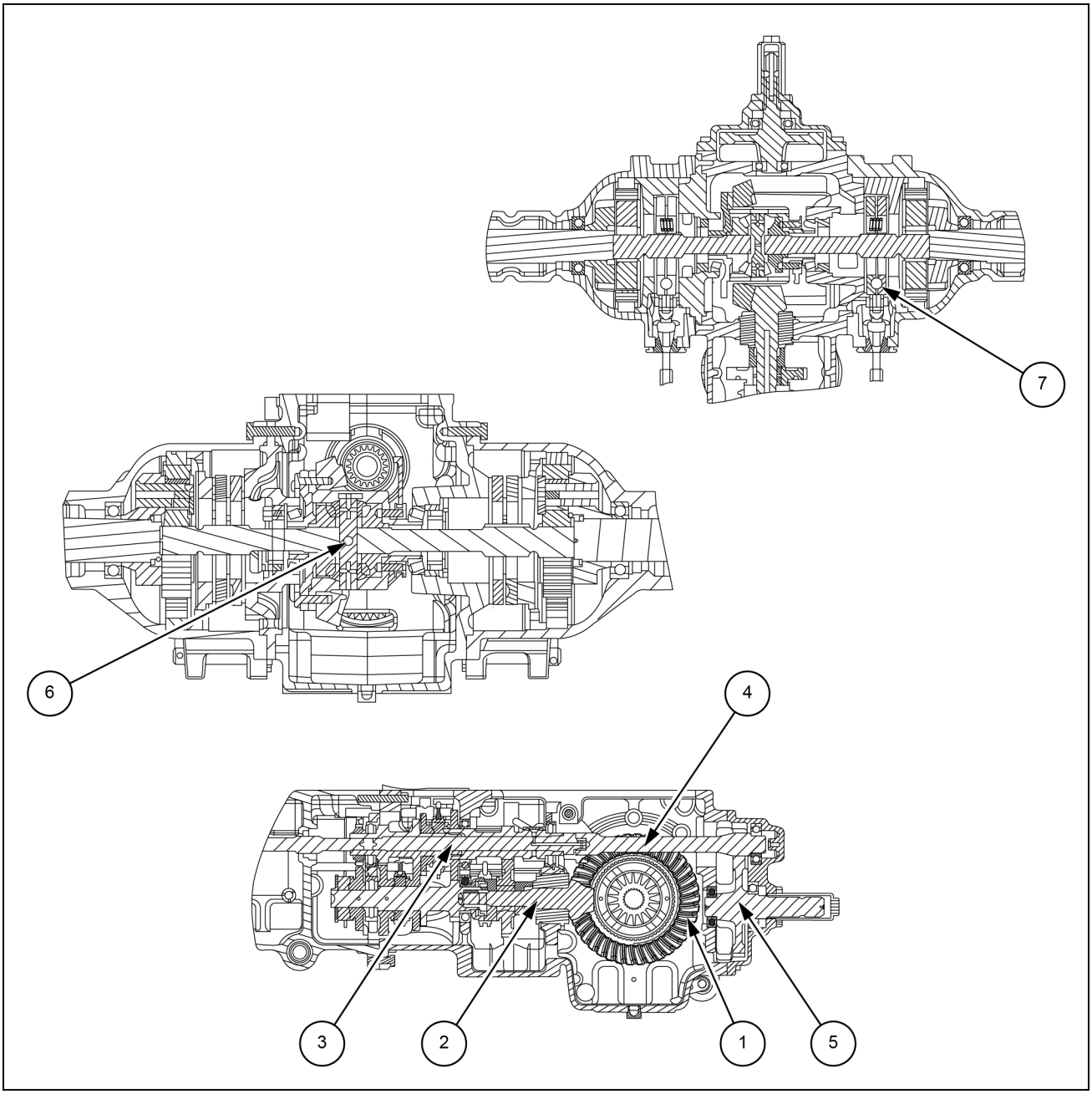
Operation description	Sealant specification
Rear axle to transmission housing **(S1)**	**LOCTITE® 518**
Lift housing to transmission housing **(S2)**	**LOCTITE® 518**
Power Take-Off (PTO) cover plate **(S3)**	**LOCTITE® 518**
Crown wheel bolts **(S4)**	**LOCTITE® 243**



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Rear bevel gear set and differential - Sectional view

Crown wheel and differential assembly



GNIL14TR04241GB 1

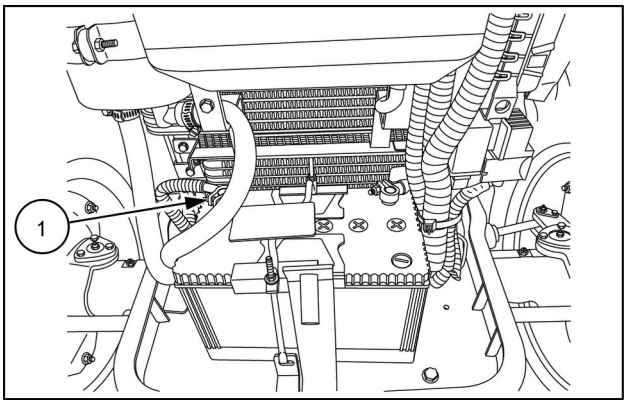
1. Crown wheel
2. Pinion shaft
3. Input shaft
4. Power Take-Off (PTO) input shaft
5. Power Take-Off (PTO) shaft
6. Differential assembly
7. Brake

Rear bevel gear set and differential - Remove

Crown wheel and differential housing

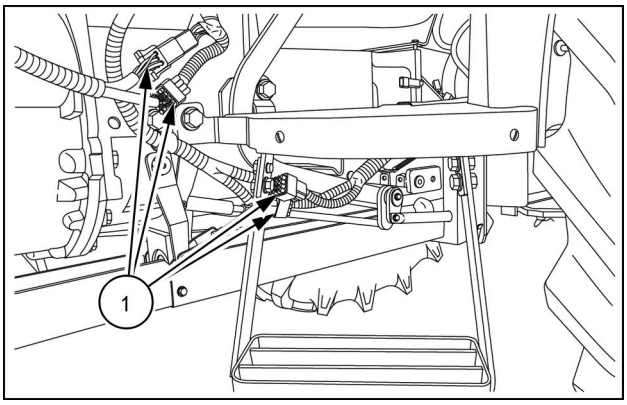
To remove the crown wheel and differential housing, final drive housing, brake assembly and Power Take-Off (PTO) assembly has to be removed.
Remove the rear axle housing as follows:

1. Detach the negative cable **(1)** from the battery and insulate.



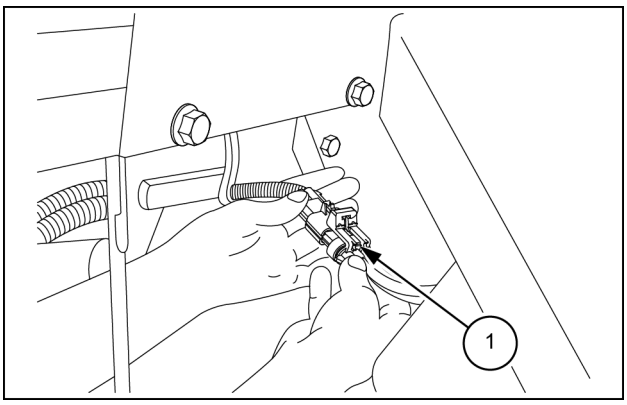
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2. Disconnect the electrical couplings **(1)**.



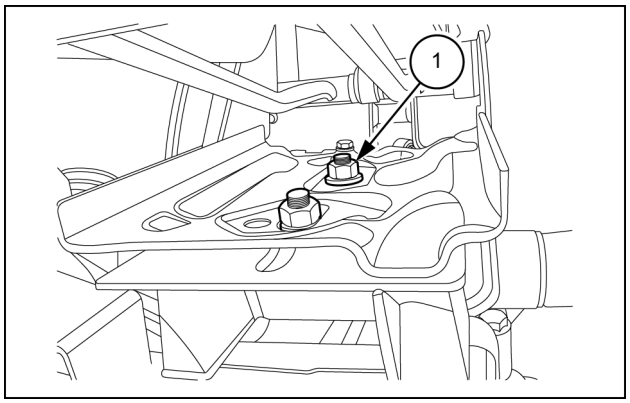
GNIL14TR00797AA 2

3. Detach electric connections **(1)** between left and right-hand side fenders.



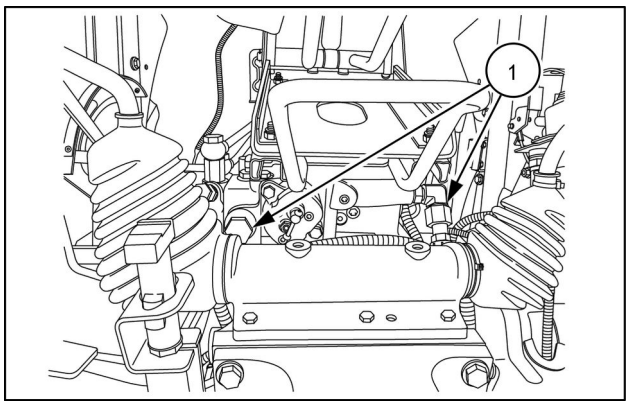
GNIL14TR04245AB 3

4. Loosen the bolts **(1)**, detach electrical connection and remove operator seat from the hydraulic housing.



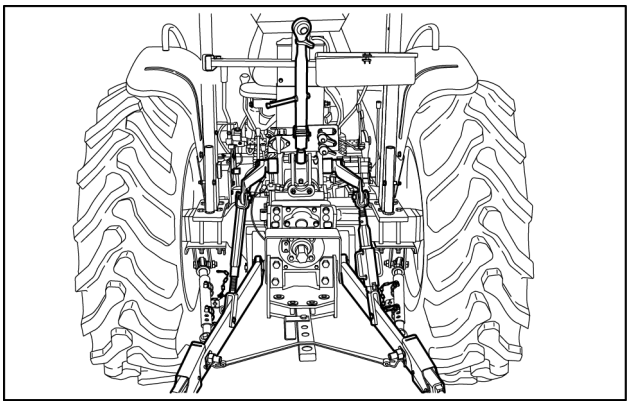
GNIL14TR04246AB 4

5. Disconnect hydraulic lines **(1)** on the hydraulic lift body.



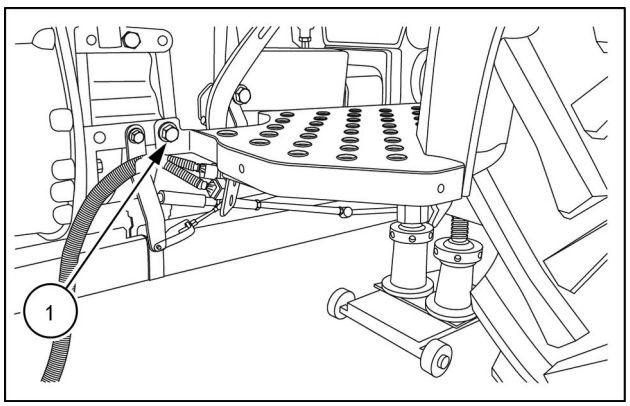
GNIL14TR00798AA 5

6. Remove three point linkages from the tractor.



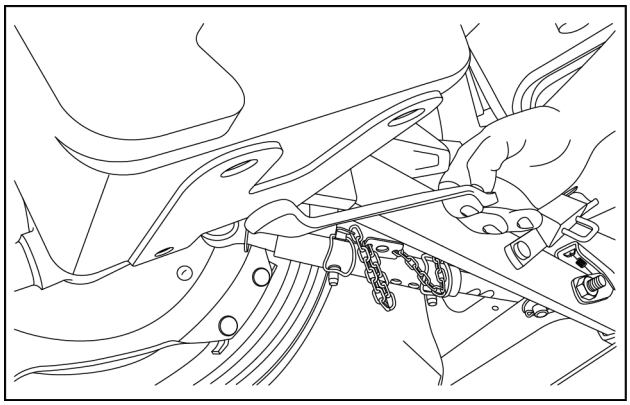
GNIL14TR00562AA 6

7. Loosen bolts securing foot rest to fender on both sides.



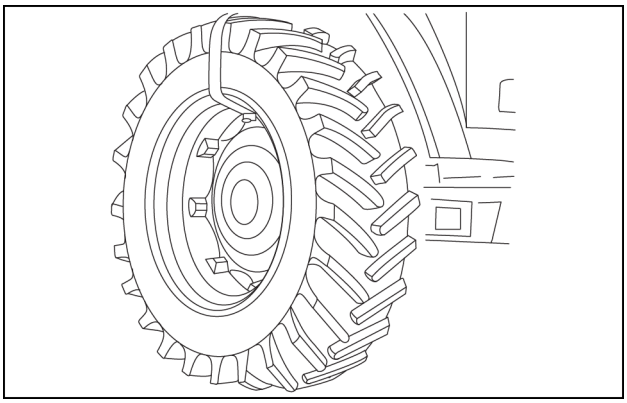
GNIL14TR00767AA 7

8. Place the wedges at front and back on both sides of front tires.
9. Jack up rear axle of the tractor and place two suitable stands under transmission housing to raise the wheels off the ground.
10. Drain oil from the transmission housing.



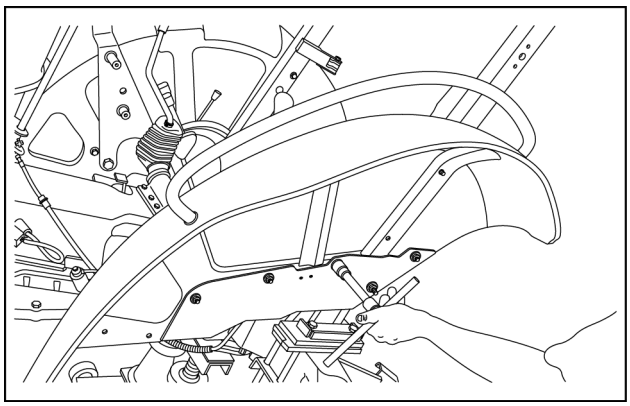
GNIL14TR00564AA 8

11. Remove both left and right-hand side wheels.



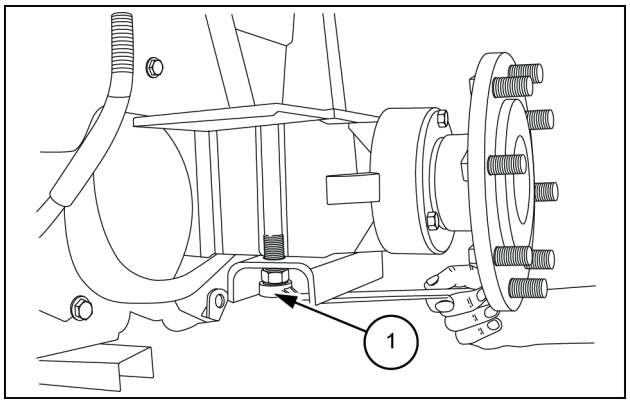
GNIL14TR04252AA 9

12. Loosen the bolts and remove fenders from both sides.



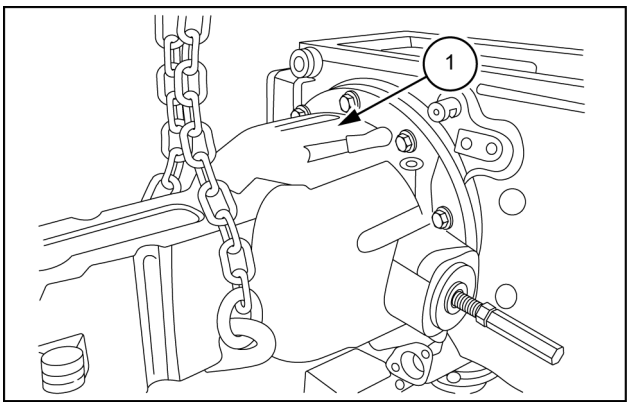
GNIL14TR00790AA 10

13. Loosen the bolts **(1)** and remove ROPS.



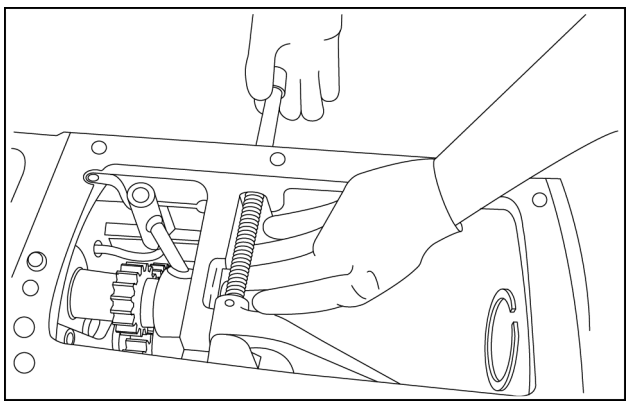
GNIL14TR04251AA 11

14. Wrap suitable chain or nylon rope on the final drive housing **(1)** and connect it to a hoist. Loosen attaching bolts and remove the entire final drive.



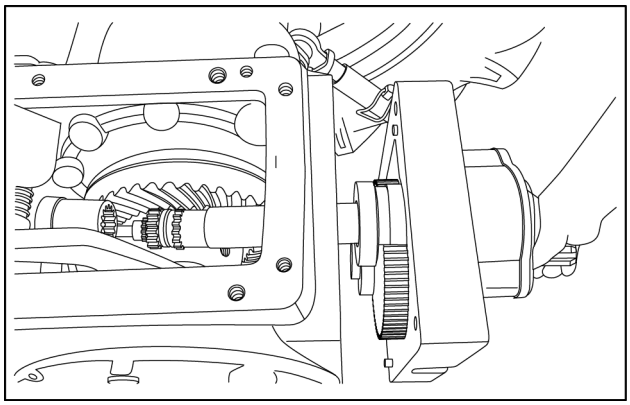
GNIL14TR04253AB 12

15. Repeat for the final drive housing on the other side.
16. Remove the cover plate by removing Allen screw **(1)** and remove cover plate **(2)**. Retrieve oil rings 2 numbers from the housing and cover plate respectively.
17. Loosen the bolts securing hydraulic lift housing to transmission housing. Lift the hydraulic lift assembly using suitable hoist and place it on a flat surfaced table.
18. Remove Power Take-Off (PTO) engaging levers and differential lock.



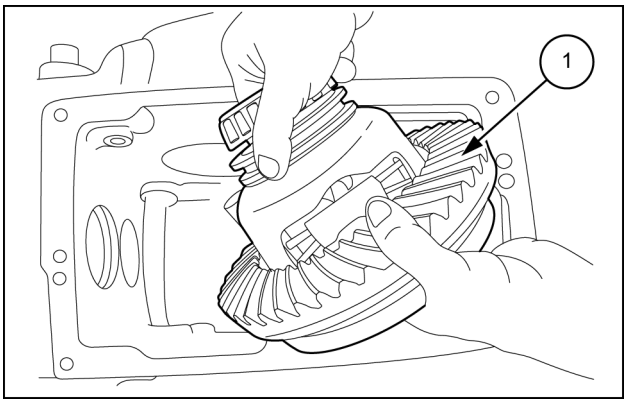
GNIL14TR04255AA 13

19. Remove PTO RPM sensor cable. Loosen the rear Power Take-Off (PTO) cover bolts and pull out the cover along with Power Take-Off (PTO) shaft and Power Take-Off (PTO) input shaft assembly. See **Rear mechanical control - Remove (31.101)**.



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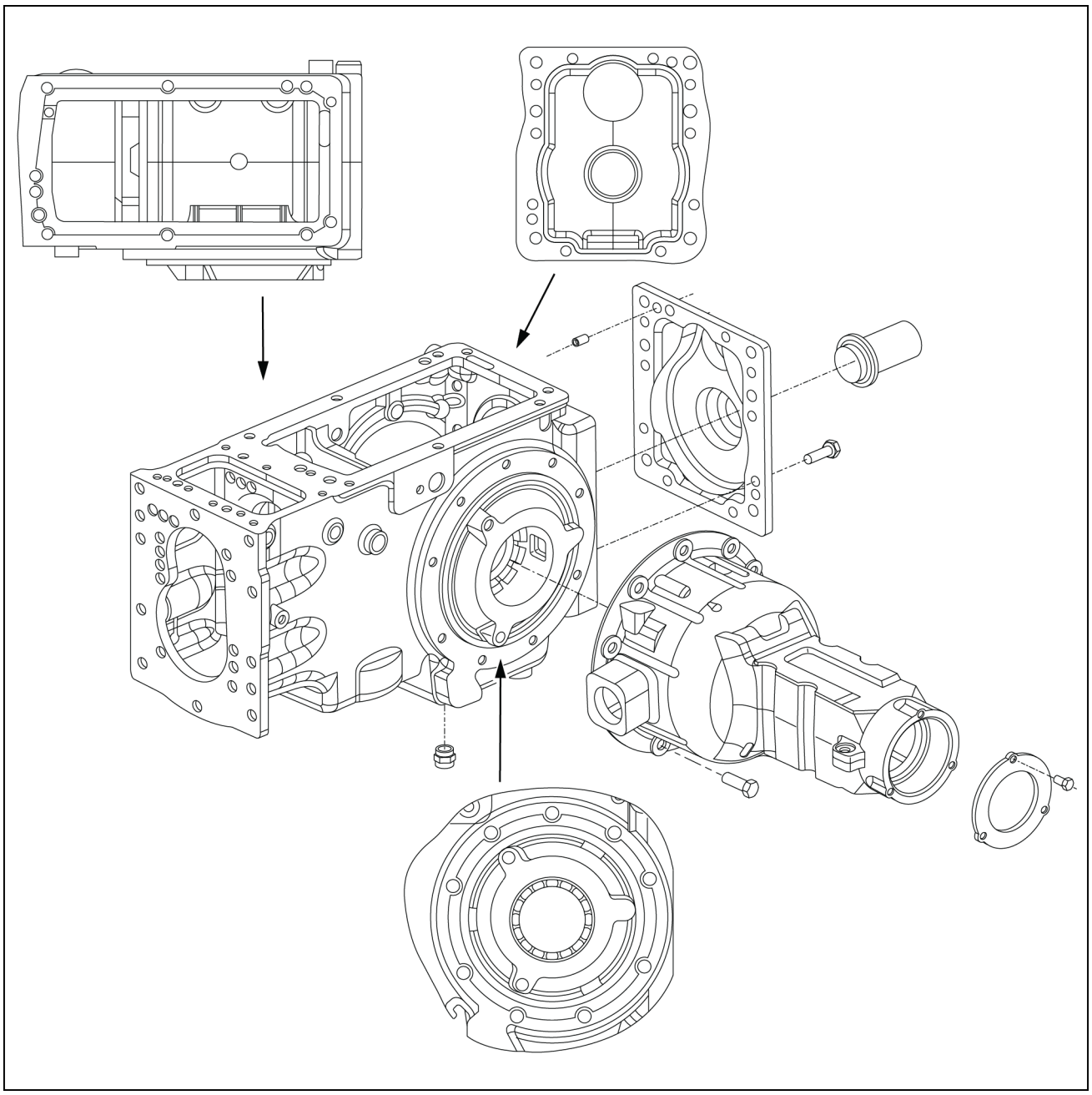
20. Take out the differential assembly along with crown wheel.



GNIL14TR04258AB 15

Rear bevel gear set and differential - Install

1. Re-install the differential housing observing the following.
   - Re-assembly follows the disassembly procedure in reverse. See **Rear bevel gear set and differential - Install (27.106)**.
   - Check seals and replace if damaged.
   - Before reassembling housings supports and covers thoroughly clean and degrease mating surfaces and apply a bead of liquid gasket of approx. **2.000 mm** (**0.079 in**) of diameter following the patterns shown in the figure.
   - Tighten to correct torques.
   - Preload tapper roller bearings by adding and removing shims and set crown pinion backlash by following the procedure given below.



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Pattern for application of sealant during installation of Power Take-Off (PTO) cover, final drive housing and mechanical lift housing.

- Check the backlash with the help of dial gauge. Permissible backlash is **0.180 - 0.230 mm** (**0.007 - 0.009 in**), if it is less than tighten left-hand side ring nut after slightly loosening right-hand side ring nut.
- If it is more than **0.180 - 0.230 mm** (**0.007 - 0.009 in**) then first loosen left-hand side ring nut and then tighten right-hand side ring nut.

Differential - Disassemble

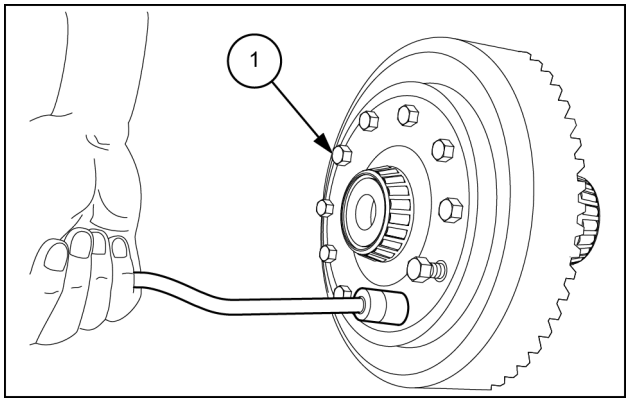
⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

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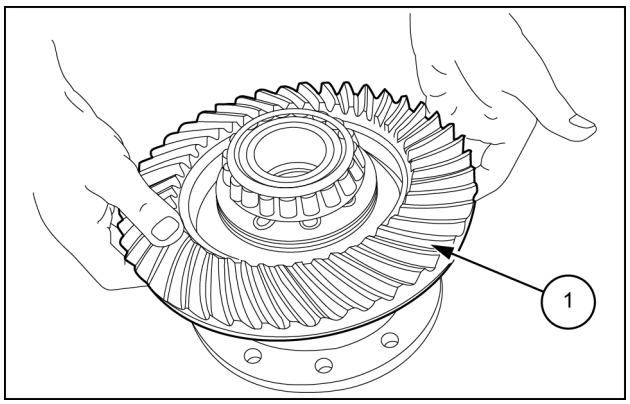
With the assembly removed from the rear axle housing proceed as follows:

1. Loosen the crown wheel attaching bolts **(1)**.



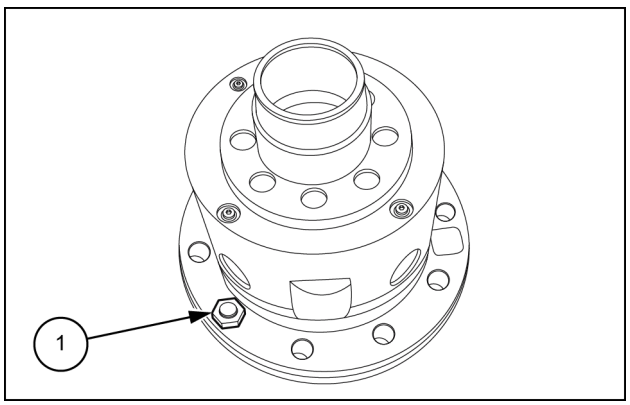
GNIL14TR04260AB 1

2. Detach the crown wheel **(1)** from the differential housing.



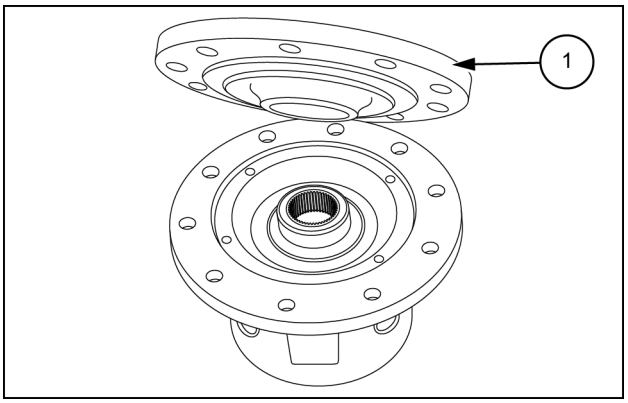
GNIL14TR04261AB 2

3. Loosen and remove all the bolts **(1)** from the casing.



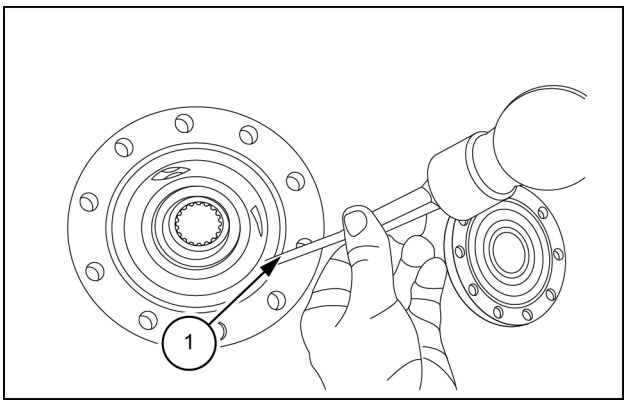
GNIL14TR04262AB 3

4. Lift the cover **(1)** as shown to get access to differential gears.



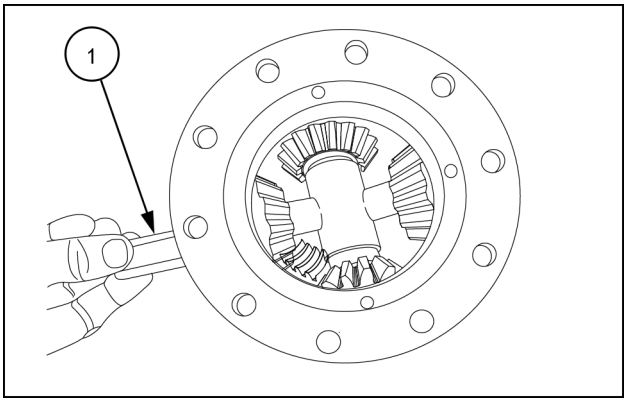
GNIL14TR04263AB 4

5. Remove the locking pin **(1)** locking the differential gear pivot pin.



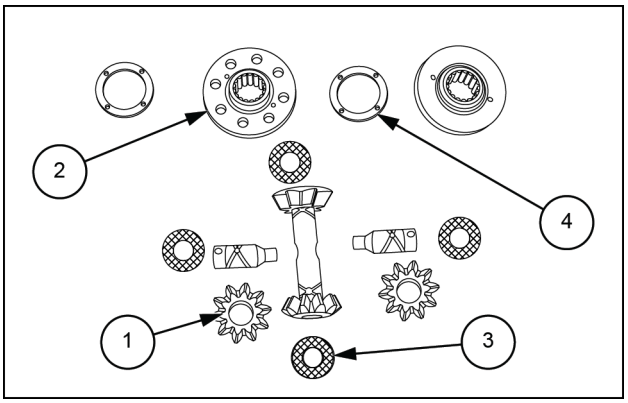
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6. Remove the pivot pin **(1)** and withdraw the side gears from the differential housing along with trust washer.



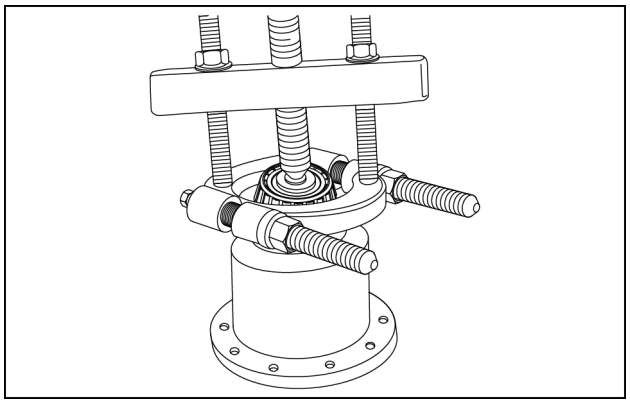
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NOTE: *Four differential gear **(1)** and side gear **(2)** have thrust washers with same thickness.*



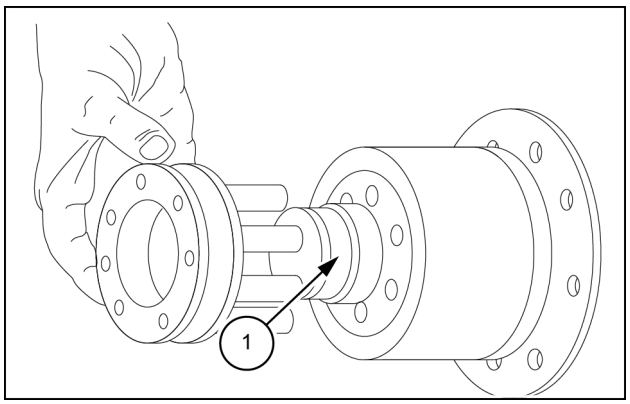
GNIL14TR04266AB 7

7. Using suitable puller special tool number 291051 and 291052 remove the bearings from both the sides.



GNIL14TR04267AA 8

8. Remove the differential lock clutch from the housing.



GNIL14TR04268AB 9

Differential - Inspect

Inspect all gears thrust washers bearings for any kind of damages or wear. Replace if necessary.

Differential - Assemble

⚠ CAUTION

Pinch hazard!
Always use suitable tools to align mating parts. DO NOT use your hand or fingers.
Failure to comply could result in minor or moderate injury.

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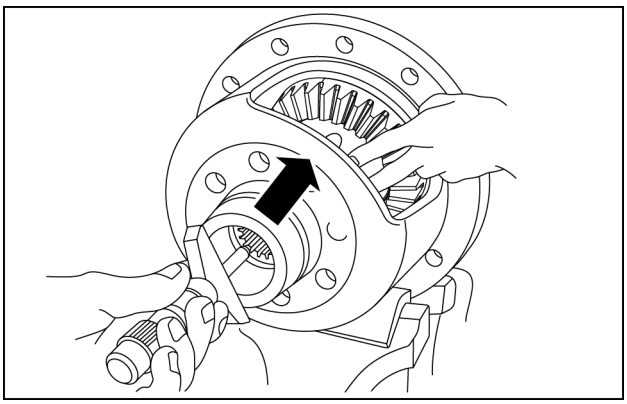
Re-install all the components of the differential assembly observing the following.

- Re-assembly follows the disassembly procedure in reverse.. See **Differential - Disassemble (27.106)**.
- Set crown or pinion backlash and total preload setting. See **Differential - Backlash (27.106)**.
- Use suitable tools to fit bearings.
- Tighten to correct torques.
- Use thread sealant **LOCTITE® 243™** on crown wheel bolts.
- Set sun star backlash to **0.180 - 0.250 mm** (**0.007 - 0.010 in**).

Differential - Backlash

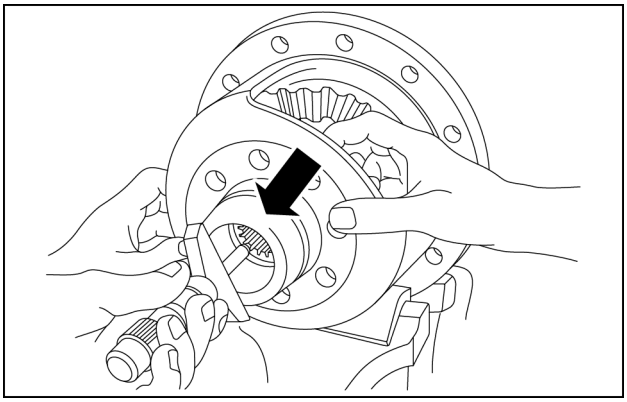
Differential pinion and side gear backlash adjustment

Fit the two side gears **(15)** in the differential carrier without the shims **(12)**.
Install differential pinions **(13)** complete with thrust washer **(14)** and journal **(3)** and tighten bolts **(1)** a few turns to prevent journal work out.
Bring left-hand side gear into full contact with differential pinion.
Using a depth gauge measure dimension **(H1)** at two diametrically opposed points and average the two readings.



GNIL14TR04269AB 1

Then push side gear into contact with differential carrier and measure dimension **(H2)**.
Repeat the same operations on right-hand side gear.
End float of each side gear without the baulk ring must be:
Gs or Gd = H1 - H2
where:
Gs = Left-hand side gear end float.
Gd = Right-hand side gear end float.
H1 and H2 = Dimensions measured on left-hand side or right-hand side gears.
Normal differential pinion and side gear backlash is **0.15 mm** (**0.01 in**).
Note that the average ratio normal backlash to the equivalent side gear end float is 1 to 1.7.
Side gear end float corresponding to normal backlash will be:
0.15 x 1.8 = **0.250 mm** (**0.010 in**).
Consequently the shim thickness required in the differential carrier is given by:
Ss = Gs - 0.25 (for left-hand side gear)
Sd = Gd - 0.25 (for right-hand side gear)
Available shims are **1.200 - 2.000 mm** (**0.047 - 0.079 in**).
Install closest to calculated thickness.

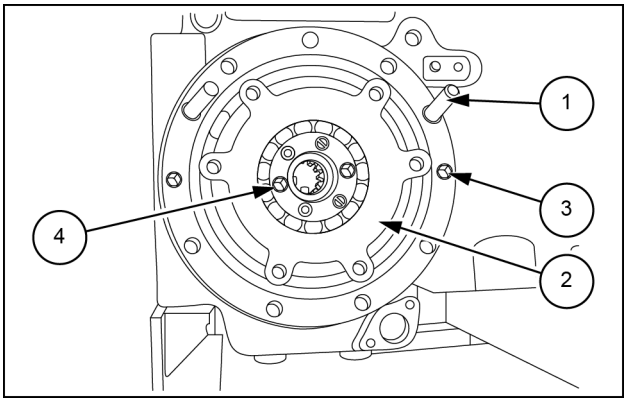


GNIL14TR04270AB 2

Adjustment of bevel wheel bearings and crown pinion

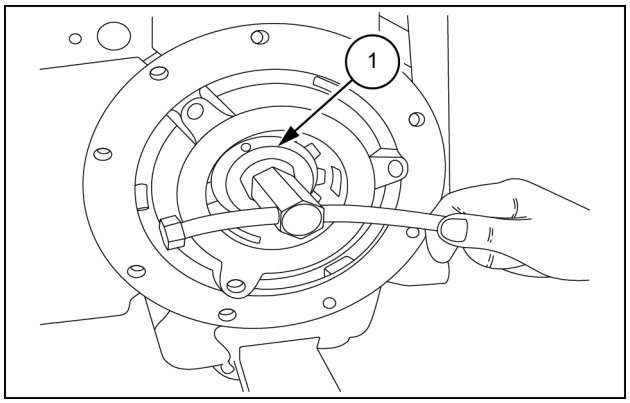
NOTE: *Place O-ring in the housing before fitting cover plate.*

1. Fit the locator pins **(1)** and fit the cover plate **(2)** tighten the plate with Allen screws **(3)**, screw out two Allen screws **(4)** and remove lock plate from both sides.



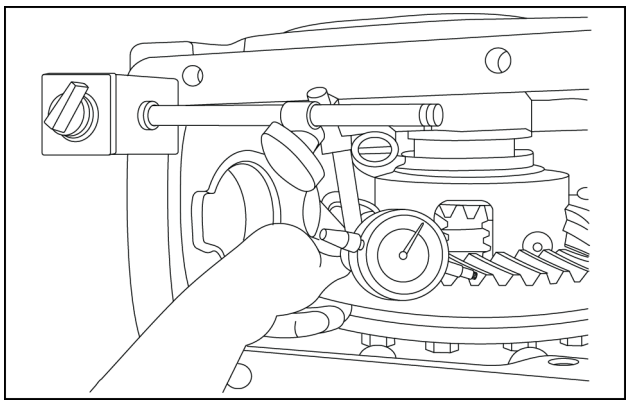
GNIL14TR04271AA 3

2. Tighten left-hand side ring nut **(1)** using special tool number 9971349 until minimum backlash between the bevel teeth is **1.000 mm** (**0.039 in**).



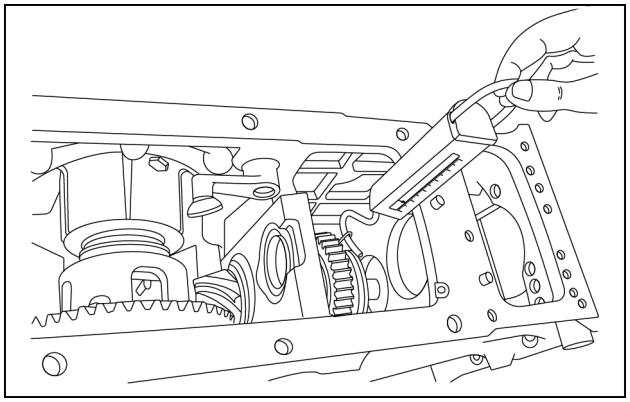
GNIL14TR04272AB 4

3. Measure the backlash using dial gauge and magnetic stand as shown in figure. Backlash to keep in between **0.180 - 0.230 mm** (**0.007 - 0.009 in**).



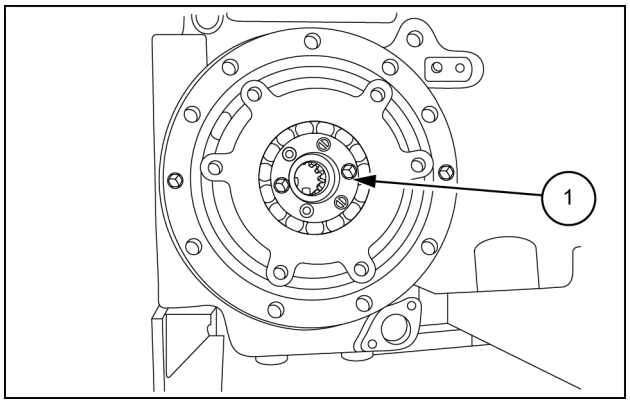
GNIL14TR04273AA 5

4. Measure the torque using a spring balance and chord wound around the sleeve of low gear it should be between **4.00 - 5.50 kgm** (**28.93 - 39.78 ftlbs**).



GNIL14TR04274AA 6

5. Fit the lock plate **(1)** back on bearing support apply thread lock sealant **LOCTITE® 243™** to the Allen screws.



GNIL14TR04275AA 7

Bevel pinion - Remove

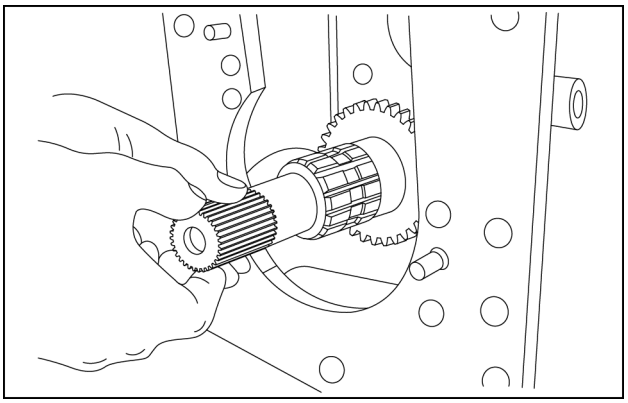
⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

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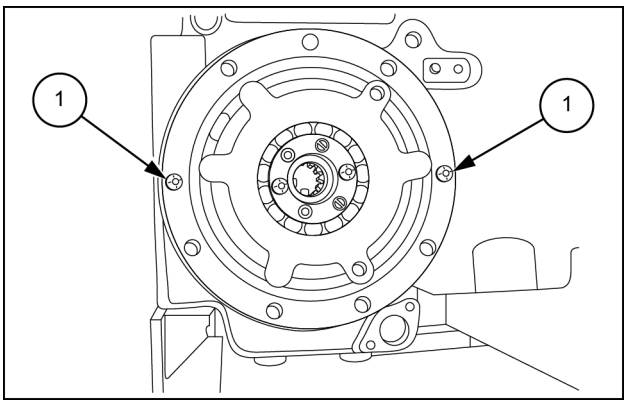
To remove the pinion shaft, it is necessary to remove the transmission housing, from the tractor following the procedure described under transmission assembly removal installation. Also it is required to remove Power Take-Off (PTO) cover and related components.

1. Remove the driven shaft, drive shaft and range shaft before dismantling pinion shaft.



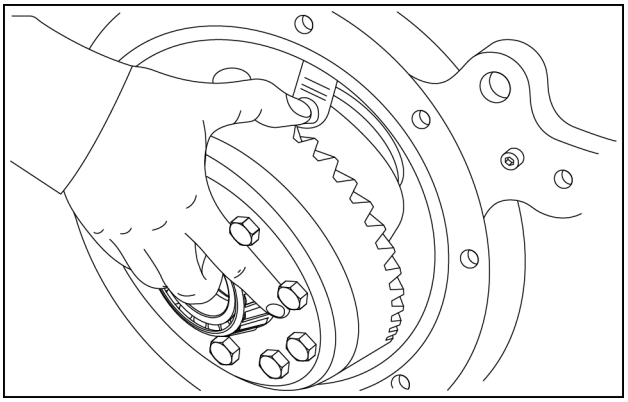
GNIL14TR04069AA 1

2. 1. To remove the crown wheel loosen set screws **(1)** from the cover plate.
   2. Remove crown wheel along with cover plate, retrieve rubber ring from the housing.



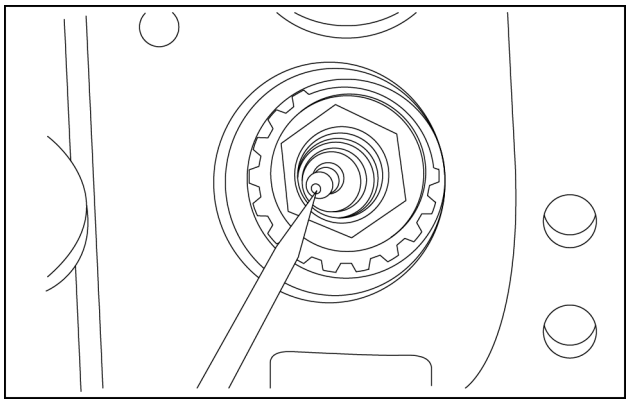
GNIL14TR04070AB 2

3. Remove the crown wheel along with differential housing.



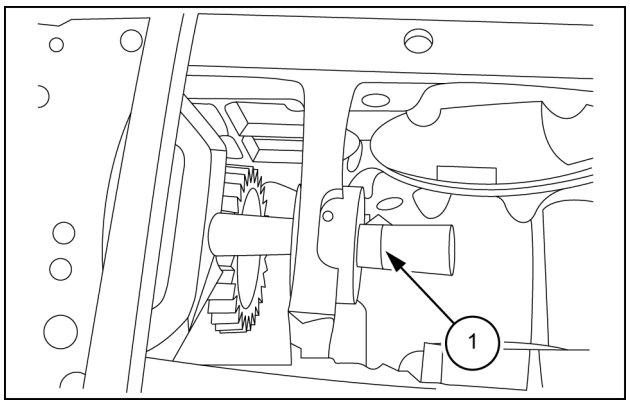
GNIL14TR04071AA 3

4. Open the lock of pinion locking check nut with the help of screw driver.



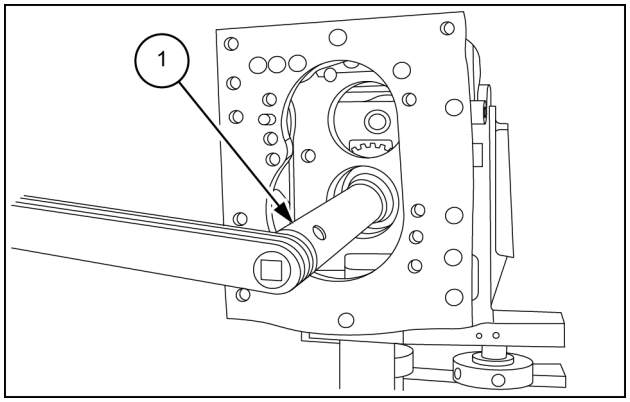
GNIL14TR04072AA 4

5. Fit pinion locking tool special tool **(1)** number 84261392.



GNIL14TR04073AB 5

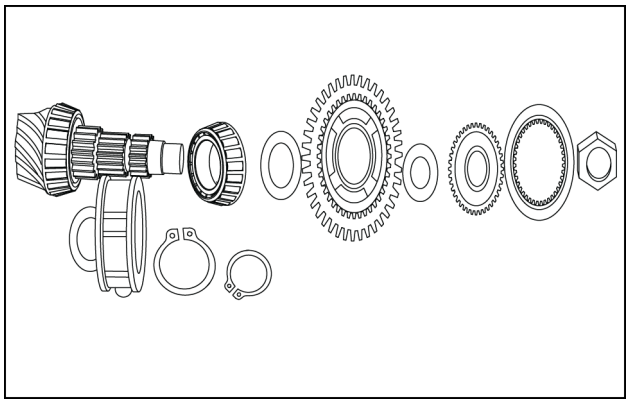
6. Remove the pinion shaft lock nut using special tool number 84261389.



GNIL14TR04074AB 6

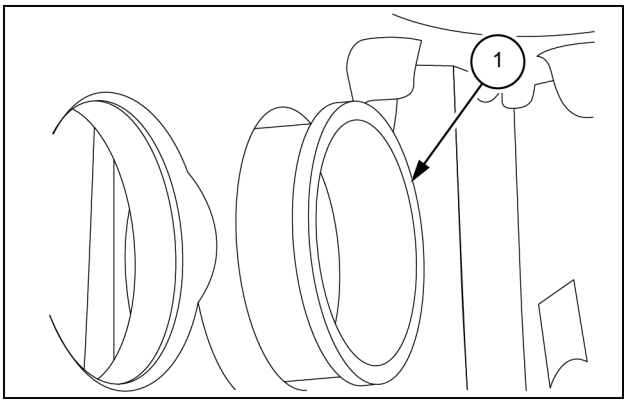
7. Withdraw pinion shaft from the differential housing and retrieve low gear, sleeve, coupling etc from the pinion shaft.

NOTE: *Keep deep cut of hub towards pinion check nut side.*



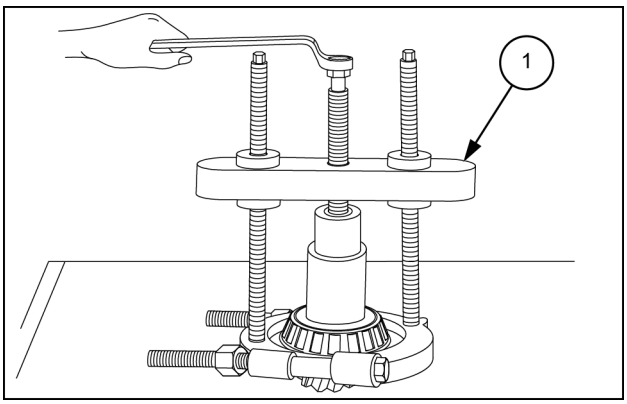
GNIL14TR04075AA 7

8. Remove the circlip lock of the Gama Basasa bearing to remove bearing cone **(1)** from the housing.



GNIL14TR04076AB 8

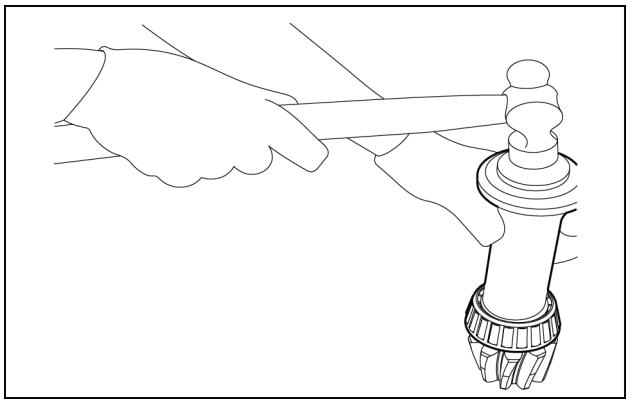
9. Remove bearing from the pinion shaft using special tool number 291051 and 291052.



GNIL14TR04077AB 9

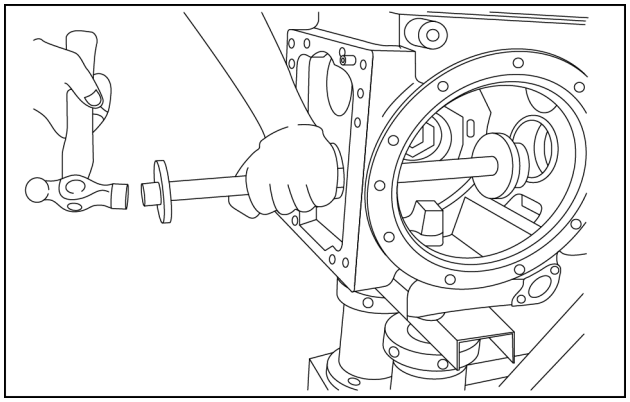
Bevel pinion - Install

1. Install the bearing on pinion.



GNIL14TR04078AB 1

2. Fit the outer cone of Gama Bassa bearing and fit circlip lock.

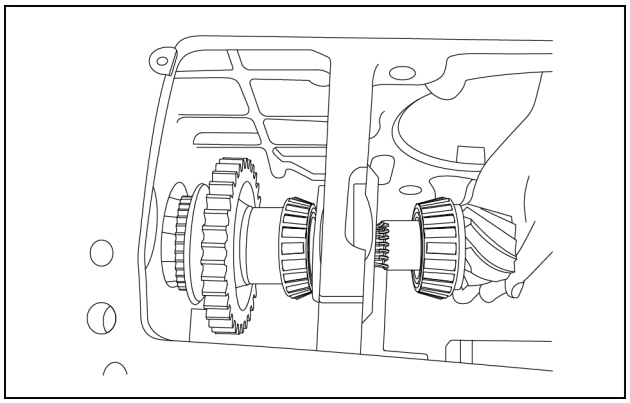


GNIL14TR04079AA 2

3. Fit pinion shaft along with hub range, sliding sleeve, bush and low gear as shown.

NOTE: *Fit small spacer keeping cuts towards pinion teeth side, also big spacer cut towards similarly.*

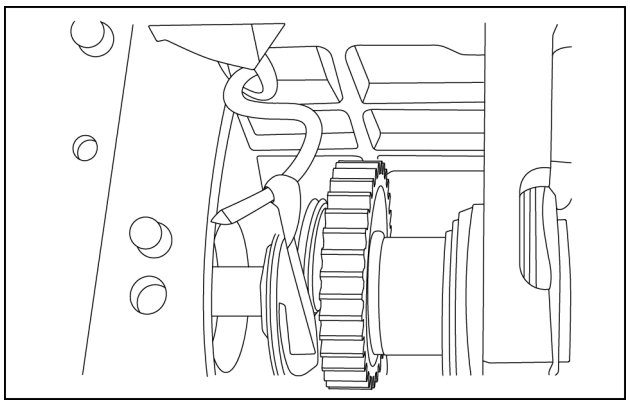
NOTE: *Keep deep portion of low gear hub, towards pinion check nut side. After fitment check low gear it should rotate free.*



GNIL14TR04080AA 3

4. After fitting pinion, tighten pinion check nut at **28 kgm** (**203 ftlbs.**) and check pinion bearing preload by wrapping a cord around low gear hub with the help or spring balance it should be **2.5 - 3.0 kgm** (**18.1 - 21.7 ftlbs.**).

NOTE: *If recommended preload not comes, hammer pinion using aluminium rod lock pinion check not, and check again.*



GNIL14TR04081AA 4

Rear bevel gear set and differential - Troubleshooting

Problem	Possible Cause	Correction
Noisy rear axle when the tractor is moving and also when transmission in neutral (not originating from final drives)	1. Pinion and/or ring gear bearing wrong adjustment	Remove rear axle housing and adjust pinion and ring gear bearings correctly
	2. Excess differential side gears to half-shaft spline backlash	Remove rear axle housing and replace damaged parts
Noisy rear axle with tractor under load and upon release	1. Excess bevel pinion to ring gear backlash	Remove rear axle housing and adjust bevel pinion and ring gear bearings correctly
	2. Fault or defective inner components	Remove rear axle housing, replace worn parts and adjust differential gear backlash correctly
Noisy rear axle with overheating	1. Insufficient pinion and/or ring gear bearing backlash	Remove rear axle housing and adjust bevel pinion and ring gear bearings correctly
	2. Insufficient bevel pinion to ring gear tooth backlash	Remove rear axle housing and adjust ring gear bearings correctly

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Index

Rear axle system - 27

Rear bevel gear set and differential - 106

Bevel pinion - Install 24
Bevel pinion - Remove 21
Differential - Assemble 18
Differential - Backlash 19
Differential - Disassemble 14
Differential - Inspect 17
Rear bevel gear set and differential - General specification 3
Rear bevel gear set and differential - Install 12
Rear bevel gear set and differential - Remove 7
Rear bevel gear set and differential - Sealing 4
Rear bevel gear set and differential - Sectional view 6
Rear bevel gear set and differential - Special tools 4
Rear bevel gear set and differential - Torque 3
Rear bevel gear set and differential - Troubleshooting 25

https://truckmanualshub.com/

Rear axle system - 27

Planetary and final drives - 120

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Rear axle system - 27

Planetary and final drives - 120

TECHNICAL DATA

Planetary and final drives
General specification 3

FUNCTIONAL DATA

Final drive housing
Sectional view 4

SERVICE

Final drive housing
Disassemble 5
Assemble 12

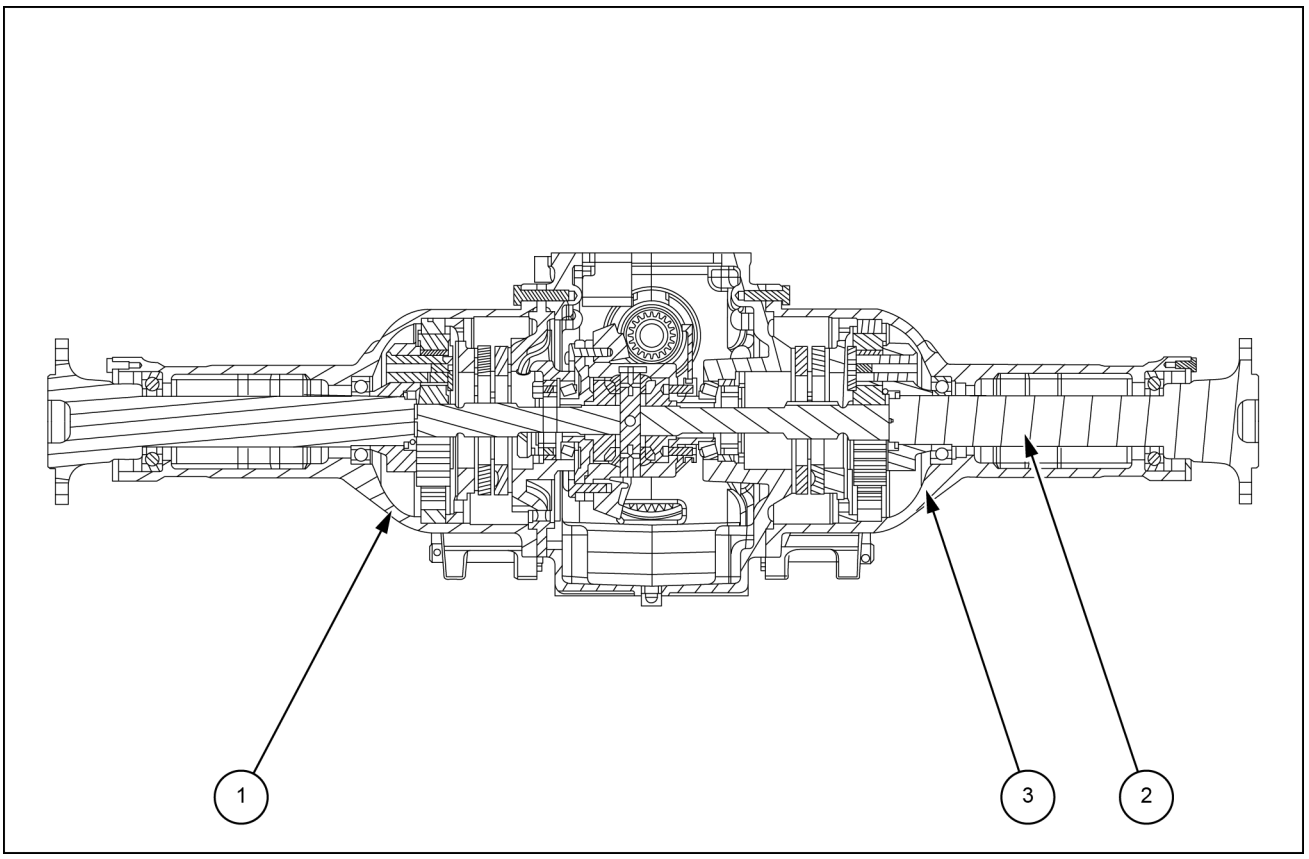
DIAGNOSTIC

Final drive housing
Troubleshooting 13

Planetary and final drives - General specification

Type	Epicyclic
Reduction ratio	**6.550 mm** (**0.258 in**)

Final drive housing - Sectional view



GNIL14TR04242FB 1

Final drive

1. Trumpet housing
2. Rear wheel shaft
3. Planet gear

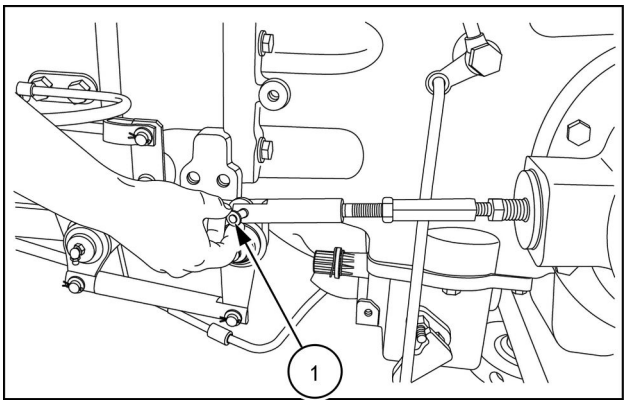
Final drive housing - Disassemble

⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

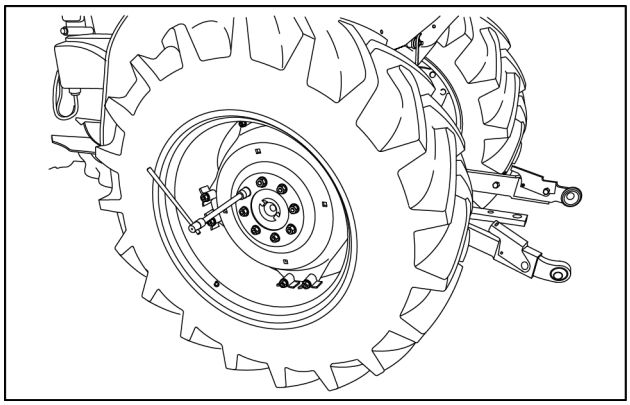
W0208A

1. Remove the pin **(1)** and disconnect the brake linkage.



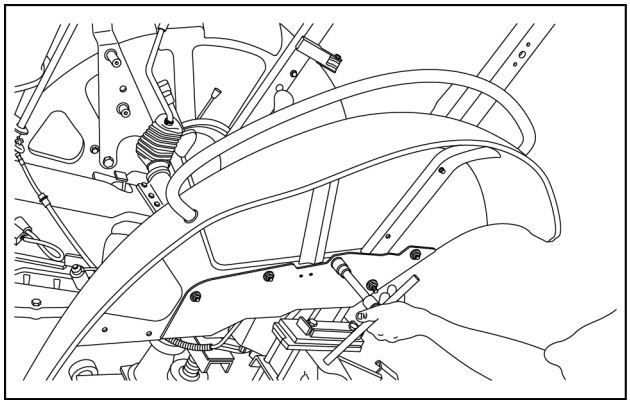
GNIL14TR00789AA 1

2. Loosen the bolts and remove the rear wheel.



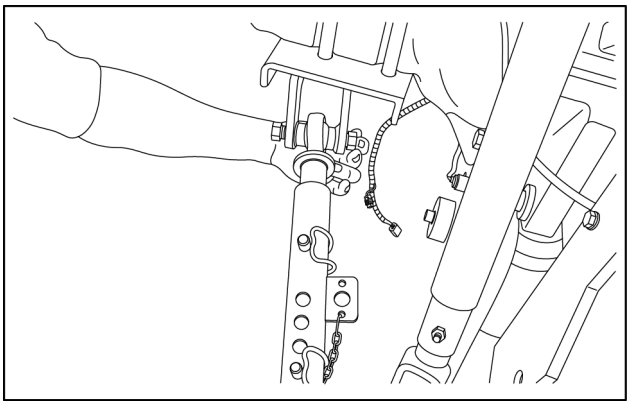
GNIL14TR00866AA 2

3. Loosen the bolts and remove fender.



GNIL14TR00790AA 3

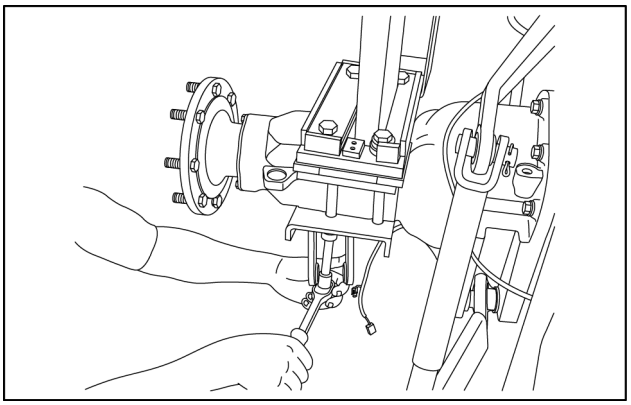
4. Remove the check chain and lower link of the three point linkage.



GNIL14TR00864AA 4

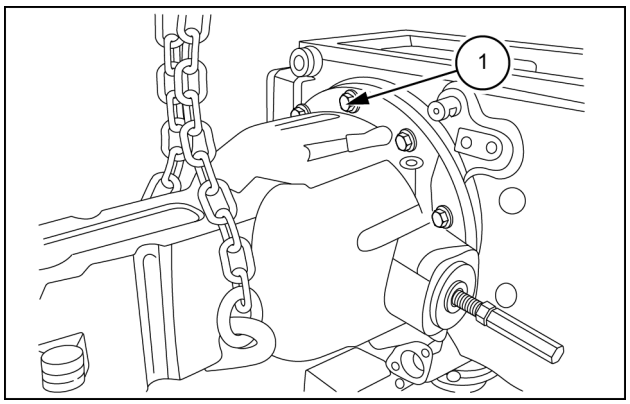
5. Remove the ROPS (Roll Over Protective Structure).

NOTE: *Use a suitable hoist.*



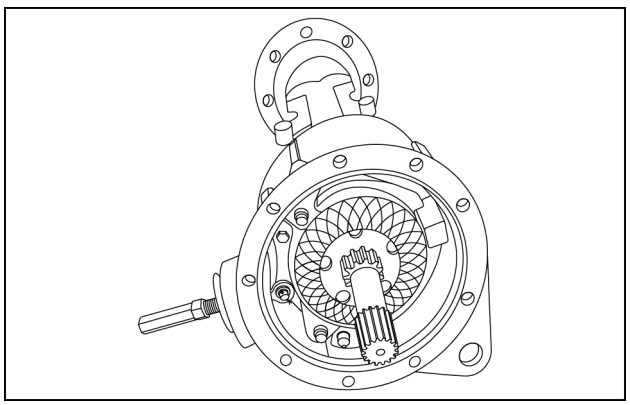
GNIL14TR00865AA 5

6. 1. Wrap chain around final drive housing and loosen bolts **(1)**.
   2. Remove the final drive housing.



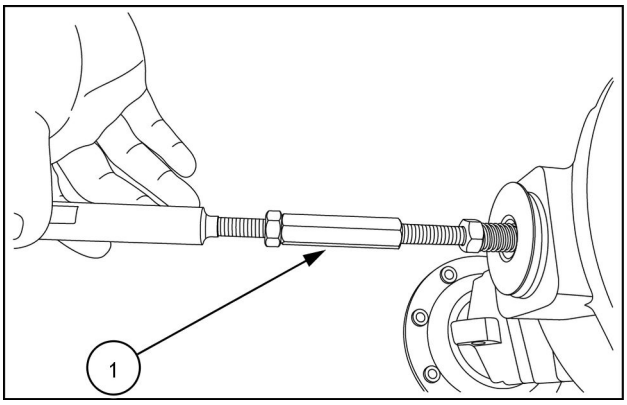
GNIL14TR04276AB 6

7. Place the trumpet housing assembly on plane surface.



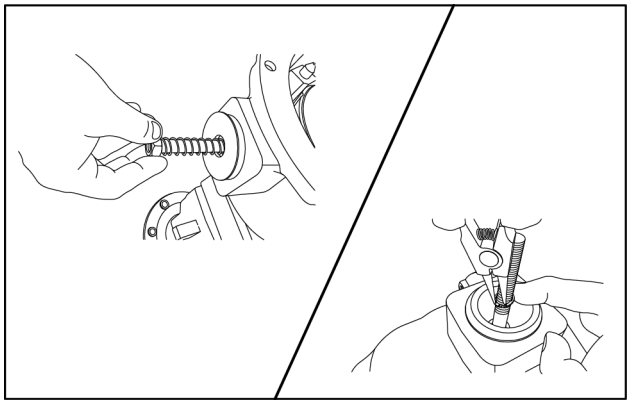
GNIL14TR04336AA 7

8. Remove the linkage **(1)**.



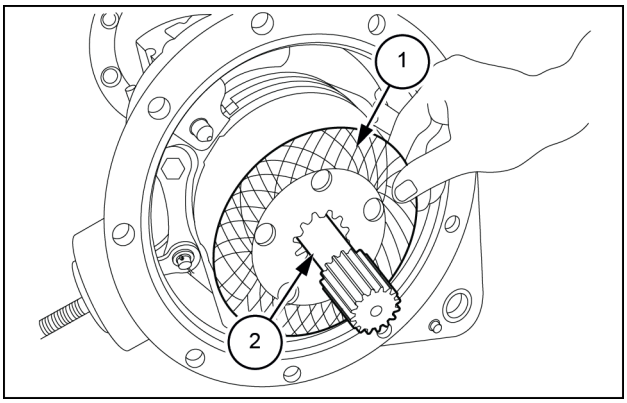
GNIL14TR00792AA 8

9. Remove the nut and spring. Remove the circlip.



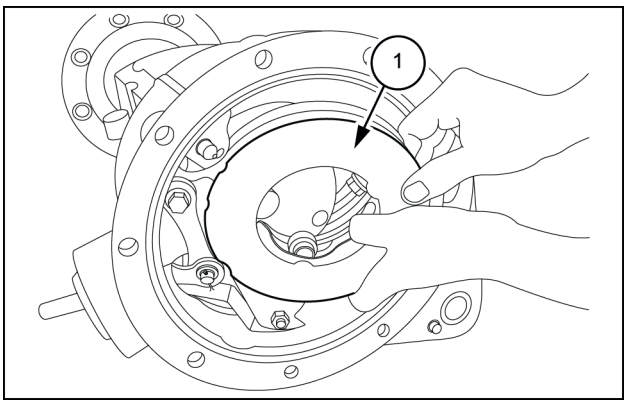
GNIL14TR00791AA 9

10. Remove brake disc **(1)** and shaft **(2)**.



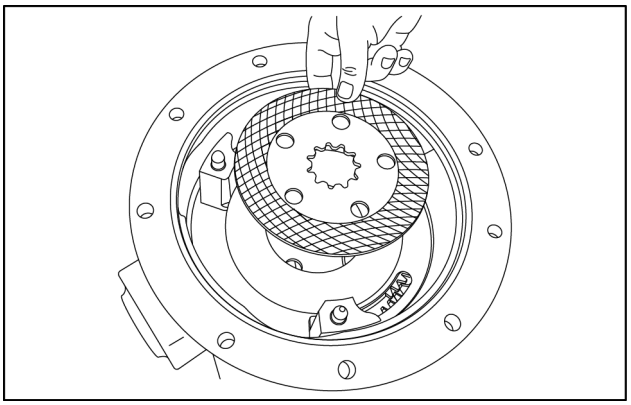
GNIL14TR04277AB 10

11. Remove the brake actuator assembly **(1)**.



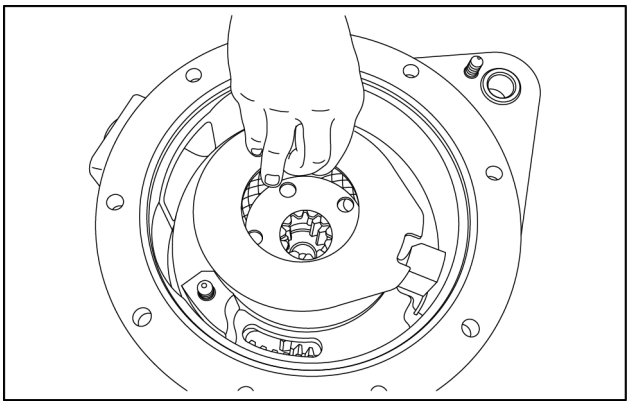
GNIL14TR04278AB 11

12. Remove second brake disc.



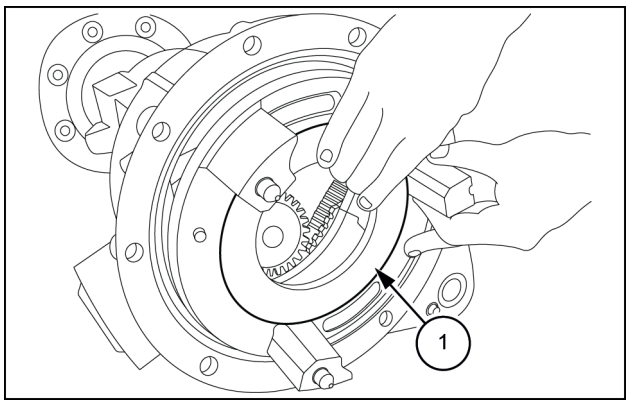
GNIL14TR00779AA 12

13. Remove intermediate plate and third brake disc.



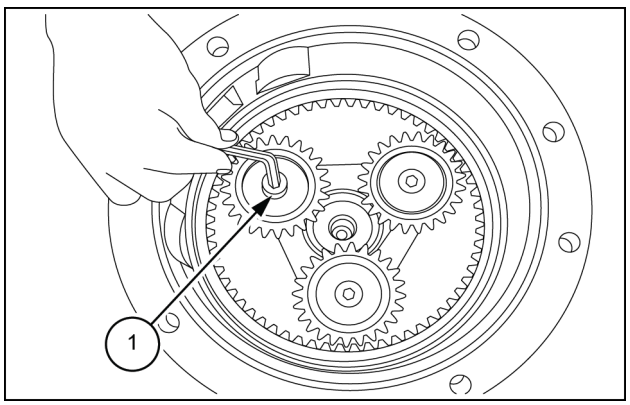
GNIL14TR00780AA 13

14. Remove dual brake support **(1)** as shown.



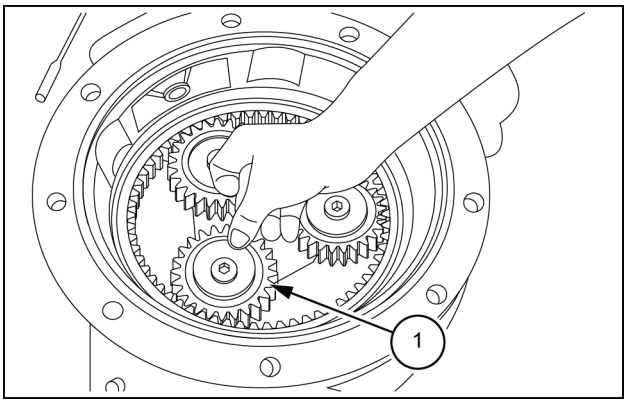
GNIL14TR04279AB 14

15. Remove the set screw **(1)** holding the cover for road wheel shaft.



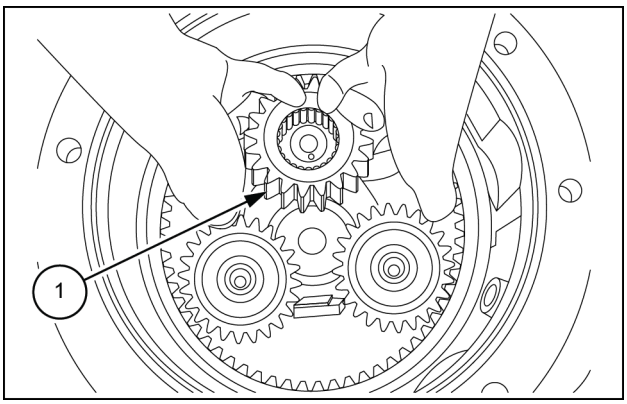
GNIL14TR04280AB 15

16. Remove spacers **(1)** planet final drive.



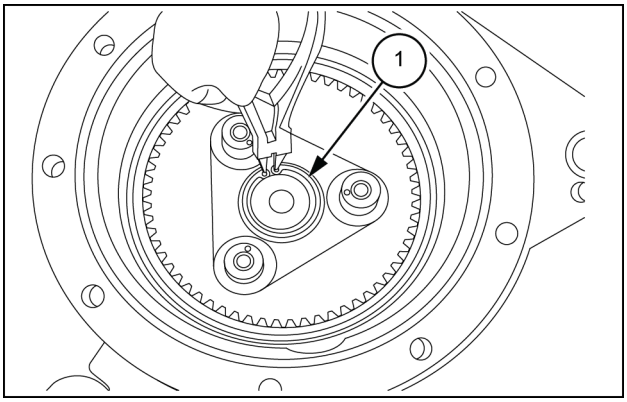
GNIL14TR04281AB 16

17. Remove all three planet gears along with needle bearings.



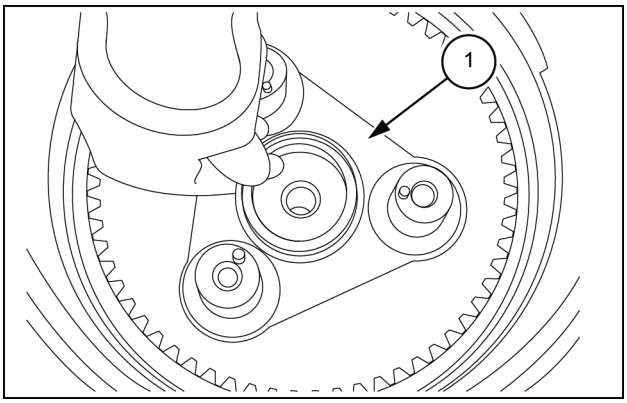
GNIL14TR04282AB 17

18. Remove the circlip lock **(1)** of planet carrier sub assembly.



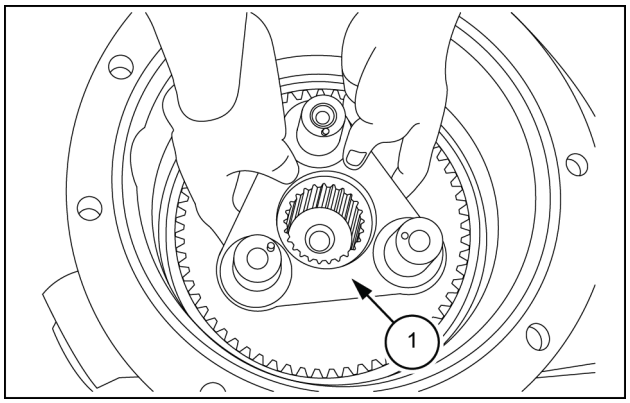
GNIL14TR04283AB 18

19. Remove the spacer and shims **(1)**.



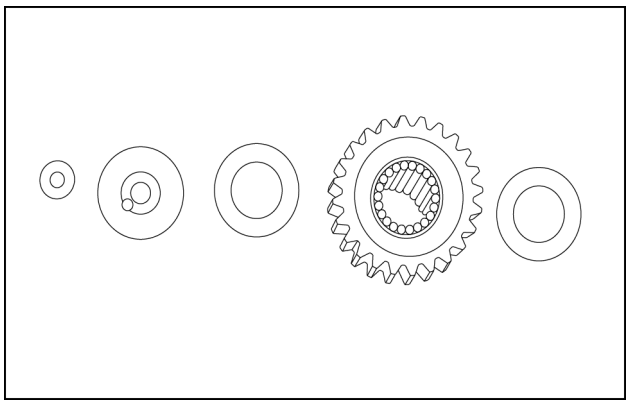
GNIL14TR04284AB 19

20. Remove planet carrier sub assembly **(1)**.



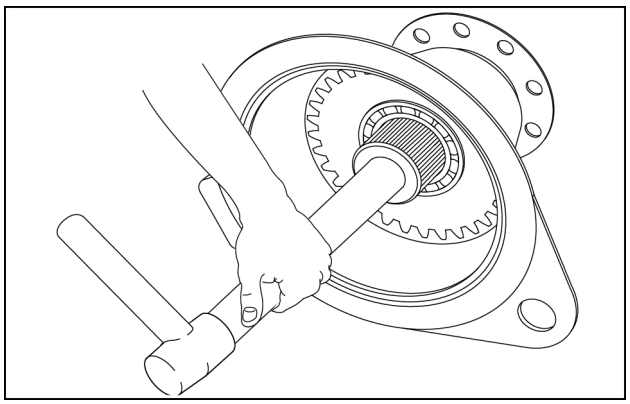
GNIL14TR04285AB 20

21. Check planet gear spacers and needle bearings for damage, replace if found worn out.



GNIL14TR04286AA 21

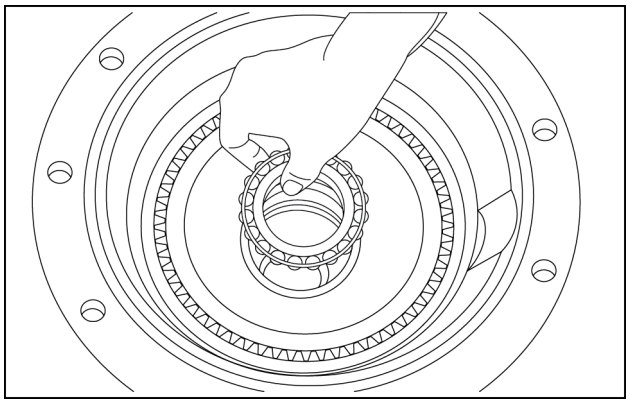
22. Hammer the wheel axle shaft out of the final drive housing.



GNIL14TR04287AA 22

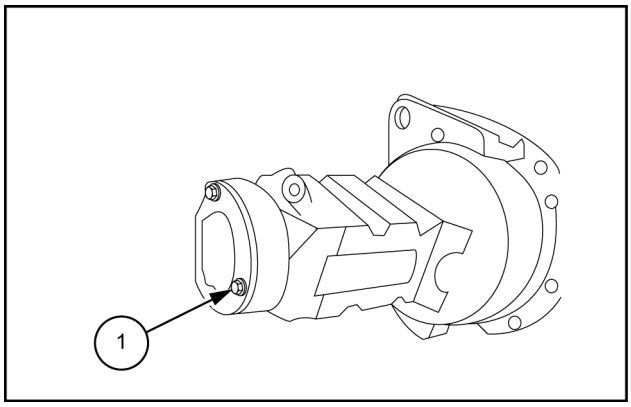
23. Retrieve the taper roller bearing.

NOTE: *Ball bearings are fitted in low duty trumpet housing.*



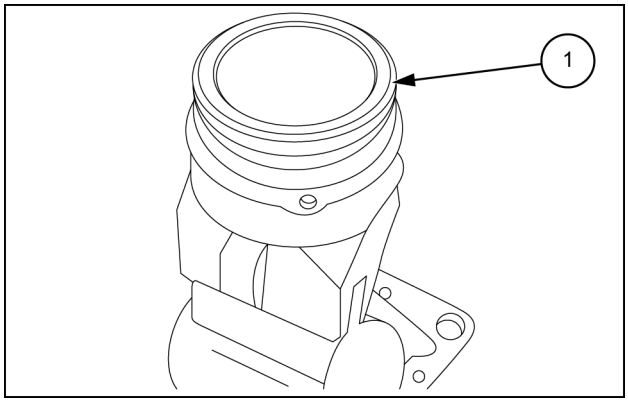
GNIL14TR04288AA 23

24. Loosen the three bolts of mud protection cover from the final drive housing.



GNIL14TR04289AB 24

25. Retrieve oil seal from the housing.

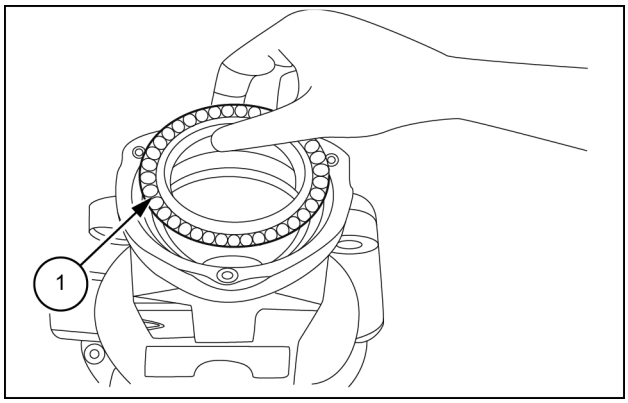


GNIL14TR04290AA 25

26. Retrieve the taper roller bearing, external spacer seal and oil seal from the trumpet.

NOTE: *During assembly insert bearing spacer over bearing manually in heavy duty drive line.*

NOTE: *Ball bearing is fitted in low duty trumpet housing.*



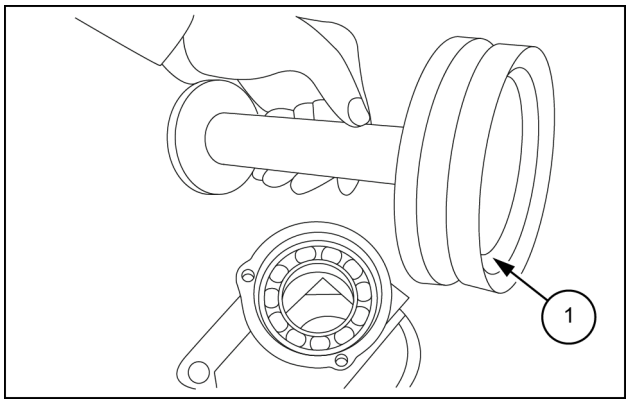
GNIL14TR04291AB 26

Final drive housing - Assemble

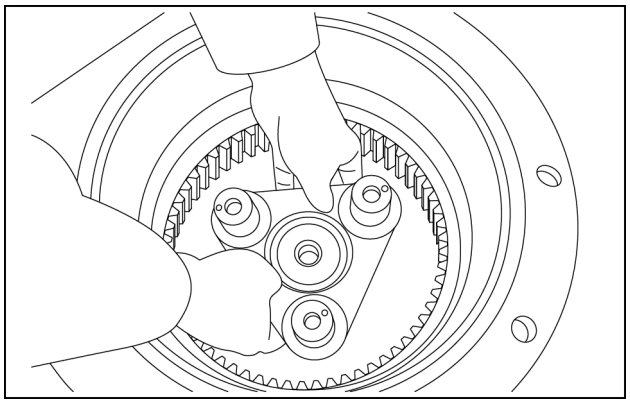
Reinstall wheel and axle shaft in final drive housing observing the following:

- Re assembling follows the removal procedure. See **Final drive housing - Disassemble (27.120)**.
- Refer to figure for correct orientation of the shafts bearings sleeves and seals.
- Check seals and replace if damaged.
- Fit final drive housing oil seal back, by using the special tool number 84261386.
- Check planet carrier after fitting circlip lock on axle for free play. If notice any free play remove circlip lock and place suitable shim below the spacer, so as to eliminate free play completely.

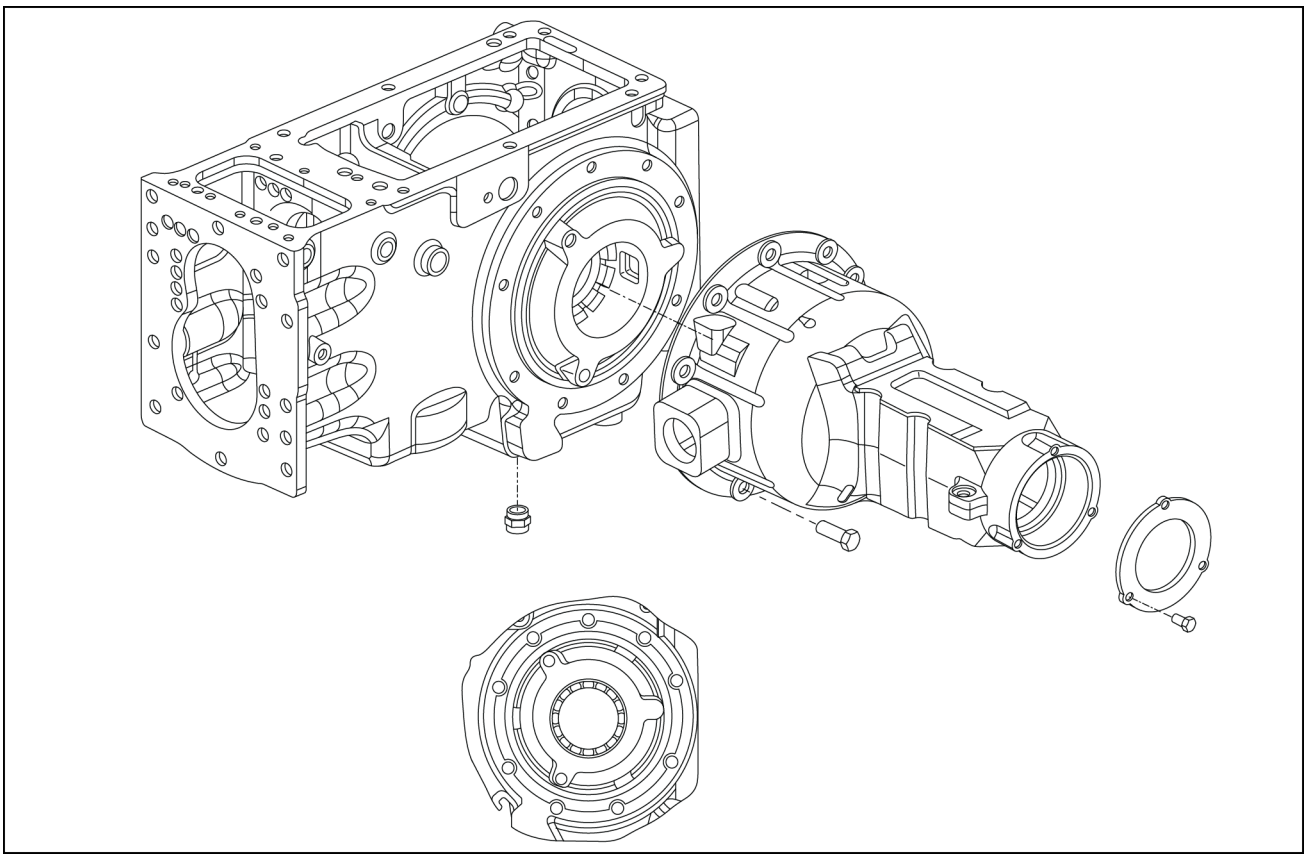
  NOTE: *In low duty trumpet housing bearing preload is not required.*
- Before reassembling housing and covers thoroughly clean and de-grease mating surfaces and apply a **2.00 mm** (**0.08 in**) bead of sealant following the pattern shown in the figure.



GNIL14TR04292AB 1



GNIL14TR04293AA 2



GNIL14TR04294FA 3

Final drive housing - Troubleshooting

Problem	Possible Cause	Correction
Noisy final drives when the tractor is moving and also with transmission in neutral	1. Wheel axle shaft bearing badly adjusted	Remove final drive case and adjust bearings
	2. Faulty or defective inner components.	Remove final drive case and replace damaged parts
	3. Excess bull and pinion gear backlash	Remove final drive case and replace damaged parts

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Index

Rear axle system - 27

Planetary and final drives - 120

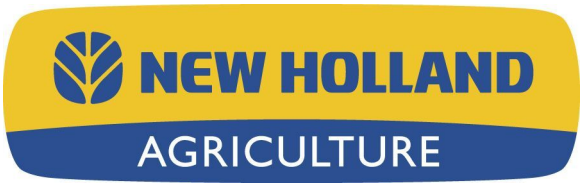
Final drive housing - Assemble 12
Final drive housing - Disassemble 5
Final drive housing - Sectional view 4
Final drive housing - Troubleshooting 13
Planetary and final drives - General specification 3

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SERVICE - Technical Publications & Tools



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SERVICE MANUAL

Power Take-Off (PTO)

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

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Contents

Power Take-Off (PTO) - 31

[31.101] Rear mechanical control 31.1

[31.110] One-speed rear Power Take-Off (PTO) 31.2

[31.114] Two-speed rear Power Take-Off (PTO) 31.3

https://truckmanualshub.com/

Power Take-Off (PTO) - 31

Rear mechanical control - 101

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Power Take-Off (PTO) - 31

Rear mechanical control - 101

TECHNICAL DATA

Rear mechanical control
General specification 3
Torque 3
Sealing 4
Special tools 5

FUNCTIONAL DATA

Rear mechanical control
Sectional view 6

SERVICE

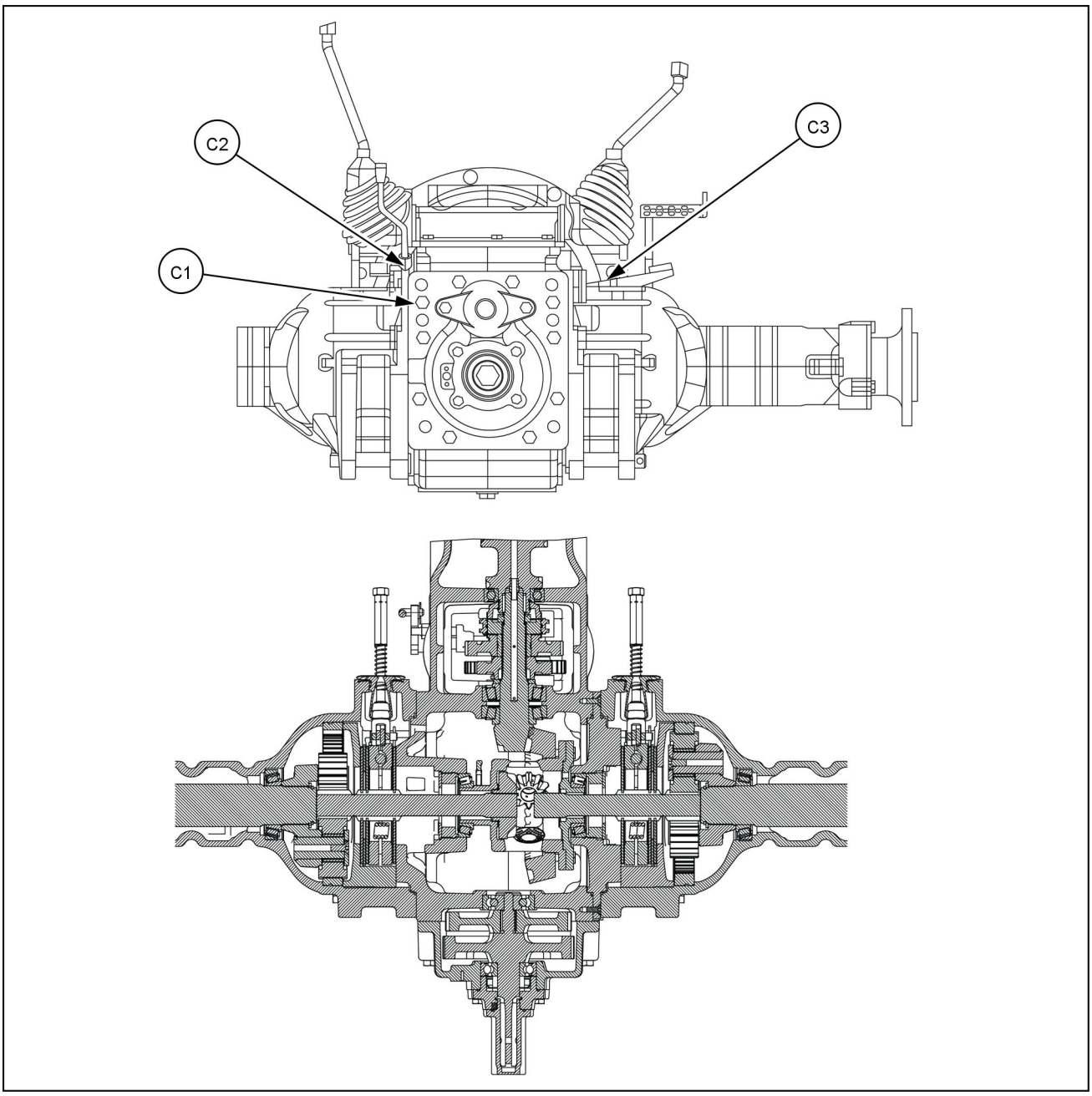
Rear mechanical control
Remove 7
Install 11

Rear mechanical control - General specification

Type	Single Speed 540 rpm PTO is provided in base model. Double Speed 540/540E rpm PTO with Ground Speed is provided as an option.
Engagement and control	Through mechanical clutch
Rotation (looking from tractor rear end)	Clock wise
Engine speed	
• **540 RPM** (standard) Power Take-Off (PTO) speed	**2575 RPM**
• **540E RPM** (economical) Power Take-Off (PTO) speed	**2016 RPM**
Output shaft	
Number of splines	6
Shaft diameter	**28.86 - 28.96 mm** (**1.136 - 1.14 in**)

Rear mechanical control - Torque

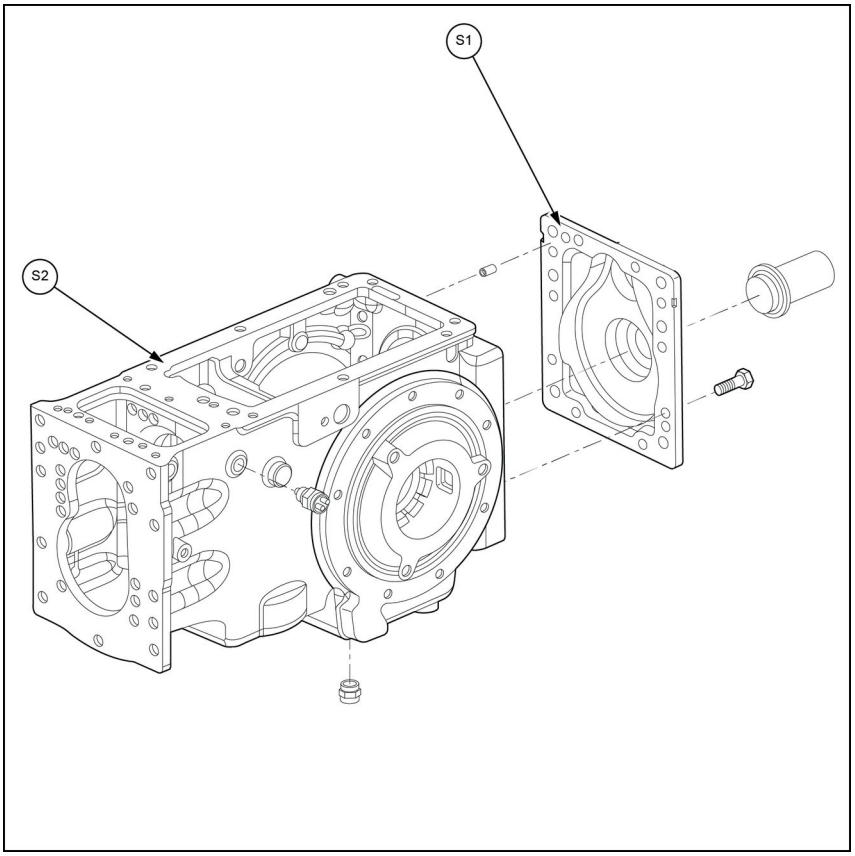
Description	Thread size	Torque
Power Take-Off (PTO) case mounting bolts **(C1)**	M12 x 1.25	**10.00 kgf** (**22.05 lbf**)
Power Take-Off (PTO) lever plate screws **(C2)**	M8	**0.90 kgf** (**1.98 lbf**)
Differential lock pedal screw **(C3)**	M10 x 1.25	**6.00 kgf** (**13.23 lbf**)



GNIL14TR00831GA 1

Rear mechanical control - Sealing

Operation description	Sealant specification
Power Take-Off (PTO) rear cover **(S1)**	**LOCTITE® 518**
Hydraulic to transmission housing **(S2)**	**LOCTITE® 518**

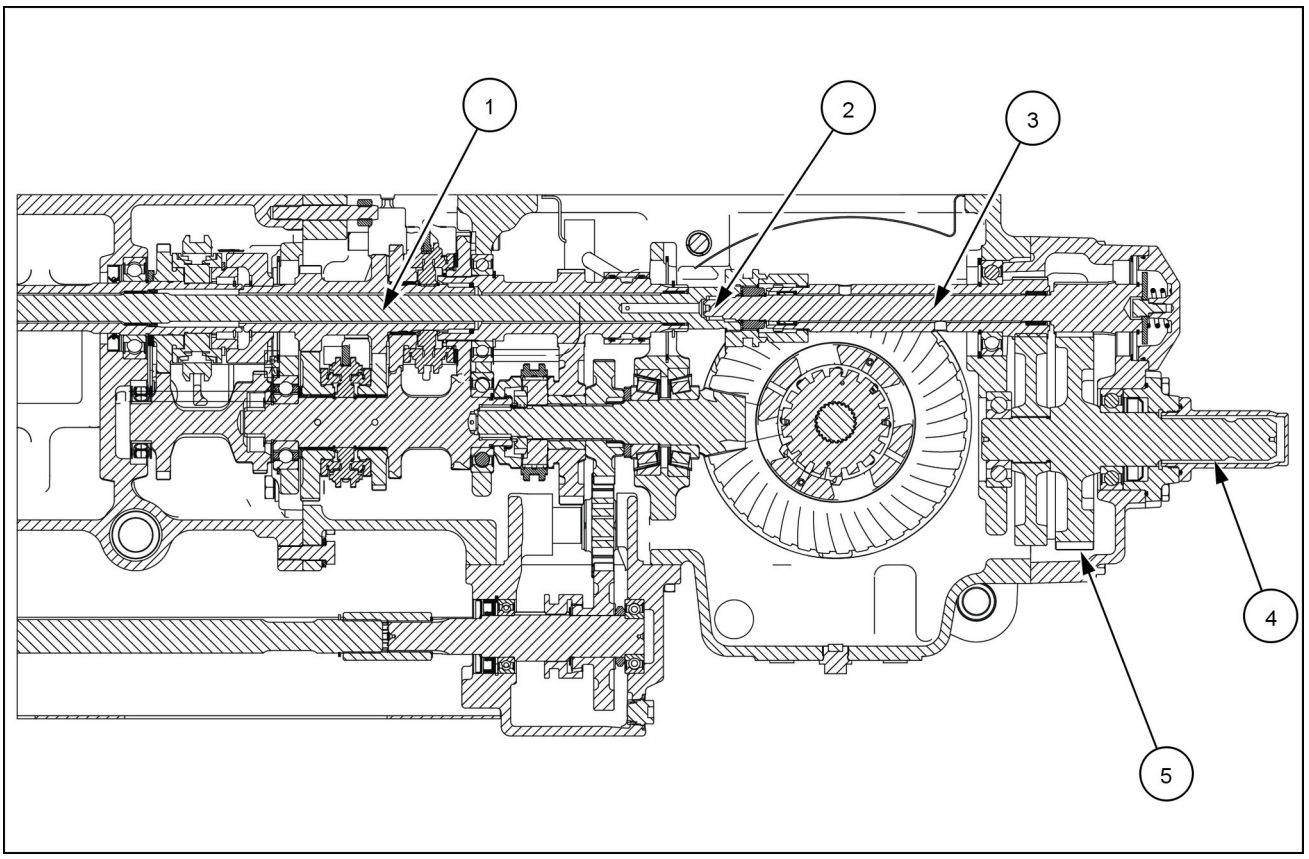


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Rear mechanical control - Special tools

Operation description	Tools specification
Power Take-Off (PTO) rear cover seal installer	84261381
Yoke and spreader	291051 and 291052

Rear mechanical control - Sectional view



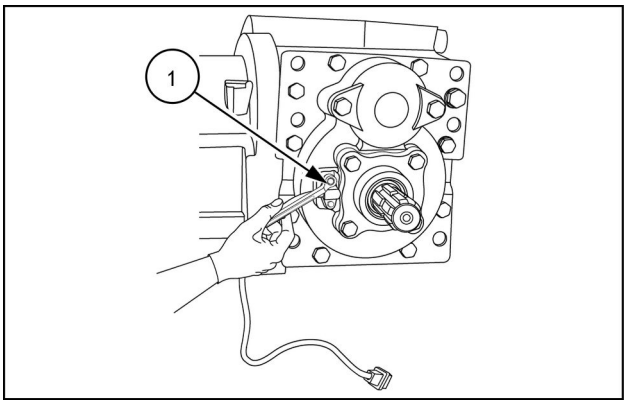
GNIL14TR00826FA 1

1. Transmission input shaft
2. Power Take-Off (PTO) engaging sleeve
3. Power Take-Off (PTO) input shaft
4. Power Take-Off (PTO) shaft
5. Reduction gear

Rear mechanical control - Remove

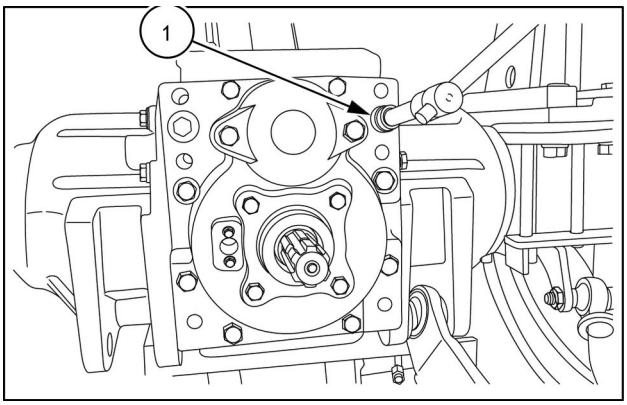
PTO shaft assembly

1. Remove hydraulic lift assembly by following the procedures given in **Main lift system - Remove (35.100)**.
2. Disconnect the PTO RPM sensor electrical connection. Loosen the bolts **(1)** and remove the PTO RPM sensor.



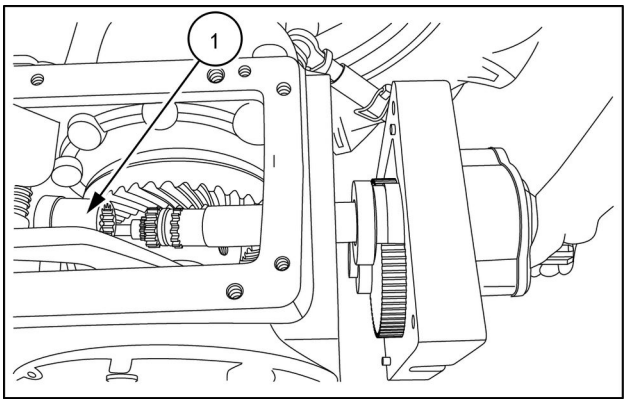
GNIL14TR00743AA 1

3. Loosen the bolts **(1)** securing PTO rear cover to the differential housing.



GNIL14TR00741AA 2

4. Remove the PTO shaft assembly rear cover. Remove the PTO engaging coupler **(1)** and retrieve PTO engage, disengage pad.



GNIL14TR00742AA 3

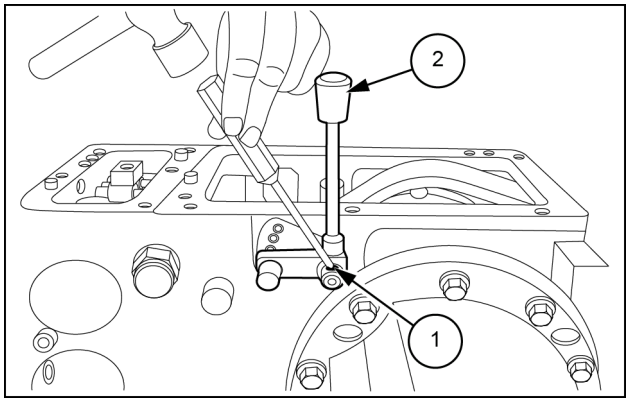
PTO levers and internal linkages

⚠ CAUTION

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in minor or moderate injury.

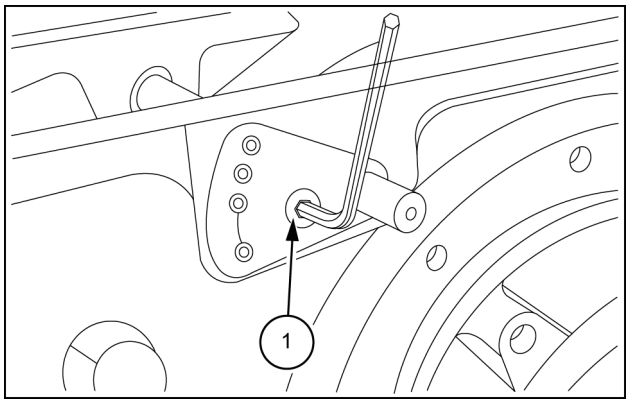
C0145A

5. Push out roll pin **(1)** and remove main PTO lever **(2)** from the shaft.



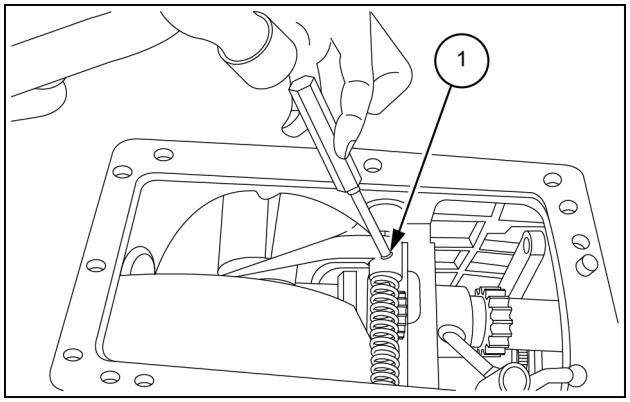
GNIL14TR04303AB 4

6. Loosen set screw **(1)** and remove plate.



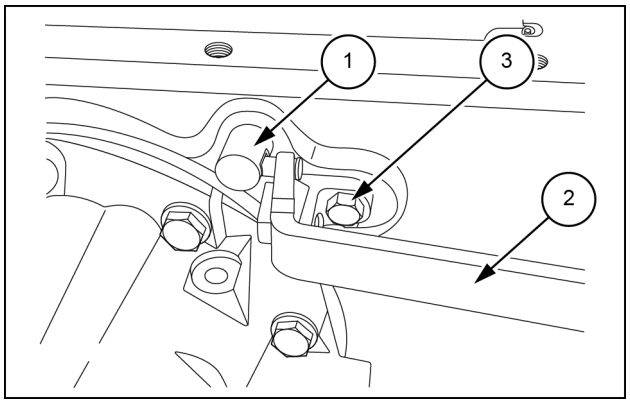
GNIL14TR04304AB 5

7. Remove roll pin holding differential lock fork **(1)** and PTO coupler fork.



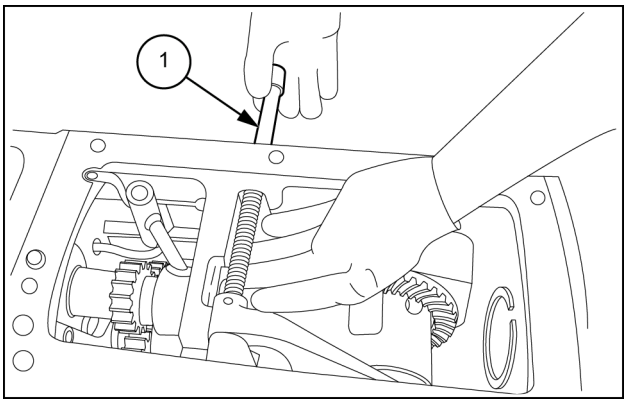
GNIL14TR04305AB 6

8. Remove the differential pedal lever **(2)** by unscrewing two bolts **(3)** securing the bracket.



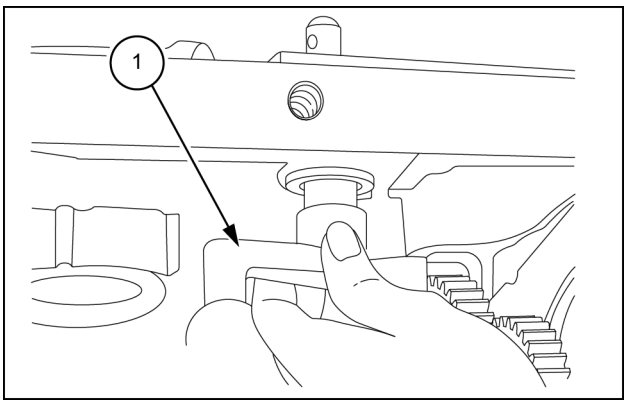
GNIL14TR04307AB 7

9. Push out the differential lock shaft **(1)** and PTO lever shaft.



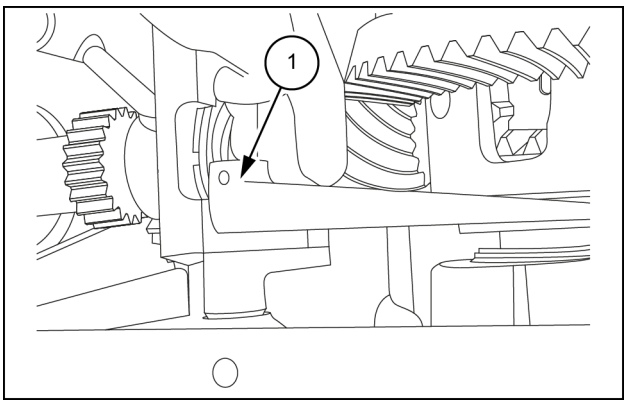
GNIL14TR04308AB 8

10. Remove PTO fork **(1)**.



GNIL14TR04309AB 9

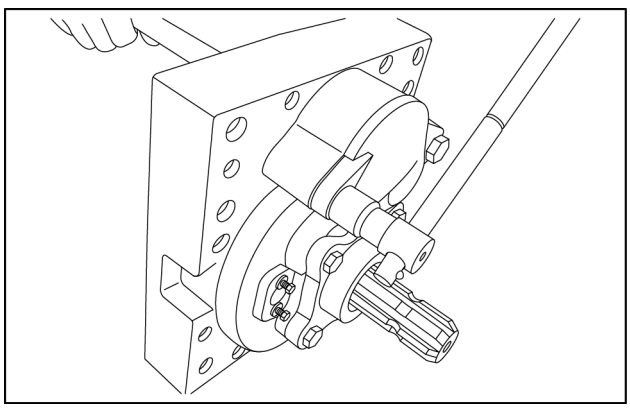
11. Remove differential lock pedal fork **(1)**.



GNIL14TR04310AB 10

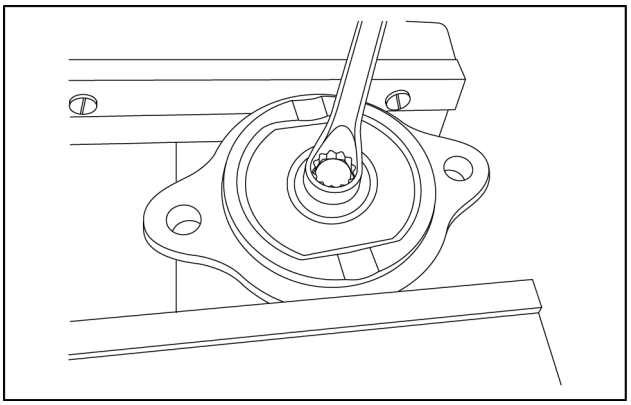
PTO input shaft cover

12. Loosen the bolts and remove the PTO input shaft cover.



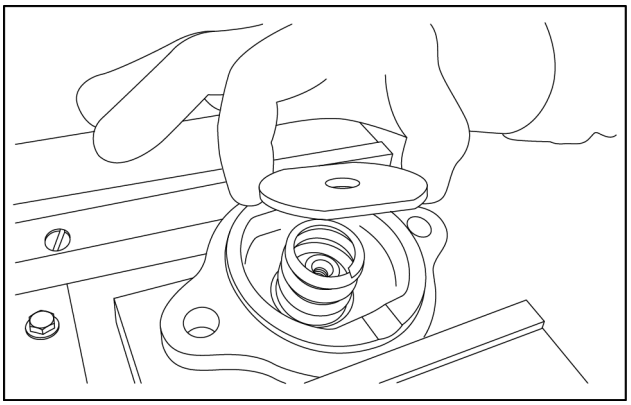
GNIL14TR00744AA 11

13. Loosen the bolt from the inner side of the cover plate.



GNIL14TR00738AA 12

14. Retrieve the inner plate and the spring from the cover.



GNIL14TR00739AA 13

Rear mechanical control - Install

For installation, follow the removal process in reverse order.

NOTE: *Torque all the bolts to correct value. See* ***Rear mechanical control - Torque (31.101)****.*

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Index

Power Take-Off (PTO) - 31

Rear mechanical control - 101

Rear mechanical control - General specification 3
Rear mechanical control - Install 11
Rear mechanical control - Remove 7
Rear mechanical control - Sealing 4
Rear mechanical control - Sectional view 6
Rear mechanical control - Special tools 5
Rear mechanical control - Torque 3

https://truckmanualshub.com/

Power Take-Off (PTO) - 31

One-speed rear Power Take-Off (PTO) - 110

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Power Take-Off (PTO) - 31

One-speed rear Power Take-Off (PTO) - 110

FUNCTIONAL DATA

One-speed rear Power Take-Off (PTO)
Overview 3

SERVICE

One-speed rear Power Take-Off (PTO)
Disassemble 4
Assemble 5

One-speed rear Power Take-Off (PTO) - Overview

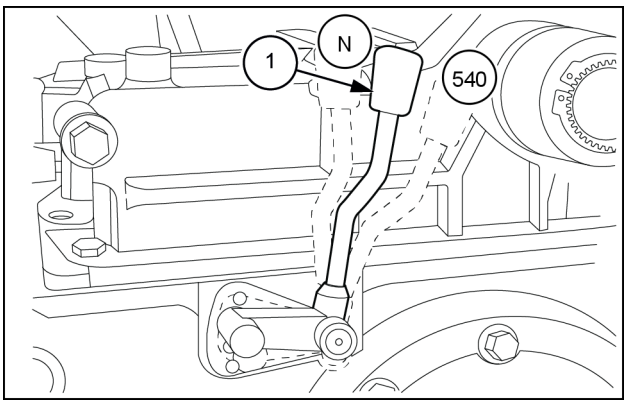
The Power Take-Off (PTO) transfers engine power directly to mounted, semi-mounted or trailed equipment via a splined shaft at the rear of the tractor.

The system utilizes the standard 6 -splines shaft designed to operator at **540 RPM**, the speed at which most Power Take-Off (PTO) driven equipment is designed to run.

The Power Take-Off (PTO) input shaft front end can be connected and disconnected to the transmission input shaft by means of a lever **(1)** on the left hand-side of the transmission unit.
Move the lever **(1)** backward to engage the PTO. Move the lever **(1)** forward to disengage the PTO.

The rear end of the Power Take-Off (PTO) input shaft is connected to the Power Take-Off (PTO) output shaft through reduction gears.

The standard speed of 540 PTO RPM can be obtained at 2575 engine rpm.



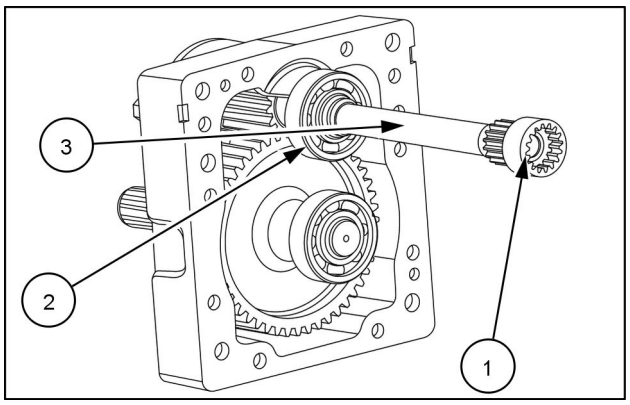
GNIL14TR04298AB 1

DANGER
To avoid inadvertent movement of the implement, disengage the Power Take-Off (PTO) after each use

WARNING
Whenever operating Power Take-Off (PTO) equipment, observe the following precautions:

One-speed rear Power Take-Off (PTO) - Disassemble

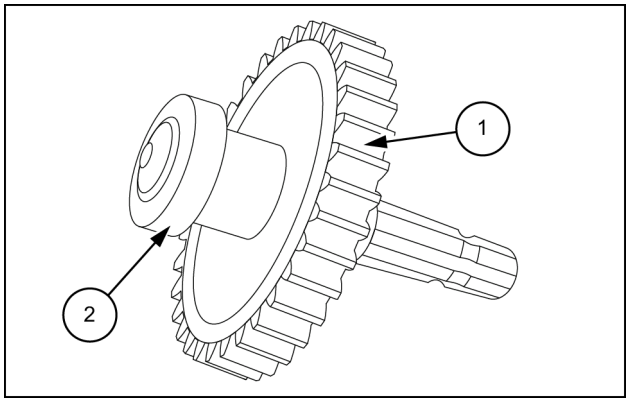
1. Remove the hydraulic lift assembly, PTO external control and PTO cover. See **Rear mechanical control - Remove (31.101)**.
2. Remove the PTO input shaft cover. Remove the PTO coupler **(1)**. Remove the bearing **(2)**. Remove the PTO drive shaft assembly **(3)** from the PTO rear cover.



GNIL14TR00768AA 1

3. Remove the Power Take-Off (PTO) driven shaft along with gear **(1)** and take out bearing **(2)** if necessary.

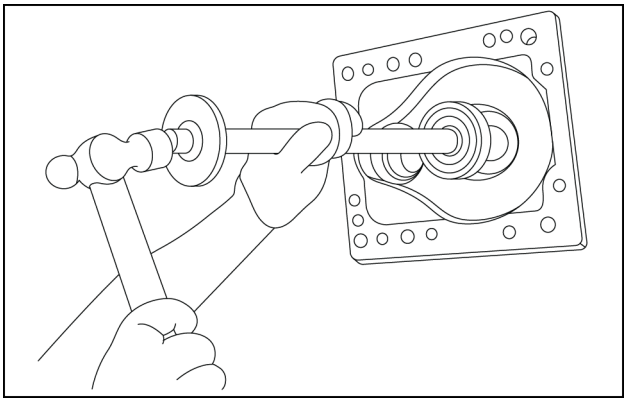
NOTE: *Gear is the integral part of Power Take-Off (PTO) shaft in single speed Power Take-Off (PTO)*



GNIL14TR04324AB 2

One-speed rear Power Take-Off (PTO) - Assemble

1. For assembly, follow the disassembly process in reverse order.
2. Fit Power Take-Off (PTO) shaft seal **(1)** as shown in figure.



GNIL14TR04325AA 1

https://truckmanualshub.com/

Index

Power Take-Off (PTO) - 31

One-speed rear Power Take-Off (PTO) - 110

One-speed rear Power Take-Off (PTO) - Assemble 5
One-speed rear Power Take-Off (PTO) - Disassemble 4
One-speed rear Power Take-Off (PTO) - Overview 3

https://truckmanualshub.com/

Power Take-Off (PTO) - 31

Two-speed rear Power Take-Off (PTO) - 114

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Power Take-Off (PTO) - 31

Two-speed rear Power Take-Off (PTO) - 114

FUNCTIONAL DATA

Two-speed rear Power Take-Off (PTO)
Overview 3

SERVICE

Two-speed rear Power Take-Off (PTO)
Disassemble 4
Inspect 6
Assemble 7

Two-speed rear Power Take-Off (PTO) - Overview

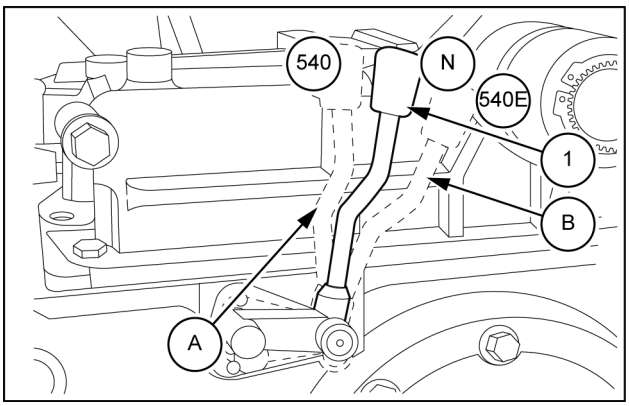
The Power Take-Off (PTO) transfers engine power directly to mounted, semi-mounted or trailed equipment via a splined shaft at the rear of the tractor.

The system utilizes the standard 6 -splines shaft designed to operator at **540 RPM**, the speed at which most Power Take-Off (PTO) driven equipment is designed to run.

The Power Take-Off (PTO) input shaft front end can be connected and disconnected to the transmission input shaft by means of a lever **(1)** on the left hand-side of the transmission unit.

The rear end of the Power Take-Off (PTO) input shaft is connected to the Power Take-Off (PTO) output shaft through reduction gears.

The standard speed of 540 PTO RPM can be obtained at 2575 engine rpm. Shift lever forward to get normal 540 PTO RPM, and shift rearward to get ground speed or 540E PTO. 540 Economy RPM can be obtained at 2016 engine RPM.



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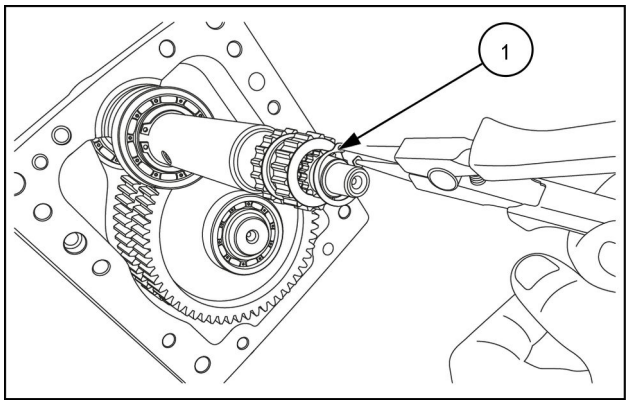
Power Take-Off (PTO)	Engine	Lever position	Application
540 RPM	**2575 RPM**	Forward	Rotavator thresher, etc.
540E RPM	**2016 RPM**	Backward	Water pump, etc

DANGER
To avoid inadvertent movement of the implement, disengage the Power Take-Off (PTO) after each use

WARNING
Whenever operating Power Take-Off (PTO) equipment, observe the following precautions:

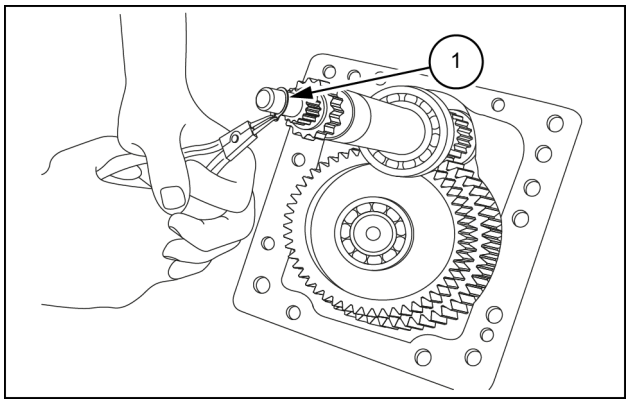
Two-speed rear Power Take-Off (PTO) - Disassemble

1. Remove circlip lock **(1)** from the outer hollow Power Take-Off (PTO) shaft and remove coupling gear.



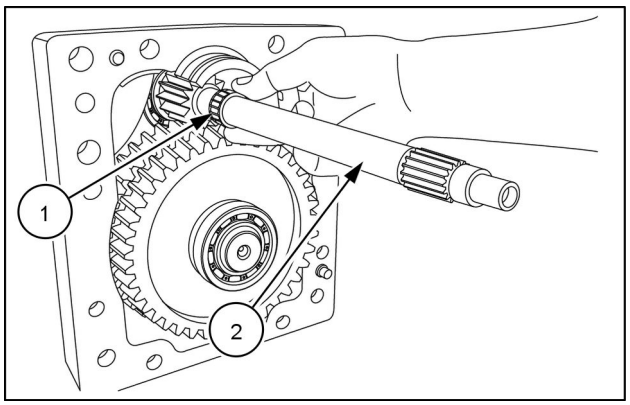
GNIL14TR00745AA 1

2. Remove the circlip lock **(1)**, needle roller bearing. Take out the hollow Power Take-Off (PTO) shaft.



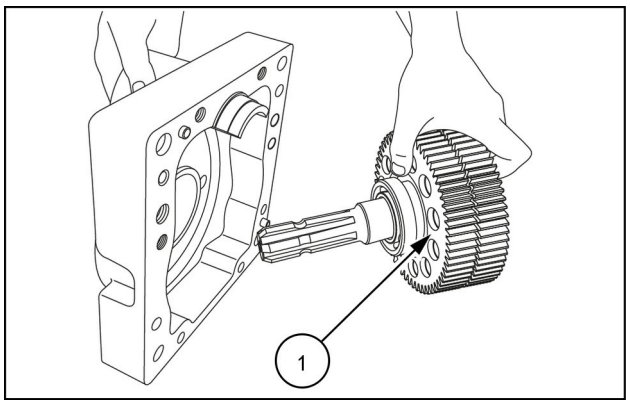
GNIL14TR04312AB 2

3. Retrieve the needle roller bearing **(1)** Remove the PTO input shaft cover. Remove the Power Take-Off (PTO) drive shaft assembly **(2)** from the rear cover.



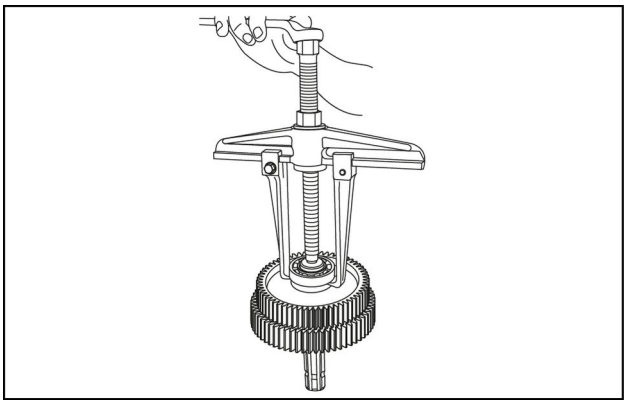
GNIL14TR00749AA 3

4. Remove Power Take-Off (PTO) output shaft and gear assembly **(1)**.



GNIL14TR00750AA 4

5. To dismantle Power Take-Off (PTO) gears assembly use special tool number 291051 and 291052 as shown in figure to remove bearing.

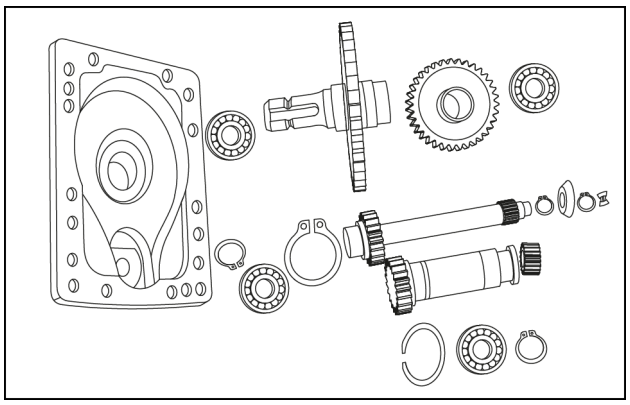


GNIL14TR00751AA 5

Two-speed rear Power Take-Off (PTO) - Inspect

PTO shaft assembly inspection

Check the gears shaft and bearings, for wear and damages. If required replace by new parts.



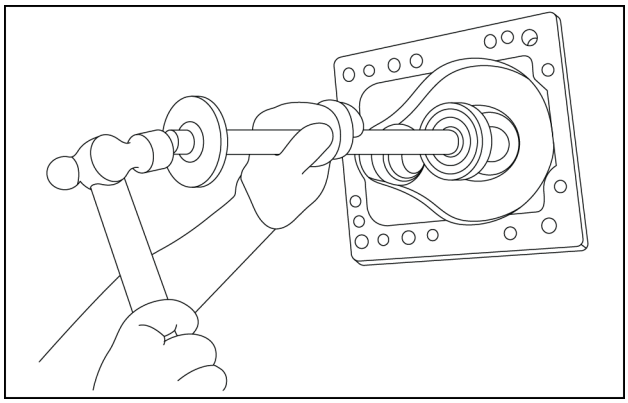
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Two-speed rear Power Take-Off (PTO) - Assemble

Power Take-Off (PTO) shaft assembly

Re-install Power Take-Off (PTO) shaft assembly in differential housing observing the following:

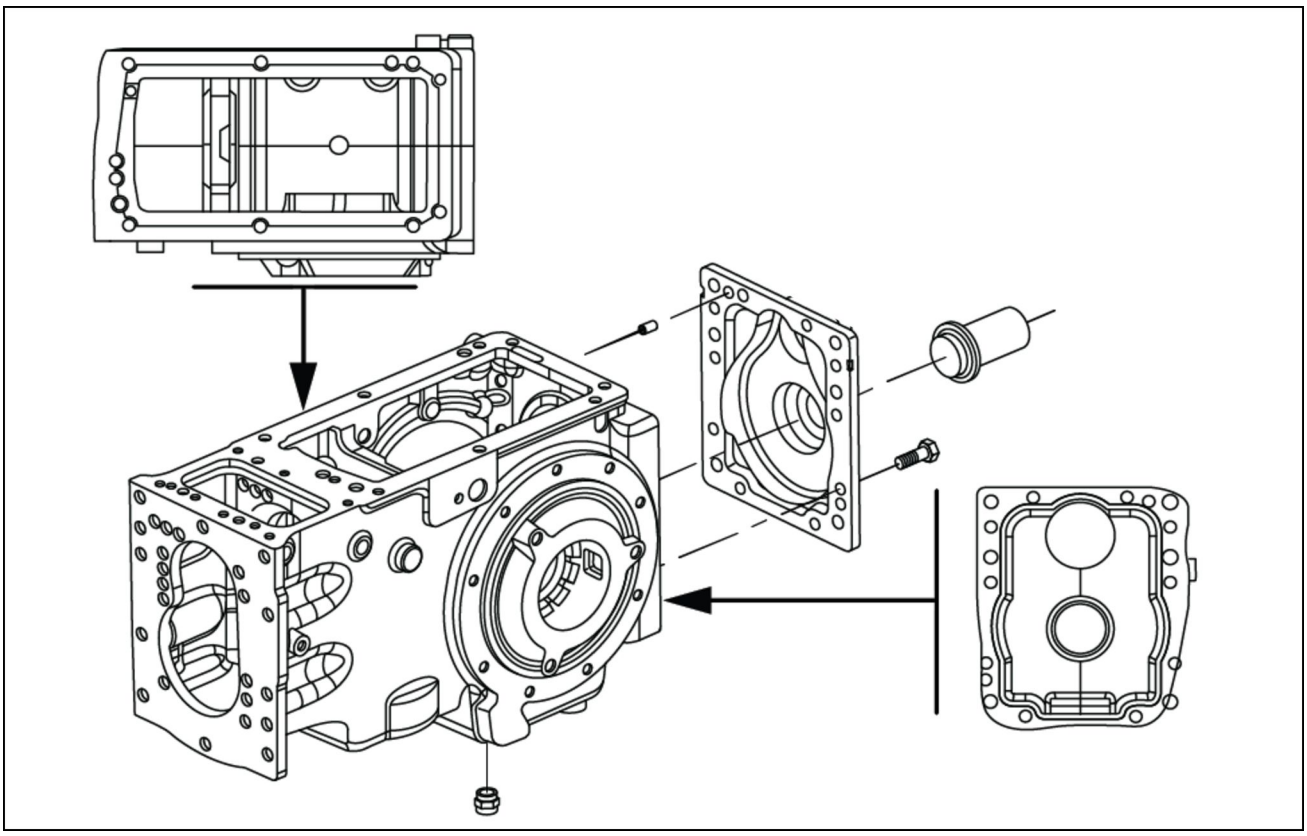
- Re-assembling follows the disassembly procedure in reverse. Refer to **Two-speed rear Power Take-Off (PTO) - Disassemble (31.114)**.
- Refer to figure for correct orientation of the gears and sleeve.
- Check seals and replace if damaged. Fit the Power Take-Off (PTO) oil seal in the Power Take-Off (PTO) rear cover with the help of special tool number 84261386



GNIL14TR04318AA 1

- Before reassembling Power Take-Off (PTO) cover, Thoroughly clean and degrease mating surfaces and apply a **2.00 mm** (**0.08 in**) bead of sealant following the pattern shown in **2**
- Tighten the rear cover bolts to **50 N·m** (**37 lb ft**).

NOTE: *Keep bigger collar of the gear toward bearings.*



GNIL14TR04320GA 2

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Index

Power Take-Off (PTO) - 31

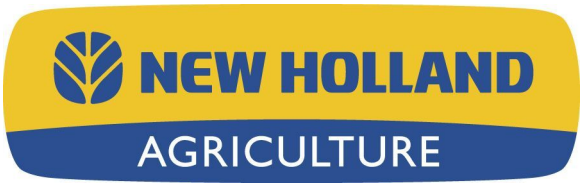
Two-speed rear Power Take-Off (PTO) - 114

Two-speed rear Power Take-Off (PTO) - Assemble 7
Two-speed rear Power Take-Off (PTO) - Disassemble 4
Two-speed rear Power Take-Off (PTO) - Inspect 6
Two-speed rear Power Take-Off (PTO) - Overview 3

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SERVICE - Technical Publications & Tools



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SERVICE MANUAL

Brakes and controls

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Brakes and controls - 33

[33.120] Mechanical service brakes 33.1

https://truckmanualshub.com/

Brakes and controls - 33

Mechanical service brakes - 120

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Brakes and controls - 33

Mechanical service brakes - 120

TECHNICAL DATA

Mechanical service brakes
General specification . . . 3
Special tools . . . 3
Torque . . . 3
Sealing . . . 4

FUNCTIONAL DATA

Mechanical service brakes
Exploded view . . . 6
Overview . . . 7
Sectional view . . . 8

SERVICE

Mechanical service brakes
Remove . . . 9
Inspect . . . 12
Install . . . 13

Brake control pedals and shafts
Remove . . . 15
Adjust . . . 17

DIAGNOSTIC

Mechanical service brakes
Troubleshooting . . . 18

Mechanical service brakes - General specification

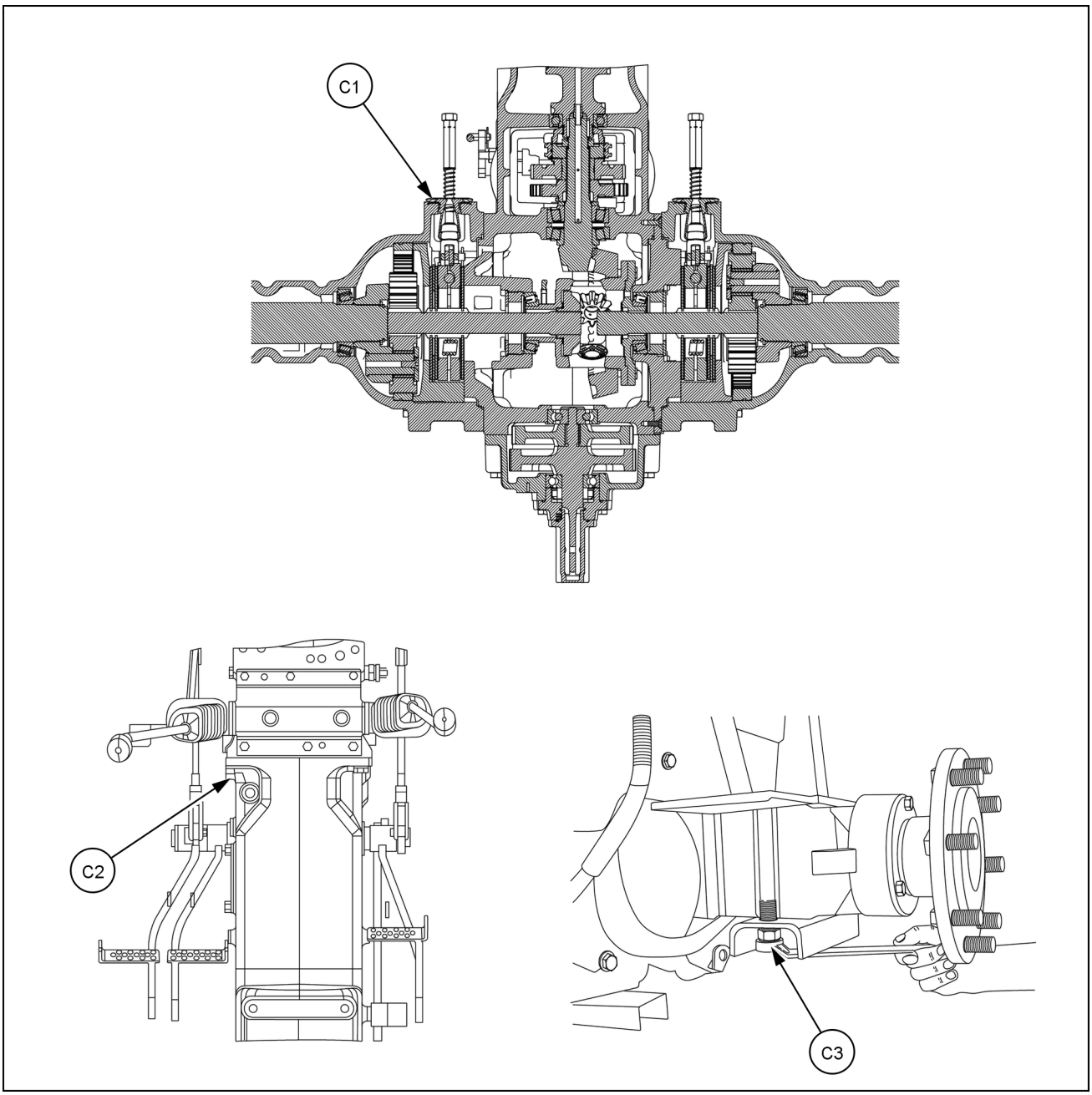
Type	Oil immersed disc brakes acting on differential axle shaft
Control Service brake Parking brake	 Mechanical, independent pedal control Mechanical, hand lever pull type
Number of discs per side	3 each side
Brake oil specification	APGSAE 20W30
Nominal brake disc thickness	**4.65 mm** (**0.183 in**)
Brake pedal free play	**50 - 55 mm** (**1.97 - 2.17 in**)

Mechanical service brakes - Special tools

Description	Tool number
Installer, brake boot in trumpet housing	84261390
Installer, rubber boot outer in brake linkage groove	84261391

Mechanical service brakes - Torque

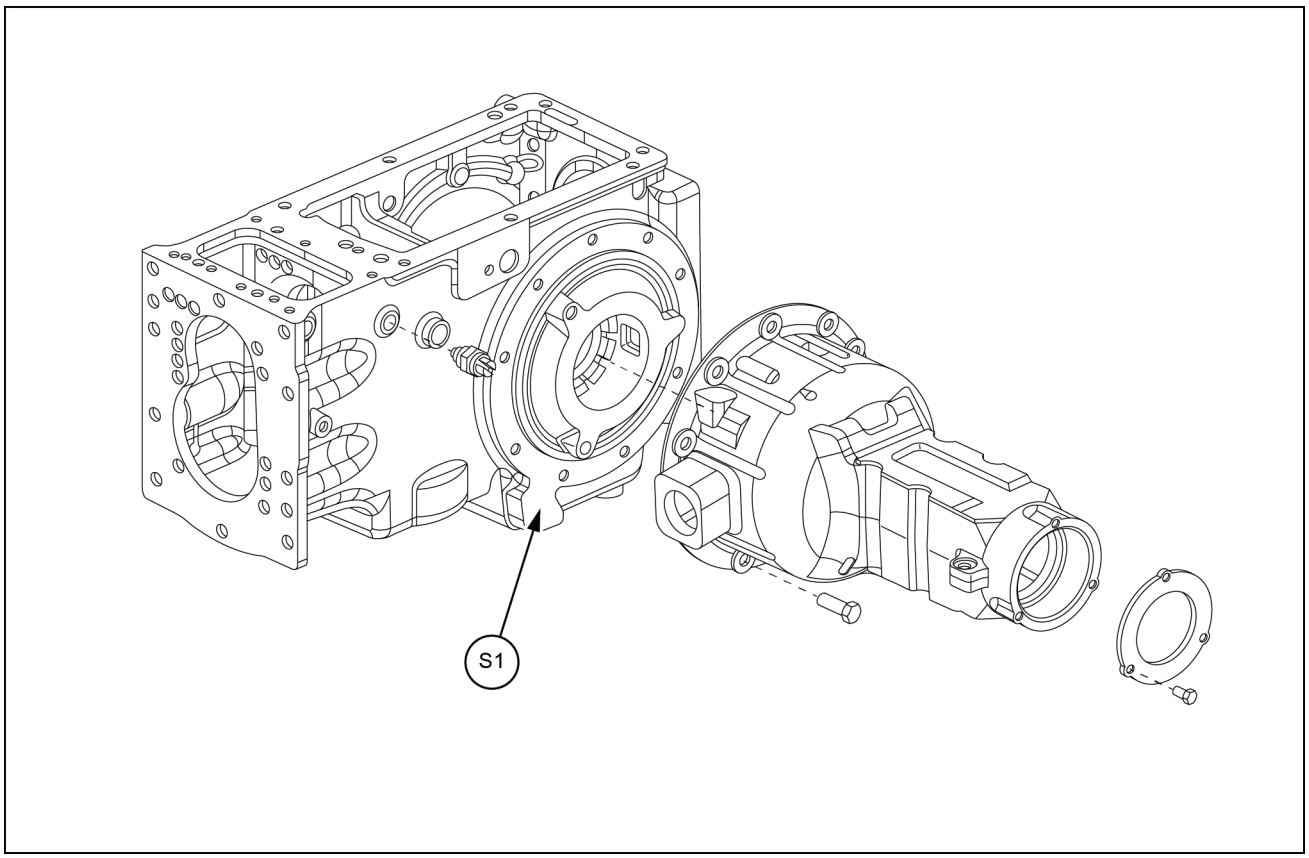
Description	Thread size	Torque
Hand brake pawl assembly mounting bolt **(C1)**	M12 x 1.25	**10 kgf** (**22 lbf**)
Clutch housing to transmission **(C2)**	M12 x 1.25	**10 kgf** (**22 lbf**)
ROPS bolts **(C3)**	M16 1.5	**20 kgf** (**44 lbf**)



GNIL14TR00832GA 1

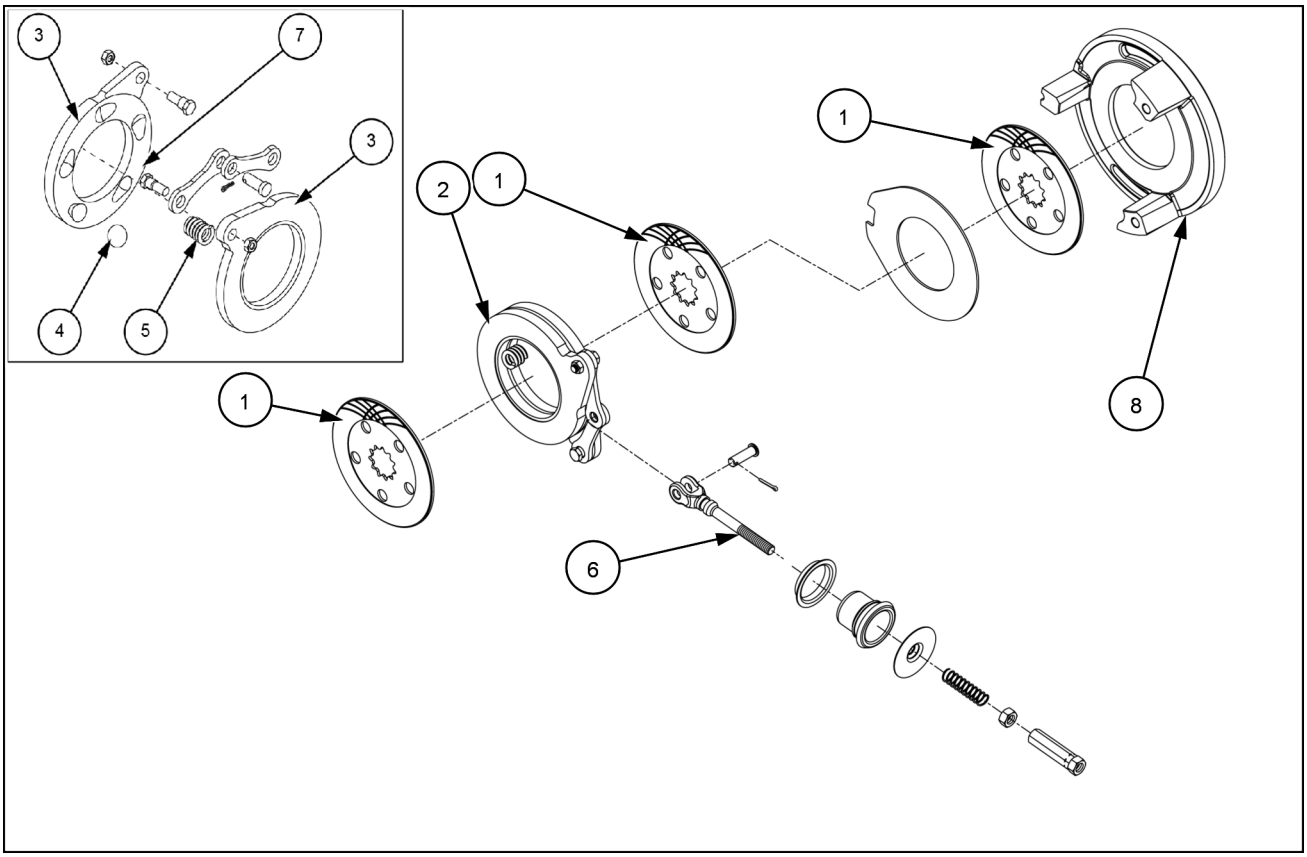
Mechanical service brakes - Sealing

Operation description	Sealant specification
Buckle up of rear axle housing to differential housing **(S1)**	**LOCTITE® 518™**



GNIL14TR04327FB 1

Mechanical service brakes - Exploded view



GNIL14TR00841GB 1

Mechanical service brakes - Overview

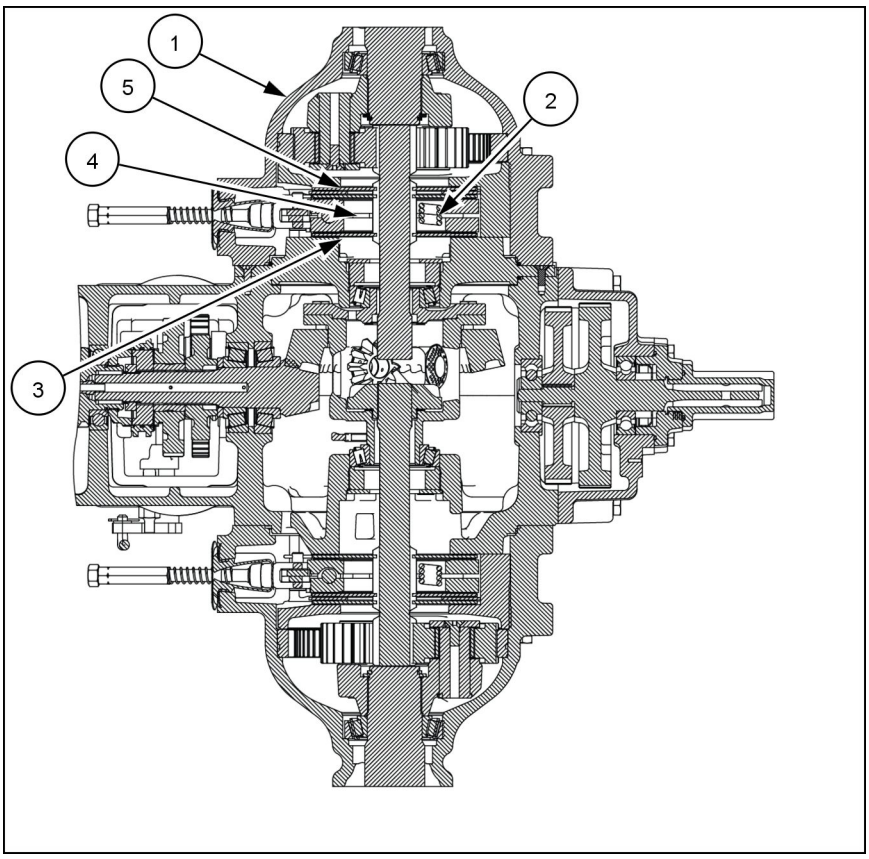
See **Mechanical service brakes - Exploded view (33.120)**.
Oil immersed brakes used, has two brake discs **(1)** both externally lined with friction material are supported by brake actuator **(2)** mounted on brake housing **(8)**. An actuating assembly is mounted between the brake discs **(1)**, which consists of two discs **(3)** separated by steel balls **(4)** but connected by short springs **(5)**. Lugs on the discs are attached to a yoke **(6)** on the operating rod.

When the tractors moving, the brake discs rotate with the axle shaft. If brake pedal is depressed, its associated brake links cause this actuating discs to turn in opposite directions. As the pressure plates turn, the balls **(4)** clamped between the actuating discs roll over the inclined surfaces of their sockets **(7)**. In the plates, thus causing the actuating discs to move axially outwards to contact the rotating brake discs which in turn contact the inner faces of the brake housing **(8)** and differential support and back-up discs. This movement increases the axial force on the housing, support back-up disc and actuator and produce brake torque. This action causes the axle shaft, hence the associated driving wheel of the tractor, to slow down and then stop rotating completely. On release of the brake, retracting springs **(5)** return the plates to their original positions.

The force exerted by the driver is transmitted to the brake assembly by a system of levers and rods. The actuating system not only connects the pedal with the brake but also increases the relatively small force available at the pedal to the much larger force required to brake the vehicle. It can also permit the braking effort to be divided between the axles in the required proportion.

Left wheel brake pedal can be retained in the applied position by means of latch controlled by a hand lever fitted at right hand side, below operator’s seat used as a parking brake.

Mechanical service brakes - Sectional view



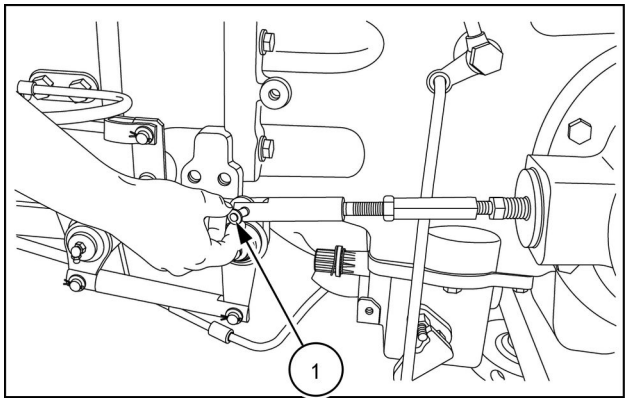
GNIL14TR00833FA 1

(1) Final drive housing
(2) Actuator return spring
(3) Inner friction plate
(4) Actuating discs
(5) Outer friction plate

Mechanical service brakes - Remove

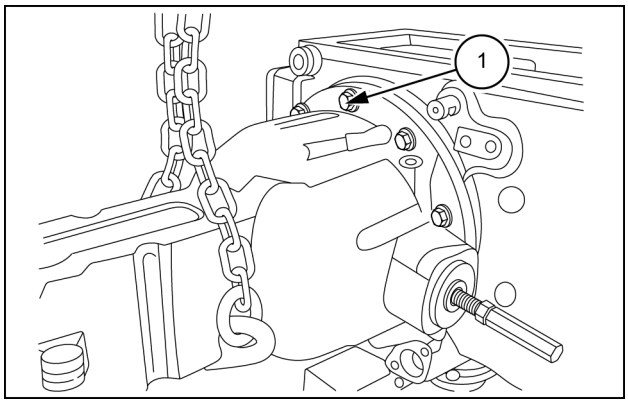
To remove brake assembly, rear axle assembly has to be removed from the transmission.

1. Remove the pin **(1)** and disconnect the brake linkage.



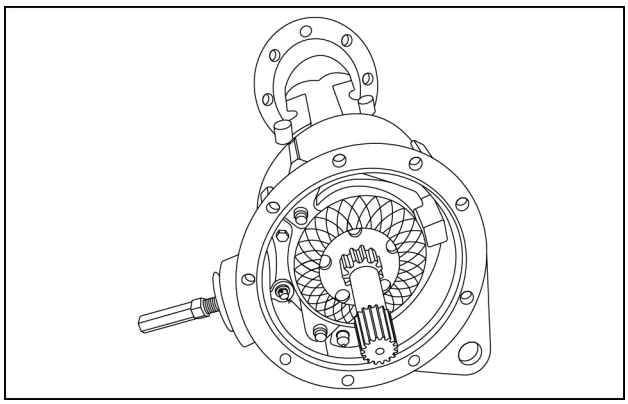
GNIL14TR00789AA 1

2. Wrap chain around final drive housing and loosen bolts **(1)**. Remove the final drive housing.



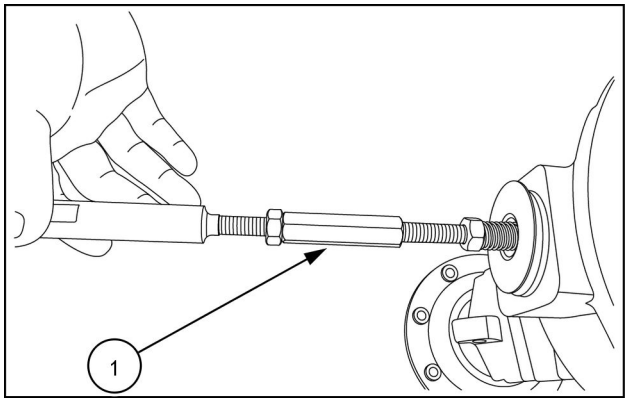
GNIL14TR04276AB 2

3. Place the trumpet housing assembly on plane surface.



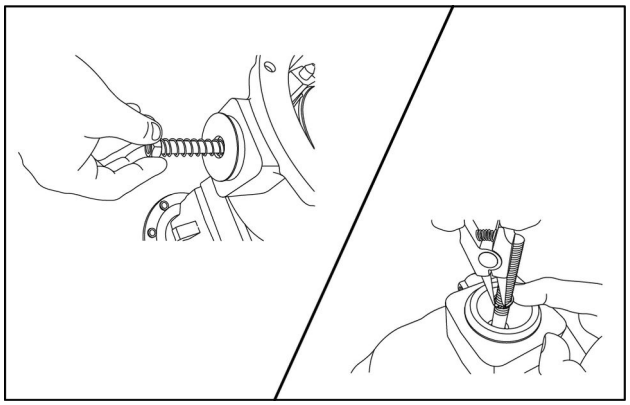
GNIL14TR04336AA 3

4. Remove the linkage **(1)**.



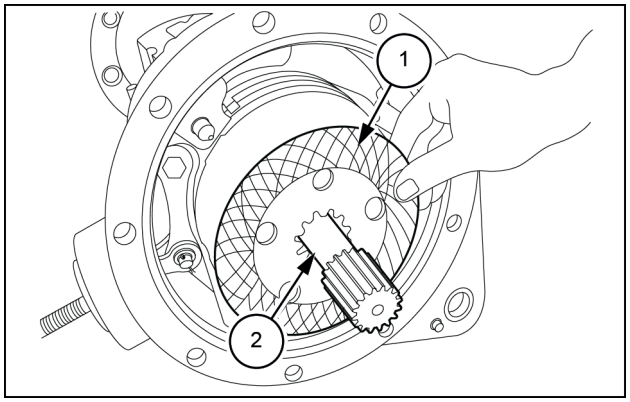
GNIL14TR00792AA 4

5. Remove the nut and spring. Remove the circlip.



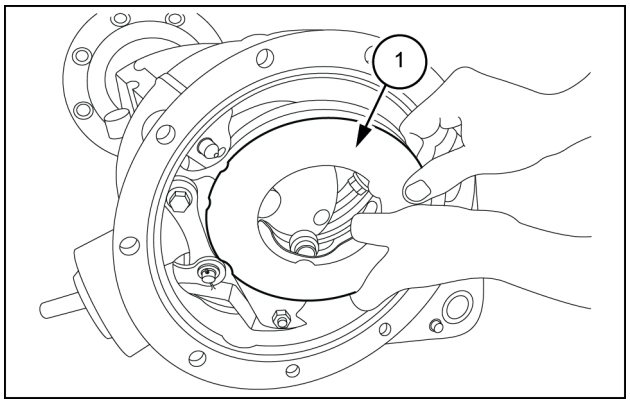
GNIL14TR00791AA 5

6. Remove brake disc **(1)** and shaft **(2)**.



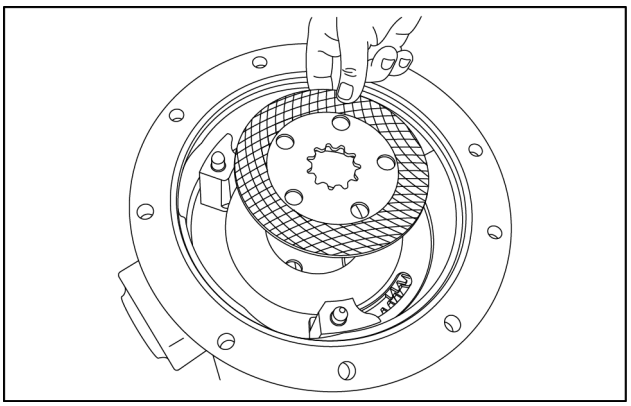
GNIL14TR04277AB 6

7. Remove the brake actuator assembly **(1)**.



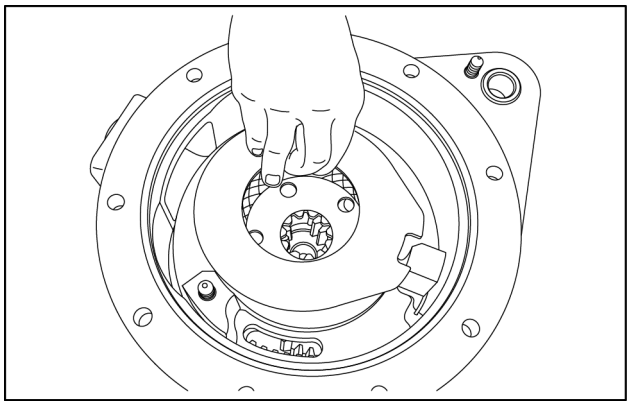
GNIL14TR04278AB 7

8. Remove second brake disc.



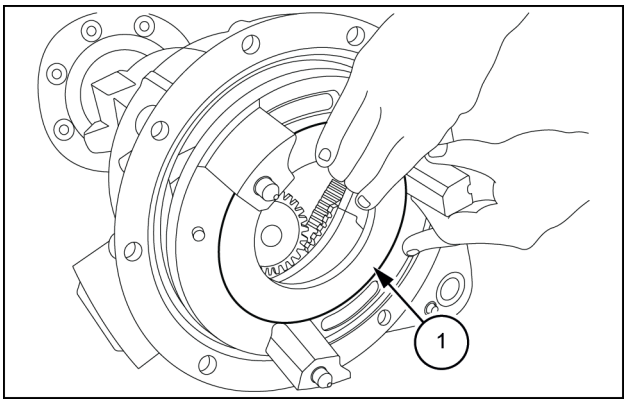
GNIL14TR00779AA 8

9. Remove intermediate plate and third brake disc.



GNIL14TR00780AA 9

10. Remove dual brake support **(1)** as shown.



GNIL14TR04279AB 10

Mechanical service brakes - Inspect

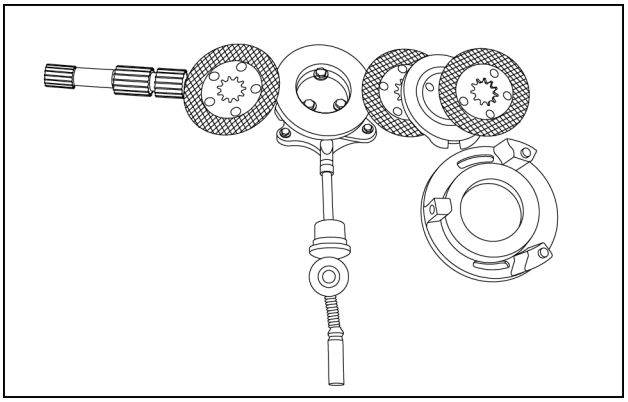
1. Inspect the brake flange friction face for wear and damage, replace if necessary.
2. Inspect the inner and outer brake discs, if badly scored, worn or cracked, replace.

NOTE: *Brake discs' thickness should be minimum* ***4.300 mm*** *(****0.169 in****).*

Mechanical service brakes - Install

NOTE: *Always use suitable tools to align holes. Do not use hand or fingers.*

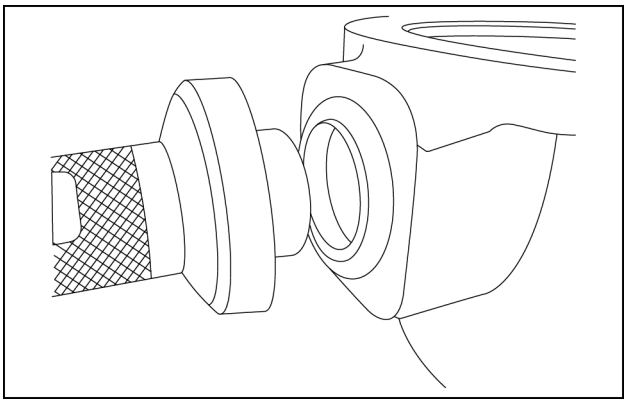
1. Reinstall the brake assembly and rear axle housing to the differential housing taking the following into consideration.
   - Reassembly follows the disassembly procedure in reverse, form step 5 back to step 1.
   - Refer to figure to orient the different parts.
   - Use special tool number 84261390 to fit the brake rubber boot in the brake linkage groove and brake rubber brake boot with special tool number 84261391 in trumpet housing.



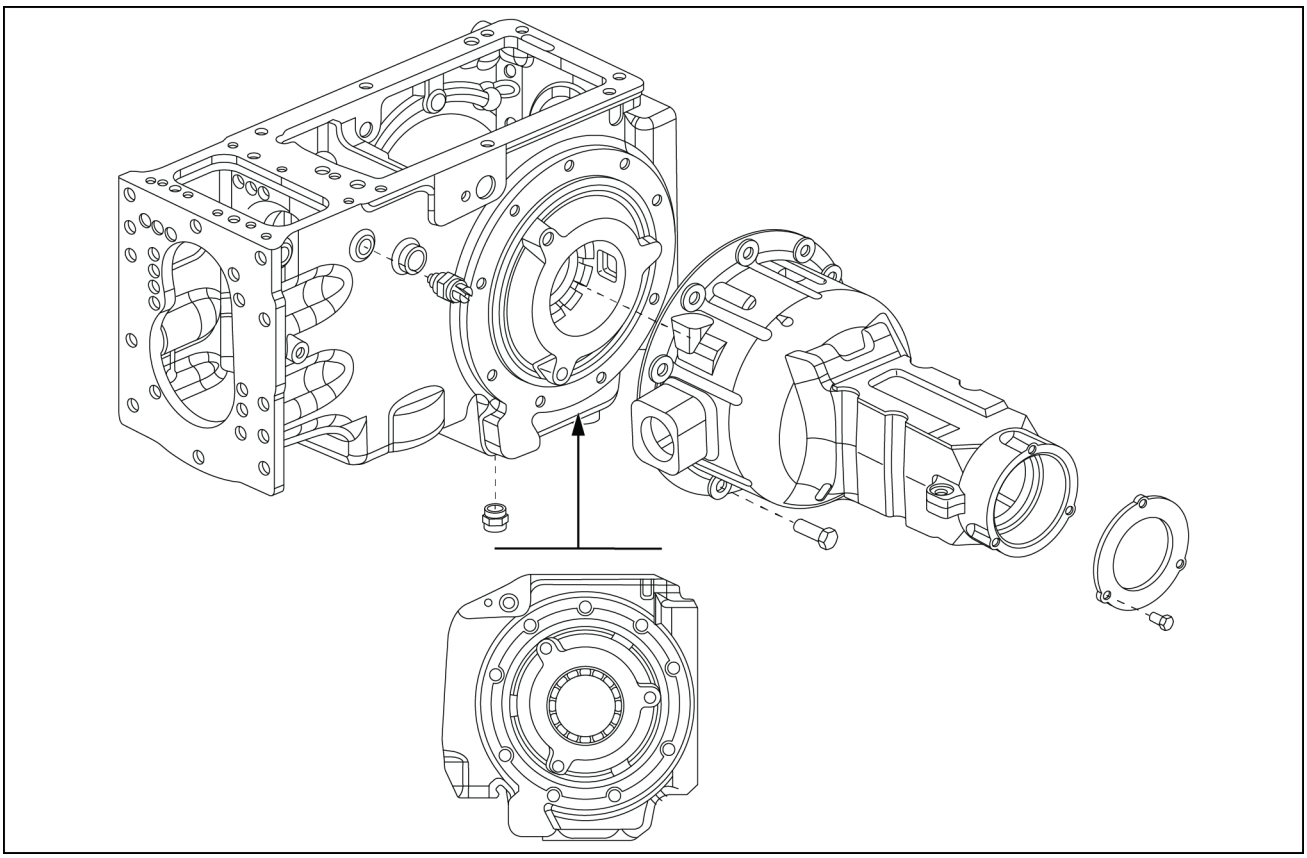
GNIL14TR04340AA 1

   - Before reinstalling the rear axle housing, thoroughly clean and degrease mating surfaces and apply a bead of liquid gasket of approx. **2.000 mm** (**0.079 in**) of diameter.
   - Check seals for wear and damage and replace if necessary.
   - Tighten to correct torques.

   After brake assembly fitted in differential housing, check brake discs for free movement between brake discs.



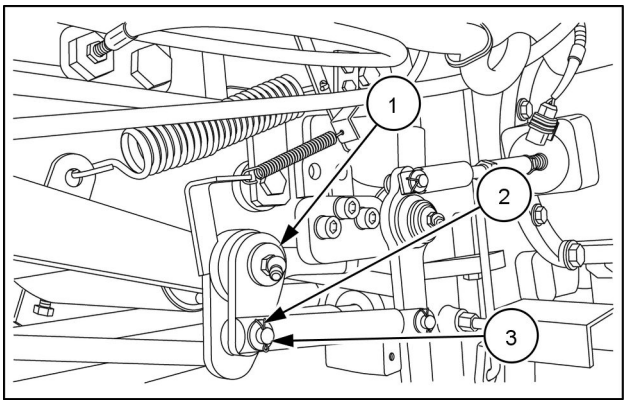
GNIL14TR04341AA 2



GNIL14TR04342FA 3

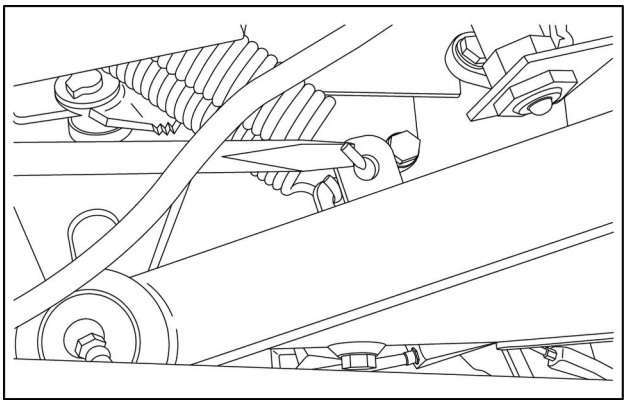
Brake control pedals and shafts - Remove

1. Remove circlip **(1)**. Unlock the clip **(2)** and remove pin **(3)** from the left-hand and right-hand side brake linkages.



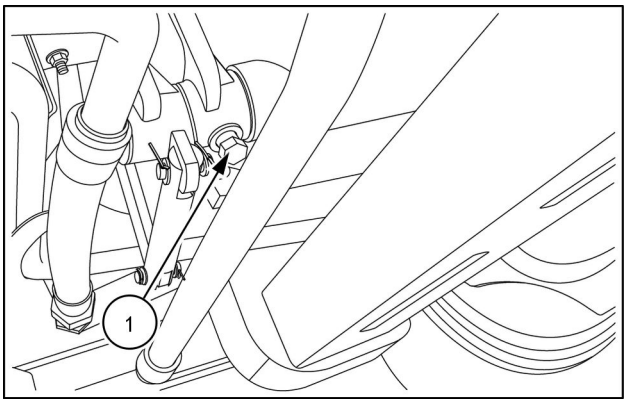
GNIL14TR00766AA 1

2. Remove the brake pedal springs. Remove the clutch pedal springs.



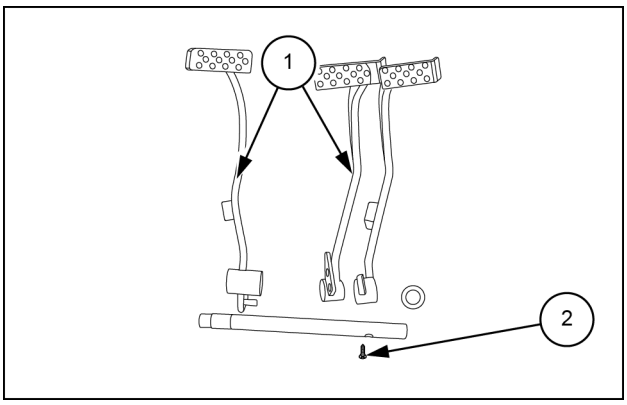
GNIL14TR00782AA 2

3. Remove the conical screw **(1)** that locks the brake shaft.



GNIL14TR00812AA 3

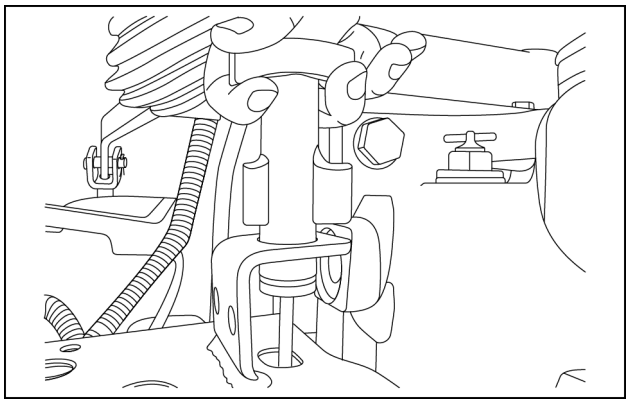
4. Slide out both left-hand and right-hand side brake pedals **(1)** from brake shaft **(2)**.



GNIL14TR04332AB 4

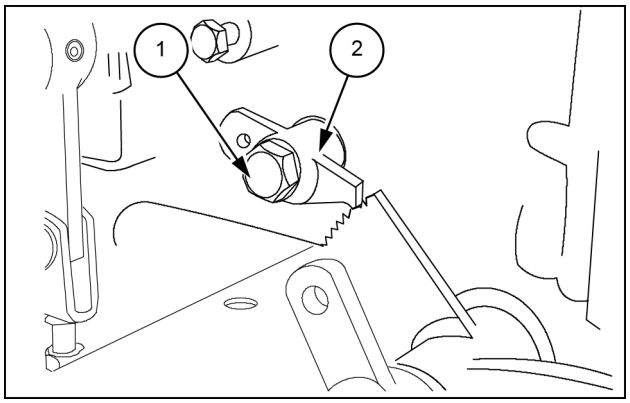
Parking brake linkage removal

5. Remove split pin from hand brake linkage.
6. Pull out hand brake lever along with linkage rod from the linkage assembly.



GNIL14TR04333AA 5

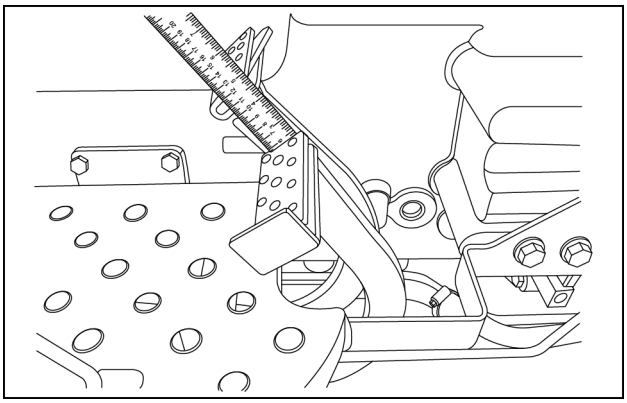
7. Loosen the bolt **(1)** and remove hand brake pawl **(2)**.



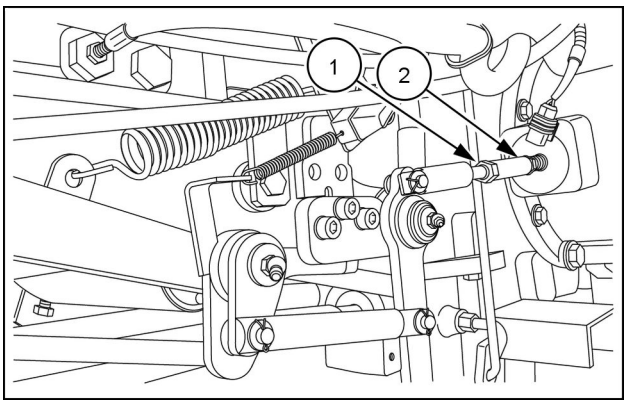
GNIL14TR04334AB 6

Brake control pedals and shafts - Adjust

1. Measure free play of the brake pedals as shown in **1** and should be **50.00 - 55.00 mm** (**1.97 - 2.17 in**). With the brake pedals locked together, the tractor should stop in a straight line when brakes are applied.
2. Adjustment is made to the brake pull rods beneath the tractor. Block the wheels, front and rear, unlock the brake pedals and release the parking brake lever. Release locking clamp, loosen locknut **(1)** and rotate the yoke **(2)** clockwise to reduce the play and anti-clockwise to increase the play figure **2**.
3. Repeat the same procedure for the left brake pull rod.
4. Lock the brake pedals together and road test to ensure that the brakes are balanced and will stop the tractor in a straight line. Any further adjustment necessary to balance the brakes should be carried out on the right brake.



GNIL14TR04343AA 1



GNIL14TR00766AA 2

Mechanical service brakes - Troubleshooting

Problem	Possible Cause	Correction
Brake actuate only when pedal is depressed fully	Incorrect Pedal adjustment	Check and adjust
Tractor pulls to one side when brakes applied	Brakes not equally adjusted	Adjust
	Wrong tire pressure	Inflate tires to correct pressure
	Wrong liners on one side	Replace discs
Brakes noisy	Oil contamination	Check and change with recommended oil.
	Wrong brake disc	Replace brake discs.
Brakes remain applied when pedals are released	Seized brake actuating linkages	Clean and lubricate linkages
Pedals are hard to operate	Seized brake actuating linkages	Clean and lubricate linkages

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Index

Brakes and controls - 33

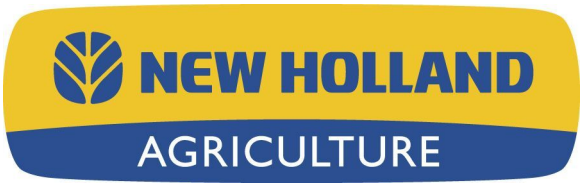
Mechanical service brakes - 120

Brake control pedals and shafts - Adjust 17
Brake control pedals and shafts - Remove 15
Mechanical service brakes - Exploded view 6
Mechanical service brakes - General specification 3
Mechanical service brakes - Inspect 12
Mechanical service brakes - Install 13
Mechanical service brakes - Overview 7
Mechanical service brakes - Remove 9
Mechanical service brakes - Sealing 4
Mechanical service brakes - Sectional view 8
Mechanical service brakes - Special tools 3
Mechanical service brakes - Torque 3
Mechanical service brakes - Troubleshooting 18

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SERVICE - Technical Publications & Tools



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SERVICE MANUAL

Hydraulic systems

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

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Contents

Hydraulic systems - 35

[35.000] Hydraulic systems 35.1

[35.100] Main lift system 35.2

[35.104] Fixed displacement pump 35.3

[35.204] Remote control valves 35.4

[35.300] Reservoir, cooler, and filters 35.5

[35.355] Hydraulic hand control 35.6

[35.359] Main control valve 35.7

https://truckmanualshub.com/

Hydraulic systems - 35

Hydraulic systems - 000

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Hydraulic systems - 35

Hydraulic systems - 000

FUNCTIONAL DATA

Hydraulic systems

Overview 3

Hydraulic schema 4

Component identification 6

DIAGNOSTIC

Hydraulic systems

Troubleshooting 8

Hydraulic systems - Overview

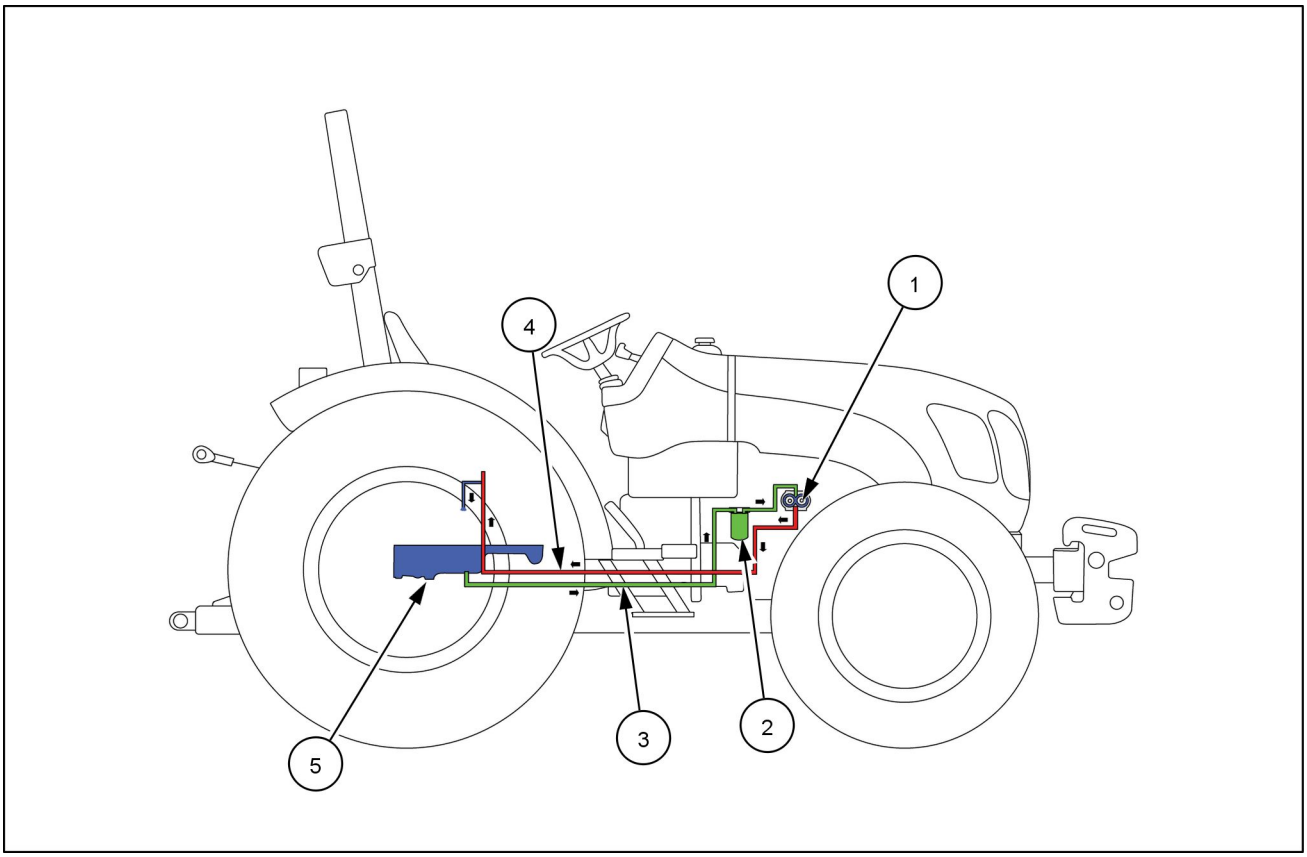
The hydraulic system on the tractor is for mechanical lift assembly to raise and lower the lift arms and thus the three point linkage.
The high pressure hydraulic circuit is an open centre load sensing type.
The hydraulic lift is connected to the hydraulic pump. The pump flow is continuous in the hydraulic system even when the circuit is not being operated.

High pressure pump is directly connected on rear side of engine timing gear. Oil is drawn from transmission case through filter. The pump supplies constant oil flow according to engine speed. High pressure oil enters the distributor valve located at the front of the lift assembly, which controls the raising and lowering of the lift.

All excess oil flow produced by the hydraulic pump is returned direct to the gear box through the control valve spool located in the distributor.

Also located within the distributor is the lift cylinder safety valve, which protect the lift cylinder and seals from excessive peaks of pressure during operation. For further details refer to the “hydraulic lift assembly”.

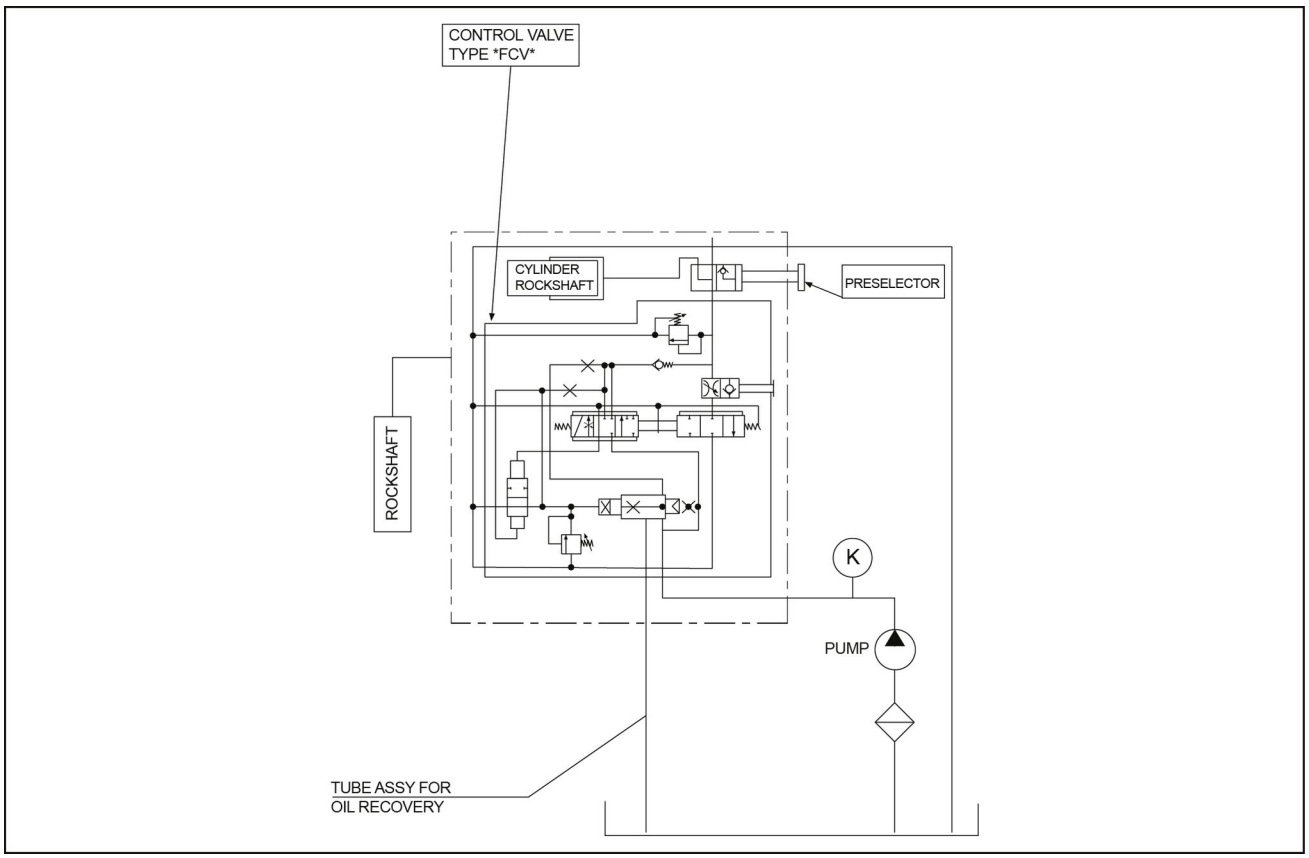
Hydraulic systems - Hydraulic schema



GNIL14TR00817GA 1

Schematic view of hydraulic system

(1) Hydraulic pump
(2) Hydraulic filter
(3) Suction line
(4) Delivery line
(5) Oil sump (transmission housing)



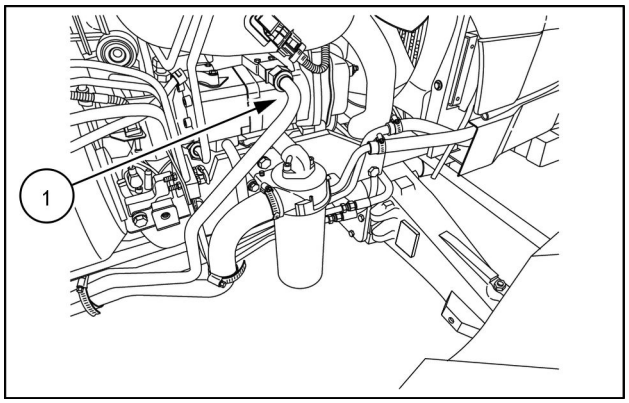
GNIL14TR00818GA 2

Hydraulic circuit diagram

Hydraulic systems - Component identification

Pump

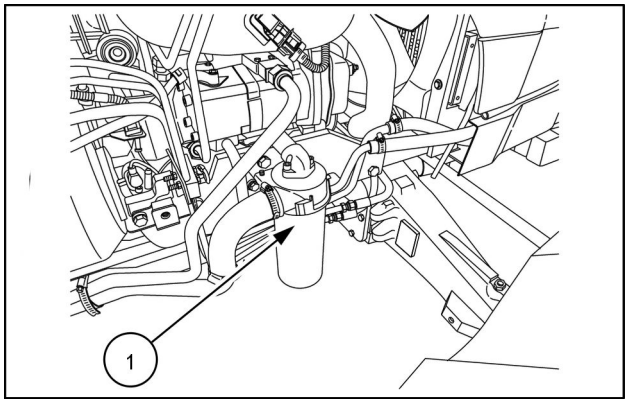
Open centre hydraulic pump assembly is of high pressure gear pump **(1)**.



GNIL14TR00519AA 1

Filter

Full-flow spin on type filter **(1)** mounted on right side of the engine on suction pump.

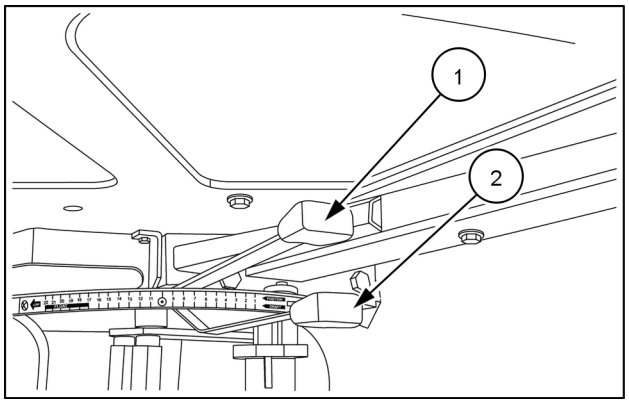


GNIL14TR00519AA 2

Mechanical hydraulic lift assembly

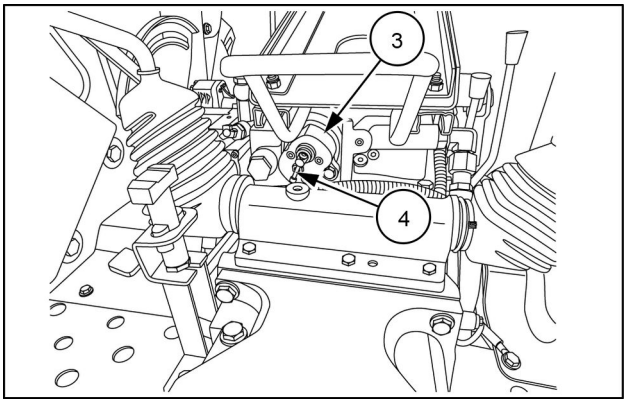
Mounted on top of transmission housing comprising of following components:

- Position control lever **(1)**
- Draft control lever **(2)**



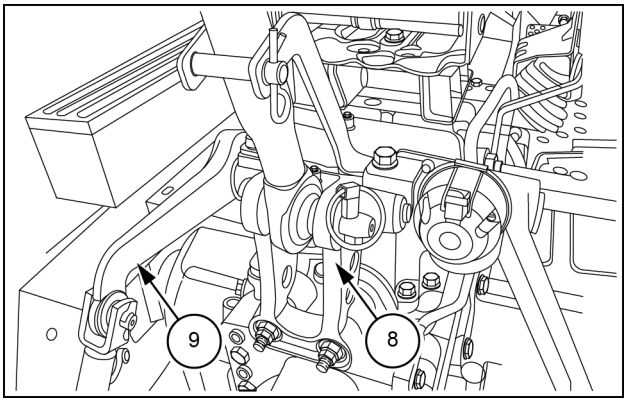
GNIL14TR00580AA 3

- Distributor **(3)**
- Response control valve **(4)**



GNIL14TR00804AA 4

- Draft sensing unit **(8)**
- Lift arms **(9)**
- Internal linkages and cylinder assembly



GNIL14TR04568AB 5

Hydraulic systems - Troubleshooting

Problem	Possible Cause	Correction
Lift arms lift jerky	Hydraulic oil level low	Add hydraulic oil to correct level
	Suction Filter is clogged	Replace oil filter
	Pump has an air suction leak	Check all inlet pipe connections
Lift arms do not lift	Inner control valve spool not shifting to open position	Remove control valve and clean spool
	Regulator valve not shifting	Remove and clean regulator valve
Lift arms do not lower	Discharge valve blocked	Remove discharge valve and clean
	Lowering response valve closed	Open lowering response valve by turning counterclockwise
Lift arms do not lower full travel	Incorrect adjustment of the position control lever	Adjust position control lever
	Control valve sensitivity adjustment not adjusted correctly	Adjust control valve sensitivity
Low lift capacity	Damaged control valve outer diameter O-rings	Replace O-rings as necessary
	Relief valve not adjusted correctly	Adjust relief valve to specification
	Worn lift cylinder piston seal	Replace damaged seal
Lift arms cycle up and down with load applied with engine running	Lift cylinder piston seal damaged	Replace piston seal
	Discharge valve not adjusted correctly	Adjust sensitivity of control valve
	Lift check valve not seating properly	Inspect lift check valve for contamination
	Safety valve not seating properly	Inspect safety valve for contamination
Lift arms leak down when engine is not running	Lift cylinder piston seal damaged	Replace piston seal
	Discharge valve not adjusted correctly	Adjust sensitivity of control valve
	Lift check valve not seating properly	Inspect lift check valve for contamination
	Safety valve not seating properly	Inspect safety valve for contamination
When lift arms are at maximum lift height, with the engine running, the lift arms cycle up and down	Position control lever maximum height position not adjusted correctly	Adjust position control lever maximum position setting

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Index

Hydraulic systems - 35

Hydraulic systems - 000

Hydraulic systems - Component identification 6
Hydraulic systems - Hydraulic schema 4
Hydraulic systems - Overview 3
Hydraulic systems - Troubleshooting 8

https://truckmanualshub.com/

https://truckmanualshub.com/

Hydraulic systems - 35

Main lift system - 100

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Hydraulic systems - 35

Main lift system - 100

TECHNICAL DATA

Main lift system
General specification 3
Torque 3
Sealing 4
Special tools 5

FUNCTIONAL DATA

Main lift system
Dynamic description 6

SERVICE

Main lift system
Remove 11
Install 13
Disassemble 14
Assemble 21
Adjust 22
Inspect 27

DIAGNOSTIC

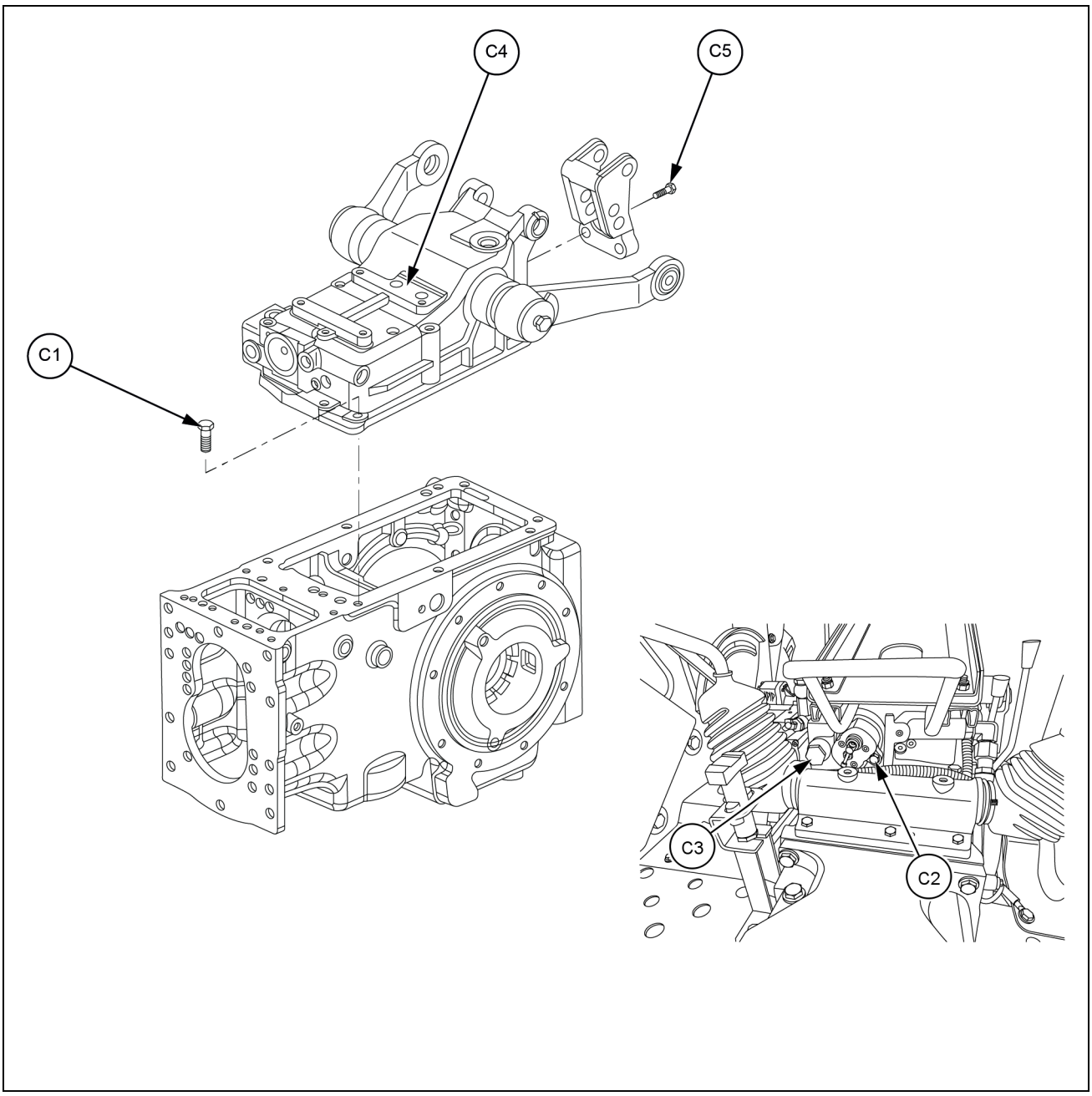
Main lift system
Troubleshooting 29

Main lift system - General specification

Type	With separate position or draft control, Mixed position/draft control plus draft sensitivity and float control
Control	Through two independent levers external knob on control valve
Response/drop rate adjustment	Through external knob on control valve
Single-acting cylinder • Bore and stroke • Displacement	**85.0 mm** (**3.3 in**) x **88.0 mm** (**3.5 in**) for **1100.0 kg** (**2425.1 lb**) **90.0 mm** (**3.5 in**) x **117.0 mm** (**4.6 in**) for **1500.0 kg** (**3306.9 lb**) **500 cm³** for **1100.0 kg** (**2425.1 lb**) **745 cm³** for **1500.0 kg** (**3306.9 lb**)
Pressure regulating valve setting	**190 bar** (**2755 psi**)
Cylinder safety valve opening pressure	**205.0 bar** (**2972.5 psi**)
Implement attachment	
Type	3-Point hitch
Category	I & II
Draft control	Through top link
Maximum lifting capacity at hitch point	**1100 kg** (**2425 lb**) and **1500.0 kg** (**3306.9 lb**) for heavy duty

Main lift system - Torque

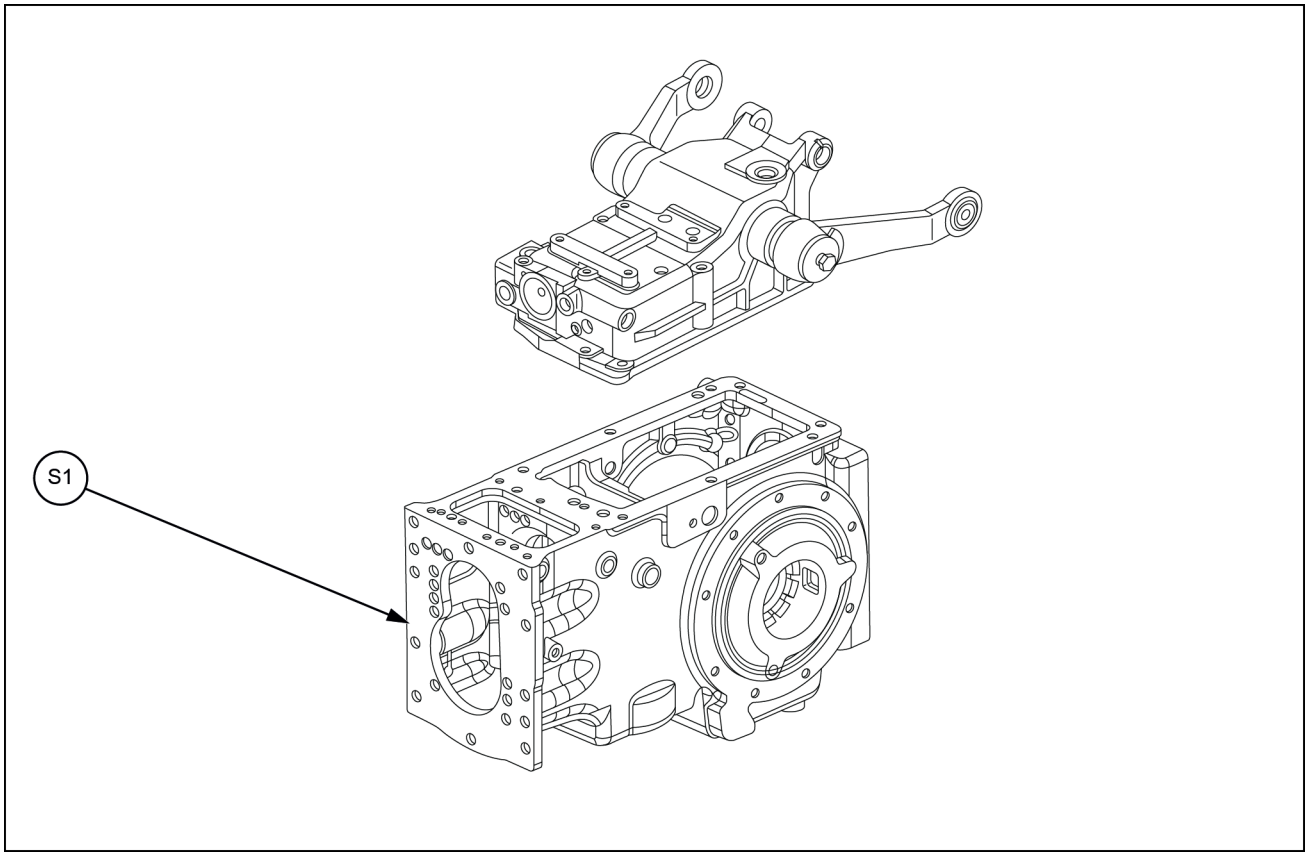
Description	Thread size	Torque
Bolts, lift to housing **(C1)**	M10 x 1.25 and M12 x 1.25	**23.6 - 42.0 kgf** (**52.0 - 92.6 lbf**)
Bolts, distributor to lift housing **(C2)**	M8 x 1.25	**3.0 kgf** (**6.6 lbf**)
Banjo bolts, delivery pipe to distributor **(C3)**	M22 x 1.25	**7.5 kgf** (**16.5 lbf**)
Hydraulic cylinder to lift housing **(C4)**	M12 and M14 x 1.25	**7.5 kgf** (**16.5 lbf**)
Bolts, top link support **(C5)**	M8 x 1.25	**5.0 kgf** (**11.0 lbf**)



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Main lift system - Sealing

Operation description	Sealant specification
Lift housing to transmission housing **(S1)**	**LOCTITE® 518™**



GNIL14TR04583FB 1

Main lift system - Special tools

Tool description	Tool number
Installer, lift arm seal with protector	9970873
Socket for spool height adjustment	9970874
Adapter hydraulic pressure checking	9970877

Main lift system - Dynamic description

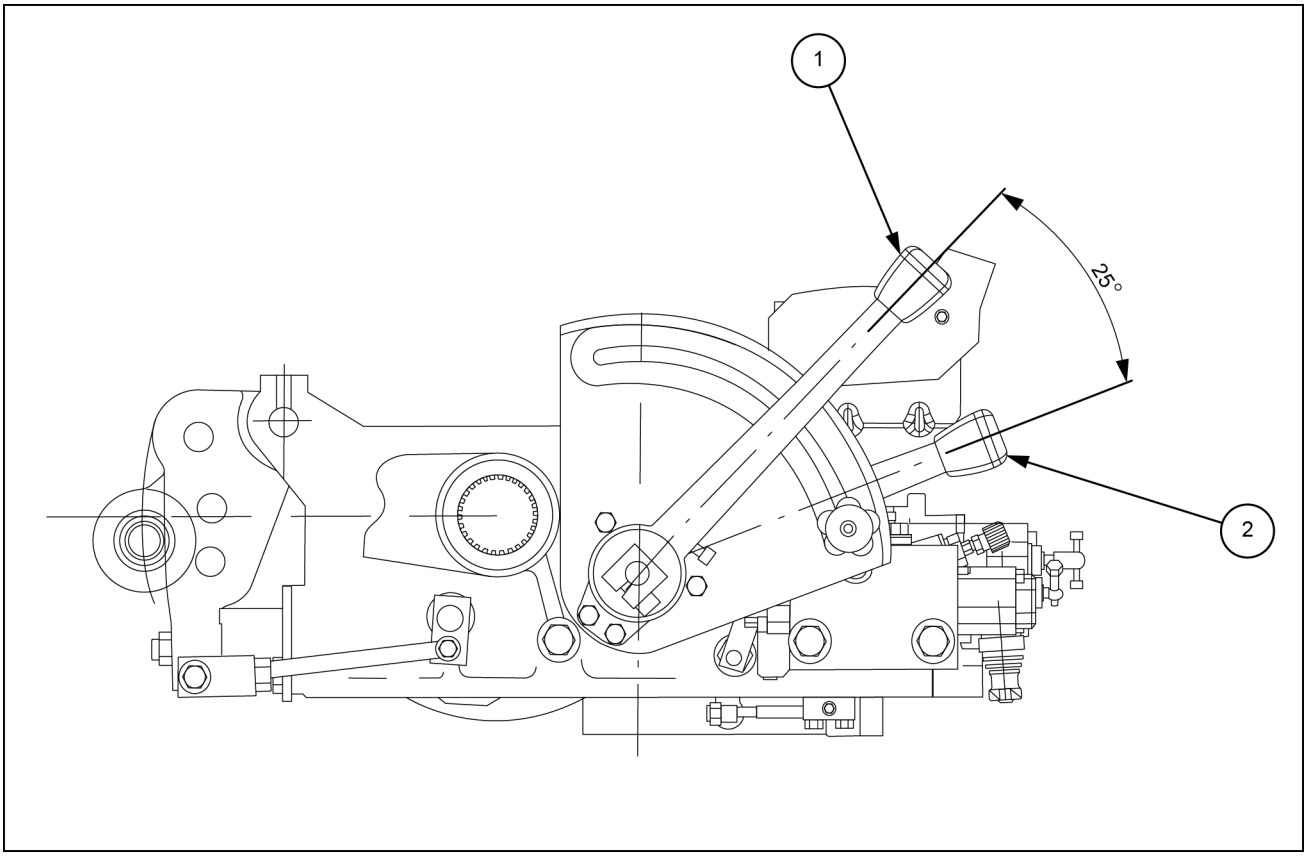
Control levers

A) Position control

B) Draft control

C) Combined operation for position and draft control

The above operations may be chosen in consideration of the work to be carried out, the implement type and the soil superficial hardness.



GNIL14TR04603FB 1

Position control

Move the draft control lever **(2)** fully down. Fix the implement position, inside or outside the soil, by moving the lever **(1)** up for raising and down for lowering.

The implement movement is proportional to the movement range fixed by means of lever **(1)**.

Draft control

Move the position control lever **(2)** fully down, have the implement penetrated into the ground till reaching the desired depth by gradually moving the lever **(2)** down.

The implement depth reached is proportional to the draft determined by soil hardness.

In this condition the rock shaft keeps the draft required automatically constant.

Once the draft is regulated at the end of the rope is possible to lift the implement with position lever **(2)** in order to keep in memory the draft.

During last movement stroke of lever **(2)** a floating function is obtained and the rock shaft does not control the draft.

Combined operation for position and draft control

In case of workings carried out under draft control on not-homogeneous soils, during which excessive implement penetration may occur, it is convenient to use the combined position and draft control.

Have the implement penetrated into the ground and search for the desired working depth in the way described for the draft control.

When the desired depth is reached, gradually move up the lever 1 till the lower links slightly start raising.

The rock shaft operates under controlled draft, but at the same time it prevents the implement from excessively penetrating into the ground causing a not very uniform work, when coming up against a less hard ground.

For raising and moving the implement penetrated at the end and beginning of each pass, acting on position lever 1 only.

NOTE: *It is not correct to find the position with the draft lever 2 because the lifting and lowering of arms with this lever changes with the top link position.*

This can be on neutral-positive-negative-position depending on the draft force, or to change the force on the top link bracket as per the implement weight.

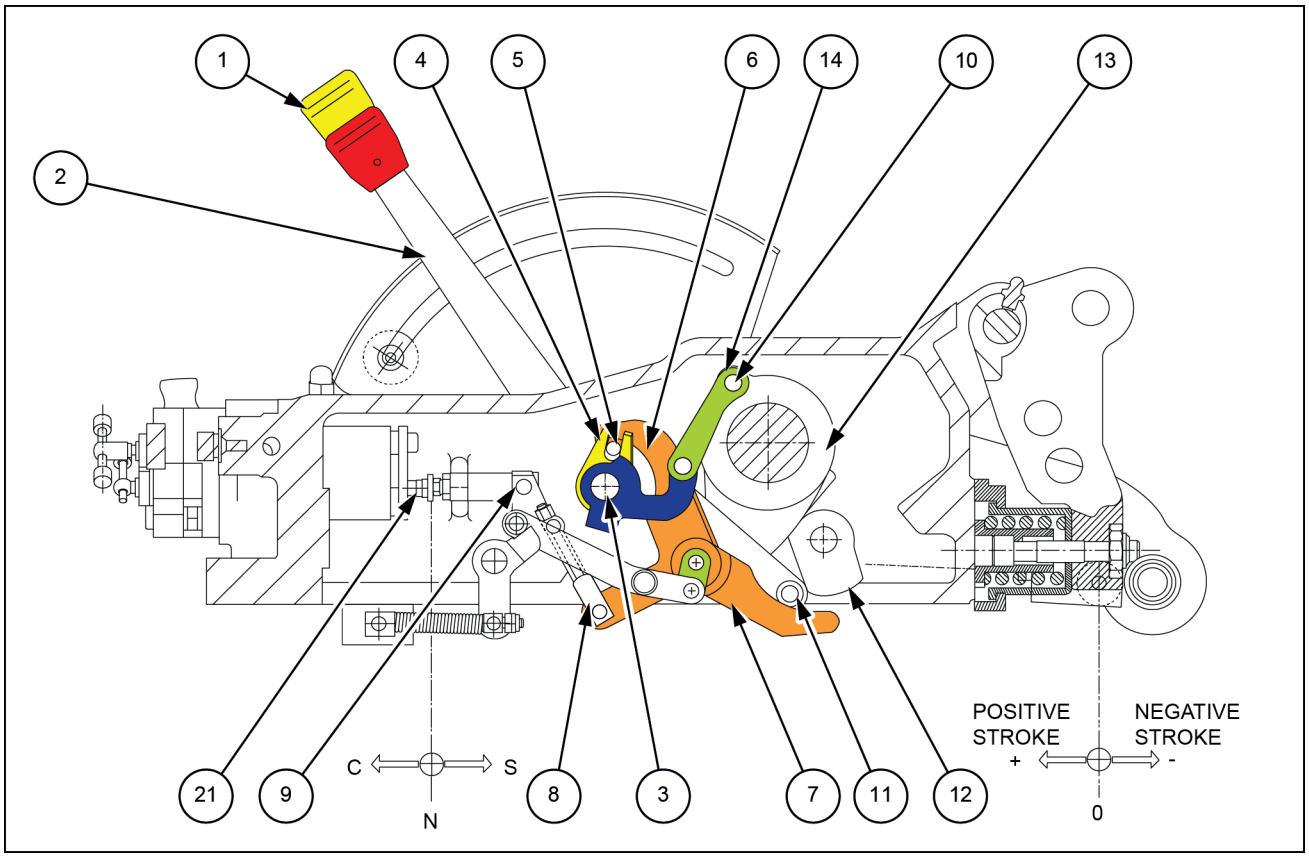
Internal linkage system

A) Functioning of position control

B) Functioning of draft control

C) Combined functioning of position and draft control

Functioning of position control



GNIL14TR04600FB 2

See **2**.

By positioning the draft control lever **(2)** against the backstop. The roller **(11)** which slides on the flywheel **(7)** of draft cam **(12)**, will be moved away completely.

In this way the draft levers will not in anyway interfere with the operation of the position control.

The arms are raised by moving the position control lever **(1)** upward, and the leverage system will act in the following way.

Crank **(4)** being an integral part of shaft **(3)** turns in a clockwise direction and causes roller **(5)** to slide on the position cam **(6)**, in turn causing the clockwise rotation of flywheel **(7)**. The flywheel will transmit an anti clockwise rotation, by means of friction shock absorber **(8)** to the transmission lever **(9)** that will bring distributor shaft **(21)** into delivery position **(C)**, thus causing the arms to be lifted.

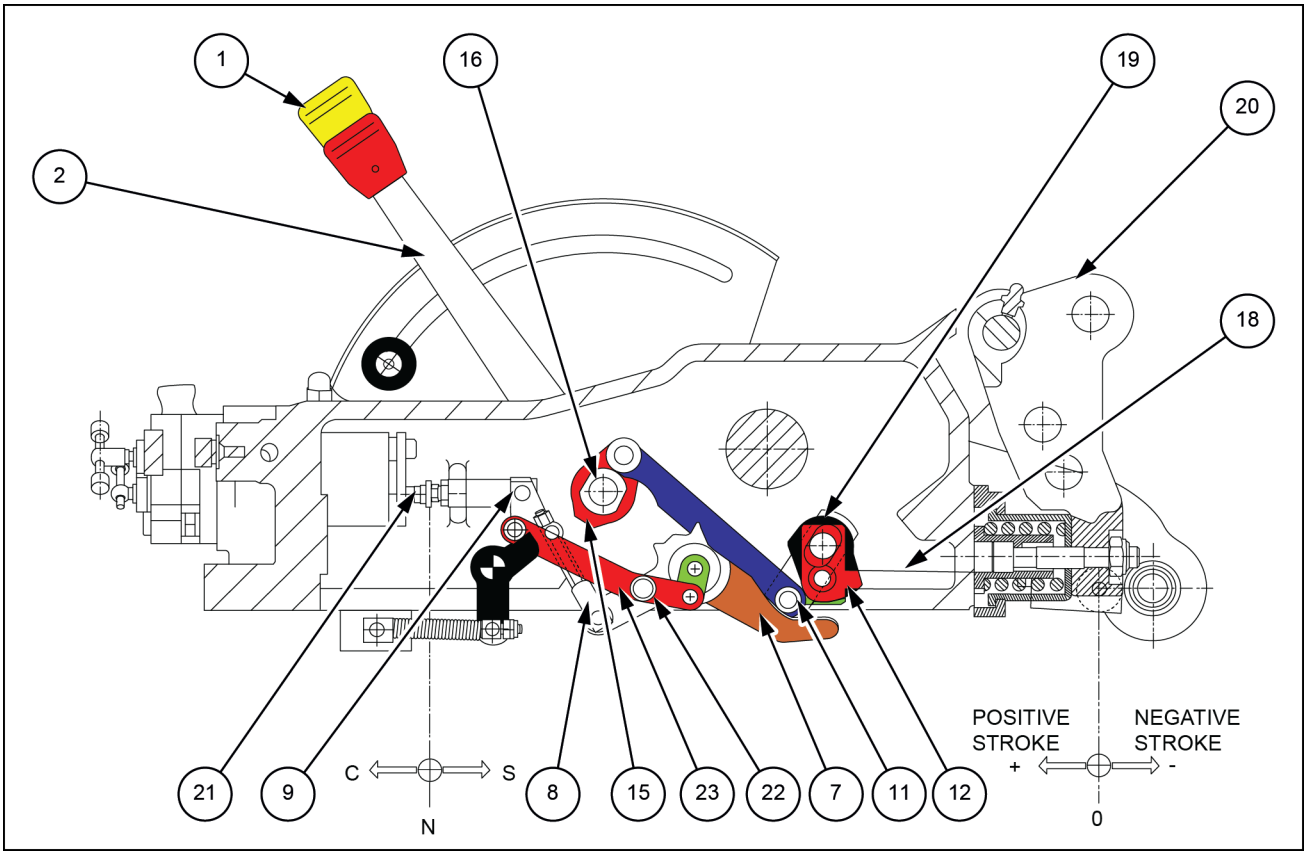
During the lifting movement of the arms, crank **(13)** with pin **(10)** will rotate in an anti-clockwise direction, and by means of the link **(14)** will cause position cam **(6)** to rotate clockwise.

When the roller **(5)** meets the inclined plane of the cam **(6)**, it allows the anti-clockwise rotation of the flywheel **(7)** that by means of a friction shock absorber **(8)** rotates the lever **(9)** in a clockwise direction, which is pushed by the spring of the control valve shaft **(21)** which moves to position **(N)** (neutral phase) and thus blocking the movement of the lifting arms.

During the lowering phase of the arms the movements of the levers indicated above will occur in the opposite sense.

The position of the arms, during lifting and lowering, correspond to a specific position of the position control lever **(1)**.

Functioning of draft control



GNIL14TR04601FB 3

See **3**.

By positioning the control lever **(1)** for position control against the backstop. The crank **(4)** reaches its maximum position of anti-clockwise rotation. In said position the roller **(5)** is totally lowered from the inclined plane of position cam **(6)** allowing the anti-clockwise rotation of flywheel **(7)** as well as the clockwise rotation of the transmission lever

(9) that is pushed by the spring of shaft **(21)** which in turn will position itself for the discharge position **(S)**. In this way the position levers will not interfere with the functioning of the draft control levers.

By positioning the draft control lever **(2)** against backstop. Draft control shaft **(16)** is caused to rotate clockwise.

The crank **(15)** being an integral part of shaft **(16)**,will reach its extreme position of clockwise rotation, and by means of tension rod **(17)** will move roller **(11)**, the latter acting on the draft cam **(12)**. This causes flywheel **(7)** to rotate clockwise which by means of function shock absorber **(8)** produces the anti-clockwise rotation of transmission lever **(9)** thus setting the distributor shaft **(21)** in delivery position **(C)** and consequently lifting the arms.

The arms will come to a stop only as soon as the piston comes into contact with the pin of the limit stop **(22)**.

This limit stop, by means of tension rod **(23)** causes lever **(9)** to rotate clockwise, thereby compressing the spring of friction shock absorber **(8)** and thus releasing shaft **(21)** which now can move to the neutral position **(N)** where it is pushed outward by its spring.

Moving the draft control lever **(2)** toward backstop **(E)**, the leverage system will function in the following manner:

The crank **(15)** being an integral part of the draft shaft **(16)**, rotates counter-clockwise and by means of tension rod **(17)** causes roller **(11)** to slide on flywheel **(7)**.

The roller **(11)** when it meets the inclined plane of the draft cam **(12)**, permits the counter-clockwise rotation of flywheel **(7)** which by means of shock absorber **(8)** will rotate transmission lever **(9)** in a clockwise manner thus leaving distributor shaft **(21)** free to move into neutral position **(N)** and continuing the movement of lever **(2)**, in the discharge position **(S)**, causing the arms to lower.

In fact, during the initial part of the movement toward backstop **(E)**, of draft control lever **(2)** the corresponding lowering of the arms does not happen yet.

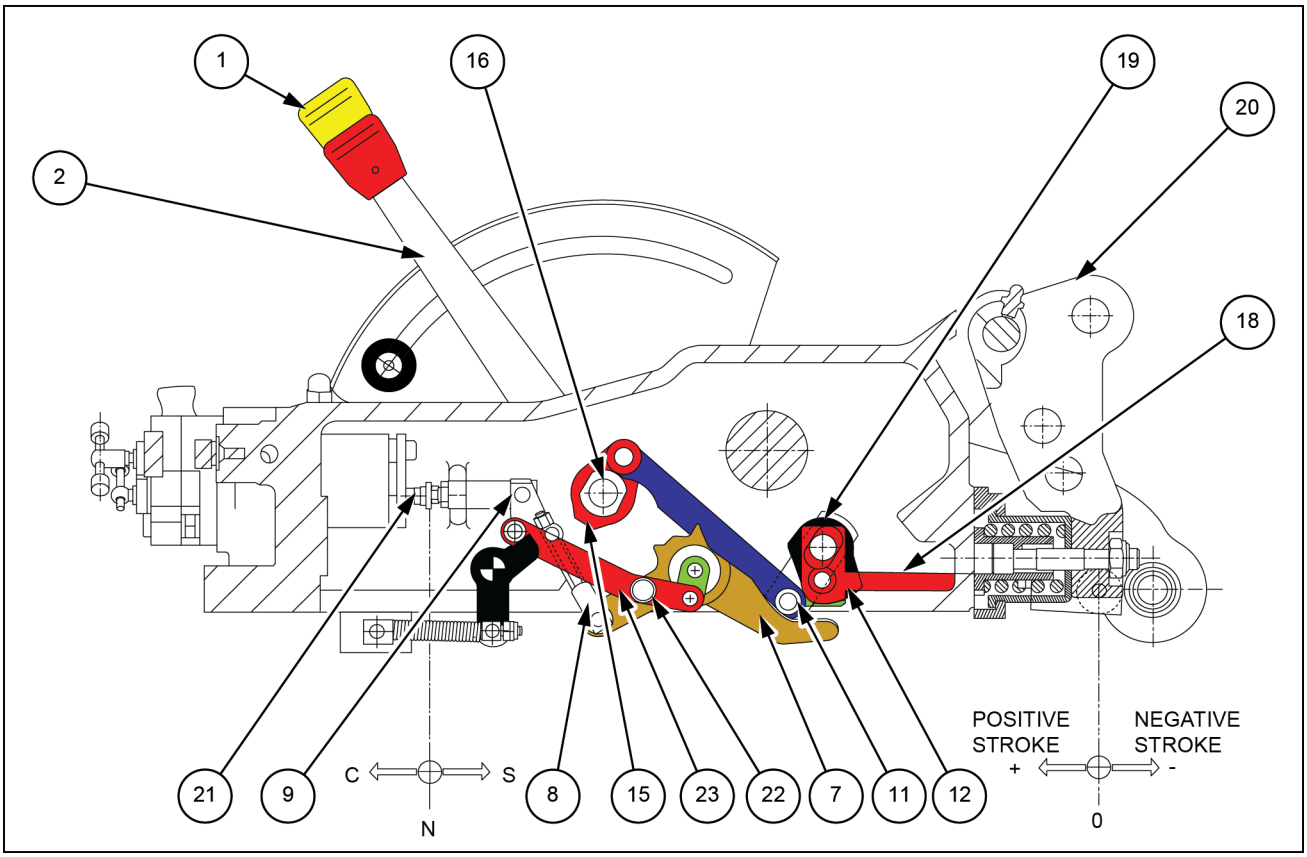
The traction force on the top link point **(20)** acts on tension rod **(18)** in the direction indicated by the arrow (+) (positive) causing flywheel **(19)** to rotate clockwise together with draft cam **(12)** which is fastened to the same pin.

When the inclined plane of draft cam **(12)** meets roller **(11)**, a clockwise rotation of flywheel **(7)** is achieved which by means of shock absorber **(8)** will cause transmission lever **(9)** to rotate counter-clockwise thereby moving the distributor shaft **(21)** into neutral position **(N)** and stopping the movement of the arms.

As the traction force is increased, draft cam **(12)** will further move roller **(11)** thus incrementing the movement as described above.

The distributor shaft **(21)** will move from neutral position **(N)** to delivery position **(C)** causing the arms to be lifted. When the traction force diminishes, shaft **(21)** will return to the neutral position or to the lowering position which will mean an inverse movement of the leverage systems to what is described above.

Combined functioning of position and draft control



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To utilise the lifting device in this condition it is necessary to observe the following instructions:

- Move the position control lever **(1)** upwards with respect to the backstop **(E)** until the maximum working depth has been attained.
- Determine the desired minimum working depth by operating the draft control lever and raising it from its zero position so that roller **(11)**, acting on the draft cam **(12)** will move the distributor shaft **(21)** into the lifting position **(C)** and causing a further upward movement of the lifting arms.

Due to the position previously established by position control lever **(1)**, flywheel **(7)**, roller **(4)** and position cam **(6)**, the distributor shaft **(21)** is prevented from entering the lowering position **(S)** and therefore the arms cannot sink even though the traction force acting on the top link point **(20)** will tend to diminish and putting stress on the tension rod **(18)** in the direction of arrow (-) (negative).

This condition will not prevent the rock shaft from operating with the draft control when, in the presence of more consistent soil, the traction force on the top link **(20)** will tend to increase, exerting pressure on the tension rod **(18)** in the direction of arrow (+) (positive).

Consequently the combined operation of position and draft control will limit variations in height towards the ground, as happens during the use of the draft control, and at the same time ensuring the maximum possible depth desirable.

Main lift system - Remove

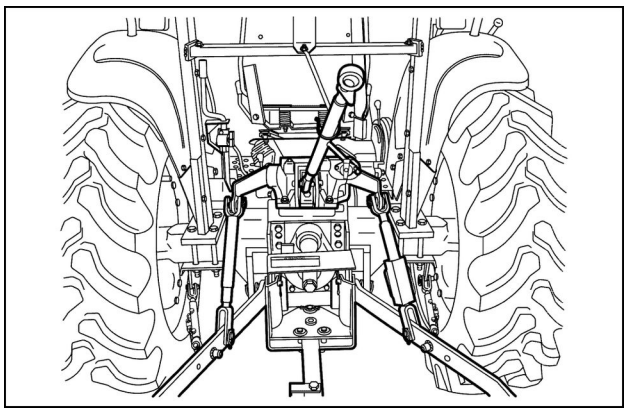
⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

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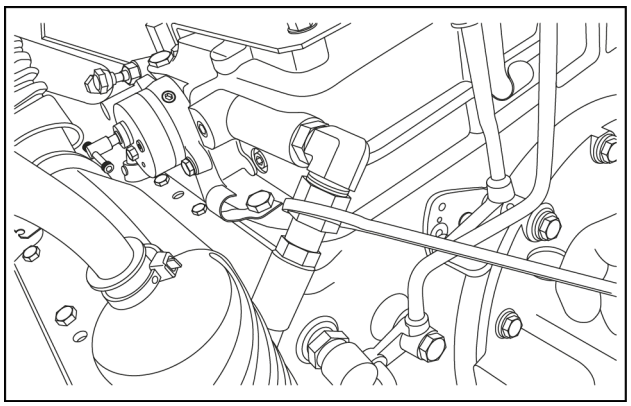
Remove the hydraulic lift from the rear axle housing as follows:

1. Remove three-point linkages (top link, lower link and lift rod) from the tractor.



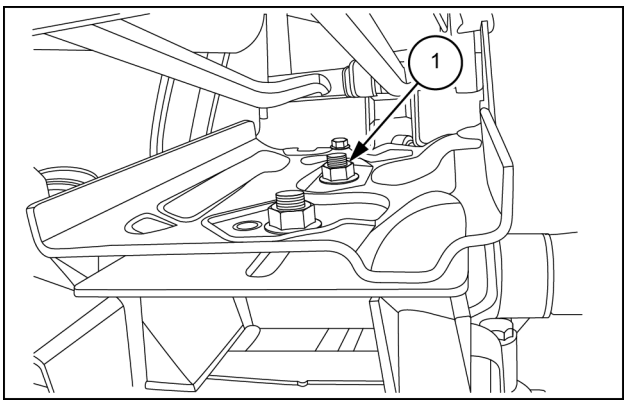
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2. Disconnect delivery pipe and return pipe from the lift assembly.



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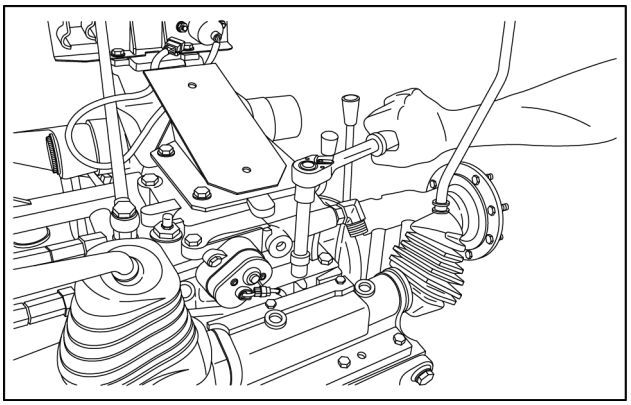
3. Disconnect the wiring coupler. Loosen the bolts **(1)**. Remove the operator's seat from the hydraulic lift.



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4. Loosen the bolts securing hydraulic lift housing to transmission housing.
5. Lift the hydraulic lift assembly using suitable hoist and place it on a flat surfaced table.

NOTICE: *Never lift the housing by holding distributor knobs and delicate parts.*



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Main lift system - Install

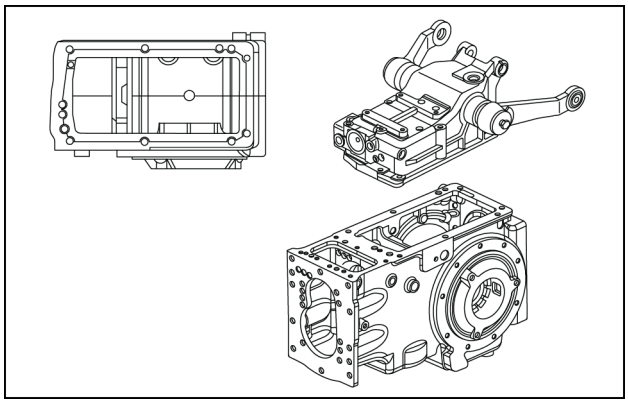
⚠ CAUTION

Pinch hazard!
Always use suitable tools to align mating parts. DO NOT use your hand or fingers.
Failure to comply could result in minor or moderate injury.

C0044A

Refit the hydraulic lift on the transmission housing as follows.

1. Re-installation follows the removal procedure in reverse
2. Before refitting the hydraulic lift in the rear transmission casing, clean and degrease the mating surfaces thoroughly and apply a strip of sealing compound of about **2.00 mm** (**0.08 in**) diameter as shown in the figure.
3. Apply the torque settings.



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Main lift system - Disassemble

⚠ WARNING

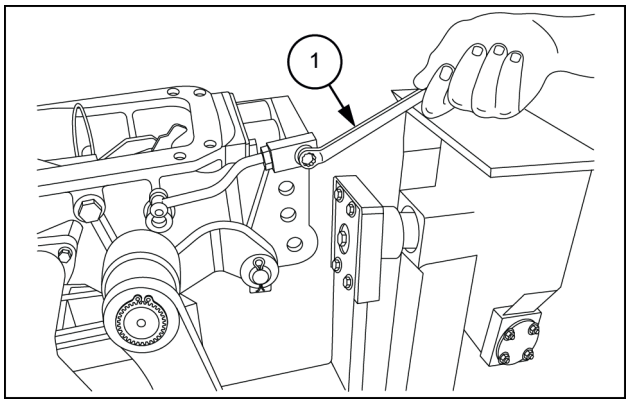
Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

W0208A

NOTE: *Draft sensing unit and related external linkages can be disassembled and assembled with the lift unit mounted on the tractor.*

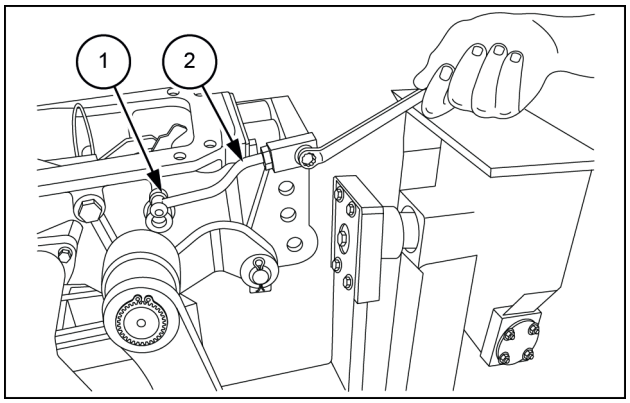
Draft sensing unit - Removal

1. Loosen the bolts **(1)** from the sensing unit.



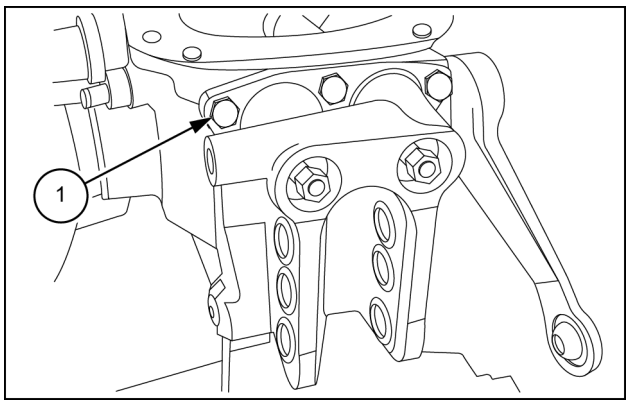
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2. Remove the lock **(1)** and remove draft link **(2)**.



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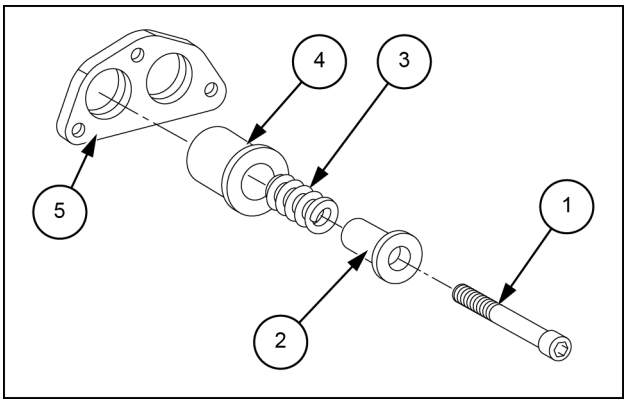
3. Loosen bolts **(1)** and set screw.
4. Remove the pin as shown in figure.
5. Remove the sensing unit from the lift housing.



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Draft sensing unit - Disassembly

6. Loosen set screws **(1)**.

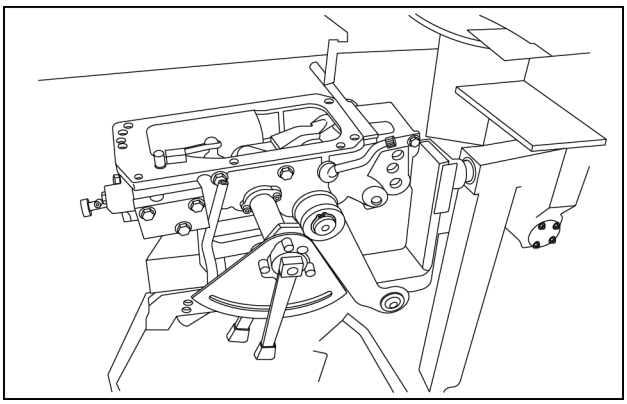


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7. Disassemble roller **(2)**, springs **(3)**, cover **(4)**, flange **(5)** from the sensing unit.

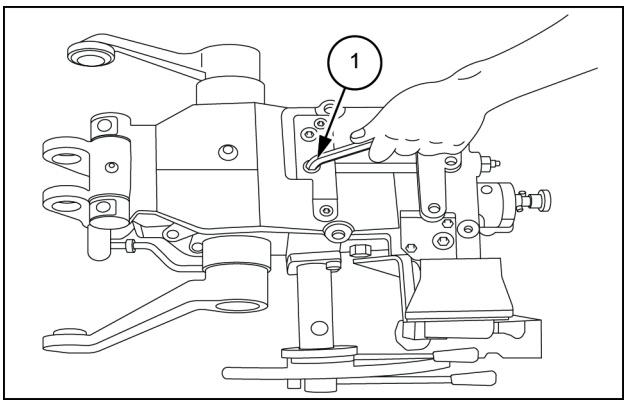
Rear lift internal controls removal

8. Remove the lift assembly from the transmission housing and fix on a rotary stand. See **Main lift system - Remove (35.100)**.



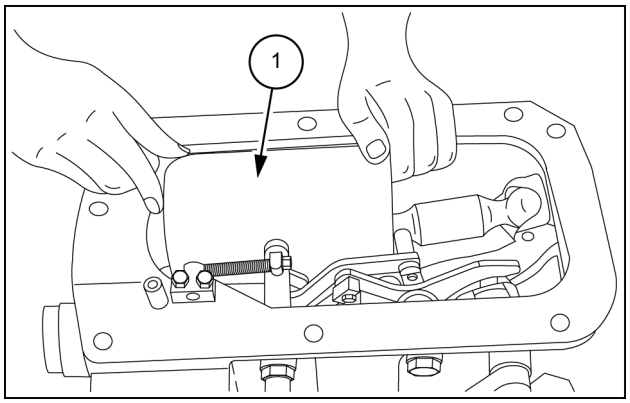
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9. Loosen the set screws **(1)**.



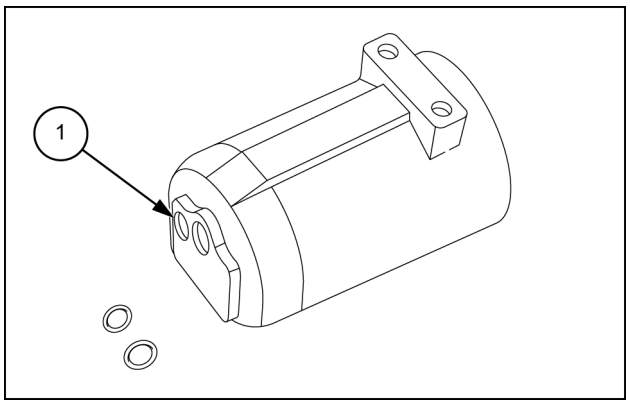
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10. Remove the cylinder **(1)** from hydraulic lift housing.



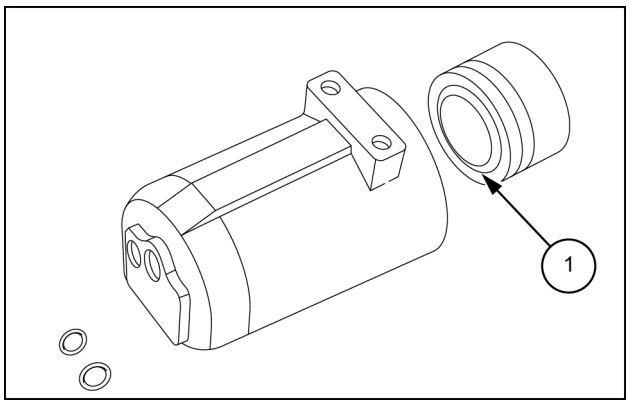
GNIL14TR04625AB 7

NOTE: *Retrieve the seal **(1)** from head of cylinder.*



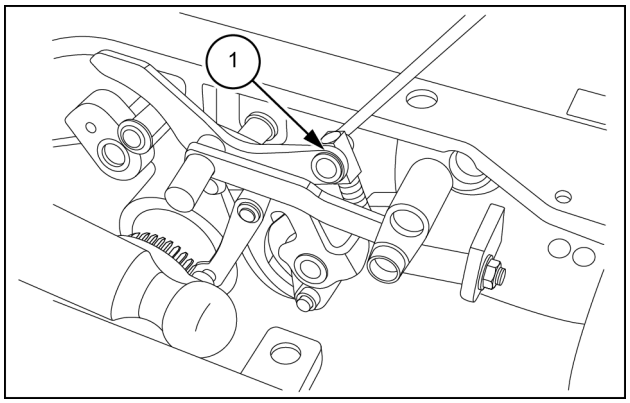
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11. Remove the piston **(1)** from the cylinder by pushing with a suitable aluminium rod from the front side.



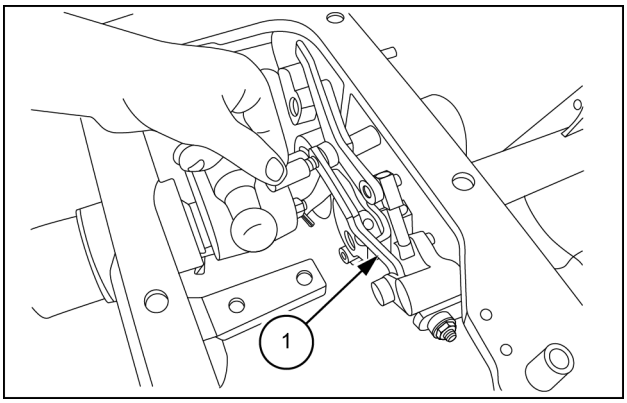
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12. Remove locks and disassemble lever **(1)**.



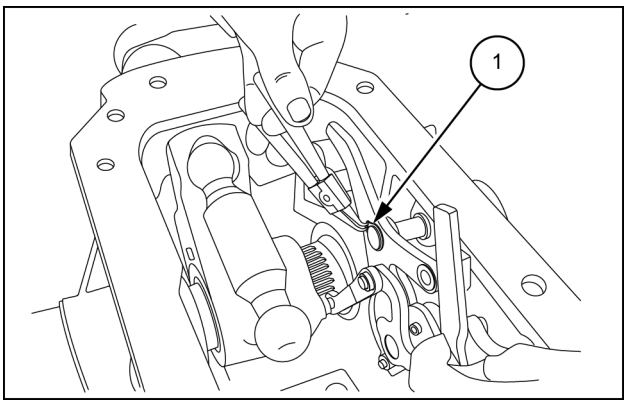
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13. Remove linkage **(1)**.



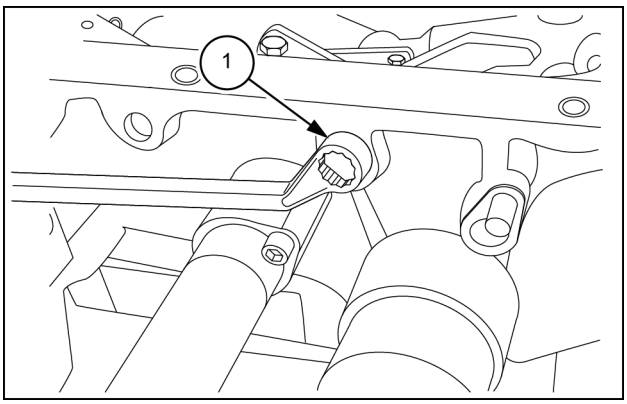
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14. Remove the lock **(1)** from the compensator pin.



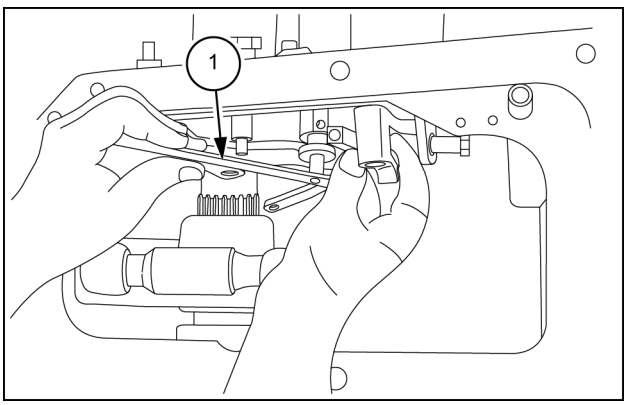
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15. Unscrew the compensator pin until face of the pin comes out of the compensator.



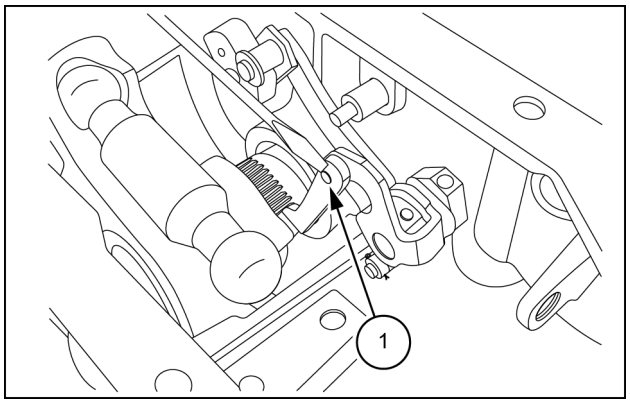
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16. Remove linkages as shown in figure.



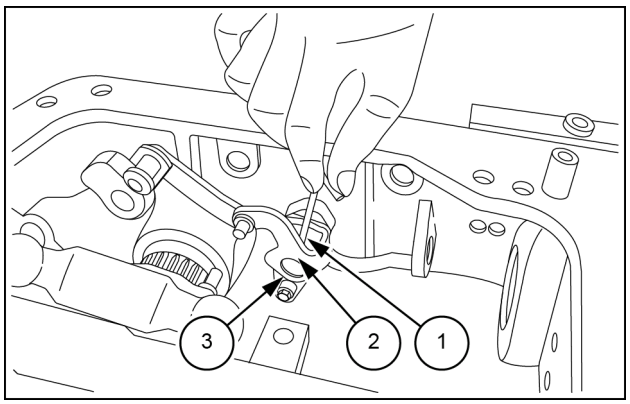
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17. Remove link **(1)**.



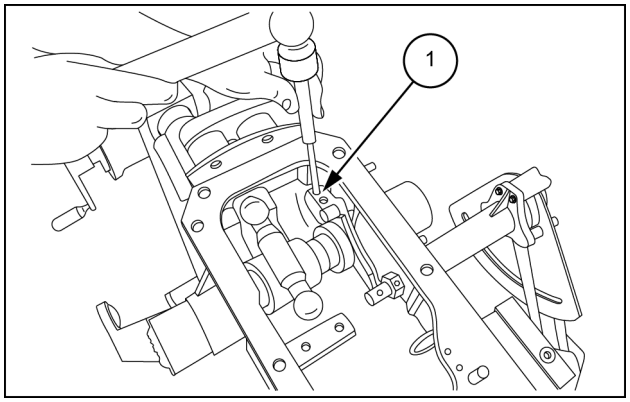
GNIL14TR04636AB 15

18. Unscrew locking screw **(1)** and remove position control cam **(2)** and bracket **(3)**.



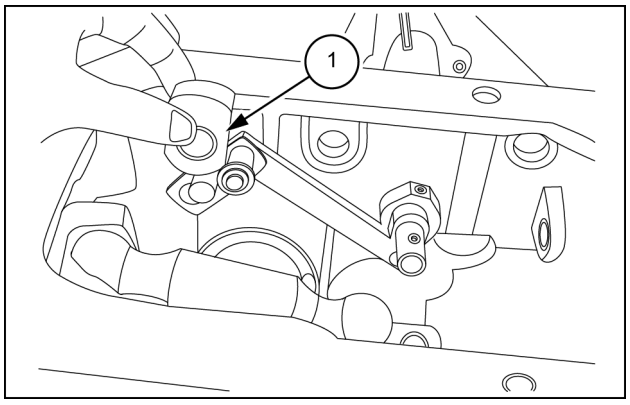
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19. Remove dowel pin **(1)**.



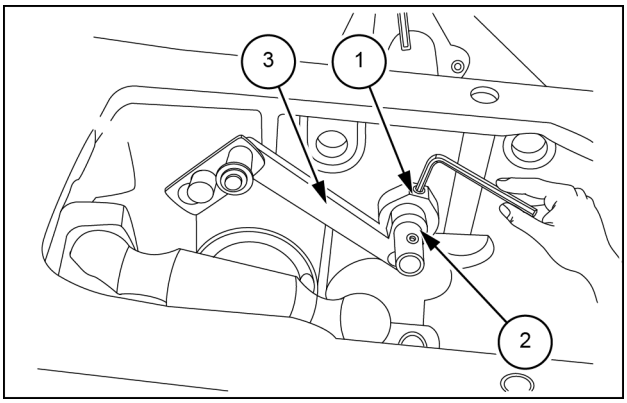
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20. Remove cam **(1)**.



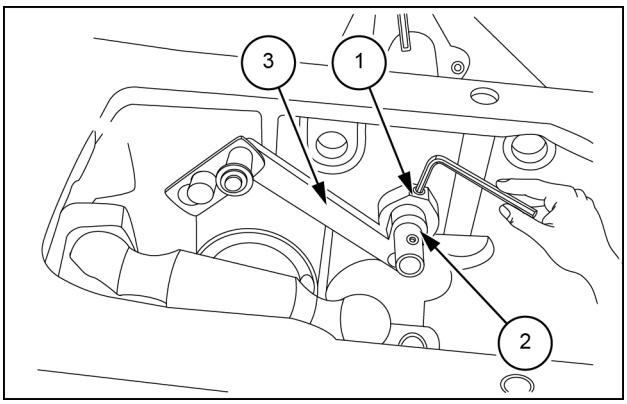
GNIL14TR04639AB 18

21. Remove lock **(1)** and disassemble link **(2)**.



GNIL14TR04641AB 19

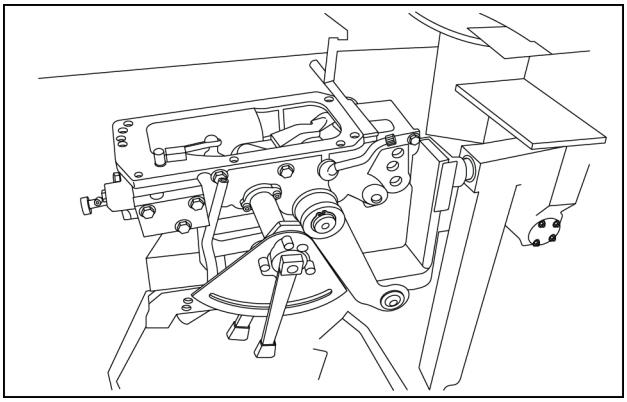
22. Unscrew locking screw **(1)** and disassemble lever **(2)** along with link **(3)**.



GNIL14TR04641AB 20

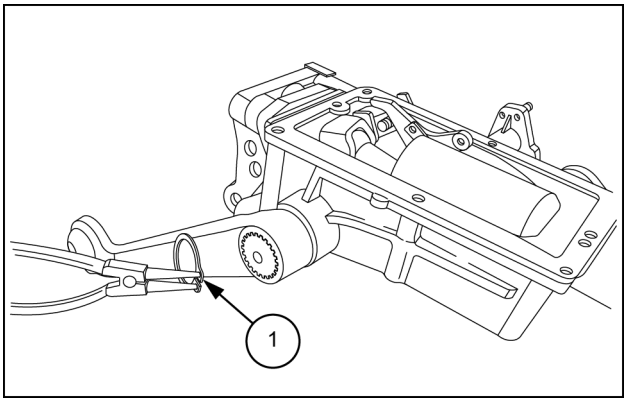
Lift arm shaft - removal

23. Remove lift assembly from the tractor and fix it on a rotary stand. Refer to **Main lift system - Remove (35.100)**.



GNIL14TR04642AA 21

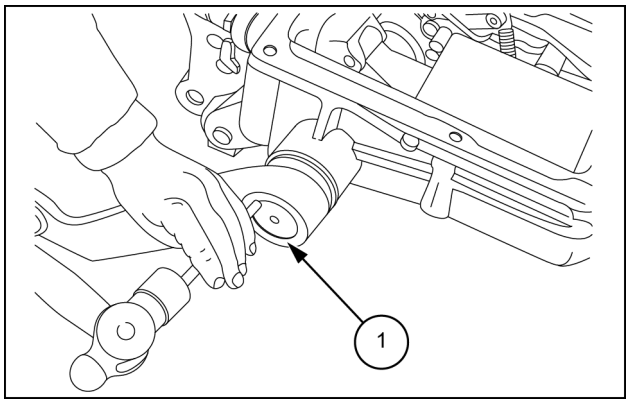
24. Remove the circlip **(1)** from lift arm shaft.



GNIL14TR04643AB 22

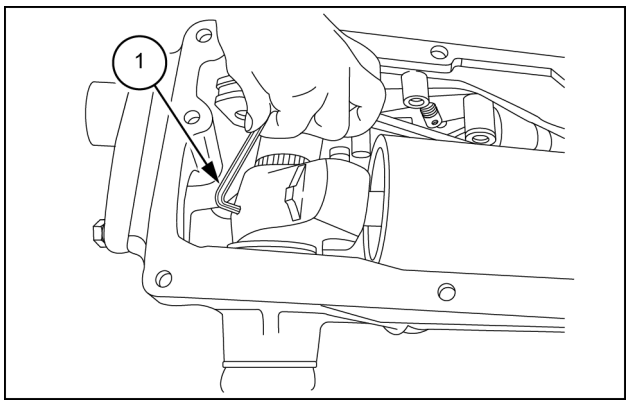
25. Remove the lift arm from the shaft.

NOTE: *Before removing lift arm punch a mark* ***(1)*** *on both lift arm and shaft to facilitate the assembly in original position.*



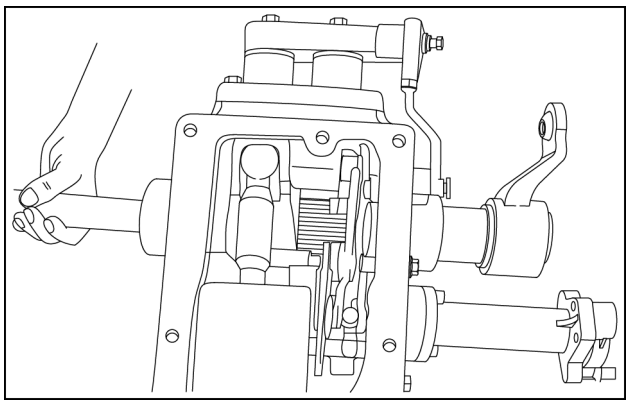
GNIL14TR04644AB 23

26. Repeat the same for the other side lift arm.



GNIL14TR04645AB 24

27. Remove the locking sensor **(1)** locking crank and shaft.
28. Push the shaft from left-hand side towards right-hand side by hammering gently using aluminium or copper rod.



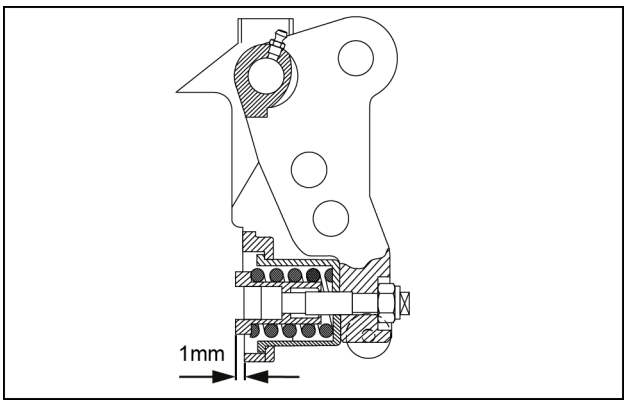
GNIL14TR04646AA 25

Main lift system - Assemble

Draft sensing unit

Assemble and reinstall sensing unit on hydraulic housing observing the following:

1. Assembly and reinstallation follows the removal procedure is reverse from step 7 to step 1.
2. Tighten all fasteners to correct torque. See **Main lift system - Torque (35.100)**.
3. The top face of spring roller:
   - Should be **1.000 mm** (**0.039 in**) above the top face of flange.
   - In case, if it is less add shims and if more remove shims.
4. Refer to page for correct settings.



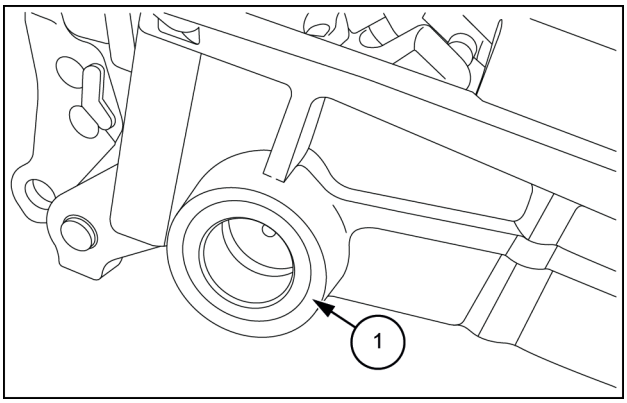
GNIL14TR04622AA 1

Rear lift internal controls

5. Re-assembling follows disassembly procedure in reverse.

Lift arm shaft

6. Reinstall the shaft and lift arm in the lift housing observing the following:
   - Reinstallation follows the removal procedure in reverse. Refer to **Main lift system - Disassemble (35.100)** from step 6 to step 1.
   - See **Main lift system - Install (35.100)** for reinstallation of lift assembly on tractor.
   - Check the seals **(1)** and replace if required.
   - Use special tool number 9970873 to fix the seal.
   - Tighten all fasteners to correct torque as detailed in **Main lift system - Torque (35.100)**.



GNIL14TR04647AB 2

Main lift system - Adjust

In case of complete disassembly of the lift it is necessary to make the following adjustments:

A. Control valve sensitivity setting

B. Position control lever setting

C. Draft control lever setting

D. Reaction spring setting

E. Internal push rod setting

A. Position control lever setting

With reference to **1**.

The adjustment is carried out in order to establish the maximum raised position of the rockshaft's lifting arms.

Completely lower the arms and apply a light weight which creates a pressure in the cylinder of **50 - 60 bar** (**725 - 870 psi**).

Loosen the fastening screw **(6)** so as to free the position control lever **(1)** from the shaft **(5)**.

With the draft control lever **(2)** at its lowest position against the backstop **(E)** raise the position control lever **(1)** against the backstop **(F)**.

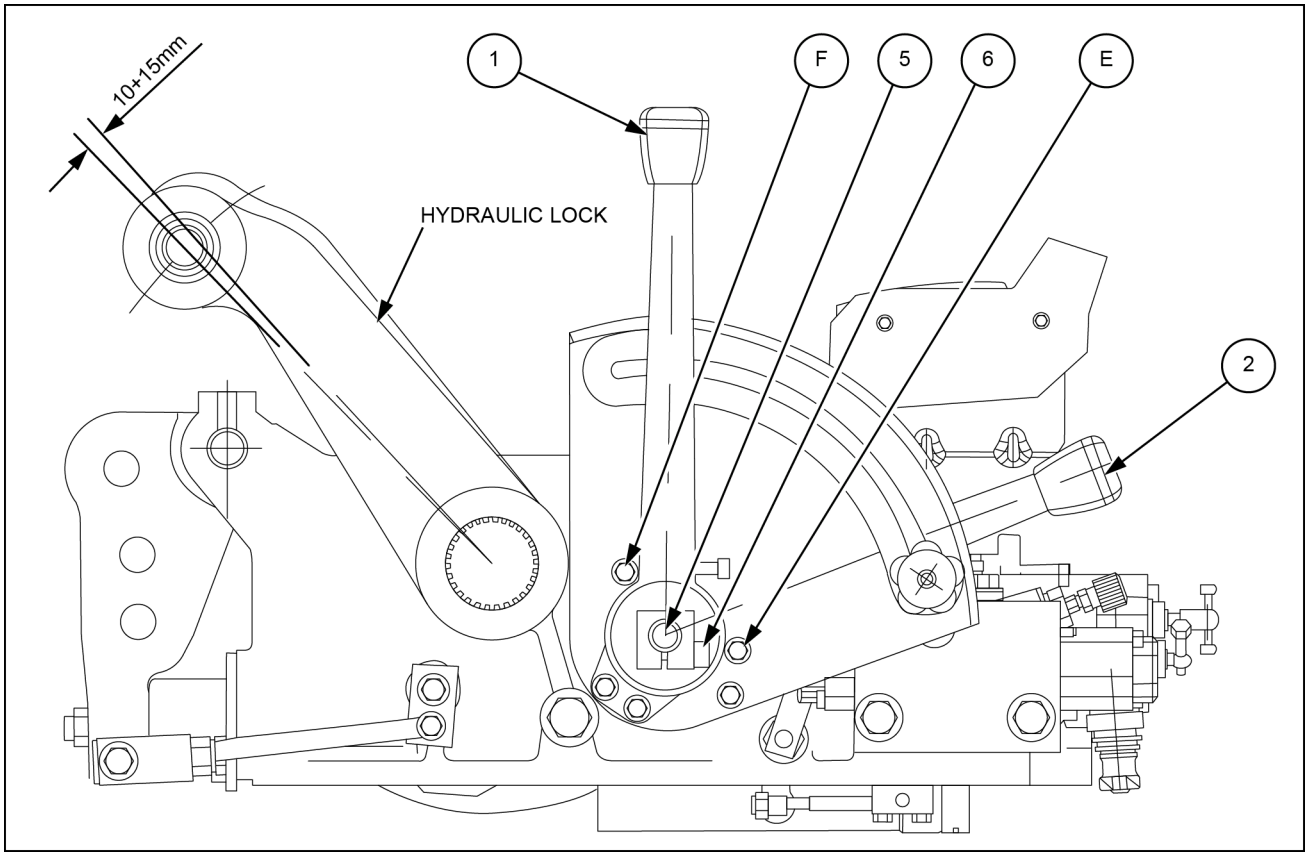
Maintaining fixed the levers **(1)** and **(2)** and with a **13.0 mm** (**0.5 in**) open end wrench rotate slowly in an anti-clockwise direction the position control shaft **(5)** so as to raise the arms to their maximum raised position which is determined by the internal hydraulic limit stop.

Since during the functioning of the position control the hydraulic limit stop must not be triggered it is necessary to have a safety margin of ~ **10.0 - 15.0 mm** (**0.4 - 0.6 in**).

In order to do this, rotate slowly in a clockwise direction the shaft **(5)** until the arms are lowered by the required safety margin.

At this point keep the shaft **(5)** fixed and with lever **(1)** against the backstop **(F)** keep the lever fixed with the shaft by tightening fully the fastening screw **(6)**.

To control, raise completely the arms by moving the position control lever **(1)** against the backstop **(F)** raising completely the draft control lever **(2)** there is a further movement upwards of the rockshaft arms. This movement should be contained within **15.0 - 20.0 mm** (**0.6 - 0.8 in**).



GNIL14TR04652FB 1

B. Draft control lever setting

With reference to **2**.

The adjustment of the draft control lever must be carried out to have a correct synchronisation between this lever and the stroke (positive and negative) of the top link bracket in order to make full use of the reaction spring.

The adjustment must be carried out without implements or loads applied to the three point linkage **(20)** (i.e. in a neutral position).

Position the two control levers **(1)** and **(2)** in the lowest position.

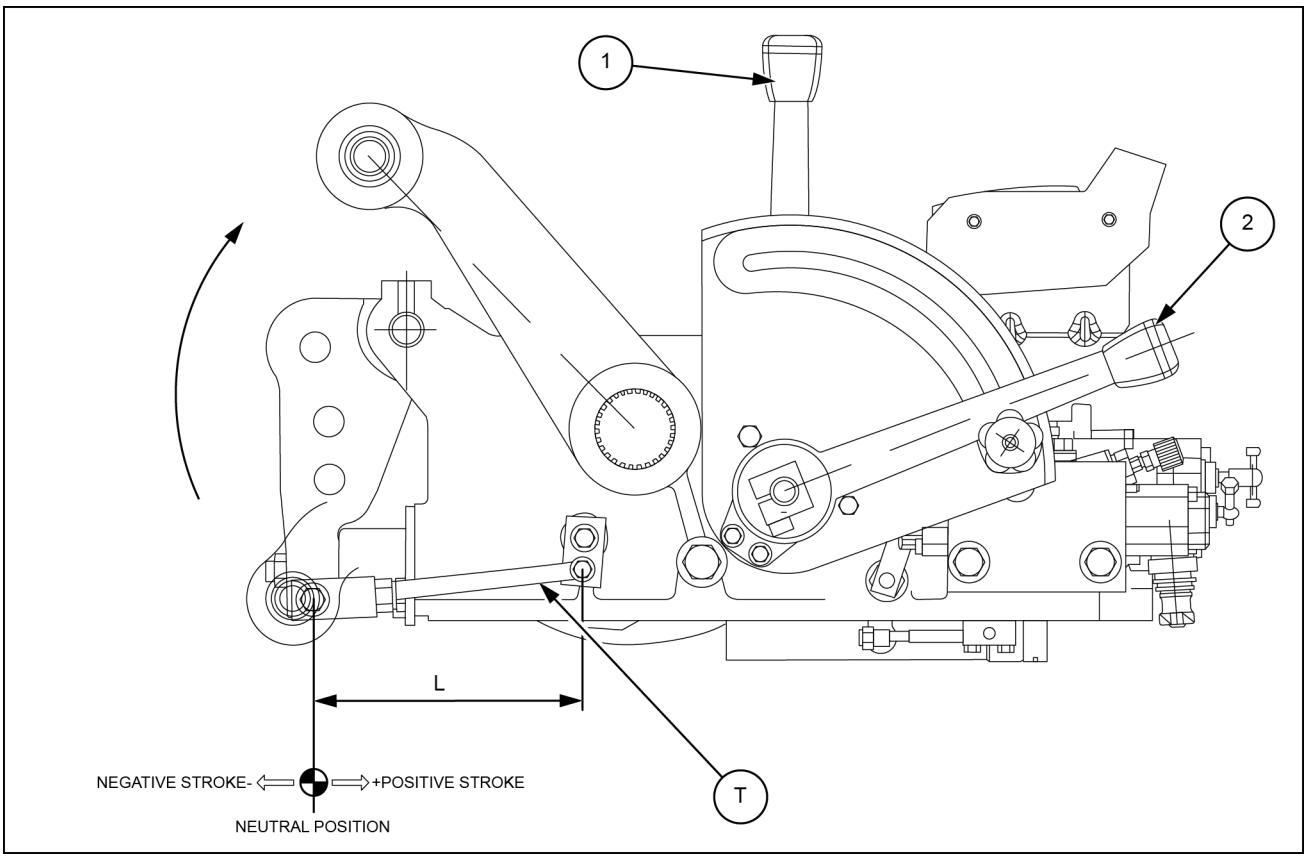
With the motor running at minimum RPM slowly raise the draft control lever **(2)**.

The adjustment of the draft lever **(2)** is correct when it is moved upward to the (6-8) sign on the sector and this allows the arms to be completely raised.

If the lever **(2)** raises completely the arms before arriving at the (6-8) sign on the sector then the measurement **(L)** of the rod **(T)** must be shortened.

If the lever **(2)** raises completely the arms after passing the (6-8) sign on the sector then the measurement **(L)** of the rod **(T)** must be lengthened.

NOTE: *The position of the lever **(1)** establishes only the position of the arms but does not influence the adjustment of the draft control lever **(2)**.*



GNIL14TR04653FB 2

C. Reaction spring setting

With reference to figure **3**.

For a correct functioning of the rockshaft the top link bracket, when it is not working, must not have an axial play in the positive (+) and negative (-).

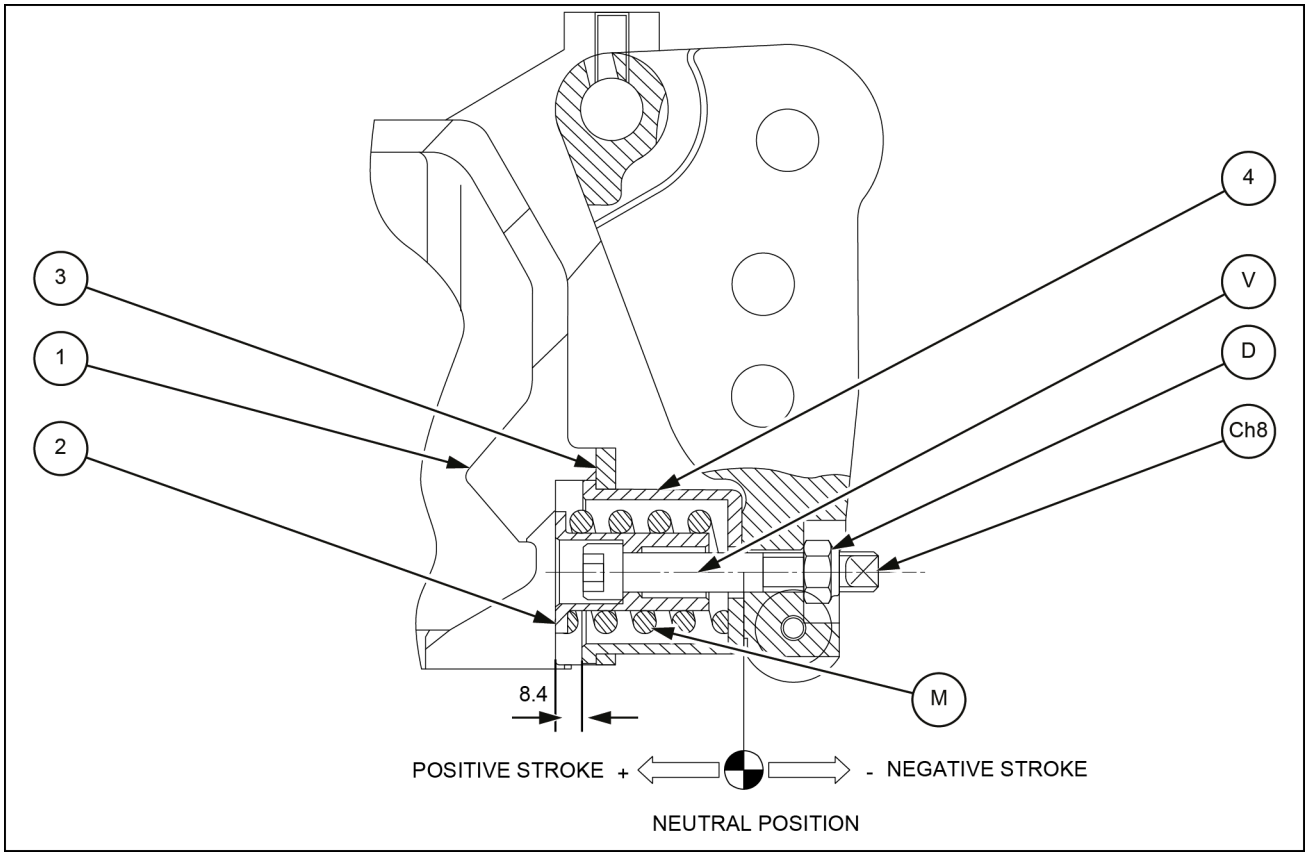
After having carried out a correct assembly, the spring holder **(2)** must rest against the rockshaft housing **(1)**, while the spring holder cover **(4)** must rest against the flange **(3)**.

In this condition the spring **(M)** is set to a preload of **0.30 - 0.60 mm** (**0.01 - 0.02 in**).

Before assembling the complete reaction assembly to the rockshaft housing a pre-assembly of the spring **(M)** is needed in order to obtain a measurement of about **8.40 mm** (**0.33 in**).

After carrying out the reaction assembly a definitive adjustment is made:

Keep the screw **(V)** fixed with an **8.00 mm** (**0.31 in**) wrench and adjust the self-locking nut **(D)** by tightening or loosening it gradually in order to eliminate the axial play completely.



GNIL14TR04654FB 3

D. Internal push rod setting

With reference to figure **4**.

If the rockshaft is disassembled and if the regulator **(R)** must be changed it is advisable to control the measurement “X” (~10,5) in order to re-assemble the push rod in the same position.

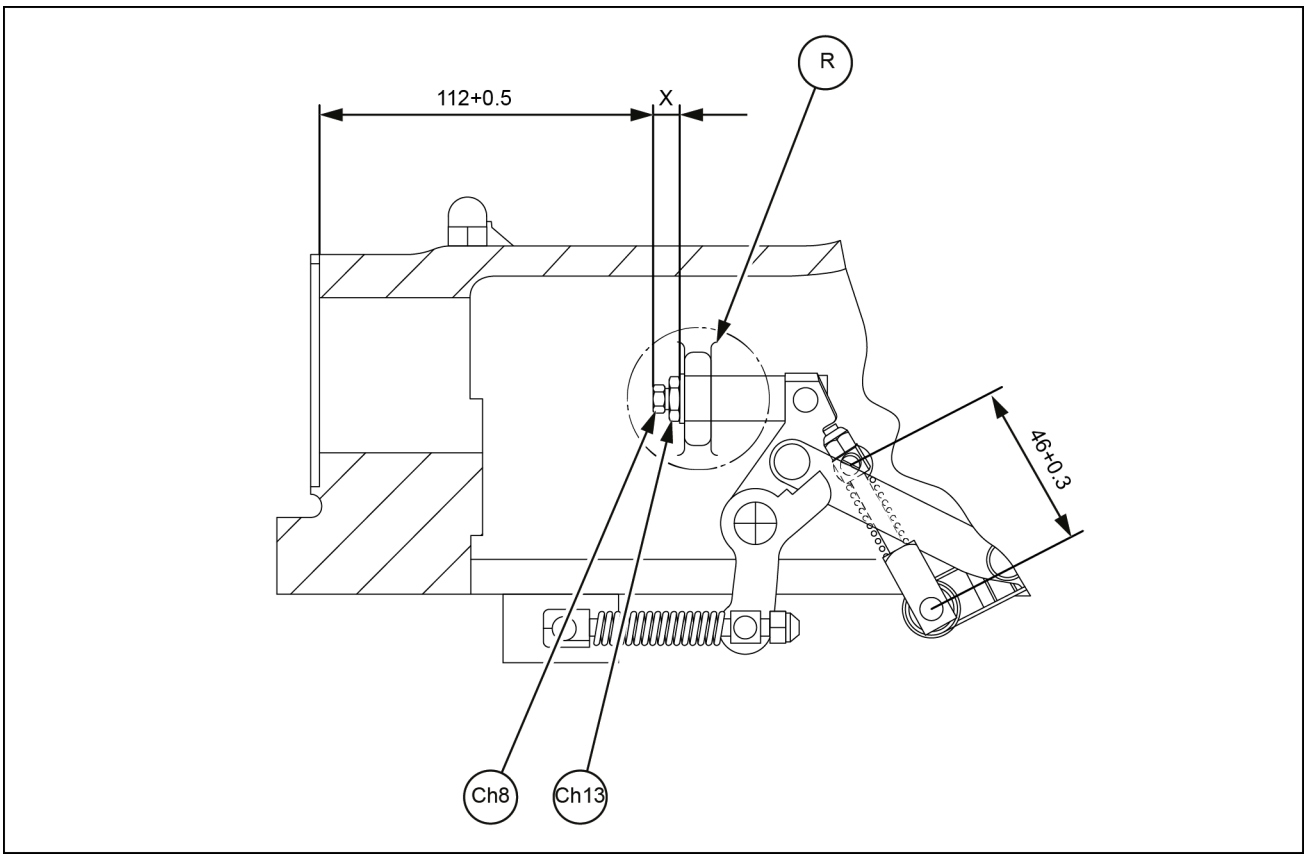
Ensure also that the measurement of the spring is **46.00 - 46.30 mm** (**1.81 - 1.82 in**).

The control of the measurement of the push rod with respect to the control valve face is carried out after making all the adjustments (sensitivity of control valve - position control lever - draft control lever).

With the rock shaft’s arms completely lowered and without loads or implements on the three point linkage (neutral position), position the two control levers **(1)** and **(2)** at their lower position against the backstop **(F)**.

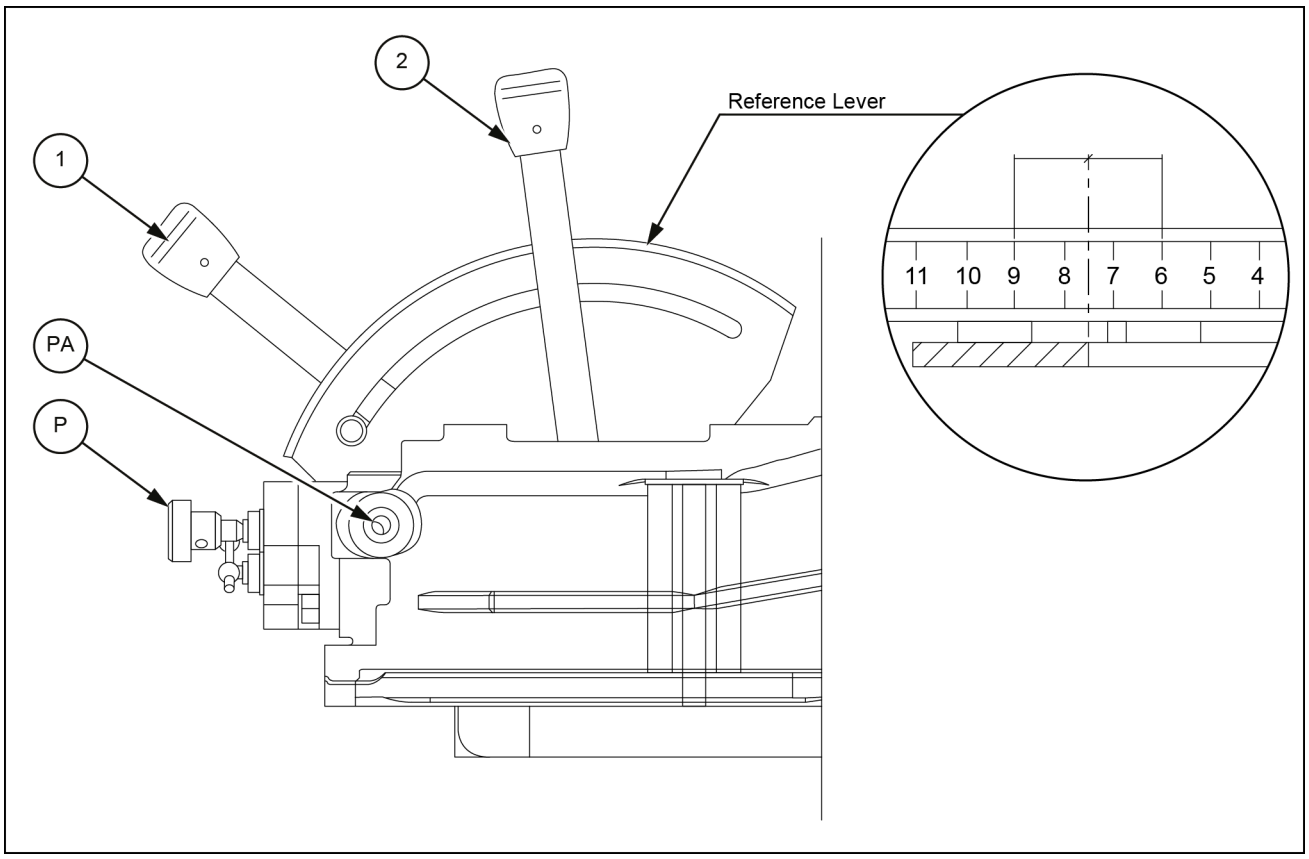
In this position push the push rod and verify with the appropriate gauge that the distance of **112.00 - 112.50 mm** (**4.41 - 4.43 in**) is correct.

NOTE: *If the measurement “X” is changed it is obligatory to carry out again the adjustment of the position and draft control levers.*



GNIL14TR04655FB 4

Main lift system - Inspect



GNIL14TR04650FB 1

The pre selector **(P)** is used to connect the auxiliary port-thread M18 x 1.5 and send the oil to a single acting cylinder-for example a wagon dump-and moving it with the draft lever **(2)**.

In this way the oil that normally is filling the rock-shaft cylinder is deviated to the external cylinder.

- Connect the port **(PA)** to the single acting usage e.g. Wagon dump cylinder.
- For safety fully lower the lift arms by putting down both draft and position levers.
- Screw completely the pre selector **(P)** in order to block the oil passage to the rock shaft cylinder.
- To obtain the acting of external cylinder move up slowly the draft lever **(2)**. If the top link bracket is in neutral position (without any implement attached) the effect starts when the lever **(2)** is between numbers 9-6 on the sector.
- To obtain the stop of the acting move back down a little the draft lever.
- To obtain the discharge - cylinder closing - lower down fully the draft lever **(2)**.

NOTE: *In the acting phase-external cylinder opening-if the single acting arrives to the end of the stroke the relief valve enters in action with the possibility to damage the pump if the system is left for a long time in this position.*

Therefore after having reached the required movement of the cylinder it is important to not forget to move back down a little the lever **(2)** in order to stop the cylinder or to discharge the oil.

Main lift system - Troubleshooting

Problem	Possible Cause	Correction
The Rockshaft lifts jerkily	Insufficient oil level in the tank	Top up the level
	Pump inlet filter clogged	Clean or replace the filter
	Infiltration of air into the pump inlet pipe	Check the inlet pipe and any coupling and gasket
Rockshaft does not operate	Differential valve blocked or dirty	Remove the control valve and unblock the regulator piston
The rock shaft starts to lift, but it stops as soon as it feels the load, without the functioning of the over-pressure valve	Tension rod measurement **(L)** is not correct (Refer to **Main lift system - Adjust (35.100)**)	Adjust the draft control lever (Refer to **Main lift system - Adjust (35.100)**)
The rock shaft does not descend over its entire travel	Faulty adjustment of the position control lever **(1)**	Adjust position control lever (Refer to **Main lift system - Adjust (35.100)**)
The rock shaft does not descend	Discharge valve blocked	Remove control valve and unblock or clean discharge valve
	Lever RD closed	Turn lever RD in anti-clockwise
Lifting capacity does not match that prescribed	Deterioration of the control valve seal rings	Remove control valve and replace the external seal rings
	Relief and safety valves out or calibration	Control calibration of the valves
	Poor pump efficiency	Replace the pump
	Excessive loss of oil from control valve	Overhaul the control valve
The rock shaft supports loads with difficulty	Piston gasket worn	Replace the gasket
When the motor is off	Oil leakage from safety valve	Remove control valve and adjust valve
	Oil leakage from check valve	Remove the control valve and adjust valve
With the arms raised at backstop and with the engine on, we have verified a rhythmic oscillation, with the engine off the load does not lower	Incorrectly adjusted of position control lever which, at maximum raised height, causes the internal automatic backstop to function	Adjust the position control lever (Refer to **Main lift system - Adjust (35.100)**)
The draft control does not function, the rock shaft raises and lowers only with the position lever	Draft control lever is adjusted badly	Adjust the draft control lever (**Main lift system - Adjust (35.100)**).
The position control does not function, the rock shaft raises and lowers only with the draft lever	Position control lever is adjusted badly	Adjust the position control lever (Refer to **Main lift system - Adjust (35.100)**)
Rockshaft does not lift and the relief valve acts with the possibility to damage the pump	Pre selector i s fully closed	Unscrew fully the pre-selector **(P)** (Refer to **Main lift system - Adjust (35.100)**).

https://truckmanualshub.com/

Index

Hydraulic systems - 35

Main lift system - 100

Main lift system - Adjust 22
Main lift system - Assemble 21
Main lift system - Disassemble 14
Main lift system - Dynamic description 6
Main lift system - General specification 3
Main lift system - Inspect 27
Main lift system - Install 13
Main lift system - Remove 11
Main lift system - Sealing 4
Main lift system - Special tools 5
Main lift system - Torque 3
Main lift system - Troubleshooting 29

https://truckmanualshub.com/

Hydraulic systems - 35

Fixed displacement pump - 104

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Hydraulic systems - 35

Fixed displacement pump - 104

TECHNICAL DATA

Fixed displacement pump
General specification 3

SERVICE

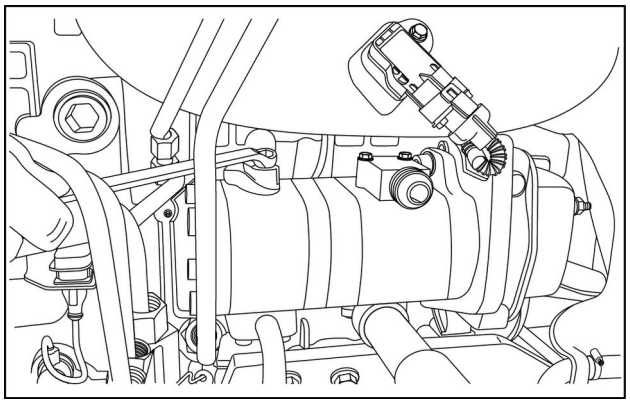
Fixed displacement pump
Remove 4
Install 6

Fixed displacement pump - General specification

FILTER	
Type	Full-flow spin on type
Location	On suction pipe before pump intake, on the right-hand side of the engine
PUMP	
Type	Gear type (In tandem with the steering pump), drawing oil from transmission housing
Location	On the right-hand side of the engine
Mounting	Fitted on engine timing case and driven by timing gears
Make	Rexroth (Bosch Group)
Drive	Engine timing gears
Rotation (seen from the free end of the drive shaft)	Anti-clockwise
Displacement	**16 cm³** per revolution
Max. rotational speed	**3300 RPM**
Flow at **1500 RPM** & **210 bar**	**21.12 L/min**

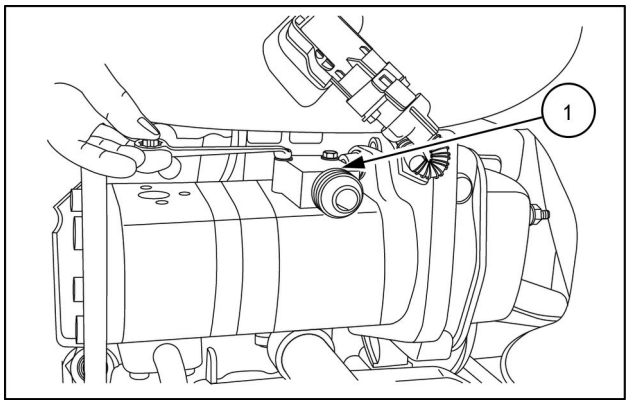
Fixed displacement pump - Remove

1. Disconnect the power steering pipes on the hydraulic hump.



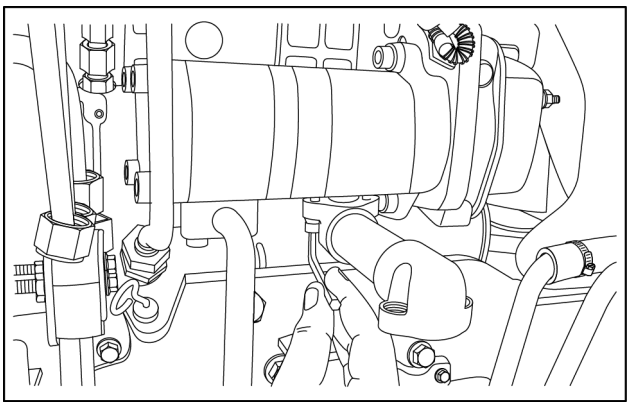
GNIL14TR00729AA 1

2. Disconnect the hydraulic delivery pipe on the pump and remove the connector **(1)**.



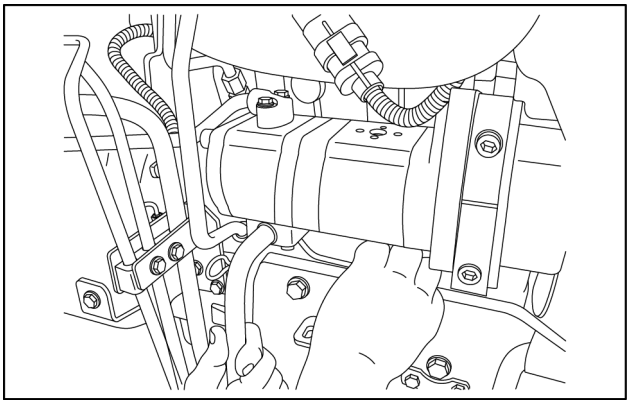
GNIL14TR00730AA 2

3. Remove the hydraulic filter and connector between hydraulic filter and pump.



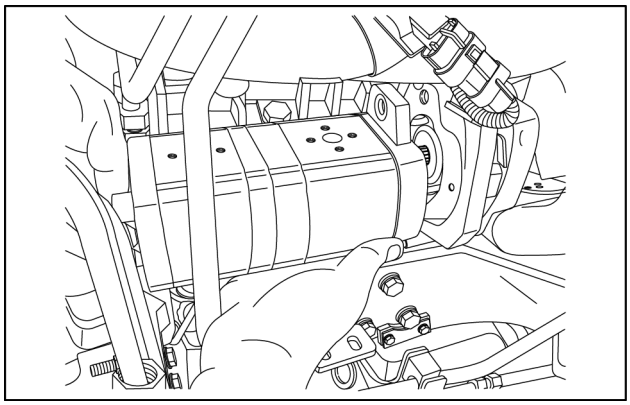
GNIL14TR00731AA 3

4. Remove the power steering suction pipe.



GNIL14TR00732AA 4

5. Loosen the allen screws and remove the hydraulic pump.



GNIL14TR00733AA 5

Fixed displacement pump - Install

For installation, follow the removal process in reverse order.

https://truckmanualshub.com/

Index

Hydraulic systems - 35

Fixed displacement pump - 104

Fixed displacement pump - General specification 3
Fixed displacement pump - Install 6
Fixed displacement pump - Remove 4

https://truckmanualshub.com/

https://truckmanualshub.com/

Hydraulic systems - 35

Remote control valves - 204

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Hydraulic systems - 35

Remote control valves - 204

SERVICE

Remote control valve
Remove 3
Remove 5
Install 7
Mid-mount remote control valve
Remove 8
Install 10

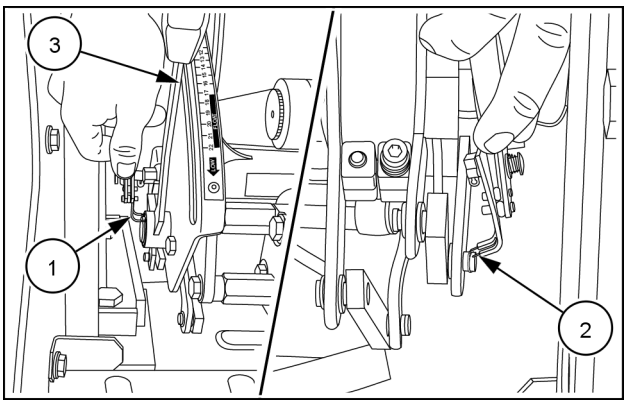
Remote control valve - Remove

⚠ WARNING

Escaping fluid!
Lower the three-point hitch to the ground and relieve all pressure from the hydraulic system before installing the kit.
Failure to comply could result in death or serious injury.

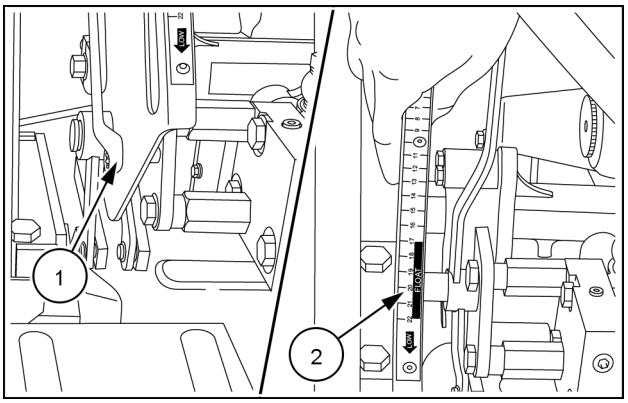
W1114A

1. Loosen the set screw and remove the remote control valve lever.
2. Remove the two circlip **(1)** and **(2)** from position control lever. Remove the position control lever **(3)**.



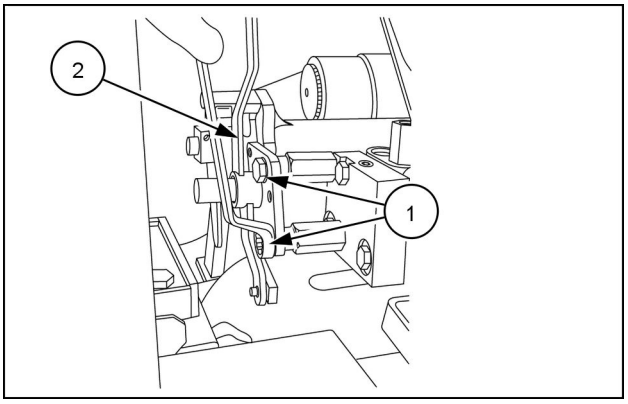
GNIL14TR00646AA 1

3. Loosen the two bolts **(1)** and remove the quadrant **(2)**.



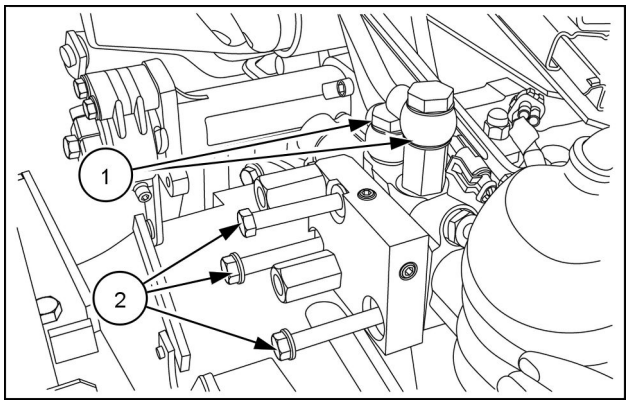
GNIL14TR00647AA 2

4. Loosen the bolts **(1)** and remove the draft control lever **(2)**.



GNIL14TR00648AA 3

5. 1. Remove the hydraulic pipes **(1)** on remote control valve.
   2. Loosen the bolts **(2)** and remove the plate.
   3. Remove the remote control valve.



GNIL14TR00649AA 4

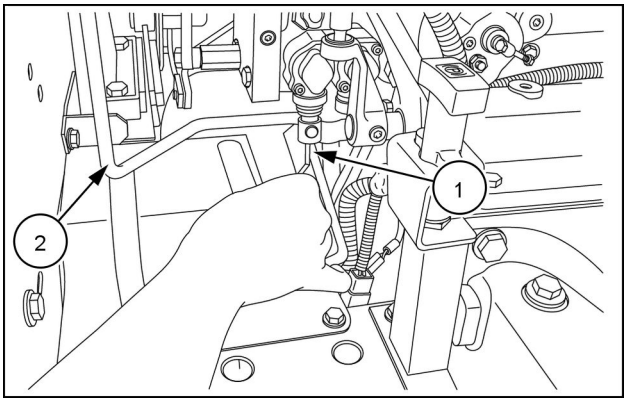
Remote control valve - Remove

⚠ WARNING

Escaping fluid!
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Failure to comply could result in death or serious injury.

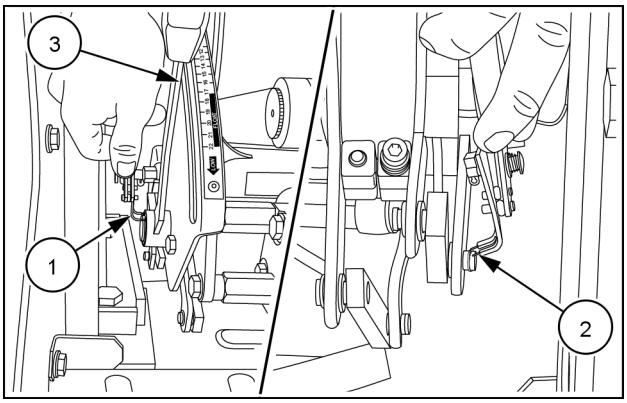
W1114A

1. 1. Loosen the set screw **(1)**. Remove the remote control valve lever **(2)**.
   2. Similarly remove the another remote control valve lever.



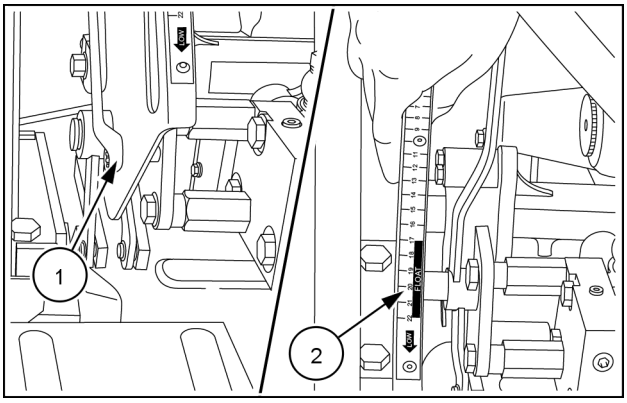
GNIL14TR00659AA 1

2. Remove the two circlip **(1)** and **(2)** from position control lever. Remove the position control lever **(3)**.



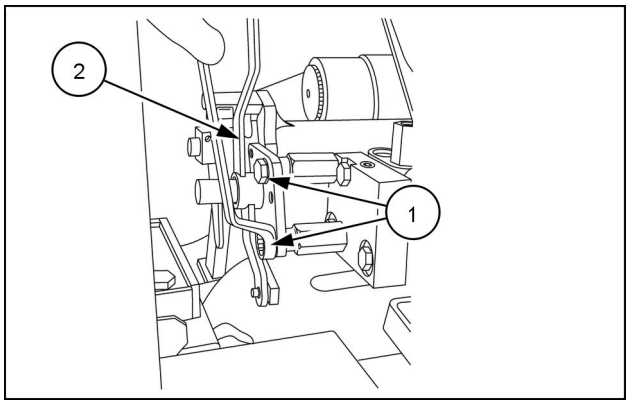
GNIL14TR00646AA 2

3. Loosen the two bolts **(1)** and remove the quadrant **(2)**.



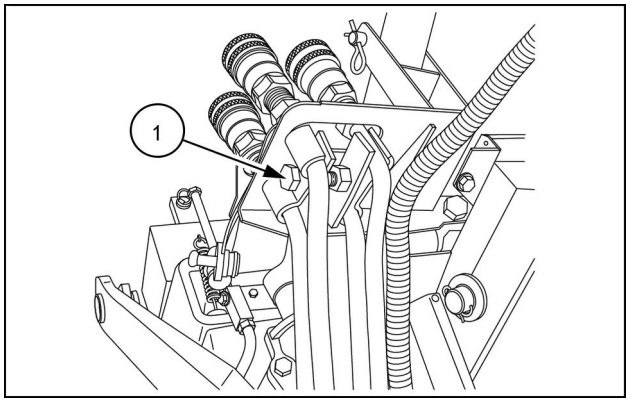
GNIL14TR00647AA 3

4. Loosen the bolts **(1)** and remove the draft control lever **(2)**.



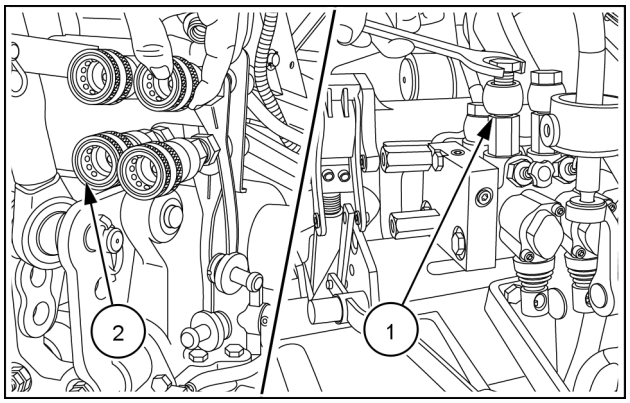
GNIL14TR00648AA 4

5. Loosen the bolt **(1)**.



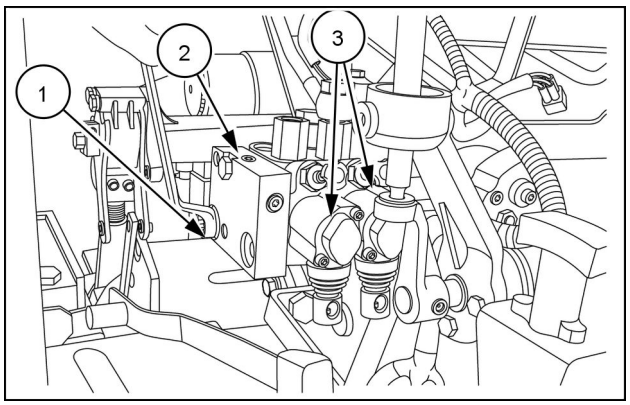
GNIL14TR00658AA 5

6. Loosen the bolts **(1)**. Remove the hoses **(2)**.



GNIL14TR00657AA 6

7. 1. Loosen the bolts **(1)**.
   2. Remove the plate **(2)**.
   3. Remove the two remote control valves **(3)**.



GNIL14TR00652AA 7

Remote control valve - Install

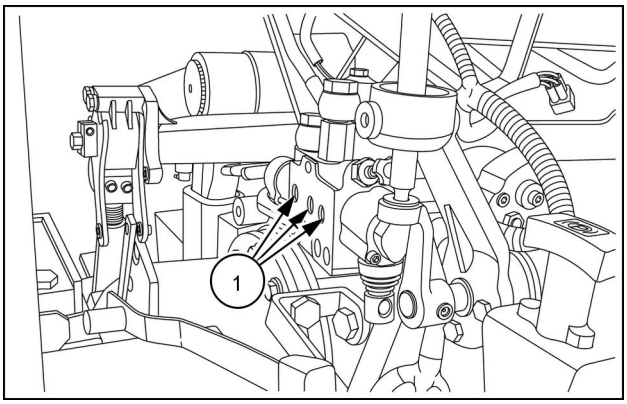
⚠ WARNING

Escaping fluid!
Lower the three-point hitch to the ground and relieve all pressure from the hydraulic system before installing the kit.
Failure to comply could result in death or serious injury.

W1114A

NOTE: *For installation, follow the removal process in reverse order.*

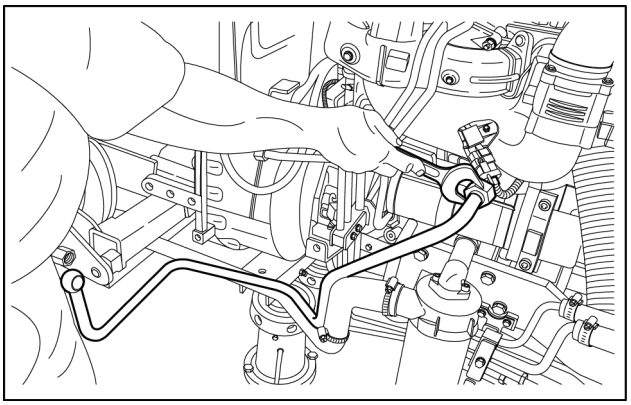
Lubricate the seal rings **(1)** lightly with petroleum jelly. This will help to hold rings in position during installation.



GNIL14TR00650AA 1

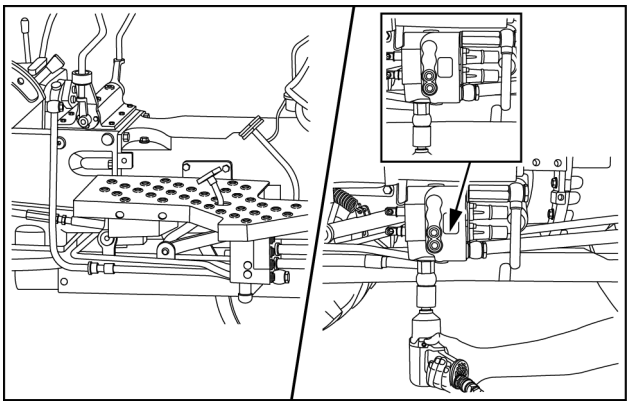
Mid-mount remote control valve - Remove

1. Disconnect the two joystick cable from the mid-mount valve. See **Joystick and Electric Hydraulic (EH) control - Remove (55.512)**.
2. Disconnect the hydraulic delivery pipe between hydraulic pump and mid-mount valve.



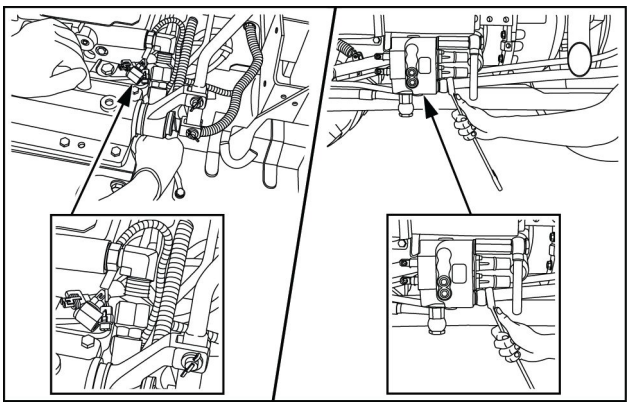
GNIL14TR00783AA 1

3. Disconnect the hydraulic delivery pipe between mid-mount valve and main control valve.



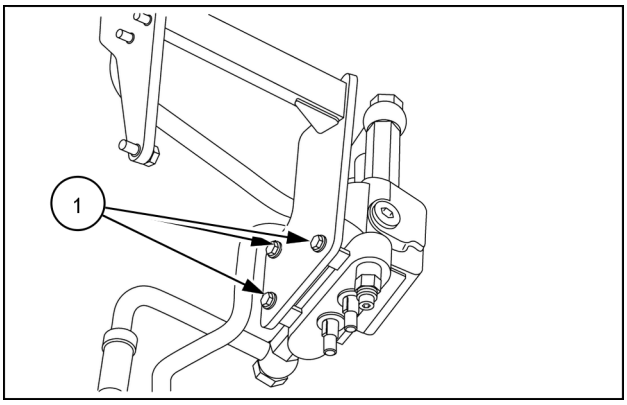
GNIL14TR00843AA 2

4. Disconnect the hydraulic line between the mid-mount valve and hydraulic lift body.



GNIL14TR00842AA 3

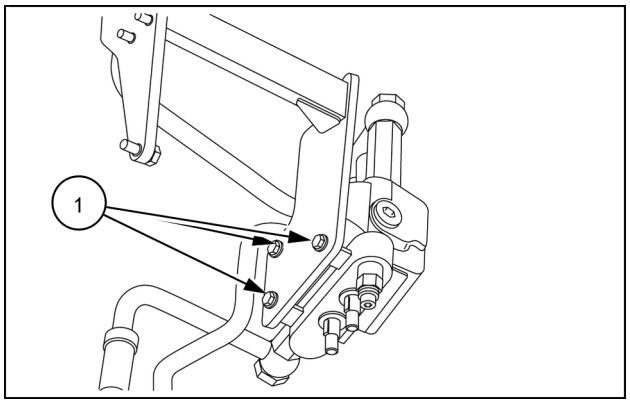
5. Loosen the bolts **(1)** and remove the mid-mount valve from the mounting bracket.



GNIL14TR00844AA 4

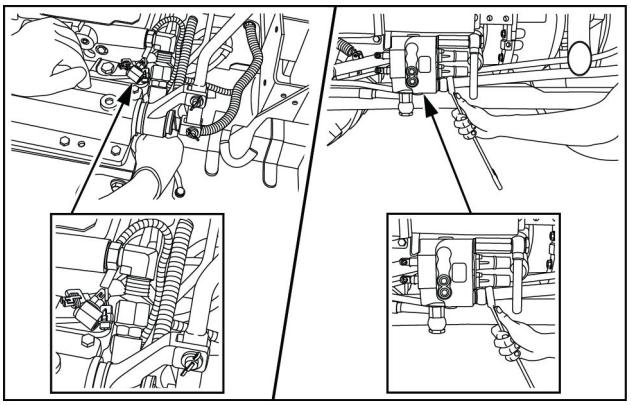
Mid-mount remote control valve - Install

1. Install the mid-mount valve on the mounting bracket and tighten the bolts **(1)**.



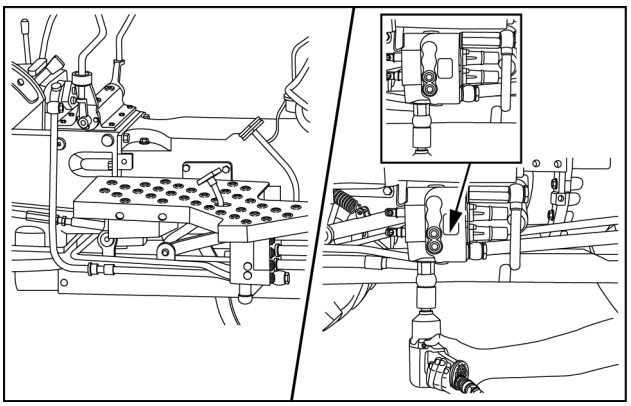
GNIL14TR00844AA 1

2. Connect the hydraulic line between the mid-mount valve and hydraulic lift body.



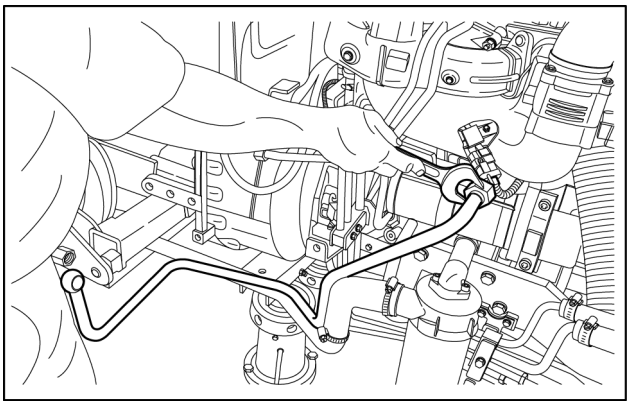
GNIL14TR00842AA 2

3. Connect the hydraulic delivery pipe between mid-mount valve and main control valve.



GNIL14TR00843AA 3

4. Connect the hydraulic delivery pipe between hydraulic pump and mid-mount valve.



GNIL14TR00783AA 4

5. Connect the joystick cables. See **Joystick and Electric Hydraulic (EH) control - Install (55.512)**.

https://truckmanualshub.com/

Index

Hydraulic systems - 35

Remote control valves - 204

Mid-mount remote control valve - Install 10
Mid-mount remote control valve - Remove 8
Remote control valve - Install 7
Remote control valve - Remove 3
Remote control valve - Remove 5

https://truckmanualshub.com/

https://truckmanualshub.com/

Hydraulic systems - 35

Reservoir, cooler, and filters - 300

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Hydraulic systems - 35

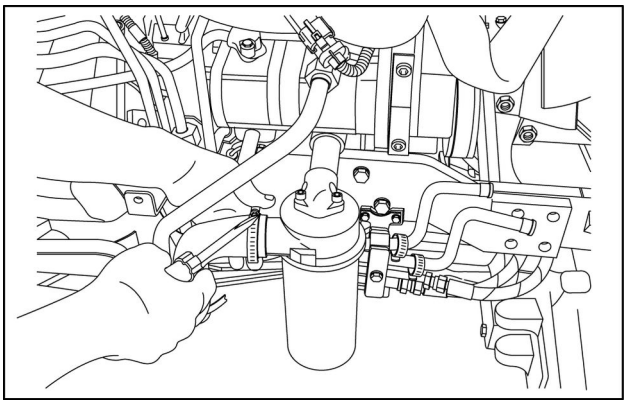
Reservoir, cooler, and filters - 300

SERVICE

Oil filters
Remove 3
Install 4

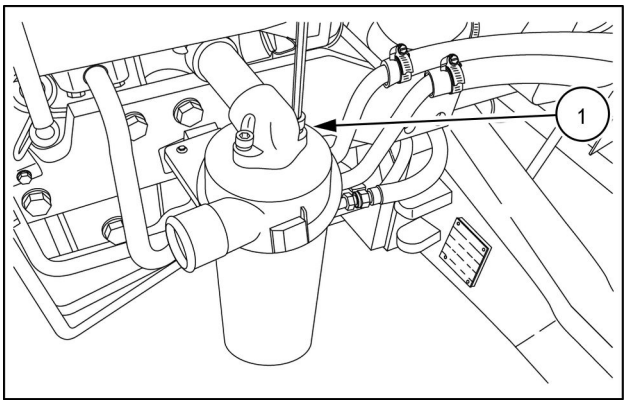
Oil filters - Remove

1. Loosen the clamp and remove the suction pipe from the hydraulic filter.



GNIL14TR00725AA 1

2. Loosen the allen screws **(1)** and remove the hydraulic filter.



GNIL14TR00728AA 2

Oil filters - Install

For installation, follow the reverse order of removal.

https://truckmanualshub.com/

Index

Hydraulic systems - 35

Reservoir, cooler, and filters - 300

Oil filters - Install 4
Oil filters - Remove 3

https://truckmanualshub.com/

https://truckmanualshub.com/

Hydraulic systems - 35

Hydraulic hand control - 355

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Hydraulic systems - 35

Hydraulic hand control - 355

FUNCTIONAL DATA

Hydraulic hand control

Overview 3

SERVICE

Hydraulic hand control

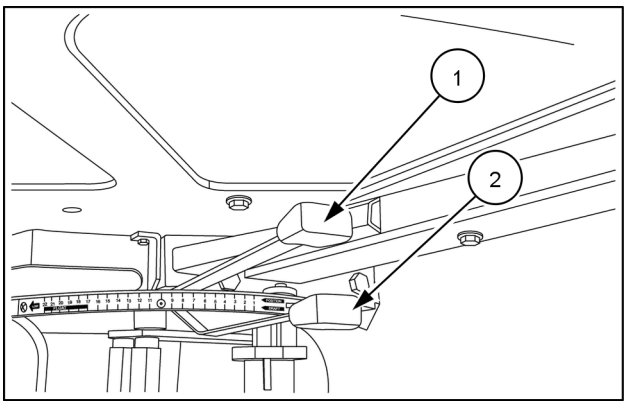
Disassemble 5

Assemble 7

Hydraulic hand control - Overview

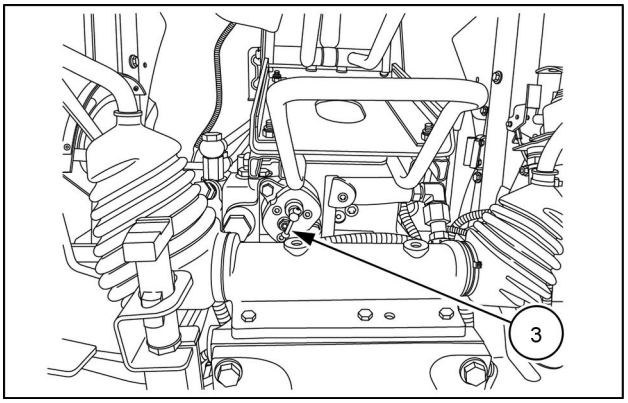
This is a live hydraulic system, where gear type hydraulic pump is mounted directly to timing case. transmission lubrication oil is used also as hydraulic oil. This system described here mechanically senses changes in the draft loading via the top link of the three point linkage. The system allows the operator to select position control, draft control, mixed control and float.

CAUTION
Hydraulic filter is to be changed at regular intervals as recommended. Hydraulic and transmission parts may get damaged if filter is choked. Always use genuine NEW HOLLAND filters.



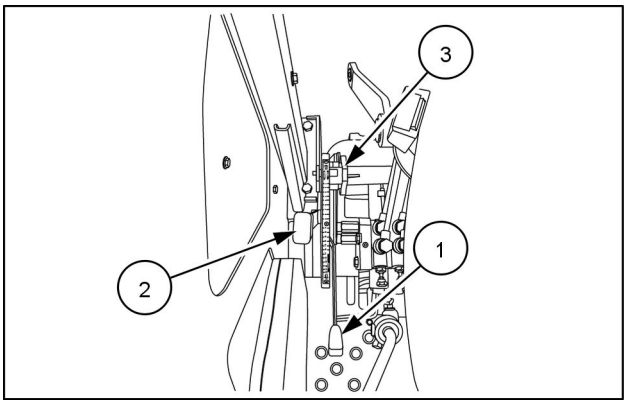
GNIL14TR00580AA 1

The system is operated by position control lever **(1)**, draft control lever **(2)**, and response control **(3)**.



GNIL14TR00798AA 2

NOTE: *Some mounted or semi-mounted equipment may interfere with and cause damage to tractor sheet metal. To avoid damage check for clearance between tractor and implements.*



GNIL14TR00813AA 3

Position control operation

Position control provides accurate control of implements such as sprayers, rakes, rotary tillers, etc. that operate above the ground. Once set, position control will maintain the selected implement height.

NOTE: *Always set the system to position control at any time when not actually operating in draft control, such as when attaching or transporting equipment or when no equipment is attached.*

Move the draft control lever **(1)** fully forward in the quadrant. Set the required implement height/depth using the position control lever **(2)**. Pull the lever back to raise the implement, push forward to lower. Implement height/depth is relative to the position of the lever in quadrant.

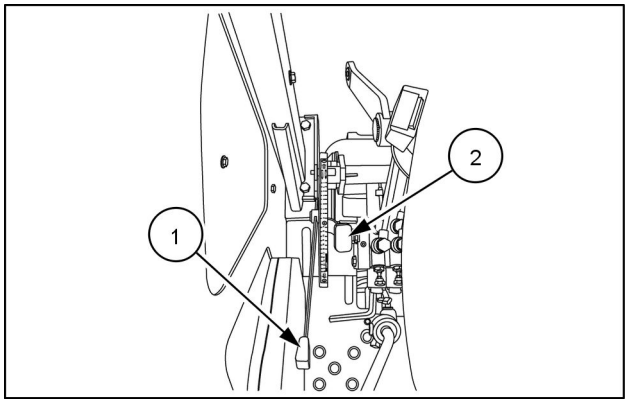
An adjustable stop **(3)** is provided to enable the lever to be returned to the required working position.

Draft control operation

Draft control is most suitable for mounted or semi-mounted implements operating in the ground. Changes in the working depth or changes in soil resistance will cause draft loading on the implement to increase or decrease.

Move the position control lever **(1)** fully forward. Lower the implement in to the work using draft control lever **(2)**. Push the lever forward to increase the draft loading. Pull rearwards to reduce the draft loading. Forward movement of the draft control lever will increase the implement depth and rearward movement will reduce the depth.

Once set, tractor hydraulic system will automatically adjust the implement depth to maintain an even pull on the tractor and minimise wheel slip.

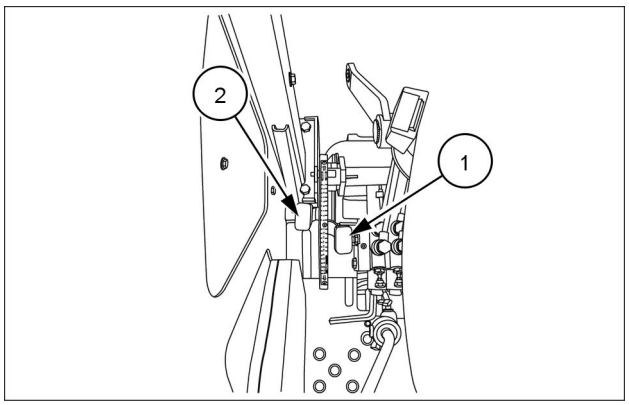


GNIL14TR00814AA 4

Combined position and draft control operation

On very light soil or varying soil types in the same field, it may be necessary to use the draft control and position control in combination. When starting work, lower the implement to the required depth by means of the draft control lever **(1)**.

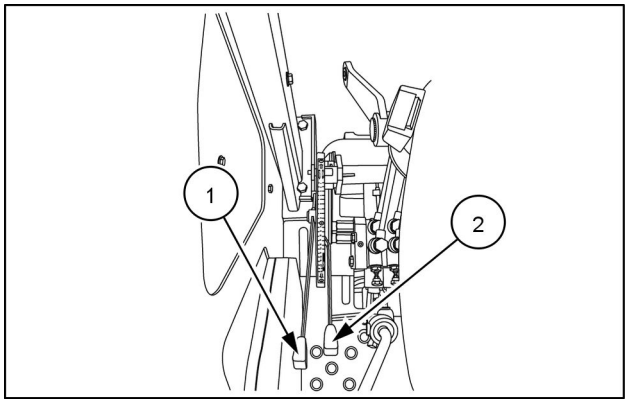
When the implement reaches the required depth, raise the position control lever **(2)** back until the lift arms tend to rise. The lift linkage is now in draft control but the position control function prevents the system from sinking too deep when draft reduces.



GNIL14TR00815AA 5

Float operation

Move the position control lever **(1)** and the draft control lever **(2)** fully forward. The 3-point linkage will now be free to 'float' or follow the ground contour, a feature useful for scraper blades etc.



GNIL14TR00816AA 6

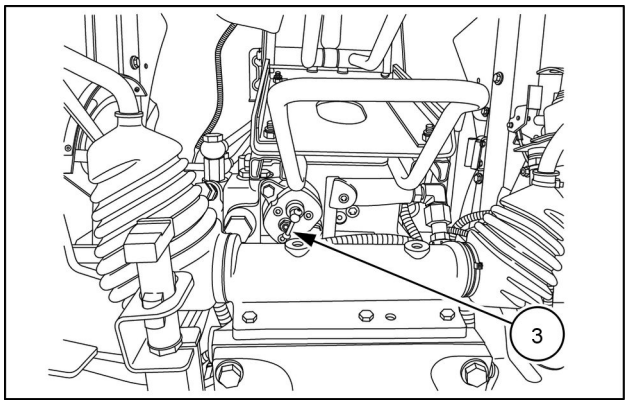
Response control

The response control knob **(1)** varies the speed of drop of the lower links.

Clockwise rotation - Decreases speed of drop

Anti-clockwise rotation - Increases speed of drop

NOTE: *To lock implements in transport position when driving on road, fully raise position control lever **(1)**, **6** and screw in (rotate clockwise) knob **(1)**, **7**.*



GNIL14TR00798AA 7

Hydraulic hand control - Disassemble

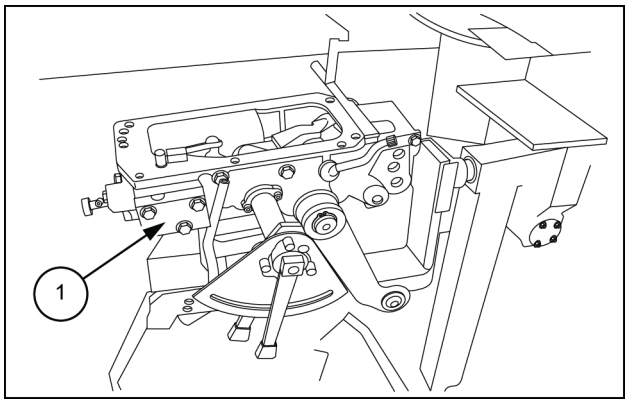
⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

W0208A

Lift external controls can be disassembled and reassembled only with the lift on a work bench or on a rotary stand. It is possible to remove only position control lever when the lift assembly is mounted on the tractor.

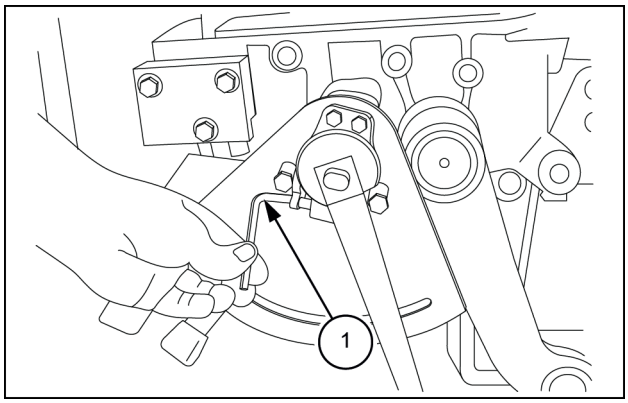
1. Remove the lift from the transmission housing and place on a work bench or fix on a rotary stand.



GNIL14TR04610AB 1

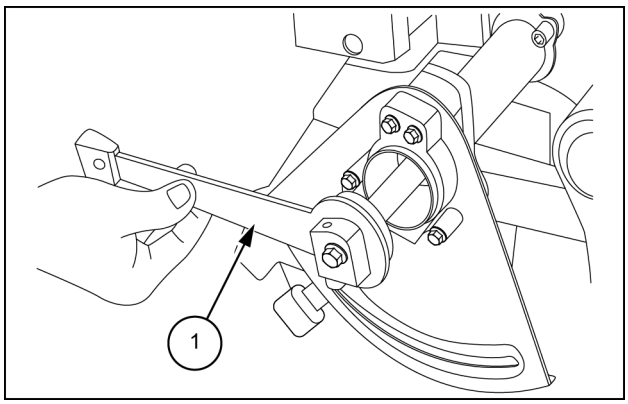
2. Loosen set screws **(1)** and remove position control lever hub along with nylon washer.

NOTE: *Nylon washers can be removed from hub by loosening Allen screw.*



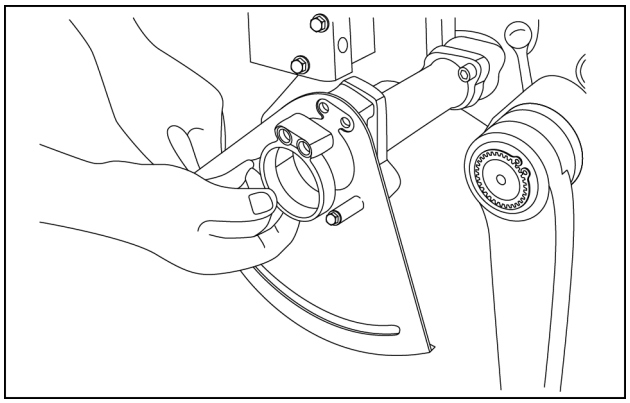
GNIL14TR04611AA 2

3. 1. After loosening set screws remove position control lever **(1)**.
   2. Remove bolts **(2)** to take out sector plate.



GNIL14TR04612AB 3

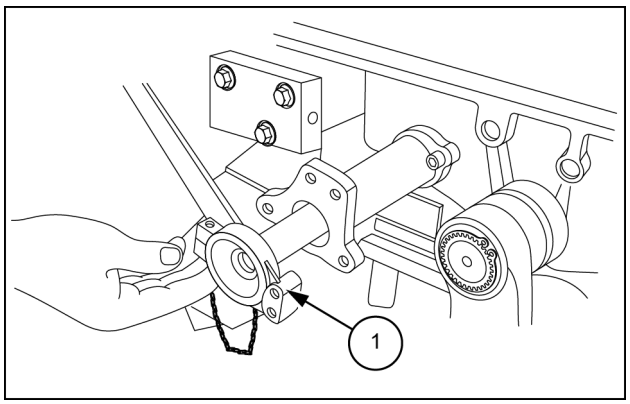
4. 1. Remove draft control lever hub by loosening set screws **(1)** along with the nylon washer.
   2. Remove sector plate.



GNIL14TR04613AB 4

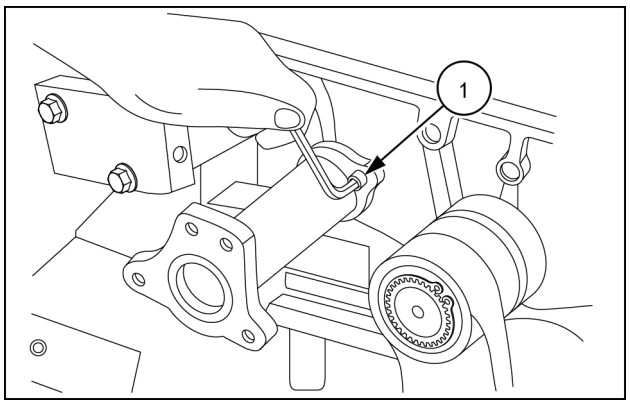
5. Draft control lever is welded on draft control shaft. Remove the position control shaft and draft control shaft to remove the draft control lever internal linkages.
   1. Remove set screw.
   2. Remove linkages from the shafts.

NOTE: *Remove hydraulic linkages to remove set screw.*



GNIL14TR04614AB 5

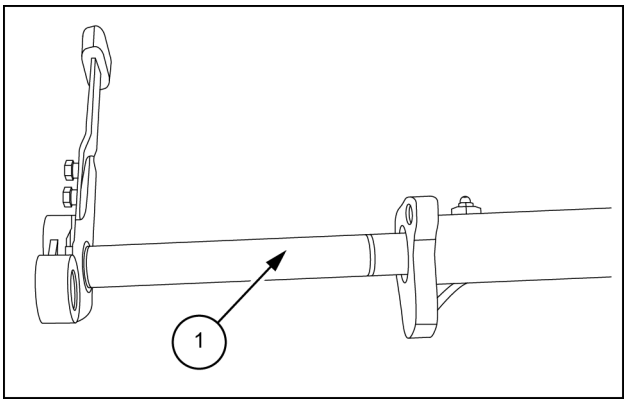
6. Remove set screw **(1)** to remove shaft.



GNIL14TR04615AA 6

Hydraulic hand control - Assemble

1. Reassemble the lift external controls following the disassemble procedure in reverse.
2. Check the O-rings on the draft control shaft for any damage. If necessary, replace by new O-rings.



GNIL14TR04616AB 1

https://truckmanualshub.com/

Index

Hydraulic systems - 35

Hydraulic hand control - 355

Hydraulic hand control - Assemble 7
Hydraulic hand control - Disassemble 5
Hydraulic hand control - Overview 3

https://truckmanualshub.com/

Hydraulic systems - 35

Main control valve - 359

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Hydraulic systems - 35

Main control valve - 359

FUNCTIONAL DATA

Main control valve
Overview 3

SERVICE

Main control valve
Remove (Distributor assembly) 8
Install 9

Main control valve - Overview

The distributor is pre-set to perform three phases.

A. Neutral phase

B. Lifting phase

C. Lowering phase

A. Neutral phase

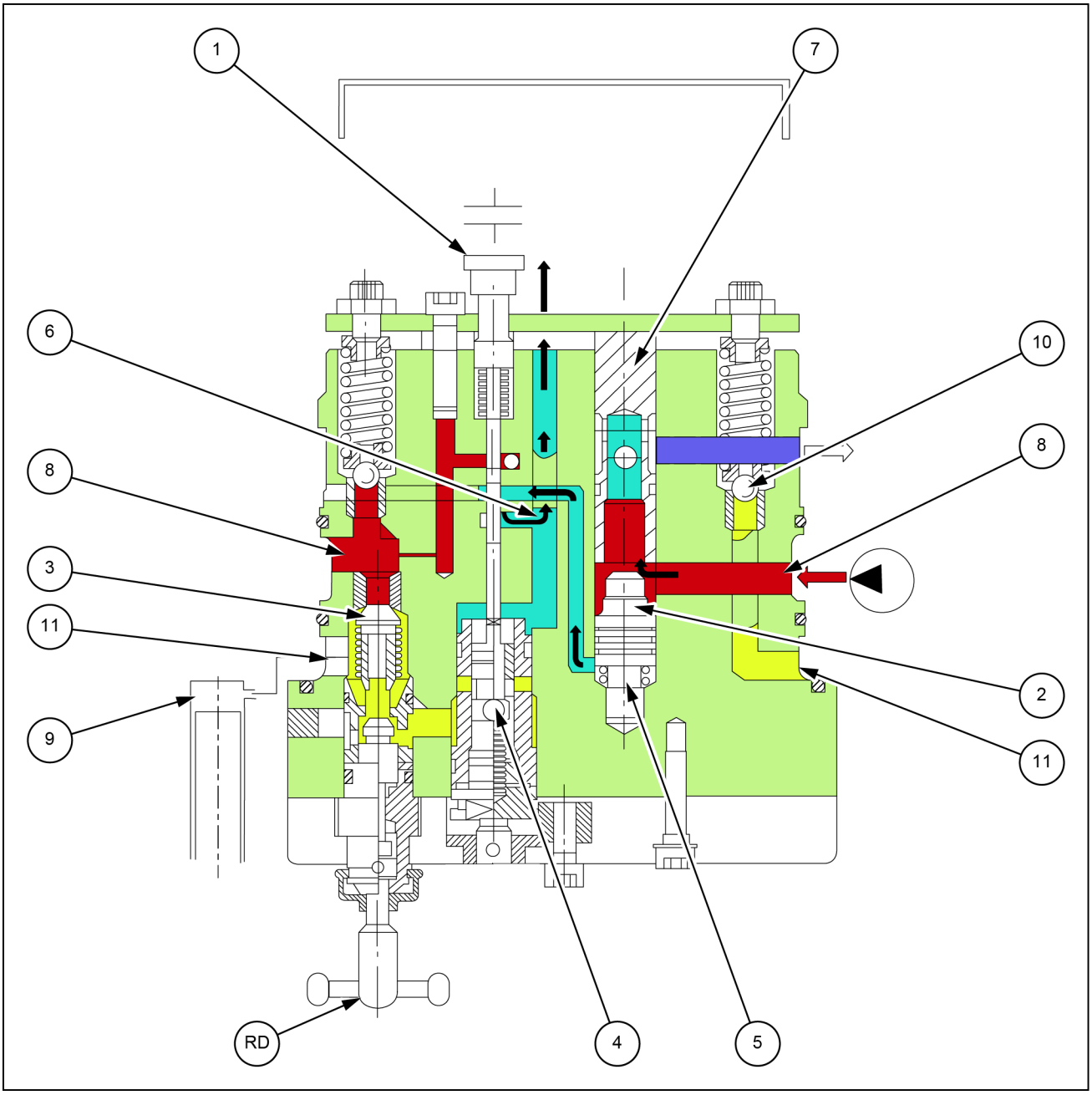
In this phase the control valve keeps pressure on the oil contained in the cylinder thus allowing the oil coming from the pump to flow freely to the tank.

In this phase the control spool **(1)** is in such a position to connect the chamber **(5)** of the differential valve **(2)** directly to the discharge through hole **(6)**.

The oil coming from the pump enters the annular duct **(8)** and moves the differential valve **(2)** upwards which then opens the discharge hole **(7)** and enables the oil to go to the tank.

The oil contained in the cylinder **(9)** is kept under pressure by the check valve **(3)**, by the discharge valve **(4)** and safety valve **(10)** connected to the cylinder **(9)** by the annular duct **(11)** thus holding the load applied to the lifting arms.

The safety valve **(10)** secures protection from any possible over-pressure during the implement movement.



GNIL14TR00834GA 1

B. Lifting phase

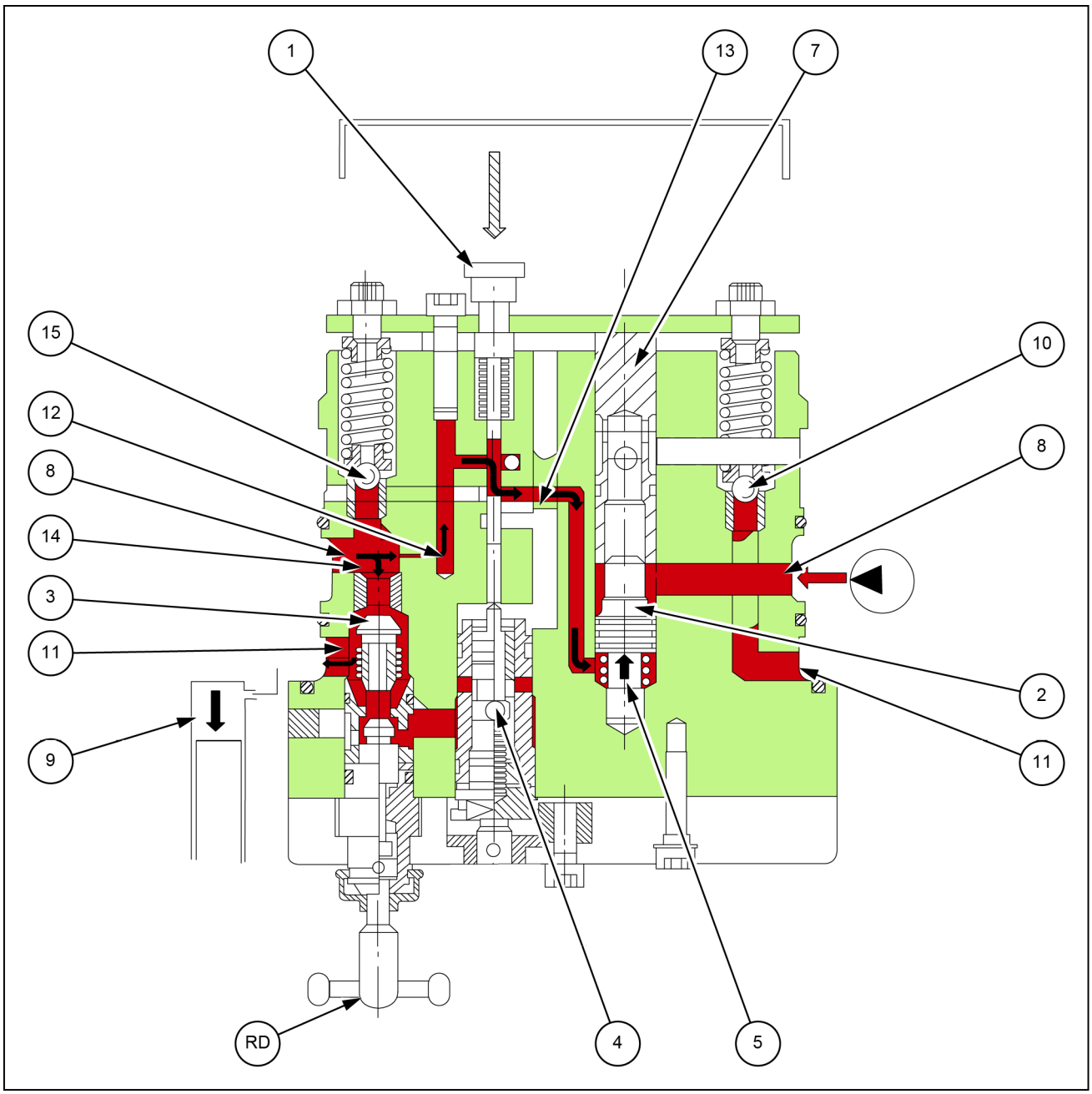
During this phase, the control valve supplies the oil under pressure to the cylinder **(9)** and it consequently lifts the arms.

The control spool **(1)** is in such a position to connect the chamber **(5)** of the differential valve **(2)** with the oil coming from the pump through annular duct **(8)** and holes **(12)** and **(13)** making in this way the valve itself to close.

The oil from the pump finding the differential valve **(2)** closed goes to cylinder, pass the hole **(14)** opens the check valve **(3)** enters in the annular duct **(11)** and enters the chamber **(9)**.

The lifting speed depends on the pump RPM.

In this phase the maximum lifting pressure is controlled by the safety valve **(15)** that is connected to annular duct **(8)** through hole **(14)** and then to the oil inlet.



GNIL14TR00835GA 2

C. Lowering phase

During this phase, the control valve supplies at the same time the oil coming from the pump and the oil contained in the cylinder to the discharge causing the lowering of the arms.

The control spool **(1)** is in such a position to connect chamber **(5)** of differential valve directly to the discharge through hole **(6)**.

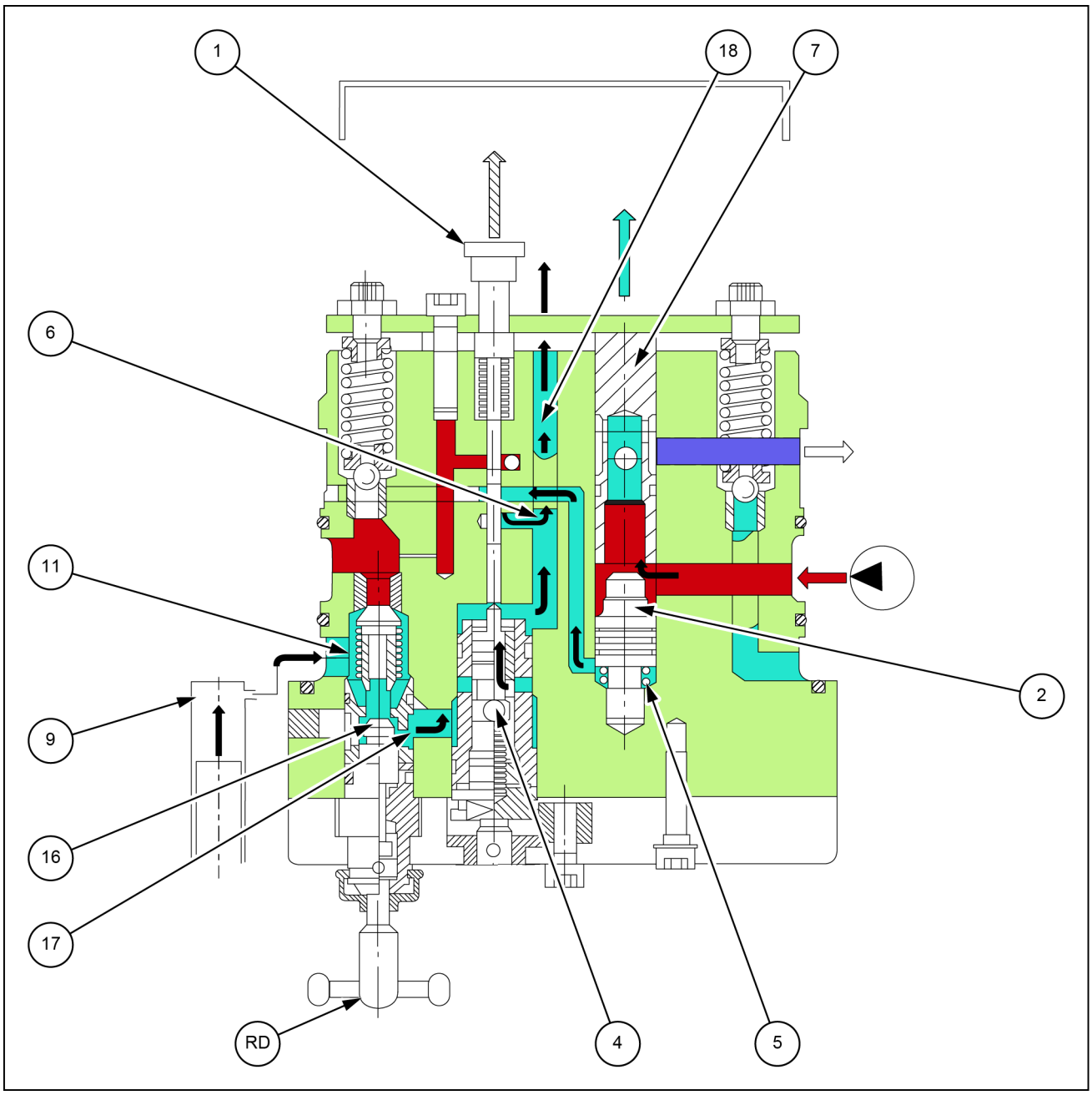
The oil coming from the pump enters the annular duct **(8)** and moves the differential valve **(2)** upwards which then opens the discharge hole **(7)** and enables the oil to go to the tank.

At the same time the pressure oil contained in the cylinder **(9)** flows to the tank therefore causing the lowering of the arms.

From chamber **(9)** the oil goes into the annular duct **(11)** passing the lowering speed regulation valve **(16)** through the connecting hole **(17)** enter into the discharge valve **(4)** that is kept open from the spool **(1)** and goes to discharge from hole **(18)**.

In this phase the lowering speed of the implement can be adjusted with lever **(RD)**.

By screwing the lever the lowering speed is reduced, by screwing totally the valve **(16)** is closed on the seat and therefore the arms are locked for transport safety.



GNIL14TR00836GA 3

Main control valve - Remove (Distributor assembly)

⚠ WARNING

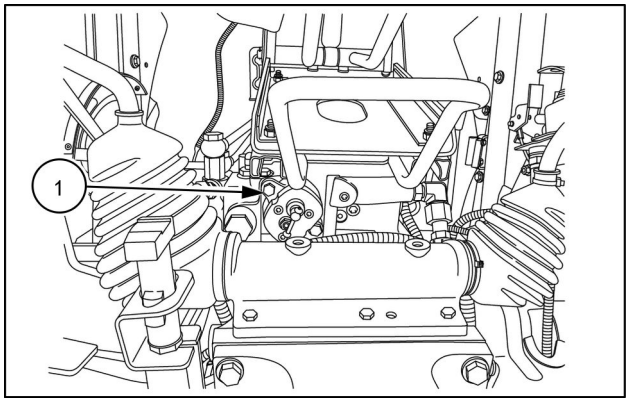
Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

W0208A

1. Loosen the bolts **(1)** and remove distributor assembly from lift housing.

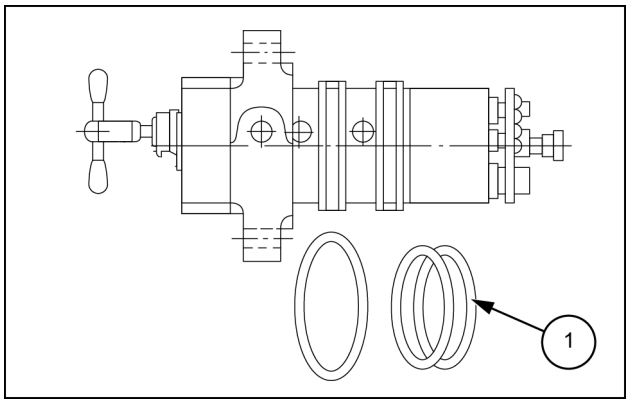
NOTE: *Distributor assembly is not serviceable. Replace complete assembly if found defective.*

2. Insert the distributor assembly back on the lift assembly and tighten the bolts **(1)**.



GNIL14TR00798AA 1

NOTE: *Check the O-rings **(1)** for any damage on distributor assembly before installing and replace if required.*



GNIL14TR04649AB 2

Main control valve - Install

For installation, follow the reverse order of removal.

https://truckmanualshub.com/

Index

Hydraulic systems - 35

Main control valve - 359

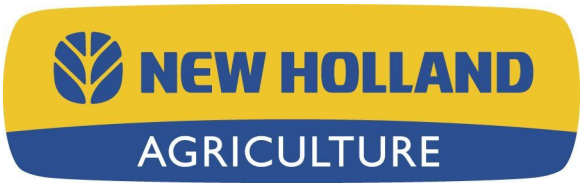
Main control valve - Install 9
Main control valve - Overview 3
Main control valve - Remove (Distributor assembly) 8

https://truckmanualshub.com/

https://truckmanualshub.com/

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SERVICE - Technical Publications & Tools



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https://truckmanualshub.com/

SERVICE MANUAL

Steering

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Steering - 41

[41.101] Steering control 41.1

[41.200] Hydraulic control components 41.2

[41.206] Pump 41.3

[41.216] Cylinders 41.4

https://truckmanualshub.com/

Steering - 41

Steering control - 101

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Steering - 41

Steering control - 101

TECHNICAL DATA

Steering control
Special tools 3

FUNCTIONAL DATA

Steering control
Overview – Hydrostatic steering 4

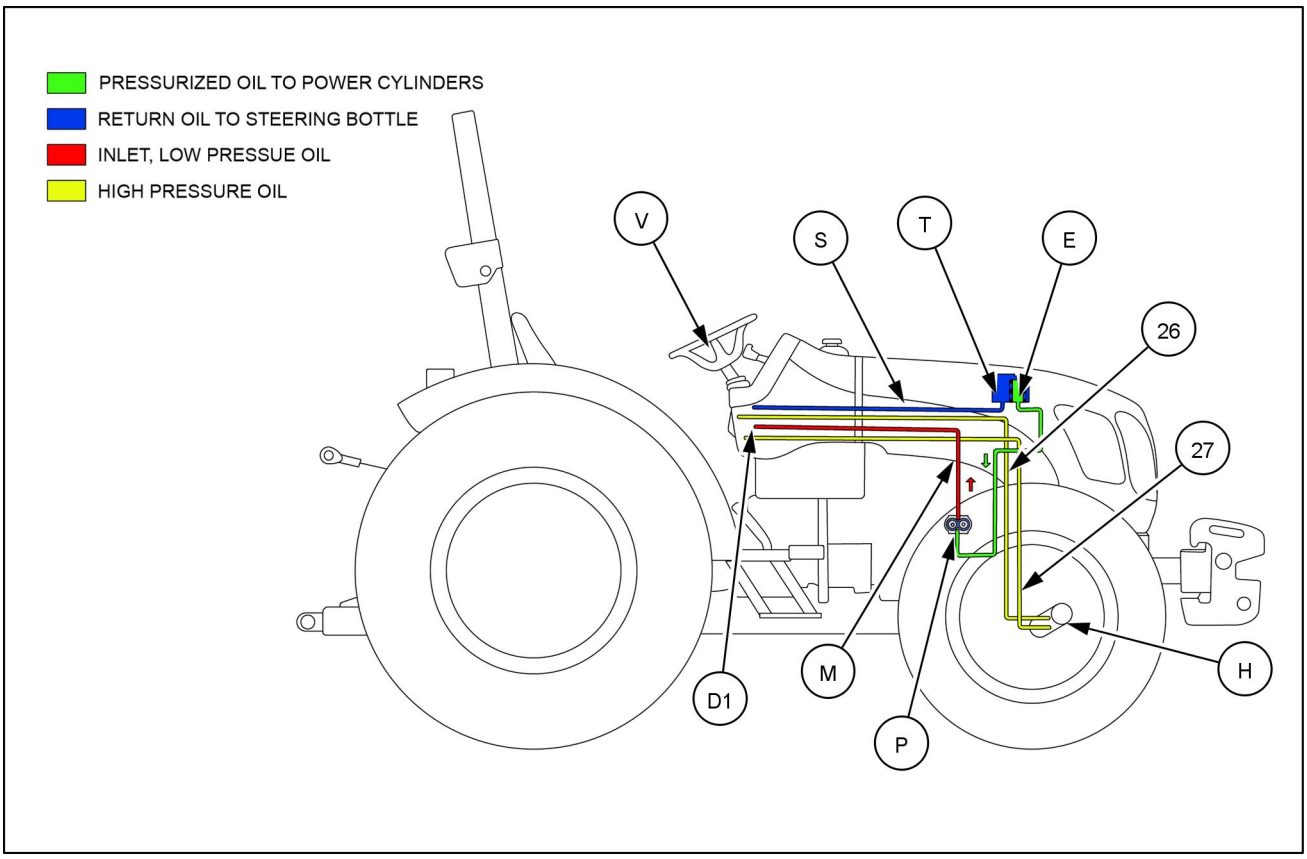
DIAGNOSTIC

Steering control
Troubleshooting 10

Steering control - Special tools

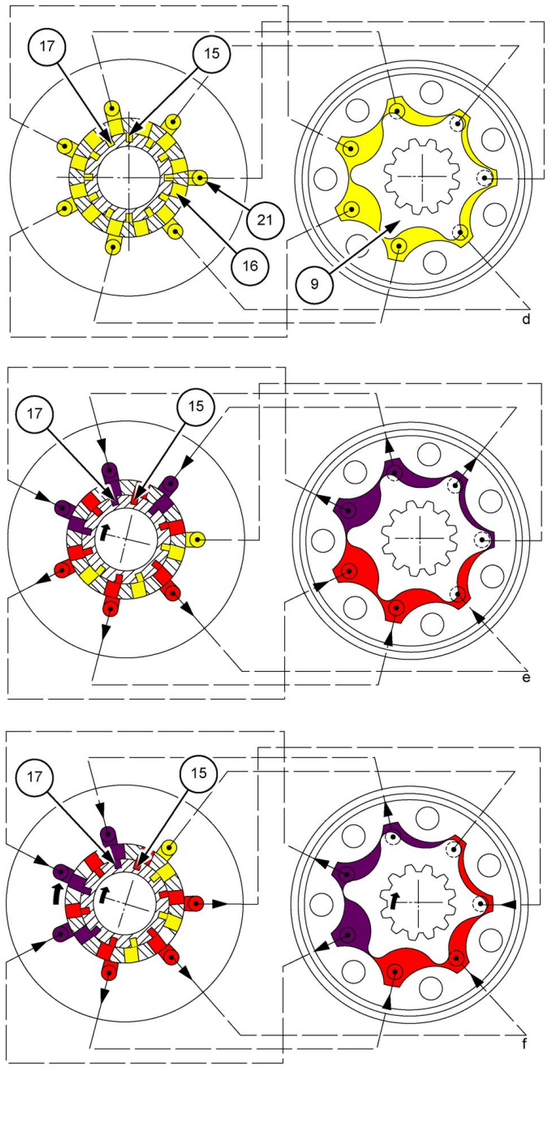
Description	Tool number
Steering wheel puller	**380001672** and **380003008**
Adapter, power steering pressure check (includes in the set of hydraulic pressure kit 292870)	291318
Power steering rotor spring installer	292927

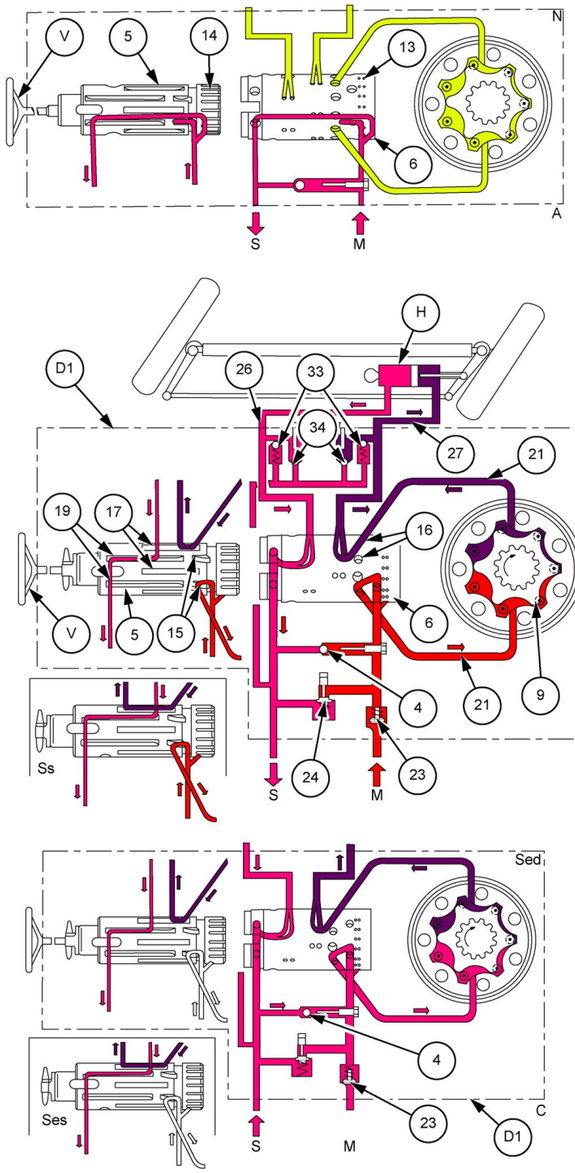
Steering control - Overview – Hydrostatic steering

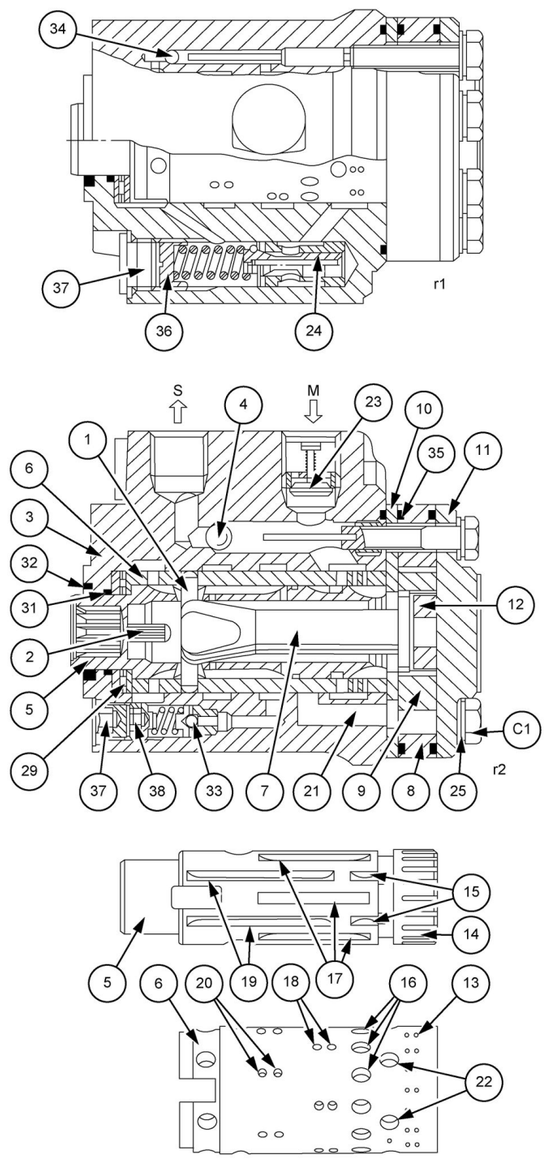


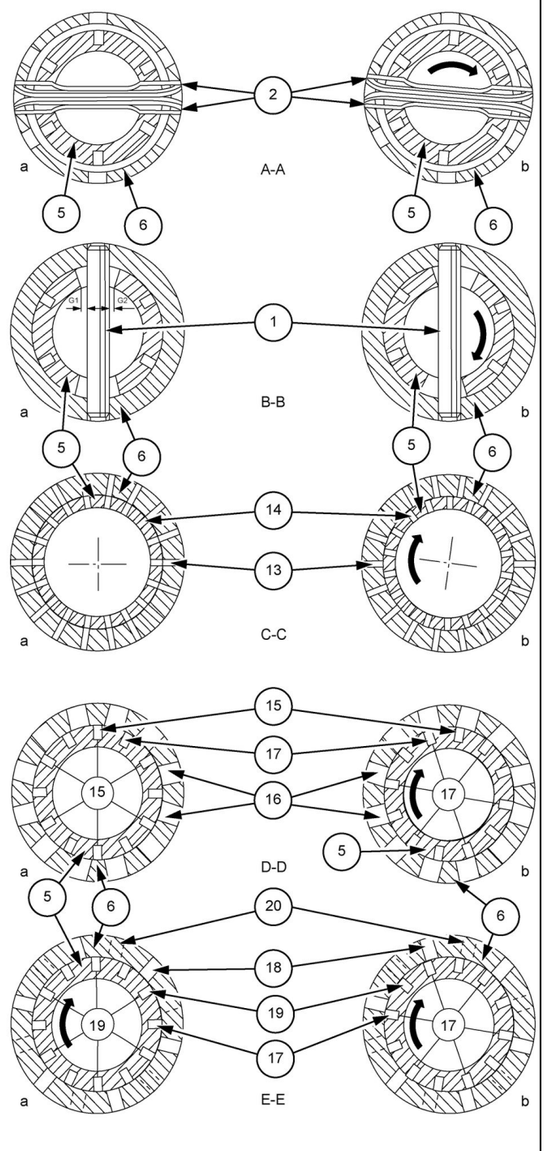
GNIL14TR00870FA 1

D1. Control valve
E. Filter cartridge
H. Power cylinder
M. Pump outlet line
P. Hydraulic pump
S. Return to tank
T. Reservoir
V. Steering wheel









GNIL14TR04488JB 2

A.	Operation in straight-ahead driving position	11.	Cover
B.	Right-hand side **(Sd)** and left-hand side **(Ss)** steer	12.	Spacer
C.	Right-hand side and left-hand side emergency steer **(Sed)** and **(Ses)**	13, 14.	Oil ports
d.	Operation diagram for straight-ahead driving	15.	Rotor inlet passages (6 off)
e, f.	Operation diagram for two-stage right-hand side steering	16.	Connecting port (12 off) communicating with passages (**(15)** and **(17)**) alternatively
E.	Filter cartridge	17.	Pressure passages (6 off) to power cylinder communicating with the rotor recesses and ports (**(18)** and **(20)**)
g.	Steering system schematics	18.	Right-hand side power cylinder chamber outlet or exhaust ports (6 pairs)
H.	Power cylinder	19.	Power cylinder exhaust passages (6 off) communicating with ports (**(18)** and **(20)**)
M.	Pump outlet line	20.	Left-hand side power cylinder chamber outlet or exhaust ports (6 off)
P.	Hydraulic pump	21.	Oil passage from ports **(16)** to rotor recesses
S.	Return to tank	22.	Supply ports for passages **(15)**
T.	Reservoir	23.	Check valve
V.	Steering wheel	24.	Relief valve
a.	Section through control unit with valve **(5)** in neutral	25.	Washer
b.	Sections through control unit with valve **(5)** in right-hand side steer position (for left-hand side steer, valve rotation is symmetrical in opposite direction)	26.	Oil passage to left-hand side power cylinder chamber
G1, G2.	Gap between pin **(1)** and rotary valve **(5)**	27.	Oil passage to right-hand side cylinder chamber, piston rod side
r1, r2.	Sections through DANFOSS OSPC 100 control valve	29.	Thrust bearing
1.	Drive pin	31.	Seals
2.	Sleeve return springs	32.	Dust excluder
3.	Control valve body	33.	Cylinder safety valves
4.	Check valve	34.	Make-up valves
5.	Rotary valve	35.	O-rings
6.	Valve seat sleeve	36.	Valve adjusting screw
7.	Rotor drive shaft	37.	Plugs
8.	Rotor cam ring	38.	Valve adjusting screw
9.	Rotor		
10.	Thrust ring		

Hydrostatic steering system is powered (when the engine is running) by steering pump mounted on the front side of the engine timing gear.

Hydrostatic steering system incorporate a steering pump **(1)** pressurizes the steering column operated control valve **(2)**. The pressurized oil from the control valve operates the axle mounted double acting steering cylinder **(3)**.

The control valve is bolted to a bracket mounted on transmission housing and connected to the steering column by a spindle shaft.

The steering cylinder is fixed at one end to the front axle beam and at the other to an eye on the spindle arm.

The pressure relief value for the system is contained within the steering control valve itself.

Operation

Oil is drawn from the reservoir **(4)** and into the pump through a filter **(3)**, pressurized by the rotation of the gears and expelled through the pump outlet port to the steering control valve. The pressurized oil when received at the control valve is directed to the steering actuating cylinder when the steering wheel is turned.

The control valve incorporates a metering unit which regulates the volume of oil supplied to the cylinder so that it is proportional to the angular movement of the steering wheel. The metering unit in combination with the check value also allows the steering to be operated manually without pressurised oil being supplied from the pump.

The system is fully hydrostatic and as such there is no mechanical connection between the steering column and the steering wheels.

Straight - ahead driving (A, a, d)

With steering wheel **(V)** stationary, rotary valve **(5)** takes neutral position relative to sleeve **(6)**. This position is maintained through the action of springs **(2)**, (see figure **2** section A-A) and the following conditions exist:

- Pin **(1)**, (see figure **2** section B-B) is central in the valve **(5)** aperture.
- Ports **(13)** and **(14)** are in alignment (see figure **2** section C-C) and the oil pressure from pump **(P)** is returned to tank.
- Passages **(15)**, **(17)** and **(19)** on the valve (see figure **2** sections D-D and E-E) are off register relative to ports **(16)**, **(18)** and **(20)** on the sleeve (i.e. all ports in communication with the power cylinder remain closed).

Right-hand side steer (B, Sd, b, e, f)

Upon turning steering wheel **(V)** clockwise, springs **(2)**, (see figure **2** section A-A) deflect allowing valve **(5)** to rotate relative to sleeve **(6)** until gap **(G)**, (see figure **2** section B-B) is taken up.

Thus:

- Ports **(13)** and **(14)**, (see figure **2** section C-C) go out of alignment to discontinue oil return.
- Six passages **(15)**, (see figure **2** section D-D) line up with an equal number of ports **(16)** connected instant by instant with the rotor recesses during the inlet phase.
- Six pressure passages **(17)**, (see figure **2** section E-E) line up with ports **(18)** communicating with the power cylinder. Moreover, the oil pressure passages communicate with the remaining ports **(16)**, (see figure **2** section D-D) connected instant by instant with the rotor recesses during the actuation phase.
- Six exhaust passages **(19)** line up with ports **(20)**, (see figure **2** section E-E) communicating with the power cylinder.

Once the gap **(G)** is eliminated valve **(5)** positively transmits steering wheel input to both sleeve **(6)** and rotor **(9)** through pin **(1)** and shaft **(7)**. Diagrams (e and f) show the principle of operation at start of right-hand side steer and after a certain amount of wheel rotation.

The flow of oil pressure from pump to rotor during inlet, and from rotor to power cylinder line during the power actuation phase, is provided instant by instant.

Left-hand side steer (B, Ss)

Upon turning the steering wheel anti-clockwise, a reversal of the above sequence is obtained and delivery passages **(17)**, (see figure **2** section E-E) supply ports **(20)** to bring about left-hand side steering.

Emergency hydraulic steer (C, Sed, Ses)

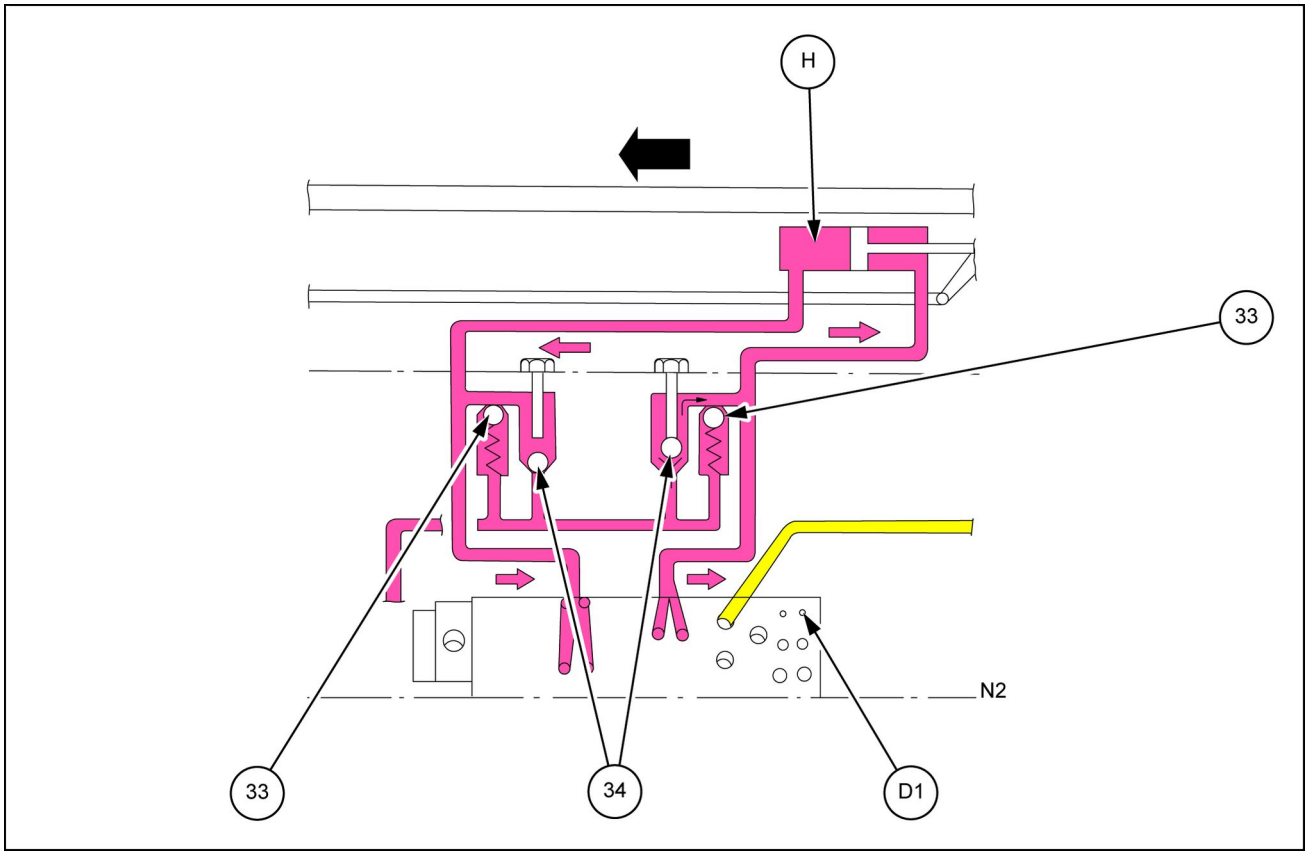
Steering is possible even in cases of loss of hydraulic pressure. Upon turning the steering wheel, valve **(5)** takes up the normal operating position, whilst the rotor functions as a hand pump directing oil pressure to the power cylinder.

Check valve **(4)** opens, thereby permitting the flow of oil from tank to rotor by-passing the pump. Valve **(23)** remains closed preventing leakage in connecting line between pump and control unit.

Power cylinder safety and make-up valves (N2)

As of safety valves open **(33)**, pressure created by piston **(H)** is exhausted in one cylinder chamber under the action of strong external stress on wheels. Simultaneously, vacuum in the opposite chamber is compensated by oil flow through the opening of the associated make up valve **(34)**. Pressure in one cylinder chamber deriving from small external stress which are not sufficient to open cylinder safety valve, is exhausted through normal leakage past control valve **(D)**, while vacuum in the opposite chamber is compensated through make-up **(34)**, as shown in detail N2, for DANFOSS OSPC 100 control valve.

Operation of the above valves eliminates continuous steering wheel correction and prevents front wheel shimmy, hydraulic circuit failure and damage to the steering linkage.



GNIL14TR04489FB 3

Steering control - Troubleshooting

Problem	Possible Cause	Correction
Steering wheel is heavy to turn	No or insufficient oil pressure a) Pump does not run b) Pump defective c) Pump runs in the wrong the direction d) Pump is worn out e) Pump is under dimensioned	 Start up pump (loose V-belt) Repair or replace pump Correct direction of rotation of pump or replace pump Replace pump Install a larger pump (examine pressure need and flow)
	Pressure relief valve is stuck in open position or setting pressure is too low	Repair or clean pressure relief valve. Adjust the valve to the correct pressure
	Priority valve is stuck in open position	Repair or clean the priority valve
	Too much friction in the mechanical parts of the vehicle	Lubricate bearings and joints of steering gear or repair if necessary. Check steering column installation
	Emergency steering balls missing	Install new balls
	Combination: Downstream system + steering unit with suction valve and differential cylinder are inexpedient	Change cylinder type (through going piston rod). If necessary use two differential cylinders
Hard point when starting to turn the steering wheel	Spring force in priority valve too weak	Replace spring by a stronger one (**4 bar** (**58 psi**) , **7 bar** (**102 psi**) and **10 bar** (**145 psi**))
	Air in LS and /or PP pipes	Bleed LS and PP pipes
	Clogged orifices in LS or PP side priority valve	Clean orifices in spool and in connecting plugs for LS and PP
	Oil is too thick (cold)	Let motor run until oil is warm
Regular adjustments of the steering wheel are necessary (“snake-like driving”)	Leaf spring without spring force or broken	Replace leaf springs
	Spring in double shock valve broken	Replace shock valve
	Gear wheel set worn	Replace gear wheel set
	Cylinder seized or piston seals worn	Replace defective parts
Neutral position of steering wheel cannot be obtained, i.e. there is a tendency of “Motoring”	Steering Column and steering unit out of line	Align the steering column with steering unit
	Too little or no play between steering column and steering unit input shaft	Adjust the play and, if necessary, shorten the splines journal.
	Pinching between inner and outer spools	Contact your authorised NEW HOLLAND
“Motoring” effect. The steering wheel can turn on its own	Leaf springs are stuck or broken and have therefore reduced spring force	Replace leaf springs
	Inner and outer spools pinch, possible due to dirt	Clean steering unit or contact your NEW HOLLAND dealer
	Return pressure in connection with the reaction between differential cylinder and steering unit too high	Reduce return pressure, change cylinder type or use a non-reaction control unit
Backlash	Cardan shaft fork worn or broken	Replace cardan shaft
	Leaf springs without spring force or broken	Replace leaf springs
	Worn splines on the steering column	Replace steering column
“Kick-back” in steering wheel from system. Kicks from wheels	Fault in the system	Contact your authorised NEW HOLLAND
Heavy kick-back in steering wheel in both directions	Wrong setting of cardan shaft and gear wheel set	Correct setting as shown in service manual
Turning the steering wheel activates the steered wheels opposite	Hydraulic hoses for the steering cylinders have been switched around	Reverse the hoses

Problem	Possible Cause	Correction
“Shiny” - effect. The steered wheels vibrate. (Rough tread on tires gives vibrations)	Air in the steering cylinder	Bleed cylinder. Find and remove the reason for air collection
	Mechanical connections or wheel bearings worn	Replace worn parts
Steering wheel can be turned the whole time without the steered wheels moving	Oil is needed in the tank	Fill with clean oil and bleed the system
	Steering cylinder worn	Replace or repair cylinder
	Gear wheel set worn	Replace gear wheel set
	Spacer across cardan shaft forgotten	Install spacer
Steering wheel can be turned slowly in one or both directions without the steered wheels turning	One or both anti-cavitation valves are leaky or are missing in OSPC or OVP/OVR	Clean or replace defect or missing valves
	One or both shock valves are leaky or are missing in OS PC or OVP/OVR	Clean or replace defective or missing valves
Steering is too slow and heavy when trying to turn quickly	Insufficient oil supply to steering unit, pump defective or number of revolutions too low	Replace pump or increase number of revolutions
	Relief valve setting too low	Adjust valve to correct setting
	Relief valve sticking owing to dirt	Clean the valve
	Spool in priority valve sticking owing to dirt	Clean the valve, check that spool moves easily without spring
	Too weak spring in priority valve	Replace spring by a stronger (There are 3 sizes: **4 bar** (**58 psi**), **7 bar** (**102 psi**) and **10 bar** (**145 psi**)
Too little steering force (possibly to one side only)	Pump pressure too low	Correct pump pressure
	Too little steering cylinder	Fit a larger cylinder
	Piston rod area of the differential cylinder too large compared with piston diameter	Fit cylinder with thinner piston rod or 2 differential cylinders
Leakage at either input shaft, end cover, gear-wheel set, housing or top part	Shaft defective	Replace shaft seal
	Screws loose	Tighten screws Torque 3-3, t daNm or steering unit (2, 5-3 daNm)
	Washers or O-rings defective	Replace washers and O-rings

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Index

Steering - 41

Steering control - 101

Steering control - Overview – Hydrostatic steering 4
Steering control - Special tools 3
Steering control - Troubleshooting 10

https://truckmanualshub.com/

Steering - 41

Hydraulic control components - 200

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Steering - 41

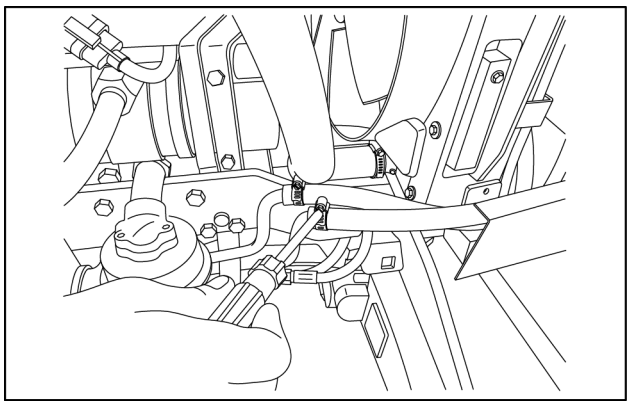
Hydraulic control components - 200

SERVICE

Hydraulic steering oil reservoir
Remove 3
Power steering control valve
Remove 4
Disassemble 5
Cleaning 9
Inspect 10
Lubricate 11
Assemble 12
Install 23
Steering circuit relief valve
Pressure test 24
Adjust 25

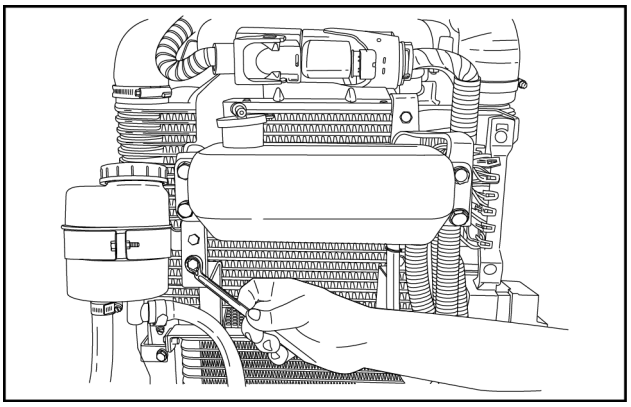
Hydraulic steering oil reservoir - Remove

1. Lift the front hood.
2. Disconnect the hoses from the steering oil reservoir.



GNIL14TR00758AA 1

3. Loosen the bolts and remove the steering oil reservoir.



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Power steering control valve - Remove

1. Position the tractor on a hard level surface and apply the parking brake.

⚠ WARNING

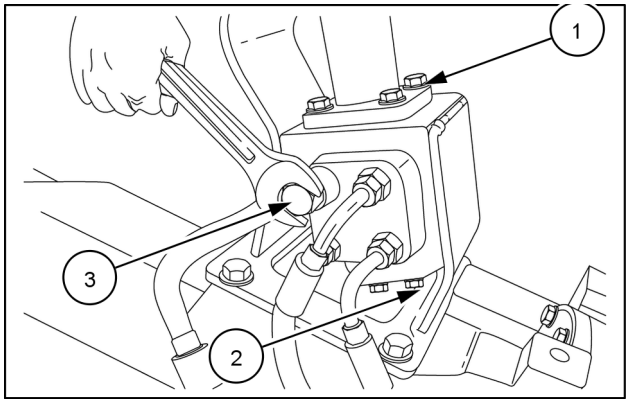
Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

W0208A

2. To gain access to the steering motor:
   - Remove tractor rear hood
   - Remove fuel tank

   For removal procedure, please refer to Engine section.

3. 1. Remove the four bolts **(1)** at the base of the steering column.
   2. Slide out the steering motor from the steering column.
   3. Remove bolts **(2)** from bracket to take out starting motor.
   4 Disconnect the four steering pipes **(3)**.



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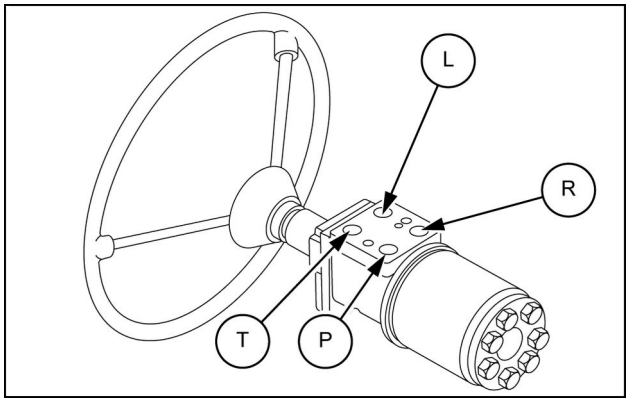
Disconnect the four supply / return tubes and O-ring seals from the steering motor
2. Cap the ends of the tubes and steering motor to prevent entry of foreign particles.

T - To tank

P - From pump

L - Left port

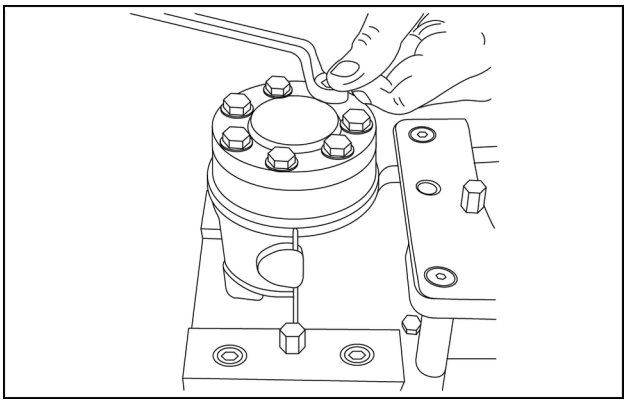
R - Right port



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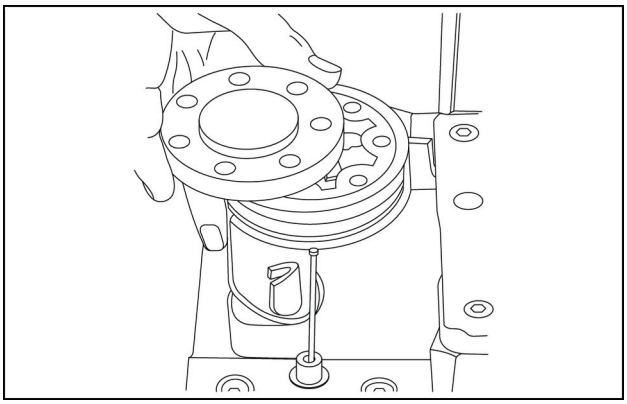
Power steering control valve - Disassemble

1. Hold the steering securely in a vice.
2. Remove the end cover bolts (6 plus one special screw).



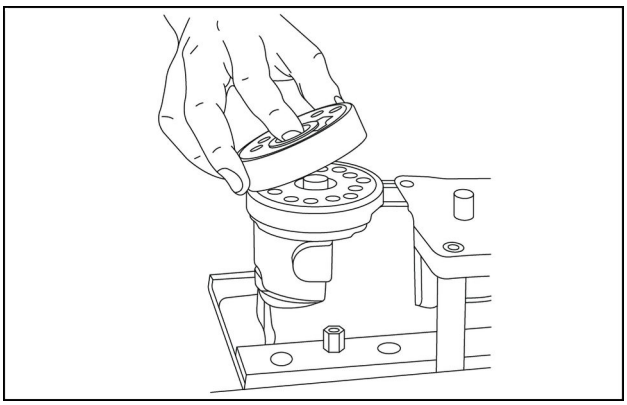
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3. Remove the end cover, sideways.



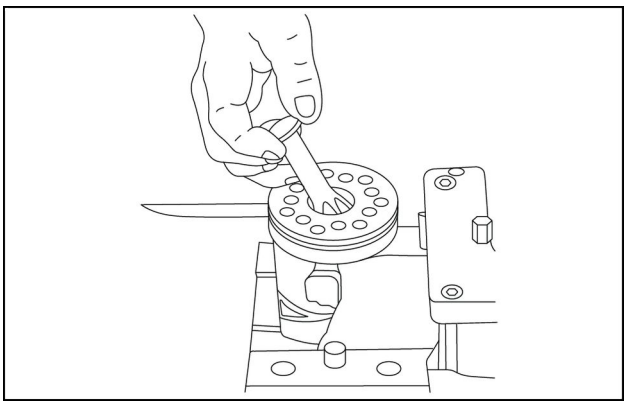
GNIL14TR04493AA 2

4. Lift the gear wheel set (with spacer fitted) off the unit. Take out the two O-rings.



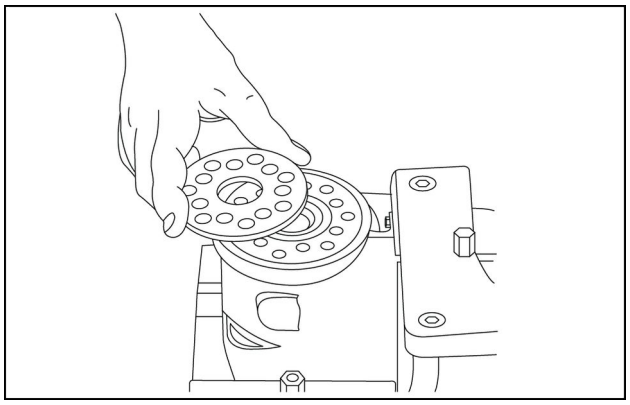
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5. Remove cardan shaft.



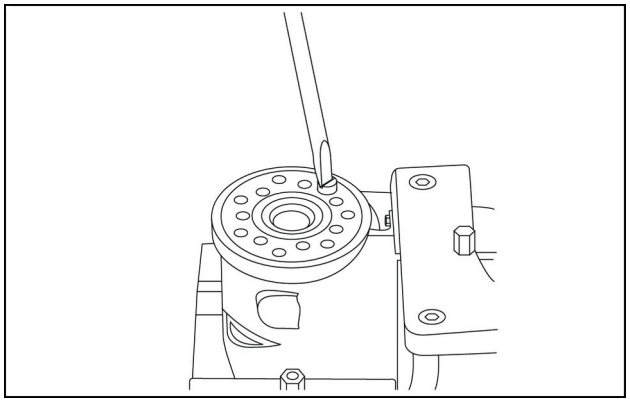
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6. Remove distributor plate.



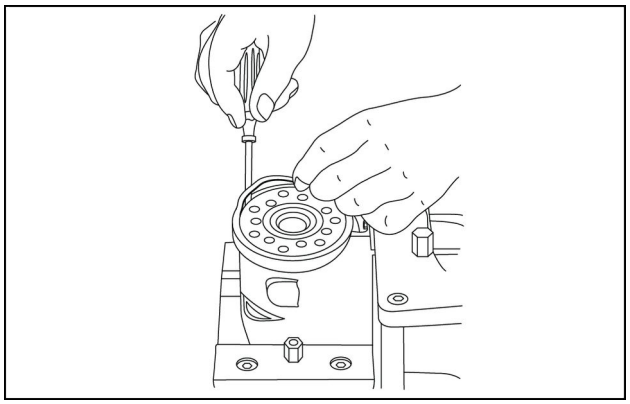
GNIL14TR04496AA 5

7. Screw out the threaded bush over the check valve.



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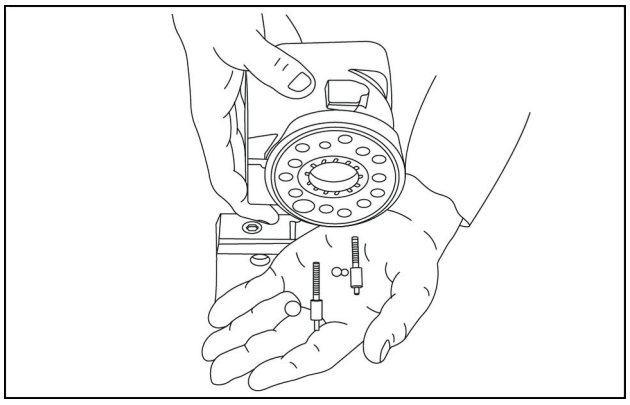
8. Remove O-ring.



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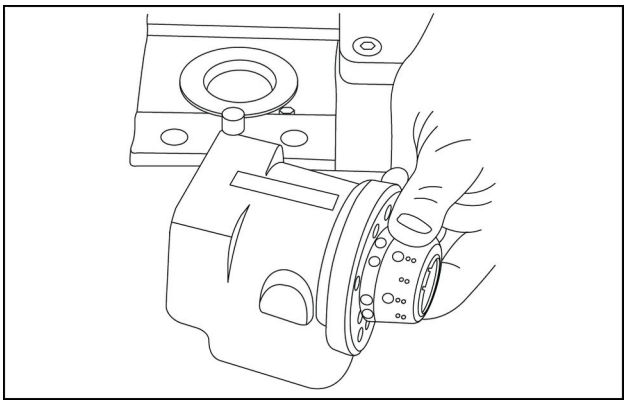
9. Shake out the check valve ball and suction valve pins and balls.

NOTE: *Replace pins prior to the reassembly.*



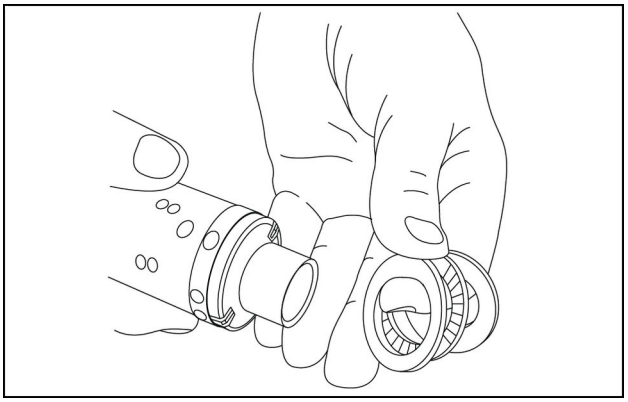
GNIL14TR04499AA 8

10. Take care to keep the cross pin in the sleeve and spool horizontal. The pin can be seen through the open end of the spool. Press the spool inwards and the sleeve, ring, bearing races and needle bearing will be pushed out of the housing together.



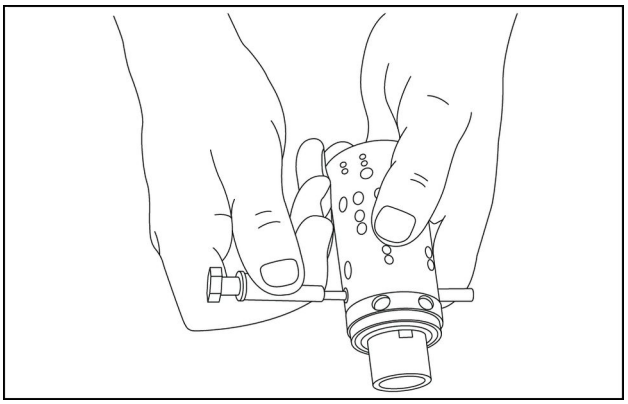
GNIL14TR04500AA 9

11. Take ring, bearing races and needle bearing from sleeve and spool. The outer (thin) bearing race can sometimes “stick” in the housing, therefore check that it has come out.



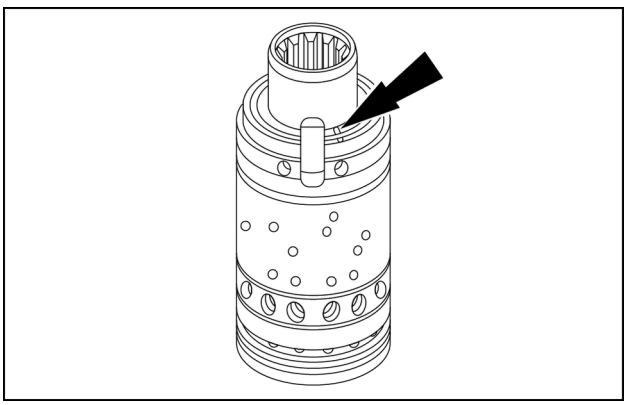
GNIL14TR04501AA 10

12. Press out the cross pin. Use the special screw from the end cover.



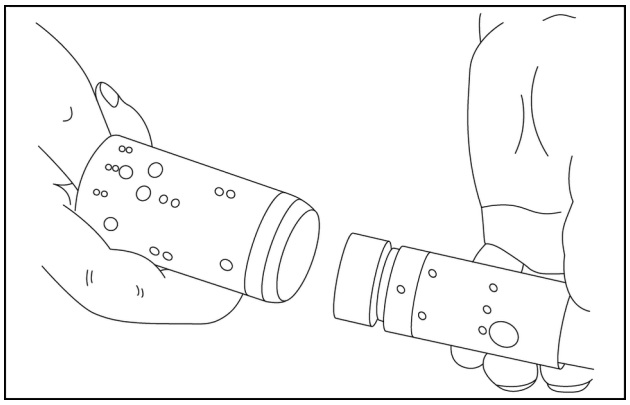
GNIL14TR04502AA 11

NOTE: *A small mark has been made with pumice stone on both spool and sleeve close to one of the slots for the neutral position springs (see figure). If the mark is not visible, remember to leave a mark of your own on sleeve and spool before the neutral position springs are dismantled.*



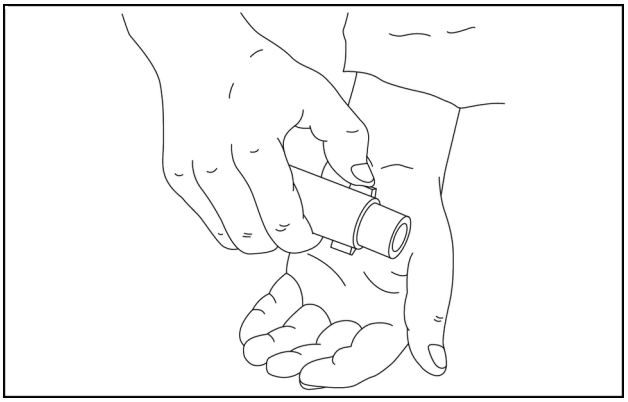
GNIL14TR04503AA 12

13. Carefully press the spool out of the sleeve.



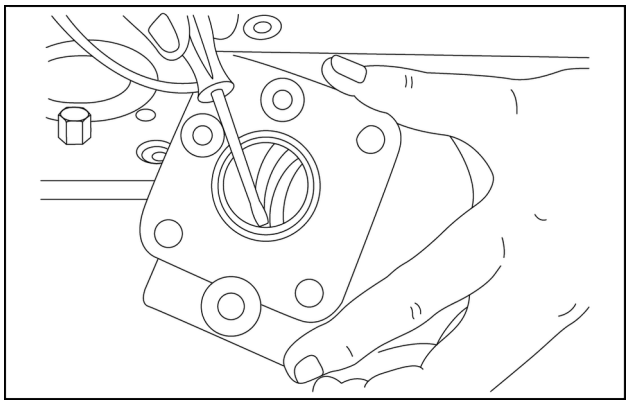
GNIL14TR04504AA 13

14. Press the neutral position springs out of their slots in the spool.



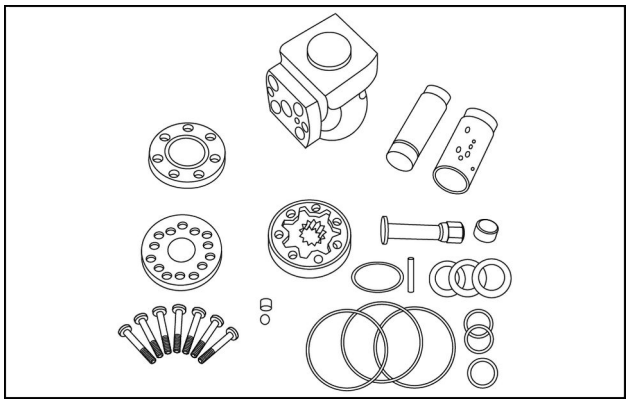
GNIL14TR04505AA 14

15. Remove dust seal and O-ring /kin-ring /roto glyd.



GNIL14TR04506AA 15

16. The steering unit OSPB is now completely dismantled.



GNIL14TR04507AA 16

Power steering control valve - Cleaning

Clean all parts carefully in Shellsoi K or something similar.

Power steering control valve - Inspect

Replace all seals and washers. Check all parts carefully. Make the necessary replacements.

Power steering control valve - Lubricate

Before assembly, lubricate all parts with hydraulic oil.

Power steering control valve - Assemble

⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

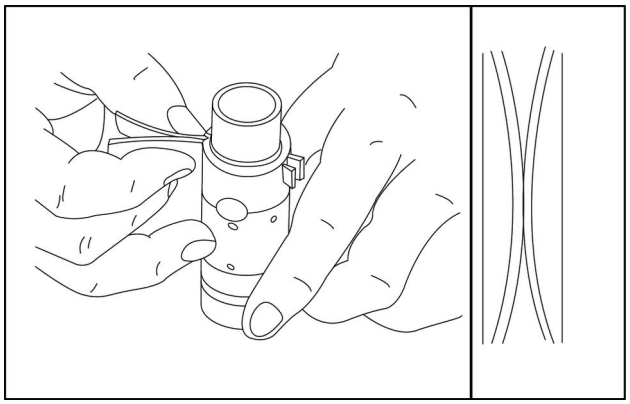
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⚠ CAUTION

Pinch hazard!
Always use suitable tools to align mating parts. DO NOT use your hand or fingers.
Failure to comply could result in minor or moderate injury.

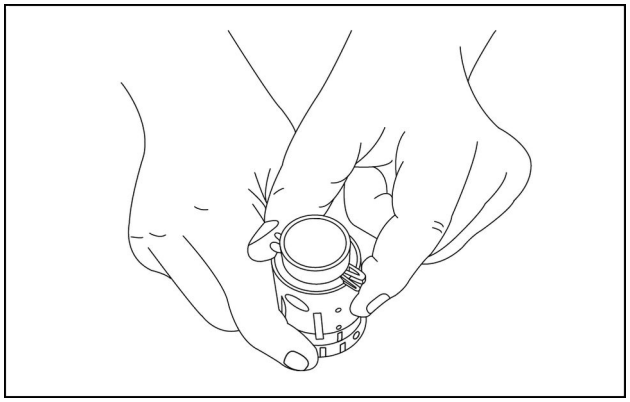
C0044A

1. Place the two flat neutral position springs in the slot. Place the curved springs between the flat ones and press them into the place.



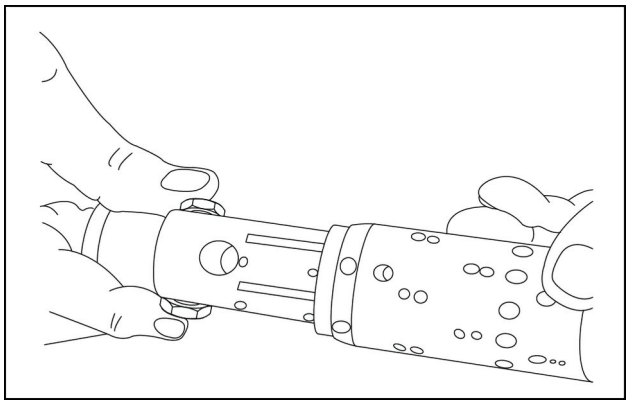
GNIL14TR04508AA 1

2. Line up the spring set.



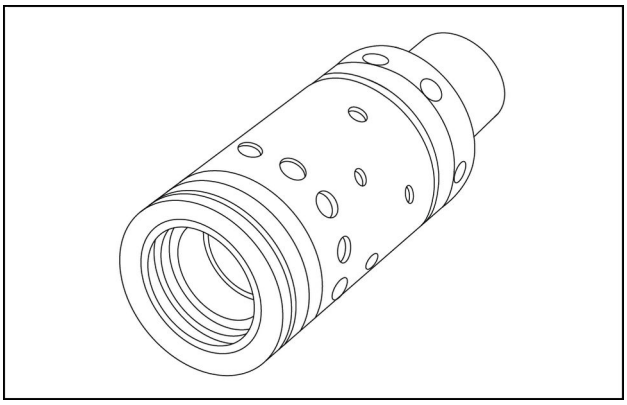
GNIL14TR04509AA 2

3. Guide the spool into the sleeve. Make sure that spool and sleeve are placed correctly in relation to each other.



GNIL14TR04510AA 3

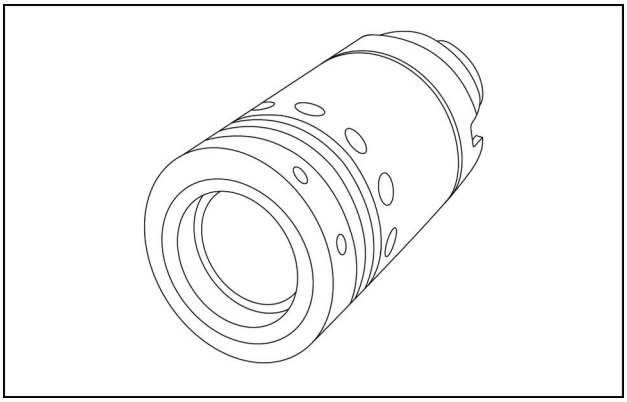
4. Assemble spool and sleeve.



GNIL14TR04511AA 4

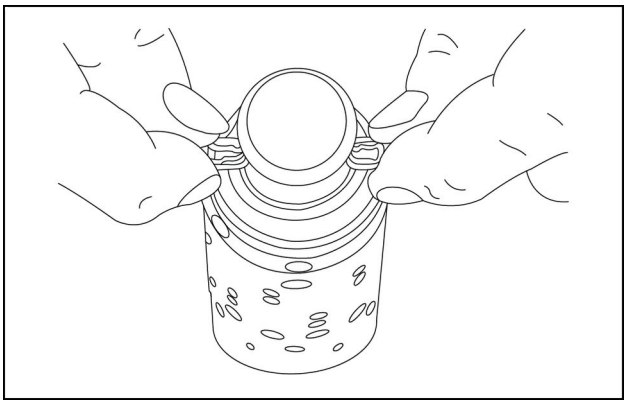
NOTE: *When assembling spool and sleeve, only two possible ways of positioning the spring slots are correct.*

There are three slots in the spool and three holes in the sleeve in the end of the spool/sleeve, opposite to the end with speing slots. Place the slots and holes opposite each other so that parts of the holes in the sleeve are visible through the slots in the spool.



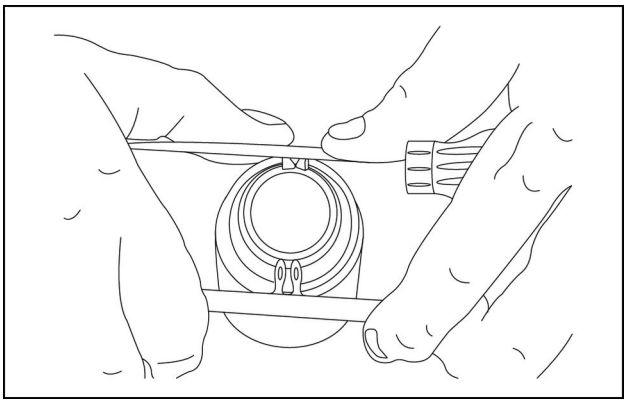
GNIL14TR04512AA 5

5. Press the springs together and push the neutral position springs into place in the sleeve.



GNIL14TR04513AA 6

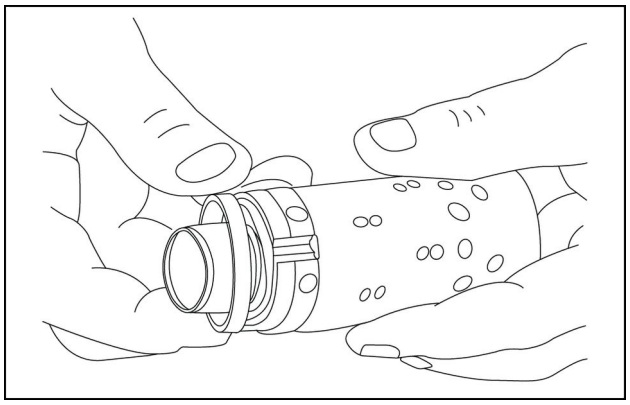
6. Line up the springs and centre them.



GNIL14TR04514AA 7

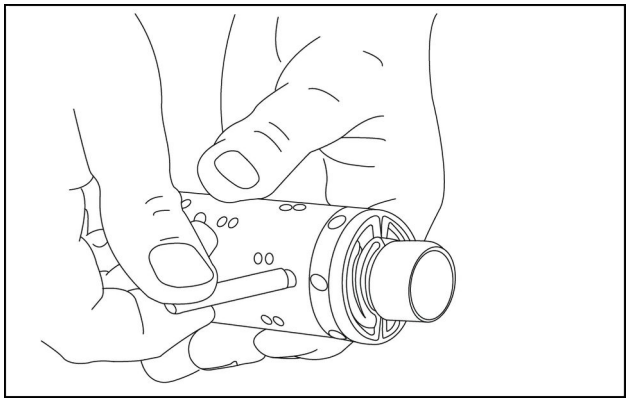
7. Guide the ring down over the sleeve.

NOTE: *The ring should be able to move - free of the springs.*



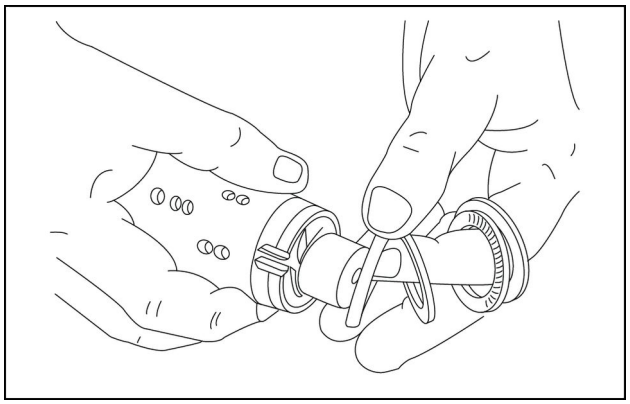
GNIL14TR04515AA 8

8. Fit the cross pin into the spool/sleeve.



GNIL14TR04516AA 9

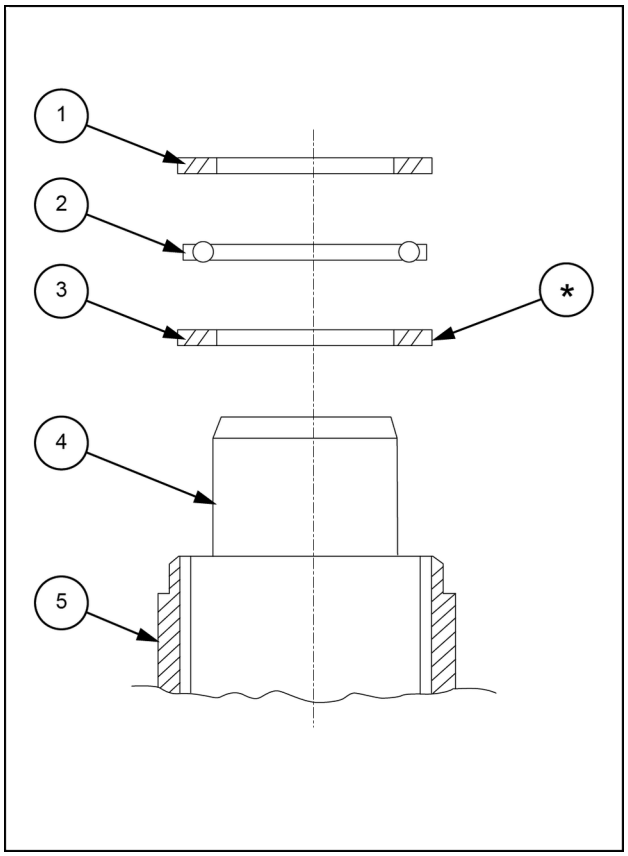
9. Fit bearing races and needle bearing as shown on below drawing.



GNIL14TR04517AA 10

Assembly pattern for standard bearing

1. Outer bearing race
2. Needle bearing
3. Inner bearing race
4. Spool
5. Sleeve

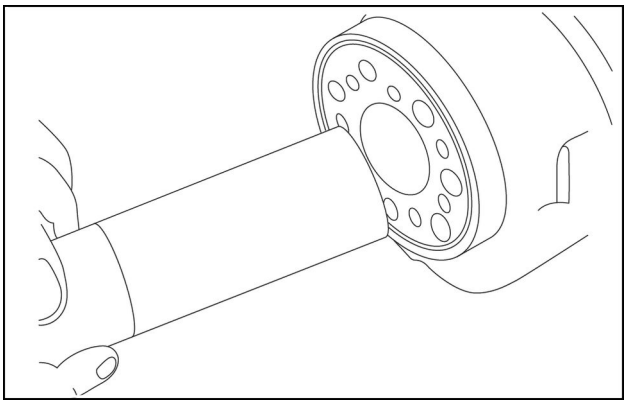


GNIL14TR04518AB 11

*The inside chamfer on the inner bearing race must face the inner spool.

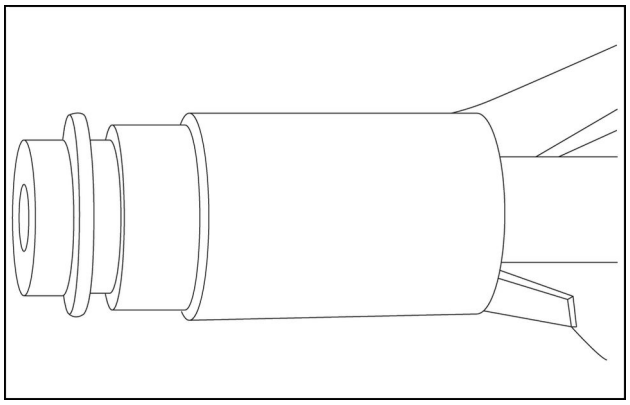
Installation of O-ring

1. Turn the steering unit until the bore is horizontal in position. Guide the outer part of the assembly tool into the bore for the spool/sleeve.



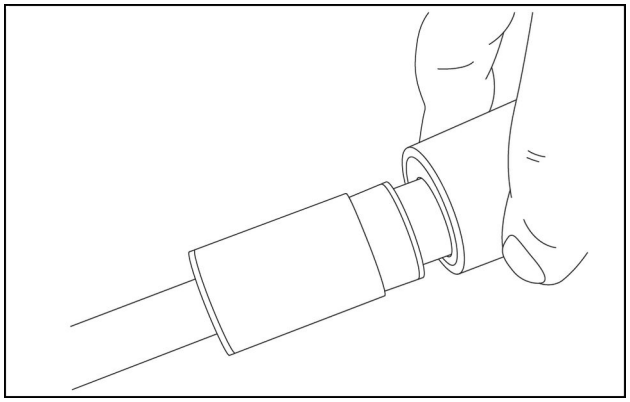
GNIL14TR04519AA 12

2. Grease O-ring and king ring/roto glyd with hydraulic oil and place them on the tool.



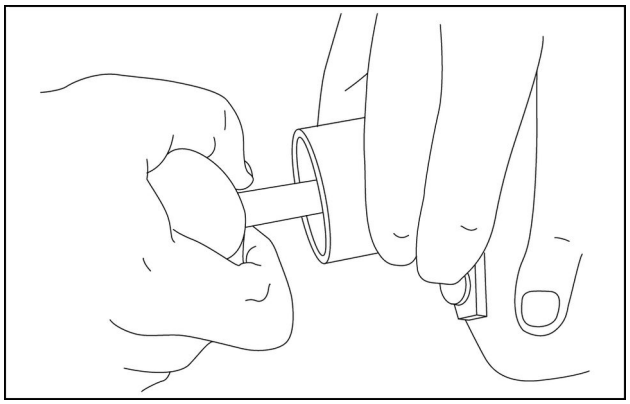
GNIL14TR04520AA 13

3. Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.



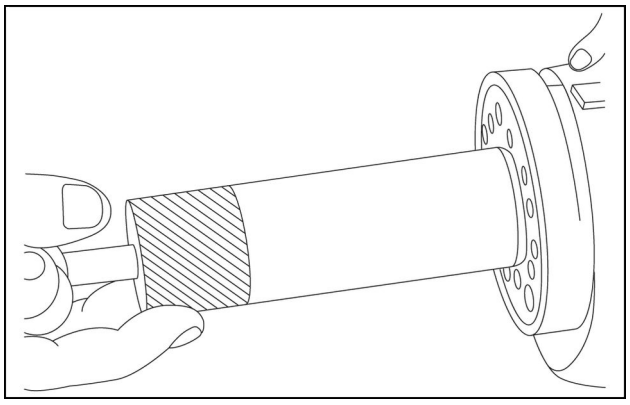
GNIL14TR04521AA 14

4. Press and turn the O-ring/kin-ring into position in the housing.



GNIL14TR04522AA 15

5. Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.



GNIL14TR04523AA 16

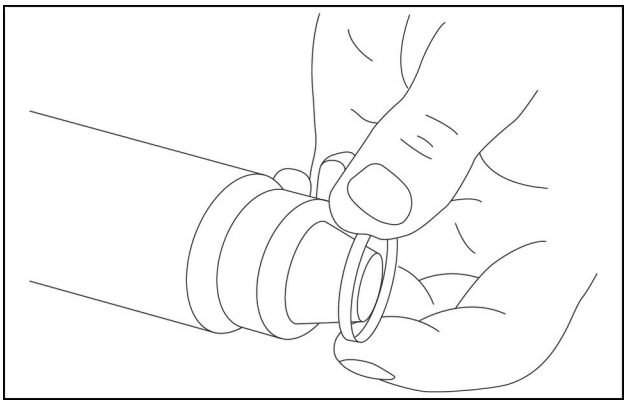
Installation of lip seal

⚠ CAUTION

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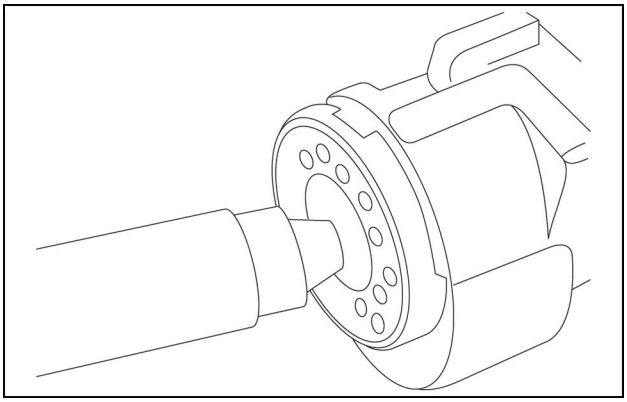
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1. Lubricate the lip seal with hydraulic oil and place it on the assembly tool.



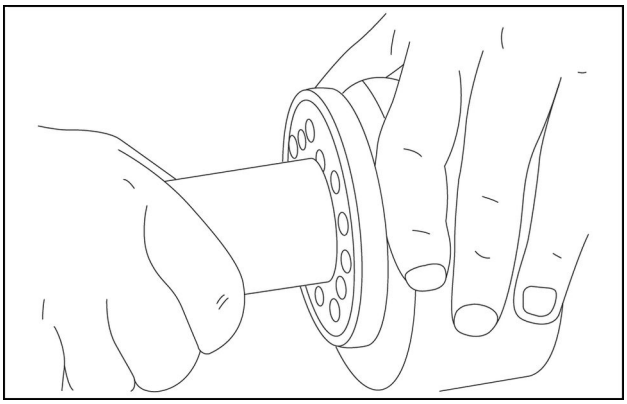
GNIL14TR04524AA 17

2. Guide the assembly tool right to the bottom.



GNIL14TR04525AA 18

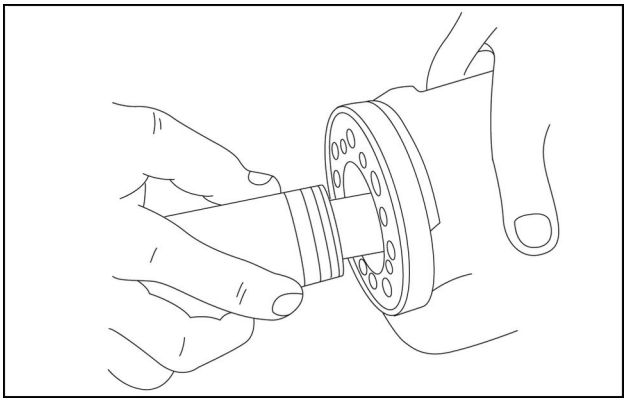
3. Press and turn the lip seal into place in the housing.



GNIL14TR04526AA 19

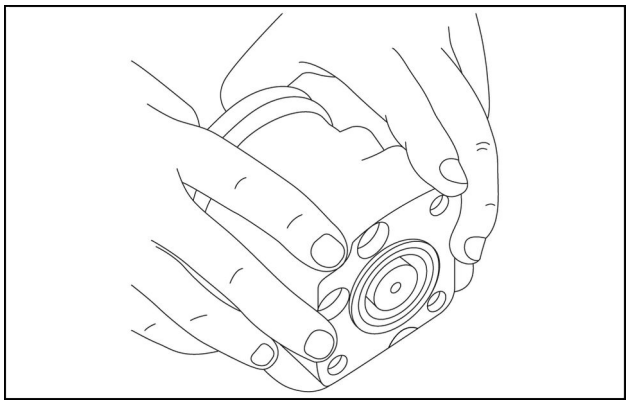
4. With a light turning movement, guide the spool and sleeve into the bore.

NOTE: *Fit the spool set holding the cross pin horizontal.*



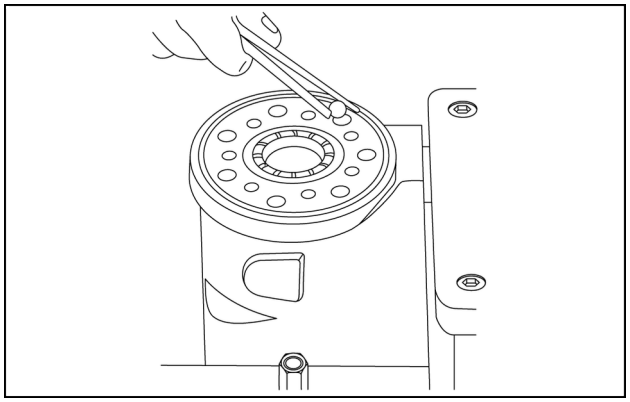
GNIL14TR04527AA 20

5. The spool set will push out the assembly tool guide. The O-ring and kin ring/roto glyd are now in position.



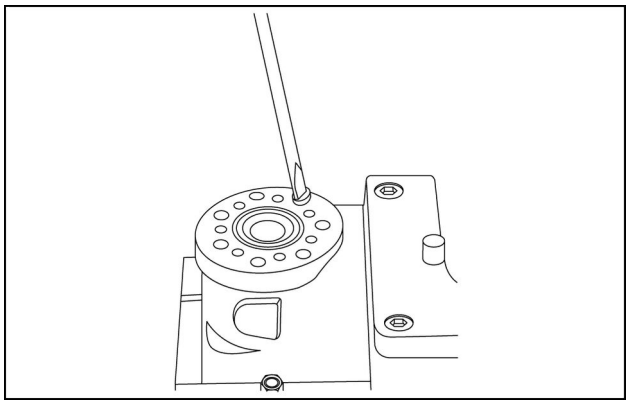
GNIL14TR04528AA 21

6. Turn the steering unit until the bore is vertical again. Put the check valve ball into the hole indicated by the arrow.



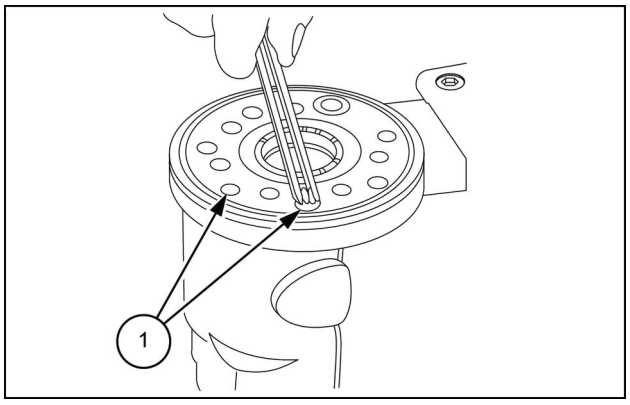
GNIL14TR04529AA 22

7. Screw the threaded bush lightly into the check valve bore. The top of the bush must lie just below the surface of the housing.



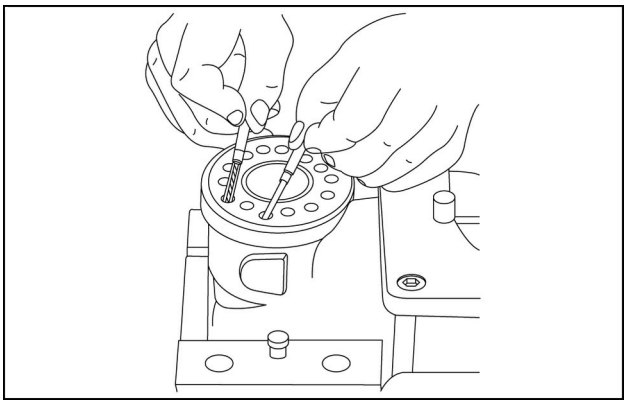
GNIL14TR04530AA 23

8. Place a ball in the two holes **(1)**.



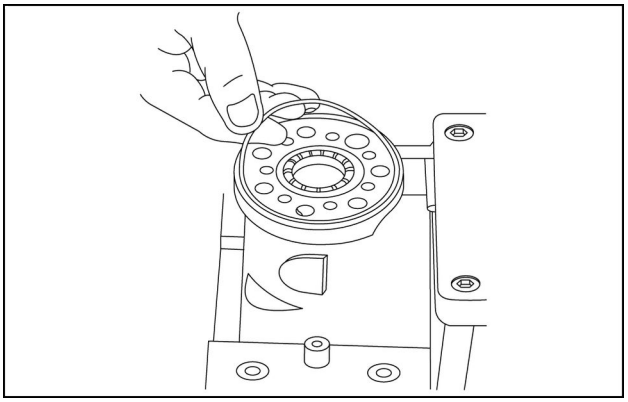
GNIL14TR04531AB 24

9. Place a new pin in the same two holes.



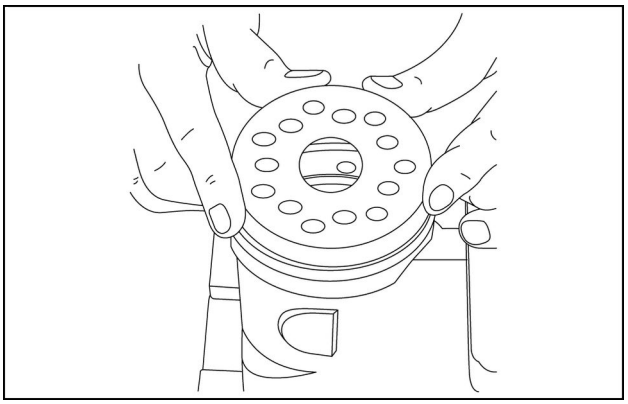
GNIL14TR04538AA 25

10. Grease the O-ring with mineral oil approximately viscosity 500 mm2/s at **20 °C** (**68 °F**).



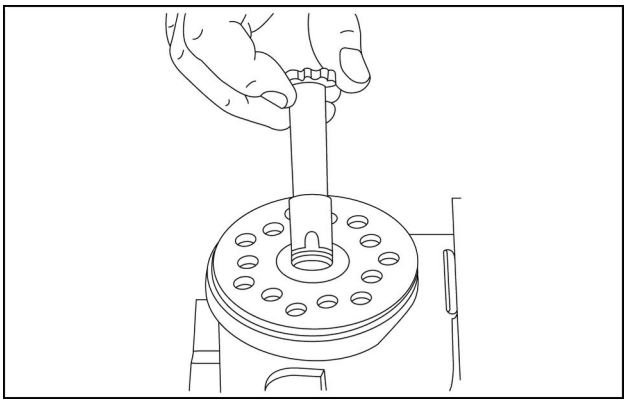
GNIL14TR04532AA 26

11. Place the distributor plate so that the channel holes match the holes in the housing.



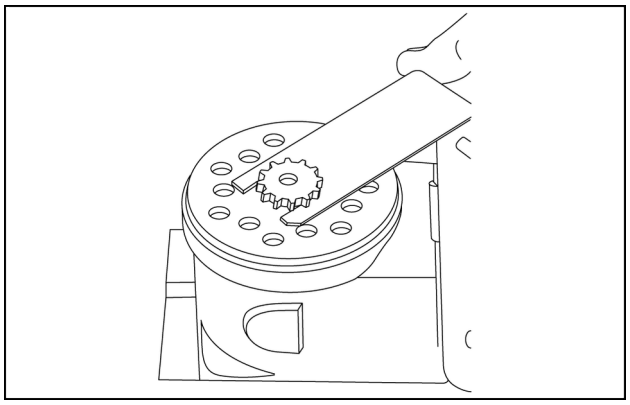
GNIL14TR04533AA 27

12. Guide the cardan shaft down into the bore so that the slot is parallel with the connection flange.



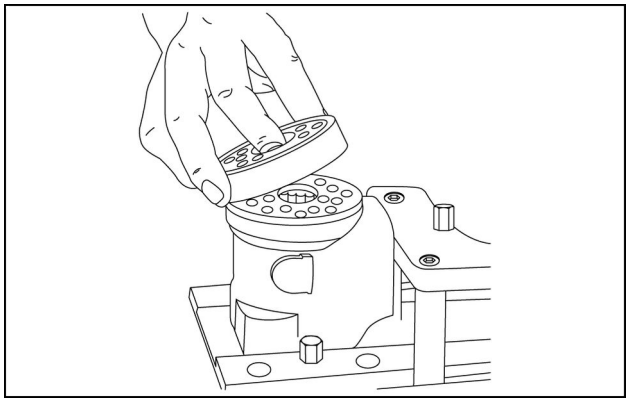
GNIL14TR04534AA 28

13. Place the cardan shaft as shown - so that it is held in position by mounting fork.



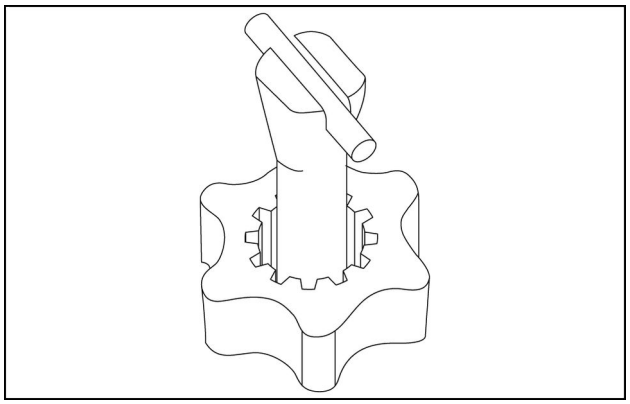
GNIL14TR04535AA 29

14. Grease two O-rings with mineral oil approximately viscosity 500 mm2/s at **20 °C** (**68 °F**) and place them in the two grooves in the gear rim. Fit the gearwheel and rim on the cardan shaft.



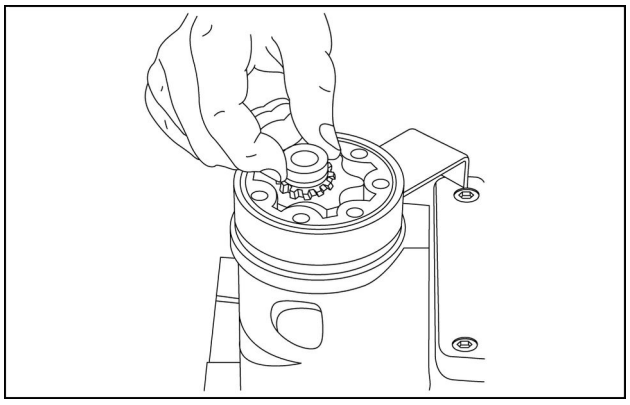
GNIL14TR04536AA 30

NOTE: *Fit the gear wheel (rotor) and cardon shaft so that a tooth base in the rotor is positioned in relation to the shaft slot as shown. Turn the gear rim so that the seven through holes match the holes in the housing.*



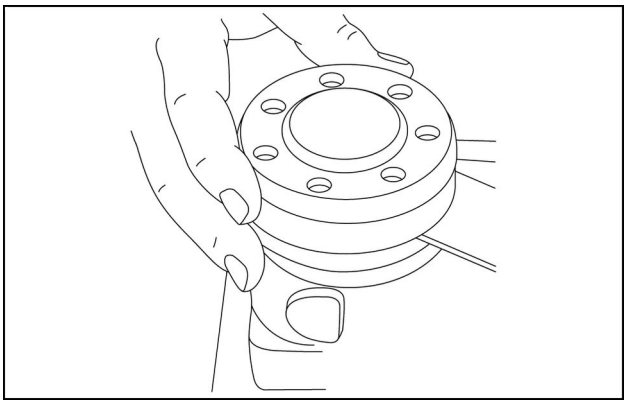
GNIL14TR04537AA 31

15. Fit the spacer, if any.



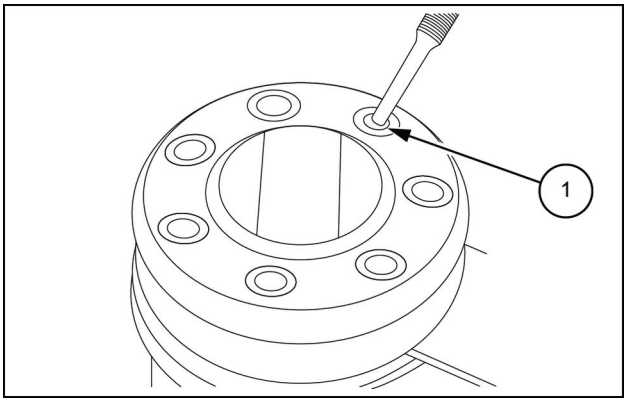
GNIL14TR04539AA 32

16. Place the end cover in position.



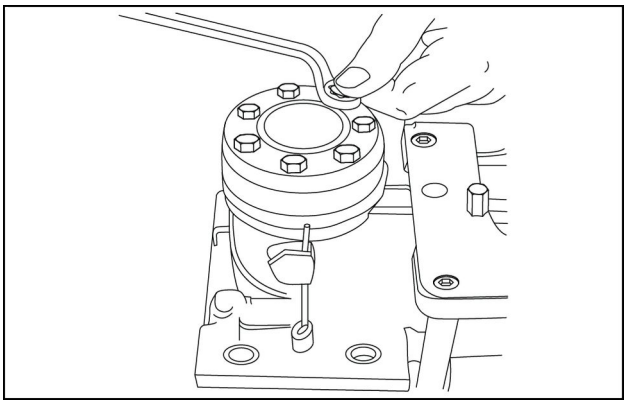
GNIL14TR04540AA 33

17. Fit the special screw with washer and place it in the hole **(1)**.



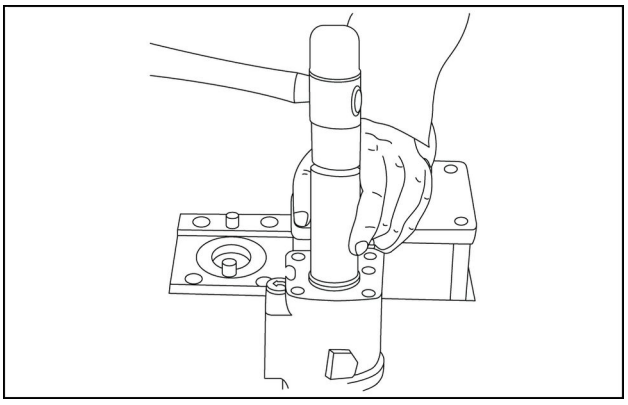
GNIL14TR04541AB 34

18. Fit the six screws with washers and insert them. Cross-tighten all the screws and the rolled pin with a torque of 3.0 ± 0.6 daNm. The steering motor can now be function tested.



GNIL14TR04542AA 35

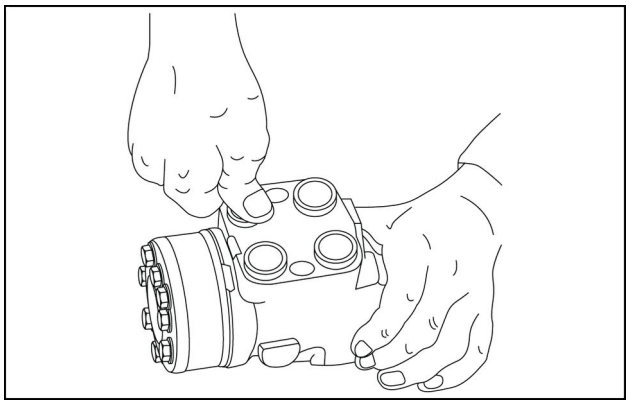
19. Fit the dust seal ring in the housing using suitable tool and a plastic hammer.



GNIL14TR04543AA 36

20. Press the plastic plugs into the connection ports.

NOTE: *Do not use a hammer.*



GNIL14TR04544AA 37

Power steering control valve - Install

For installation, follow the removal process in reverse.

Steering circuit relief valve - Pressure test

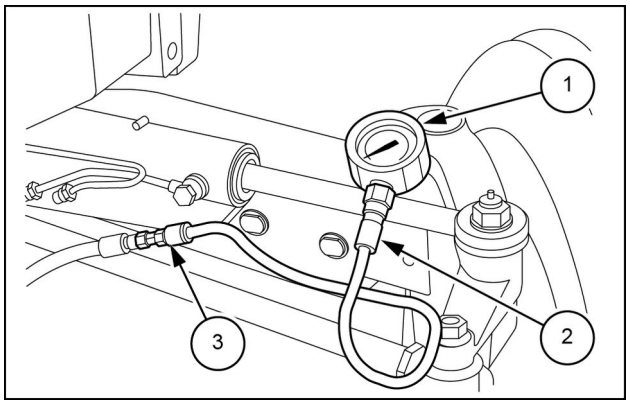
NOTE: *There is no relief valve in steering pump and the following pressure test must only be performed as specified below. Failure to observe this precaution may result in severe damage to the hydraulic pump.*

1. Turn steering onto full left-hand side lock.
2. Disconnect left-hand side turn feed hose at steering cylinder.
3. Install power steering pressure checking kit. (special tool number 292870 with adapter 271318). As shown in Fig. **1**.
4. Start tractor and set engine speed to **1450 RPM**. Turn steering wheel to the left with a pull of approximately **22 N** (**5 lb**) and observe the pressure reading.

NOTE: *The use of a force greater than **22 N** (**5 lb**) at the rim of the steering wheel may lead to slightly inaccurate readings due to the pumping action of the hydrostatic steering motor.*

   If the steering test was satisfactory but pressure readings are away from specification the relief valve in the steering motor must be adjusted.
   The pressure reading should be **110 - 125 bar** (**1595 - 1812 psi**).

5. If the system pressure is not to specification proceed to relief valve adjustment.

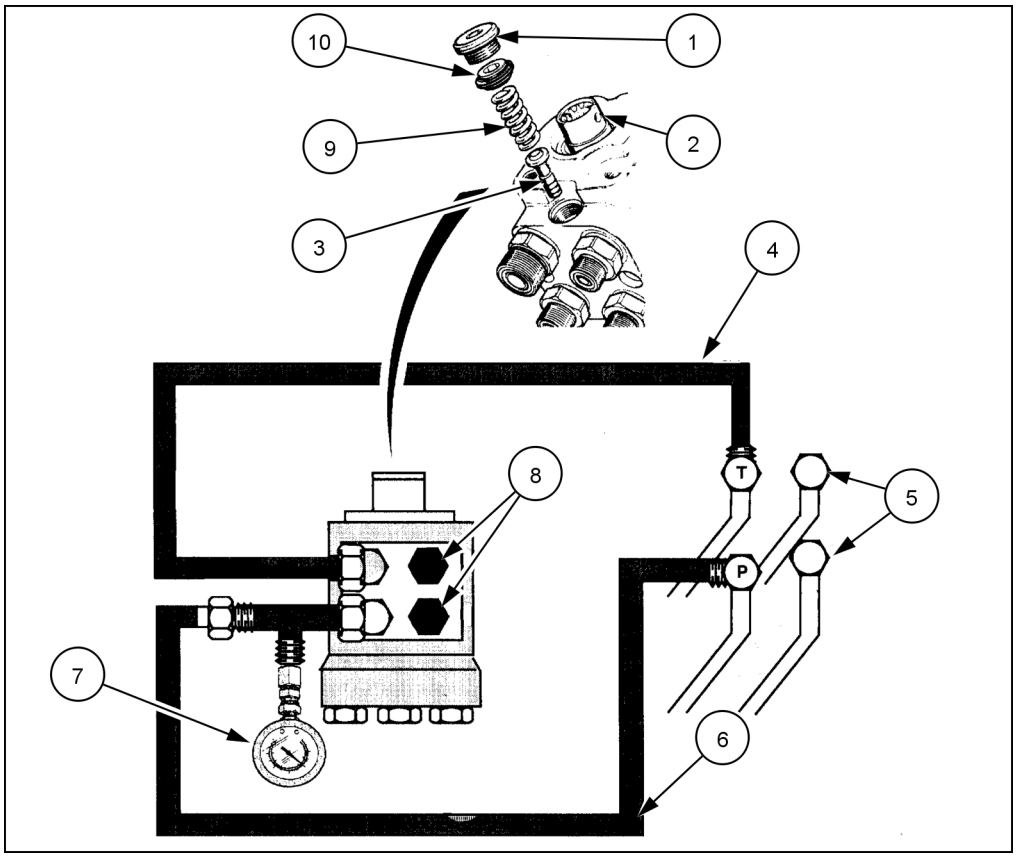


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Steering circuit relief valve - Adjust

NOTE: *To adjust the steering system relief valve it is necessary to remove the steering motor from the steering bracket, to gain access to the hexagon headed adjusting screw.*

1. Disconnect the steering motor from the steering bracket, and remove from the tractor refer to **Power steering control valve - Remove (41.200)**
2. Fabricate suitable test hose to connect pump pipeline to steering motor. Connect locally procured 'T' joint between test hose and steering motor and Install pressure gauge as in Figure **1**.
3. Cap all connections to steering cylinder.
4. Connect the return hose normally. If required connect with extra hose and suitable adopter.
5. Start the engine and idle between **1450 - 1500 RPM**.Run the tractor until the transmission oil reaches normal working temperature.
6. With the engine running, turn the steering motor shaft to obtain full lock. The pressure gauge reading should read **10300 kPa** (**1494 psi**).
7. If the pressure readings are not correct, reset the adjuster, **(1)**, using an **6 mm** (**0.2 in**) hexagon key.



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1. Adjuster
2. Steering shaft
3. Relief valve
4. Steering Motor Output Hose
5. Tractor tubes to steering cylinder
6. Hose for pump supply to steering motor
7. Pressure gauge **20684 kPa** (**3000 psi**)
8. Cap
9. Spring
10. Plug

https://truckmanualshub.com/

Index

Steering - 41

Hydraulic control components - 200

Hydraulic steering oil reservoir - Remove 3
Power steering control valve - Assemble 12
Power steering control valve - Cleaning 9
Power steering control valve - Disassemble 5
Power steering control valve - Inspect 10
Power steering control valve - Install 23
Power steering control valve - Lubricate 11
Power steering control valve - Remove 4
Steering circuit relief valve - Adjust 25
Steering circuit relief valve - Pressure test 24

https://truckmanualshub.com/

Steering - 41

Pump - 206

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

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Contents

Steering - 41

Pump - 206

TECHNICAL DATA

Power steering pump
General specification 3

SERVICE

Pump
Remove 4
Install 5

Power steering pump - General specification

Type	Gear type (In tandem with the hydraulic lift pump), drawing oil from steering oil reservoir
Location	On the right-hand side of the engine
Mounting	Fitted on engine timing case and driven by timing gears
Make	Rexroth (Bosch Group)
Drive	Engine timing gears
Rotation (seen from the free end of the drive shaft)	Anti-clockwise
Displacement	**8 cm³** per revolution
Max. rotational speed	**3300 RPM**
Flow at **1500 RPM** & **210 bar**	**10.56 L/min**

Pump - Remove

Steering pump is in tandem with the hydraulic pump. See **Fixed displacement pump - Remove (35.104)** for steering pump removal.

Pump - Install

For installation, follow the removal process in reverse.

https://truckmanualshub.com/

Index

Steering - 41

Pump - 206

Power steering pump - General specification 3
Pump - Install 5
Pump - Remove 4

https://truckmanualshub.com/

Steering - 41

Cylinders - 216

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

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Contents

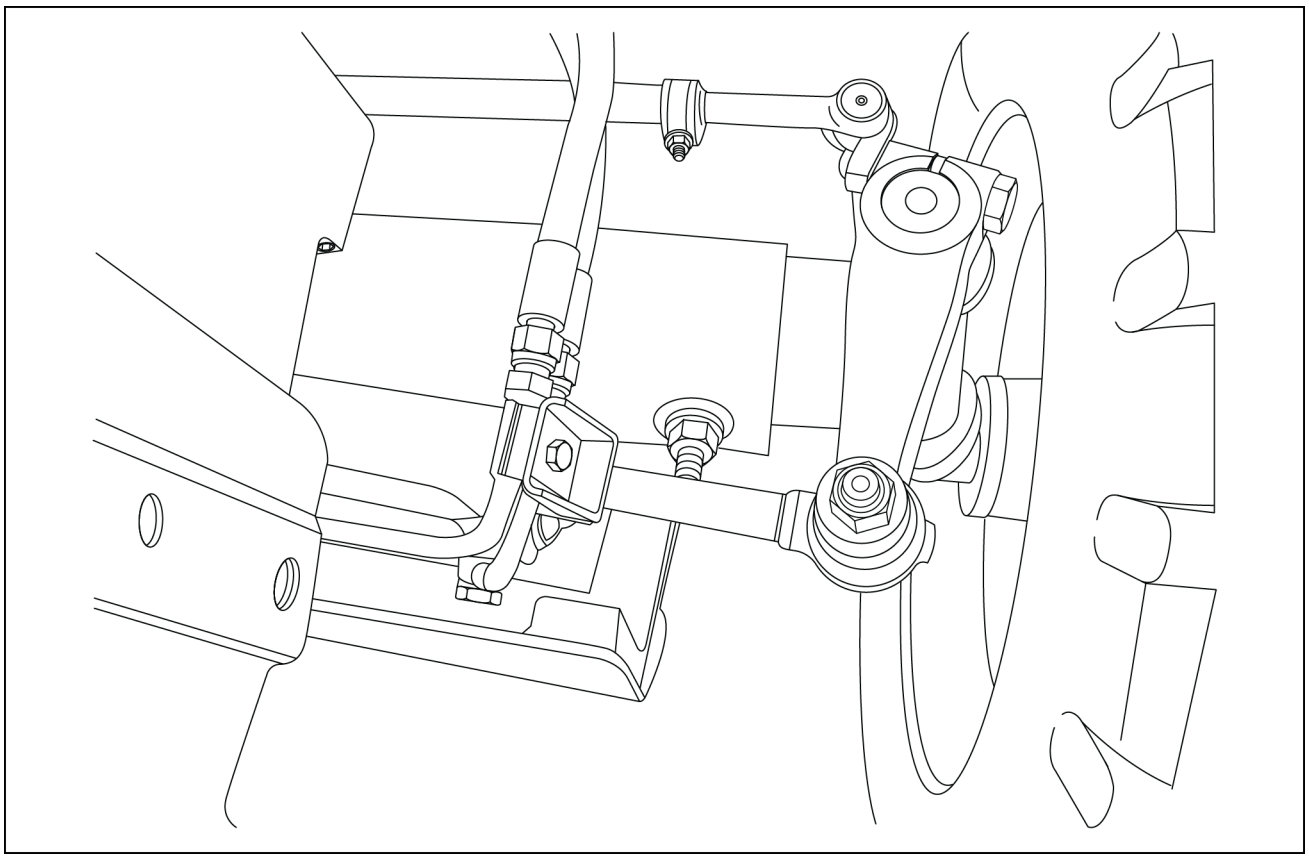
Steering - 41

Cylinders - 216

SERVICE

Steering cylinder
Remove – 2WD 3
Overhaul 4
Install 9

Steering cylinder - Remove – 2WD



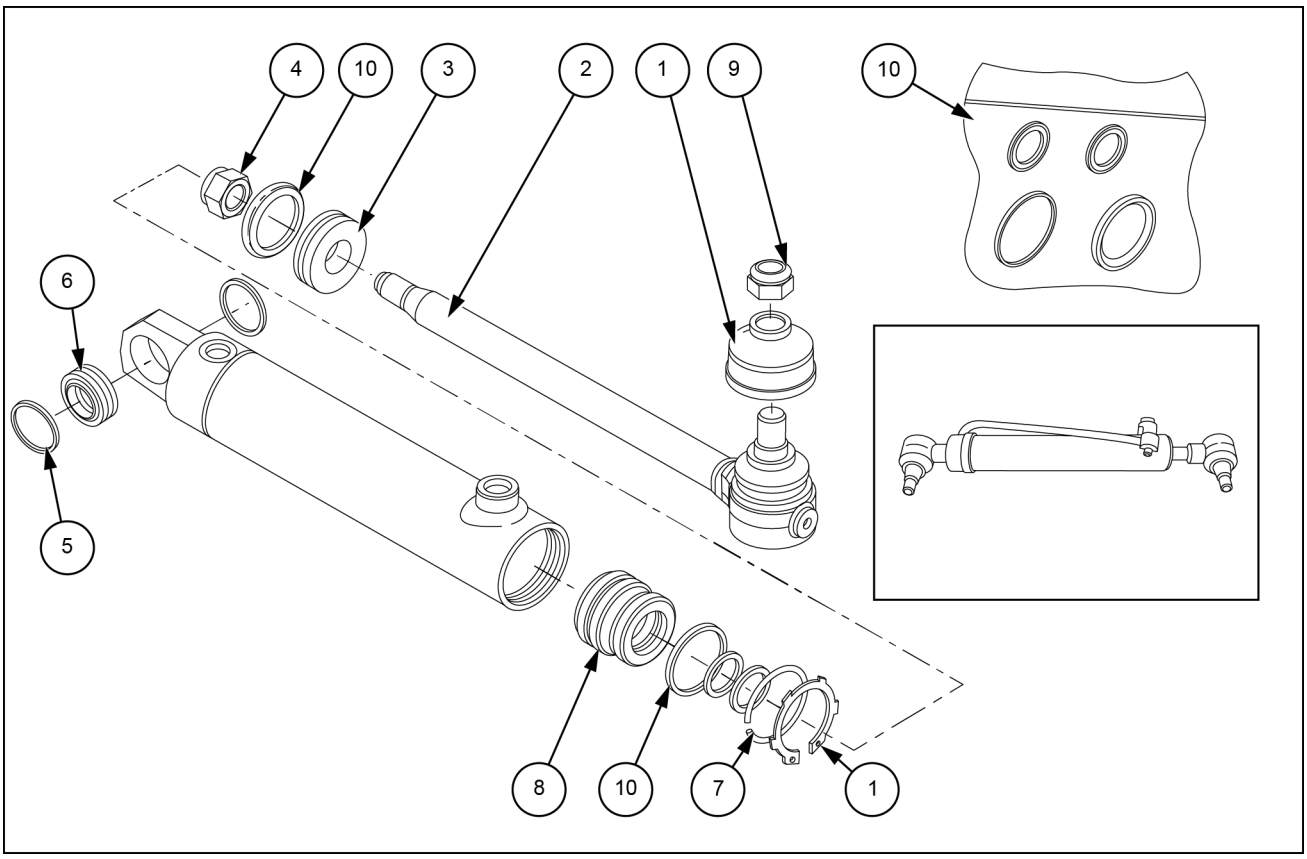
GNIL14TR04545FB 1

1. Stand the tractor on a hard level surface and position the front wheel in the straight ahead position.
2. Disconnect flexible pipes, cap the open pipe ends and remove hose clamps.

NOTE: *Position of flexible pipes and orientation of connectors must be the same upon re-assembly.*

3. Remove the nut securing the cylinder rod ball joint to the steering arm and separate the joint, **1**.
4. Remove the nut securing the steering cylinder on front axle beam.
5. Remove the steering cylinder from the tractor and retrieve washer, spacer and bolt (pivot pin).

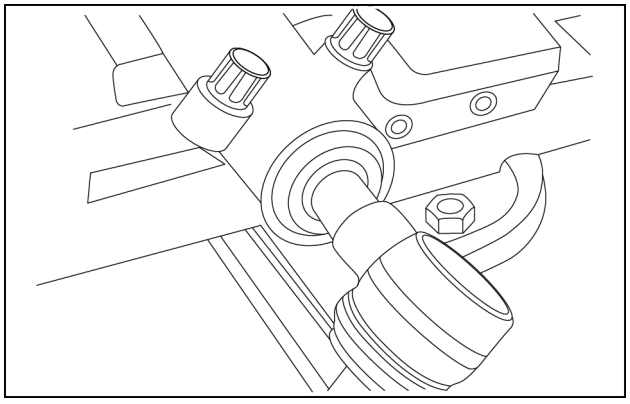
Steering cylinder - Overhaul



GNIL14TR04546FB 1

1. Seeger (5 and 7 also)
2. Assembled rod
3. Piston
4. Lock nut
5. Ball joint
6. Head
7. Nut
8. Seal kit

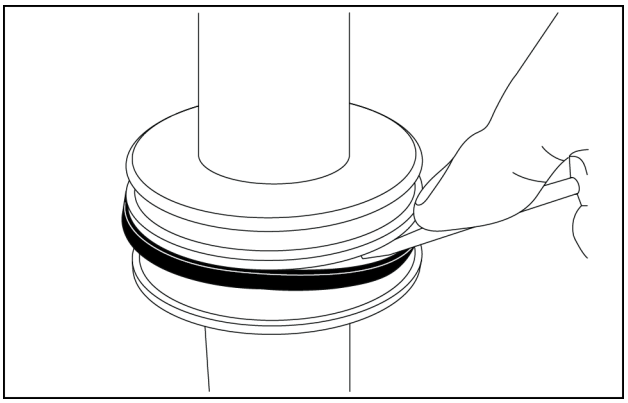
1. Fix the body taking care not to scratch it.
2. Push the rod to the end of the stroke (in the welded side).
3. Use the seeger clamp to remove the head seeger.
4. Use the head bell and the plastic hammer to push the head inside the body **20.00 - 30.00 mm** (**0.79 - 1.18 in**).



GNIL14TR04548AA 2

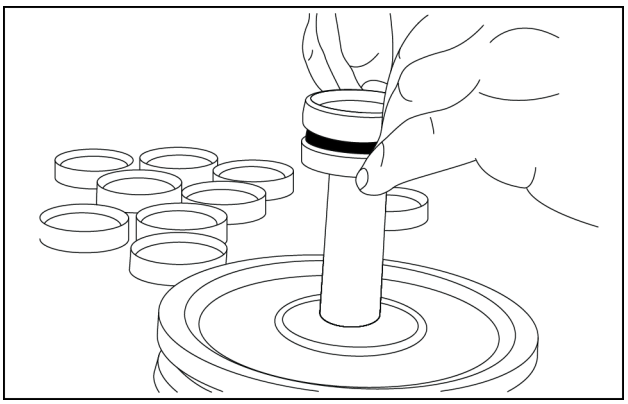
5. Remove the internal retaining ring with screw driver.
6. Remove the head hammering the rod. Remove the piston after unscrew the self locking nut.

NOTE: *Check that oil ports are not plugged and remove internal oil.*



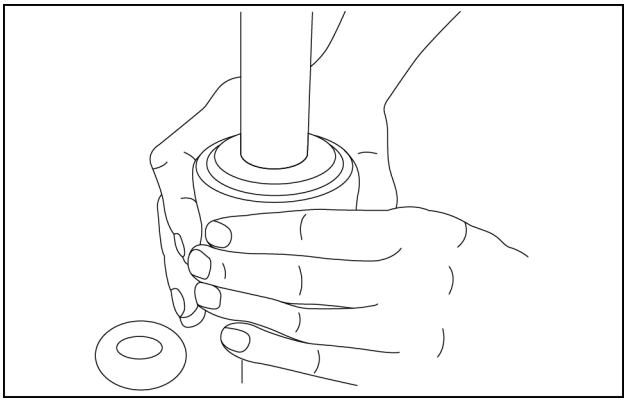
GNIL14TR04547AA 3

7. Extract the rod by pulling. Seal on the piston could require energetic action. Clamp the rod paying special attention to not scratch its surface.
8. Remove with the screw driver piston seal and O-ring under the seal.



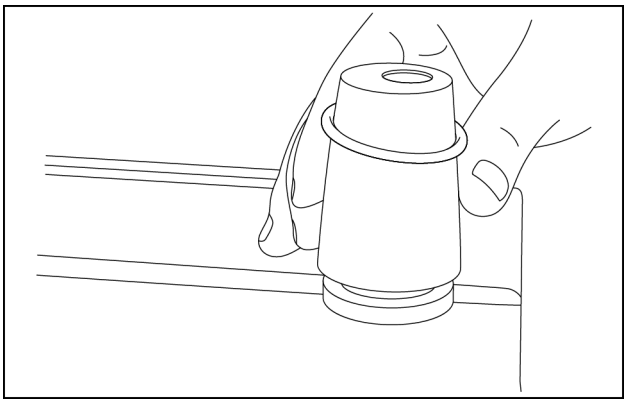
GNIL14TR04549AA 4

9. Throw away used seal and open the seal kit and clean the piston.



GNIL14TR04550AA 5

10. Apply piston seal mounting bell against piston and insert the O-ring having it slipping on the bell.



GNIL14TR04551AB 6

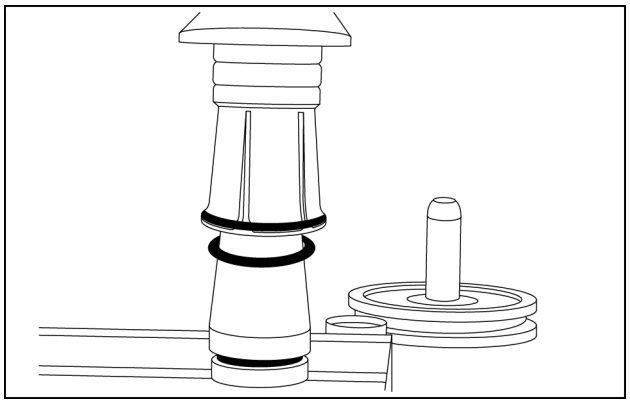
Installation of lip seal

⚠ CAUTION

Pinch hazard!
Always use suitable tools to align mating parts.
DO NOT use your hand or fingers.
Failure to comply could result in minor or moderate injury.

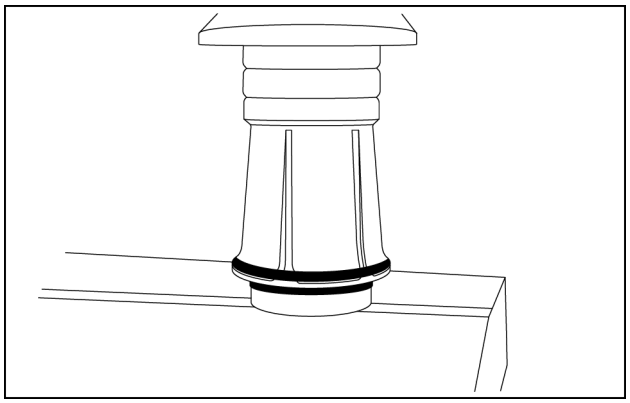
C0044A

1. Lubricate the lip seal with hydraulic oil and place it on the assembly tool.



GNIL14TR04552AA 7

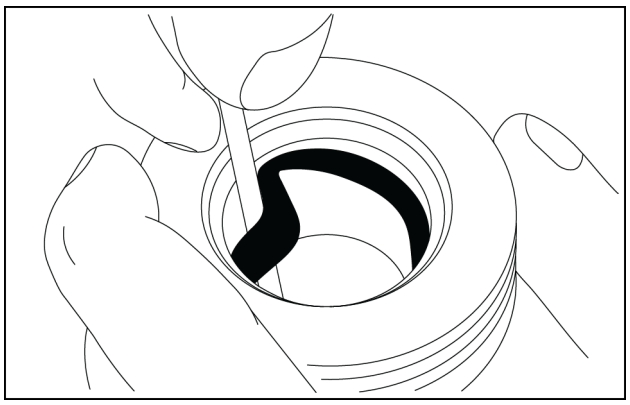
2. Insert the external ring of the piston seal over the O-ring just mounted in this way. Position the ring over the bell, take the pushing tool and overpass with it in the piston. The seal will fit its groove automatically.



GNIL14TR04553AA 8

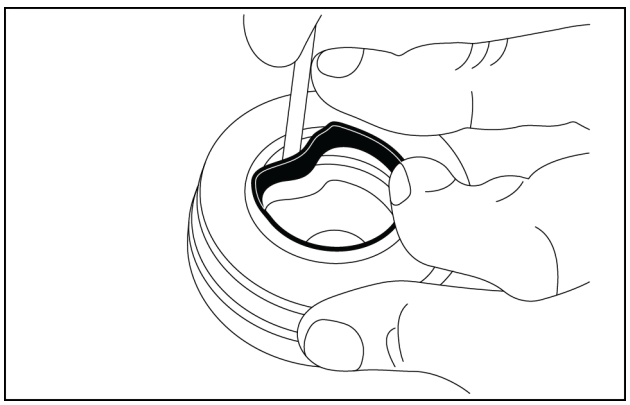
3. Calibrate the seal with the appropriate tool.

NOTICE: *Use the screwdriver with care avoiding scratches on seal grooves.*



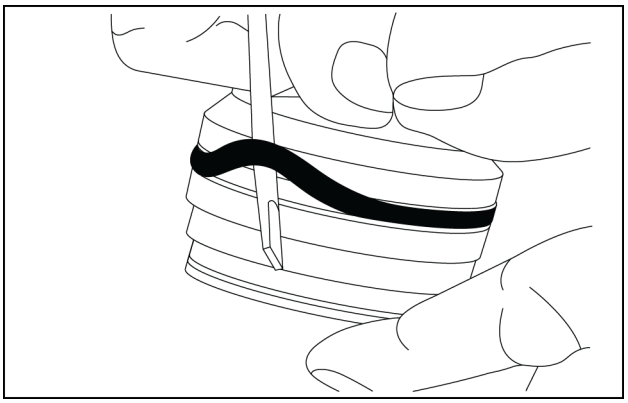
GNIL14TR04554AA 9

4. Remove seals on the head with the screw driver.



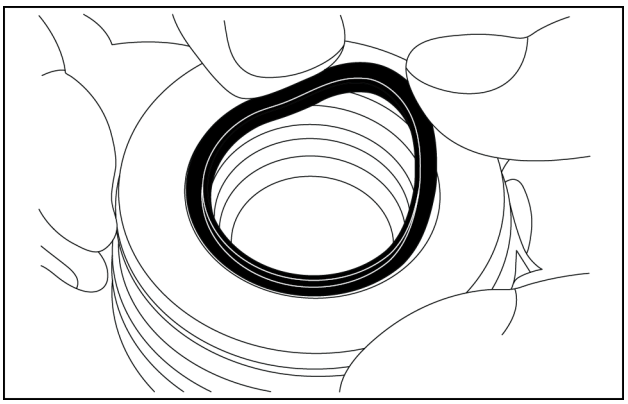
GNIL14TR04555AA 10

5. Wash the head and verify whether the rags have been generated during disassembling and working



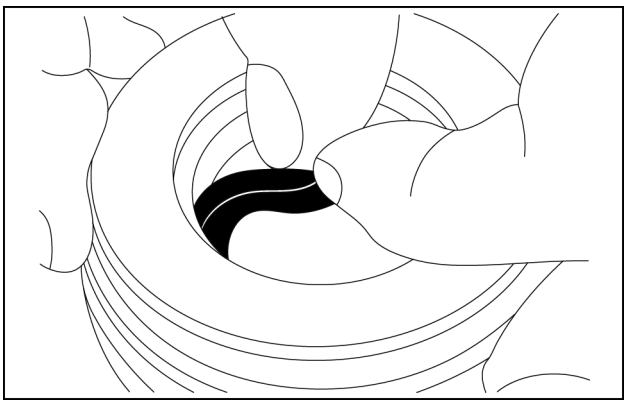
GNIL14TR04556AA 11

6. Manual mount rod seal, taking care about the orientation of the lips. (Oriented to retain oil).



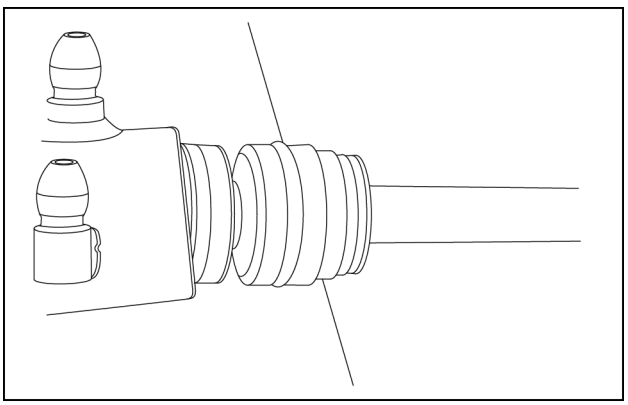
GNIL14TR04557AA 12

7. Mount manually the wiper (taking care about lip orientation) and the static seal (external).



GNIL14TR04558AA 13

8. Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.
9. Lubricate the lip seal with hydraulic oil and place it on the assembly tool.



GNIL14TR04559AA 14

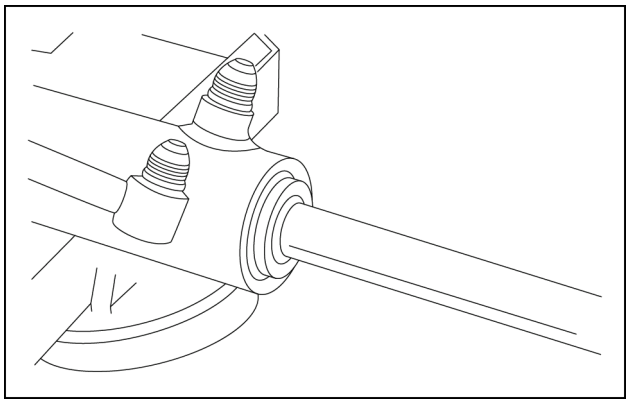
Installation of lip seal

⚠ CAUTION

Pinch hazard!
Always use suitable tools to align mating parts.
DO NOT use your hand or fingers.
Failure to comply could result in minor or moderate injury.

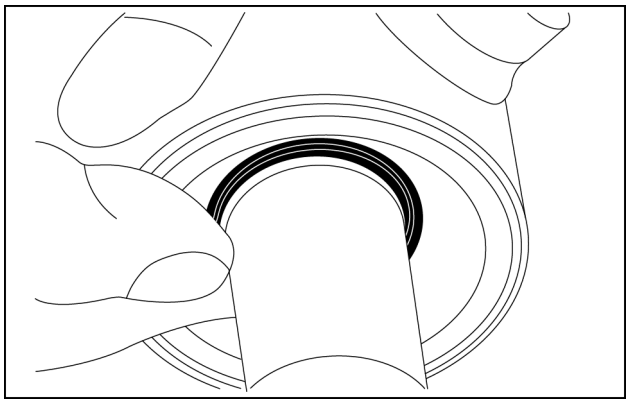
C0044A

1. Insert the head and piston on rod-screw self locking nut at torque (Nm). Grease every seal on body, head and piston. Grease the internal wall of body (**20.00 - 30.00 mm** (**0.79 - 1.18 in**)) entrance zone.



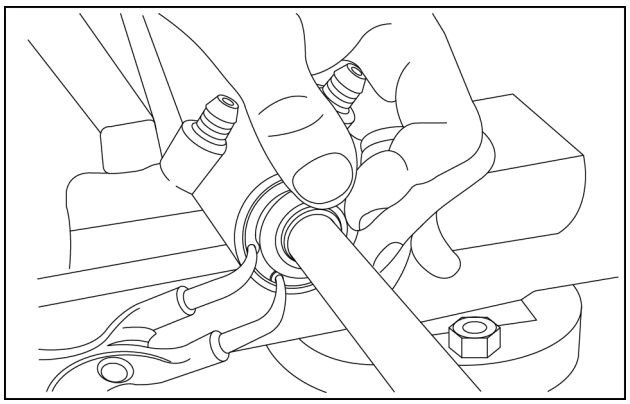
GNIL14TR04560AA 15

2. Insert the assembled rod. Taking care to not damage piston seal. Hammer the rod to end of stroke. Unscrew the rod bell and screw on the other side.



GNIL14TR04561AA 16

3. Insert the head manually up to **20.00 - 30.00 mm** (**0.79 - 1.18 in**) inside.



GNIL14TR04562AA 17

Steering cylinder - Install

For installation, follow the removal process in reverse order.

https://truckmanualshub.com/

Index

Steering - 41

Cylinders - 216

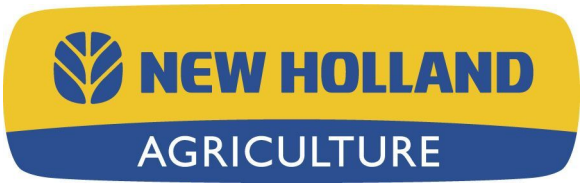
Steering cylinder - Install 9
Steering cylinder - Overhaul 4
Steering cylinder - Remove – 2WD 3

https://truckmanualshub.com/

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https://truckmanualshub.com/

SERVICE MANUAL

Wheels

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Wheels - 44

[44.511] Front wheels 44.1

[44.520] Rear wheels 44.2

https://truckmanualshub.com/

Wheels - 44

Front wheels - 511

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Wheels - 44

Front wheels - 511

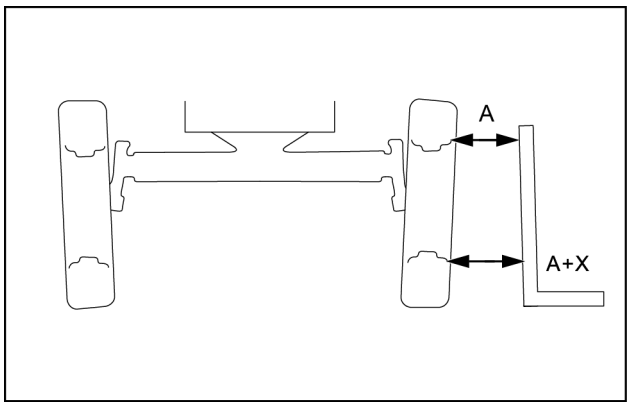
SERVICE

Front wheels
Test – 2WD 3
Toe in adjust – 2WD 4
Adjust 5
Adjust 7

Front wheels - Test – 2WD

Wheel camber test

When the tractor moves along a straight line, wheels should be tilted by **2 °** relative to the ground. Check the front wheel camber that corresponds to a difference (X) of approximately **15.0 mm** (**0.6 in**) between the rim edges.



GNIL14TR04457AB 1

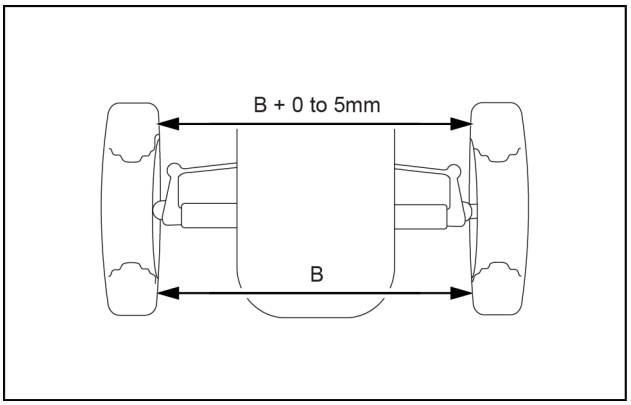
Front wheels - Toe in adjust – 2WD

Front wheel toe-in test

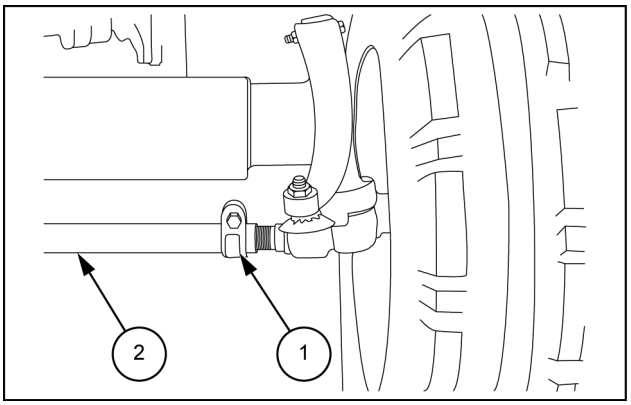
When the tractor moves along a straight line, wheels should be parallel to the tractor centre line or slightly toe-in until a max. of **0.50 mm** (**0.02 in**), measured between the rim edges.

Check the correct toe-in as follows:

1. Inflate front tires to a pressure of **1.7 bar** (**25.0 psi**).
2. Place the steering wheel at mid-travel, with one spoke along the tractor centre line.
3. Check if wheels are parallel to the tractor centre line.
4. Measure the distance **(B)** between the wheel inner rims at hub height at the front of the wheels.
5. Measure the distance between the wheel inner rims at hub height at the rear of the wheels. The measurement taken should be the same as **(B)** or greater by up to **5.00 mm** (**0.20 in**) max.
6. If it is necessary to adjust the front wheel toe-in, proceed as follows:
   - Loosen the clamp **(1)** on both end of the track control rod.
   - Turn the track control rod **(2)** in or out to shorten or lengthen the track control rod until desired toe-in is achieved.
   - Tighten the clamp **(1)**.



GNIL14TR04458AB 1

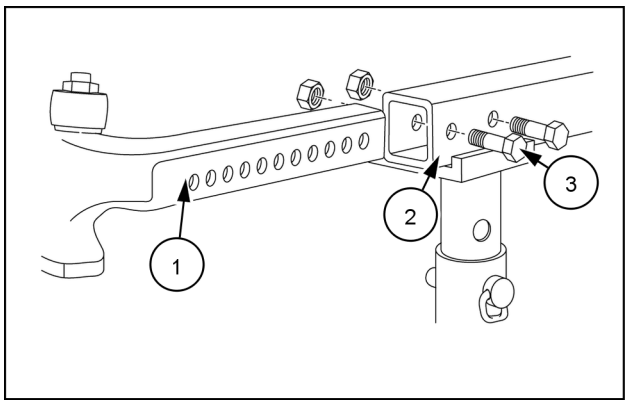


GNIL14TR04459AB 2

Front wheels - Adjust

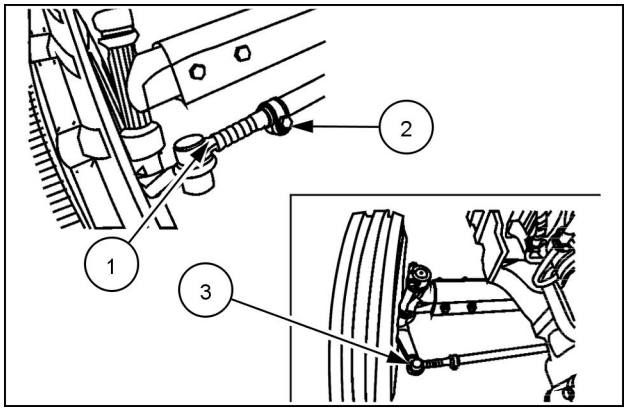
Tread adjustment

1. The front axle consists of a hollow center beam **(1)** with a telescopic section **(2)** at each end. Seven holes at **50 mm** (**1.97 in**) intervals are provided in the telescopic sections for adjustment purposes. Adjustment of the front wheel track width is done by extending both ends of the axle equally.
   To extend the axle, apply the hand brake and place blocks at the front and rear of the rear wheels. Jack up the front axle and place on axle stands. Remove the securing bolts, **(3)**, securing the left-hand telescopic section to the center beam.
   Repeat the same for the right-hand side of the axle.



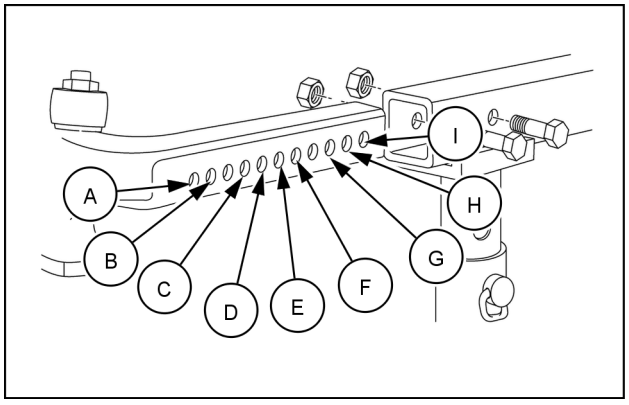
GNIL14TR00500AA 1

2. The tie rod is adjustable and consists of a central, hollow tube with a solid extendible section at each end. The left-hand end of the tie rod has a number of notches **(1)** at **50 mm** (**1.97 in**) intervals. A locating bolt **(2)** passes through a clamp and one of the notches in the solid section and locks the tie rod assembly at the desired length. Additionally, the right-hand end of the tie rod is threaded **(3)** to provide fine adjustment of toe-in. Remove the locating bolt **(2)** from the left-hand end of the tie rod. This will permit the tie rod to extend or retract freely.



76099305N 2

3. Reset both axle telescopic sections. Passing the securing bolts through the center beam and telescopic sections, as indicated in **3** and table below:



GNIL14TR00500AA 3

Securing Bolt Locations	2WD
2WD Dished In	**7.50 - 16**
AC	1424 mm
BD	1524 mm
CE	1624 mm
DF	1724 mm
EG	1824 mm
FH	1924 mm
2WD Dished Out	

Securing Bolt Locations	2WD
AC	1472 mm
BD	1572 mm
CE	1672 mm
DF	1772 mm
EG	1872 mm
FH	1972 mm

4. Tighten the nuts on the axle extension securing bolts to **118 N·m** (**87 lb ft**).
   With both front wheels parallel, install the locating bolt **(2)** in the nearest aligning notch in the tie rod. Tighten the nut on the locating bolt to **24.5 N·m** (**18 lb ft**).

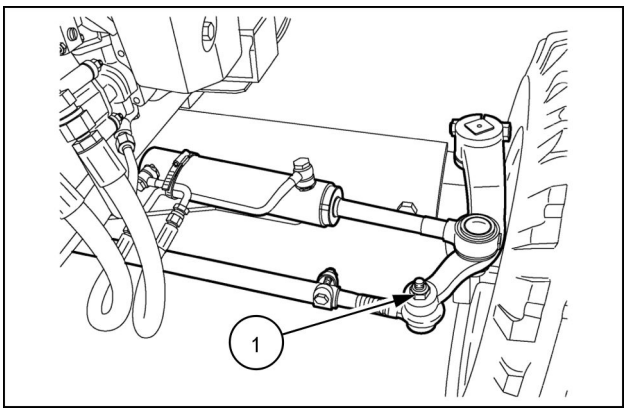
NOTE: *The tread settings shown are approximate. The front wheel discs are off-set, relative to the center line of the rim. The tread settings in the table are with the dished side of the wheel nearest the axle hub. If the front wheels are reversed on the hubs the tread settings shown in the table will be increased by approximately **25 mm** (**0.98 in**).*

Tractor model	Front wheel bolt torque
	320.0 N·m (**236.0 lb ft**)

NOTE: *Re-check all torque settings after **50 h** of operation.*

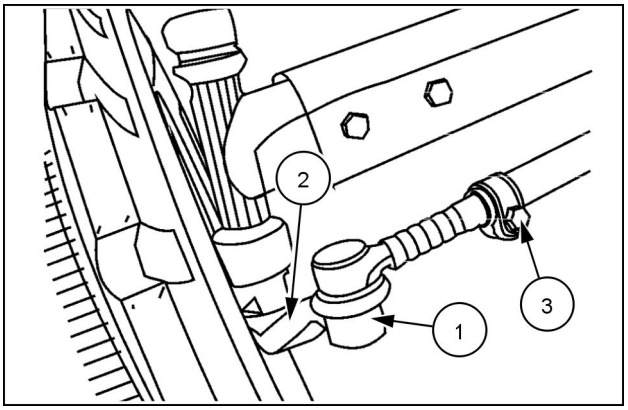
Tie rod

5. The tie rod located behind the axle must be disengaged to permit adjustment of the axle. The tie rod is telescopic and consists of a central hollow tube with a solid extendible section at each end. Remove the locating bolt **(1)** from both ends of the tie rod. The position for the setting of the steering cylinder will also change respectively. Reset the left and right axle telescopic sections, passing the securing bolts through the center beam and telescopic sections, as indicated in **3**, see chart.



86090130N 4

6. Remove the nut **(1)** at the right end of the tie rod. Withdraw the tie rod from arm **(2)**. Loosen the bolt **(3)** and rotate the threaded end to shorten or lengthen the tie rod assembly until the toe-in is correct. Torque all bolts or nuts securely to correct values.



20108792 5

Front wheels - Adjust

⚠ WARNING

Roll-over hazard!
Never operate the machine with a loose wheel rim or disc. Always tighten nuts and/or bolts to the specified torque value and at the recommended intervals.
Failure to comply could result in death or serious injury.

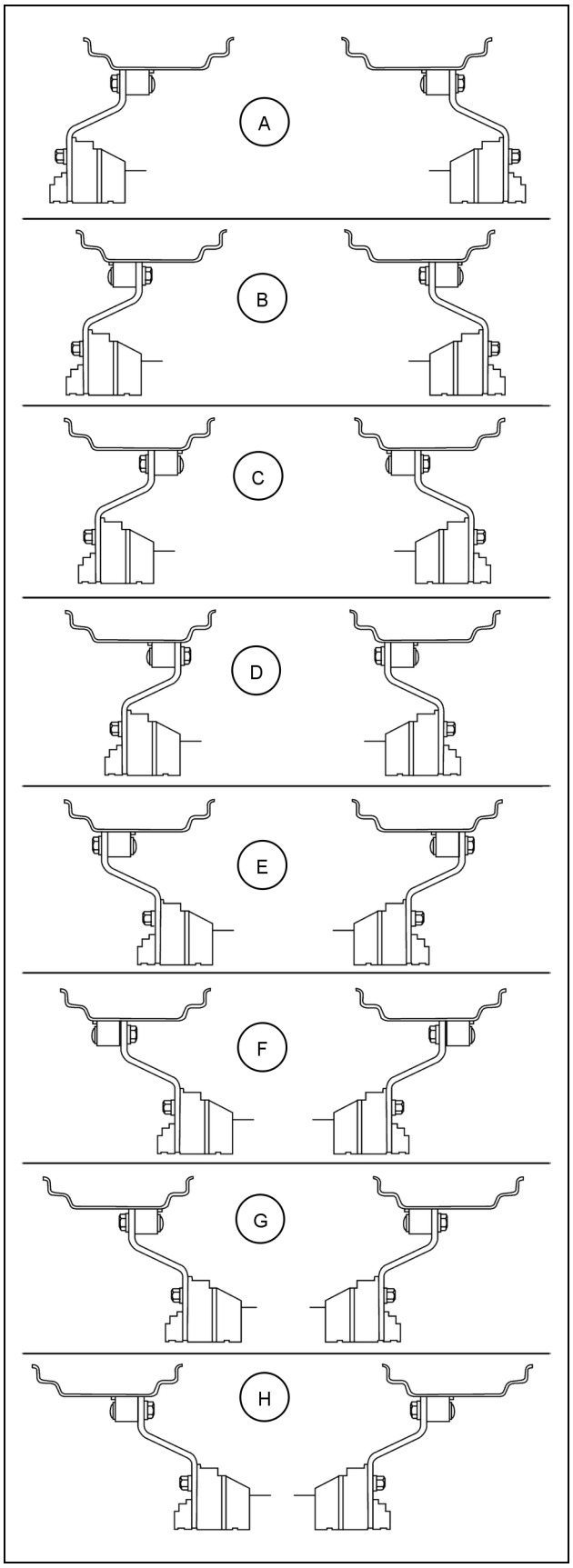
W0346B

Tread setting

4WD Front Axle	4WD Tread Setting
	9.5 —24
(A)	NA
(B)	NA
(C)	NA
(D)(Standard)	**1558.0 mm** (**61.3 in**)
(E)	**1522.0 mm** (**59.9 in**)
(F)	**1630.0 mm** (**64.2 in**)
(G)	**1650.0 mm** (**65.0 in**)
(H)	**1758.0 mm** (**69.2 in**)

4WD Front Axle	
	R4 **12.5/80-18**
Front	**1532 mm**

1. Front wheel bolt torque: **192.0 N·m** (**141.6 lb ft**)



76096164N-85X23 1

https://truckmanualshub.com/

Index

Wheels - 44

Front wheels - 511

Front wheels - Adjust 5
Front wheels - Adjust 7
Front wheels - Test – 2WD 3
Front wheels - Toe in adjust – 2WD 4

https://truckmanualshub.com/

https://truckmanualshub.com/

Wheels - 44

Rear wheels - 520

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Wheels - 44

Rear wheels - 520

SERVICE

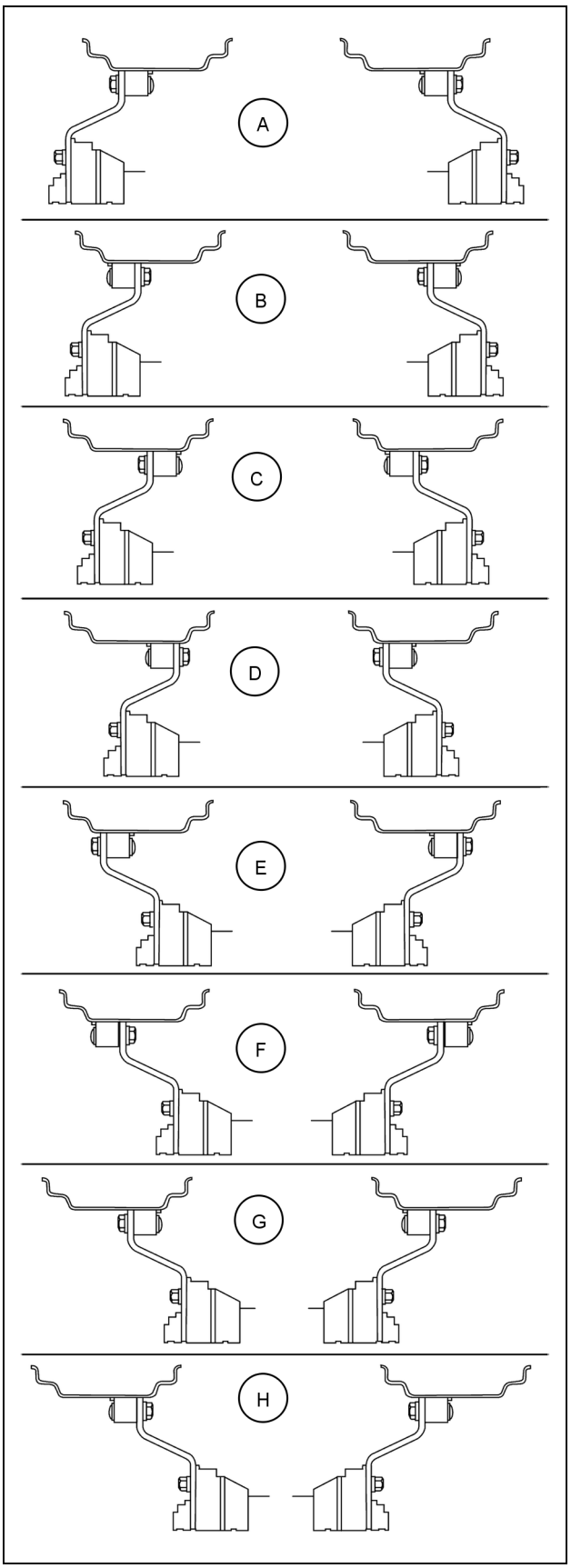
Rear wheel
Adjust 3

Rear wheel - Adjust

Tread adjustment

1. Rear wheel track adjustment is done by changing the wheel rim relative to the center disc, the rim and/or the disc relative to the axle hub or by interchanging the rear wheels.
The drawings shown in the table illustrate the wheel rim and disc positions viewed from rear of the tractor relative to the hub at various track width settings. Track width (the distance between the center of the tires) are nominal and may vary by as much as **13 mm** (**0.5 in**).
2. When installing or adjusting a wheel, torque the bolts to the following values. Recheck after driving the tractor for 1 hour and 8 hours operation, and thereafter at the 50 hour intervals:

NOTICE: *When interchanging left and right wheel assemblies, ensure the "V" of the tire tread remains pointing in the direction of forward travel of tractor for better grip.*
With certain options and/or tire sizes, narrower track settings may not be possible due to minimal clearance between tires and fenders or equipment.



76096164N-85X23 1

Rear disc to hub bolts	**192 N·m** (**142 lb ft**)
Rear disc to rim nuts	**239 N·m** (**176 lb ft**)

Rear Axle Configuration	2WD	2WD & 4WD	4WD
	13.6 R 28	**14.9 R 28**	**R4 18.4X24**
(A)	N/A	N/A	N/A
(B)	N/A	N/A	**1438.0 mm** (**56.6 in**)
(C)	N/A	N/A	N/A
(D)	**1336.0 mm** (**52.6 in**)	**1336.0 mm** (**52.6 in**)	N/A
(E)	**1420.0 mm** (**56 in**)	**1420.0 mm** (**56 in**)	N/A
(F)	**1534.0 mm** (**60.4 in**)	**1534.0 mm** (**60.4 in**)	N/A
(G)	**1623.0 mm** (**64 in**)	**1623.0 mm** (**64 in**)	N/A
(H)	**1737.0 mm** (**68.4 in**)	**1737.0 mm** (**68.4 in**)	N/A

Index

Wheels - 44

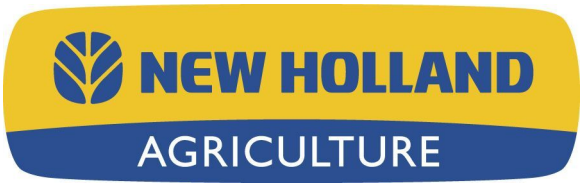
Rear wheels - 520

Rear wheel - Adjust 3

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NEW HOLLAND AGRICULTURE

SERVICE MANUAL

Electrical systems

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Electrical systems - 55

[55.000] Electrical system 55.1

[55.024] Transmission control system 55.2

[55.048] Rear Power Take-Off (PTO) control system 55.3

[55.100] Harnesses and connectors 55.4

[55.201] Engine starting system 55.5

[55.301] Alternator 55.6

[55.302] Battery 55.7

[55.404] External lighting 55.8

[55.405] External lighting switches and relays 55.9

[55.408] Warning indicators, alarms, and instruments 55.10

[55.512] Cab controls 55.11

[55.DTC] FAULT CODES 55.12

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Electrical systems - 55

Electrical system - 000

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Electrical systems - 55

Electrical system - 000

TECHNICAL DATA

Electrical system
General specification 3

FUNCTIONAL DATA

Electrical system
Overview 4

DIAGNOSTIC

Electrical system
Troubleshooting 5

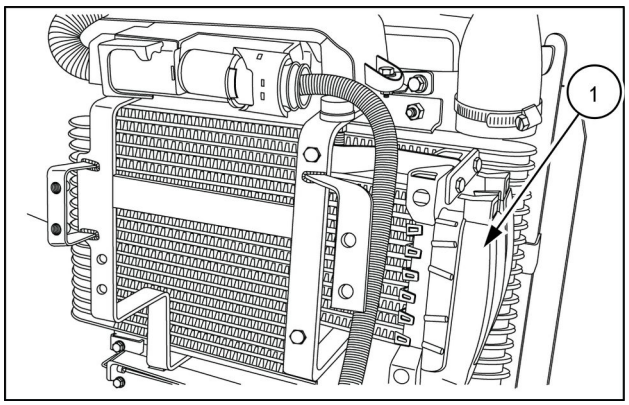
Electrical system - General specification

Main system protection	Mega Fuse **125 A**
Number of fuses for protection	6
Alternator	**75 A**
Battery type	**12 V** Negative ground BCI group 47 CCA 600-850
Cold-start aid	Yes
Starter motor - type	Solenoid operated
Starter kw (hp) rating	**2.0 kW** (**2.7 Hp**)
Bulb rating and type	
Head light	**12 V 55/65 W**
Turn signal	**12 V 21 W**
Tail light	**12 V 21 W** / No. 1157
Parking lamp	**12 V 5 W**
Work lamp	**12 V 50 W**
Enhanced turn lamps (red)	**12 V 21 W**

Electrical system - Overview

The electrical system of the tractor consists of various wiring harnesses, lights, switches, battery, alternator, starter and instrument cluster.
Fuses **(1)** protect electrical circuits with thin pieces of wire, which heat up and melt when too much current flows through them. This opens circuit and protects the wiring from burning. This can occur in the event of a 'short circuit', or by connecting equipment which demands a current greater than the circuit, designed to carry. The fuse is specially designed and in the event of failure, a new fuse of the same rating should be fitted.

NOTICE: *The fuse should never be repaired or replaced by a fuse of a higher rating.*
If the fuse repeatedly 'blows' the cause must be investigated and repaired.



GNIL14TR00762AA 1

Electrical system - Troubleshooting

Problem	Possible Cause	Correction
Charge light remains illuminated	Faulty alternator component.	Test alternator and repair a necessary.
	Short circuit to ground between alternator and warning lamp.	Check wiring and repair as necessary.
Charge light does not illuminate	Blown fuse panel, **15 A** instrument panel fuse.	Inspect **15 A** fuse and replace as necessary.
	Faulty charge indicator bulb.	Inspect indicator bulb and replace as necessary.
	Open charge light circuit.	Inspect connections, grounds, and wiring for charge circuit and repair as necessary.
Insufficient or no battery charge, hard starting, or dim indicator light	Battery charge less than 75%.	Test battery. Charge, add water, or replace as necessary.
	Fan belt slipping.	Check fan belt tension, adjust as necessary.
	Loose wiring connections.	Check wiring connections for charge circuit, repair as necessary.
	Continuity fault in external wiring.	Check wiring harness and repair as necessary.
	Blown fuse panel, **15 A** alternator excitation fuse.	Inspect **15 A** fuse and replace as necessary.
Battery failure, frequent burnout of lamps and fuses	Overcharge condition.	Check alternator voltage output and repair as necessary.
	Ground circuit for alternator short-circuited.	Check alternator wiring and connections and repair as necessary.

https://truckmanualshub.com/

Index

Electrical systems - 55

Electrical system - 000

Electrical system - General specification 3
Electrical system - Overview 4
Electrical system - Troubleshooting 5

https://truckmanualshub.com/

Electrical systems - 55

Transmission control system - 024

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Electrical systems - 55

Transmission control system - 024

SERVICE

Transmission control system
Ground speed control - Test Transmission range safety switch (*) 3

(*) See content for specific models

Ground speed control - Test Transmission range safety switch

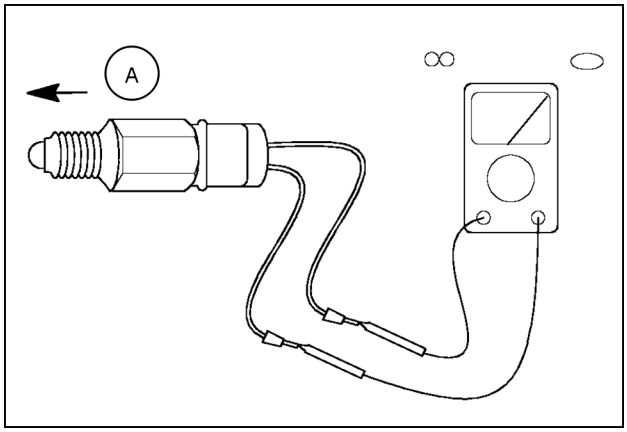
Workmaster™ 50	NA
Workmaster™ 60	NA

NOTE: *Use an ohmmeter to test the transmission range safety switch for electrical continuity.*

Extended position

1. With the transmission range safety switch plunger in the extended position "A", there will be electrical continuity across the terminal leads.

1. If continuity does not exist while the switch is in the "Extended " position, the switch is defective and needs replaced.



30002201 1

Retracted position (not shown)

1. With the switch plunger in retracted position, continuity will not exist between the terminal leads.

2. If continuity exits while the switch is in the "Retracted" position, the switch is defective and needs replaced.

https://truckmanualshub.com/

Index

Electrical systems - 55

Transmission control system - 024

Ground speed control - Test Transmission range safety switch (*) 3

(*) See content for specific models

https://truckmanualshub.com/

Electrical systems - 55

Rear Power Take-Off (PTO) control system - 048

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Electrical systems - 55

Rear Power Take-Off (PTO) control system - 048

FUNCTIONAL DATA

Power Take-Off (PTO) speed sensor

Static description PTO Safety switch 3

SERVICE

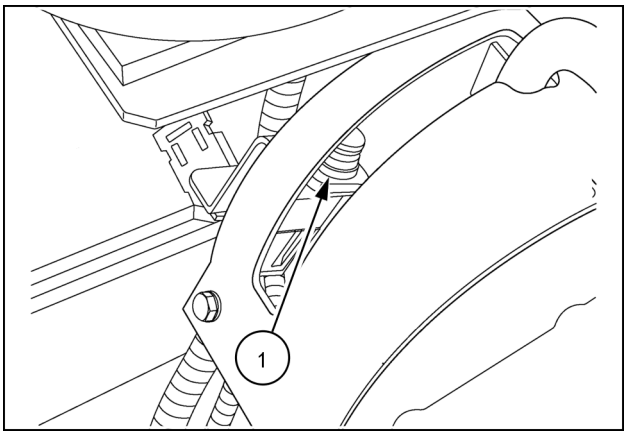
Power Take-Off (PTO) speed sensor

Remove 4

Install 5

Power Take-Off (PTO) speed sensor - Static description PTO Safety switch

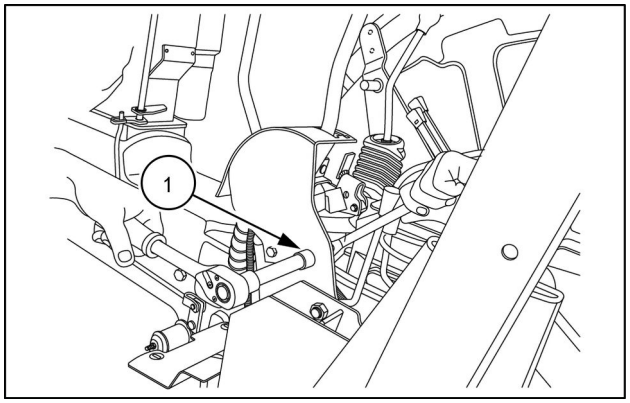
The PTO safety switch, **(1)**, is a double pole, single throw-style switch located on the PTO control lever quadrant. The switch has a rubber booted push button actuator and is activated by the PTO clutch lever. When the PTO clutch lever is in the "OFF" position, the switch button is "OUT" when the PTO clutch is engaged the switch button is in the "IN" position.



86072157 1

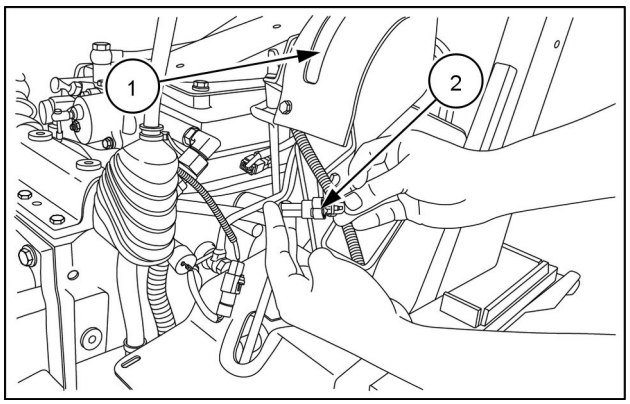
Power Take-Off (PTO) speed sensor - Remove

1. Remove the fender from left side of the tractor. See **Fenders and guards - Remove (90.116)**.
2. Loosen the bolts **(1)**.



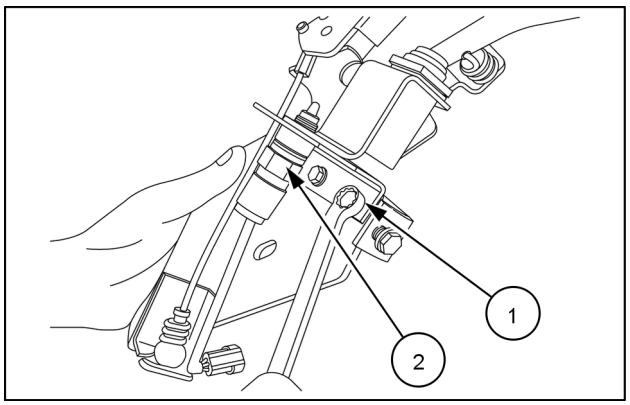
GNIL14TR00840AA 1

3. Lift the plate **(1)** access the wire connector.
4. Disconnect the wiring **(2)**.



GNIL14TR00838AA 2

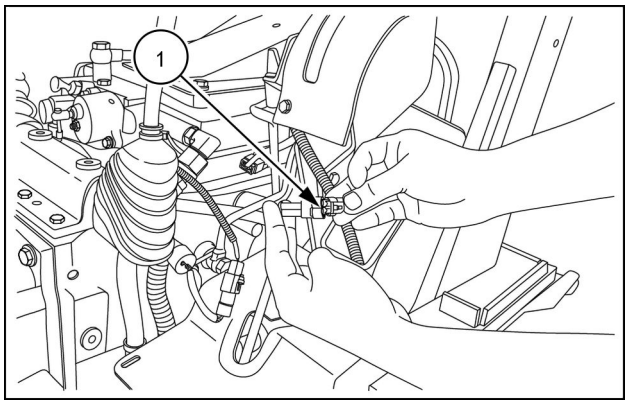
5. Loosen the bolts **(1)** and remove the sensor assembly.
6. Loosen the nut **(2)** and remove the PTO sensor.



GNIL14TR00839AA 3

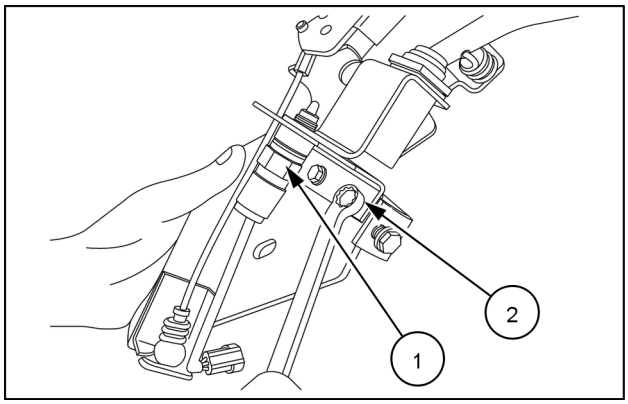
Power Take-Off (PTO) speed sensor - Install

1. Connect the wiring **(1)**.



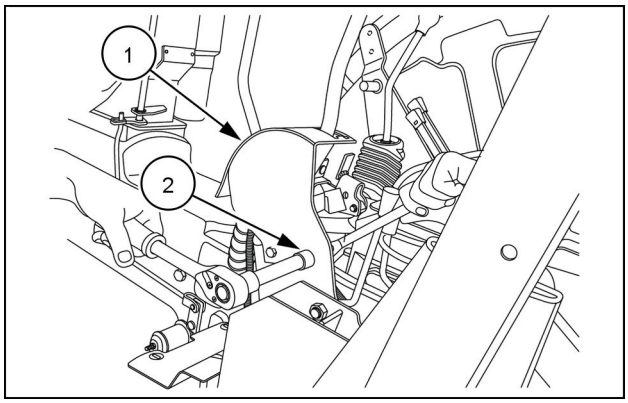
GNIL14TR00838AA 1

2. Fit the PTO sensor and tighten the nut **(1)**.
3. Tighten the bolts **(2)**.



GNIL14TR00839AA 2

4. Install the plate **(1)**. Tighten the bolts **(2)**.



GNIL14TR00840AA 3

https://truckmanualshub.com/

Index

Electrical systems - 55

Rear Power Take-Off (PTO) control system - 048

Power Take-Off (PTO) speed sensor - Install 5
Power Take-Off (PTO) speed sensor - Remove 4
Power Take-Off (PTO) speed sensor - Static description PTO Safety switch 3

https://truckmanualshub.com/

Electrical systems - 55

Harnesses and connectors - 100

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Electrical systems - 55

Harnesses and connectors - 100

FUNCTIONAL DATA

Wiring harnesses

Electrical schematic sheet 02 SH02-POWER DISTRIBUTION:GEP FUSE BOX 4
Electrical schematic sheet 03 SH03-STARTING/CHARGING SYSTEM 6
Electrical schematic sheet 04 SH04-POWER DISTRIBUTION:GEP RELAY BOX 8
Electrical schematic sheet 05 SH05-GROUNDING SYSTEM 10
Electrical schematic sheet 06 SH06-IGNITION/CONTROL SWITCHES 12
Electrical schematic sheet 07 SH07-INSTRUMENT CLUSTER: ADIC 14
Electrical schematic sheet 08 SH08-ENGINE CONTROL UNIT: ECU 16
Electrical schematic sheet 09 SH09-SAFETY LOGIC 18
Electrical schematic sheet 10 SH10-FRONT HEAD LIGHTS 20
Electrical schematic sheet 11 SH11-REAR LIGHTS 22
Electrical schematic sheet 12 SH12-DIAGONESTIC/TRAILER SOCKET 24
Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) 26
Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) 28
Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) 30

Wire connectors

Component diagram 00 33
Component diagram 01 38
Component diagram 02 42
Component diagram 05 46
Component diagram 10 48
Component diagram 20 49
Component diagram 21 51
Component diagram 30 54
Component diagram 40 57
Component diagram 50 59
Component diagram 51 62
Component diagram 52 64
Component diagram 60 65
Component diagram 61 66
Component diagram 70 67
Component diagram 71 68

https://truckmanualshub.com/

Component diagram 90 69
Component diagram 00 - Connectors X-9001 to X-9009 70
Component diagram 01 - Connectors X-9010 to X-9019 75
Component diagram 02 - Connectors X-9020 to X-9029 76
Component diagram 03 - Connectors X-9030 to X-9039 77
Component diagram 10 - Connectors X-9101 to X-9109 81
Component diagram 11 - Connectors X-9110 to X-9119 84
Component diagram 12 - Connectors X-9120 to X-9129 85

Electrical components

Fuse description 88
Voltage source description 90
Relay description 91
Motor description 93
Switch description 94

SERVICE

Wiring harnesses

Repair 95

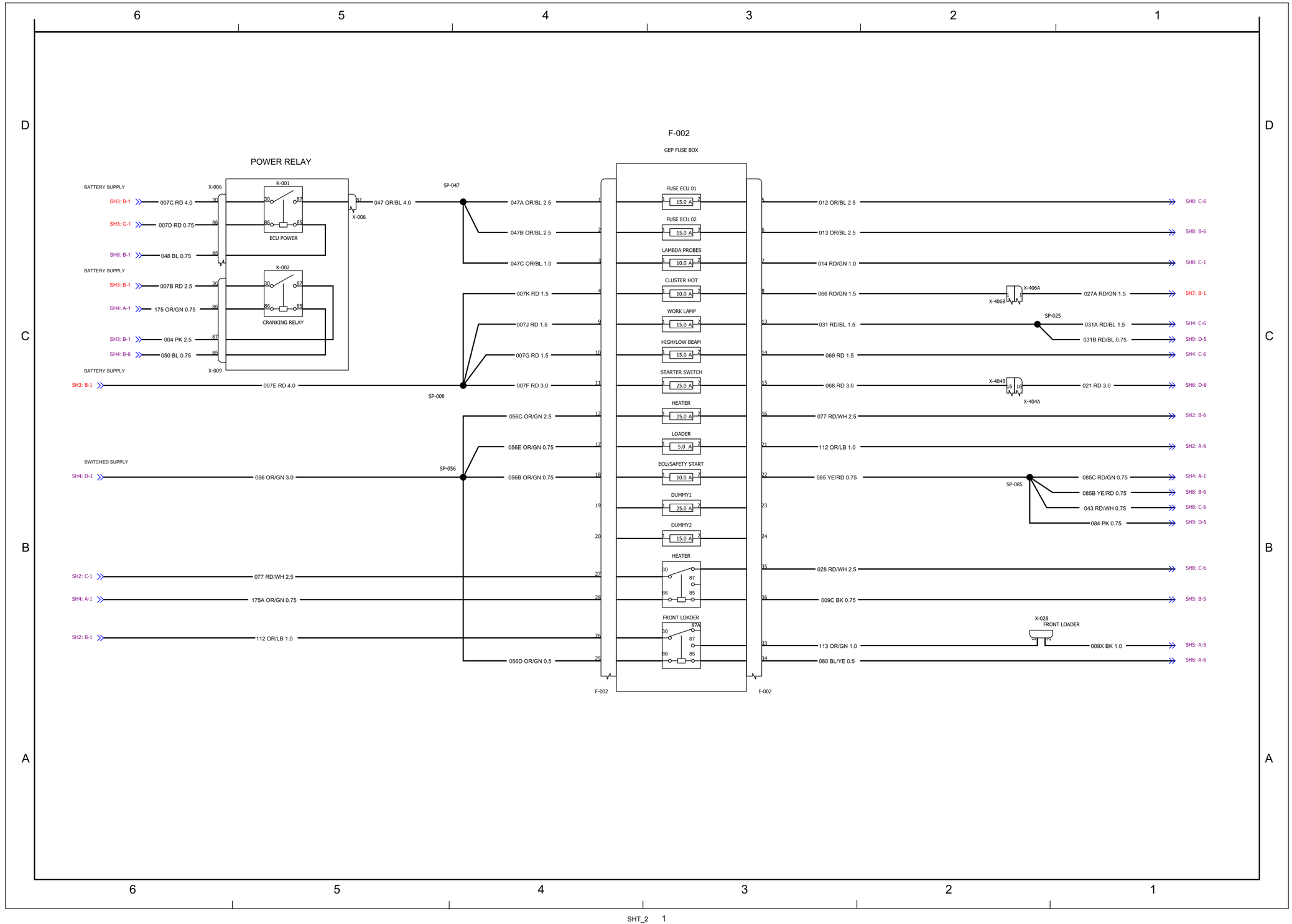
DIAGNOSTIC

Wiring harnesses

Troubleshooting Safety start circuit - Operator present 97
Troubleshooting Safety start circuit - Operator not present 97
Troubleshooting Safe Operation - Operator Present 98
Troubleshooting Safe operation - Operator not present, PTO "OFF" 98
Troubleshooting Safe operation - Operator not present; PTO “ON” 98

Wiring harnesses - Electrical schematic sheet 02 SH02-POWER DISTRIBUTION:GEP FUSE BOX

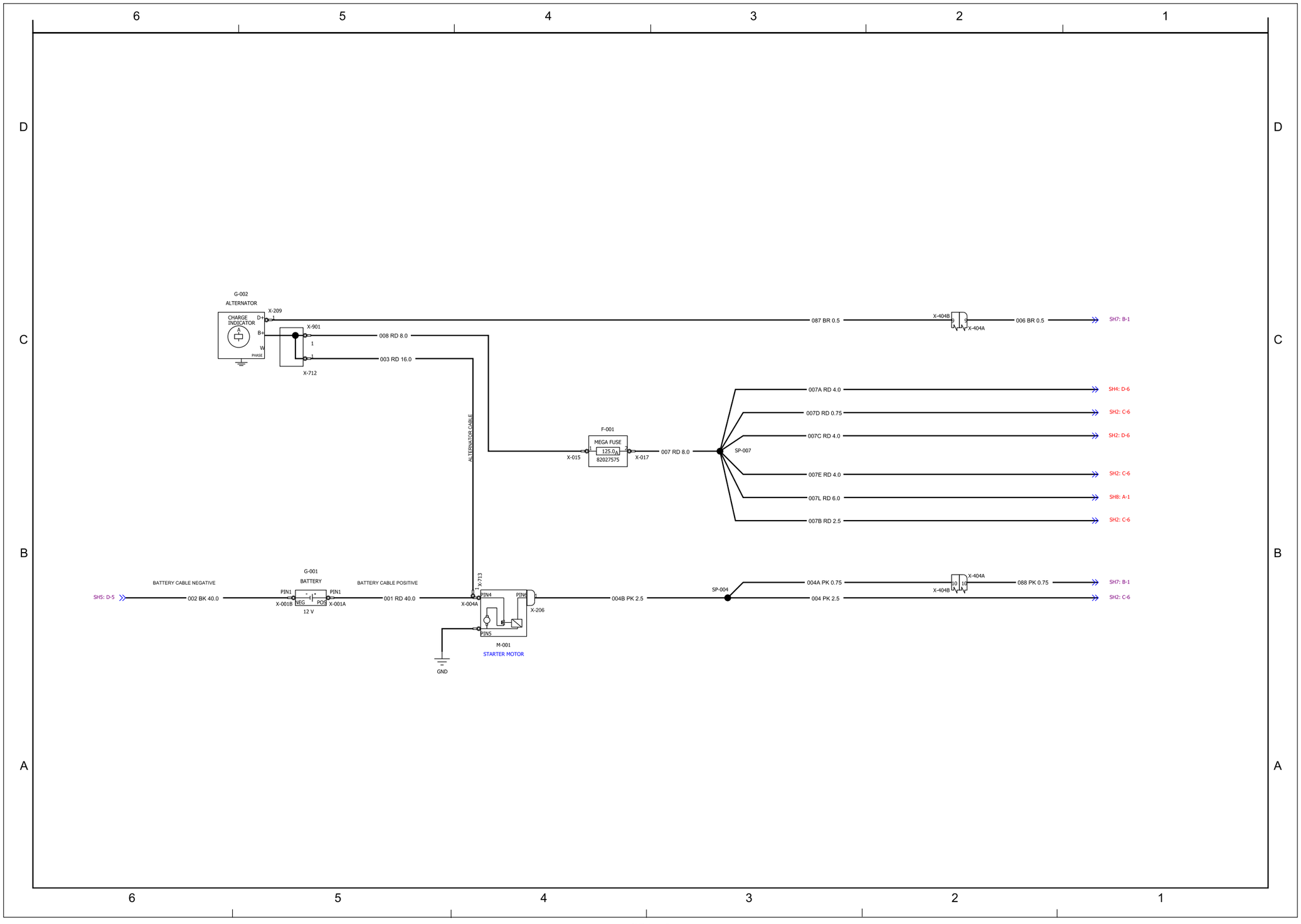
Type	Component	Connector / Link	Description
Fuse	**F-002**	F-002	GEP - FUSE BOX
Fuse	**F-003**		FUSE ECU 01
Fuse	**F-004**		FUSE ECU 02
Fuse	**F-005**		LAMBDA PROBES
Fuse	**F-006**		CLUSTER HOT
Fuse	**F-007**		WORK LAMP
Fuse	**F-008**		HIGH/LOW BEAM
Fuse	**F-009**		STARTER SWITCH
Fuse	**F-010**		HEATER
Fuse	**F-011**		LOADER
Fuse	**F-012**		ECU/SAFETY START
Fuse	**F-013**		DUMMY1
Fuse	**F-014**		DUMMY2
Relay	**K-001**		ECU POWER
Relay	**K-002**		CRANKING RELAY
Relay	**K-013**		FRONT LOADER
Relay	**K-014**		HEATER
Connector	X-006	**X-006**	ECU RELAY
Connector	X-009	**X-009**	CRANKING RELAY
Connector	X-027	**X-027**	PRE HEATER
Connector	X-028	**X-028**	FRONT LOADER
Connector	X-404A	X-404A	ENGINE-MAIN INTERCONNECT
Connector	X-404B	**X-404B**	MAIN-ENGINE INTERCONNECT
Connector	X-406A	X-406A	TO ENGINE HARNESS
Connector	X-406B	**X-406B**	TO MAIN HARNESS


F-002
GEP FUSE BOX
POWER RELAY
K-001
ECU POWER
K-002
CRANKING RELAY
BATTERY SUPPLY
SH3: B-1
007C RD 4.0
X-006
30
86
85
87
SH3: C-1
007D RD 0.75
SH8: B-1
048 BL 0.75
BATTERY SUPPLY
SH3: B-1
007B RD 2.5
SH4: A-1
175 OR/GN 0.75
SH3: B-1
004 PK 2.5
SH4: B-6
050 BL 0.75
X-009
BATTERY SUPPLY
SH3: B-1
007E RD 4.0
047 OR/BL 4.0
X-006
SP-047
SP-008
047A OR/BL 2.5
047B OR/BL 2.5
047C OR/BL 1.0
007K RD 1.5
007J RD 1.5
007G RD 1.5
007F RD 3.0
056C OR/GN 2.5
056E OR/GN 0.75
SWITCHED SUPPLY
SH4: D-1
056 OR/GN 3.0
SP-056
056B OR/GN 0.75
SH2: C-1
077 RD/WH 2.5
SH4: A-1
175A OR/GN 0.75
SH2: B-1
112 OR/LB 1.0
056D OR/GN 0.5
FUSE ECU 01
15.0 A
FUSE ECU 02
15.0 A
LAMBDA PROBES
10.0 A
CLUSTER HOT
10.0 A
WORK LAMP
15.0 A
HIGH/LOW BEAM
15.0 A
STARTER SWITCH
25.0 A
HEATER
25.0 A
LOADER
5.0 A
ECU/SAFETY START
10.0 A
DUMMY1
25.0 A
DUMMY2
15.0 A
HEATER
FRONT LOADER
87A
012 OR/BL 2.5
013 OR/BL 2.5
014 RD/GN 1.0
066 RD/GN 1.5
031 RD/BL 1.5
069 RD 1.5
068 RD 3.0
077 RD/WH 2.5
112 OR/LB 1.0
085 YE/RD 0.75
028 RD/WH 2.5
009C BK 0.75
113 OR/GN 1.0
080 BL/YE 0.5
SH8: C-6
SH8: B-6
SH8: C-1
SH7: B-1
X-406A
X-406B
027A RD/GN 1.5
SP-025
031A RD/BL 1.5
031B RD/BL 0.75
SH4: C-6
SH9: D-5
SH4: C-6
X-404B
X-404A
021 RD 3.0
SH6: D-6
SH2: B-6
SH2: A-6
SP-085
085C RD/GN 0.75
085B YE/RD 0.75
043 RD/WH 0.75
084 PK 0.75
SH4: A-1
SH8: B-6
SH8: C-6
SH9: D-5
SH8: C-6
SH5: B-5
X-028
FRONT LOADER
009X BK 1.0
SH5: A-5
SH6: A-6
F-002
F-002

SHT_2 1

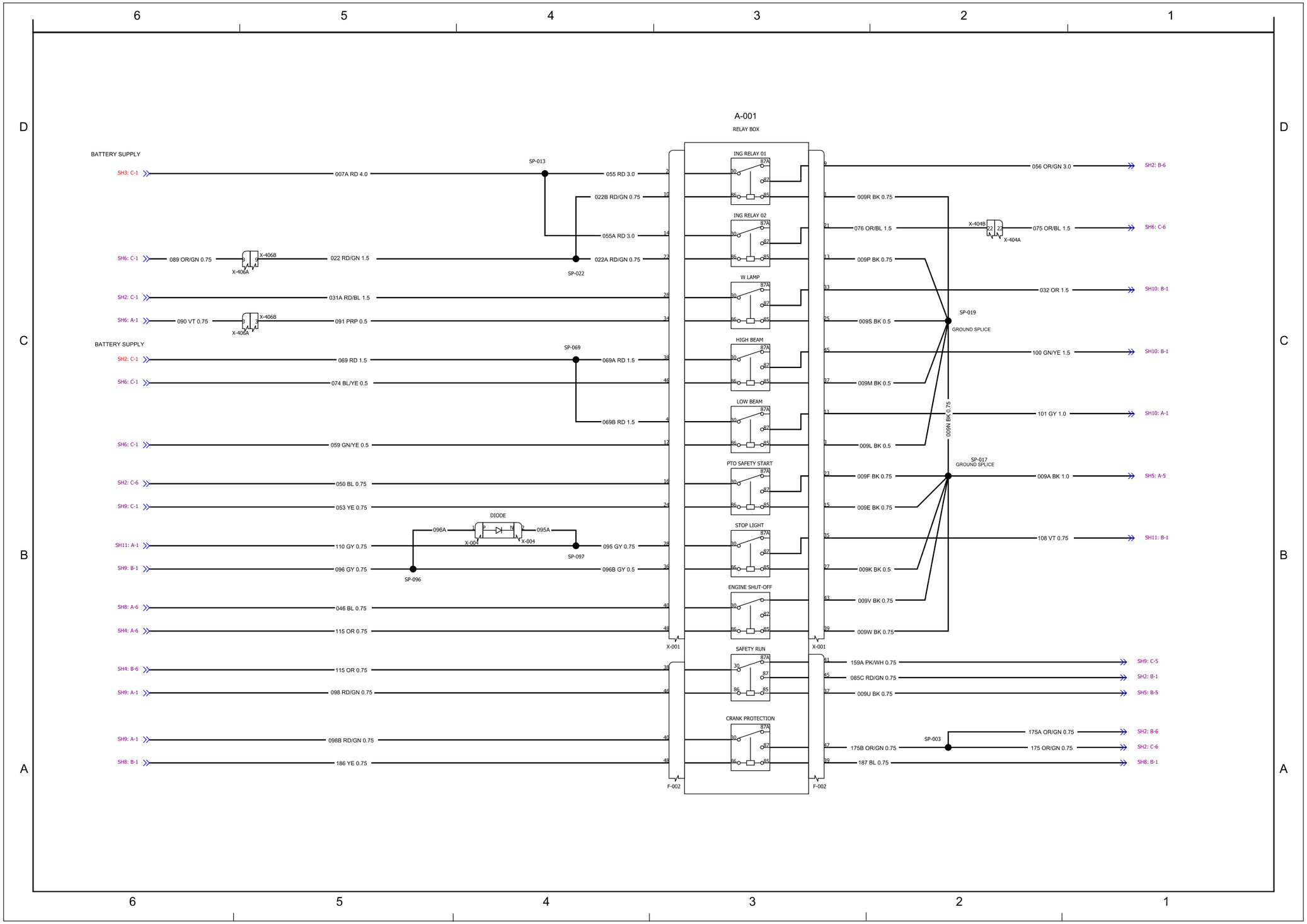
Wiring harnesses - Electrical schematic sheet 03 SH03-STARTING/ CHARGING SYSTEM

Type	Component	Connector / Link	Description
Fuse	**F-001**	**X-015 X-017**	MEGA FUSE
Voltage source	**G-001**	**X-001A X-001B**	BATTERY
Voltage source	**G-002**	**X-209**	ALTERNATOR
Motor	**M-001**	RT001 **X-004A X-206**	STARTER MOTOR
Connector	X-001A	**X-001A**	
Connector	X-001B	**X-001B**	
Connector	X-004A	**X-004A**	
Connector	X-009	**X-009**	CRANKING RELAY
Connector	X-015	**X-015**	TO MEGA FUSE
Connector	X-017	**X-017**	FROM MEGA FUSE
Connector	X-206	**X-206**	TO STARTER MOTOR
Connector	X-209	**X-209**	ALTERNATOR D+
Connector	X-404A	X-404A	ENGINE-MAIN INTERCONNECT
Connector	X-404B	**X-404B**	MAIN-ENGINE INTERCONNECT
Connector	X-712	**X-712**	ALTERNATOR B+
Connector	X-713	**X-713**	TO STARTER MOTOR
Connector	X-901	**X-901**	ALTERNATOR B+


6
5
4
3
2
1
D
C
B
A
G-002
ALTERNATOR
CHARGE INDICATOR
D+
B+
W
PHASE
X-209
X-901
X-712
087 BR 0.5
X-404B
X-404A
006 BR 0.5
SH7: B-1
008 RD 8.0
003 RD 16.0
ALTERNATOR CABLE
F-001
MEGA FUSE
125.0A
82027575
X-015
X-017
007 RD 8.0
SP-007
007A RD 4.0
007D RD 0.75
007C RD 4.0
007E RD 4.0
007L RD 6.0
007B RD 2.5
SH4: D-6
SH2: C-6
SH2: D-6
SH2: C-6
SH8: A-1
SH2: C-6
G-001
BATTERY
BATTERY CABLE NEGATIVE
BATTERY CABLE POSITIVE
SH5: D-5
002 BK 40.0
PIN1
NEG
POS
X-001B
X-001A
12 V
001 RD 40.0
X-713
X-004A
PIN4
PIN5
X-206
PIN5
M-001
STARTER MOTOR
GND
004B PK 2.5
SP-004
004A PK 0.75
004 PK 2.5
X-404A
X-404B
088 PK 0.75
SH7: B-1
SH2: C-6
SHT_3 1

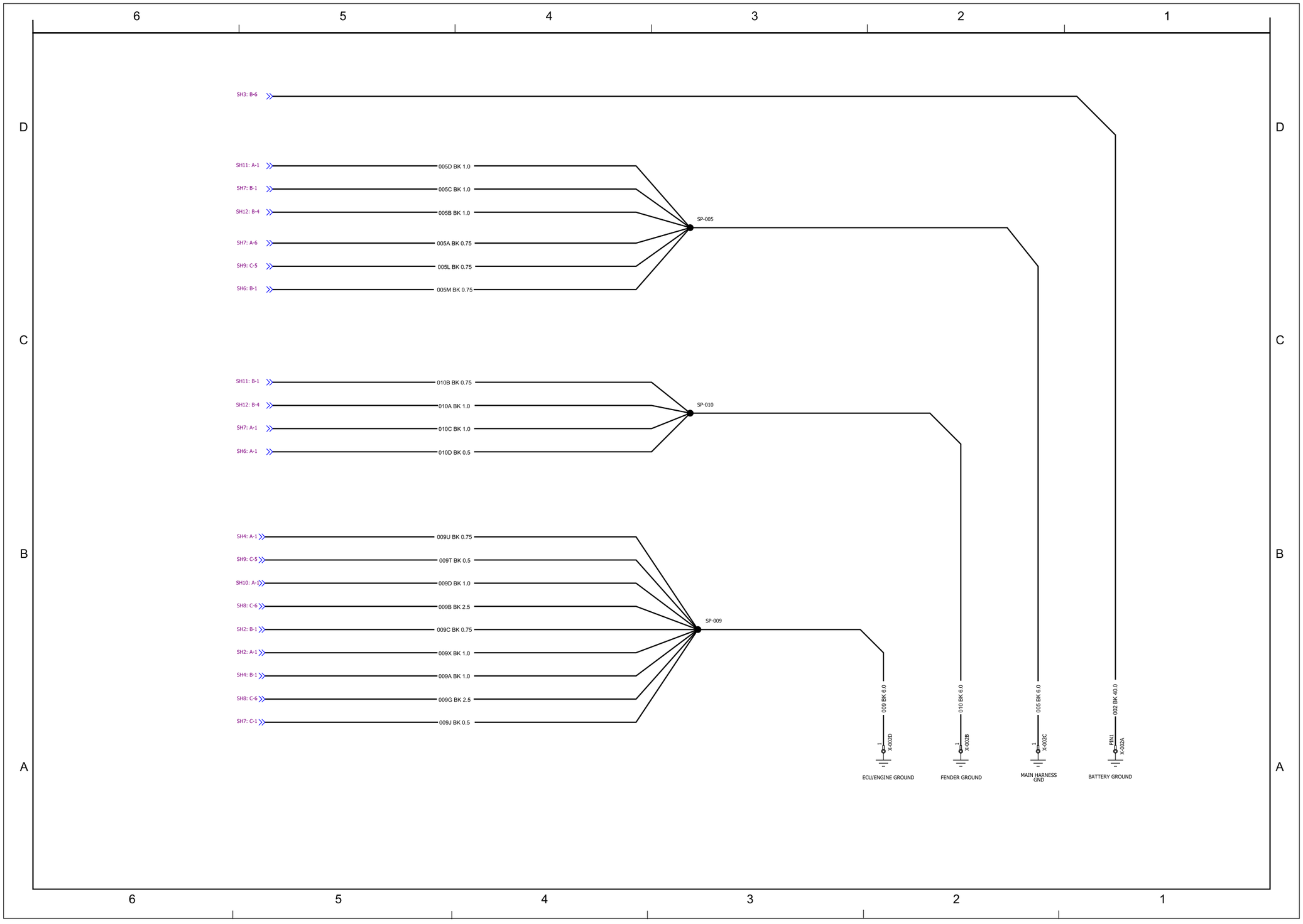
Wiring harnesses - Electrical schematic sheet 04 SH04-POWER DISTRIBUTION:GEP RELAY BOX

Type	Component	Connector / Link	Description
Fuse	**F-002**	F-002	GEP - FUSE BOX
Relay	**K-003**		ING RELAY 01
Relay	**K-004**		ING RELAY 02
Relay	**K-005**		W LAMP
Relay	**K-006**		HIGH BEAM
Relay	**K-007**		LOW BEAM
Relay	**K-008**		PTO SAFETY START
Relay	**K-009**		STOP LIGHT
Relay	**K-010**		ENGINE SHUT-OFF
Relay	**K-011**		SAFETY RUN
Relay	**K-012**		CRANK PROTECTION
Connector	X-001	**X-001**	
Connector	X-004	**X-004**	DIODE
Connector	X-009	**X-009**	CRANKING RELAY
Connector	X-404A	X-404A	ENGINE-MAIN INTERCONNECT
Connector	X-404B	**X-404B**	MAIN-ENGINE INTERCONNECT
Connector	X-406A	X-406A	TO ENGINE HARNESS
Connector	X-406B	**X-406B**	TO MAIN HARNESS


A-001
RELAY BOX
BATTERY SUPPLY
SH3: C-1
007A RD 4.0
SP-013
055 RD 3.0
022B RD/GN 0.75
055A RD 3.0
SH6: C-1
089 OR/GN 0.75
X-406B
X-406A
022 RD/GN 1.5
022A RD/GN 0.75
SP-022
SH2: C-1
031A RD/BL 1.5
SH6: A-1
090 VT 0.75
091 PRP 0.5
BATTERY SUPPLY
SP-069
SH2: C-1
069 RD 1.5
069A RD 1.5
SH6: C-1
074 BL/YE 0.5
069B RD 1.5
SH6: C-1
059 GN/YE 0.5
SH2: C-6
050 BL 0.75
SH9: C-1
053 YE 0.75
DIODE
096A
095A
X-004
SH11: A-1
110 GY 0.75
095 GY 0.75
SP-097
SH9: B-1
096 GY 0.75
096B GY 0.5
SP-096
SH8: A-6
046 BL 0.75
SH4: A-6
115 OR 0.75
SH4: B-6
115 OR 0.75
SH9: A-1
098 RD/GN 0.75
SH9: A-1
098B RD/GN 0.75
SH8: B-1
186 YE 0.75
ING RELAY 01
ING RELAY 02
W LAMP
HIGH BEAM
LOW BEAM
PTO SAFETY START
STOP LIGHT
ENGINE SHUT-OFF
SAFETY RUN
CRANK PROTECTION
87A
87
30
86
85
87
X-001
F-002
056 OR/GN 3.0
SH2: B-6
009R BK 0.75
076 OR/BL 1.5
X-404B
X-404A
075 OR/BL 1.5
SH6: C-6
009P BK 0.75
032 OR 1.5
SH10: B-1
SP-019
GROUND SPLICE
009S BK 0.5
100 GN/YE 1.5
SH10: B-1
009M BK 0.5
101 GY 1.0
SH10: A-1
009N BK 0.75
009L BK 0.5
SP-017
GROUND SPLICE
009F BK 0.75
009A BK 1.0
SH5: A-5
009E BK 0.75
108 VT 0.75
SH11: B-1
009K BK 0.5
009V BK 0.75
009W BK 0.75
159A PK/WH 0.75
SH9: C-5
085C RD/GN 0.75
SH2: B-1
009U BK 0.75
SH5: B-5
SP-003
175A OR/GN 0.75
SH2: B-6
175 OR/GN 0.75
SH2: C-6
175B OR/GN 0.75
187 BL 0.75
SH8: B-1
6
5
4
3
2
1
D
C
B
A
SHT_4 1

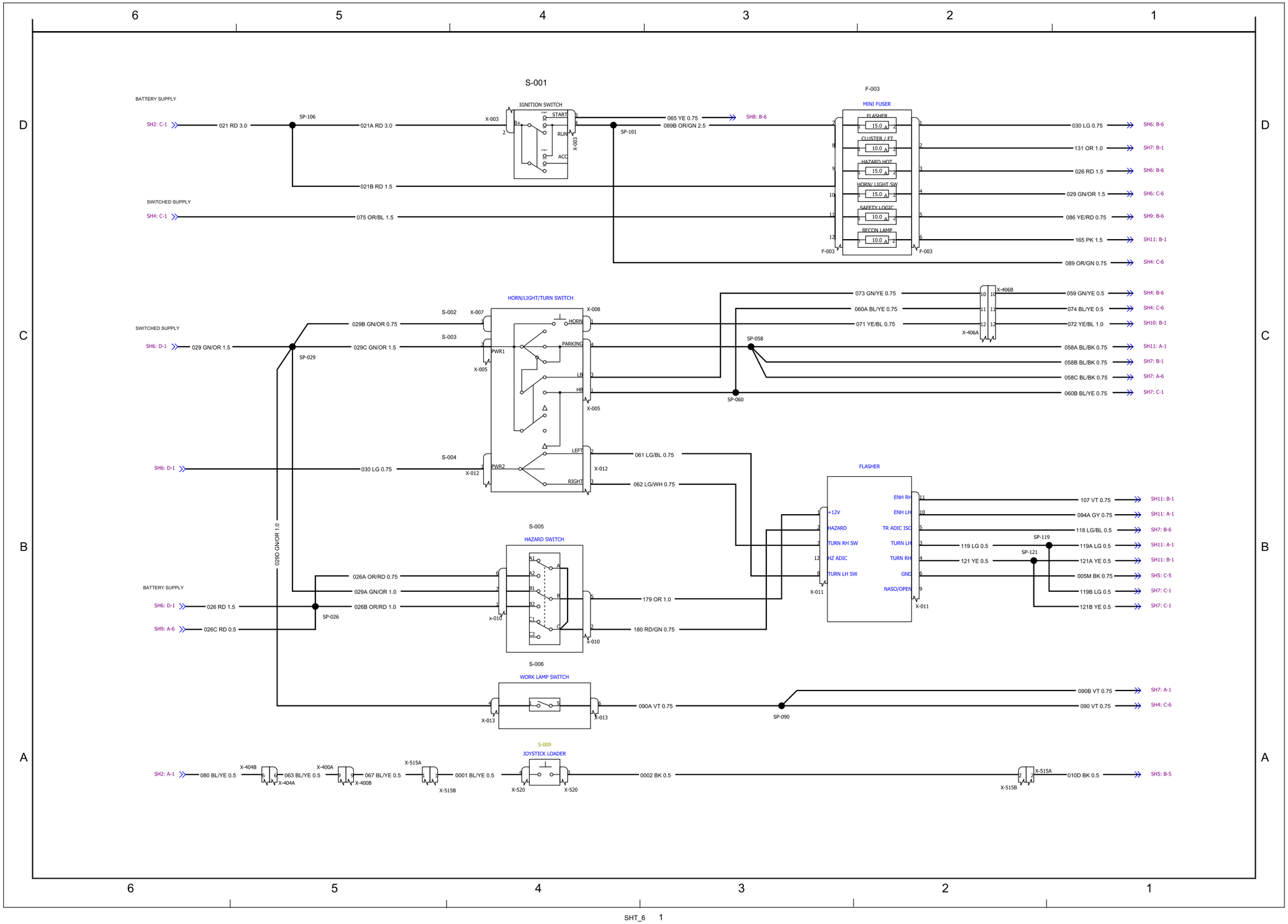
Wiring harnesses - Electrical schematic sheet 05 SH05-GROUNDING SYSTEM

Type	Component	Connector / Link	Description
Fuse	**F-002**	F-002	GEP - FUSE BOX
Connector	X-002A	**X-002A**	GROUND TERMINAL
Connector	X-002B	**X-002B**	FENDER GROUND
Connector	X-002C	**X-002C**	MAIN HARNESS GND
Connector	X-002D	**X-002D**	ECU/ENGINE GROUND


6
5
4
3
2
1
D
C
B
A
SH3: B-6
SH11: A-1
005D BK 1.0
SH7: B-1
005C BK 1.0
SH12: B-4
005B BK 1.0
SP-005
SH7: A-6
005A BK 0.75
SH9: C-5
005L BK 0.75
SH6: B-1
005M BK 0.75
SH11: B-1
010B BK 0.75
SH12: B-4
010A BK 1.0
SP-010
SH7: A-1
010C BK 1.0
SH6: A-1
010D BK 0.5
SH4: A-1
009U BK 0.75
SH9: C-5
009T BK 0.5
SH10: A-1
009D BK 1.0
SH8: C-6
009B BK 2.5
SH2: B-1
009C BK 0.75
SP-009
SH2: A-1
009X BK 1.0
SH4: B-1
009A BK 1.0
SH8: C-6
009G BK 2.5
SH7: C-1
009J BK 0.5
009 BK 6.0
X-002D
ECU/ENGINE GROUND
010 BK 6.0
X-002B
FENDER GROUND
005 BK 6.0
X-002C
MAIN HARNESS GND
002 BK 40.0
PIN1
X-002A
BATTERY GROUND
SHT_5 1

Wiring harnesses - Electrical schematic sheet 06 SH06-IGNITION/ CONTROL SWITCHES

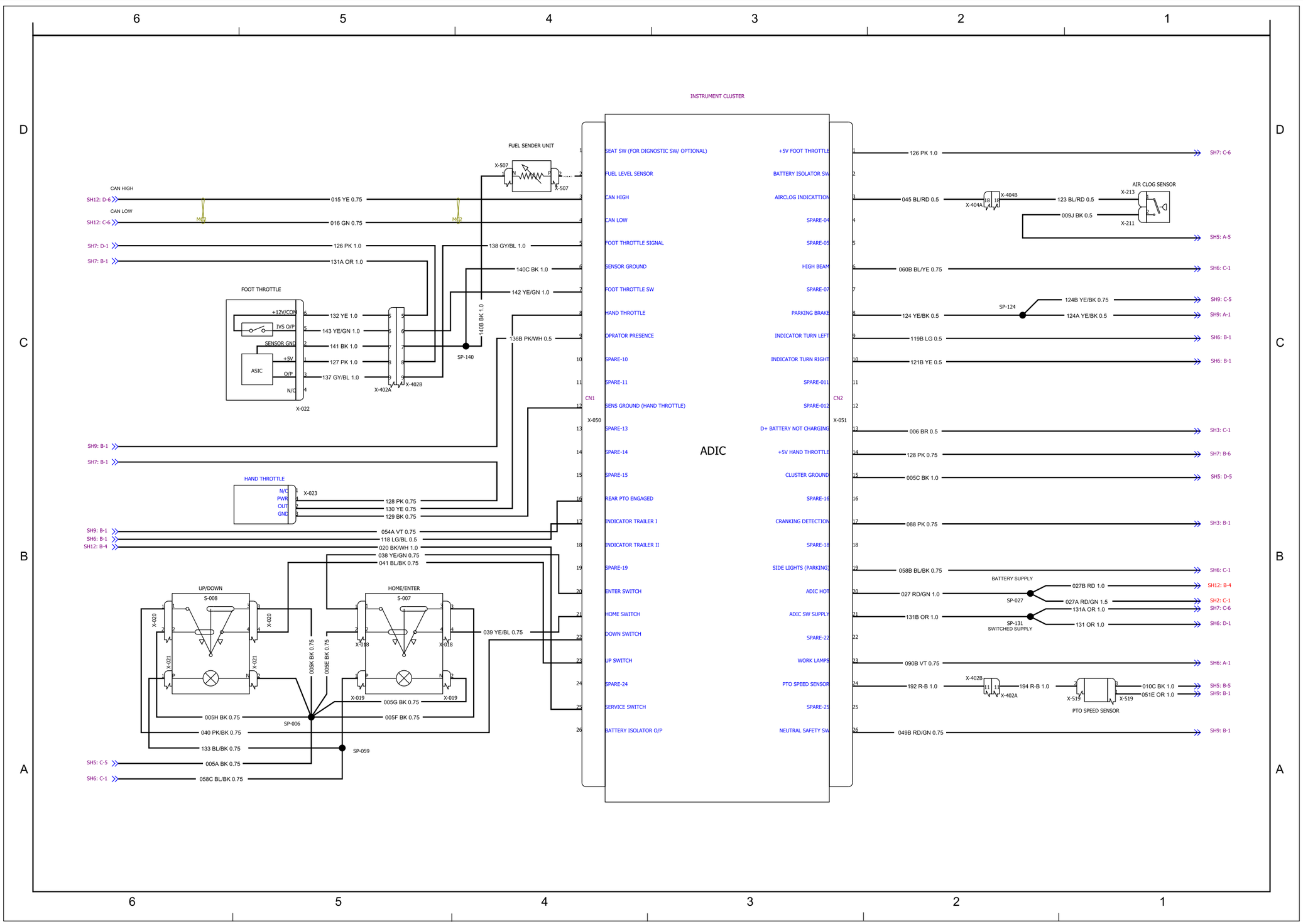
Type	Component	Connector / Link	Description
Fuse	**F-003**		FUSE ECU 01
Fuse	**F-015**		FLASHER
Fuse	**F-016**		CLUSTER / FT
Fuse	**F-017**		HAZARD HOT
Fuse	**F-018**		HORN/ LIGHT SW
Fuse	**F-019**		SAFETY LOGIC
Fuse	**F-020**		BECON LAMP
Switch	**S-001**	**X-003**	IGNITION SWITCH
Switch	**S-009**	**X-520**	JOYSTICK LOADER
Connector	X-001	**X-001**	
Connector	X-003	**X-003**	IGNITION SWITCH
Connector	X-005	**X-005**	LIGHT SWITCH
Connector	X-007	**X-007**	HORN SWITCH CN1
Connector	X-008	**X-008**	HORN SWITCH CN2
Connector	X-011	**X-011**	TURN FLASHER
Connector	X-012	**X-012**	TURN SWITCH
Connector	X-013	**X-013**	WORK LAMP
Connector	X-400A	**X-400A**	MAIN-FENDER INTERCONNECT
Connector	X-400B	X-400B	FENDER-MAIN INTERCONNECT
Connector	X-404A	X-404A	ENGINE-MAIN INTERCONNECT
Connector	X-404B	**X-404B**	MAIN-ENGINE INTERCONNECT
Connector	X-406A	X-406A	TO ENGINE HARNESS
Connector	X-406B	**X-406B**	TO MAIN HARNESS
Connector	X-515A	**X-515A**	TO JOYSTICK PIGTAIL
Connector	X-515B	X-515B	TO HARNESS FENDER
Connector	X-520	**X-520**	LOADER JOYSTICK


S-001
IGNITION SWITCH
BATTERY SUPPLY
SH2: C-1
021 RD 3.0
SP-106
021A RD 3.0
X-003
START
RUN
ACC
X-003
065 YE 0.75
089B OR/GN 2.5
SH8: B-6
SP-101
021B RD 1.5
F-003
MINI FUSER
FLASHER
15.0 A
CLUSTER / FT
10.0 A
HAZARD HOT
15.0 A
HORN/ LIGHT SW
15.0 A
SAFETY LOGIC
10.0 A
BECON LAMP
10.0 A
F-003
F-003
030 LG 0.75
SH6: B-6
131 OR 1.0
SH7: B-1
026 RD 1.5
SH6: B-6
029 GN/OR 1.5
SH6: C-6
086 YE/RD 0.75
SH9: B-6
165 PK 1.5
SH11: B-1
089 OR/GN 0.75
SH4: C-6
SWITCHED SUPPLY
SH4: C-1
075 OR/BL 1.5
SWITCHED SUPPLY
SH6: D-1
029 GN/OR 1.5
SP-029
HORN/LIGHT/TURN SWITCH
S-002
X-007
S-003
PWR1
X-005
X-008
HORN
PARKING
LB
HB
X-005
029B GN/OR 0.75
029C GN/OR 1.5
073 GN/YE 0.75
060A BL/YE 0.75
071 YE/BL 0.75
X-406B
X-406A
059 GN/YE 0.5
SH4: B-6
074 BL/YE 0.5
SH4: C-6
072 YE/BL 1.0
SH10: B-1
SP-058
SP-060
058A BL/BK 0.75
SH11: A-1
058B BL/BK 0.75
SH7: B-1
058C BL/BK 0.75
SH7: A-6
060B BL/YE 0.75
SH7: C-1
S-004
X-012
PWR2
LEFT
RIGHT
X-012
SH6: D-1
030 LG 0.75
061 LG/BL 0.75
062 LG/WH 0.75
FLASHER
ENH RH
ENH LH
TR ADIC ISC
TURN LH
TURN RH
GND
NASO/OPEN
+12V
HAZARD
TURN RH SW
HZ ADIC
TURN LH SW
X-011
X-011
107 VT 0.75
SH11: B-1
094A GY 0.75
SH11: A-1
118 LG/BL 0.5
SH7: B-6
119 LG 0.5
121 YE 0.5
SP-119
SP-121
119A LG 0.5
SH11: A-1
121A YE 0.5
SH11: B-1
005M BK 0.75
SH5: C-5
119B LG 0.5
SH7: C-1
121B YE 0.5
SH7: C-1
029D GN/OR 1.0
S-005
HAZARD SWITCH
BATTERY SUPPLY
SH6: D-1
026 RD 1.5
SH9: A-6
026C RD 0.5
SP-026
026A OR/RD 0.75
029A GN/OR 1.0
026B OR/RD 1.0
x-010
X-010
179 OR 1.0
180 RD/GN 0.75
S-006
WORK LAMP SWITCH
X-013
X-013
090A VT 0.75
SP-090
090B VT 0.75
SH7: A-1
090 VT 0.75
SH4: C-6
S-009
JOYSTICK LOADER
SH2: A-1
080 BL/YE 0.5
X-404B
063 BL/YE 0.5
X-404A
X-400A
067 BL/YE 0.5
X-400B
X-515A
0001 BL/YE 0.5
X-515B
X-520
X-520
0002 BK 0.5
X-515B
X-515A
010D BK 0.5
SH5: B-5

SHT_6 1

Wiring harnesses - Electrical schematic sheet 07 SH07-INSTRUMENT CLUSTER: ADIC

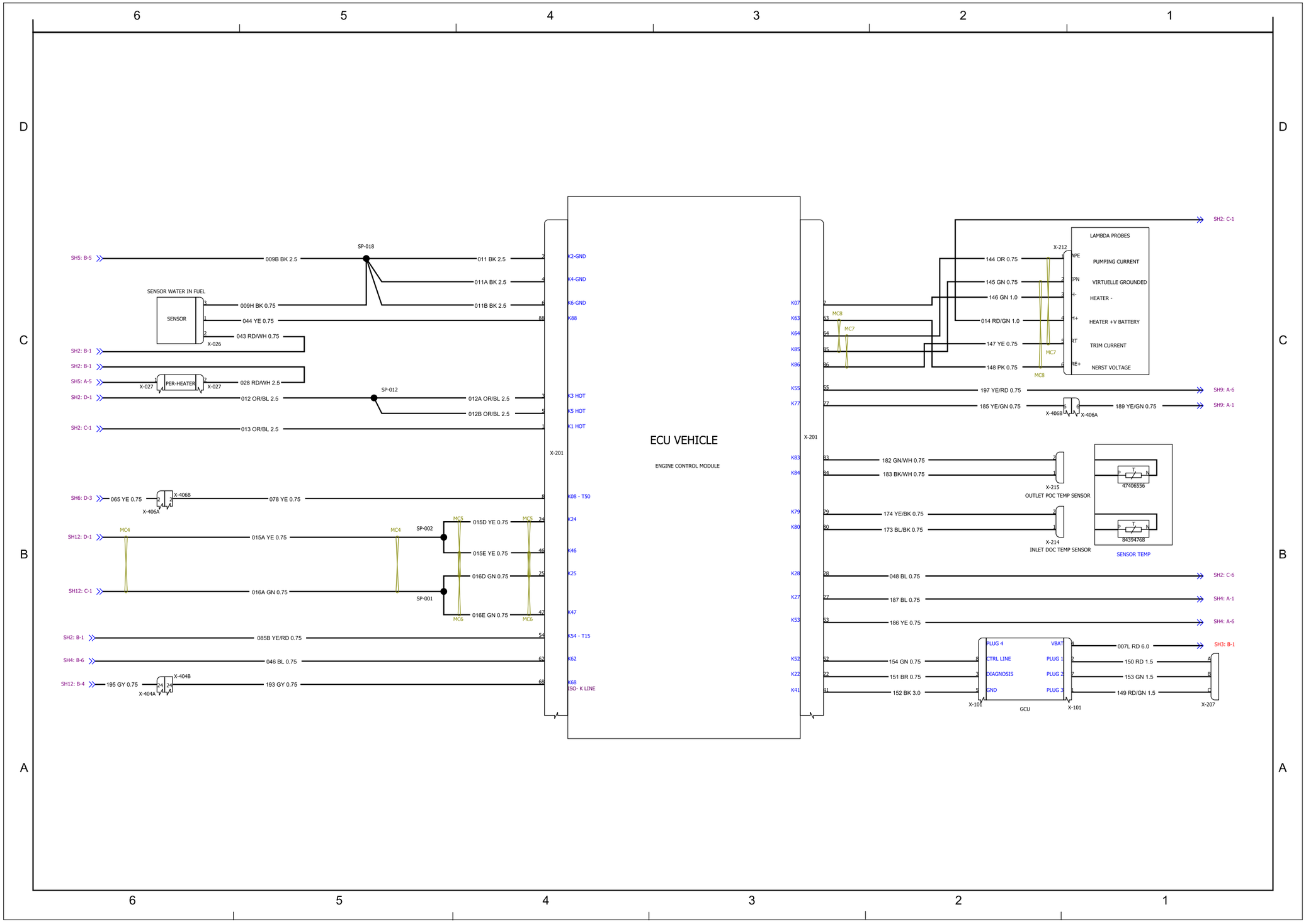
Type	Component	Connector / Link	Description
Switch	**S-007**	**X-018 X-019**	HOME/ENTER
Switch	**S-008**	**X-020 X-021**	UP/DOWN
Connector	X-018	**X-018**	HOME ENTER SWITCH
Connector	X-019	**X-019**	SWITCH LAMP H/E
Connector	X-020	**X-020**	UP/DOWN SWITCH
Connector	X-021	**X-021**	SWITCH LAMP U/D
Connector	X-022	**X-022**	FOOT THROTTLE
Connector	X-023	**X-023**	HAND THROTTLE
Connector	X-050	**X-050**	INSTRUMENT CLUSTER CN-1
Connector	X-051	**X-051**	INSTRUMENT CLUSTER CN-2
Connector	X-105	**X-105**	OPRATOR SAFETY MODULE
Connector	X-211	**X-211**	AIR CLOG SWITCH
Connector	X-213	**X-213**	AIR CLOG SWITCH
Connector	X-402A	X-402A	FENDER-MAIN INTERCONNECT
Connector	X-402B	**X-402B**	MAIN-FENDER INTERCONNECT
Connector	X-404A	X-404A	ENGINE-MAIN INTERCONNECT
Connector	X-404B	**X-404B**	MAIN-ENGINE INTERCONNECT
Connector	X-507	**X-507**	FUEL SENDER UNIT
Connector	X-519	**X-519**	SPEED SENSOR PTO


INSTRUMENT CLUSTER
ADIC
CN1
X-050
CN2
X-051
SEAT SW (FOR DIGNOSTIC SW/ OPTIONAL)
FUEL LEVEL SENSOR
CAN HIGH
CAN LOW
FOOT THROTTLE SIGNAL
SENSOR GROUND
FOOT THROTTLE SW
HAND THROTTLE
OPRATOR PRESENCE
SPARE-10
SPARE-11
SENS GROUND (HAND THROTTLE)
SPARE-13
SPARE-14
SPARE-15
REAR PTO ENGAGED
INDICATOR TRAILER I
INDICATOR TRAILER II
SPARE-19
ENTER SWITCH
HOME SWITCH
DOWN SWITCH
UP SWITCH
SPARE-24
SERVICE SWITCH
BATTERY ISOLATOR O/P
+5V FOOT THROTTLE
BATTERY ISOLATOR SW
AIRCLOG INDICATTION
SPARE-04
SPARE-05
HIGH BEAM
SPARE-07
PARKING BRAKE
INDICATOR TURN LEFT
INDICATOR TURN RIGHT
SPARE-011
SPARE-012
D+ BATTERY NOT CHARGING
+5V HAND THROTTLE
CLUSTER GROUND
SPARE-16
CRANKING DETECTION
SPARE-18
SIDE LIGHTS (PARKING)
ADIC HOT
ADIC SW SUPPLY
SPARE-22
WORK LAMPS
PTO SPEED SENSOR
SPARE-25
NEUTRAL SAFETY SW
FUEL SENDER UNIT
X-507
CAN HIGH
SH12: D-6
CAN LOW
SH12: C-6
SH7: D-1
SH7: B-1
015 YE 0.75
016 GN 0.75
126 PK 1.0
131A OR 1.0
138 GY/BL 1.0
140C BK 1.0
142 YE/GN 1.0
136B PK/WH 0.5
140B BK 1.0
SP-140
FOOT THROTTLE
+12V/COM
IVS O/P
SENSOR GND
+5V
ASIC
O/P
N/C
X-022
132 YE 1.0
143 YE/GN 1.0
141 BK 1.0
127 PK 1.0
137 GY/BL 1.0
X-402A
X-402B
SH9: B-1
SH7: B-1
HAND THROTTLE
N/C
PWR
OUT
GND
X-023
128 PK 0.75
130 YE 0.75
129 BK 0.75
SH9: B-1
SH6: B-1
SH12: B-4
054A VT 0.75
118 LG/BL 0.5
020 BK/WH 1.0
038 YE/GN 0.75
041 BL/BK 0.75
UP/DOWN
S-008
HOME/ENTER
S-007
X-020
X-021
X-018
X-019
039 YE/BL 0.75
005K BK 0.75
005E BK 0.75
005G BK 0.75
005H BK 0.75
005F BK 0.75
040 PK/BK 0.75
133 BL/BK 0.75
005A BK 0.75
058C BL/BK 0.75
SP-006
SP-059
SH5: C-5
SH6: C-1
126 PK 1.0
SH7: C-6
045 BL/RD 0.5
X-404A
X-404B
123 BL/RD 0.5
009J BK 0.5
AIR CLOG SENSOR
X-213
X-211
SH5: A-5
060B BL/YE 0.75
SH6: C-1
124B YE/BK 0.75
SH9: C-5
SP-124
124 YE/BK 0.5
124A YE/BK 0.5
SH9: A-1
119B LG 0.5
SH6: B-1
121B YE 0.5
SH6: B-1
006 BR 0.5
SH3: C-1
128 PK 0.75
SH7: B-6
005C BK 1.0
SH5: D-5
088 PK 0.75
SH3: B-1
058B BL/BK 0.75
SH6: C-1
BATTERY SUPPLY
027 RD/GN 1.0
027B RD 1.0
SH12: B-4
SP-027
027A RD/GN 1.5
SH2: C-1
131B OR 1.0
131A OR 1.0
SH7: C-6
SP-131
SWITCHED SUPPLY
131 OR 1.0
SH6: D-1
090B VT 0.75
SH6: A-1
192 R-B 1.0
194 R-B 1.0
010C BK 1.0
SH5: B-5
051E OR 1.0
SH9: B-1
PTO SPEED SENSOR
049B RD/GN 0.75
SH9: B-1

SHT_7 1

Wiring harnesses - Electrical schematic sheet 08 SH08-ENGINE CONTROL UNIT: ECU

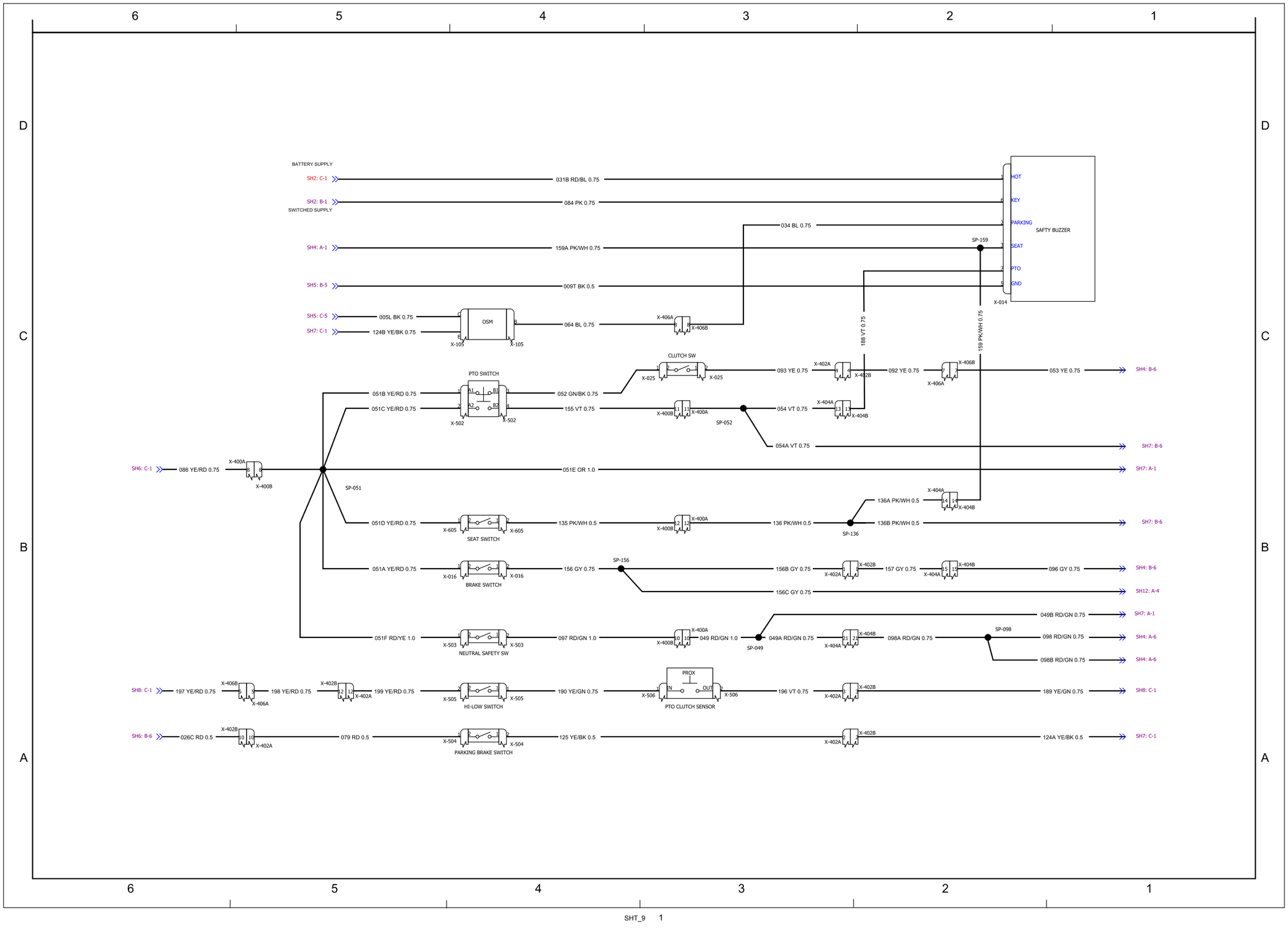
Type	Component	Connector / Link	Description
Connector	X-003	**X-003**	IGNITION SWITCH
Connector	X-026	**X-026**	SENSOR WATER IN FUEL
Connector	X-027	**X-027**	PRE HEATER
Connector	X-101	**X-101**	GCU
Connector	X-201	**X-201**	ECU VEHICLE
Connector	X-207	**X-207**	TO ENGINE GLOW PLUGS
Connector	X-212	**X-212**	LAMBDA SENSOR
Connector	X-214	**X-214**	INLET DOC TEMP SENSOR
Connector	X-215	**X-215**	OUTLET POC TEMP SENSOR
Connector	X-404A	X-404A	ENGINE-MAIN INTERCONNECT
Connector	X-404B	**X-404B**	MAIN-ENGINE INTERCONNECT
Connector	X-406A	X-406A	TO ENGINE HARNESS
Connector	X-406B	**X-406B**	TO MAIN HARNESS


ECU VEHICLE
ENGINE CONTROL MODULE
X-201
SP-018
SP-012
SP-002
SP-001
SENSOR WATER IN FUEL
SENSOR
X-026
PER-HEATER
X-027
X-406A
X-406B
X-404A
X-404B
MC4
MC5
MC6
MC7
MC8
009B BK 2.5
011 BK 2.5
011A BK 2.5
011B BK 2.5
009H BK 0.75
044 YE 0.75
043 RD/WH 0.75
028 RD/WH 2.5
012 OR/BL 2.5
012A OR/BL 2.5
012B OR/BL 2.5
013 OR/BL 2.5
065 YE 0.75
078 YE 0.75
015A YE 0.75
015D YE 0.75
015E YE 0.75
016A GN 0.75
016D GN 0.75
016E GN 0.75
085B YE/RD 0.75
046 BL 0.75
195 GY 0.75
193 GY 0.75
K2-GND
K4-GND
K6-GND
K88
K3 HOT
K5 HOT
K1 HOT
K08 - T50
K24
K46
K25
K47
K54 - T15
K62
K68
ISO- K LINE
SH5: B-5
SH2: B-1
SH5: A-5
SH2: D-1
SH2: C-1
SH6: D-3
SH12: D-1
SH12: C-1
SH4: B-6
SH12: B-4
LAMBDA PROBES
PUMPING CURRENT
VIRTUELLE GROUNDED
HEATER -
HEATER +V BATTERY
TRIM CURRENT
NERST VOLTAGE
144 OR 0.75
145 GN 0.75
146 GN 1.0
014 RD/GN 1.0
147 YE 0.75
148 PK 0.75
197 YE/RD 0.75
185 YE/GN 0.75
189 YE/GN 0.75
182 GN/WH 0.75
183 BK/WH 0.75
174 YE/BK 0.75
173 BL/BK 0.75
048 BL 0.75
187 BL 0.75
186 YE 0.75
154 GN 0.75
151 BR 0.75
152 BK 3.0
OUTLET POC TEMP SENSOR
INLET DOC TEMP SENSOR
SENSOR TEMP
47406556
84394768
PLUG 4
CTRL LINE
DIAGNOSIS
GND
VBAT
PLUG 1
PLUG 2
PLUG 3
GCU
007L RD 6.0
150 RD 1.5
153 GN 1.5
149 RD/GN 1.5
SH2: C-1
SH9: A-6
SH9: A-1
SH2: C-6
SH4: A-1
SH4: A-6
SH3: B-1

SHT_8 1

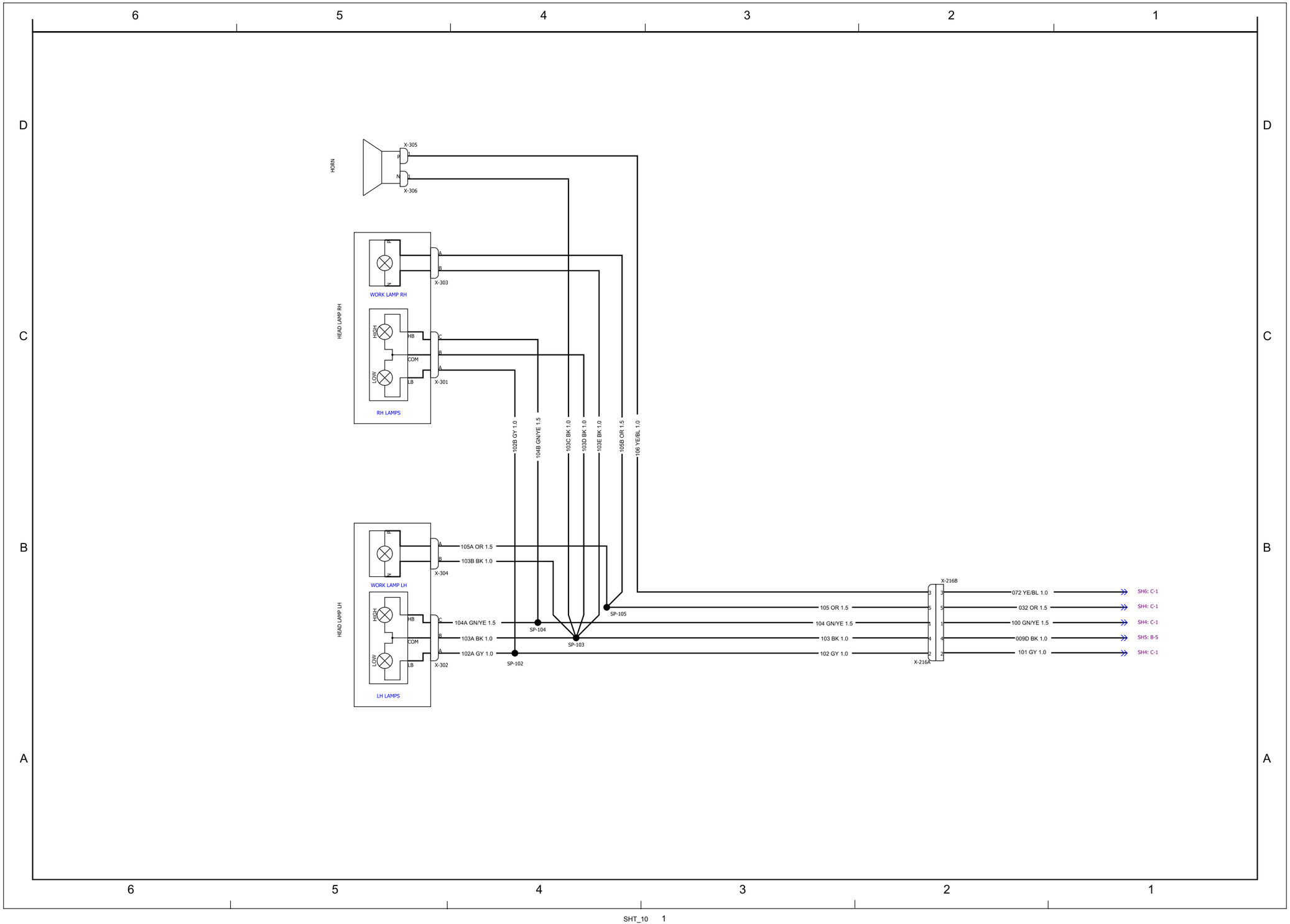
Wiring harnesses - Electrical schematic sheet 09 SH09-SAFETY LOGIC

Type	Component	Connector / Link	Description
Fuse	**F-002**	F-002	GEP - FUSE BOX
Connector	X-014	**X-014**	SAFETY BUZZER
Connector	X-016	**X-016**	BRAKE SWITCH
Connector	X-025	**X-025**	CLUTCH SWITCH
Connector	X-105	**X-105**	OPRATOR SAFETY MODULE
Connector	X-400A	**X-400A**	MAIN-FENDER INTERCONNECT
Connector	X-400B	X-400B	FENDER-MAIN INTERCONNECT
Connector	X-402A	X-402A	FENDER-MAIN INTERCONNECT
Connector	X-402B	**X-402B**	MAIN-FENDER INTERCONNECT
Connector	X-404A	X-404A	ENGINE-MAIN INTERCONNECT
Connector	X-404B	**X-404B**	MAIN-ENGINE INTERCONNECT
Connector	X-406A	X-406A	TO ENGINE HARNESS
Connector	X-406B	**X-406B**	TO MAIN HARNESS
Connector	X-502	**X-502**	PTO SWITCH
Connector	X-503	**X-503**	NEUTRAL SAFETY SWITCH
Connector	X-504	**X-504**	PARKING BRAKE SWITCH
Connector	X-505	**X-505**	HI/LOW SWITCH
Connector	X-506	**X-506**	PTO CLUTCH SENSOR
Connector	X-605	**X-605**	SEAT SWITCH


BATTERY SUPPLY
SH2: C-1
031B RD/BL 0.75
SH2: B-1
084 PK 0.75
SWITCHED SUPPLY
SH4: A-1
159A PK/WH 0.75
SH5: B-5
009T BK 0.5
SH5: C-5
005L BK 0.75
SH7: C-1
124B YE/BK 0.75
OSM
X-105
064 BL 0.75
X-406A
X-406B
034 BL 0.75
SP-159
HOT
KEY
PARKING
SEAT
PTO
GND
SAFTY BUZZER
X-014
188 VT 0.75
159 PK/WH 0.75
CLUTCH SW
X-025
093 YE 0.75
X-402A
X-402B
092 YE 0.75
X-406B
X-406A
053 YE 0.75
SH4: B-6
PTO SWITCH
051B YE/RD 0.75
051C YE/RD 0.75
052 GN/BK 0.75
155 VT 0.75
X-502
X-400B
X-400A
SP-052
054 VT 0.75
X-404A
X-404B
054A VT 0.75
SH7: B-6
SH6: C-1
086 YE/RD 0.75
X-400A
X-400B
051E OR 1.0
SH7: A-1
SP-051
136A PK/WH 0.5
051D YE/RD 0.75
X-605
SEAT SWITCH
135 PK/WH 0.5
136 PK/WH 0.5
SP-136
136B PK/WH 0.5
SH7: B-6
051A YE/RD 0.75
X-016
BRAKE SWITCH
156 GY 0.75
SP-156
156B GY 0.75
157 GY 0.75
096 GY 0.75
SH4: B-6
156C GY 0.75
SH12: A-4
049B RD/GN 0.75
SH7: A-1
051F RD/YE 1.0
X-503
NEUTRAL SAFETY SW
097 RD/GN 1.0
049 RD/GN 1.0
SP-049
049A RD/GN 0.75
098A RD/GN 0.75
SP-098
098 RD/GN 0.75
SH4: A-6
098B RD/GN 0.75
SH4: A-6
SH8: C-1
197 YE/RD 0.75
198 YE/RD 0.75
199 YE/RD 0.75
X-505
HI-LOW SWITCH
190 YE/GN 0.75
PROX
IN
OUT
X-506
PTO CLUTCH SENSOR
196 VT 0.75
189 YE/GN 0.75
SH8: C-1
SH6: B-6
026C RD 0.5
079 RD 0.5
X-504
PARKING BRAKE SWITCH
125 YE/BK 0.5
124A YE/BK 0.5
SH7: C-1
SHT_9 1

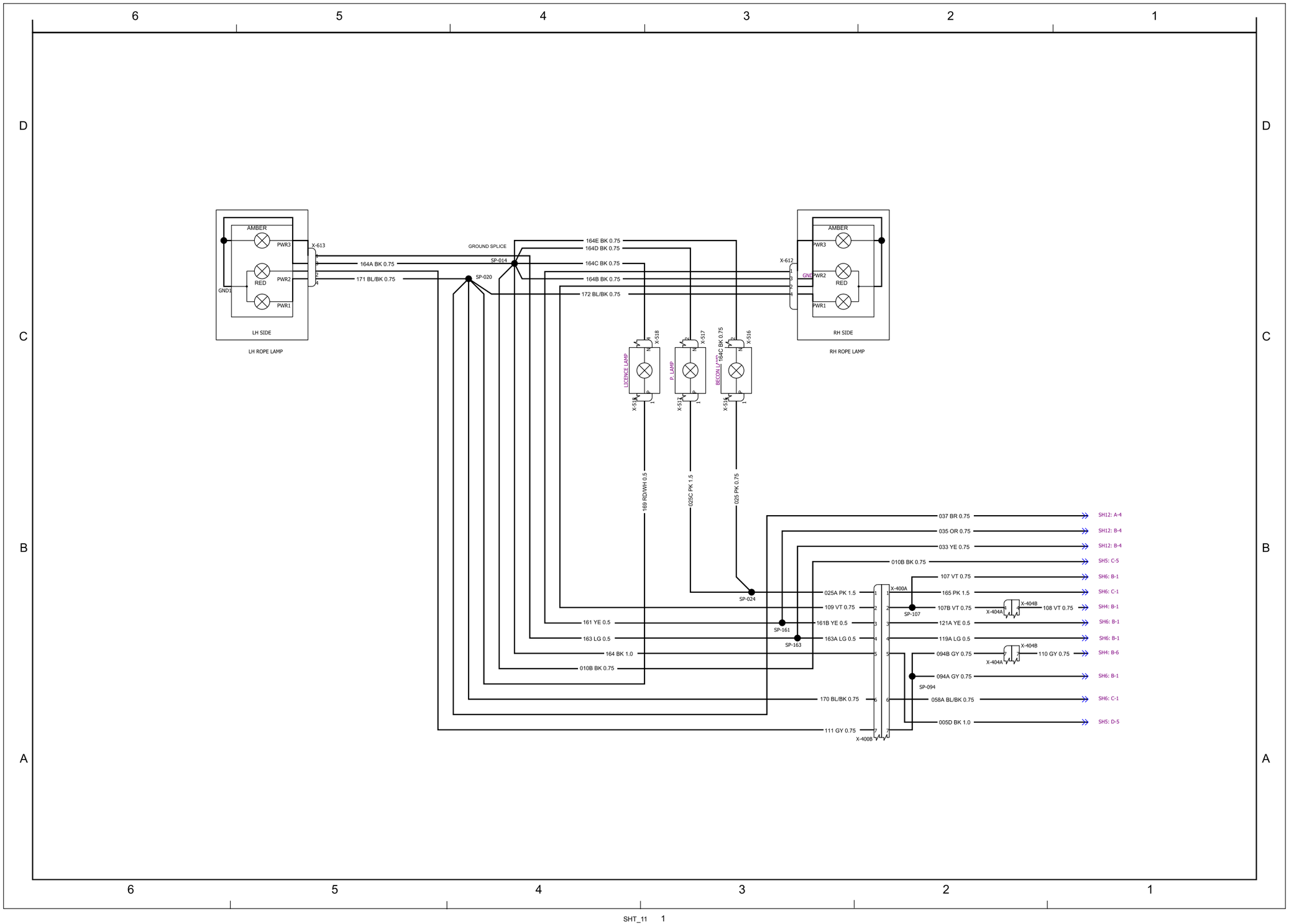
Wiring harnesses - Electrical schematic sheet 10 SH10-FRONT HEAD LIGHTS

Type	Component	Connector / Link	Description
Connector	X-001	**X-001**	
Connector	X-216A	X-216A	ENGINE INTERCONNECT
Connector	X-216B	**X-216B**	HEADLAMP INTERCONNECT
Connector	X-301	**X-301**	HEADLAMP RH
Connector	X-302	**X-302**	HEADLAMP LH
Connector	X-303	**X-303**	WORKLAMP RH
Connector	X-304	**X-304**	WORKLAMP LH
Connector	X-305	**X-305**	HORN
Connector	X-306	**X-306**	HORN GND


HORN
X-305
X-306
HEAD LAMP RH
WORK LAMP RH
X-303
HIGH
LOW
HB
COM
LB
X-301
RH LAMPS
102B GY 1.0
104B GN/YE 1.5
103C BK 1.0
103D BK 1.0
103E BK 1.0
105B OR 1.5
106 YE/BL 1.0
HEAD LAMP LH
WORK LAMP LH
X-304
105A OR 1.5
103B BK 1.0
104A GN/YE 1.5
103A BK 1.0
102A GY 1.0
X-302
LH LAMPS
SP-102
SP-103
SP-104
SP-105
X-216B
X-216A
105 OR 1.5
104 GN/YE 1.5
103 BK 1.0
102 GY 1.0
072 YE/BL 1.0
032 OR 1.5
100 GN/YE 1.5
009D BK 1.0
101 GY 1.0
SH6: C-1
SH4: C-1
SH4: C-1
SH5: B-5
SH4: C-1
SHT_10 1

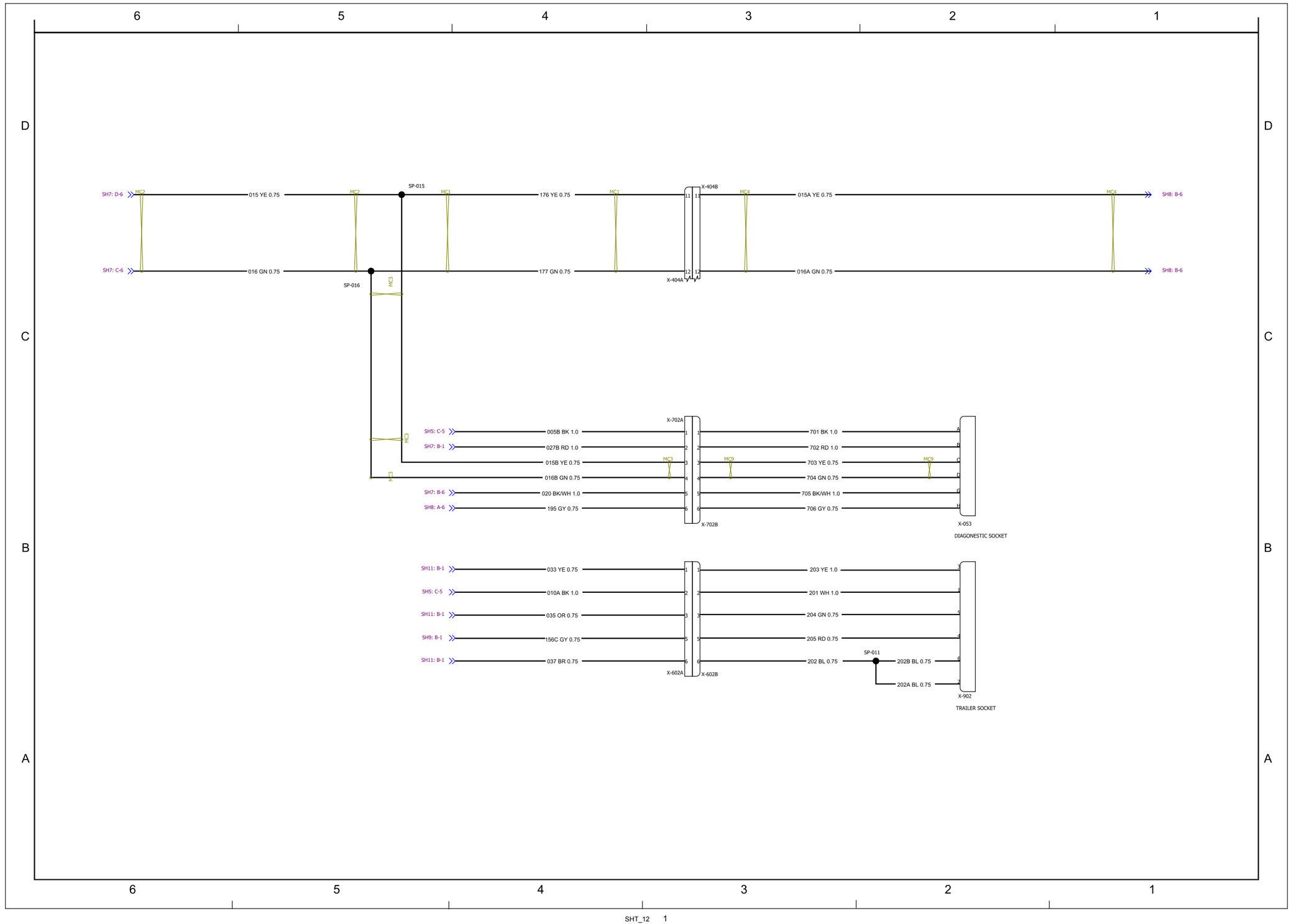
Wiring harnesses - Electrical schematic sheet 11 SH11-REAR LIGHTS

Type	Component	Connector / Link	Description
Connector	X-011	**X-011**	TURN FLASHER
Connector	X-400A	**X-400A**	MAIN-FENDER INTERCONNECT
Connector	X-400B	X-400B	FENDER-MAIN INTERCONNECT
Connector	X-404A	X-404A	ENGINE-MAIN INTERCONNECT
Connector	X-404B	**X-404B**	MAIN-ENGINE INTERCONNECT
Connector	X-516	**X-516**	BECON LAMP
Connector	X-517	**X-517**	IMPLEMENT LAMP
Connector	X-518	**X-518**	LICENCE LAMP
Connector	X-612	**X-612**	ROPE LAMP RH
Connector	X-613	**X-613**	ROPE LAMP LH


AMBER
PWR3
RED
PWR2
PWR1
GND1
X-613
LH SIDE
LH ROPE LAMP
GROUND SPLICE
SP-014
SP-020
164E BK 0.75
164D BK 0.75
164A BK 0.75
164C BK 0.75
171 BL/BK 0.75
164B BK 0.75
172 BL/BK 0.75
X-612
GND
RH SIDE
RH ROPE LAMP
LICENCE LAMP
P. LAMP
X-518
X-517
X-516
X-515
X-514
X-513
169 RD/WH 0.5
025C PK 1.5
025 PK 0.75
037 BR 0.75
035 OR 0.75
033 YE 0.75
010B BK 0.75
107 VT 0.75
025A PK 1.5
109 VT 0.75
161 YE 0.5
163 LG 0.5
164 BK 1.0
010B BK 0.75
170 BL/BK 0.75
111 GY 0.75
SP-024
SP-161
SP-163
SP-107
SP-094
X-400A
X-400B
165 PK 1.5
107B VT 0.75
161B YE 0.5
163A LG 0.5
X-404A
X-404B
108 VT 0.75
121A YE 0.5
119A LG 0.5
094B GY 0.75
110 GY 0.75
094A GY 0.75
058A BL/BK 0.75
005D BK 1.0
SH12: A-4
SH12: B-4
SH12: B-4
SH5: C-5
SH6: B-1
SH6: C-1
SH4: B-1
SH6: B-1
SH6: B-1
SH4: B-6
SH6: B-1
SH6: C-1
SH5: D-5
SHT_11 1

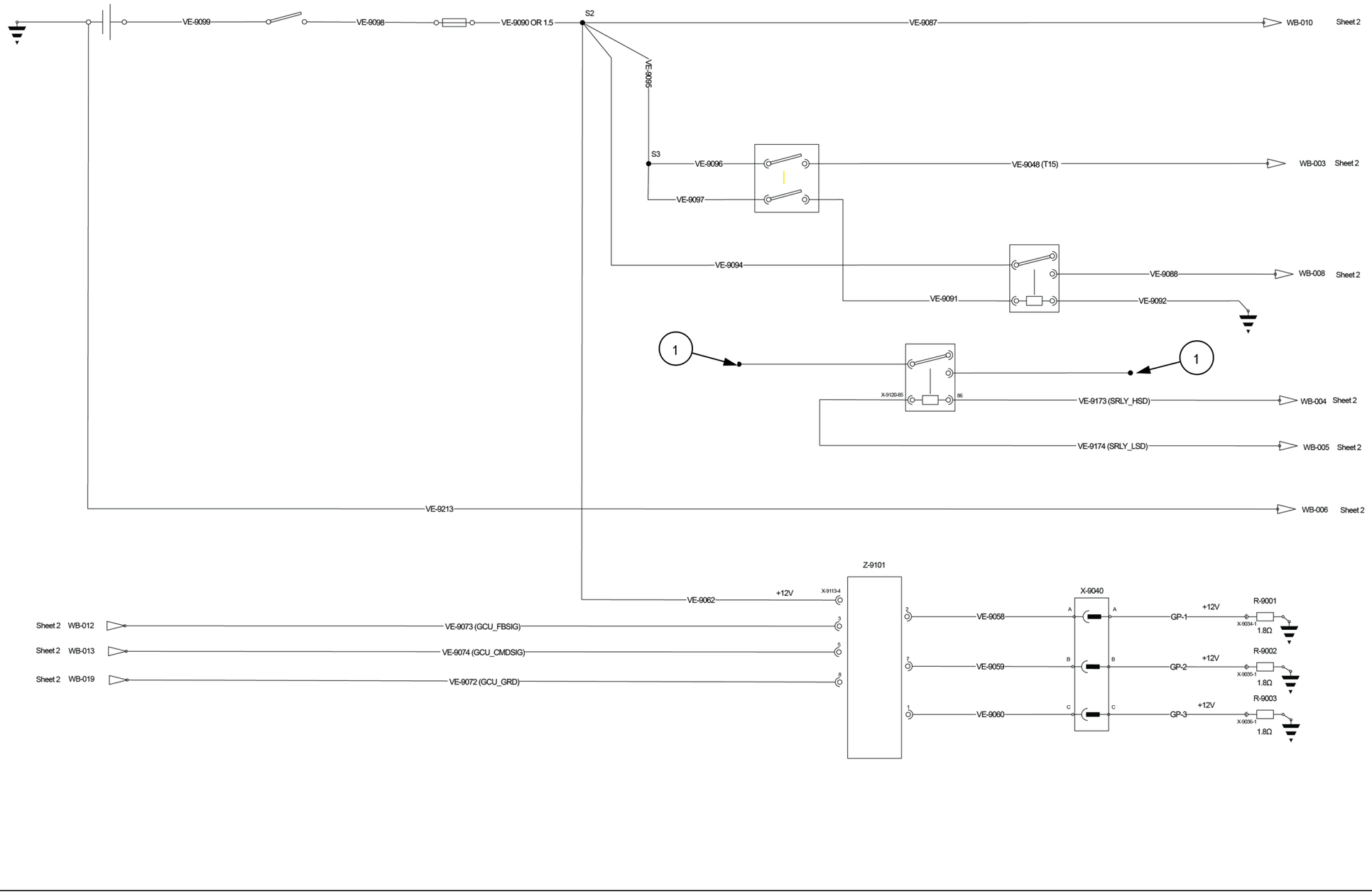
Wiring harnesses - Electrical schematic sheet 12 SH12-DIAGONESTIC/ TRAILER SOCKET

Type	Component	Connector / Link	Description
Connector	X-053	**X-053**	DIAGONESTIC SOCKET
Connector	X-404A	X-404A	ENGINE-MAIN INTERCONNECT
Connector	X-404B	**X-404B**	MAIN-ENGINE INTERCONNECT
Connector	X-602A	**X-602A**	TO TRAILER HARNESS
Connector	X-602B	X-602B	TO FENDER HARNESS
Connector	X-702A	**X-702A**	TO DIAGONESTIC SOCKET
Connector	X-702B	X-702B	TO MAIN HARNESS
Connector	X-902	**X-902**	TRAILER SOCKET


6
5
4
3
2
1
D
C
B
A
SH7: D-6
MC2
015 YE 0.75
MC2
SP-015
MC1
176 YE 0.75
MC1
X-404B
11
11
MC4
015A YE 0.75
MC4
SH8: B-6
SH7: C-6
016 GN 0.75
SP-016
MC3
177 GN 0.75
12
12
X-404A
016A GN 0.75
SH8: B-6
X-702A
SH5: C-5
005B BK 1.0
MC3
SH7: B-1
027B RD 1.0
015B YE 0.75
MC3
MC9
703 YE 0.75
MC9
016B GN 0.75
MC3
704 GN 0.75
SH7: B-6
020 BK/WH 1.0
705 BK/WH 1.0
SH8: A-6
195 GY 0.75
706 GY 0.75
X-702B
X-053
DIAGONESTIC SOCKET
SH11: B-1
033 YE 0.75
203 YE 1.0
SH5: C-5
010A BK 1.0
201 WH 1.0
SH11: B-1
035 OR 0.75
204 GN 0.75
SH9: B-1
156C GY 0.75
205 RD 0.75
SH11: B-1
037 BR 0.75
202 BL 0.75
SP-011
202B BL 0.75
202A BL 0.75
X-602A
X-602B
X-902
TRAILER SOCKET
SHT_12 1

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics)

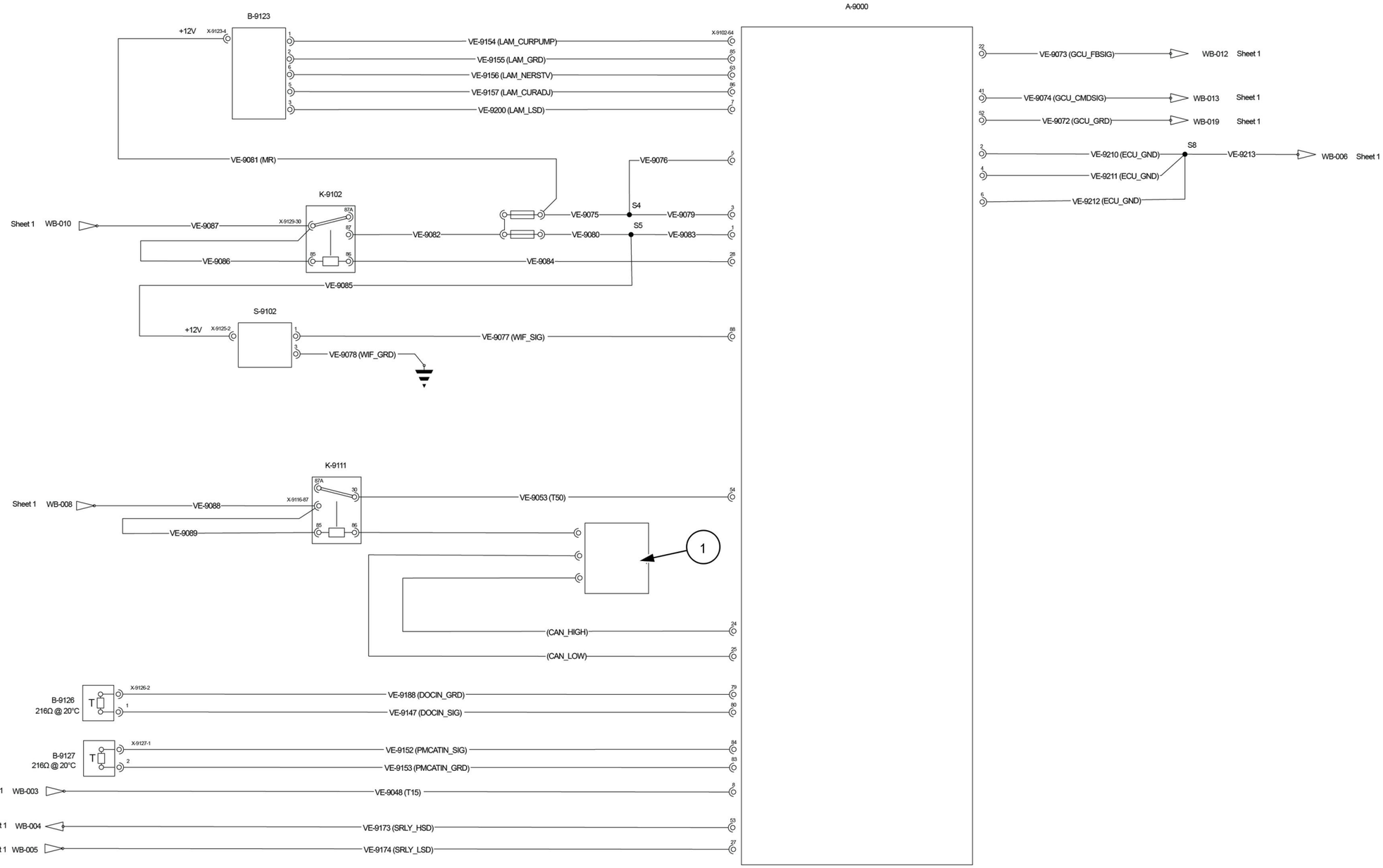
Component Identifier	Description
K-9104	Starter control relay
R-9001	Cylinder 1 glow plug
R-9002	Cylinder 2 glow plug
R-9003	Cylinder 3 glow plug
Z-9101	Glow plug control unit
(1) to machine starting circuit, see machine schematics.	



NHIL15ENG0123JA 1

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics)

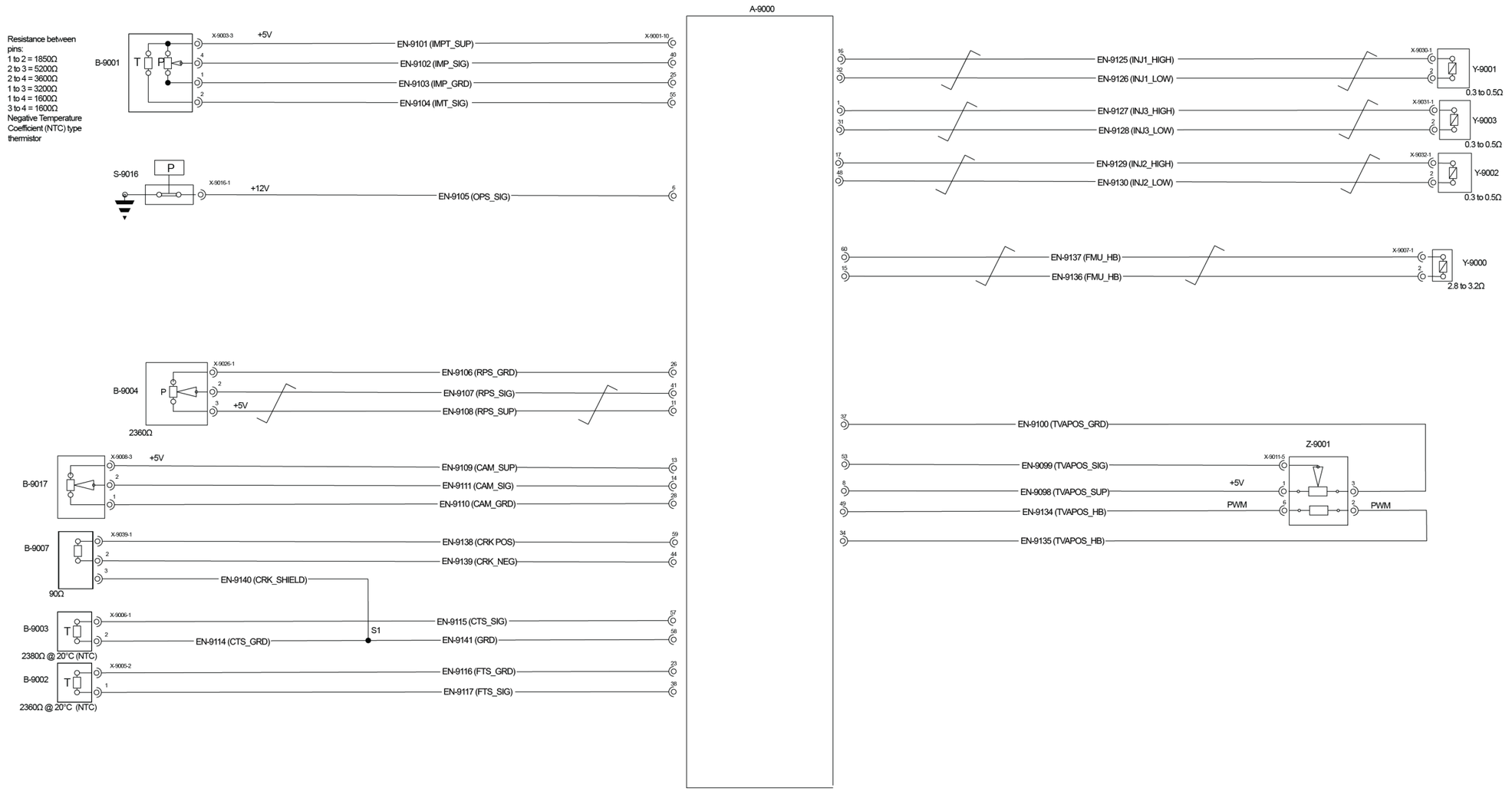
Component Identifier	Description
A-9000	Engine Control Unit (ECU)
B-9123	Lambda (Universal Heated Exhaust Gas Oxygen (UHEGO) sensor
B-9126	Diesel Oxidation Catalyst (DOC) inlet temperature sensor
B-9127	Particulate Matter (PM) catalyst intlet temperature sensor
K-9102	Main relay
K-9111	Engine shut-off relay
S-9102	Water in fuel switch
(1) represents the potential vehicle control module present on the machine, see machine schematics.	



NHIL15ENG0154JA 1

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics)

Component identifier	Description
A-9000	Engine Control Unit (ECU)
B-9001	Intake manifold pressure and temperature sensor
B-9002	Fuel temperature sensor
B-9003	Coolant temperature sensor
B-9004	Rail pressure sensor
B-9007	Crankshaft sensor
B-9017	Camshaft sensor
S-9016	Oil pressure switch
Y-9000	Fuel metering unit
Y-9001	Cylinder 1 injector (Bank 1 Injector 1)
Y-9002	Cylinder 2 injector (Bank 1 Injector 2)
Y-9003	Cylinder 3 injector (Bank 2 Injector 1)
Z-9001	Throttle valve actuator

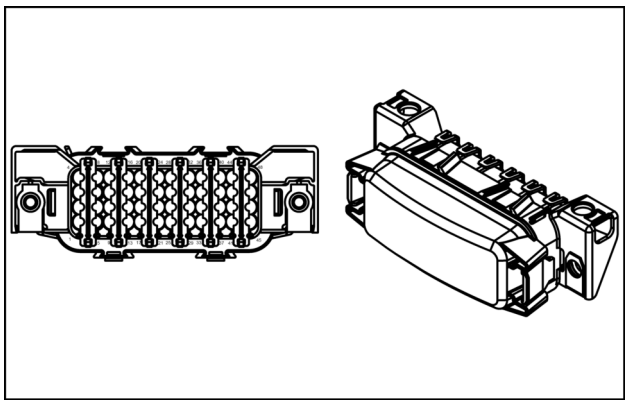


SHEET 3

NHIL15ENG0155JA 1

Wire connectors - Component diagram 00

X-001 - (84380518) (Female)



84380518 1

84380518

Pin	From	Wire	Description	Color-Size	Frame
1	SP-019-P-X	009R	009R	BK - 0.75	**SHEET 04**
2	SP-013-P-X	055	055	RD - 3.0	
3	SP-019-P-X	009L	009L	BK - 0.5	
4	SP-069-P-X	069B	069B	RD - 1.5	
9	SP-056-P-X	056	056	OR/GN - 3.0	
10	SP-022-P-X	022B	022B	RD/GN - 0.75	
12	**X-406B pin 10** TO MAIN HARNESS	059	059	GN/YE - 0.5	
13	SP-019-P-X	009P	009P	BK - 0.75	
14	SP-013-P-X	055A	055A	RD - 3.0	
15	SP-017-P-X	009E	009E	BK - 0.75	
16	**X-009 pin 85** CRANKING RELAY	050	050	BL - 0.75	**SHEET 02**
21	**X-404B pin 22** MAIN-ENGINE INTERCONNECT	076	076	OR/BL - 1.5	**SHEET 04**
22	SP-022-P-X	022A	022A	RD/GN - 0.75	
23	SP-017-P-X	009F	009F	BK - 0.75	
24	**X-406B pin 7** TO MAIN HARNESS	053	053	YE - 0.75	
25	SP-019-P-X	009S	009S	BK - 0.5	
26	SP-025-P-X	031A	031A	RD/BL - 1.5	**SHEET 02**
27	SP-017-P-X	009K	009K	BK - 0.5	**SHEET 04**
28	SP-097-P-X	095	095	GY - 0.75	
33	**X-216B pin 5** HEADLAMP INTERCONNECT	032	WORK LAMP	OR - 1.5	
34	**X-406B pin 3** TO MAIN HARNESS	091	091	PRP - 0.5	
35	**X-404B pin 4** MAIN-ENGINE INTERCONNECT	108	108	VT - 0.75	
36	SP-096-P-X	096B	096B	GY - 0.5	
37	SP-019-P-X	009M	009M	BK - 0.5	
38	SP-069-P-X	069A	069A	RD - 1.5	
39	SP-017-P-X	009W	009W	BK - 0.75	
40	**X-201 (Female) pin 62** ECU VEHICLE	046	046	BL - 0.75	
43	SP-017-P-X	009V	009V	BK - 0.75	
45	**X-216B pin 1** HEADLAMP INTERCONNECT	100	100	GN/YE - 1.5	
46	**X-406B pin 11** TO MAIN HARNESS	074	074	BL/YE - 0.5	
48	F-002-P-38 GEP - FUSE BOX	115	115	OR - 0.75	

X-001A - [G-001] (Male)

Pin	From	Wire	Description	Color-Size	Frame
PIN1	**X-004A (Male) pin PIN1**	001	BATTERY CABLE POSITIVE	RD - 40.0	**SHEET 03**

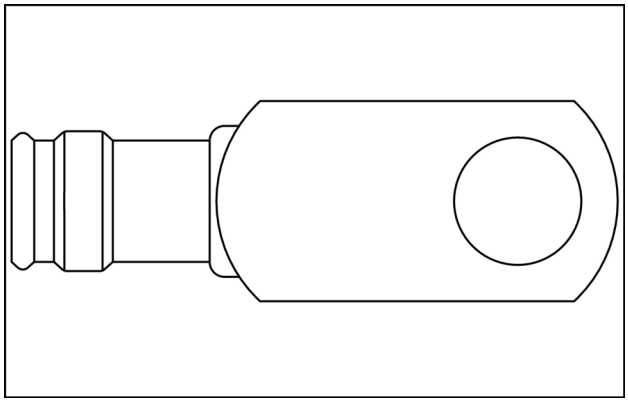
X-001B - [G-001] (Male)

Pin	From	Wire	Description	Color-Size	Frame
PIN1	**X-002A (Male) pin PIN1** GROUND TERMINAL	002	BATTERY CABLE GROUND	BK - 40.0	**SHEET 03**

X-002A - GROUND TERMINAL (Male)

Pin	From	Wire	Description	Color-Size	Frame
PIN1	**X-001B pin PIN1**	002	BATTERY CABLE GROUND	BK - 40.0	**SHEET 03**

X-002B - FENDER GROUND (84153309) (Male)

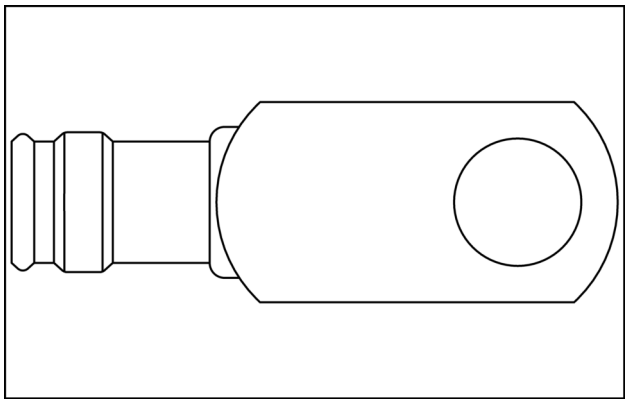


84153309 2

84153309

Pin	From	Wire	Description	Color-Size	Frame
1	SP-010-P-X	010	FENDER GROUND	BK - 6.0	**SHEET 05**

X-002C - MAIN HARNESS GND (84153309) (Male)

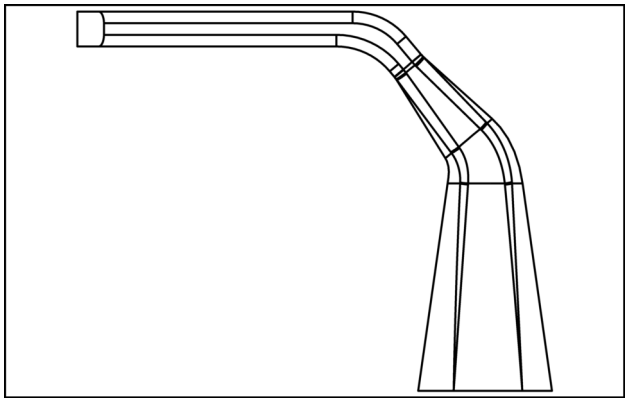


84153309 3

84153309

Pin	From	Wire	Description	Color-Size	Frame
1	SP-005-P-X	005	MAIN HARNESS GND	BK - 6.0	**SHEET 05**

X-002D - ECU/ENGINE GROUND (84179566) (Male)

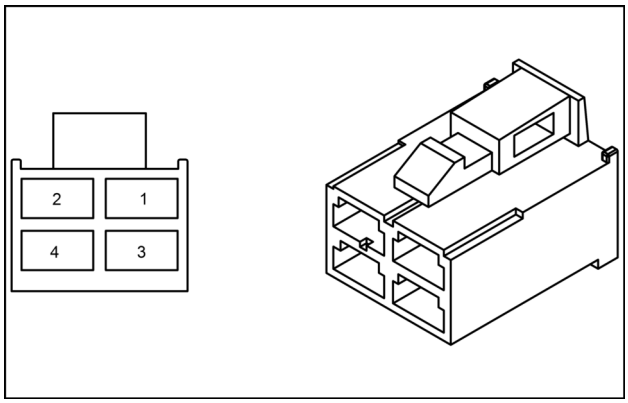


84179566 4

84179566

Pin	From	Wire	Description	Color-Size	Frame
1	SP-009-P-X	009	ECU/ENGINE GROUND	BK - 6.0	**SHEET 05**

X-003 - IGNITION SWITCH [S-001] (84479009) (Female)

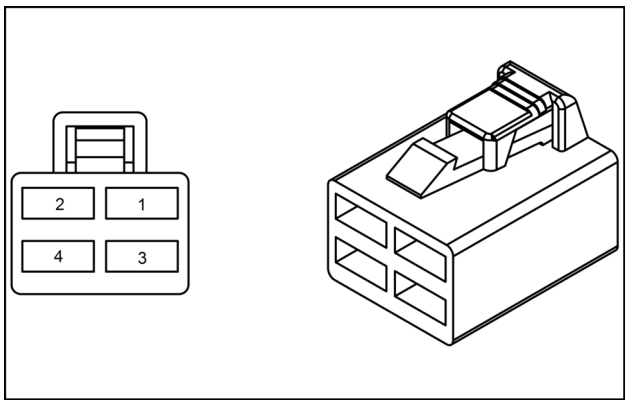


84479009 5

84479009

Pin	From	Wire	Description	Color-Size	Frame
2	SP-106-P-X	021A	021A	RD - 3.0	**SHEET 06**
3	X-406A-P-2	065	065	YE - 0.75	
4	SP-101-P-X	089A	089A	RD/GN - 2.5	

X-004 - DIODE (84179574) (Female)



84179574 6

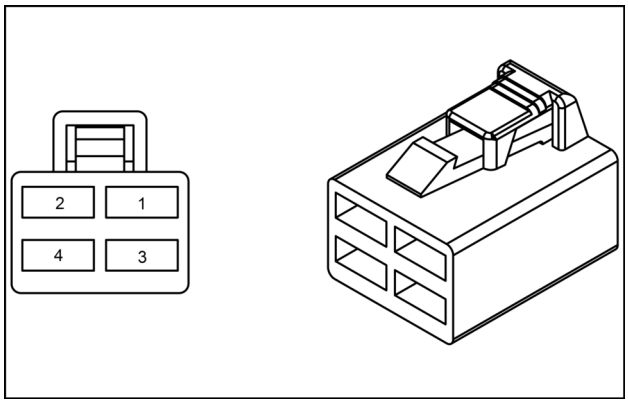
84179574

Pin	From	Wire	Description	Color-Size	Frame
1	SP-096-P-X	096A	096A	GY - 0.75	**SHEET 04**
2	SP-097-P-X	095A	095A	GY - 0.75	

X-004A - [M-001] (Male)

Pin	From	Wire	Description	Color-Size	Frame
PIN1	**X-001A (Male) pin PIN1**	001	BATTERY CABLE POSITIVE	RD - 40.0	**SHEET 03**

X-005 - LIGHT SWITCH (84179574) (Female)

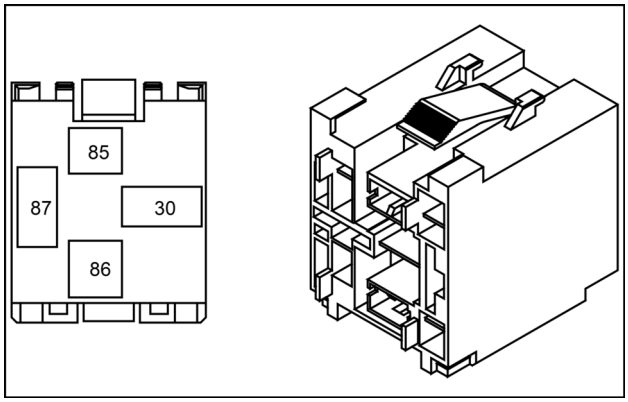


84179574 7

84179574

Pin	From	Wire	Description	Color-Size	Frame
1	SP-060-P-X	060	060	BL/YE - 0.75	**SHEET 06**
2	SP-029-P-X	029C	029C	GN/OR - 1.5	
2	HORN/LIGHT/TURN SWITCH-P-PWR1	WIRE235	WIRE235		
3	X-406A-P-10	073	073	GN/YE - 0.75	
4	SP-058-P-X	058	058	BL/BK - 0.75	

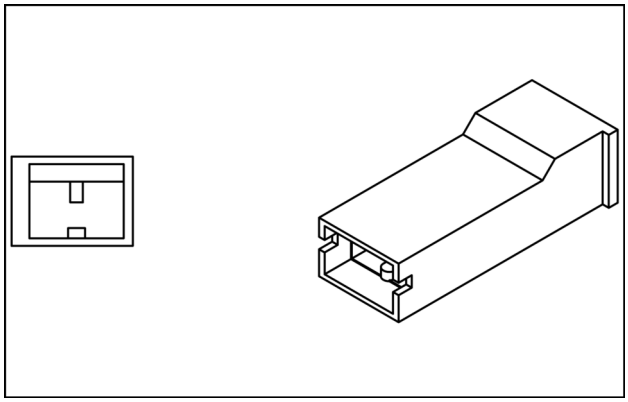
X-006 - ECU RELAY (47781083) (Male)



47781083 8

47781083

X-007 - HORN SWITCH CN1 (87581782) (Female)

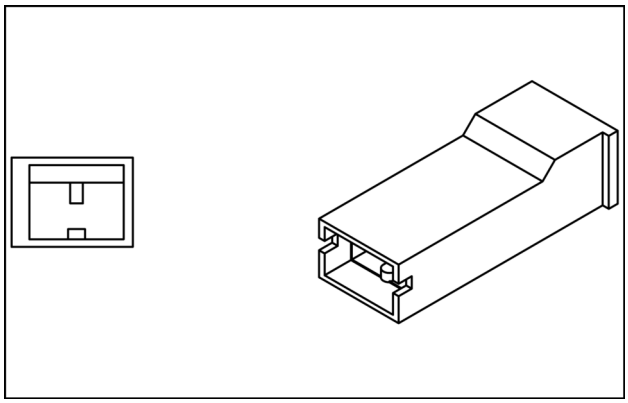


87581782 9

87581782

Pin	From	Wire	Description	Color-Size	Frame
1	SP-029-P-X	029B	029B	GN/OR - 0.75	**SHEET 06**

X-008 - HORN SWITCH CN2 (87581782) (Female)

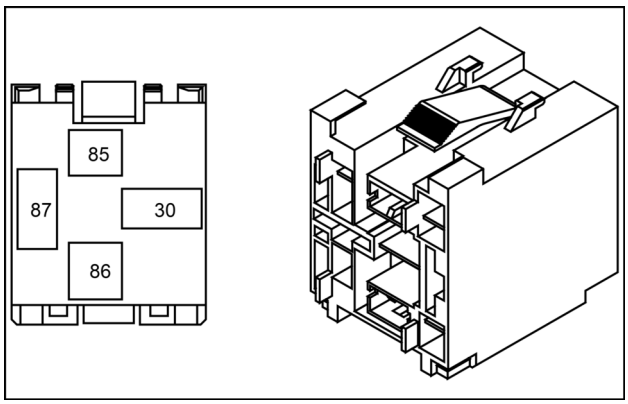


87581782 10

87581782

Pin	From	Wire	Description	Color-Size	Frame
1	X-406A-P-12	071	071	YE/BL - 0.75	**SHEET 06**

X-009 - CRANKING RELAY (47781083) (Male)

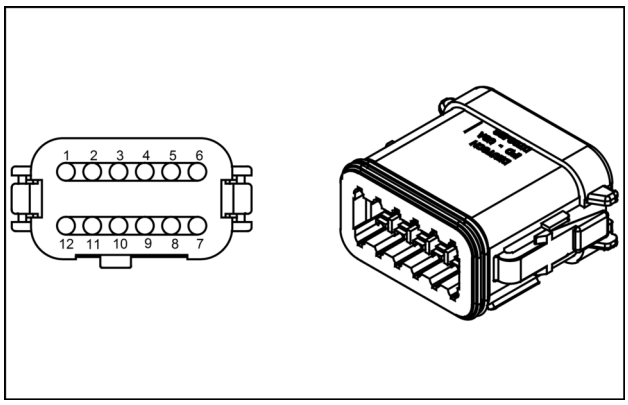


47781083 11

47781083

Wire connectors - Component diagram 01

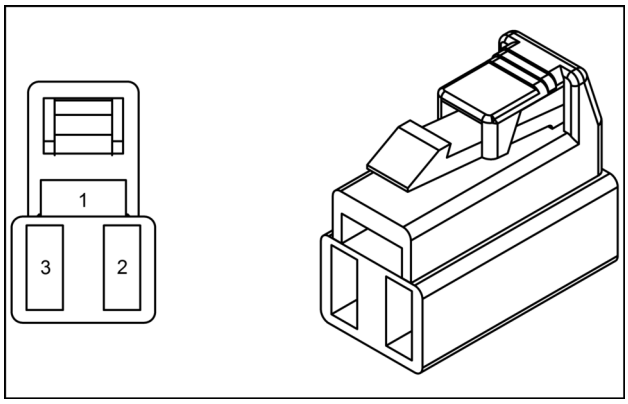
X-011 - TURN FLASHER (47781082) (Male)



47781082 1

47781082

X-012 - TURN SWITCH (84179572) (Female)

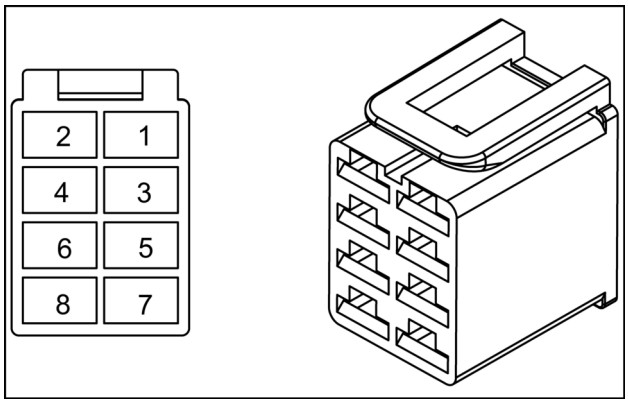


84179572 2

84179572

Pin	From	Wire	Description	Color-Size	Frame
1	F-003-P-1 MINI FUSER	030	TURN/STOP LAMP	LG - 0.75	**SHEET 06**
2	**X-011 pin 8** TURN FLASHER	061	061	LG/BL - 0.75	
3	**X-011 pin 7** TURN FLASHER	062	062	LG/WH - 0.75	

X-013 - WORK LAMP (84179576) (Female)

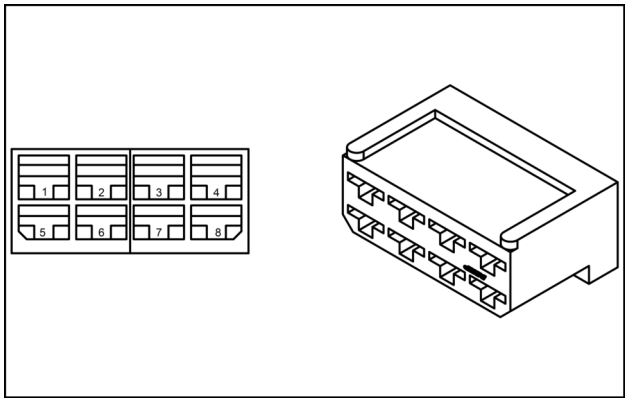


84179576 3

84179576

Pin	From	Wire	Description	Color-Size	Frame
4	SP-029-P-X	029D	029D	GN/OR - 1.0	**SHEET 06**
6	SP-090-P-X	090A	090A	VT - 0.75	

X-014 - SAFETY BUZZER (87700098) (Female)

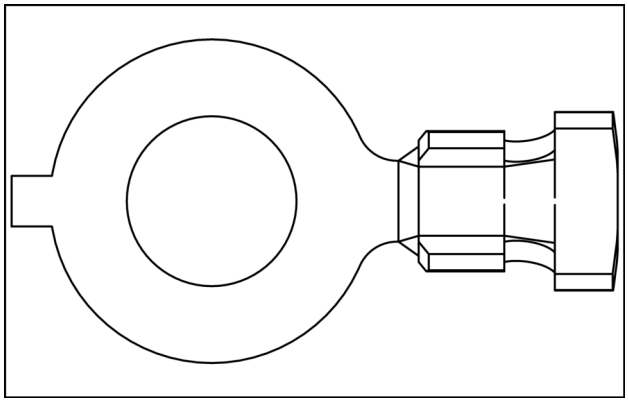


87700098 4

87700098

Pin	From	Wire	Description	Color-Size	Frame
1	SP-025-P-X	031B	031B	RD/BL - 0.75	**SHEET 09**
2	**X-406B pin 8** TO MAIN HARNESS	034	034	BL - 0.75	
3	SP-159-P-X	159B	159B	PK/WH - 0.5	
5	SP-009-P-X	009T	009T	BK - 0.5	**SHEET 05**
6	SP-085-P-X	084	084	PK - 0.75	**SHEET 02**

X-015 - TO MEGA FUSE [F-001] (84488487) (Male)

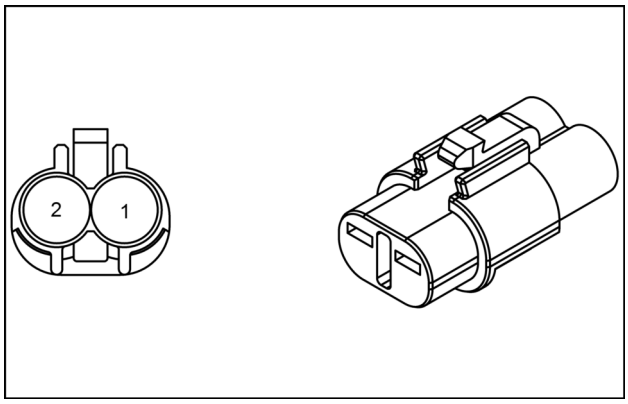


84488487 5

84488487

Pin	From	Wire	Description	Color-Size	Frame
1	**X-901 (Male) pin 1** ALTERNATOR B+	008	008	RD - 8.0	**SHEET 03**

X-016 - BRAKE SWITCH (84182898) (Female)

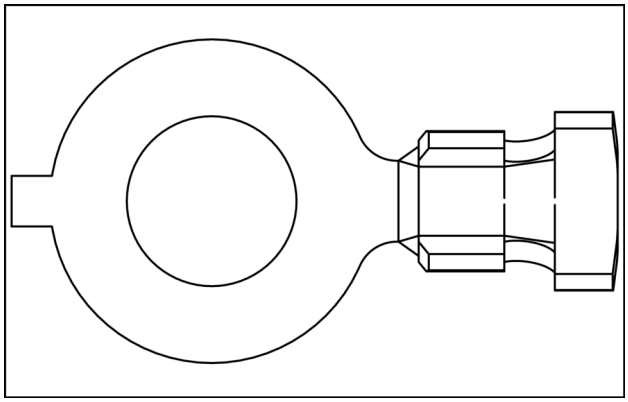


84182898 6

84182898

Pin	From	Wire	Description	Color-Size	Frame
1	SP-051-P-X	051A	051A	YE/RD - 0.75	**SHEET 09**
2	SP-156-P-X	156	156	GY - 0.75	

X-017 - FROM MEGA FUSE [F-001] (84488487) (Male)

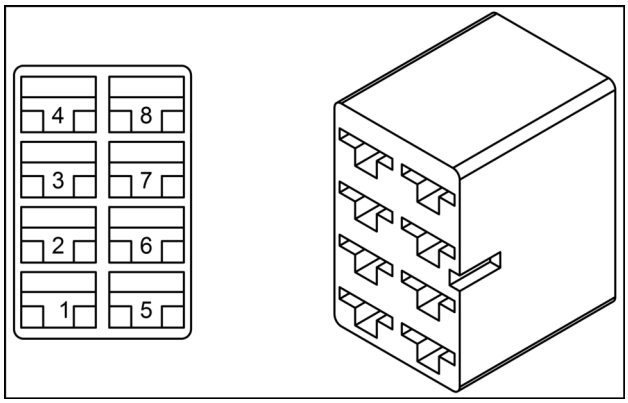


84488487 7

84488487

Pin	From	Wire	Description	Color-Size	Frame
1	SP-007-P-X	007	007	RD - 8.0	**SHEET 03**

X-018 - HOME ENTER SWITCH [S-007] (87745329) (Female)

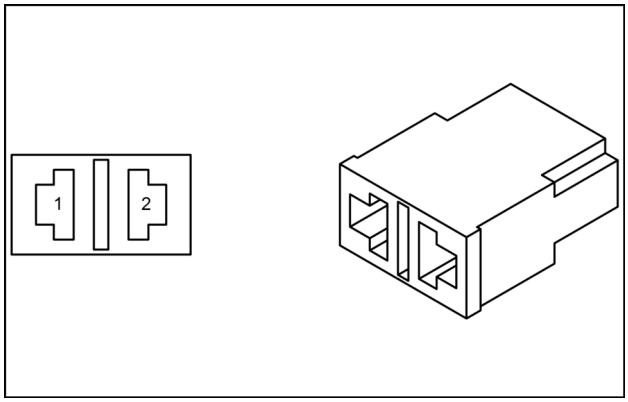


87745329 8

87745329

Pin	From	Wire	Description	Color-Size	Frame
1	**X-050 (Female) pin 20** INSTRUMENT CLUSTER CN-1	038	NAVIGATION SW ENTER	YE/GN - 0.75	**SHEET 07**
2	SP-006-P-X	005E	005E	BK - 0.75	
3	SP-006-P-X	005F	005F	BK - 0.75	
4	**X-050 (Female) pin 21** INSTRUMENT CLUSTER CN-1	039	NAVIGATION SW HOME	YE/BL - 0.75	

X-019 - SWITCH LAMP H/E [S-007] (84131048) (Female)



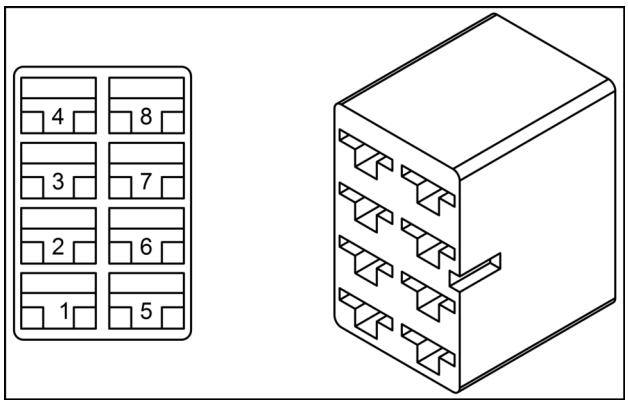
84131048 9

84131048

Pin	From	Wire	Description	Color-Size	Frame
1	SP-059-P-X	134	134	BL/BK - 0.75	**SHEET 07**
2	SP-006-P-X	005G	005G	BK - 0.75	

Wire connectors - Component diagram 02

X-020 - UP/DOWN SWITCH [S-008] (87745329) (Female)

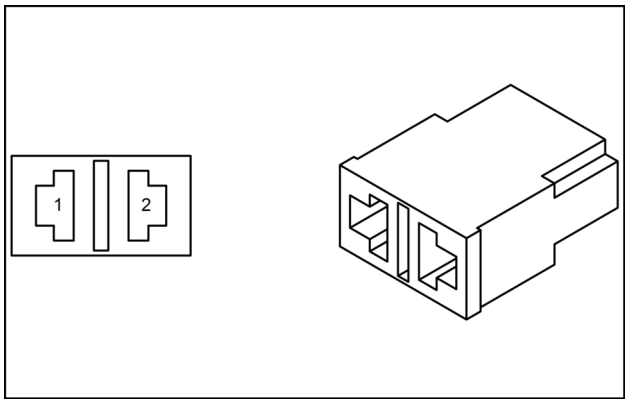


87745329 1

87745329

Pin	From	Wire	Description	Color-Size	Frame
1	**X-050 (Female) pin 22** INSTRUMENT CLUSTER CN-1	040	NAVIGATION SW DWN	PK/BK - 0.75	**SHEET 07**
2	SP-006-P-X	005H	005H	BK - 0.75	
3	SP-006-P-X	005K	005K	BK - 0.75	
4	**X-050 (Female) pin 23** INSTRUMENT CLUSTER CN-1	041	NAVIGATION SW UP	BL/BK - 0.75	

X-021 - SWITCH LAMP U/D [S-008] (84131048) (Female)

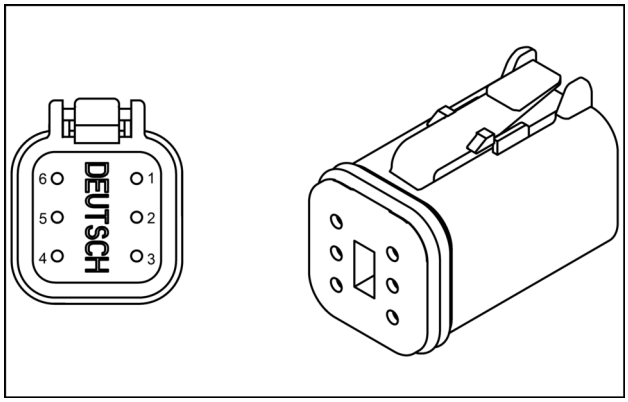


84131048 2

84131048

Pin	From	Wire	Description	Color-Size	Frame
1	SP-059-P-X	133	133	BL/BK - 0.75	**SHEET 07**
2	SP-006-P-X	005J	005J	BK - 0.75	

X-022 - FOOT THROTTLE (87694109) (Female)

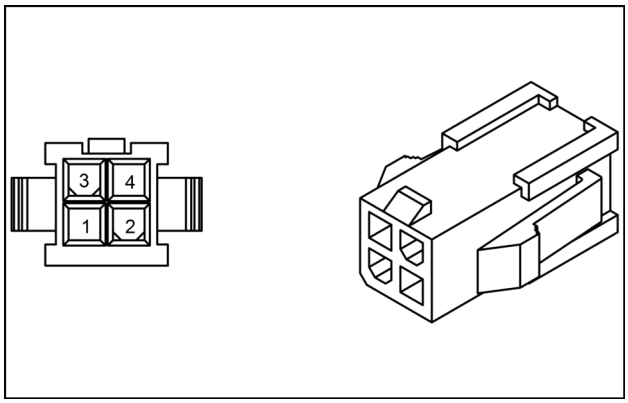


87694109 3

87694109

Pin	From	Wire	Description	Color-Size	Frame
1	X-402A-P-8	127	FOOT THROTTLE	PK - 1.0	**SHEET 07**
2	X-402A-P-7	141	FOOT THROTTLE	BK - 1.0	
3	X-402A-P-9	137	FOOT THROTTLE	GY/BL - 1.0	
5	X-402A-P-6	143	FOOT THROTTLE	YE/GN - 1.0	
6	X-402A-P-5	132	FOOT THROTTLE	YE - 1.0	

X-023 - HAND THROTTLE (87694694) (Male)

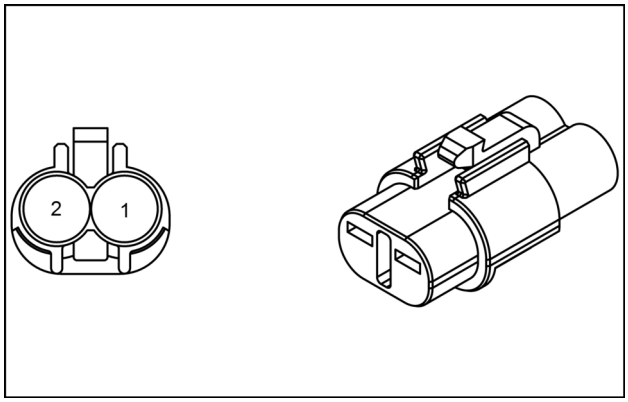


87694694 4

87694694

Pin	From	Wire	Description	Color-Size	Frame
2	**X-050 (Female) pin 8** INSTRUMENT CLUSTER CN-1	130	HAND THROTTLE	YE - 0.75	**SHEET 07**
3	**X-050 (Female) pin 12** INSTRUMENT CLUSTER CN-1	129	HAND THROTTLE SENS GROUND	BK - 0.75	
4	**X-051 pin 14** INSTRUMENT CLUSTER CN-2	128	HAND THROTTLE PWR	PK - 0.75	

X-025 - CLUTCH SWITCH (84182898) (Female)

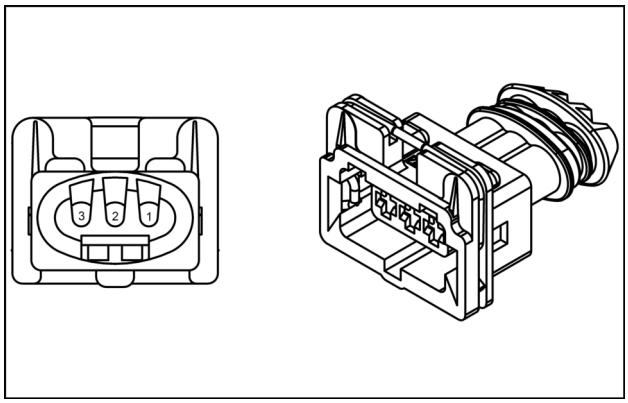


84182898 5

84182898

Pin	From	Wire	Description	Color-Size	Frame
1	**X-502 (Female) pin 3** PTO SWITCH	052	052	GN/BK - 0.75	**SHEET 09**
2	X-402A-P-4	093	093	YE - 0.75	

X-026 - SENSOR WATER IN FUEL (87709663) (Female)

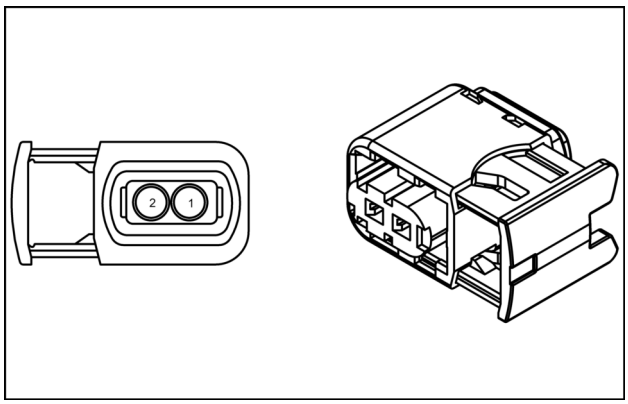


87709663 6

87709663

Pin	From	Wire	Description	Color-Size	Frame
1	**X-201 (Female) pin 88** ECU VEHICLE	044	044	YE - 0.75	**SHEET 08**
3	SP-018-P-X	009H	009H	BK - 0.75	

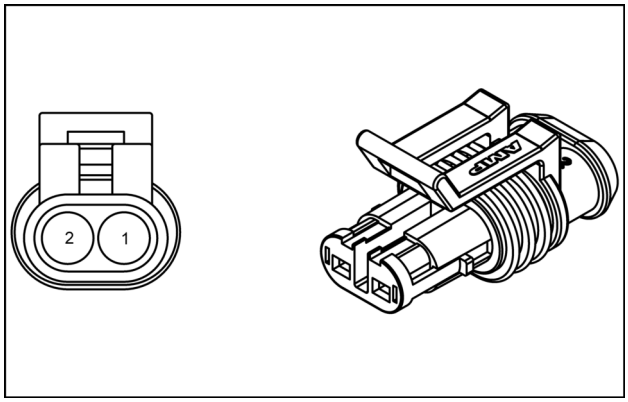
X-027 - PRE HEATER (84146680) (Male)



84146680 7

84146680

X-028 - FRONT LOADER (82012083) (Female)



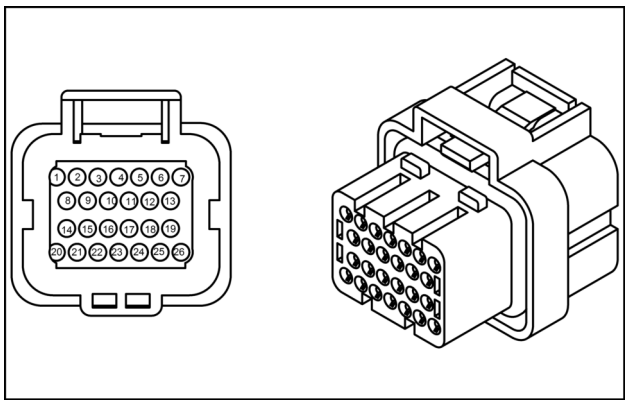
82012083 8

82012083

Pin	From	Wire	Description	Color-Size	Frame
1	F-002-Female-P-33 GEP - FUSE BOX	113	113	OR/GN - 1.0	**SHEET 02**
2	SP-009-P-X	009X	009X	BK - 1.0	

Wire connectors - Component diagram 05

X-050 - INSTRUMENT CLUSTER CN-1 (82028493) (Female)

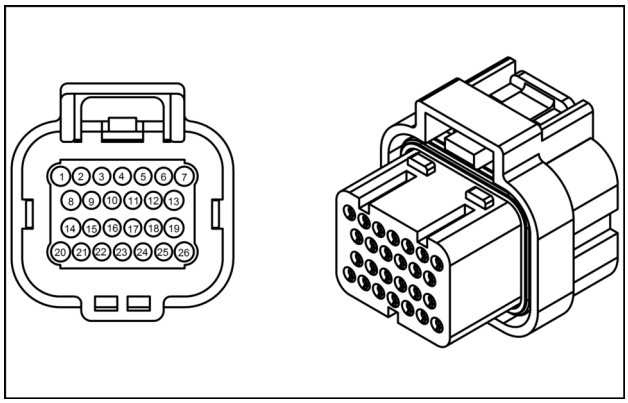


82028493 1

82028493

Pin	From	Wire	Description	Color-Size	Frame
2	**X-507 (Female) pin 2** FUEL SENDER UNIT	042	FUEL SENDER UNIT	BL - 0.75	**SHEET 07**
3	SP-015-P-X	015	CAN HIGH	YE - 0.75	
4	SP-016-P-X	016	CAN LOW	GN - 0.75	
5	**X-402B pin 9** MAIN-FENDER INTERCONNECT	138	138	GY/BL - 1.0	
6	SP-140-P-X	140C	SENSOR GND	BK - 1.0	
7	**X-402B pin 6** MAIN-FENDER INTERCONNECT	142	142	YE/GN - 1.0	
8	**X-023 (Male) pin 2** HAND THROTTLE	130	HAND THROTTLE	YE - 0.75	
9	SP-136-P-X	136B	136B	PK/WH - 0.5	
12	**X-023 (Male) pin 3** HAND THROTTLE	129	HAND THROTTLE SENS GROUND	BK - 0.75	
17	**X-011 pin 5** TURN FLASHER	118	118	LG/BL - 0.5	
20	**X-018 (Female) pin 1** HOME ENTER SWITCH	038	NAVIGATION SW ENTER	YE/GN - 0.75	
21	**X-018 (Female) pin 4** HOME ENTER SWITCH	039	NAVIGATION SW HOME	YE/BL - 0.75	
22	**X-020 (Female) pin 1** UP/DOWN SWITCH	040	NAVIGATION SW DWN	PK/BK - 0.75	
23	**X-020 (Female) pin 4** UP/DOWN SWITCH	041	NAVIGATION SW UP	BL/BK - 0.75	
25	**X-702A pin 5** TO DIAGONESTIC SOCKET	020	SERVICE SWITCH	BK/WH - 1.0	

X-051 - INSTRUMENT CLUSTER CN-2 (82016219) (Female)

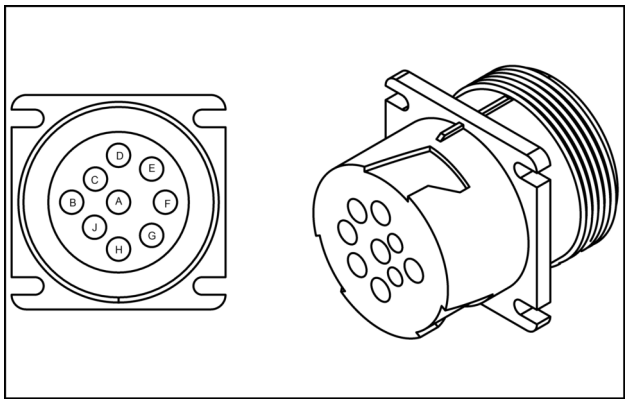


82016219 2

82016219

Pin	From	Wire	Description	Color-Size	Frame
1	**X-402B pin 8** MAIN-FENDER INTERCONNECT	126	126	PK - 1.0	**SHEET 07**
3	X-404A-P-18	045	AIR CLOG	BL/RD - 0.5	
6	SP-060-P-X	060B	HIGH BEAM	BL/YE - 0.75	
8	SP-124-P-X	124	PARKING BRAKE	YE/BK - 0.5	
9	SP-119-P-X	119B	INDICATOR TURN LEFT	LG - 0.5	
10	SP-121-P-X	121B	INDICATOR TURN RIGHT	YE - 0.5	
13	X-404A-P-9	006	D+ BATTERY	BR - 0.5	**SHEET 03**
14	**X-023 pin 4** HAND THROTTLE	128	HAND THROTTLE PWR	PK - 0.75	**SHEET 07**
15	SP-005-P-X	005C	GND ADIC	BK - 1.0	**SHEET 05**
17	X-404A-P-10	088	088	PK - 0.75	**SHEET 03**
19	SP-058-P-X	058B	SIDE LIGHTS	BL/BK - 0.75	**SHEET 07**
20	SP-027-P-X	027	027	RD/GN - 1.0	
21	SP-131-P-X	131B	131B	OR - 1.0	
23	SP-090-P-X	090B	WORK LAMP	VT - 0.75	
24	**X-402B pin 11** MAIN-FENDER INTERCONNECT	192	PTO SPEED SENSOR	R-B - 1.0	
26	SP-049-P-X	049B	NEUTRAL SAFETY ADIC	RD/GN - 0.75	

X-053 - DIAGONESTIC SOCKET (87516075) (Male)



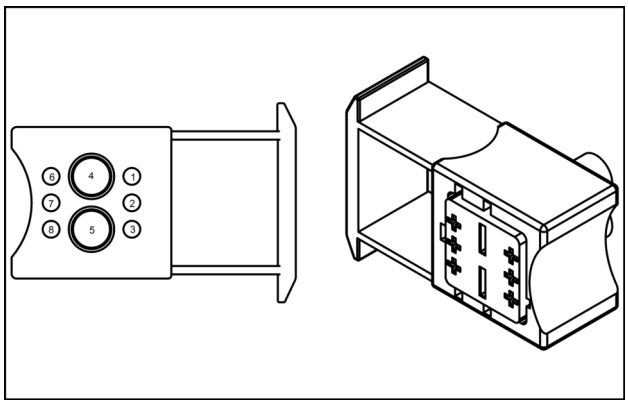
87516075 3

87516075

Pin	From	Wire	Description	Color-Size	Frame
A	X-702B-Female-P-1	701	701	BK - 1.0	**SHEET 12**
B	X-702B-Female-P-2	702	702	RD - 1.0	
C	X-702B-Female-P-3	703	703	YE - 0.75	
D	X-702B-Female-P-4	704	704	GN - 0.75	
G	X-702B-Female-P-5	705	705	BK/WH - 1.0	
H	X-702B-Female-P-6	706	706	GY - 0.75	

Wire connectors - Component diagram 10

X-101 - GCU (84356962) (Female)

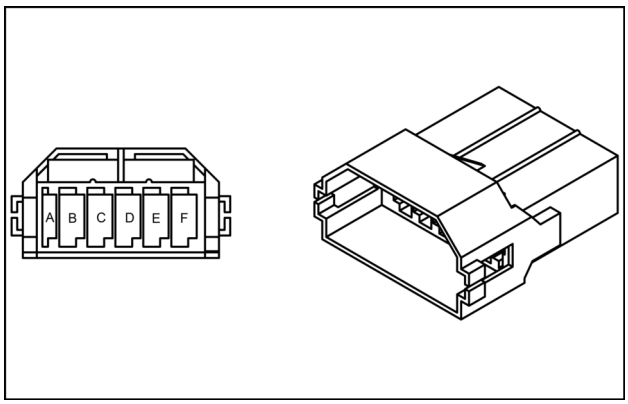


84356962 1

84356962

Pin	From	Wire	Description	Color-Size	Frame
1	**X-207 (Female) pin C** TO ENGINE GLOW PLUGS	149	149	RD/GN - 1.5	**SHEET 08**
3	**X-201 (Female) pin 22** ECU VEHICLE	151	151	BR - 0.75	
4	SP-007-P-X	007L	007L	RD - 6.0	
5	**X-201 (Female) pin 41** ECU VEHICLE	152	152	BK - 3.0	
7	**X-207 (Female) pin B** TO ENGINE GLOW PLUGS	153	153	GN - 1.5	
8	**X-201 (Female) pin 52** ECU VEHICLE	154	154	GN - 0.75	

X-105 - OPRATOR SAFETY MODULE (84479170) (Female)



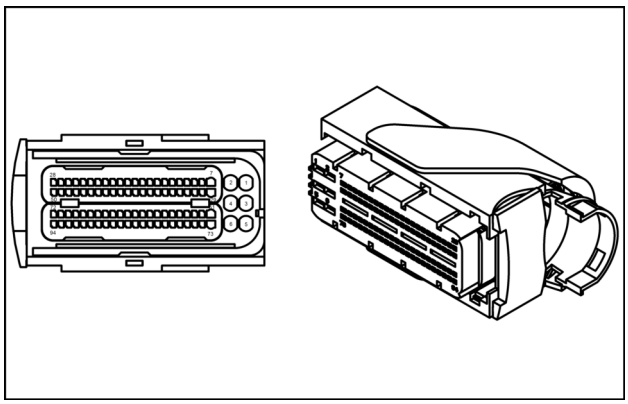
84479170 2

84479170

Pin	From	Wire	Description	Color-Size	Frame
B	X-406A-P-8	064	064	BL - 0.75	**SHEET 07**
C	SP-005-P-X	005L	005L	BK - 0.75	**SHEET 05**
E	SP-124-P-X	124B	124B	YE/BK - 0.75	**SHEET 07**

Wire connectors - Component diagram 20

X-201 - ECU VEHICLE (87745798) (Female)

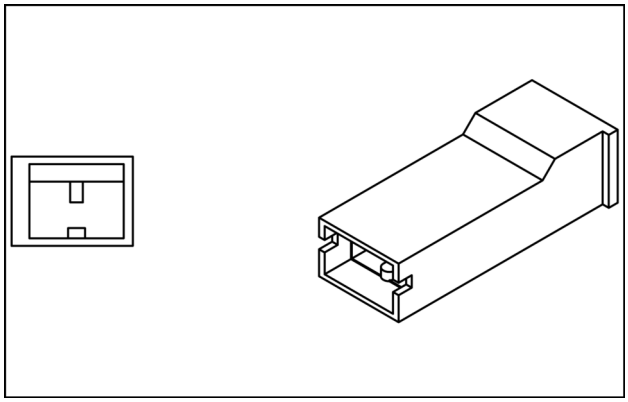


87745798 1

87745798

Pin	From	Wire	Description	Color-Size	Frame
1	F-002-P-6 GEP - FUSE BOX	013	013	OR/BL - 2.5	**SHEET 08**
2	SP-018-P-X	011	011	BK - 2.5	
3	SP-012-P-X	012A	012A	OR/BL - 2.5	
4	SP-018-P-X	011A	011A	BK - 2.5	
5	SP-012-P-X	012B	012B	OR/BL - 2.5	
6	SP-018-P-X	011B	011B	BK - 2.5	
7	**X-212 (Female) pin 3** LAMBDA SENSOR	146	146	GN - 1.0	
8	**X-406B pin 2** TO MAIN HARNESS	078	078	YE - 0.75	
22	**X-101 (Female) pin 3** GCU	151	151	BR - 0.75	
24	SP-002-P-X	015D	CAN HIGH	YE - 0.75	
25	SP-001-P-X	016D	CAN LOW	GN - 0.75	
28	**X-006 pin 85** ECU RELAY	048	ECU GND SIGNAL	BL - 0.75	
41	**X-101 (Female) pin 5** GCU	152	152	BK - 3.0	
46	SP-002-P-X	015E	CAN HIGH	YE - 0.75	
47	SP-001-P-X	016E	CAN LOW	GN - 0.75	
52	**X-101 (Female) pin 8** GCU	154	154	GN - 0.75	
53	F-002-Female-P-48 GEP - FUSE BOX	186	STARTER HIGH	YE - 0.75	
54	SP-085-P-X	085B	085B	YE/RD - 0.75	
55	**X-406B pin 5** TO MAIN HARNESS	197	197	YE/RD - 0.75	
62	**X-001 pin 40**	046	046	BL - 0.75	**SHEET 04**
63	**X-212 (Female) pin 6** LAMBDA SENSOR	148	148	PK - 0.75	**SHEET 08**
64	**X-212 (Female) pin 1** LAMBDA SENSOR	144	144	OR - 0.75	
77	**X-406B pin 6** TO MAIN HARNESS	185	185	YE/GN - 0.75	
80	**X-214 (Female) pin 1** INLET DOC TEMP SENSOR	173	173	BL/BK - 0.75	
83	**X-215 (Female) pin 2** OUTLET POC TEMP SENSOR	182	182	GN/WH - 0.75	
85	**X-212 (Female) pin 2** LAMBDA SENSOR	145	145	GN - 0.75	
86	**X-212 (Female) pin 5** LAMBDA SENSOR	147	147	YE - 0.75	
88	**X-026 (Female) pin 1** SENSOR WATER IN FUEL	044	044	YE - 0.75	

X-206 - TO STARTER MOTOR [M-001] (87581782) (Female)

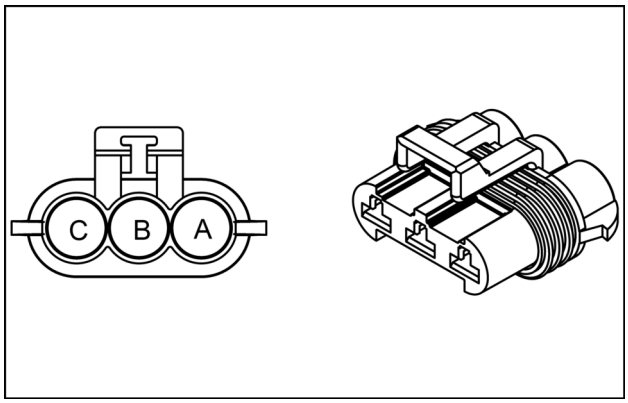


87581782 2

87581782

Pin	From	Wire	Description	Color-Size	Frame
1	SP-004-P-X	004B	004B	PK - 2.5	**SHEET 03**

X-207 - TO ENGINE GLOW PLUGS (87693326) (Female)

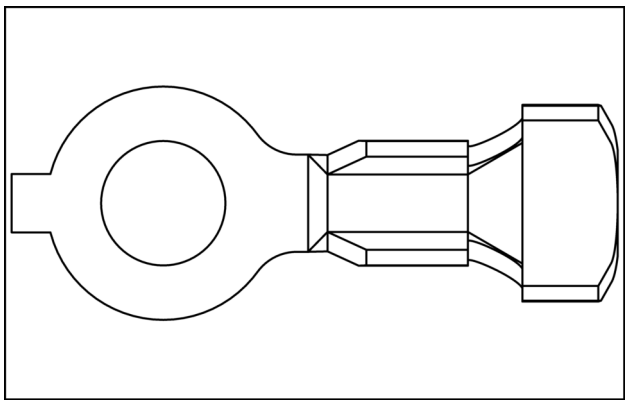


87693326 3

87693326

Pin	From	Wire	Description	Color-Size	Frame
B	**X-101 (Female) pin 7** GCU	153	153	GN - 1.5	**SHEET 08**
C	**X-101 (Female) pin 1** GCU	149	149	RD/GN - 1.5	

X-209 - ALTERNATOR D+ [G-002] (84477008) (Male)



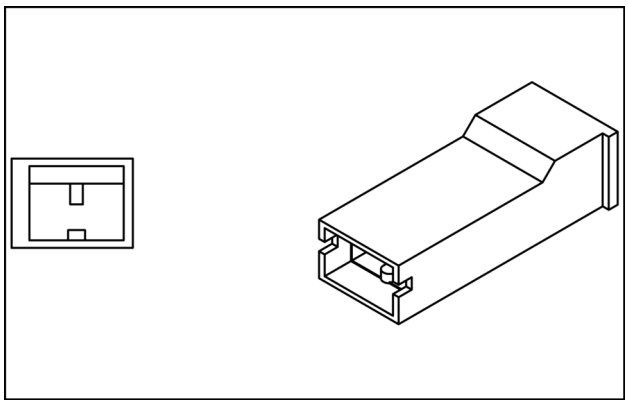
84477008 4

84477008

Pin	From	Wire	Description	Color-Size	Frame
1	**X-404B pin 9** MAIN-ENGINE INTERCONNECT	087	087	BR - 0.5	**SHEET 03**

Wire connectors - Component diagram 21

X-211 - AIR CLOG SWITCH (87581782) (Female)

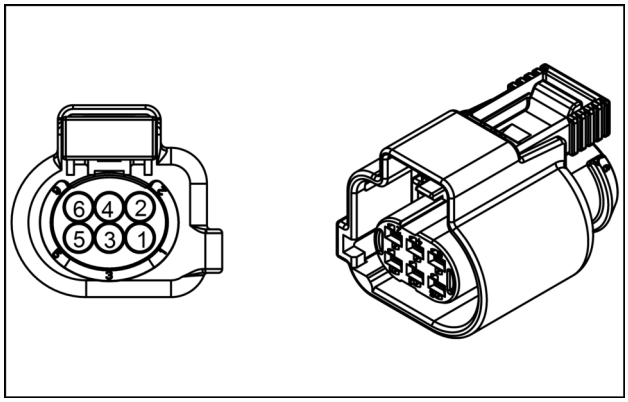


87581782 1

87581782

Pin	From	Wire	Description	Color-Size	Frame
1	SP-009-P-X	009J	009J	BK - 0.5	**SHEET 05**

X-212 - LAMBDA SENSOR (84301132) (Female)

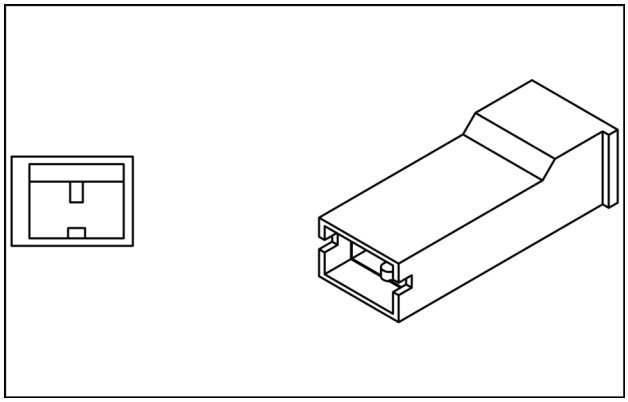


84301132 2

84301132

Pin	From	Wire	Description	Color-Size	Frame
1	**X-201 (Female) pin 64** ECU VEHICLE	144	144	OR - 0.75	**SHEET 08**
2	**X-201 (Female) pin 85** ECU VEHICLE	145	145	GN - 0.75	
3	**X-201 (Female) pin 7** ECU VEHICLE	146	146	GN - 1.0	
4	F-002-P-7 GEP - FUSE BOX	014	014	RD/GN - 1.0	
5	**X-201 (Female) pin 86** ECU VEHICLE	147	147	YE - 0.75	
6	**X-201 (Female) pin 63** ECU VEHICLE	148	148	PK - 0.75	

X-213 - AIR CLOG SWITCH (87581782) (Female)

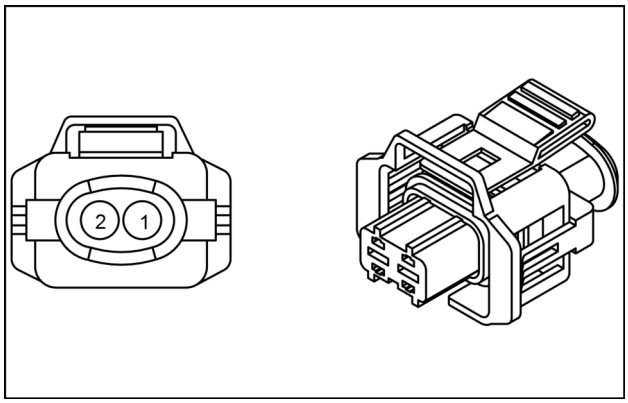


87581782 3

87581782

Pin	From	Wire	Description	Color-Size	Frame
1	**X-404B pin 18** MAIN-ENGINE INTERCONNECT	123	AIR CLOG SENSOR	BL/RD - 0.5	**SHEET 07**

X-214 - INLET DOC TEMP SENSOR (87709793) (Female)

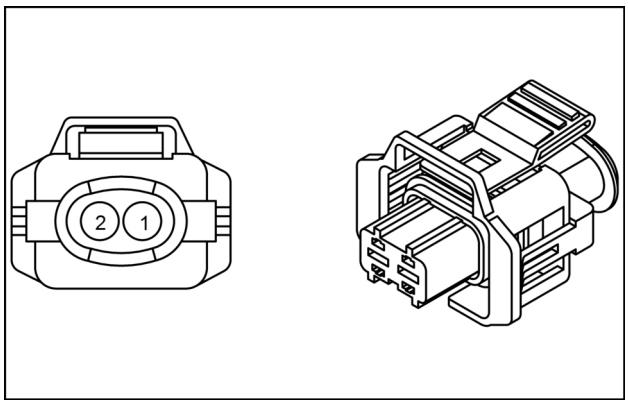


87709793 4

87709793

Pin	From	Wire	Description	Color-Size	Frame
1	**X-201 (Female) pin 80** ECU VEHICLE	173	173	BL/BK - 0.75	**SHEET 08**

X-215 - OUTLET POC TEMP SENSOR (87709793) (Female)

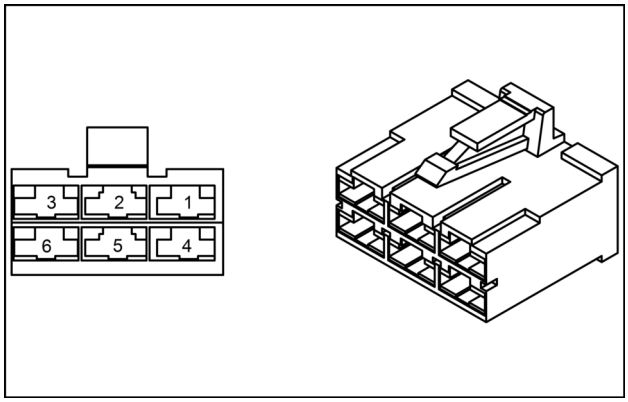


87709793 5

87709793

Pin	From	Wire	Description	Color-Size	Frame
2	**X-201 (Female) pin 83** ECU VEHICLE	182	182	GN/WH - 0.75	**SHEET 08**

X-216B - HEADLAMP INTERCONNECT (47405381) (Female)



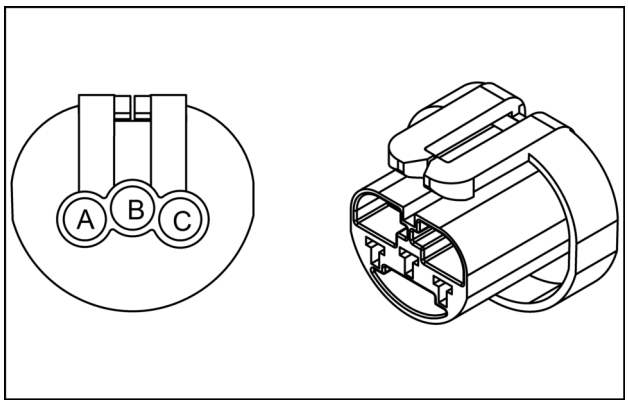
47405381 6

47405381

Pin	From	Wire	Description	Color-Size	Frame
1	**X-001 pin 45**	100	100	GN/YE - 1.5	**SHEET 10**
3	**X-406B pin 12** TO MAIN HARNESS	072	072	YE/BL - 1.0	**SHEET 06**
4	SP-009-P-X	009D	009D	BK - 1.0	**SHEET 05**
5	**X-001 pin 33**	032	WORK LAMP	OR - 1.5	**SHEET 10**

Wire connectors - Component diagram 30

X-301 - HEADLAMP RH (87697641) (Female)

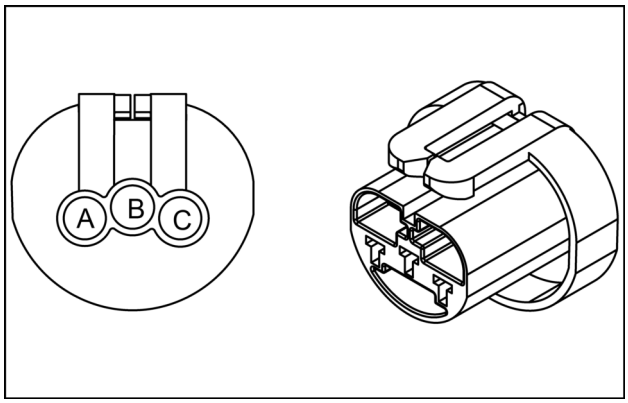


87697641 1

87697641

Pin	From	Wire	Description	Color-Size	Frame
A	SP-102-P-X	102B	102B	GY - 1.0	**SHEET 10**
B	SP-103-P-X	103D	103D	BK - 1.0	
C	SP-104-P-X	104B	104B	GN/YE - 1.5	

X-302 - HEADLAMP LH (87697641) (Female)

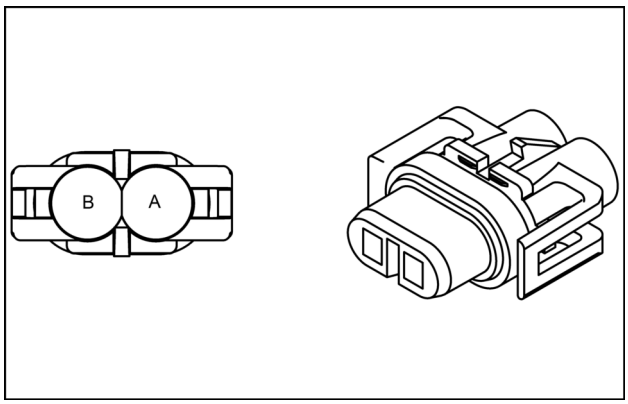


87697641 2

87697641

Pin	From	Wire	Description	Color-Size	Frame
A	SP-102-P-X	102A	102A	GY - 1.0	**SHEET 10**
B	SP-103-P-X	103A	103A	BK - 1.0	
C	SP-104-P-X	104A	104A	GN/YE - 1.5	

X-303 - WORKLAMP RH (82003123) (Female)

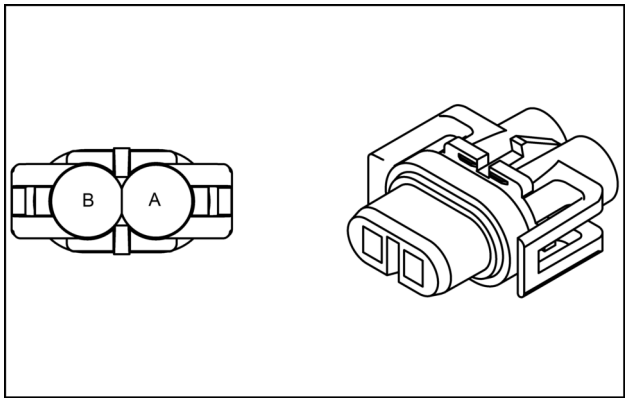


82003123 3

82003123

Pin	From	Wire	Description	Color-Size	Frame
A	SP-105-P-X	105B	105B	OR - 1.5	**SHEET 10**
B	SP-103-P-X	103E	103E	BK - 1.0	

X-304 - WORKLAMP LH (82003123) (Female)

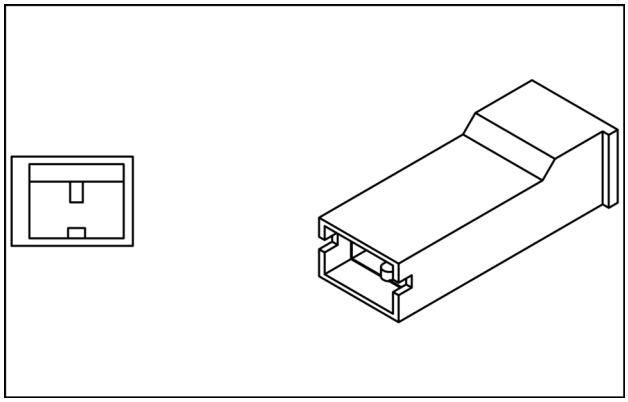


82003123 4

82003123

Pin	From	Wire	Description	Color-Size	Frame
A	SP-105-P-X	105A	105A	OR - 1.5	**SHEET 10**
B	SP-103-P-X	103B	103B	BK - 1.0	

X-305 - HORN (87581782) (Female)

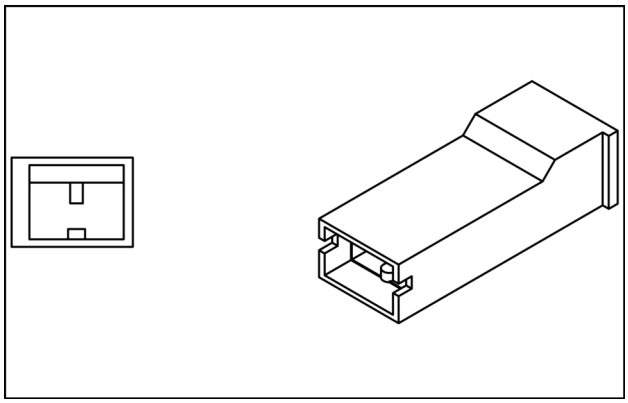


87581782 5

87581782

Pin	From	Wire	Description	Color-Size	Frame
1	X-216A-Male-P-3	106	106	YE/BL - 1.0	**SHEET 10**

X-306 - HORN GND (87581782) (Female)



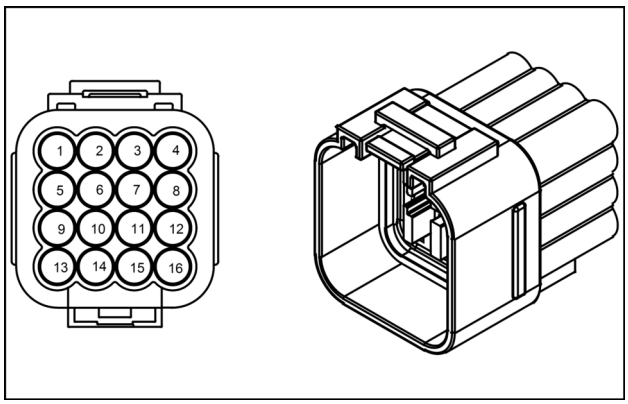
87581782 6

87581782

Pin	From	Wire	Description	Color-Size	Frame
1	SP-103-P-X	103C	103C	BK - 1.0	**SHEET 10**

Wire connectors - Component diagram 40

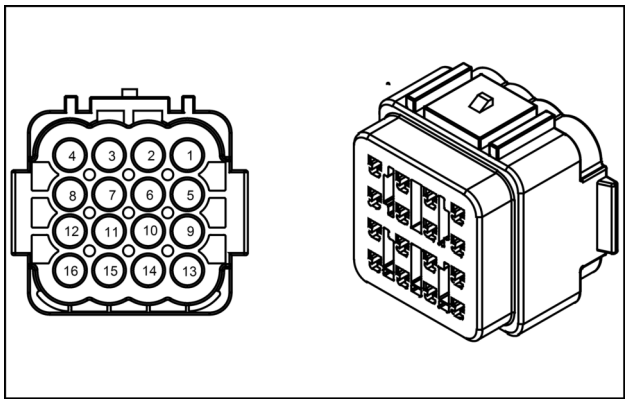
X-400A - MAIN-FENDER INTERCONNECT (47731490) (Female)



47731490 1

47731490

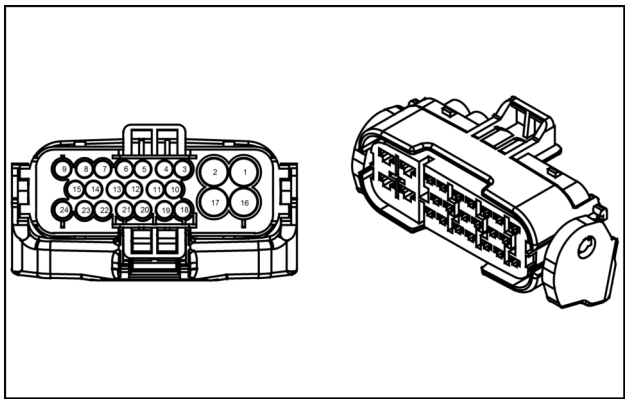
X-402B - MAIN-FENDER INTERCONNECT (47731489) (Female)



47731489 2

47731489

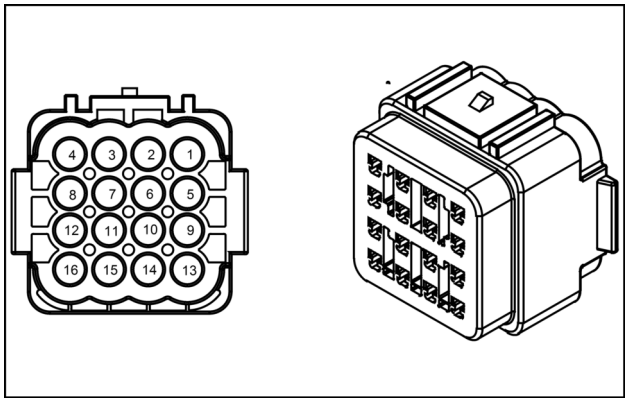
X-404B - MAIN-ENGINE INTERCONNECT (47731487) (Female)



47731487 3

47731487

X-406B - TO MAIN HARNESS (47731489) (Female)

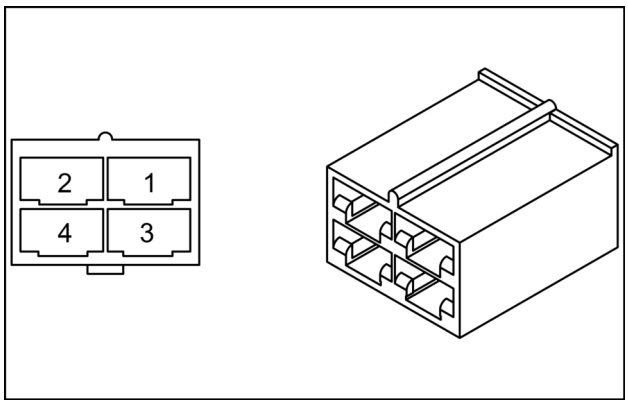


47731489 4

47731489

Wire connectors - Component diagram 50

X-502 - PTO SWITCH (84488490) (Female)

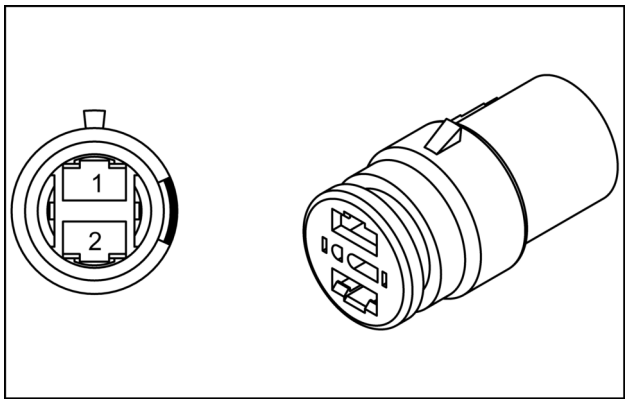


84488490 1

84488490

Pin	From	Wire	Description	Color-Size	Frame
1	SP-051-P-X	051B	051B	YE/RD - 0.75	**SHEET 09**
2	SP-051-P-X	051C	051C	YE/RD - 0.75	
3	**X-025 (Female) pin 1** CLUTCH SWITCH	052	052	GN/BK - 0.75	
4	X-400B-P-11	155	155	VT - 0.75	

X-503 - NEUTRAL SAFETY SWITCH (47413294) (Female)

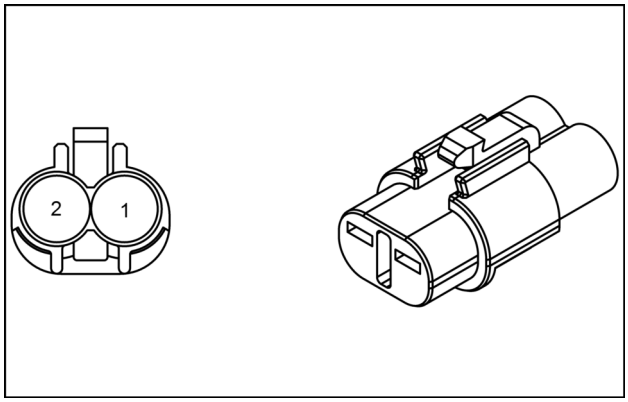


47413294 2

47413294

Pin	From	Wire	Description	Color-Size	Frame
1	SP-051-P-X	051F	051F	RD/YE - 1.0	**SHEET 09**
2	X-400B-P-10	097	097	RD/GN - 1.0	

X-504 - PARKING BRAKE SWITCH (84182898) (Female)

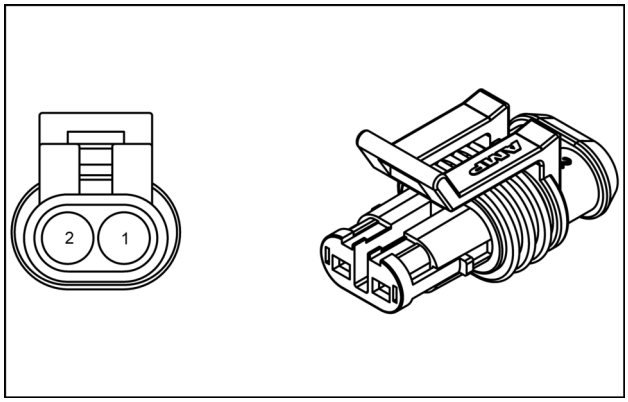


84182898 3

84182898

Pin	From	Wire	Description	Color-Size	Frame
1	X-402A-P-10	079	079	RD - 0.5	**SHEET 09**
2	X-402A-P-2	125	125	YE/BK - 0.5	

X-505 - HI/LOW SWITCH [HI-LOW SWITCH] (82012083) (Female)

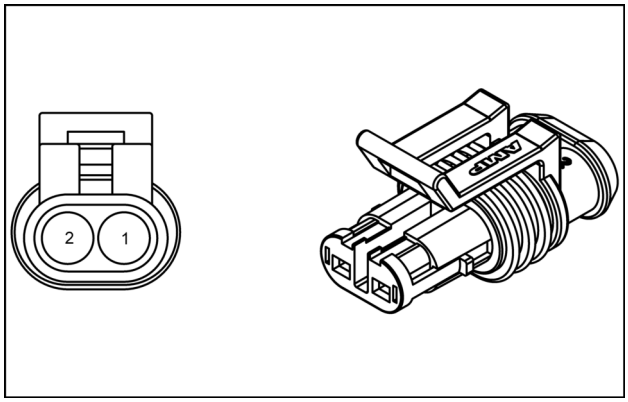


82012083 4

82012083

Pin	From	Wire	Description	Color-Size	Frame
1	**X-506 (Female) pin 1** PTO CLUTCH SENSOR	190	190	YE/GN - 0.75	**SHEET 09**
2	X-402A-P-12	199	199	YE/RD - 0.75	

X-506 - PTO CLUTCH SENSOR (82012083) (Female)

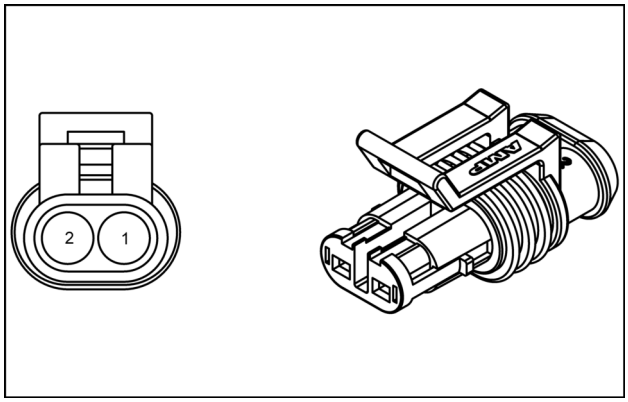


82012083 5

82012083

Pin	From	Wire	Description	Color-Size	Frame
1	**X-505 (Female) pin 1** HI/LOW SWITCH	190	190	YE/GN - 0.75	**SHEET 09**
2	X-402A-P-3	196	196	VT - 0.75	

X-507 - FUEL SENDER UNIT (82012083) (Female)



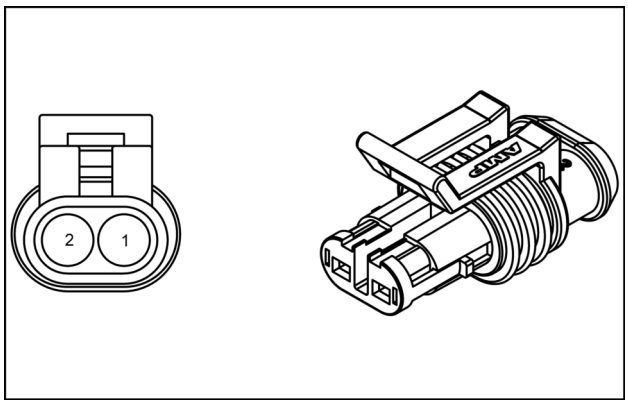
82012083 6

82012083

Pin	From	Wire	Description	Color-Size	Frame
1	SP-140-P-X	140B	SENSOR GND	BK - 1.0	**SHEET 07**
2	**X-050 (Female) pin 2** INSTRUMENT CLUSTER CN-1	042	FUEL SENDER UNIT	BL - 0.75	

Wire connectors - Component diagram 51

X-515A - TO JOYSTICK PIGTAIL (82012083) (Female)

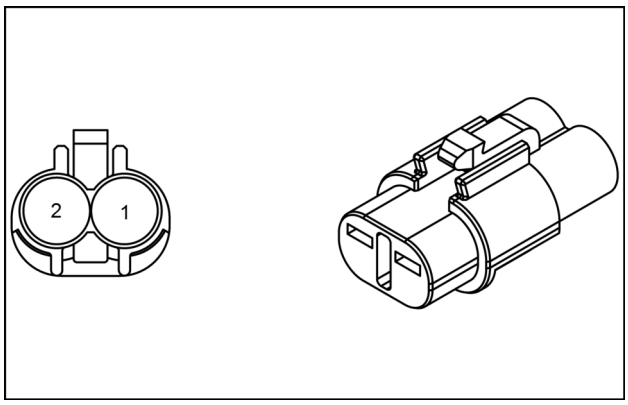


82012083 1

82012083

Pin	From	Wire	Description	Color-Size	Frame
1	X-400B-P-9	067	067	BL/YE - 0.5	**SHEET 06**
2	SP-010-P-X	010D	010D	BK - 0.5	

X-516 - BECON LAMP (84182898) (Female)

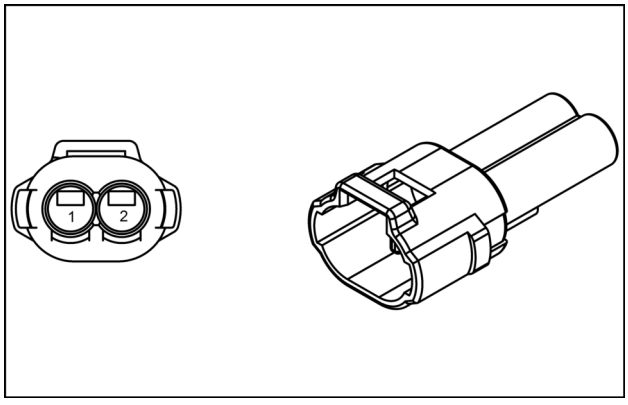


84182898 2

84182898

Pin	From	Wire	Description	Color-Size	Frame
1	SP-024-P-X	025	025	PK - 0.75	**SHEET 11**
2	SP-014-P-X	164E	164E	BK - 0.75	

X-517 - IMPLEMENT LAMP (84477032) (Male)

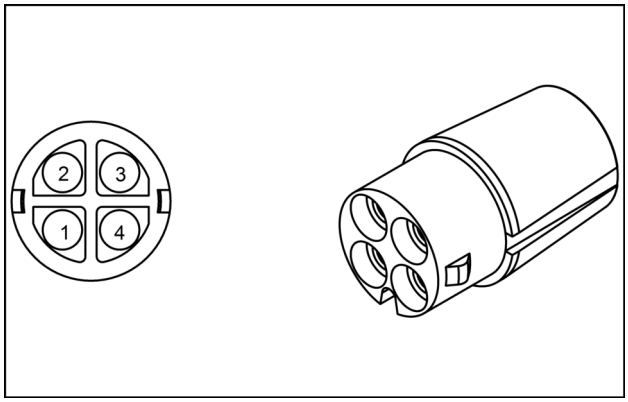


84477032 3

84477032

Pin	From	Wire	Description	Color-Size	Frame
1	SP-024-P-X	025C	025C	PK - 1.5	**SHEET 11**
2	SP-014-P-X	164D	164D	BK - 0.75	

X-518 - LICENCE LAMP (82000579) (Female)

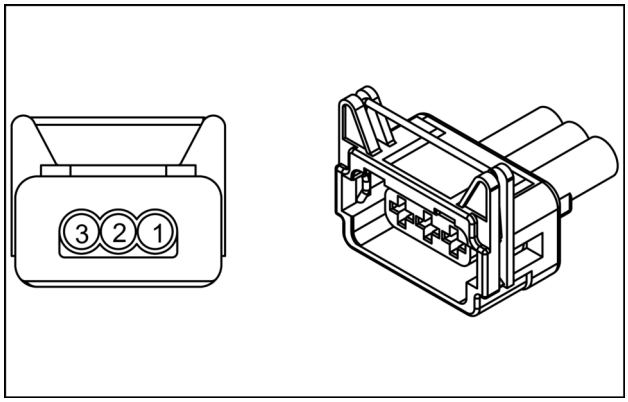


82000579 4

82000579

Pin	From	Wire	Description	Color-Size	Frame
1	SP-020-P-X	169	169	RD/WH - 0.5	**SHEET 11**
4	SP-014-P-X	164C	164C	BK - 0.75	

X-519 - SPEED SENSOR PTO (82865818) (Female)



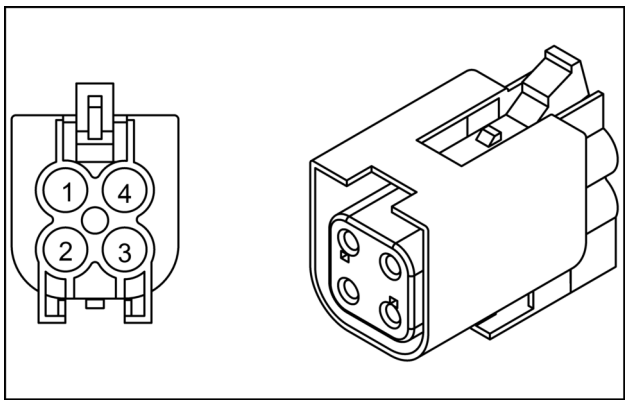
82865818 5

82865818

Pin	From	Wire	Description	Color-Size	Frame
1	SP-051-P-X	051E	051E	OR - 1.0	**SHEET 07**
2	X-402A-P-11	194	PTO SPEED SENSOR	R-B - 1.0	
3	SP-010-P-X	010C	010C	BK - 1.0	**SHEET 05**

Wire connectors - Component diagram 52

X-520 - LOADER JOYSTICK [S-009] (87715977) (Female)



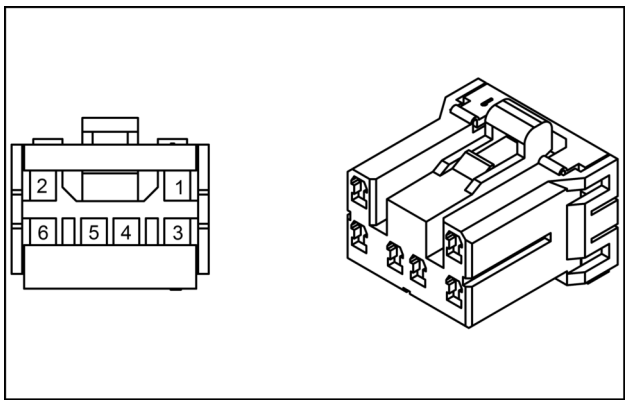
87715977 1

87715977

Pin	From	Wire	Description	Color-Size	Frame
3	X-515B-Male-P-2	0002	0002	BK - 0.5	**SHEET 06**
4	X-515B-Male-P-1	0001	0001	BL/YE - 0.5	

Wire connectors - Component diagram 60

X-602A - TO TRAILER HARNESS (84253498) (Female)

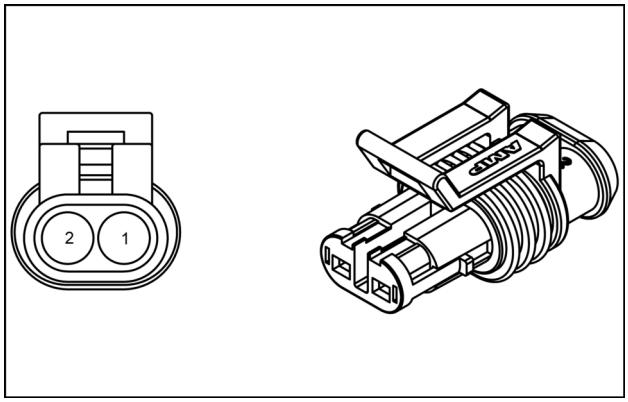


84253498 1

84253498

Pin	From	Wire	Description	Color-Size	Frame
1	SP-163-P-X	033	033	YE - 0.75	**SHEET 11**
2	SP-010-P-X	010A	010A	BK - 1.0	**SHEET 05**
3	SP-161-P-X	035	035	OR - 0.75	**SHEET 11**
6	SP-020-P-X	037	037	BR - 0.75	

X-605 - SEAT SWITCH (82012083) (Female)



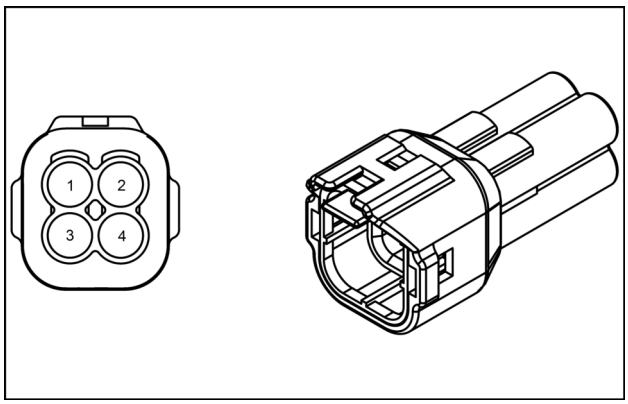
82012083 2

82012083

Pin	From	Wire	Description	Color-Size	Frame
1	SP-051-P-X	051D	051D	YE/RD - 0.75	**SHEET 09**
2	X-400B-P-12	135	135	PK/WH - 0.5	

Wire connectors - Component diagram 61

X-612 - ROPE LAMP RH (84182907) (Male)

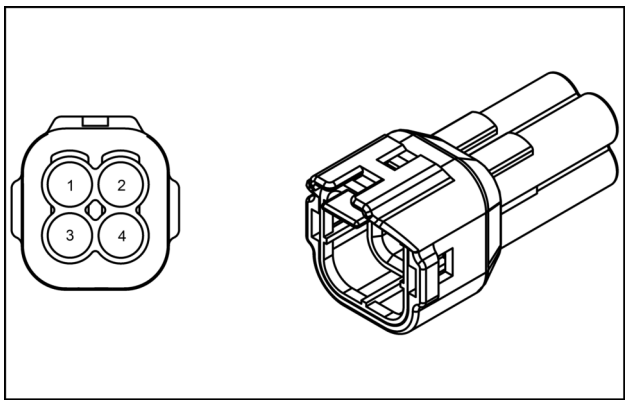


84182907 1

84182907

Pin	From	Wire	Description	Color-Size	Frame
3	SP-014-P-X	164B	164B	BK - 0.75	**SHEET 11**
4	SP-020-P-X	172	172	BL/BK - 0.75	

X-613 - ROPE LAMP LH (84182907) (Male)



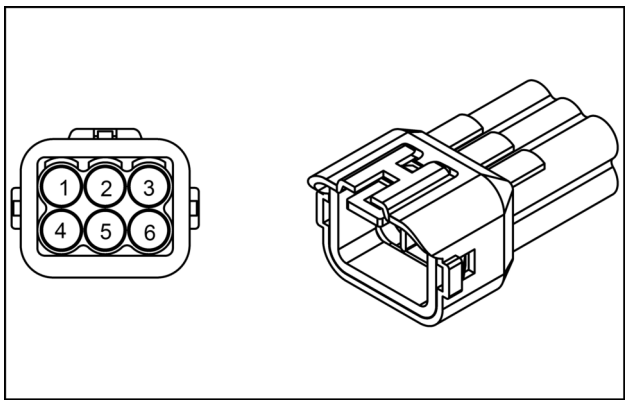
84182907 2

84182907

Pin	From	Wire	Description	Color-Size	Frame
1	SP-163-P-X	163	163	LG - 0.5	**SHEET 11**
2	X-400B-P-7	111	111	GY - 0.75	
3	SP-014-P-X	164A	164A	BK - 0.75	
4	SP-020-P-X	171	171	BL/BK - 0.75	

Wire connectors - Component diagram 70

X-702A - TO DIAGONESTIC SOCKET (47511905) (Female)

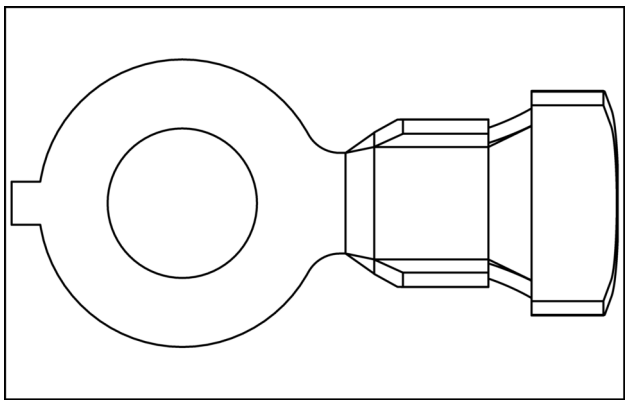


47511905 1

47511905

Wire connectors - Component diagram 71

X-712 - ALTERNATOR B+ (84488486) (Male)

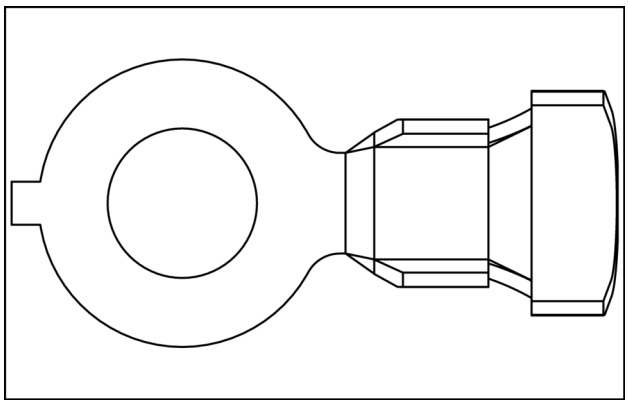


84488486 1

84488486

Pin	From	Wire	Description	Color-Size	Frame
1	**X-713 (Male) pin 1** TO STARTER MOTOR	003	ALTERNATOR CABLE	RD - 16.0	**SHEET 03**

X-713 - TO STARTER MOTOR (84488486) (Male)



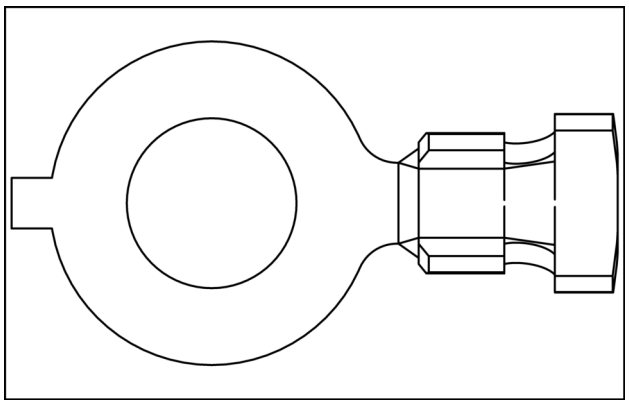
84488486 2

84488486

Pin	From	Wire	Description	Color-Size	Frame
1	**X-712 (Male) pin 1** ALTERNATOR B+	003	ALTERNATOR CABLE	RD - 16.0	**SHEET 03**

Wire connectors - Component diagram 90

X-901 - ALTERNATOR B+ (84488487) (Male)

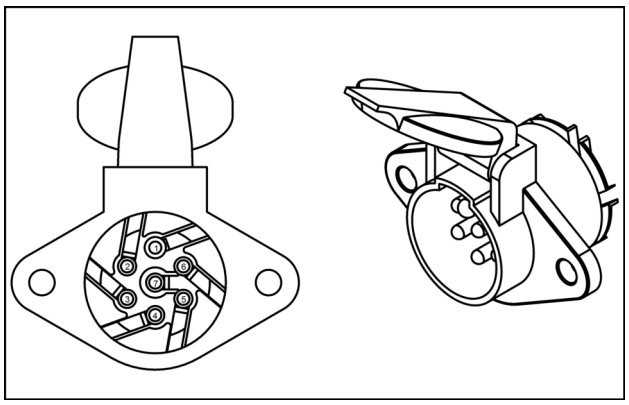


84488487 1

84488487

Pin	From	Wire	Description	Color-Size	Frame
1	**X-015 (Male) pin 1** TO MEGA FUSE	008	008	RD - 8.0	**SHEET 03**

X-902 - TRAILER SOCKET (84531642) (Male)



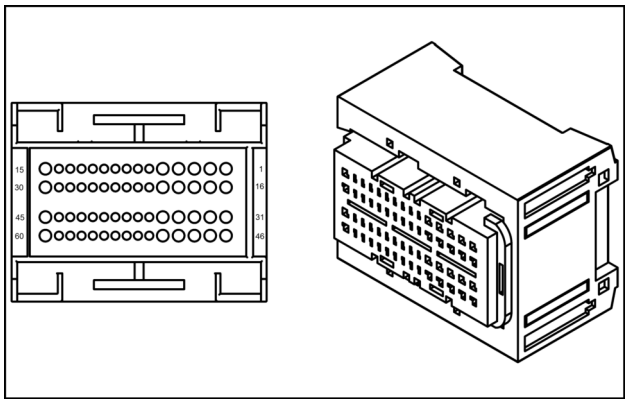
84531642 2

84531642

Pin	From	Wire	Description	Color-Size	Frame
1	X-602B-Male-P-2	201	201	WH - 1.0	**SHEET 12**
2	SP-011-P-X	202A	202A	BL - 0.75	
4	X-602B-Male-P-5	205	205	RD - 0.75	
6	SP-011-P-X	202B	202B	BL - 0.75	

Wire connectors - Component diagram 00 - Connectors X-9001 to X-9009

Connector X-9001 - Engine Control Unit (ECU) connector A



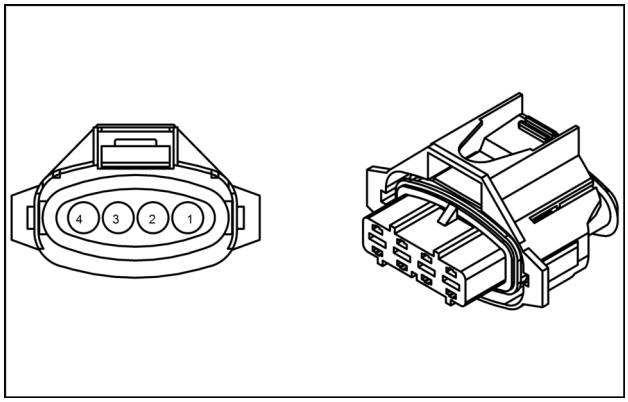
84474053 1

84474053

CONNECTOR X-9001 - ECU connector A			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
A01	EN-9128	High Side Driver (HSD), Bank 2 Injector 1 (Cylinder 3)	**SHEET 03**
A02	-	-	
A03	-	-	
A04	-	-	
A05	-	-	
A06	EN-9105	Input signal, Oil pressure switch	**SHEET 03**
A07	-	-	
A08	EN-9098	**+5 V** sensor supply, Throttle Valve Actuator (TVA) position sensor	**SHEET 03**
A09	-	-	
A10	EN-9101	**+5 V** sensor supply, Intake manifold pressure sensor	**SHEET 03**
A11	EN-9108	**+5 V** sensor supply, Rail pressure sensor	
A12	-	-	
A13	EN-9109	**+5 V** sensor supply, Camshaft speed sensor	**SHEET 03**
A14	EN-9111	Input signal, Camshaft speed sensor	
A15	EN-9136	Switched voltage supply, Fuel metering unit	
A16	EN-9125	HSD, Bank 1 Injector 1 (Cylinder 1)	
A17	EN-9129	HSD, Bank 1 Injector 2 (Cylinder 2)	
A18	-	-	
A19	-	-	
A20	-	-	
A21	-	-	
A22	-	-	
A23	EN-9116	Reference ground, Fuel temperature sensor	**SHEET 03**
A24	-	-	
A25	EN-9103	Reference ground, Intake manifold pressure sensor	**SHEET 03**
A26	EN-9106	Reference ground, Rail pressure sensor	
A27	-	-	

CONNECTOR X-9001 - ECU connector A			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
A28	EN-9110	Reference ground, Camshaft speed sensor	**SHEET 03**
A29	-	-	
A30	-	-	
A31	EN-9128	Low Side Driver (LSD), Bank 2 Injector 1 (Cylinder 3)	**SHEET 03**
A32	EN-9126	LSD, Bank 1 Injector 1 (Cylinder 1)	
A33	-	-	
A34	EN-9135	H-bridge Pulse-Width Modulated supply, TVA motor	**SHEET 03**
A35	-	-	
A36	-	-	
A37	EN-9100	Reference ground, TVA position sensor	**SHEET 03**
A38	EN-9117	Input signal, Fuel temperature sensor	
A39	-	-	
A40	EN-9102	Input signal, Intake manifold pressure sensor	**SHEET 03**
A41	EN-9107	Input signal, Rail pressure sensor	
A42	-	-	
A43	-	-	
A44	EN-9139	Input signal, negative, Crankshaft position sensor	**SHEET 03**
A45	-	-	
A46	-	-	
A47	-	-	
A48	EN-9130	LSD, Bank 1 Injector 2 (Cylinder 2)	**SHEET 03**
A49	EN-9134	H-bridge Pulse-Width Modulated supply, TVA motor	
A50	-	-	
A51	-	-	
A52	-	-	
A53	EN-9099	Input signal, TVA position sensor	**SHEET 03**
A54	-	-	
A55	EN-9104	Input signal, Intake manifold temperature sensor	**SHEET 03**
A56	-	-	
A57	EN-9115	Input signal, Coolant temperature sensor	**SHEET 03**
A58	EN-9141	Reference ground, Coolant temperature sensor	
A59	EN-9138	Input signal, positive, Crankshaft position sensor	
A60	EN-9137	LSD, Fuel metering unit	

Connector X-9003 - Intake manifold pressure and temperature sensor

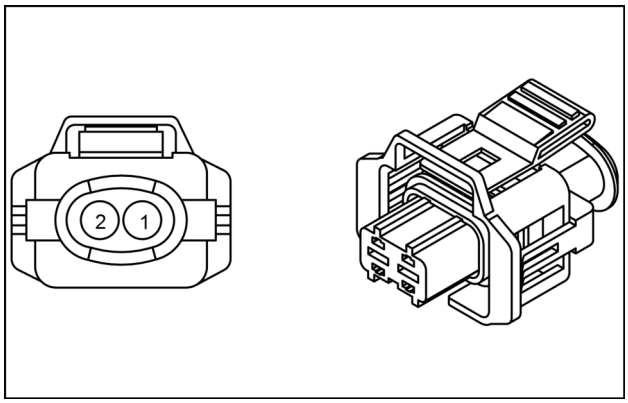


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CONNECTOR X-9003 - Intake manifold pressure and temperature sensor			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	EN-9103	Engine Control Unit (ECU) reference ground, pressure and temperature	**SHEET 03**
2	EN-9104	ECU input signal, temperature	
3	EN-9101	ECU **+5 V** sensor supply, pressure sensor	
4	EN-9102	ECU input signal, pressure	

Connector X-9005 - Fuel temperature sensor

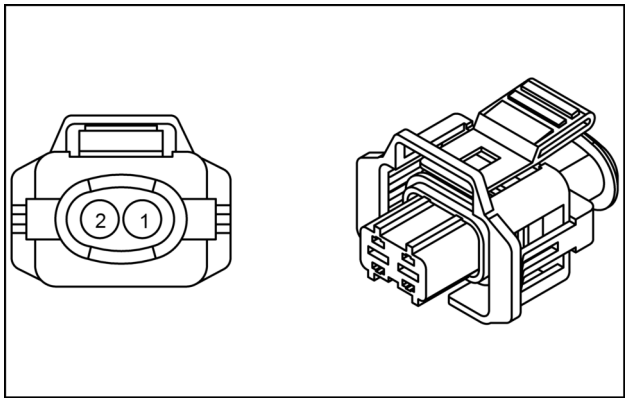


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CONNECTOR X-9005 - Fuel temperature sensor			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	EN-9117	Engine Control Unit (ECU) input signal, temperature	**SHEET 03**
2	EN-9116	ECU reference ground	

Connector X-9006 - Coolant temperature sensor

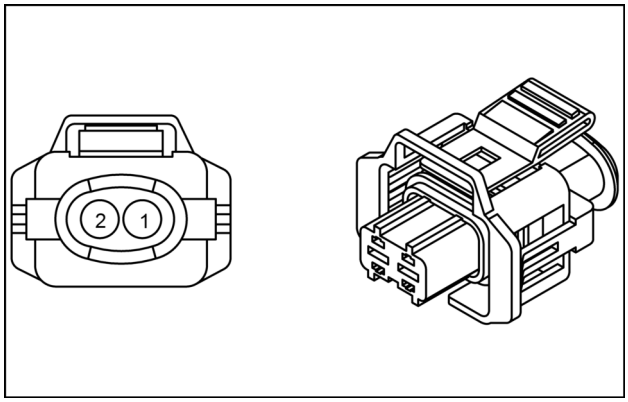


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CONNECTOR X-9006 - Coolant temperature sensor			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	EN-9115	Engine Control Unit (ECU) input signal, temperature	**SHEET 03**
2	EN-9114	ECU reference ground	

Connector X-9007 - Fuel metering unit

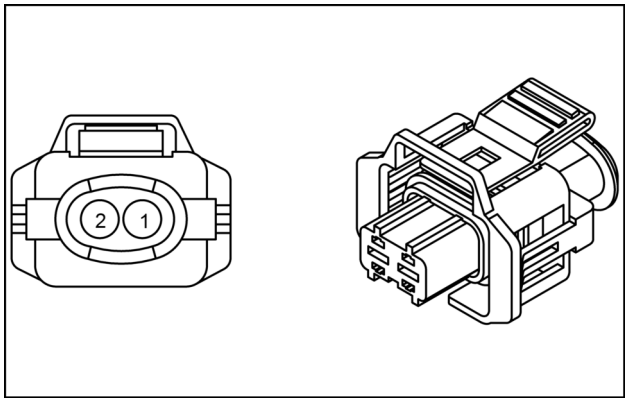


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CONNECTOR X-9007 - Fuel metering unit			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	EN-9137	Switched **12 V** supply voltage, Engine Control Unit (ECU)	**SHEET 03**
2	EN-9136	PWM Low side driver, ECU	

Connector X-9008 - Camshaft phase sensor



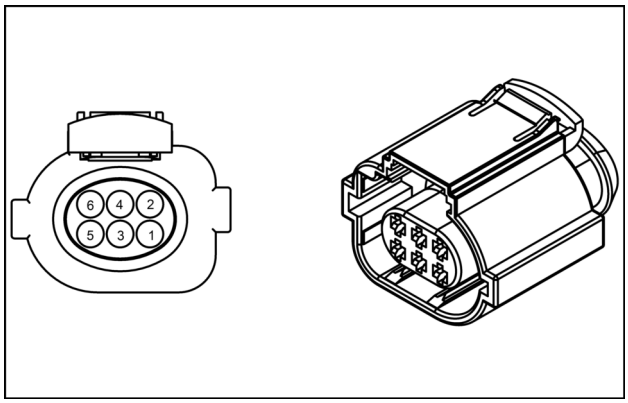
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CONNECTOR X-9008 - Camshaft phase sensor			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	EN-9110	Reference ground, Engine Control Unit (ECU)	**SHEET 03**
2	EN-9111	Input signal, ECU	
3	EN-9109	**+5 V** sensor supply, ECU	

Wire connectors - Component diagram 01 - Connectors X-9010 to X-9019

Connector X-9011 - Throttle Valve Actuator (TVA)

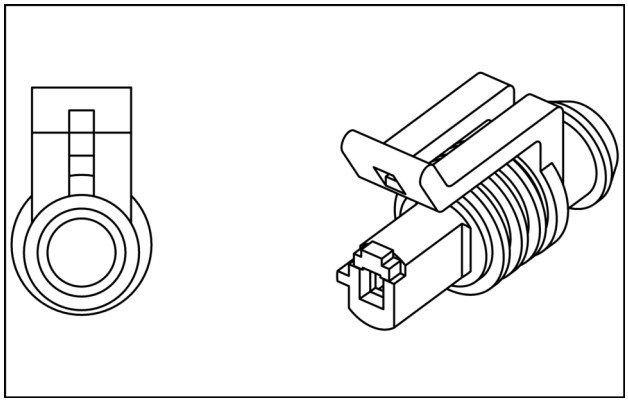


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CONNECTOR X-9011 - TVA			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	EN-9098	**+5 V** sensor supply, Engine Control Unit (ECU)	**SHEET 03**
2	EN-9135	H-bridge Pulse-Width Modulated (PWM) supply, ECU	
3	EN-9100	Reference ground, ECU	
4	-		
5	EN-9099	Position signal, ECU	**SHEET 03**
6	EN-9134	H-bridge Pulse-Width Modulated (PWM) supply, ECU	

Connector X-9016 - Oil pressure switch



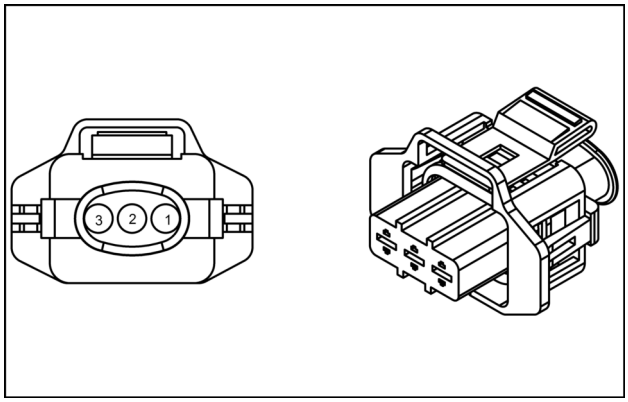
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CONNECTOR X-9016 - Oil pressure switch			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	EN-9105	Input signal, Engine Control Unit (ECU)	**SHEET 03**

Wire connectors - Component diagram 02 - Connectors X-9020 to X-9029

Connector X-9026 - Rail pressure sensor



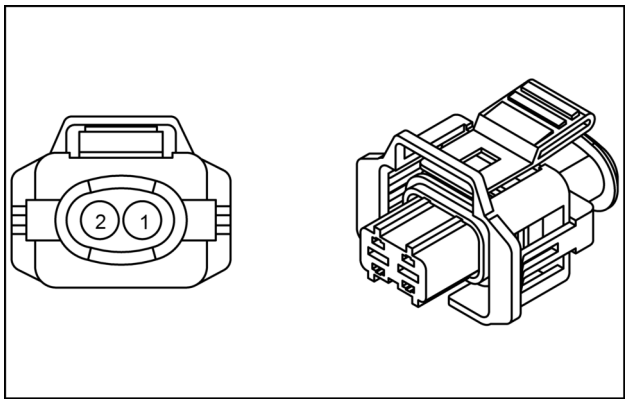
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CONNECTOR X-9026 - Rail pressure sensor			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	EN-9106	Reference ground, Engine Control Unit (ECU)	**SHEET 03**
2	EN-9107	Input signal, ECU	
3	EN-9108	**+5 V** sensor supply, ECU	

Wire connectors - Component diagram 03 - Connectors X-9030 to X-9039

Connector X-9030 - Cylinder 1 injector (Bank 1 Injector 1)

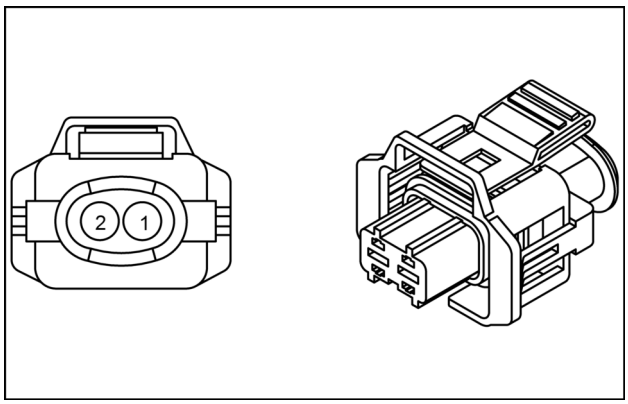


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CONNECTOR X-9030 - Cylinder 1 injector			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	EN-9125	High Side Driver (HSD), Engine Control Unit (ECU)	**SHEET 03**
2	EN-9126	Low Side Driver (LSD), Engine Control Unit (ECU)	

Connector X-9031 - Cylinder 3 injector (Bank 2 Injector 1)

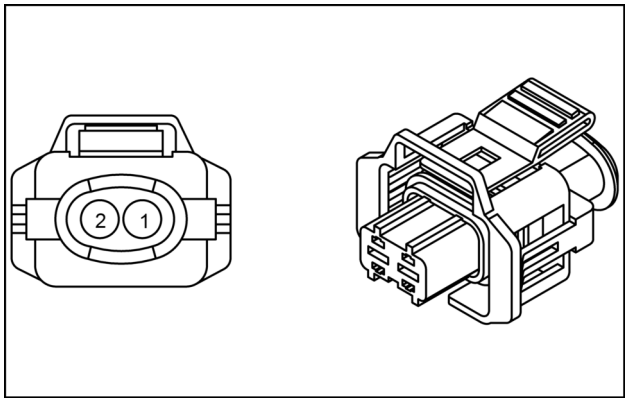


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CONNECTOR X-9031 - Cylinder 3 injector			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	EN-9127	High Side Driver (HSD), Engine Control Unit (ECU)	**SHEET 03**
2	EN-9128	Low Side Driver (LSD), Engine Control Unit (ECU)	

Connector X-9032 - Cylinder 2 injector (Bank 1 injector 2)

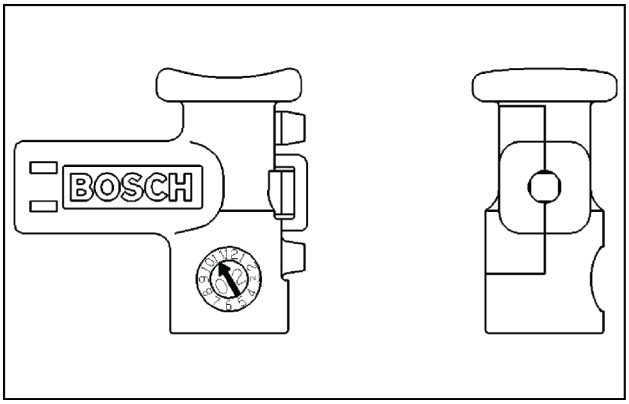


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CONNECTOR X-9032 - Cylinder 2 injector			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	EN-9129	High Side Driver (HSD), Engine Control Unit (ECU)	**SHEET 03**
2	EN-9130	Low Side Driver (LSD), Engine Control Unit (ECU)	

Connector X-9034 - Cylinder 1 glow plug

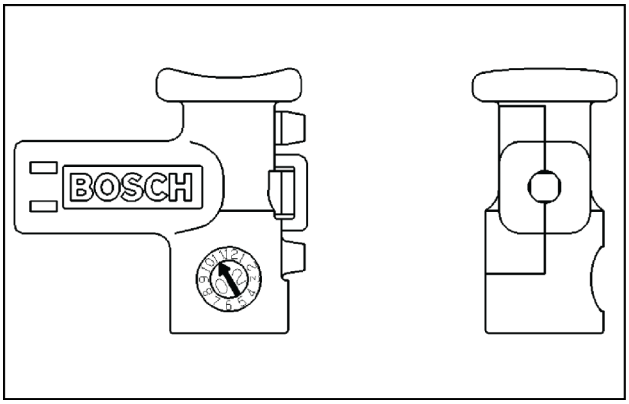


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CONNECTOR X-9034 - Cylinder 1 glow plug			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	GP-1	Glow plug supply	**SHEET 01**

Connector X-9035 - Cylinder 2 glow plug

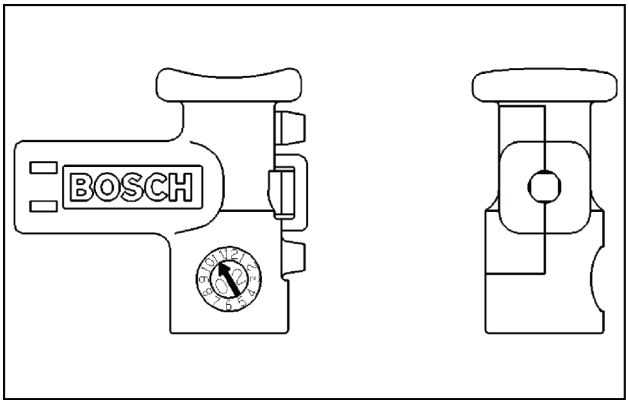


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CONNECTOR X-9035 - Cylinder 2 glow plug			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	GP-2	Glow plug supply	**SHEET 01**

Connector X-9036 - Cylinder 3 glow plug

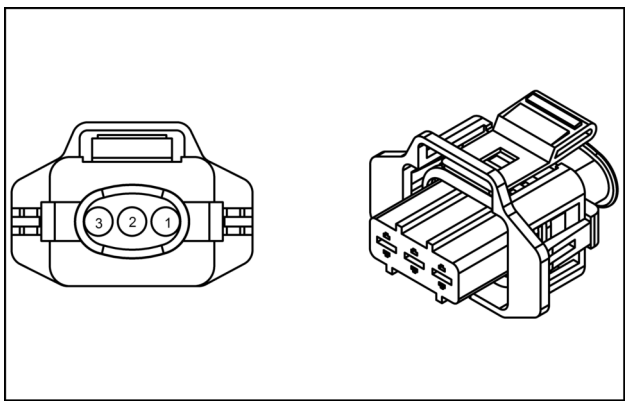


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CONNECTOR X-9036 - Cylinder 3 glow plug			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	GP-3	Glow plug supply	**SHEET 01**

Connector X-9039 - Crankshaft speed sensor



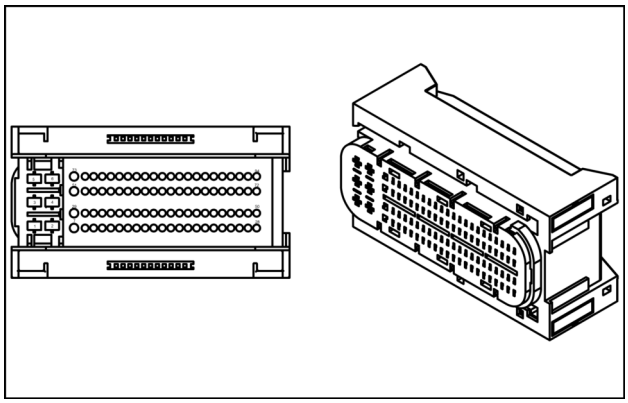
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CONNECTOR X-9039 - Crankshaft speed sensor			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	EN-9138	Input signal, positive, Engine Control Unit (ECU)	**SHEET 03**
2	EN-9139	Input signal, negative, Engine Control Unit (ECU)	
3	EN-9140	Reference ground, Engine Control Unit (ECU)	

Wire connectors - Component diagram 10 - Connectors X-9101 to X-9109

Connector X-9102 - Engine Control Unit (ECU) connector K



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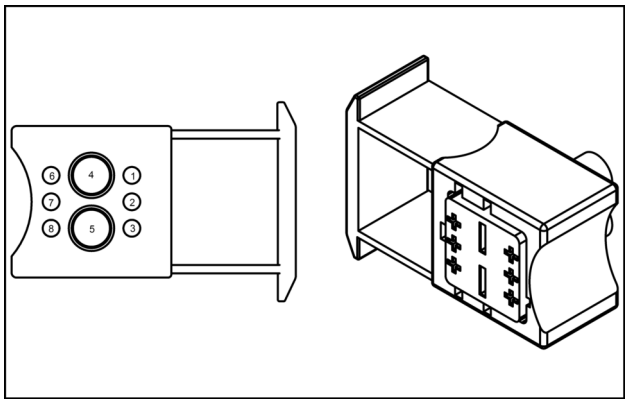
CONNECTOR X-9102 - ECU connector K			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
K01	VE-9083	Main relay switched fused supply, independent source	**SHEET 02**
K02	VE-9210	Ground, Battery minus (negative) terminal	
K03	VE-9079	Main relay switched fused supply, shared source (K05)	
K04	VE-9211	Ground, Battery minus (negative) terminal	
K05	VE-9076	Main relay switched fused supply, shared source (K03)	
K06	VE-9212	Ground, Battery minus (negative) terminal	
K07	VE-9200	Low Side Driver (LSD), DEF/AdBlue® tank heating valve	
K08	VE-9048	Input signal, Key switch start position	
K09	-	-	
K10	-	-	
K11	-	-	
K12	-	-	
K13	-	-	
K14	-	-	
K15	-	-	
K16	-	-	
K17	-	-	
K18	-	-	
K19	-	-	
K20	-	-	
K21	-	-	
K22	VE-9073	Input signal, Glow-plug Control Unit (GCU) feedback	**SHEET 02**
K23	-	-	
K24	VE-####	CAN 1 High, Diagnostic and maintenance connector	**SHEET 02**
K25	VE-####	CAN 1 Low, Diagnostic and maintenance connector	
K26	-	-	

CONNECTOR X-9102 - ECU connector K			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
K27	VE-9174	LSD, Starter control relay	**SHEET 02**
K28	VE-9084	LSD, Main relay	
K29	-	-	
K30	-	-	
K31	-	-	
k32	-	-	
K33	-	-	
K34	-	-	
K35	-	-	
K36	-	-	
K37			
K38			
K39	-	-	
K40	-	-	
K41	VE-9074	Reference ground, GCU	**SHEET 02**
K42	-	-	
K43	-	-	
K44	-	-	
K45	-	-	
K46	-	-	
K47	-	-	
K48	-	-	
K49	-	-	
K50	-	-	
K51	-	-	
K52	VE-9072	LSD, GCU	**SHEET 02**
K53	VE-9173	HSD, Starter control relay	
K54	VE-9053	Input signal, Key switch ON/ACC position	
K55	-	-	
K56	-	-	
K57	-	-	
K58	-	-	
K59	-	-	
K60	-	-	
K61	-	-	
K62	-	-	
K63	VE-9156	Input signal, Lambda sensor voltage nernst	**SHEET 02**
K64	VE-9154	Input signal, Lambda sensor current pump	
K65	-	-	
K66	-	-	
K67	-	-	
K68		ISO-K Interface, Diagnostic and monitoring connector K-line	**SHEET 02**
K69	-	-	
K70	-	-	
K71	-	-	
K72	-	-	
K73	-	-	
K74	-	-	
K75	-	-	
K76	-	-	
K77	-	-	

CONNECTOR X-9102 - ECU connector K			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
K78	-	-	
K79	VE-9188	Reference ground, Exhaust gas temperature DOC sensor	**SHEET 02**
K80	VE-9147	Input signal, Exhaust gas temperature DOC sensor	
K81	-	-	
K82	-	-	
K83	VE-9153	Reference ground, Exhaust gas temperature POC sensor	**SHEET 02**
K84	VE-9152	Input signal, Exhaust gas temperature POC sensor	
K85	VE-9155	Reference ground, Lambda sensor	
K86	VE-9157	Input signal, Lambda sensor current adjust	
K87	-	-	
K88	VE-9077	Input signal, Water in fuel switch	**SHEET 02**
K89	-	-	
K90	-	-	
K91	-	-	
K92	-	-	
K93	-	-	
K94	-	-	

Wire connectors - Component diagram 11 - Connectors X-9110 to X-9119

Connector X-9113 - Glow-plugs control unit



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CONNECTOR X-9113 - Glow-plugs control unit			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	VE-9060	High Side Driver (HSD), Glow-plug 3	**SHEET 01**
2	VE-9058	High Side Driver (HSD), Glow-plug 1	
3	VE-9073	Feedback signal, Engine Control Unit (ECU)	
4	VE-9062	**12 V** Supply, Battery positive	
5	VE-9074	Reference ground, ECU	
6	-	-	
7	VE-9059	High Side Driver (HSD), Glow-plug 2	**SHEET 01**
8	VE-9072	Control signal, ECU	

Connector X-9116 - Engine shut-off relay

NOTE: *Relays are in product relay panels. See product service manual for pinout image of this connector.*

CONNECTOR X-9116 - Engine shut-off relay			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
85	VE-9089	Switched battery voltage, Power relay	**SHEET 02**
86	VE-####	Low side control, Operator safety module	
30	VE-9053	Key switch signal (T50), Engine Control Unit (ECU)	
87A	-	-	
87	VE-9088, VE-9089	Switched battery voltage, Power relay	**SHEET 02**

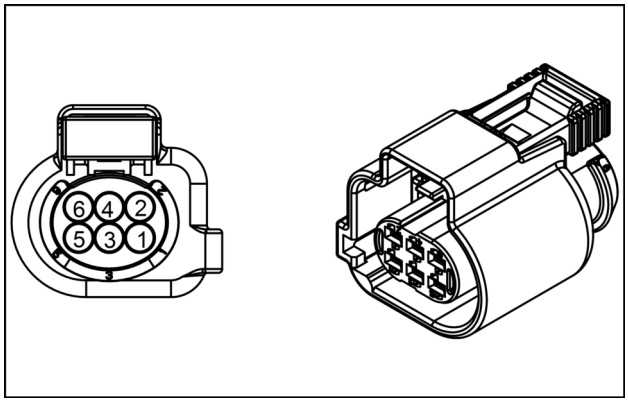
Wire connectors - Component diagram 12 - Connectors X-9120 to X-9129

Connector X-9120 - ECU start relay

NOTE: *Relays are in product relay panels. See product service manual for pinout image of this connector.*

CONNECTOR X-9120 - ECU start relay			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
30	VE-####	Switched **12 V** source, Neutral switch	**SHEET 01**
85	VE-9174	Low side switched control, Engine Control Unit (ECU)	
86	VE-9173	High side switched control, ECU	
87	VE-####	High side control, Crank relay	
87A	-	-	

Connector X-9123 - Lambda sensor

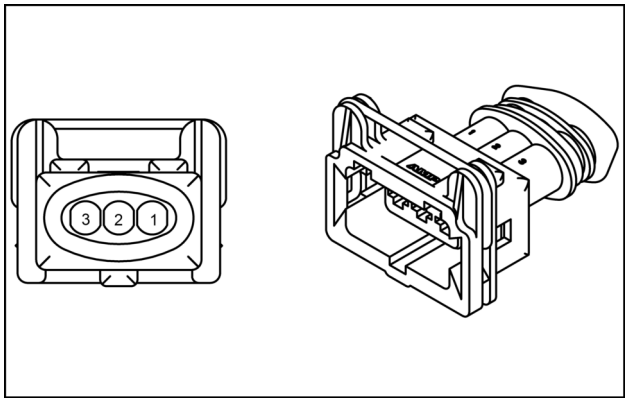


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CONNECTOR X-9123 - Lambda sensor			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	VE-9154	Current pump input, Engine Control Unit (ECU)	**SHEET 02**
2	VE-9155	Reference ground, ECU	
3	VE-9200	Low side switched control, ECU	
4	VE-9081	Switched **12 V** source, Main ECU power relay	
5	VE-9157	Current adjust input, ECU	
6	VE-9156	Nernst voltage input, ECU	

Connector X-9125 - Water in fuel sensor

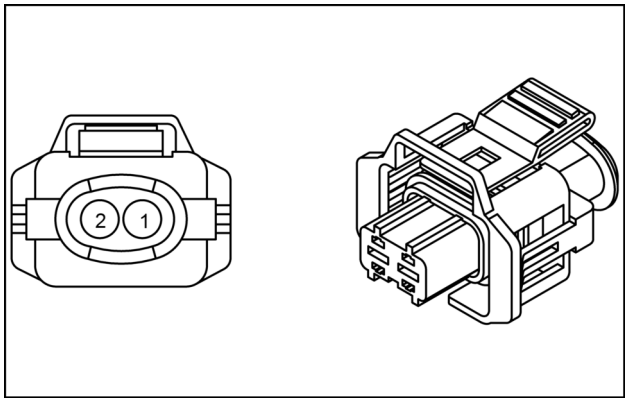


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CONNECTOR X-9125 - Water in fuel sensor			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	VE-9077	Input signal, Engine Control Unit (ECU)	**SHEET 02**
2	VE-9085	Switched source voltage, Main ECU power relay	
3	VE-9078	Frame ground	

Connector X-9126 - Exhaust gas temperature Diesel Oxidation Catalyst (DOC) sensor

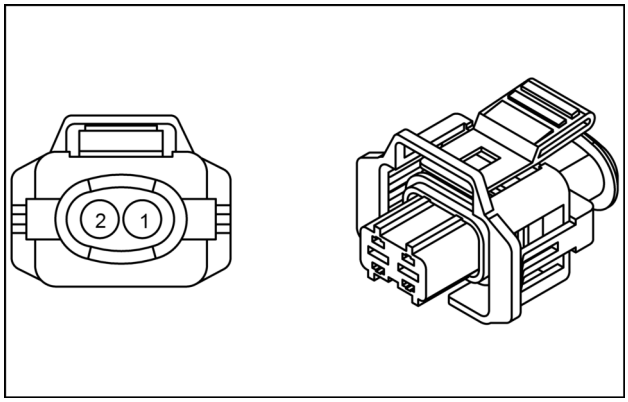


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CONNECTOR X-9126 - Exhaust gas temperature DOC sensor			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	VE-9147	Input signal, Engine Control Unit (ECU)	**SHEET 02**
2	VE-9188	Reference ground, ECU	

Connector X-9127 - Exhaust gas temperature Pre-Oxidation Catalyst (POC) sensor



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CONNECTOR X-9127 - Exhaust gas temperature POC sensor			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	VE-9152	Input signal, Engine Control Unit (ECU)	**SHEET 02**
2	VE-9153	Reference ground, ECU	

Connector X-9129 - Main ECU power relay

NOTE: *Relays are in product relay panels. See product service manual for pinout image of this connector.*

CONNECTOR X-9129 - Main ECU power relay			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
30	VE-9087, VE-9086	**12 V** source, Battery positive	**SHEET 02**
85	VE-9086	**12 V** source, battery positive	
86	VE-9084	Low side switched control, Engine Control Unit (ECU)	
87	VE-9082	Controlled source, fuse panel	
87A	-	-	

Electrical components - Fuse description

F-001 - MEGA FUSE (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 03**
Connectors	**X-015 (Male)** **X-017 (Male)**

F-002 - GEP - FUSE BOX (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 02** **SHEET 04** **SHEET 05** **SHEET 09**

F-003 - FUSE ECU 01 (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 02** **SHEET 06**

F-004 - FUSE ECU 02 (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 02**

F-005 - LAMBDA PROBES (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 02**

F-006 - CLUSTER HOT (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 02**

F-007 - WORK LAMP (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 02**

F-008 - HIGH/LOW BEAM (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 02**

F-009 - STARTER SWITCH (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 02**

F-010 - HEATER (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 02**

F-011 - LOADER (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 02**

F-012 - ECU/SAFETY START (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 02**

F-013 - DUMMY1 (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 02**

F-014 - DUMMY2 (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 02**

F-015 - FLASHER (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 06**

F-016 - CLUSTER / FT (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 06**

F-017 - HAZARD HOT (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 06**

F-018 - HORN/ LIGHT SW (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 06**

F-019 - SAFETY LOGIC (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 06**

F-020 - BECON LAMP (Fuse)

Component Type	Fuse
Wiring frames	**SHEET 06**

Electrical components - Voltage source description

G-001 - BATTERY (Voltage source)

Component Type	Voltage source
Wiring frames	**SHEET 03**
Connectors	**X-001A (Male)** **X-001B (Male)**

G-002 - ALTERNATOR (Voltage source)

Component Type	Voltage source
Wiring frames	**SHEET 03**
Connectors	**X-209 (Male)**

Electrical components - Relay description

K-001 - ECU POWER (Relay)

Component Type	Relay
Wiring frames	**SHEET 02**

K-002 - CRANKING RELAY (Relay)

Component Type	Relay
Wiring frames	**SHEET 02**

K-003 - ING RELAY 01 (Relay)

Component Type	Relay
Wiring frames	**SHEET 04**

K-004 - ING RELAY 02 (Relay)

Component Type	Relay
Wiring frames	**SHEET 04**

K-005 - W LAMP (Relay)

Component Type	Relay
Wiring frames	**SHEET 04**

K-006 - HIGH BEAM (Relay)

Component Type	Relay
Wiring frames	**SHEET 04**

K-007 - LOW BEAM (Relay)

Component Type	Relay
Wiring frames	**SHEET 04**

K-008 - PTO SAFETY START (Relay)

Component Type	Relay
Wiring frames	**SHEET 04**

K-009 - STOP LIGHT (Relay)

Component Type	Relay
Wiring frames	**SHEET 04**

K-010 - ENGINE SHUT-OFF (Relay)

Component Type	Relay
Wiring frames	**SHEET 04**

K-011 - SAFETY RUN (Relay)

Component Type	Relay
Wiring frames	**SHEET 04**

K-012 - CRANK PROTECTION (Relay)

Component Type	Relay
Wiring frames	**SHEET 04**

K-013 - FRONT LOADER (Relay)

Component Type	Relay
Wiring frames	**SHEET 02**

K-014 - HEATER (Relay)

Component Type	Relay
Wiring frames	**SHEET 02**

Electrical components - Motor description

M-001 - STARTER MOTOR (Motor)

Component Type	Motor
Wiring frames	**SHEET 03**
Connectors	**X-004A (Male)** **X-206 (Female)**

Electrical components - Switch description

S-001 - IGNITION SWITCH (Switch)

Component Type	Switch
Wiring frames	**SHEET 06**
Connectors	**X-003 (Female)**

S-007 - HOME/ENTER (Switch)

Component Type	Switch
Wiring frames	**SHEET 07**
Connectors	**X-018 (Female)** **X-019 (Female)**

S-008 - UP/DOWN (Switch)

Component Type	Switch
Wiring frames	**SHEET 07**
Connectors	**X-020 (Female)** **X-021 (Female)**

S-009 - JOYSTICK LOADER (Switch)

Component Type	Switch
Wiring frames	**SHEET 06**
Connectors	**X-520 (Female)**

Wiring harnesses - Repair

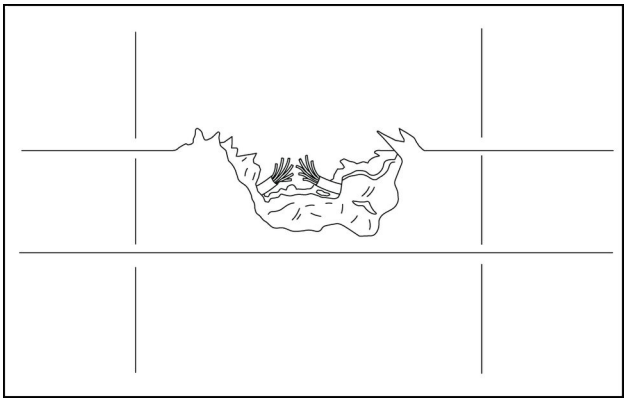
Temporary wiring harness repair

The following method to repair wiring is a temporary expedient only. Wiring should be replaced as soon as possible. Replacement of temporary repaired cables with new is particularly important if the tractor is to be used for puddling, spraying etc, as water/chemicals can enter the repaired area, travel up the cable and damage electrical components. Do not attempt to repair the wire on any system sensors as these are sealed and should only be replaced with a new component.

NOTE: *When conducting a cable repair it is important that only resin cored solder is used. Use of other types of solder may result in further cable damage.*

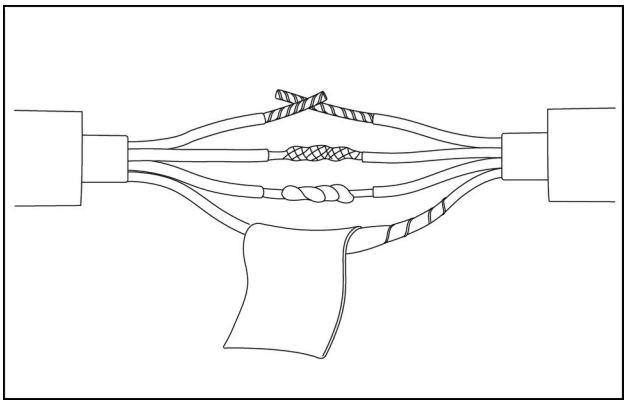
To carry out a temporary repair, proceed as follows:-

1. Locate damaged portion of cable then cut away outer protective cover on both sides of the damaged area.



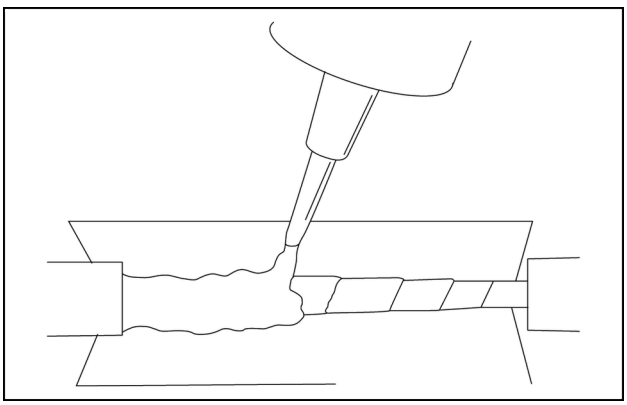
GNIL14TR04711AA 1

2. Peel back the cable from both ends of the damaged area and carefully cut away the inner cable cover at the damaged area and strip about **13.00 mm** (**0.51 in**) of insulation from the wires. Do not cut away any wire strands.
3. Using a suitable solvent, clean about **50.00 mm** (**1.97 in**) from each cover end. Clean the grey cable cover and the individual leads.
4. Twist two bare leads together for each damaged lead, being careful to match wire colors, then solder the leads using resin cored solder. Tape each repaired lead with vinyl insulation tape, figure **2**.



GNIL14TR04712AA 2

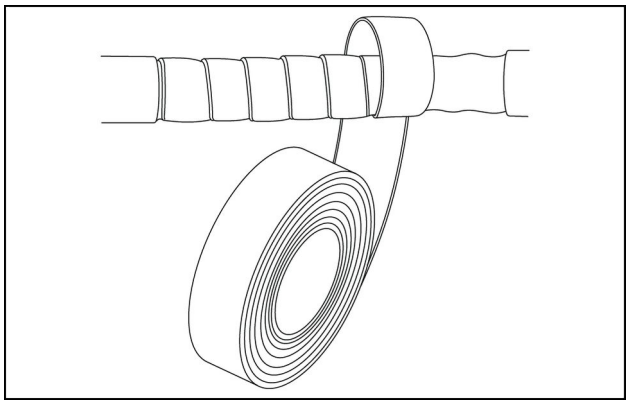
5. Wind a layer of vinyl insulation tape up to the grey cable cover at each end of the repair section. Make a paper trough, figure **3**, then apply silicon rubber compound (non hardening sealant) over the repaired section up to the cover ends. Sufficient sealant must be used to fill the ends of the cut away area.



GNIL14TR04713AA 3

6. Allow the compound to cure, then cover the area with insulating tape taking the tape well over each end of the repair. An overlap of at least **50.00 mm** (**1.97 in**) of tape at each end is necessary, figure **4**.
7. Check to ensure the repair is satisfactory and secure the repaired cable so that repeat damage is avoided.

NOTE: *This is a temporary repair only. Ensure the damaged cable is replaced as soon as possible to prevent ingress of water or chemicals.*



GNIL14TR04714AA 4

Wiring harnesses - Troubleshooting Safety start circuit - Operator present

Problem	Possible Cause	Correction
Starter motor will not energize	Insufficient battery charge.	Test battery. Charge, add water, or replace as necessary.
	Blown fusible link.	Inspect and replace fusible link as necessary.
	Defective key switch.	Test key switch and replace as necessary.
	Defective PTO safety or safety start relay.	Test relays and replace as necessary.
	Malfunctioning safety start switch.	Test neutral range, main PTO transmission clutch, and seat safety start switches for adjustment, proper operation, and faulty ground circuits.
	Malfunctioning starter motor.	Test starter motor and repair or replace as necessary.
Starter motor energizes, but fails to start engine (lacks exhaust smoke)	Blown fuse ignition, **15 A** fuse.	Replace fuse.
	Defective operator safety module.	Test module and replace as necessary.
	Defective fuel shutoff relay.	Test fuel shutoff relay and replace as necessary.
	Malfunctioning fuel shutoff solenoid.	Test fuel shutoff solenoid and replace as necessary.

Wiring harnesses - Troubleshooting Safety start circuit - Operator not present

Problem	Possible Cause	Correction
Starter motor will not energize	Insufficient battery charge.	Test battery. Charge, add water, or replace as necessary.
	Blown fusible link.	Inspect and replace fusible link as necessary.
	Defective key switch.	Test key switch and replace as necessary.
	Defective PTO safety or safety start relay.	Test relays and replace as necessary.
	Malfunctioning safety start switch.	Test neutral range, main PTO transmission clutch, and seat safety start switches for adjustment, proper operation, and faulty ground circuits.
	Defective start circuit diode.	Test start circuit diode and replace as necessary. Operator must be out of seat for test.
	Malfunctioning starter motor.	Test starter motor and repair or replace as necessary.
Starter motor energizes, but fails to start engine (lacks exhaust smoke)	Blown fuse ignition, **15 A** fuse.	Replace fuse.
	Defective operator safety module.	Test module and replace as necessary.
	Defective fuel shutoff relay.	Test fuel shutoff relay and replace as necessary.
	Malfunctioning fuel shutoff solenoid.	Test fuel shutoff solenoid and replace as necessary.

Wiring harnesses - Troubleshooting Safe Operation - Operator Present

Problem	Possible Cause	Correction
Engine does not continue to run while operator is seated	Defective seat safety switch.	Test seat safety switch and replace as necessary.
	Defective Fuel shutoff relay.	Test relay and replace as necessary.
	Malfunctioning fuel shutoff solenoid.	Test fuel shutoff solenoid and replace as necessary.
	Defective operator safety module.	Test module and replace as necessary.
	Open wiring in safe operation circuit.	Check for loose connectors, grounds, and wiring damage.
Engine continues to run after operator has left seat for more than two seconds and mid PTO and park brake is not engaged	Defective seat safety switch.	Test seat safety switch and replace as necessary.
	Defective operator safety module.	Test operator safety module and replace as necessary.
	Malfunctioning fuel shutoff solenoid.	Test fuel shutoff solenoid and replace as necessary.
	Short-circuit in wiring or faulty ground circuit.	Check for loose safety switch connectors, grounds, and wiring harness for damage.

Wiring harnesses - Troubleshooting Safe operation - Operator not present, PTO "OFF"

Problem	Possible Cause	Correction
Engine does not continue to run while operator is seated	Defective neutral safety switch.	Test neutral safety switch and replace as necessary.
	Blown **3 A** diode.	Check diode, replace if necessary.
	Defective Fuel shutoff relay.	Test relay and replace as necessary
	Malfunctioning fuel shutoff solenoid.	Test fuel shutoff solenoid and replace as necessary.
	Defective operator safety module.	Test module and replace as necessary.
	Open wiring in safe operation circuit.	Check for loose connectors, grounds, and wiring damage.
Engine continues to run after operator has left seat for more than two seconds with transmission range in gear	Defective neutral safety switch.	Test neutral safety switch and replace as necessary.
	Defective operator safety module.	Test operator safety module and replace as necessary.
	Malfunctioning fuel shutoff solenoid.	Test fuel shutoff solenoid and replace as necessary.
	Short-circuit in wiring or faulty ground circuit.	Check for loose safety switch connectors, grounds, and wiring harness for damage.

Wiring harnesses - Troubleshooting Safe operation - Operator not present; PTO “ON”

Problem	Possible Cause	Correction
Engine does not continue to run while operator is not seated	Defective fuel shutoff relay.	Test relay and replace as necessary.

Problem	Possible Cause	Correction
	Blown **3 A** diode.	Check diode, replace if necessary.
	Malfunctioning fuel shutoff solenoid.	Test fuel shutoff solenoid and replace as necessary.
	Defective operator safety module.	Test module and replace as necessary.
	Open wiring in safe operation circuit.	Check for loose connectors, grounds, and wiring damage.
Engine does not continue to run when operator is not in seat, transmission is in neutral, PTO is on, and park brake is engaged	Defective range neutral switch, PTO switch, or **3 A** diode.	Test components and replace as necessary.

https://truckmanualshub.com/

Index

Electrical systems - 55

Harnesses and connectors - 100

Wiring harnesses - Electrical schematic sheet 03 SH03-STARTING/CHARGING SYSTEM 6
Wiring harnesses - Electrical schematic sheet 04 SH04-POWER DISTRIBUTION:GEP RELAY BOX 8
Wiring harnesses - Electrical schematic sheet 05 SH05-GROUNDING SYSTEM 10
Wiring harnesses - Electrical schematic sheet 06 SH06-IGNITION/CONTROL SWITCHES 12
Wiring harnesses - Electrical schematic sheet 07 SH07-INSTRUMENT CLUSTER: ADIC 14
Wiring harnesses - Electrical schematic sheet 08 SH08-ENGINE CONTROL UNIT: ECU 16
Wiring harnesses - Electrical schematic sheet 09 SH09-SAFETY LOGIC 18
Wiring harnesses - Electrical schematic sheet 10 SH10-FRONT HEAD LIGHTS 20
Wiring harnesses - Electrical schematic sheet 11 SH11-REAR LIGHTS 22
Wiring harnesses - Electrical schematic sheet 12 SH12-DIAGONESTIC/TRAILER SOCKET 24
Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) 26
Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) 28
Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) 30
Electrical components - Fuse description 88
Electrical components - Motor description 93
Electrical components - Relay description 91
Electrical components - Switch description 94
Electrical components - Voltage source description 90
Wire connectors - Component diagram 00 - Connectors X-9001 to X-9009 70
Wire connectors - Component diagram 00 33
Wire connectors - Component diagram 01 - Connectors X-9010 to X-9019 75
Wire connectors - Component diagram 01 38
Wire connectors - Component diagram 02 - Connectors X-9020 to X-9029 76
Wire connectors - Component diagram 02 42
Wire connectors - Component diagram 03 - Connectors X-9030 to X-9039 77
Wire connectors - Component diagram 05 46
Wire connectors - Component diagram 10 - Connectors X-9101 to X-9109 81
Wire connectors - Component diagram 10 48
Wire connectors - Component diagram 11 - Connectors X-9110 to X-9119 84
Wire connectors - Component diagram 12 - Connectors X-9120 to X-9129 85
Wire connectors - Component diagram 20 49

https://truckmanualshub.com/

Wire connectors - Component diagram 21 51
Wire connectors - Component diagram 30 54
Wire connectors - Component diagram 40 57
Wire connectors - Component diagram 50 59
Wire connectors - Component diagram 51 62
Wire connectors - Component diagram 52 64
Wire connectors - Component diagram 60 65
Wire connectors - Component diagram 61 66
Wire connectors - Component diagram 70 67
Wire connectors - Component diagram 71 68
Wire connectors - Component diagram 90 69
Wiring harnesses - Electrical schematic sheet 02 SH02-POWER DISTRIBUTION:GEP FUSE BOX 4
Wiring harnesses - Repair 95
Wiring harnesses - Troubleshooting Safe Operation - Operator Present 98
Wiring harnesses - Troubleshooting Safe operation - Operator not present, PTO "OFF" 98
Wiring harnesses - Troubleshooting Safe operation - Operator not present; PTO “ON” 98
Wiring harnesses - Troubleshooting Safety start circuit - Operator not present 97
Wiring harnesses - Troubleshooting Safety start circuit - Operator present 97

https://truckmanualshub.com/

https://truckmanualshub.com/

Electrical systems - 55

Engine starting system - 201

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Electrical systems - 55

Engine starting system - 201

FUNCTIONAL DATA

Engine starting system
Dynamic description 3

SERVICE

Engine starter
Remove 5
Install 6

DIAGNOSTIC

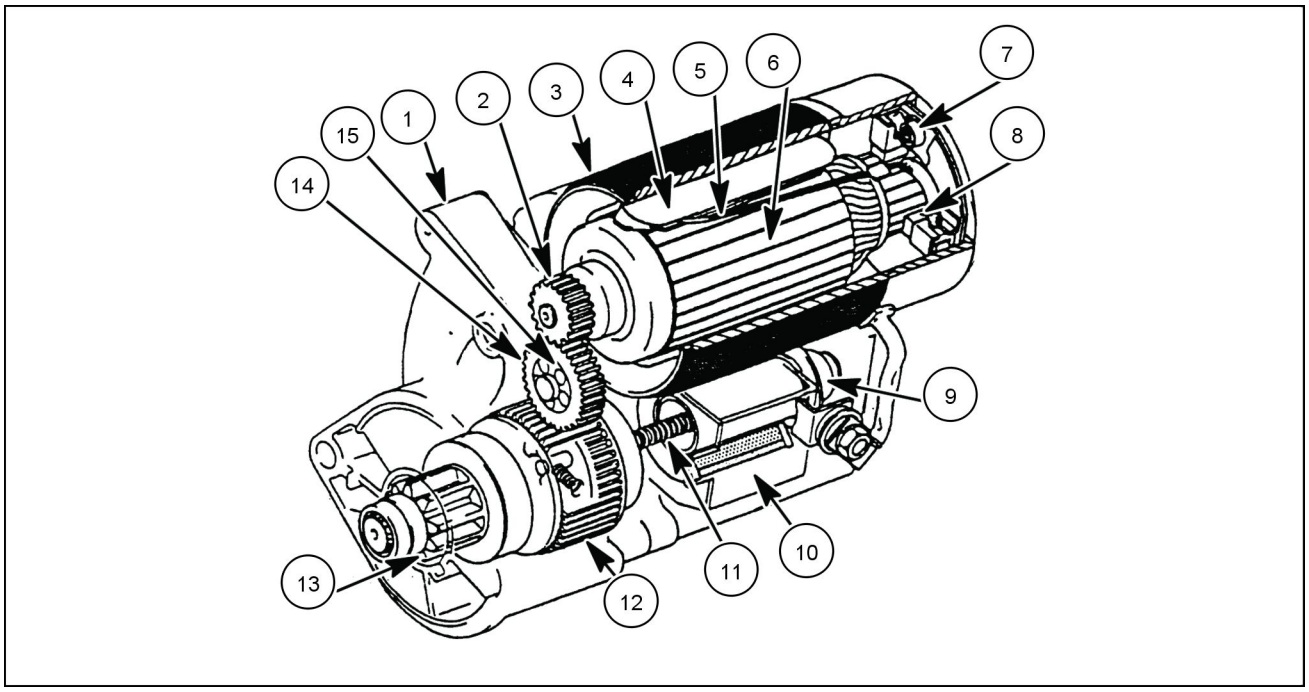
Engine starter
Troubleshooting 7

Engine starting system - Dynamic description

Description of operation

The starting system consists of a starter motor equipped with an electromagnetic starter solenoid, a key switch, a start relay, several safety switches, and heavy-duty wiring.

Starter components



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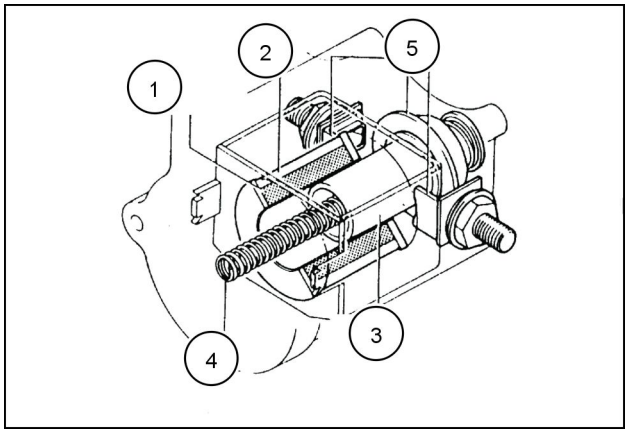
(1) Reduction Uni Cover
(2) Armature Drive Gear
(3) Motor/Field Coil Housing (Yoke)
(4) Permanent Magnet
(5) Field Coil
(6) Armature
(7) Brush Spring
(8) Brush
(9) Plunger
(10) Solenoid
(11) Return Spring
(12) Pinion Clutch
(13) Pinion
(14) Idler Gear
(15) Idler Gear Roller Bearing

Starter motor assembly

The starter motor features a high-speed motor that utilizes a gear reduction unit, an overrunning pinion clutch, **(12)**, and permanent magnets, **(4)**, in a field coil, **(5)**, for magnetic field induction. The reduction unit consists of a small drive gear, **(2)**, on the motor armature, **(6)**, which drives an idler gear, **(14)**, in the reduction unit. The idler gear is splined to the gear on the pinion clutch housing, **(12)**. When the starter solenoid, **(10)**, is energized, the solenoid plunger, **(9)**, pushes the pinion gear, **(13)**, out, engaging with the engine flywheel. The starter motor then is turning the flywheel, which rotates the engine. The use of the gear reduction unit allows use of the compact, high-speed motor and provides more torque and power to turn the engine flywheel. The sliding pinion mechanism is enclosed, resulting in a more durable mechanism.

Starter solenoid

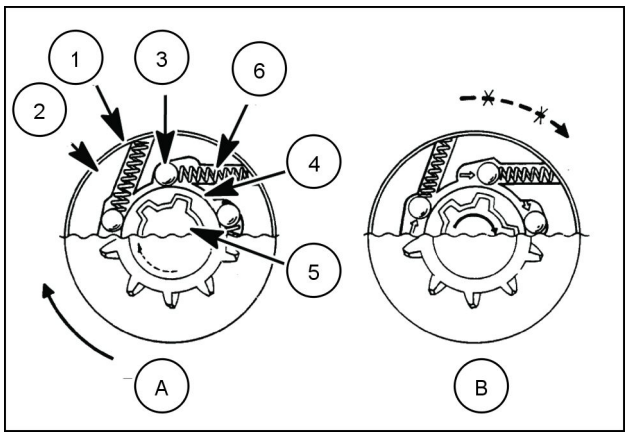
The starter solenoid is an electromagnetic type solenoid that is located on the bottom of the starter motor assembly. The solenoid contains two coils, a pull-in coil, **(1)** and a hold-in coil **(2)** When the key switch is turned to the "START" position and the safety start relay is closed (safety switches closed), current from the battery will energize the solenoid's two coils. With the coils energized, the solenoid plunger, **(3)** pushes a spring **(4)** which will then push the pinion gear out to engage the flywheel. At the same time, a set of contacts **(5)**, on the solenoid become closed, allowing current to flow to the starter motor. Closing the contacts also supplies current to both ends of the solenoid pull in coil which makes the coil become non-energized. The hold-in coil continues to engage the pinion gear with the flywheel.



SEC55CH4PG29_1 2

Pinion clutch

To prevent the engine from driving the starter motor once the engine is running, the pinion gear is equipped with an overrunning clutch. The clutch will disengage the pinion gear from the rest of the starter components once the engine has been started and the key switch is in the "START" position. The clutch consists of an outer gear/shell, **(1)**, a cam with tapered notches, **(2)**, rollers, **(3)**, roller springs, **(4)**, a splined pinion collar/tube that acts as a clutch hub, **(5)**, and the pinion shaft, **(6)**. As the starter motor engages and rotates, the rollers are locked against the pinion collar with the tension provided by the roller springs. While the rollers are locked, the clutch assembly is locked, allowing the pinion gear to rotate the flywheel. When the engine starts, the flywheel moves faster than the starter motor and this causes the rollers to become unlocked. With the rollers unlocked, the clutch assembly is unlocked, allowing the pinion gear and shaft to turn independently of the starter motor.



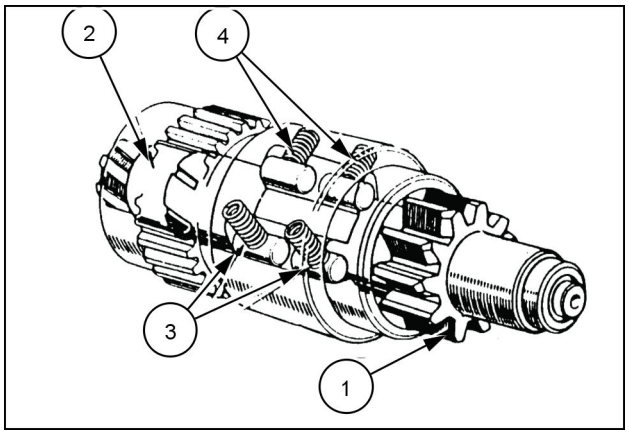
SEC55CH4P29_2 3

A - Engaged, B - Disengaged

(1) Clutch Gear
(2) Cam
(3) Roller
(4) Spline Tube - Inner (Pinion Collar)
(5) Pinion Shaft
(6) Roller Spring

The clutch is not serviceable and is replaced as a complete assembly.

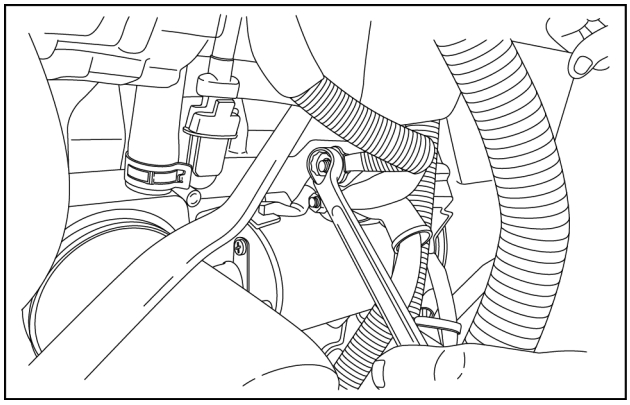
Once the engine is started and the key switch is released from the "START" position, the solenoid's pull in coil becomes energized, pulling the solenoid plunger in, which disengages the pinion from the flywheel.



SEC55CH4P29_3 4

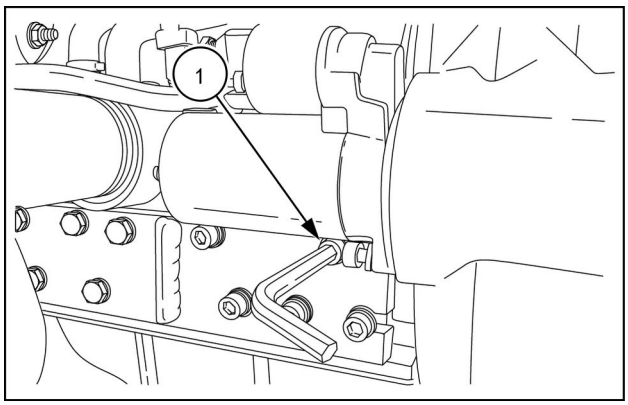
Engine starter - Remove

1. Lift the front hood.
   Disconnect the battery terminals (Negative first).
2. Disconnect the electrical connection from the starter motor.



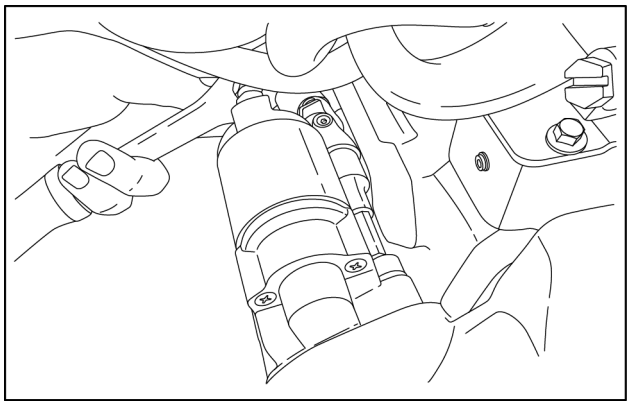
GNIL14TR00713AA 1

3. Remove the set screw **(1)** on the front axle support. It interferes while the starter motor mounting bolts are loosened.



GNIL14TR00736AA 2

4. Loosen the starter motor mounting bolts. Remove the starter motor.



GNIL14TR00735AA 3

Engine starter - Install

For installation, follow the removal process in reverse order.

Engine starter - Troubleshooting

Problem	Possible Cause	Correction
Pinion shaft fails to advance	Wiring: Open circuit battery, and switch terminal connections.	Repair or replace.
	Wiring: Open circuit, fuse.	Replace fuse.
	Key switch: No contact.	Repair or replace.
	Starter motor: Sleeve bearing burnt out.	Repair or replace.
	Starter motor: Lever broken.	Replace.
	Solenoid: Plunger movement defective or coil open or shorted.	Repair or replace.
Pinion motor rotates but no rotation transmitted to engine	Starting motor: Clutch defective.	Replace.
	Starting motor: Orbital gear or planetary gears damaged.	Replace.
Motor rotates before pinion meshes with ring gear	Starter motor: Shift lever damaged.	Replace.
	Starter motor: :Shift lever damaged	Replace.
	Starter motor: Slip ring defective.	Replace.
	Starter motor: Pinion teeth worn.	Replace.
	Starter motor: Pinion push out position defective.	Adjust.
	Engine: Ring gear worn.	Replace.
	Solenoid defective	Replace.
Pinion meshes with ring gear but starting motor fails to turn	Wiring: Line connecting solenoid to battery broken or defective ground.	Repair or replace.
	Wiring: Lead wire connecting solenoid to motor tightened improperly.	Repair or replace.
	Starting motor: Ball bearing locked.	Replace.
	Starting motor: Brush worn.	Replace.
	Starting motor: Improper installation.	Reinstall.
	Starting motor: Brush spring defective.	Replace.
	Starting motor: Commutator dirty.	Clean.
	Starting motor: Armature of field coil defective.	Repair or replace.
	Starting motor: Field coil-to-brush connection defective.	Replace.
	Solenoid: Contact not touching properly.	Replace.
	Solenoid: Contact contacting surface roughened.	Replace.
	Battery: In discharge state.	Recharge or replace.
Motor fails to stop after engine starts and key switch is turned off	Key switch: defective.	Replace.
	Defective solenoid.	Replace.

https://truckmanualshub.com/

Index

Electrical systems - 55

Engine starting system - 201

Engine starter - Install 6
Engine starter - Remove 5
Engine starter - Troubleshooting 7
Engine starting system - Dynamic description 3

https://truckmanualshub.com/

Electrical systems - 55

Alternator - 301

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Electrical systems - 55

Alternator - 301

DIAGNOSTIC

Alternator
Troubleshooting 3

Alternator - Troubleshooting

Problem	Possible Cause	Correction
No charging	Wiring: Loose connection or short circuit.	Repair.
	Alternator: Loose connection, no ground, or short circuit.	Repair or replace.
	Alternator: Defective rectifier.	Replace.
	Regulator: Defective regulator.	Replace.
	Regulator: Loose connection of alternator or regulator.	Repair or replace.
Insufficient charging	Wiring: Loose connection or short circuit.	Repair.
	Alternator: Loose drive belt.	Repair.
	Alternator: Short in rotor coil.	Replace.
	Alternator: Short in stator coil.	Replace.
	Alternator: Defective rectifier.	Replace.
	Alternator: Insufficient brush contact.	Repair or replace.
	Regulator: Defective regulator.	Replace.
	Regulator: Loose connection of alternator and regulator.	Repair.
	Battery: Defective Battery.	Replace.
Overcharge	Battery: Internal short.	Replace.
	Regulator: Defective regulator.	Replace.
Unstable Charging Circuit	Wiring: Loose connection or open wire.	Repair or replace.
	Alternator: Loose drive belt.	Repair.
	Alternator: Short in rotor coil.	Replace.
	Alternator: Short in stator coil.	Replace.
	Alternator: Broken brush or spring.	Replace.
	Alternator: Loose connection.	Repair.
	Regulator: Defective Regulator.	Replace.
	Regulator: Loose connection at alternator and regulator.	Repair or replace.
Abnormal Noise from Alternator	Alternator: Loose mounting hardware.	Repair.
	Alternator: Defective bearings.	Repair or replace.
	Alternator: Rotor core and stator in contact.	Replace.
	Alternator: Defective diode.	Replace.
	Alternator: Short in stator coil.	Replace.

https://truckmanualshub.com/

Index

Electrical systems - 55

Alternator - 301

Alternator - Troubleshooting 3

https://truckmanualshub.com/

Electrical systems - 55

Battery - 302

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Electrical systems - 55

Battery - 302

SERVICE

Battery
Remove 3
Check 4
Install 5

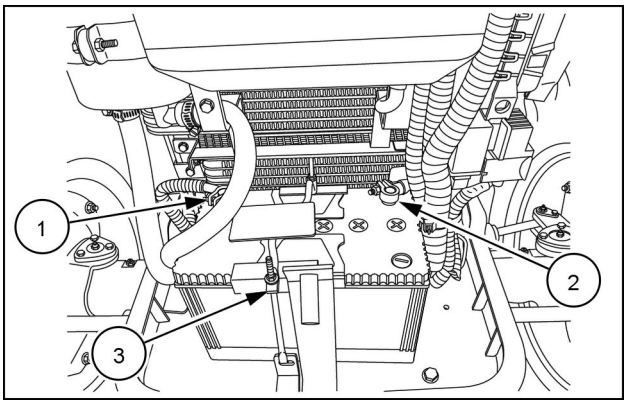
Battery - Remove

⚠ WARNING

Improper operation or service of this machine can result in an accident.
Before working on any component(s) of the electrical circuit, put the starter switch key in the off (shut down) position. When disconnecting batteries, always disconnect the negative (-) cable first. When reconnecting batteries, always connect the negative (-) cable last.
Failure to comply could result in death or serious injury.

W0264A

1. Unlatch and raise the hood to gain access to the battery.
2. Remove the negative (-) cable, **(1)**, from the negative (-) terminal on the battery.
3. Remove the positive (+) cable, **(2)**, from the positive (+) terminal on the battery.
4. Remove the nut, washer and J-bolt, **(3)**, which secures the battery to the tractor frame.
5. Remove the battery from the tractor.



GNIL14TR00784AA 1

Battery - Check

⚠ DANGER

Hazardous chemicals!
Battery electrolyte contains sulfuric acid. Contact with skin and eyes could result in severe irritation and burns. Always wear splash-proof goggles and protective clothing (gloves and aprons). Wash hands after handling.
Failure to comply will result in death or serious injury.

D0105A

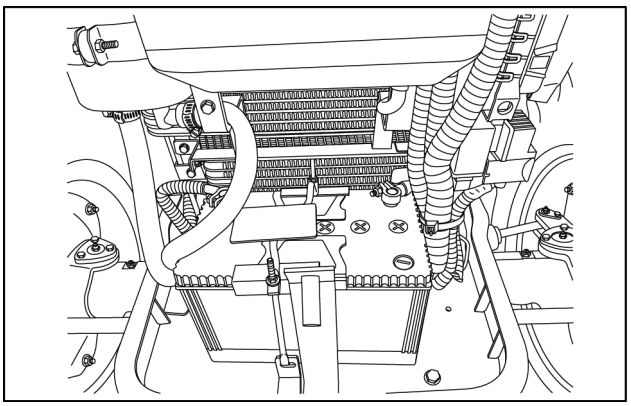
⚠ WARNING

Explosive gas!
Batteries emit explosive hydrogen gas and other fumes while charging. Ventilate the charging area. Keep the battery away from sparks, open flames, and other ignition sources. Never charge a frozen battery.
Failure to comply could result in death or serious injury.

W0005A

1. The battery is located in front of the radiator.
   The battery electrolyte level should be between the minimum and maximum lines provided on battery container.
   If necessary, top off with distilled or de-mineralized water until the level is correct. Do not overfill. Never use tap water or water from rain barrel or other source.
   To prevent the formation of corrosion, the terminals should be cleaned and smeared with petroleum jelly only, no grease should be applied.

NOTE: *Battery size - BCI group - 47 (CCA 600--850).*



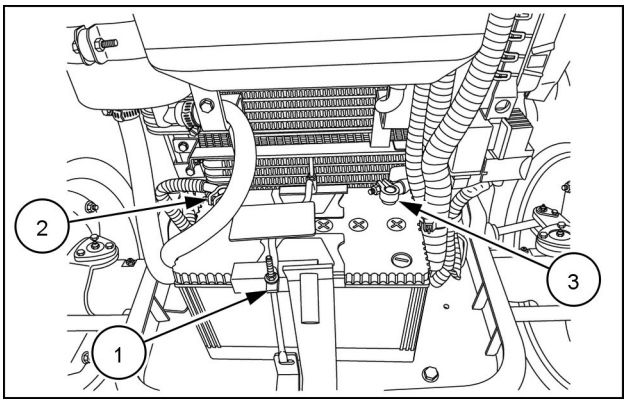
GNIL14TR00784AA 1

Battery - Install

1. Check the battery for cleanliness, especially around the terminals. Clean the area where the battery mounts to the tractor frame to prevent debris from piercing the body of the battery.
2. Check the vent caps for proper installation and tightness.
3. Ensure that no leakage occurs from the battery.
4. Install the battery squarely into position before securing with strap, and J-bolt, **(1)**.
5. Connect the negative (-) terminal, **(2)**, then the positive (+) terminal, **(3)**.

NOTE: *Coat the battery terminal clamps with petroleum jelly or equivalent. Do not use conventional lubricants as electrolyte corrosion may occur.*

6. Check battery terminal connections for correct polarity and tightness. Do not overtighten. Install dust covers over terminals, (where installed).



GNIL14TR00784AA 1

https://truckmanualshub.com/

Index

Electrical systems - 55

Battery - 302

Battery - Check 4
Battery - Install 5
Battery - Remove 3

https://truckmanualshub.com/

Electrical systems - 55

External lighting - 404

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Electrical systems - 55

External lighting - 404

SERVICE

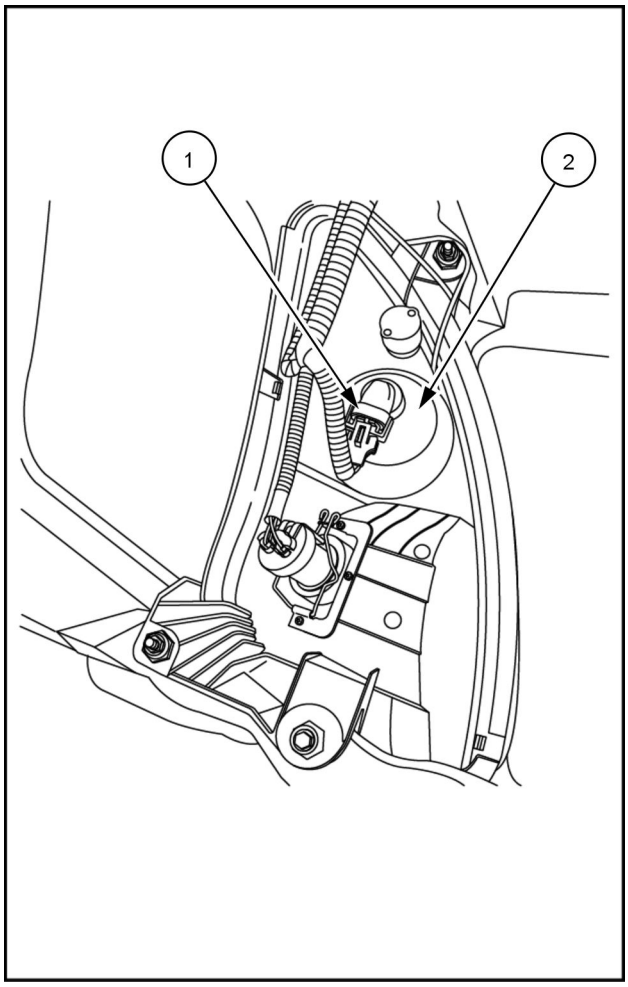
Headlight
Replace 3
Turn signal and/or hazard lights
Replace 4

DIAGNOSTIC

External lighting
Troubleshooting Lighting circuit 5
Turn signal and/or hazard lights
Troubleshooting Hazard lighting circuit 6
Troubleshooting Right turn signal circuit 6
Troubleshooting Left turn signal circuit 6

Headlight - Replace

1. Remove the electrical connector **(1)**



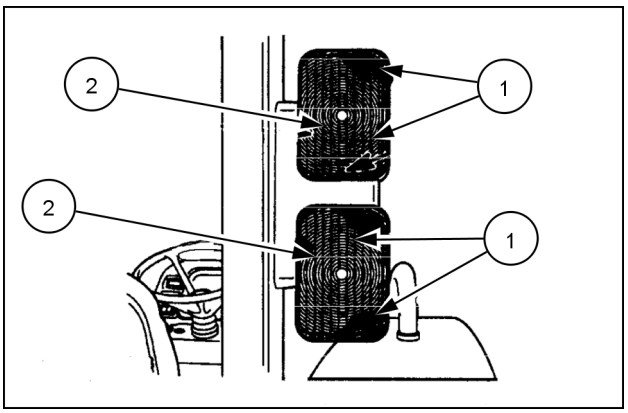
GNIL14TR00534AA 1

2. Remove the rubber boot **(2)**
3. Change a burned out bulb for another halogen bulb of the same power

Turn signal and/or hazard lights - Replace

Stop/Turn/Position lights, bulb replacement

The bulbs are accessible after removal of the plastic lenses assembly. Remove the two screws **(1)** and take out the lens assembly **(2)**. The bulbs can be removed by pressing in and turning approximately 20 degree counterclockwise. Reassemble in reverse order.



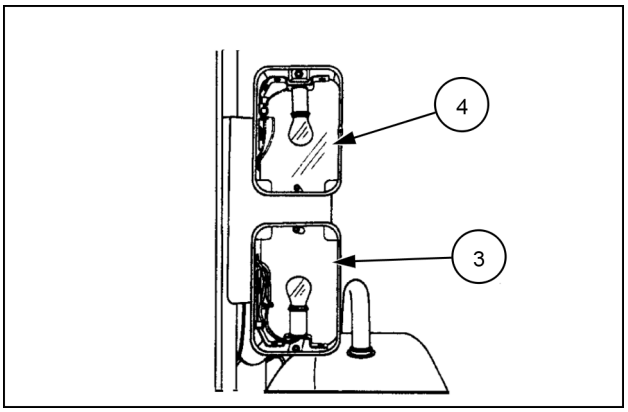
20108813 1

Tail light **(3)** and flasher/turn signal light **(4)**

NOTICE: *When replacing the lenses, take care not to over-tighten the retaining screws.*

Bulb Size

- Tail Light - #1157
- Flasher/Turn Signal - #1156



20108814 2

External lighting - Troubleshooting Lighting circuit

Problem	Possible Cause	Correction
Front road lamps will not illuminate or are dim	Insufficient battery charge.	Test battery. Charge, add water, or replace as necessary.
	Road lamp bulb faulty.	Check and replace bulb as necessary.
	Blown fusible link.	Inspect fusible link and replace as necessary.
	Blown fuse head/park, **20 A** fuse.	Replace fuse as necessary.
	Defective light switch.	Test light switch and replace as necessary.
	Improper connection at work lamp terminals or headlight socket.	Check connections and lamp socket. Repair or replace as necessary.
	Improper ground connection.	Check ground connections and repair as necessary.
Rear taillights will not illuminate or are dim	Insufficient battery charge.	Test battery. Charge, add water, or replace as necessary.
	Taillight bulb fault.	Check and replace bulb as necessary.
	Blown fusible link.	Inspect fusible link and replace as necessary.
	Blown fuse head/park, **20 A** fuse.	Replace fuse as necessary.
	Defective light switch.	Test light switch and replace as necessary.
	Improper connection at taillight lamp terminals or lamp socket.	Check connections and lamp socket. Repair or replace as necessary.
	Improper ground connection.	Check ground connections and repair as necessary.
Instrument panel illumination light not illuminated or is dim	Insufficient battery charge.	Test battery. Charge, add water, or replace as necessary.
	Instrument panel illumination bulb burnt out.	Check and replace bulb as necessary.
	Blown fuse head/park, **20 A** fuse.	Replace fuse as necessary.
	Defective light switch.	Test light switch and replace as necessary.
	Improper connection at instrument panel terminals or light socket	Check connections and socket. Repair or replace as necessary.
	Improper ground connection	Check ground connections and repair as necessary.

Turn signal and/or hazard lights - Troubleshooting Hazard lighting circuit

Problem	Possible Cause	Correction
Hazard Signal Lights will not illuminate or flash	Blown fuse hazard, **15 A** hazard signal fuse.	Inspect fuse and replace as necessary.
	Hazard signal bulb(s) burnt out.	Inspect bulb(s) and replace as necessary.
	Defective hazard switch.	Test switch and replace as necessary.
	Defective flasher cutoff relay.	Test flasher relay by using a known functioning flasher relay and replace as necessary.
	Defective hazard/turn flasher module.	Test module and replace as necessary.
	Faulty wiring or ground connection.	Inspect the tractor's wiring harness and ground terminals for damage, corrosion, and short circuits. Repair or replace as needed.
Instrument panel hazard indicator(s) does not illuminate	Indicator bulb(s) burnt out	Inspect bulb and replace as necessary
	Faulty wiring or ground connection	Inspect the tractor s wiring harness and ground terminals for damage, corrosion, and short circuits. Repair or replace as needed

Turn signal and/or hazard lights - Troubleshooting Right turn signal circuit

Problem	Possible Cause	Correction
Directional signal will not illuminate or flash	Blown fuse turn/horn, **15 A** hazard or directional signal fuse.	Inspect fuse and replace as necessary.
	Blown fuse hazard, **15 A** fuse.	Inspect fuse and replace as necessary.
	Directional signal bulb burnt out.	Inspect bulb and replace as necessary.
	Defective directional signal switch.	Test switch and replace as necessary.
	Defective hazard/turn flasher module.	Test module and replace as necessary.
	Faulty wiring or ground connection.	Inspect the tractor's wiring harness and ground terminals for damage, corrosion, and short circuits. Repair or replace as needed.
Instrument panel turn indicator does not illuminate	Indicator bulb burnt out.	Inspect bulb and replace as necessary.
	Faulty wiring or ground connection.	Inspect the tractor's wiring harness and ground terminals for damage, corrosion, and short circuits. Repair or replace as needed.

Turn signal and/or hazard lights - Troubleshooting Left turn signal circuit

Problem	Possible Cause	Correction
Directional signal will not illuminate or flash	Blown fuse turn/horn, **15 A** hazard or directional signal fuse.	Inspect fuse and replace as necessary.
	Blown fuse hazard, **15 A** fuse.	Inspect fuse and replace as necessary.
	Directional signal bulb burnt out.	Inspect bulb and replace as necessary.
	Defective directional signal switch.	Test switch and replace as necessary.
	Defective hazard/turn flasher module.	Test module and replace as necessary.

Problem	Possible Cause	Correction
	Faulty wiring or ground connection.	Inspect the tractor's wiring harness and ground terminals for damage, corrosion, and short circuits. Repair or replace as needed.
Instrument panel turn indicator does not illuminate	Indicator bulb burnt out.	Inspect bulb and replace as necessary.
	Faulty wiring or ground connection.	Inspect the tractor's wiring harness and ground terminals for damage, corrosion, and short circuits. Repair or replace as needed.

https://truckmanualshub.com/

Index

Electrical systems - 55

External lighting - 404

External lighting - Troubleshooting Lighting circuit 5
Headlight - Replace 3
Turn signal and/or hazard lights - Replace 4
Turn signal and/or hazard lights - Troubleshooting Hazard lighting circuit 6
Turn signal and/or hazard lights - Troubleshooting Left turn signal circuit 6
Turn signal and/or hazard lights - Troubleshooting Right turn signal circuit 6

https://truckmanualshub.com/

Electrical systems - 55

External lighting switches and relays - 405

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Electrical systems - 55

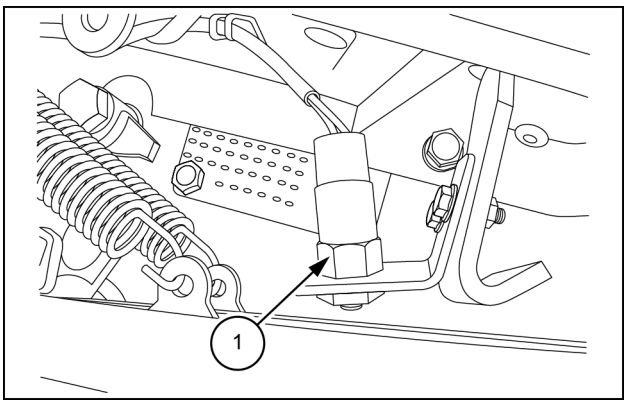
External lighting switches and relays - 405

FUNCTIONAL DATA

Brake light switch
Overview 3

Brake light switch - Overview

The brake pedal switch **(1)** is located below the right foot board near the foot brake. It is actuated while applying brake and is indicated by the light provided on the fender.



GNIL14TR04724AB 1

https://truckmanualshub.com/

Index

Electrical systems - 55

External lighting switches and relays - 405

Brake light switch - Overview 3

https://truckmanualshub.com/

Electrical systems - 55

Warning indicators, alarms, and instruments - 408

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Electrical systems - 55

Warning indicators, alarms, and instruments - 408

FUNCTIONAL DATA

Warning indicators, alarms, and instruments
Overview 3

Instrument cluster
Overview 5

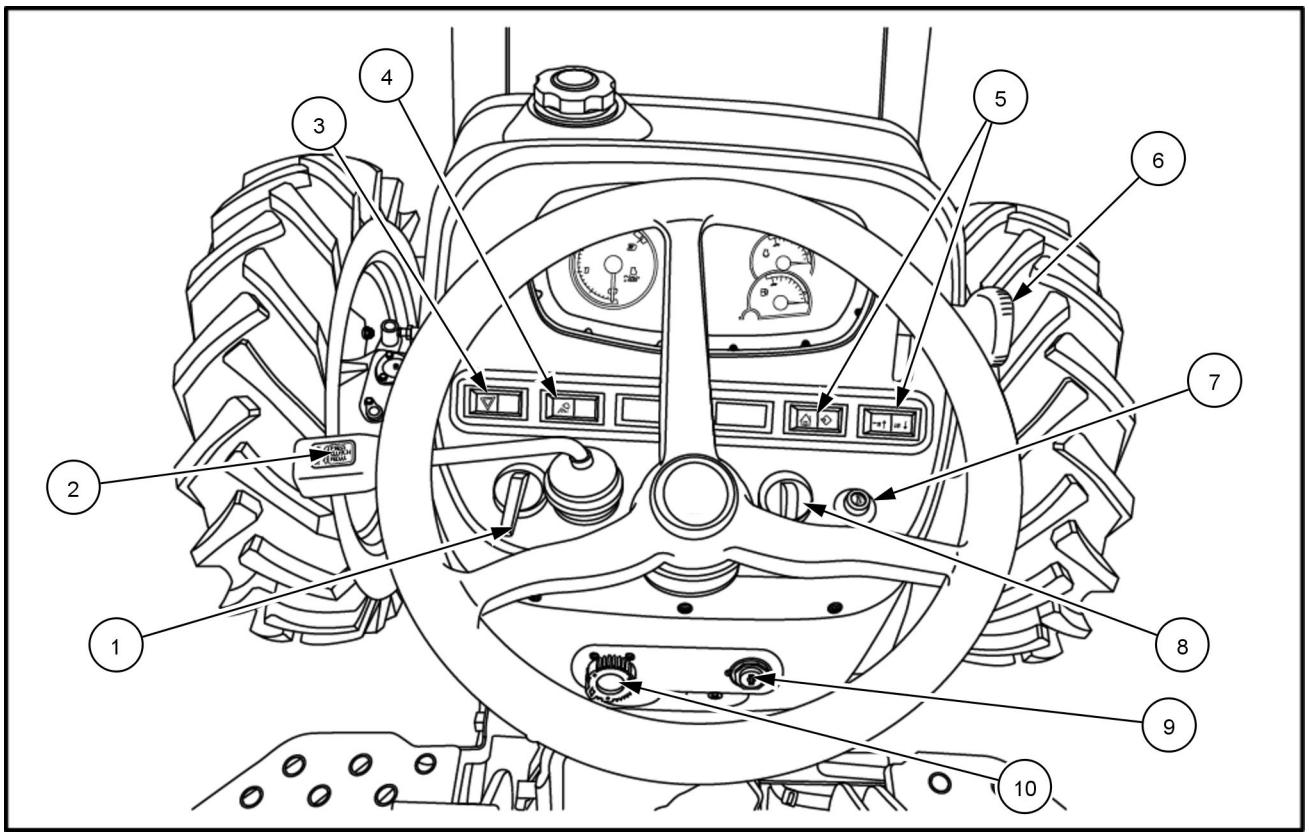
SERVICE

Instrument cluster
Remove 9
Install 12

DIAGNOSTIC

Instrument cluster
Troubleshooting 16

Warning indicators, alarms, and instruments - Overview



GNIL14TR00512AA 1

Turn signal switch

Turn signal switch **(1)** indicates turn signals and should be moved to the right to operate right turn indicator light and left to operate left turn indicator light.

NOTE: *The turn signal will operate only when the starter switch is turned on.*

Shuttle shift lever

The shuttle shift lever **(2)** is used to change the direction of travel, between forward and reverse.

Hazard switch

The hazard switch **(3)** activates the hazard flasher lights. Use the hazard flasher lights when traveling on public roads, day or night.

Head light switch

The head light switch **(4)** consists of four positions, (refer to Head Light Switch Positions).

Central display navigation buttons

The menus of the central liquid crystal display on the instrument panel are navigated through with the rocker switches **(5)** **(A)** and **(B)**.

Hand throttle lever

The hand throttle lever **(6)** should be used during the field operation.

Push the lever up to increase the engine speed and down to reduce it.

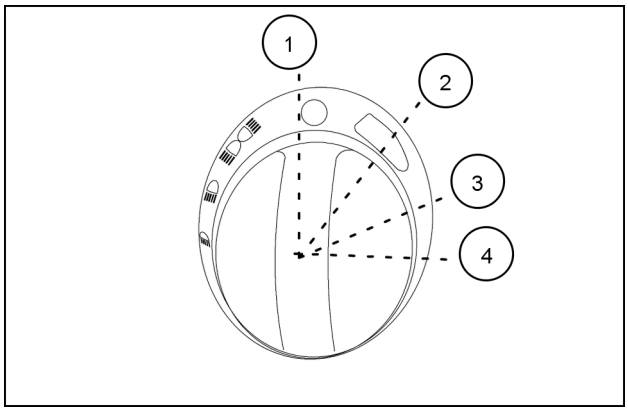
Horn Button

Press the horn button **(7)** for warning arrival

Head Light Switch Positions

The head light switch **(8)** consists of four positions,

Position **(1)** - Off
Position **(2)** - Parking lights on.
Position **(3)** - Head lamp low beam.
Position **(4)** - Head lamp high beam.



20108778 2

Key start/stop switch

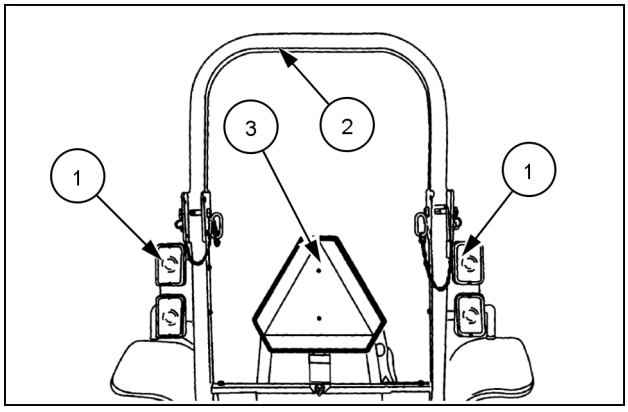
The key start switch **(9)** activates electrical equipment, lights, gauges and starting motor.

Electronic service tool socket

The Electronic Service Tool (EST) socket **(10)** is used to connect the EST to the tractor.

Hazard warning light switch

The hazard warning lights switch **(3)** (**1**) activates the hazard flashing warning lights **(1)** located on each side of the ROPS **(2)**.
The hazard flashing warning lights can be activated with the key switch in any position. For your protection, use the flasher warning lights and the SMV (Slow Moving Vehicle) emblem **(3)** when travelling on public roads, day or night.

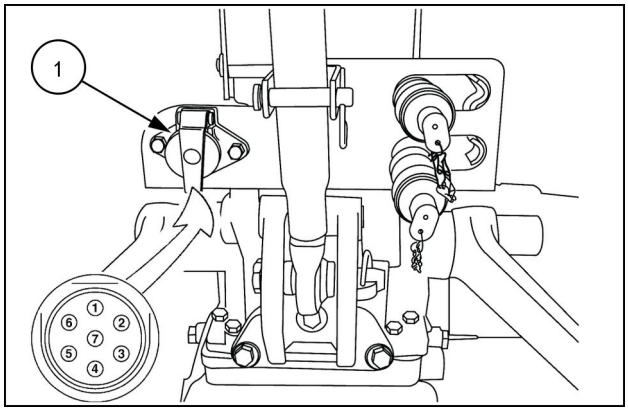


76099309N 3

Trailer electrical socket

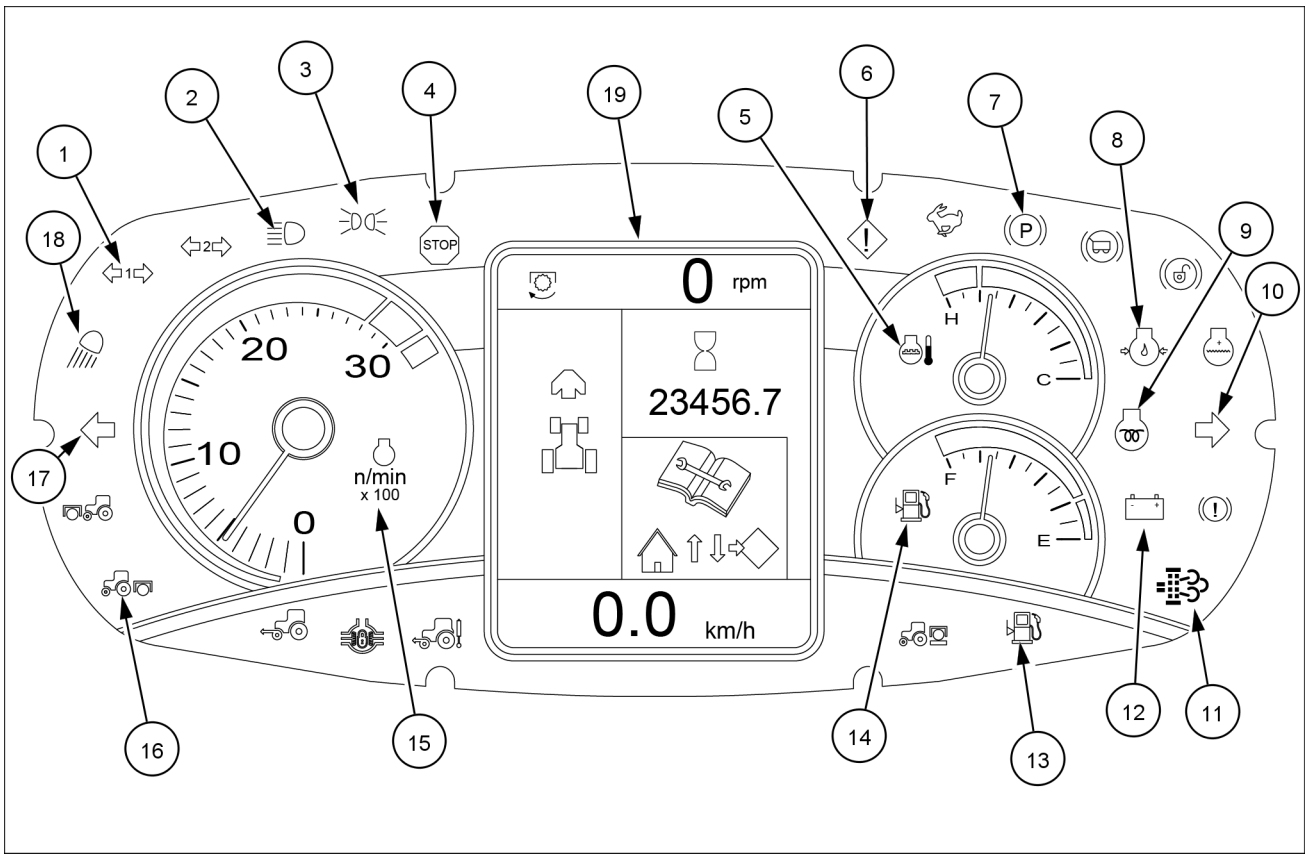
A standard 7-pin trailer socket **(1)** is provided as standard equipment and is mounted to the left side of ROPS cross brace.
The socket pin connections (see insert) are as follows:

Pin No.	Circuit
1	Ground
2	Work Lights
3	Left Hazard Flasher Light
4	Current Input (not switched)
5	Right Hazard Flasher Light
6	Taillights
7	Current Input (Switched)



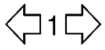
76099308N 4

Instrument cluster - Overview



GNIL14TR00509FA 1

The indicator lights on the control panel inform you of the operational condition of the machine. Some of these indicate faults arising during operation. An indicator light coming on may be followed by a continuous or intermittent buzzer. Depending on the severity of the trouble, the alarm will sound.

1 

Trailer direction indicator light (green)

This indicator light flashes together with the tractor/trailer direction indicators, if the first trailer is connected

2 

Full beam headlights (blue)

This indicator light will illuminate when the tractor lights are switched to high beam.

3 

Side lights (green)

This indicator light is illuminated when the tractor lights are turned on.

4 

Stop warning light (red)

If the red “Stop” warning light comes on, switch off the tractor immediately and look for the cause. A warning symbol will appear on the display **(30)** confirming the location of the fault.

5 

Engine coolant temperature gauge

This instrument indicates the temperature of the engine coolant.

6 

Indicator lamp (amber)
This indicator light comes on and the display shows a warning symbol **(30)**. The light blinks for 4 seconds, after which the symbol on the display disappears and the indicator light stays on steady. To display the fault, you need to go to the menu. Stop the tractor and investigate the cause of the trouble.

7 

Parking brake warning light (red)
This lights up when the key start switch is turned ON with the parking brake applied. If the key-start switch is turned OFF and the parking brake is not applied, or the operator leaves the seat without applying the parking brake, a warning buzzer will sound for approximately 10 seconds or until the parking brake has been applied.

8 

Engine oil pressure warning light (red)
Engine oil pressure indicator light (red) - This indicator light together with the red **(5)**. ”Stop” indicator light indicates the engine oil pressure is too low. Stop the engine and investigate the cause.
NOTE: With low engine oil pressure, this warning light illuminates when the start switch is in the contact position B (supply to accessories - ignition).

9 

Cold start device (amber)
The indicator lights up when the glow plugs are turned on by the key start switch.

10 

Right direction indicator (green)
This indicator light flashes at the same time as the tractor's right direction indicator. With the tractor running, if the turn signal is not switched off within 20 seconds an intermittent alarm comes on. This audible warning comes on if the direction indicator is not turned off within five minutes with the tractor stationary.

11 

Warning light of the Diesel Particulate Filter (DPF) (green)
For more details, see the chapter on regeneration of the particulate filter.

12 

Alternator charging warning light (red)
A steady light indicates that the alternator is not charging the battery.

13 

Fuel reserve (amber)
The light comes on when the tractor needs refuelling.

14 

Fuel Level Gauge
This instrument shows the fuel level in the tank.

15

Revolution counter
Indicates the engine rpm. Each subdivision of the graduated scale represents 100 revs/minute.

16 

Rear Power Take−Off (PTO) warning light (yellow)
Lights up when the engine is running and the rear power take-off is engaged.
The warning light, from being on steady, starts blinking when the power take−off exceeds the maximum permissible number of revs.

17 

Left direction indicator (green)
This indicator light flashes at the same time as the tractor's left direction indicator. With the tractor running, if the turn signal is not switched off within 20 seconds an intermittent alarm comes on. This audible warning comes on if the direction indicator is not turned off within five minutes with the tractor stationary.

18 

Work lights (amber)

This warning light illuminates when the work lights are switched on.

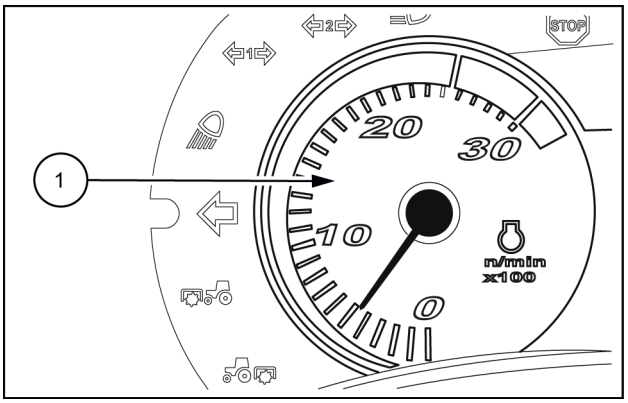
19

Information Display

The display shows information on the operational condition of the machine and highlights any trouble in the form of symbols or error codes.

Rev counter/ Techometer

The rev counter **(1)** indicates the engine rpm. Each division on the scale represents 100 rev/min., therefore, with the needle indicating 20 , the engine is running at **2000 RPM**.



DCUTLBRNE003S3A 2

Engine speed

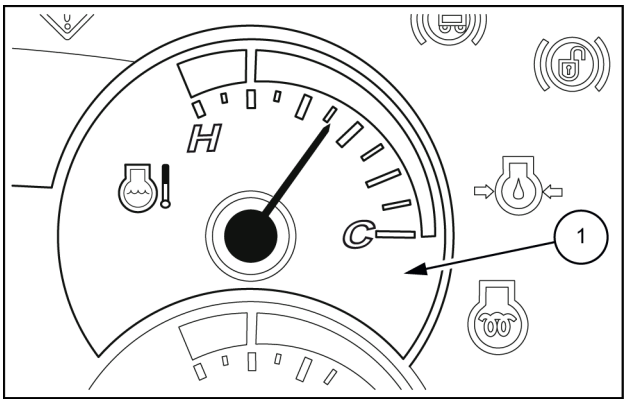
NOTICE: *Never use the engine continuously for a long time at speeds between* ***2500 - 3000 RPM*** *(yellow area on the speedometer) to avoid damage to the engine and definitely never exceed* ***3000 RPM*** *(red area on the speedometer). For appropriate use, always operate under the speed corresponding to* ***2300 RPM****.*

Engine coolant temperature gauge

The temperature display **(1)** indicates the temperature of the engine coolant.

- blue area = normal temperature;
- red area = temperature too high.

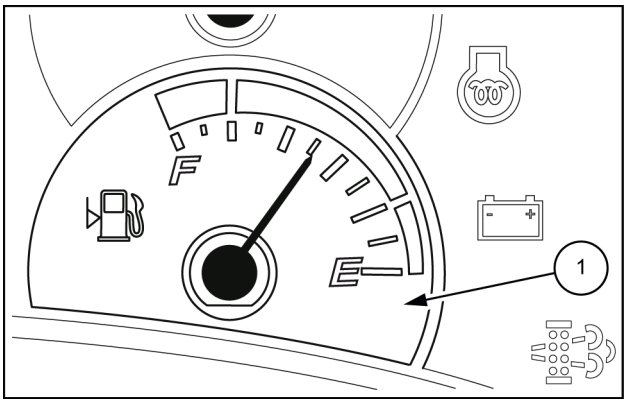
In this case, slow the engine to idling speed (without stopping the engine) and, if the light stays on, have the cooling system checked.



DCUTLBRNE004S3A 3

Fuel level gauge

This instrument **(1)** indicates the level of diesel in the tank and only works when the ignition key is turned onto ON.

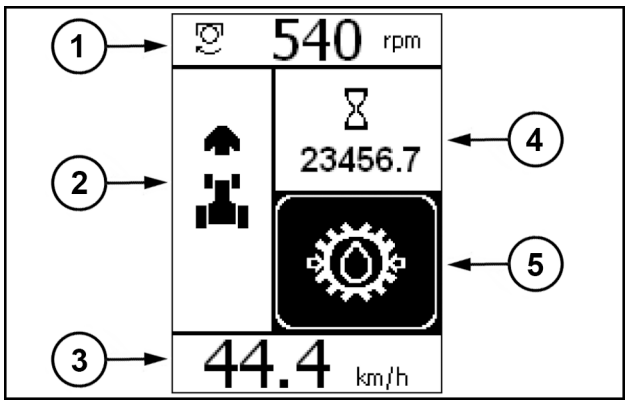


DCUTLBRNE005S3A 4

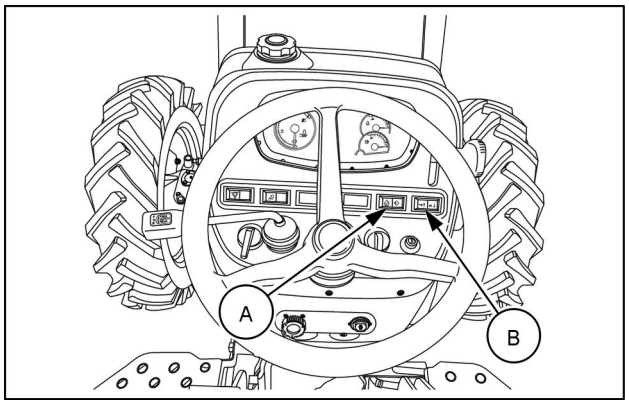
Central display

The central liquid crystal display provides the operator with a range of information

- Front or rear power take−off speed
  Front or rear lift position
  Slip
  Data displayed by pressing and releasing the button ENTER **(A)**
- Tractor direction.
- Speed of the vehicle in Km/h or MPH
- Tractor working hour meter
- Kilometers travelled
  Area worked
  Area worked per hour
  Battery voltage
  Data displayed by pressing the arrow buttons up or down **(B)**
  When necessary, warning and error messages
  Programming menu (see specific chapter)



DCAPLT5NE005S3F 5

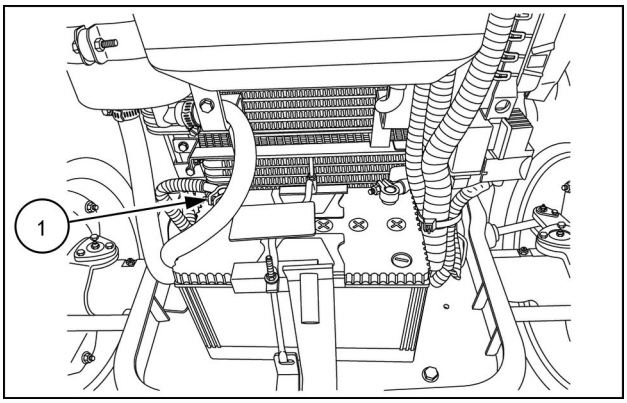


GNIL14TR00512AA 6

Instrument cluster - Remove

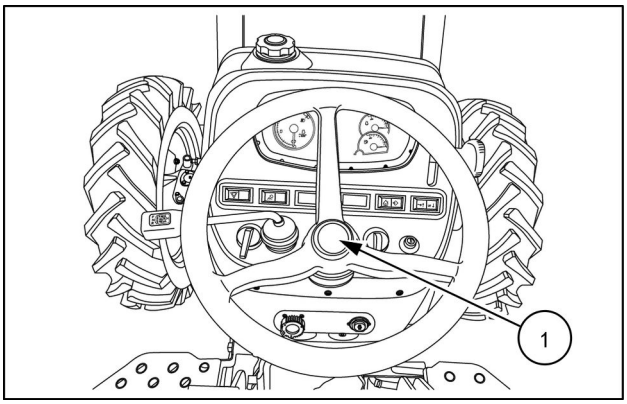
1. Lift the front hood.
2. Disconnect battery terminals.

NOTE: *Always disconnect the negative cable* ***(1)*** *first.*



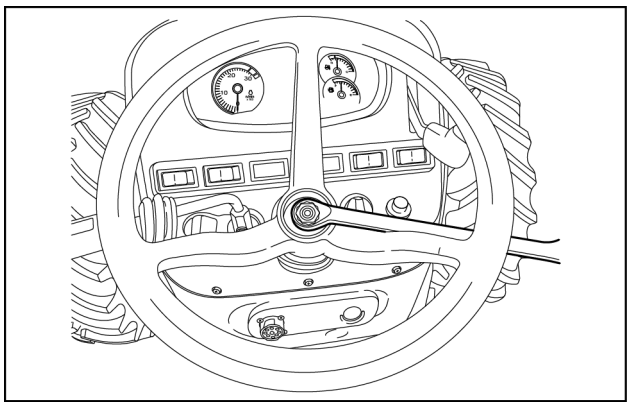
GNIL14TR00784AA 1

3. Remove the steering wheel cover **(1)**.



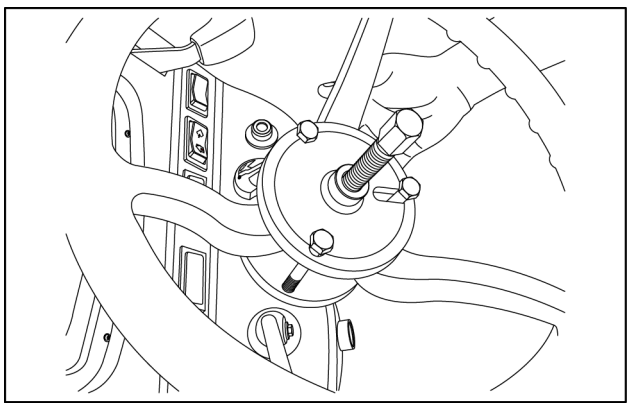
GNIL14TR00512AA 2

4. Loosen the steering wheel securing nut.



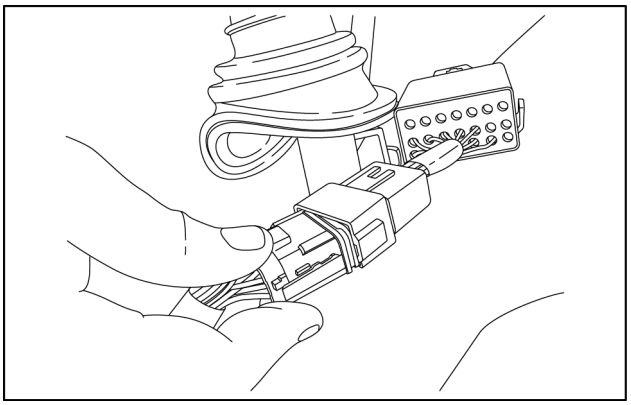
GNIL14TR00846AA 3

5. Loosen the steering wheel securing nut and remove the steering wheel using tool number 82834312 and 9971375.



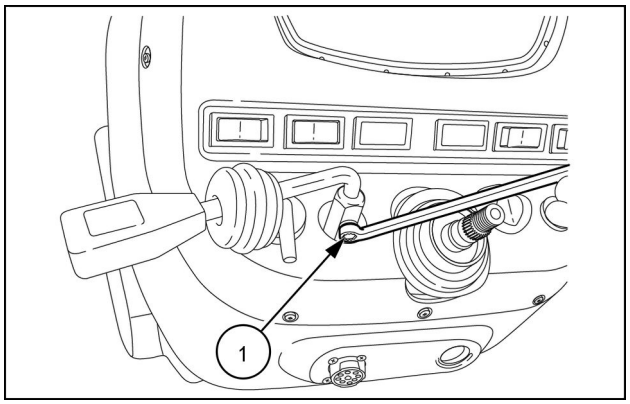
GNIL14TR00704AA 4

6. Disconnect the wiring connection **(1)** near the steering column.



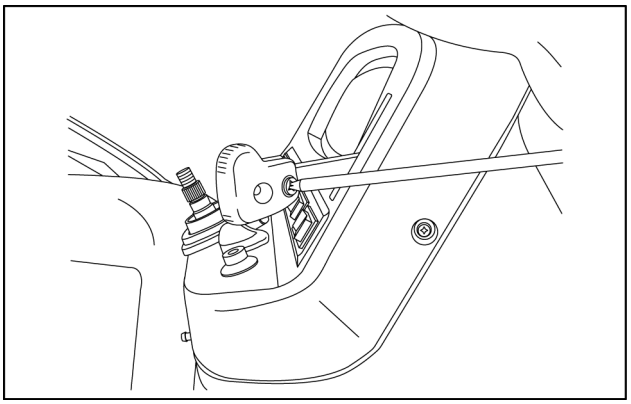
GNIL14TR00711AA 5

7. Loosen the bolt **(1)** and remove the shuttle lever.



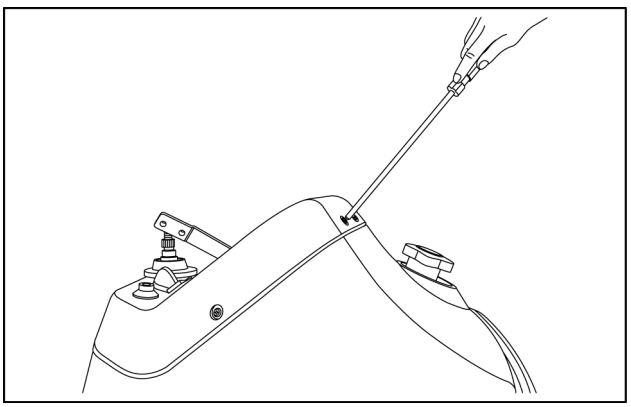
GNIL14TR00705AA 6

8. Remove the hand throttle knob.



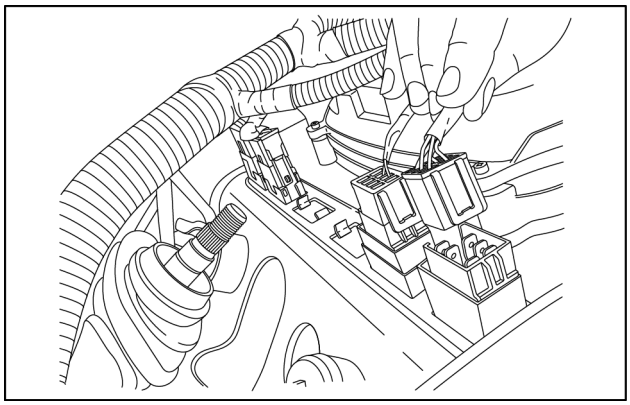
GNIL14TR00706AA 7

9. Unscrew all the screws of instrument panel.



GNIL14TR00707AA 8

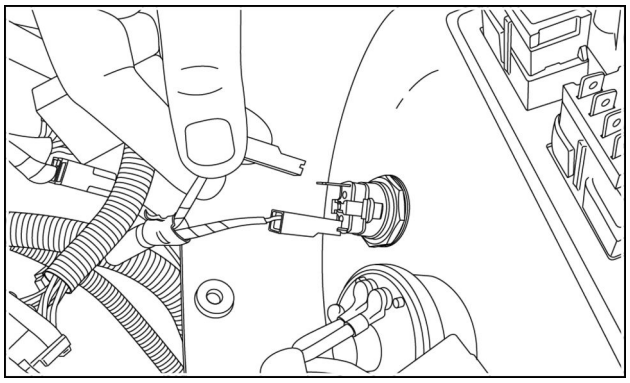
10. Pull out the instrument panel from rear hood.
11. Disconnect all the electric connections of the switches and hourmeter from the instrument cluster.



GNIL14TR00714AA 9

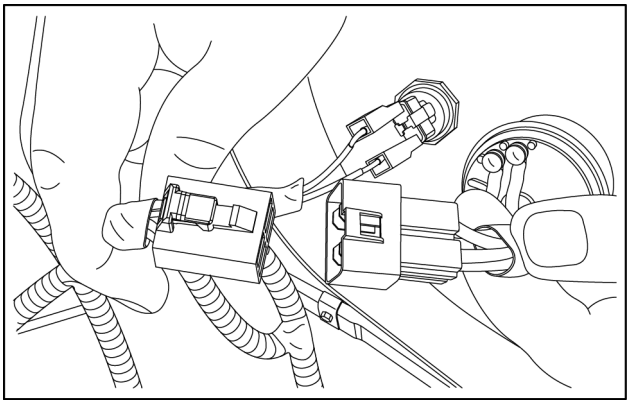
Instrument cluster - Install

1. Connect wiring coupler to horn switch.



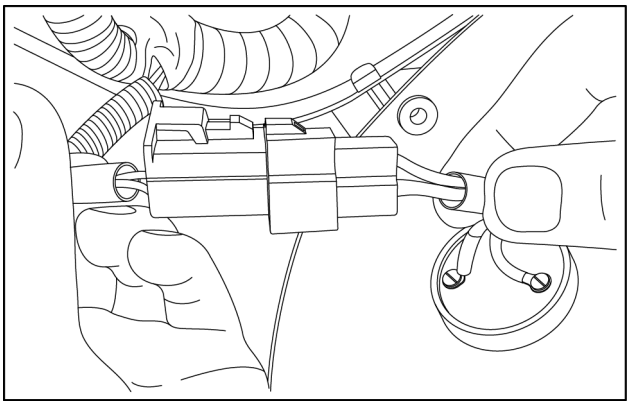
GNIL14TR00772AA 1

2. Connect wiring coupler to head light switch.



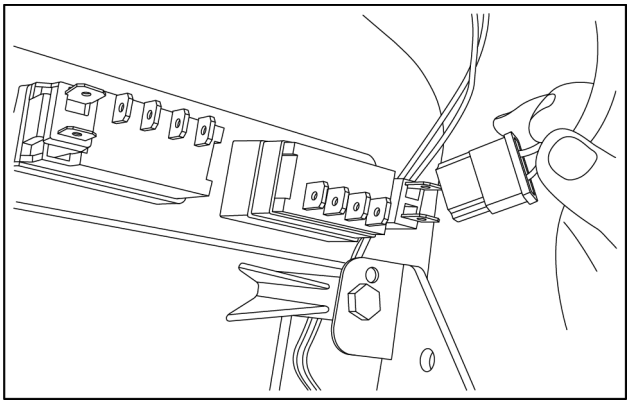
GNIL14TR00773AA 2

3. Connect wiring coupler to indicator switch.



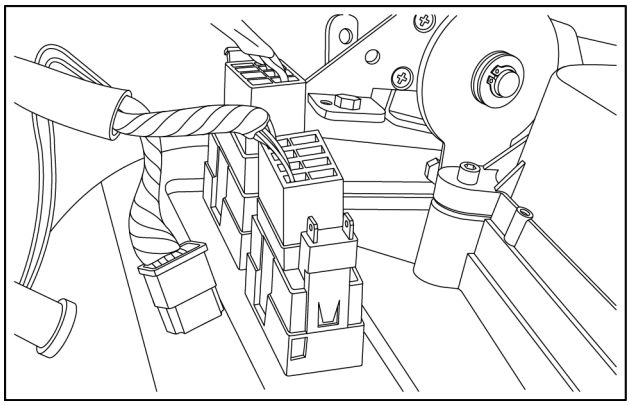
GNIL14TR00774AA 3

4. Connect wiring coupler to programming arrow switch.



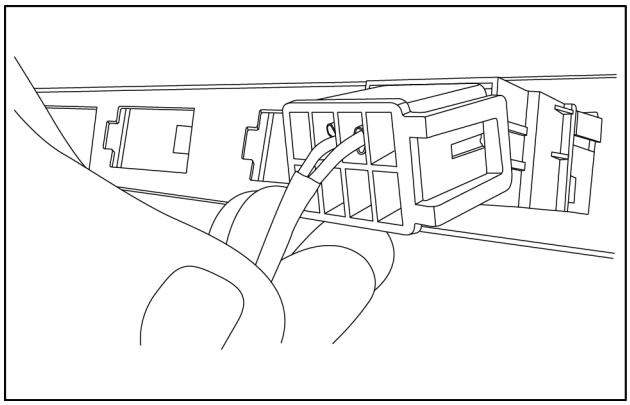
GNIL14TR00775AA 4

5. Connect wiring coupler to home programming switch.



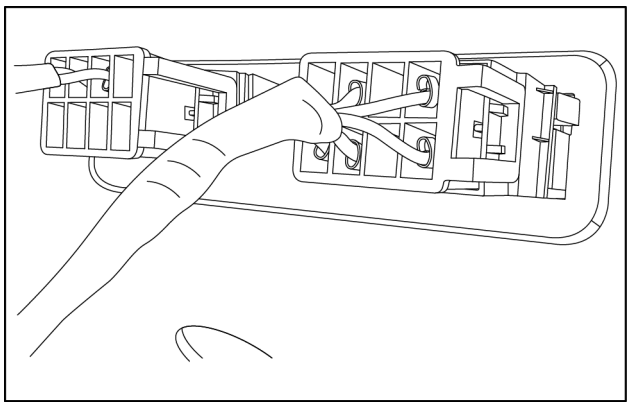
GNIL14TR00776AA 5

6. Connect wiring coupler to Hi-Lo beam switch.



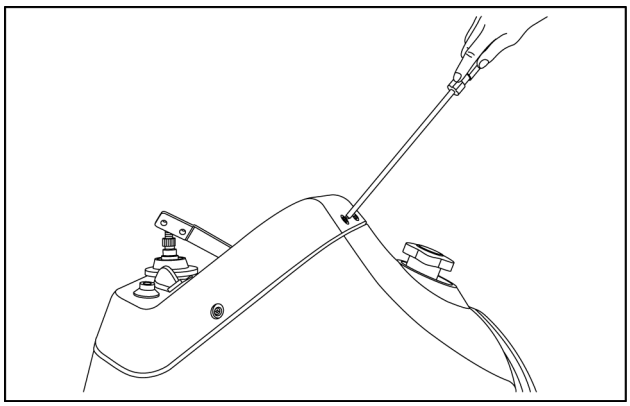
GNIL14TR00777AA 6

7. Connect wiring coupler to hazard warning switch.



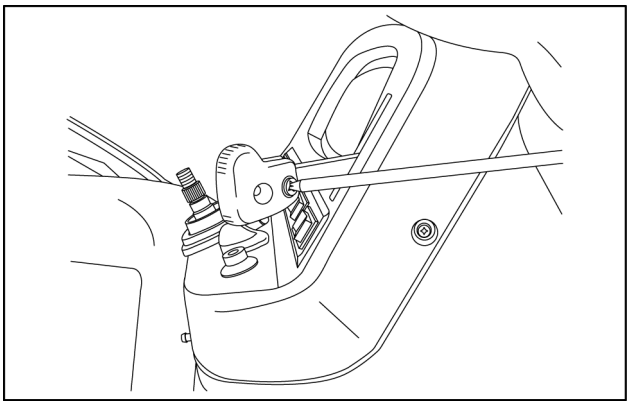
GNIL14TR00778AA 7

8. Tighten all the screws **(1)** of instrument panel.



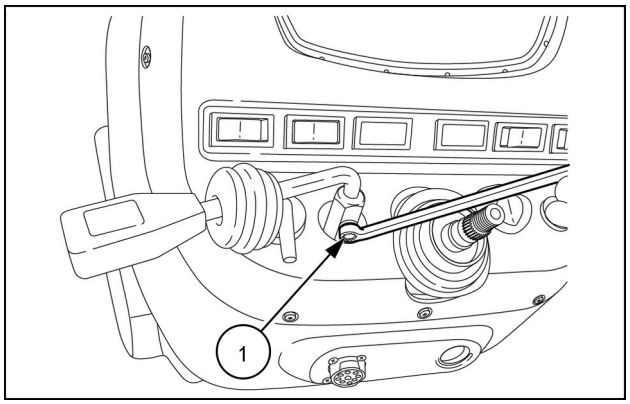
GNIL14TR00707AA 8

9. Fit the hand throttle knob.



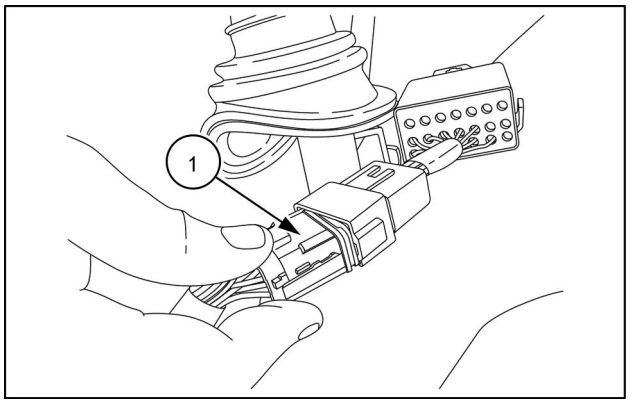
GNIL14TR00706AA 9

10. Fit the shuttle lever and tighten the bolt **(1)**.



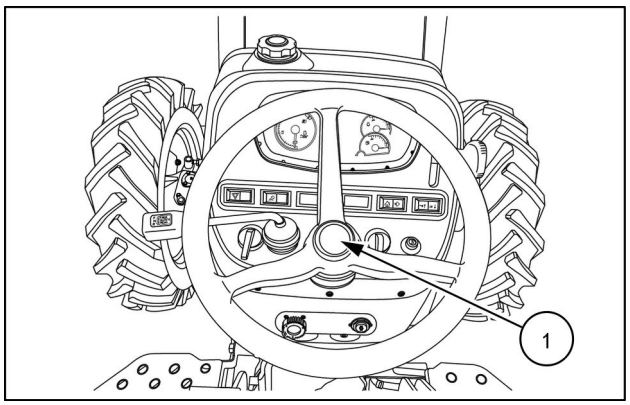
GNIL14TR00705AA 10

11. Connect the wiring coupler **(1)** near the steering column.



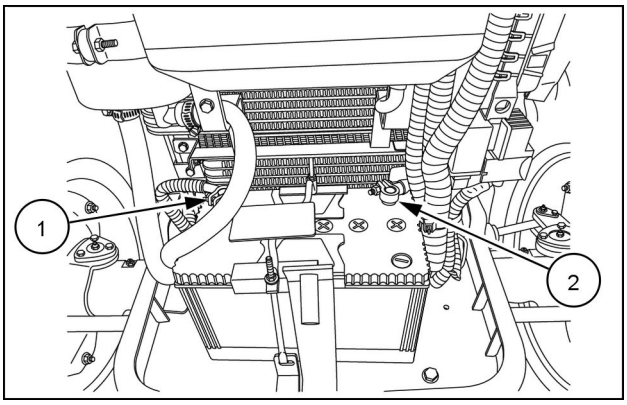
GNIL14TR00711AA 11

12. Install the steering wheel and cover **(1)**.



GNIL14TR00512AA 12

13. Connect the battery terminals **(1)** and **(2)**.



GNIL14TR00784AA 13

Instrument cluster - Troubleshooting

Problem	Possible Cause	Correction
Warning lights and gauges inoperative	Blown #6 **15 A** fuse.	Replace fuse.
Gauges erratic or inoperative	Faulty ground circuit.	Check ground connections for proper contact.
	Faulty sender.	Check sender for proper operation.
Warning lights not illuminating	Bulb is burned out	Replace bulb
	Sender wire damaged	Check wiring harness for damage
	Faulty sender	Check sender for proper operation
Gauges always show maximum reading	Sender wire shorted to ground.	Check sender wire for damage.
Erratic tachometer reading	Fan belt slipping.	Tighten fan belt.

https://truckmanualshub.com/

Index

Electrical systems - 55

Warning indicators, alarms, and instruments - 408

Instrument cluster - Install 12
Instrument cluster - Overview 5
Instrument cluster - Remove 9
Instrument cluster - Troubleshooting 16
Warning indicators, alarms, and instruments - Overview 3

https://truckmanualshub.com/

https://truckmanualshub.com/

Electrical systems - 55

Cab controls - 512

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Electrical systems - 55

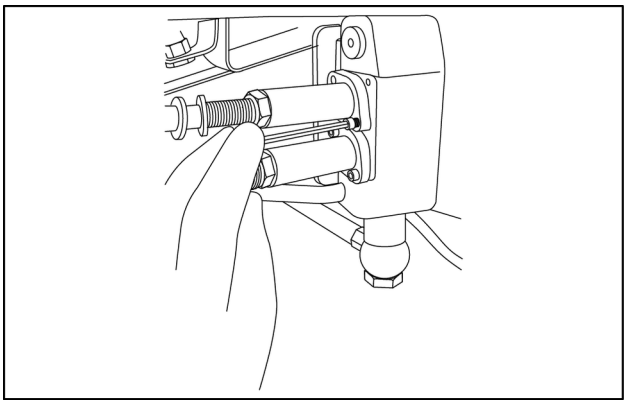
Cab controls - 512

SERVICE

Joystick and Electric Hydraulic (EH) control
Remove 3
Install 5

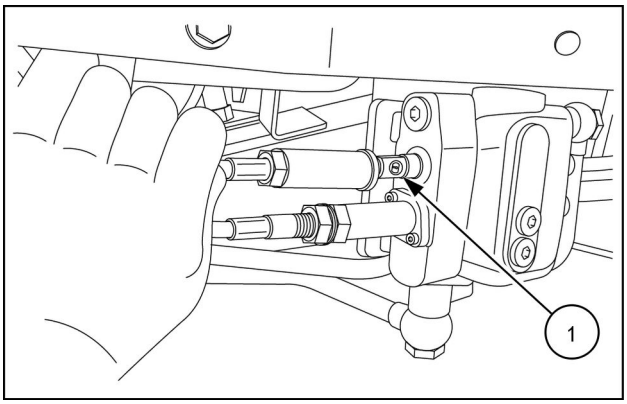
Joystick and Electric Hydraulic (EH) control - Remove

1. 1. Loosen the locknut on joystick cable.
   2. Loosen the set screws on the connectors of joystick cable.
   3. Slide the connector on the joystick cable.



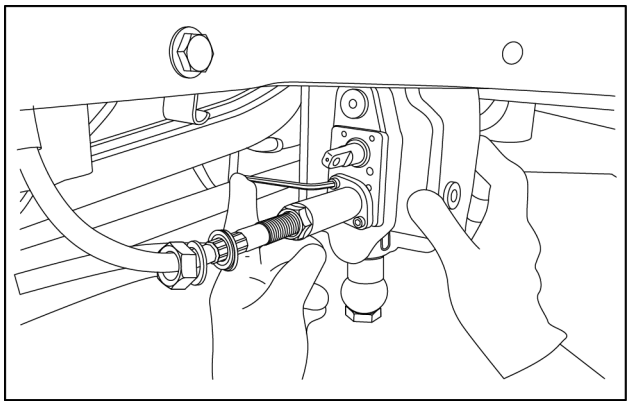
GNIL14TR00764AA 1

2. Remove the roll pin **(1)** and remove the joystick cable.



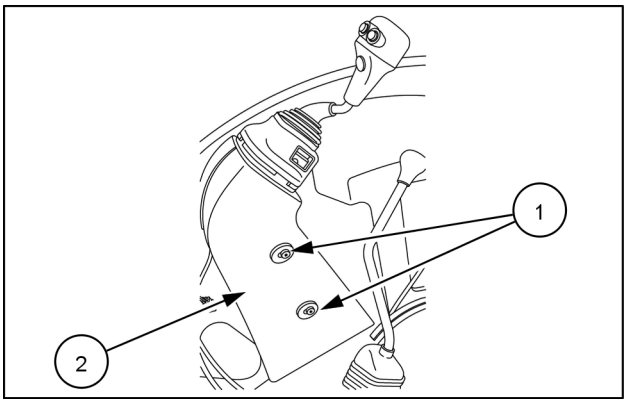
GNIL14TR00821AA 2

3. Similarly remove the other joystick cable.



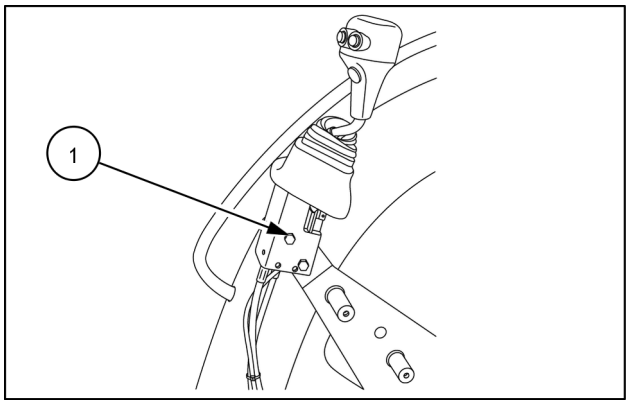
GNIL14TR00788AA 3

4. Loosen the screws **(1)** and remove the cover **(2)** of the joystick.



GNIL14TR00786AA 4

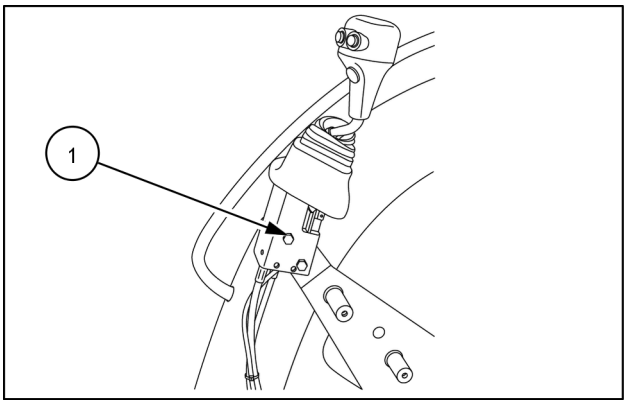
5. 1. Disconnect the electrical coupling.
   2. Loosen the bolts **(1)** and remove the joystick from the mounting bracket.



GNIL14TR00787AA 5

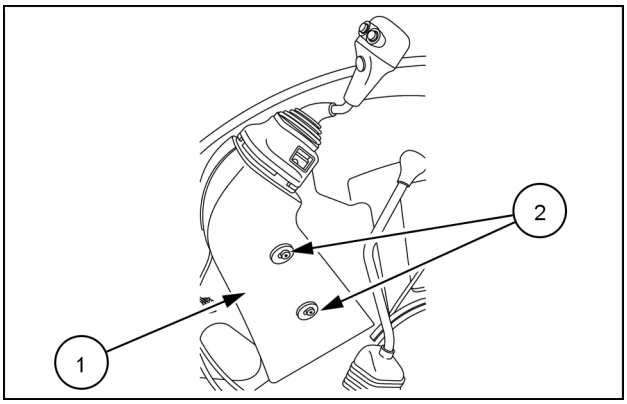
Joystick and Electric Hydraulic (EH) control - Install

1. Install the joystick on the mounting bracket and tighten the bolts **(1)**.
   Connect the electrical coupling.



GNIL14TR00787AA 1

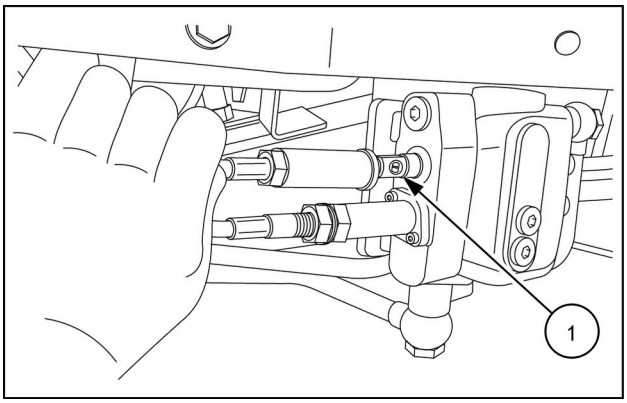
2. Fit the cover **(1)** of the joystick and tighten the screws **(2)**.



GNIL14TR00786AA 2

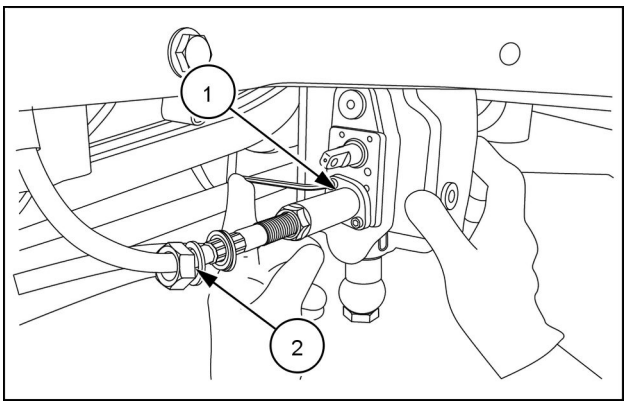
3. Insert the roll-pin **(1)** and connect the joystick cable, passing through the footboard, on the mid-mount valve.

NOTE: *Connect the green colored cable on the upper port of the mid-mount valve. Connect the yellow colored cable on the lower port of the mid-mount valve.*



GNIL14TR00821AA 3

4. Tighten the set screw **(1)** on the connector of the joystick cable.
   Tighten the locknut **(2)**.



GNIL14TR00788AA 4

https://truckmanualshub.com/

Index

Electrical systems - 55

Cab controls - 512

Joystick and Electric Hydraulic (EH) control - Install 5
Joystick and Electric Hydraulic (EH) control - Remove 3

https://truckmanualshub.com/

Electrical systems - 55

FAULT CODES - DTC

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Electrical systems - 55

FAULT CODES - DTC

DIAGNOSTIC

DTC 11C-02-Water in fuel sensor or sensor circuit failure [ECU] 8
DTC 11C-03-Water in fuel detected or water in fuel circuit failure [ECU] 10
DTC 131-03-Engine coolant temperature sensor voltage is higher than expected [ECU] 12
DTC 131-04-Engine coolant temperature sensor voltage is lower than expected [ECU] 14
DTC 133-03-Intake manifold temperature sensor voltage is higher than expected [ECU] 16
DTC 133-04-Intake manifold temperature sensor voltage is lower than expected [ECU] 18
DTC 134-00-Intake manifold pressure sensor drifted high [ECU] 20
DTC 134-01-Intake manifold pressure sensor drifted low [ECU] 21
DTC 134-03-Intake manifold pressure sensor voltage is higher than expected [ECU] 22
DTC 134-04-Intake manifold pressure sensor voltage is lower than expected [ECU] 24
DTC 135-03-Fuel temperature sensor voltage is higher than expected [ECU] 26
DTC 135-04-Fuel temperature sensor voltage is lower than expected [ECU] 28
DTC 136-03-Fuel rail pressure sensor voltage is higher than expected [ECU] 30
DTC 136-04-Fuel rail pressure sensor voltage is lower than expected [ECU] 32
DTC 137-02-Fuel pressure relief valve reached maximum allowed opening count [ECU] 34
DTC 137-03-Fuel pressure relief valve is open [ECU] 35
DTC 137-04-Fuel pressure relief valve is forced to open, perform pressure increase [ECU] 36
DTC 137-12-Averaged rail pressure is outside the expected tolerance range [ECU] 37
DTC 141-02-Crankshaft speed sensor values are not plausible [ECU] 38
DTC 141-04-Crankshaft speed sensor pattern is not plausible [ECU] 40
DTC 143-02-Camshaft speed sensor values are not plausible [ECU] 42
DTC 143-04-Camshaft speed sensor pattern is not plausible [ECU] 44
DTC 144-03-Compared camshaft and crankshaft speed sensor values are not plausible [ECU] 46
DTC 151-03-Fuel rail pressure has exceeded maximum positive deviation limits [ECU] 47
DTC 153-03-Fuel rail pressure has exceeded maximum negative deviation limits [ECU] 48
DTC 154-03-Fuel rail pressure has dropped below the minimum limit [ECU] 50
DTC 155-03-Fuel rail pressure has exceeded maximum limit [ECU] 51
DTC 157-03-High pressure pump fuel delivery quantity in over run exceeds a maximum threshold [ECU] 53
DTC 158-03-Fuel pump pressure has exceeded desired pressure limits [ECU] 54
DTC 159-02-Fuel metering unit has an open load error [ECU] 55
DTC 15D-03-PMCat Inducement less severe derating level [ECU] 57

DTC 161-02-Short circuit error of injector in cylinder 1 [ECU] 58
DTC 161-03-Short circuit of low side to high source of injector in cylinder 1 [ECU] 61
DTC 162-02-Short circuit error of injector in cylinder 2 [ECU] 63
DTC 162-03-Short circuit of low side to high source of injector in cylinder 2 [ECU] 66
DTC 163-02-Short circuit error of injector in cylinder 3 [ECU] 68
DTC 163-03-Short circuit of low side to high source of injector in cylinder 3 [ECU] 71
DTC 167-02-Open load error of injector in cylinder 1 [ECU]. 73
DTC 168-02-Open load error of injector in cylinder 2 [ECU]. 75
DTC 169-02-Open load error of injector in cylinder 3 [ECU]. 77
DTC 171-03-Injection bank 1 short circuit failure (all injectors of the same bank can be affected) [ECU]79
DTC 173-03-Injection bank 2 short circuit failure (all injectors of the same bank can be affected) [ECU]80
DTC 17C-12-ECU internal failure - Injector CY33x component [ECU] 82
DTC 17E-02-Number of desired injections exceeds threshold [ECU]. 83
DTC 17E-03-Exceeded the number of injections for a given engine speed [ECU]. 84
DTC 17E - 04-Injection control : Number of injections is limited by system [ECU]. 85
DTC 17E-12-Number of injections is limited by quantity balance of high pressure pump [ECU] 86
DTC 17F-12-Missing adjustment value programming for injector in cylinder 1 [ECU] 87
DTC 18F-02-Lambda sensor heater power stage open circuit [ECU]. 88
DTC 18F-03-Lambda sensor heater power stage short circuit to battery [ECU] 90
DTC 18F-04-Lambda sensor heater power stage short circuit to ground [ECU]. 92
DTC 18F-04-Lambda sensor heater power stage short circuit to ground [ECU]. 94
DTC 199-02-Turbocharger boost pressure is higher than expected [ECU] 96
DTC 199-02-Turbocharger boost pressure is higher than expected [ECU] 97
DTC 1B1-03-CAN A Bus off failure [ECU] 98
DTC 1B1-04-CAN A Bus off passive failure [ECU]. 100
DTC 1B5-02-CAN communication error between vehicle controller to ECU [ECU] 102
DTC 1B7-02-CAN transmit error - EEC1 message (Electronic Engine Control 1 message - Torque, accelerator pedal, engine speed, and other signals) [ECU]. 104
DTC 1C6-03-CAN communication failure between vehicle controller and ECU controller - TSC1_PE message [ECU] 106
DTC 1C8-03-CAN communication failure between vehicle controller and ECU controller - TSC1_VE message [ECU] 108
DTC 1D1-03-ECU internal failure [ECU] 110
DTC 1D2-02-ECU internal failure - EEPROM write error [ECU] 111
DTC 1D2-03-ECU internal failure - EEPROM erase error [ECU]. 112
DTC 1D2-04-ECU internal failure - EEPROM read error [ECU]. 113
DTC 1D2-12-ECU internal failure - EEPROM write/read error [ECU]. 114
DTC 1D3-12-ECU internal failure - Software resets in DSM 0 [ECU] 115
DTC 1D4-12-ECU internal failure - Query/response communication errors [ECU]. 116
DTC 1D8-12-ECU internal failure - SPI communication error [ECU]. 117
DTC 1D9-02-ECU internal failure - ADC test [ECU]. 118
DTC 1D9-03-ECU internal failure - Voltage ratio in ADC monitoring [ECU]. 119
DTC 1D9-12-ECU internal failure - NTP error in ADC monitoring [ECU] 120

DTC 1DA-12-ECU internal failure - Fuel calibration [ECU] 121
DTC 1E1-03-Starter relay high side driver circuit shorted to battery [ECU] 122
DTC 1E1-04-Starter relay high side driver circuit shorted to ground [ECU] 124
DTC 1E3-03-Fuel injection requested during overrun [ECU] 126
DTC 1E4-03-ECU internal failure - Calculated engine speed [ECU] 127
DTC 1E6-12-ECU 5 volt sensor supply 1 out of range [ECU] 128
DTC 1E7-03-ECU 5 volt sensor supply 2 out of range [ECU] 132
DTC 1E8-03-ECU 5 volt sensor supply 3 out of range [ECU] 134
DTC 1EB-03-ECU internal failure - Ambient pressure sensor voltage is higher than expected [ECU] . 136
DTC 1EB-04-ECU internal failure - Ambient pressure sensor voltage is lower than expected [ECU] . . 137
DTC 1F7-00-PMCat inlet temperature sensor physical range check high [ECU] 138
DTC 1F7-03-PMCat inlet temperature sensor voltage is higher than expected [ECU] 140
DTC 1F7-04-PMCat inlet temperature sensor voltage is lower than expected [ECU] 142
DTC 225-03-Main relay stuck error [ECU] 144
DTC 225-03-Main relay stuck error [ECU] 146
DTC 226-03-Battery voltage is higher than expected [ECU] 149
DTC 226-04-Battery voltage is lower than expected [ECU] 150
DTC 236-03-Rail pressure sensor value is above maximum offset [ECU] 152
DTC 236-03-Rail pressure sensor value is above maximum offset [ECU] 153
DTC 236-04-Rail pressure sensor value is below minimum offset [ECU] 154
DTC 237-04-Fuel pressure relief valve is forced to open, perform pressure shock [ECU] 155
DTC 237-04-Fuel pressure relief valve is forced to open, perform pressure shock [ECU] 156
DTC 237-12-Quantity balance check if a successful PRV opening is ensured [ECU] 157
DTC 237-12-Quantity balance check if a successful PRV opening is ensured [ECU] 158
DTC 238-03-Oil pressure switch active with engine off [ECU] 159
DTC 238-04-Low oil pressure [ECU] 161
DTC 256-03-Engine speed limitation via fuel injection cut off is active [ECU] 163
DTC 259-03-Fuel metering unit is shorted to battery voltage at the low side [ECU] 164
DTC 25A-03-Error in comparing energizing time to maximum value for injector in cylinder 1 [ECU] . . 166
DTC 25A-04-Error in comparing energizing time to minimum value for injector in cylinder 1 [ECU] . . . 167
DTC 25D-03-PMCat Inducement most severe derating level [ECU] 168
DTC 26F-04-The minimum rail pressure value necessary to allow fuel injection has not been reached [ECU] 169
DTC 27F-12-Missing adjustment value programming for injector in cylinder 2 [ECU] 170
DTC 299-04-Turbocharger boost pressure is lower than expected [ECU] 171
DTC 2B4-02-CAN communication failure between vehicle controller and ECU - BC2ECU2 message [ECU] 172
DTC 2C6-02-CAN communication failure between vehicle controller and ECU controller - TSC1_PE message [ECU] 174
DTC 2CC-00-Engine controller internal temperature out of range (High) [ECU] 176
DTC 2CC-01-Engine controller internal temperature out of range (Low) [ECU] 177
DTC 2CC-12-Engine controller internal temperature out of range (SPI Error - LM71) [ECU] 178
DTC 2D1-03-ECU internal failure - Error on R2S2 module [ECU] 179

DTC 2D3-12-ECU internal failure - Software resets in DSM 1 [ECU] 180
DTC 2D4-04-ECU internal failure - ROM error [ECU] 181
DTC 2E1-02-Starter relay low side driver circuit open [ECU] 182
DTC 2E1-03-Starter relay low side driver circuit shorted to battery [ECU] 184
DTC 2E1-04-Starter relay low side driver circuit shorted to ground [ECU] 186
DTC 2E1-12-Starter relay low side ECU driver circuit over temperature [ECU] 188
DTC 32B-02-Glow plug control circuits open [ECU] 190
DTC 32B-03-Glow plug control circuits shorted to battery [ECU] 192
DTC 32B-04-Glow plug control circuits shorted to ground [ECU] 194
DTC 32B-12-Glow plug control circuits shorted [ECU] 196
DTC 359-04-Fuel metering unit is shorted to ground at the low side [ECU] 198
DTC 35A-03-Error in comparing energizing time to maximum value for injector in cylinder 2 [ECU] . . 200
DTC 35A-04-Error in comparing energizing time to minimum value for injector in cylinder 2 [ECU] . . . 201
DTC 35D-03-PMCat Inducement warning [ECU] 202
DTC 37F-12-Missing adjustment value programming for injector in cylinder 3 [ECU] 203
DTC 3C8-02-CAN communication failure between vehicle controller and ECU controller - TSC1_VE message [ECU] 204
DTC 3D4-02-ECU internal failure - ECU shutdown test failure [ECU] 206
DTC 3D4-03-ECU internal failure - Wrong set response time [ECU] 207
DTC 3D4-04-ECU internal failure - SPI errors during MoCSOP execution [ECU] 208
DTC 3D4-12-ECU internal failure - Loss of synchronization to MM from CPU [ECU] 209
DTC 3E3-00-ECU internal failure - Fuel injection energizing time is not plausible [ECU] 210
DTC 3E3-01-ECU internal failure - Fuel injection energizing phase is not plausible [ECU] 211
DTC 3E3-02-Fuel injection correction has exceeded a minimum limit [ECU] 212
DTC 3E3-03-ECU internal failure - Injection quantity correction [ECU] 213
DTC 3E3-04-ECU internal failure - Rail pressure plausibility [ECU] 214
DTC 3E3-12-ECU internal failure - Torque request comparison [ECU] 215
DTC 3F6-03-DOC inlet temperature sensor voltage is higher than expected [ECU] 216
DTC 3F6-04-DOC inlet temperature sensor voltage is lower than expected [ECU] 218
DTC 426-03-Level 2 Monitoring : Reported Overvoltage of Supply [ECU] 220
DTC 426-04-Level 2 Monitoring : Reported Under Voltage of Supply [ECU] 221
DTC 435-12-Rail pressure sensor value is intermittent [ECU] 222
DTC 455-03-High pressure pump fuel delivery quantity at low idle is too high [ECU] 224
DTC 459-03-Fuel metering unit intermittent electrical connection failure [ECU] 225
DTC 45A-03-Error in comparing energizing time to maximum value for injector in cylinder 3 [ECU] . . 227
DTC 45A-04-Error in comparing energizing time to minimum value for injector in cylinder 3 [ECU] . . . 228
DTC 48D-02-Throttle valve actuator control circuit open [ECU] 229
DTC 48D-03-Throttle valve actuator control circuit over current [ECU] 231
DTC 48D-12-Throttle valve actuator control circuit over temperature [ECU] 233
DTC 4D4-03-ECU internal failure - Overvoltage monitoring error [ECU] 235
DTC 4D4-04-ECU internal failure - Undervoltage monitoring error [ECU] 236
DTC 4E3-03-ECU internal failure - Post injection quantity [ECU] 237

DTC 4E3-04-Level 2 Monitoring : Diagnosis fault check to report the error to demand for an ICO due to an error in the PoI2 shut-off [ECU] 238
DTC 4E3-12-Level 2 Monitoring : Diagnosis fault check to report the error to demand for an ICO due to an error in the PoI3 efficiency factor [ECU] 239
DTC 52C-01-Glow Control Unit (GCU) data error [ECU] 240
DTC 532-03-Engine coolant temperature has exceeded the warning threshold [ECU] 242
DTC 535-03-Maximum rail pressure exceeded [ECU] 243
DTC 54C-03-Engine over speed condition detected [ECU] 244
DTC 559-12-Fuel metering unit has an over-temperature error [ECU] 245
DTC 58C-03-Throttle valve actuator will not open to commanded position [ECU] 247
DTC 58C-04-Throttle valve actuator will not close to commanded position [ECU] 248
DTC 58D-03-Throttle valve actuator control circuit high side shorted to battery [ECU] 249
DTC 58D-04-Throttle valve actuator control circuit high side shorted to ground [ECU] 251
DTC 5D2-03-ECU internal failure - EEPROM memory failure [ECU] 253
DTC 5D4-02-ECU internal failure - WDA is not working correctly [ECU] 254
DTC 5D4-03-ECU internal failure - Alarm task period error [ECU] 255
DTC 5D4-04-ECU internal failure - Positive test failed [ECU] 256
DTC 5D4-12-ECU internal failure - Timeout in the shut off path test error [ECU] 257
DTC 5E3-03-ECU internal failure - Torque request due to fuel pressure exceeds maximum torque limit [ECU] 258
DTC 5E3-04-ECU internal failure - Torque request due to air control exceeds maximum torque limit [ECU] 259
DTC 5E3-12-ECU internal failure - Torque request exceeds maximum torque limit [ECU] 260
DTC 601-02-Lambda sensor nernst cell open circuit [ECU] 261
DTC 602-02-Lambda sensor pump current open circuit [ECU] 263
DTC 605-03-Lambda sensor O2 value above maximum threshold [ECU] 265
DTC 606-02-Lambda sensor virtual ground open circuit [ECU] 267
DTC 607-03-Lambda sensor O2 calibrator too high error [ECU] 269
DTC 607-04-Lambda sensor O2 calibrator too low error [ECU] 270
DTC 609-02-ECU internal failure - SPI chip error configuration [ECU] 271
DTC 60A-04-Lambda sensor heater battery voltage too low [ECU] 272
DTC 60B-03-Lambda sensor cell circuits short circuit to battery [ECU] 274
DTC 60B-04-Lambda sensor cell circuits short circuit to ground [ECU] 276
DTC 60C-03-Lambda sensor estimated temperature higher than threshold [ECU] 278
DTC 60C-04-Lambda sensor estimated temperature lower than threshold [ECU] 280
DTC 68D-03-Throttle valve actuator control circuit low side shorted to battery [ECU] 282
DTC 68D-04-Throttle valve actuator control circuit low side shorted to ground [ECU] 284
DTC 6D4-02-ECU internal failure - 'WDA active' reported due to errors in query/response communication [ECU] 286
DTC 6D4-03-ECU internal failure - 'ABE active' reported due to overvoltage detection [ECU] 287
DTC 6D4-04-ECU internal failure - 'ABE active' reported due to undervoltage detection [ECU] 288
DTC 6D4-12-ECU internal failure - 'WDA/ABE active' reported [ECU] 289
DTC 72C-00-Glow plug 1 control circuit shorted to ground [ECU] 290
DTC 72C-01-Glow plug 3 control circuit shorted to ground [ECU] 292

https://truckmanualshub.com/

DTC 72C-03-Glow plug 2 control circuit shorted to ground [ECU]. 294
DTC 78B-03-Throttle valve actuator position sensor voltage is higher than expected [ECU]. 296
DTC 78B-04-Throttle valve actuator position sensor voltage is lower than expected [ECU]. 298
DTC 78D-03-Throttle valve actuator control circuit over load [ECU]. 300
DTC 78D-04-Throttle valve actuator control circuit supply voltage too low [ECU] 302
DTC 7BA-02-Timeout Error of CAN-Receive-Frame CM1BC [ECU]. 303

DTC 11C-02-Water in fuel sensor or sensor circuit failure

Control Module : ECU

NOTE: *This fault code is for the Water in Fuel switch with black connector housing.*

Context:
The water in fuel switch S-9102 provides a diagnostic self-test signal (less than **3.9 V** for **2.5 s +/- 20%**) at key-ON. If the Engine Control Unit (ECU) A-9000 does not sense the diagnostic self-test signal, this fault will occur and there will be no monitoring of water content in the fuel supply.

Cause:
The ECU A-9000 has not received an acceptable water in fuel switch S-9102 self-test signal.

Possible failure modes:

1. Faulty water in fuel switch S-9102 circuit wiring, damaged.
2. Faulty water in fuel switch S-9102, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify this fault code is still present and in an active state.

   Use the Easy Engine software provided on the Electronic Service Tool (EST) to check the fault status.

   A. If the fault is still present and active, continue with Step **2**.

   B. If the fault is no longer present or is in an inactive state, Continue with Step **7**.
2. Use the EST to check for related faults that may have caused this fault to occur.

   A. If any other faults that may have caused this fault to occur are active, resolve those faults first and then return to this fault.

   B. If no other faults are active,continue with Step **3**.
3. Check the water in fuel switch S-9102 for the initial self-test voltage pulse.

   Carefully back probe the water in fuel switch S-9102 at connector **X-9125**.

   With the help of an assistant, use a multimeter to perform the following test at Key-ON:

From	To	Value
X-9125 pin 1	Chassis ground	There should be less than **3.9 V** for **2.5 s +/- 20%**.
NOTE: *The signal line should switch to battery voltage after the self-test period.*		

   A. If the self-test is successful, continue with Step **4**.

   B. If the self-test is not successful, the water in fuel switch S-9102 has failed internally. Replace the switch.
4. Check for open, short and grounded circuit conditions in the water in fuel switch S-9102 circuit.

   Disconnect the water in fuel switch S-9102 at connector **X-9125**.

   Disconnect the vehicle (VE) harness from the ECU A-9000 at connector **X-9102**.

   With the key switch in the OFF position, use a multimeter to perform the following tests, on the vehicle (VE) harness from :

From	To	Value
X-9125 pin 1	**X-9102 pin K88**	There should be continuity.
X-9125 pin 2	Chassis ground	There should be continuity.
X-9125 pin 3	**X-9102 pin K01**	There should be continuity.

Then use the multimeter to perform the following tests, on the vehicle (VE) harness from :

From	To	Value
X-9125 pin 1	**X-9125 pin 2**	There should be no continuity
X-9125 pin 1	**X-9125 pin 3**	There should be no continuity
X-9125 pin 2	**X-9125 pin 3**	There should be no continuity

Then use the multimeter to perform the following tests, on the vehicle (VE) harness from :

From	To	Value
X-9125 pin 1	Chassis ground	There should be no continuity
X-9125 pin 3	Chassis ground	There should be no continuity

A. If the results are not as expected for any of the wiring tests listed above, there is an open, short or grounded circuit condition in the vehicle harness (VE) wiring. Use the appropriate vehicle service manual and schematics to diagnose and repair the wiring.

B. If the results are as expected in all of the wiring tests listed above, the wiring is ok. Leave connectors **X-9102** and **X-9125** disconnected and continue with Step **5**.

5. Check for key switch voltage supply to water in fuel switch S-9102.

   With the key switch in an ON position, use a multimeter to perform the following test, on the vehicle (VE) harness side from :

From	To	Value
X-9125 pin 3	Chassis ground	There should be key switch voltage.
X-9125 pin 1	Chassis ground	There should be no key switch voltage.

   A. If there is key switch voltage present in the first check and not present in the second check, continue with Step **6**.

   B. If key switch voltage is not present in the first check or present in the second check, use the appropriate vehicle service manual and schematics to diagnose and repair the wiring.

6. Replace the water in fuel switch S-9102, then check to see if this fault has been resolved.

   A. If the fault is resolved, return the machine to service.

   B. If the fault is not resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

7. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 11C-03-Water in fuel detected or water in fuel circuit failure

Control Module : ECU

NOTE: *This fault code is for the Water in Fuel switch with black connector housing.*

Context:
The Engine Control Unit (ECU) A-9000 monitors the voltage output from the water in fuel switch S-9102 to determine if water is present in the fuel supply. If water is detected in the fuel, warnings will be displayed to alert the operator of potential engine damage if operation continues. High voltage signal from the water in fuel switch S-9102 indicates water present.

Cause:
This fault code is displayed to warn the operator that the Engine Control Unit (ECU) A-9000 has detected excess water in the fuel system or a fault in the water in fuel switch circuit.

Possible failure modes:

1. Excess water in the fuel supply.
2. Faulty water in fuel switch S-9102, wiring or internal (mechanical and/or electrical) failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify this fault code is still present and in an active state.

   Use the Easy Engine software provided on the Electronic Service Tool (EST) to check the fault status.

   A. If the fault is still present and active, continue with Step **2**.

   B. If the fault is no longer present or is in an inactive state, Continue with Step **7**.
2. Check fuel for water contamination.

   A. If there is water contamination, continue with Step **3**.

   B. If there is no water contamination, Continue with Step **4**.
3. Verify proper water in fuel switch S-9102 operation.

   Purge fuel supply system, replace fuel filter(s) and refill with fuel that is free of water contamination.

   Start and run engine for 5 minutes.

   Check for code to return to active status.

   A. If code returns in an active status, replace water in fuel switch S-9102.

   B. If code remains inactive, return the machine to service.
4. Check for open, short and grounded circuit conditions in the water in fuel switch S-9102 circuit.

   Disconnect the water in fuel switch S-9102 at connector **X-9125**.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key switch in the OFF position, use a multimeter to perform the following tests, on the vehicle (VE) harness from :

From	To	Value
X-9125 pin 1	**X-9102 pin K88**	There should be continuity.
X-9125 pin 2	Chassis ground	There should be continuity.
X-9125 pin 3	**X-9102 pin K01**	There should be continuity.

Then use the multimeter to perform the following tests, on the vehicle (VE) harness from :

From	To	Value
X-9125 pin 1	**X-9125 pin 2**	There should be no continuity
X-9125 pin 1	**X-9125 pin 3**	There should be no continuity
X-9125 pin 2	**X-9125 pin 3**	There should be no continuity

Then use the multimeter to perform the following tests, on the vehicle (VE) harness from :

From	To	Value
X-9125 pin 1	Chassis ground	There should be no continuity
X-9125 pin 3	Chassis ground	There should be no continuity

A. If the results are not as expected for any of the wiring tests listed above, there is an open, short or grounded circuit condition in the vehicle harness (VE) wiring. Use the appropriate vehicle service manual and schematics to diagnose and repair the wiring.

B. If the results are as expected in all of the wiring tests listed above, the wiring is ok. Leave connectors **X-9102** and **X-9125** disconnected and continue with Step **5**.

5. Check for key switch voltage supply to water in fuel switch S-9102.

   With the key switch in an ON position, use a multimeter to perform the following test, on the vehicle (VE) harness side from :

From	To	Value
X-9125 pin 3	Chassis ground	There should be key switch voltage.
X-9125 pin 1	Chassis ground	There should be no key switch voltage.

   A. If there is key switch voltage present in the first check and not present in the second check, continue with Step **6**.

   B. If key switch voltage is not present in the first check or present in the second check, use the appropriate vehicle service manual and schematics to diagnose and repair the wiring.

6. Replace the water in fuel switch S-9102, then check to see if this fault has been resolved.

   A. If the fault is resolved, return the machine to service.

   B. If the fault is not resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

7. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 131-03-Engine coolant temperature sensor voltage is higher than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the engine coolant temperature sensor B-9003 signal circuit. If the ECU A-9000 determines that voltage is higher than expected in the engine coolant temperature sensor B-9003 signal circuit, this fault will occur. If this fault is active, the ECU A-9000 will set the engine coolant temperature value to a fixed replacement value of **89.96 °C** (**193.93 °F**).

Cause:
The engine coolant temperature sensor B-9003 signal voltage is greater than **4.93 V**.

Possible failure modes:

1. Faulty engine coolant temperature sensor B-9003, short to a voltage source.
2. Faulty engine coolant temperature sensor B-9003, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.
2. Check the coolant temperature sensor B-9003 wiring for a short circuit.

   Disconnect the engine harness (EN) from the coolant temperature sensor B-9003 at connector **X-9006**.

   With the key in the OFF position, use a multimeter to perform the following voltage check on the engine harness side:

From	To	Value
X-9006 pin 1	Chassis ground	There should be no voltage.

   With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness side:

From	To	Value
X-9006 pin 1	Chassis ground	There should be less than **5.5 V**

   A. If the specified values are not measured, there is a short to a voltage source in the coolant temperature sensor B-9003 wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If the specified values are not measured, leave connector **X-9006** disconnected and continue to Step **3**.
3. Check the coolant temperature sensor B-9003 engine harness (EN) wiring for a short circuit.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side:

From	To	Value
X-9006 pin 1	**X-9001 pin A57**	There should be continuity.
X-9006 pin 2	**X-9001 pin A58**	There should be continuity.

A. If there is continuity, leave the connector **X-9001** disconnected and continue to Step **4**.

B. If there is no continuity, there is an open circuit in the coolant temperature sensor B-9003 wiring. Locate and repair the broken conductor.

4. Check the coolant temperature sensor B-9003 engine harness (EN) wiring for a short circuit.

   With the key in the OFF position, use a multimeter to perform the following continuity check from the engine harness (EN) side:

From	To	Value
X-9001 pin A57	All pins in connector **X-9001**	There should be no continuity.
X-9001 pin A58	All pins in connector **X-9001**	There should be no continuity.

   A. If there is no continuity, leave connector **X-9006** disconnected and continue to Step **5**.

   B. If there is continuity, there is a short circuit condition in the wiring. Locate and repair the shorted conductor.

5. Replace the engine coolant temperature sensor B-9003.

   Use the EST to verify the status of the this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 131-04-Engine coolant temperature sensor voltage is lower than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the engine coolant temperature sensor B-9003 signal circuit. If the ECU A-9000 determines that voltage is lower than expected in the engine coolant temperature sensor B-9003 signal circuit, this fault will occur. If this fault is active, the ECU A-9000 will set the engine coolant temperature value to a fixed replacement value of **89.96 °C** (**193.93 °F**).

Cause:
The engine coolant temperature sensor B-9003 signal voltage is less than **198.00 mV**.

Possible failure modes:

1. Faulty engine coolant temperature sensor B-9003 wiring, short to ground condition.
2. Faulty engine coolant temperature sensor B-9003, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check the coolant temperature sensor B-9003 engine harness (EN) wiring for a short to ground condition.

   Disconnect the engine harness (EN) from the coolant temperature sensor B-9003 at connector **X-9006**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side:

To	From	Value
X-9006 pin 1	**X-9006 pin 2**	There should be no continuity.
X-9006 pin 1	Chassis ground	There should be no continuity.

   A. If there is no continuity, leave connector **X-9006** disconnected and continue to Step **3**.

   B. If there is continuity, there is a short to ground condition in the coolant temperature sensor B-9003 engine harness (EN) wiring. Locate and repair the shorted conductor.
3. Check the coolant temperature sensor B-9003 engine harness (EN) wiring for a short to ground condition.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side:

From	To	Value
X-9001 pin A57	All pins in connector **X-9001**	There should be no continuity.

   A. If there is no continuity, leave connector **X-9006** disconnected and continue to Step **4**.

   B. If there is continuity, there is a short circuit in the coolant temperature sensor B-9003 engine harness (EN) wiring. Locate and repair the shorted or broken conductor.

4. Replace the engine coolant temperature sensor B-9003.

   Use the EST to verify the status of the this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 133-03-Intake manifold temperature sensor voltage is higher than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the intake manifold temperature sensor B-9001 signal circuit. If the ECU A-9000 determines that the intake manifold temperature sensor B-9001 signal circuit voltage is greater than **4.94 V**, this fault will occur.

Cause:
The ECU A-9000 has determined that the intake manifold temperature sensor B-9001 signal circuit voltage is greater than **4.94 V**

Possible failure modes:

1. Faulty intake manifold temperature sensor B-9001 wiring, short to a voltage source.
2. Faulty intake manifold temperature sensor B-9001 wiring, open circuit.
3. Faulty intake manifold temperature sensor B-9001, internal failure.
4. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.

2. Check the intake manifold temperature sensor B-9001 wiring for a short to battery condition.

   Disconnect the engine harness (EN) from the intake manifold temperature sensor B-9001 at connector **X-9003**.

   With the key in the OFF position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9003 pin 2	Chassis ground	There should be no voltage.

   With the key in the ON position, use a multimeter to perform the following voltage check at the engine harness (EN) side of the connector from :

From	To	Value
X-9003 pin 2	Chassis ground	There should be less than **5.5 V**.

   A. If the specified values are not measured, there is a short to a voltage source in the intake manifold temperature sensor B-9001 signal circuit. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If the specified values are measured, leave connector **X-9003** disconnected and continue to Step **3**.

3. Check the intake manifold temperature sensor B-9001 wiring for an open circuit condition.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check for an open circuit on the engine harness side:

From	To	Value
X-9003 pin 2	**X-9001 pin A55**	There should be continuity.
X-9003 pin 3	**X-9001 pin A10**	There should be continuity.
NOTE: *Wiggle the harness during the check to promote an intermittent electrical connection.*		

A. If there is no continuity, there is an open circuit in the intake manifold temperature sensor B-9001 wiring. Locate and repair the broken conductor.

B. If there is continuity, leave connector **X-9003** and **X-9001** disconnected and continue to Step **4**.

4. Check the intake manifold temperature sensor B-9001 engine harness (EN) wiring for a short circuit.

   With the key in the OFF position, use a multimeter to perform the following continuity check for a short circuit on the engine harness (EN) side:

From	To	Value
X-9001 pin A55	All pins in connector **X-9001**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the intake manifold temperature sensor B-9001 in the engine harness (EN) wiring. Locate and repair the shorted conductor.

   B. If there no continuity, leave connector **X-9003** disconnected and continue to Step **5**.

5. Replace the intake manifold temperature sensor B-9001.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 133-04-Intake manifold temperature sensor voltage is lower than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the intake manifold temperature sensor B-9001 signal circuit. If the ECU A-9000 determines that the intake manifold temperature sensor B-9001 signal circuit voltage is less than **266.40 mV**, this fault will occur.

Cause:
The ECU A-9000 has determined that the intake manifold temperature sensor B-9001 signal circuit voltage is less than **266.40 mV**.

Possible failure modes:

1. Faulty intake manifold temperature sensor B-9001 wiring, short to ground condition.
2. Faulty intake manifold temperature sensor B-9001, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.

2. Check the intake manifold temperature sensor B-9001 engine harness (EN) wiring.

   Disconnect the engine harness (EN) from the intake manifold temperature sensor B-9001 at connector **X-9003**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9003 pin 2	**X-9003 pin 1**	There should be no continuity.
X-9003 pin 2	Chassis ground	There should be no continuity.

   A. If there is continuity, there is a short to ground condition in the intake manifold temperature sensor B-9001 in the engine harness (EN) wiring. Locate and repair the shorted conductor.

   B. If there no continuity, leave connector **X-9003** disconnected and continue to Step **3**.

3. Check the intake manifold temperature sensor B-9001 engine harness (EN) wiring.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9001 pin A55	All pins in connector **X-9001**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the intake manifold temperature sensor B-9001 in the engine harness (EN) wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there no continuity, leave connector **X-9003** disconnected and continue to Step **4**.

4. Replace the intake manifold temperature sensor B-9001.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 134-00-Intake manifold pressure sensor drifted high

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors boost pressure using the intake manifold pressure sensor B-9001. Boost pressure is compared to environmental pressure by the ECU A-9000. If the ECU A-9000 determines that the difference between measured boost pressure and environmental pressure is greater than **0.1 bar** (**1.5 psi**), this fault will occur.

Cause:
The ECU A-9000 has determined that boost pressure is greater than environmental pressure by **0.1 bar** (**1.5 psi**).

Possible failure modes:

1. Faulty intake manifold pressure sensor B-9001, internal failure.
2. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.
2. Use the Electronic Service Tool (EST) to check the status of following related faults:

   DTC 134-03 - Intake manifold pressure sensor voltage is higher than expected

   DTC 134-04 - Intake manifold pressure sensor voltage is lower than expected

   A. If any of the listed faults are active, diagnose them first and then return to this fault.

   B. If none of the listed faults are active, continue to Step **3**.
3. Replace the intake manifold pressure sensor B-9001.

   Use the EST to verify the status of this fault, .

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate software and re-flash, if necessary.
4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

DTC 134-01-Intake manifold pressure sensor drifted low

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors boost pressure. Boost pressure is compared to environmental pressure by the ECU A-9000. If the ECU A-9000 determines that the boost pressure is less than environmental pressure by **0.1 bar** (**1.5 psi**), this fault will occur.

Cause:
The ECU A-9000 has determined that boost pressure is less than environmental pressure by **0.1 bar** (**1.5 psi**).

Possible failure modes:

1. Faulty intake manifold pressure sensor B-9001, internal failure.
2. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.
2. Use the Electronic Service Tool (EST) to check the status of following related faults:

   DTC 134-03 - Intake manifold pressure sensor voltage is higher than expected

   DTC 134-04 - Intake manifold pressure sensor voltage is lower than expected

   A. If any of the listed faults are active, diagnose them first and then return to this fault.

   B. If none of the listed faults are active, continue to Step **3**.
3. Replace the intake manifold pressure sensor B-9001.

   Use the EST to verify the status of this fault, .

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate software and re-flash, if necessary.
4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

DTC 134-03-Intake manifold pressure sensor voltage is higher than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the intake manifold pressure sensor B-9001. If the ECU A-9000 determines that the intake manifold pressure sensor B-9001 signal circuit voltage is greater than **4.92 V**, this fault will occur. If this fault is active, the intake manifold pressure value will be frozen at the last valid value for a preliminary failure or jump to a fixed replacement value of **0.98 bar** (**14.21 psi**) if the failure is validated.

Cause:
The ECU A-9000 has determined that the intake manifold pressure sensor B-9001 signal circuit voltage is greater than **4.92 V**.

Possible failure modes:

1. Faulty intake manifold pressure sensor B-9001 wiring, short to a voltage source.
2. Faulty intake manifold pressure sensor B-9001 wiring, open circuit.
3. Faulty intake manifold pressure sensor B-9001, internal failure.
4. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.

2. Check the intake manifold pressure sensor B-9001 wiring for a short to a voltage source.

   Disconnect the engine harness (EN) from the intake manifold pressure sensor B-9001 at connector **X-9003**.

   With the key in the OFF position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9003 pin 4	Chassis ground	There should be no voltage.

   With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness side :

From	To	Value
X-9003 pin 4	Chassis ground	There should be less than **5.5 V**

   A. If there is voltage, there is a short to battery or switched battery in the intake manifold pressure sensor B-9001 wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no voltage, leave connector **X-9003** disconnected and continue to Step **3**.

3. Check the intake manifold pressure sensor B-9001 wiring in the engine harness (EN) for an open circuit.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9003 pin 4	**X-9001 pin A40**	There should be continuity.
X-9003 pin 3	**X-9001 pin A10**	There should be continuity.
NOTE: *Wiggle the harness during the check to promote an intermittent electrical connection.*		

A. If there is no continuity, there is an open circuit in the intake manifold pressure sensor B-9001 wiring in the engine harness (EN). Locate and repair the broken conductor.

B. If there is continuity, leave connectors **X-9003** and **X-9001** disconnected and continue to Step **4**.

4. Check the intake manifold pressure sensor B-9001 wiring in the engine harness (EN) for a short to a voltage source.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9003 pin 4	**X-9003 pin 3**	There should be no continuity.
X-9001 pin A40	All pins in connector **X-9001**	There should be no continuity.
X-9001 pin A10	All pins in connector **X-9001**	There should be no continuity.

A. If there is continuity, there is a short circuit in the intake manifold pressure sensor B-9001 wiring in the engine harness (EN). Locate and repair the shorted conductor.

B. If there is no continuity, leave connector **X-9003** disconnected and continue to Step **5**.

5. Replace the intake manifold pressure sensor B-9001.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 134-04-Intake manifold pressure sensor voltage is lower than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the intake manifold pressure sensor B-9001. If the ECU A-9000 determines that the intake manifold pressure sensor B-9001 signal circuit voltage is less than **202.80 mV**, this fault will occur. If this fault is active, the intake manifold pressure value will be frozen at the last valid value for a preliminary failure or jump to a fixed replacement value of **0.98 bar** (**14.21 psi**) if the failure is validated.

Cause:
The ECU A-9000 has determined that the intake manifold pressure sensor B-9001 signal circuit voltage is less than **202.80 mV**.

Possible failure modes:

1. Faulty intake manifold pressure sensor B-9001 wiring, short to ground condition.
2. Faulty intake manifold pressure sensor B-9001, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.
2. Check the intake manifold pressure sensor B-9001 wiring in the engine harness (EN) for a short to ground condition.

   Disconnect the engine harness (EN) from the intake manifold pressure sensor B-9001 at connector **X-9003**.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9003 pin 4	Chassis ground	There should be no continuity.
X-9003 pin 4	**X-9003 pin 1**	There should be no continuity.
X-9001 pin A40	All pins in connector **X-9001**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the intake manifold pressure sensor B-9001 wiring in the engine harness (EN). Locate and repair the shorted conductor.

   B. If there is no continuity, leave connector **X-9003** disconnected and continue to Step **3**.
3. Replace the intake manifold pressure sensor B-9001.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 135-03-Fuel temperature sensor voltage is higher than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel temperature sensor B-9002 signal circuit voltage. If the ECU A-9000 detects a voltage greater than **4.93 V** in the signal circuit, this fault will occur. If this fault is not inhibited by another fault, the ECU A-9000 will freeze the fuel temperature value to **39.96 °C** (**103.93 °F**).

Cause:
The fuel temperature sensor B-9002 signal circuit voltage is greater than **4.93 V**.

Possible failure modes:

1. Faulty fuel temperature sensor B-9002 wiring, short to a voltage source.
2. Faulty fuel temperature sensor B-9002 wiring, open circuit.
3. Faulty fuel temperature sensor B-9002, internal failure.
4. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.

2. Check the fuel temperature sensor B-9002 for an internal failure.

   Disconnect the engine harness (EN) from the fuel temperature sensor B-9002 at connector **X-9005**.

   Use a multimeter to measure the resistance of the fuel temperature sensor B-9002 on the sensor pins :

From	To	Value
X-9005 pin 1	**X-9005 pin 2**	At approximately **20.0 °C** (**68.0 °F**), there should be between **2351 - 2648 Ω**.
NOTE: *The fuel temperature sensor B-9002 is a Negative Temperature Coefficient (NTC) thermistor. The thermistor's conductivity increases with increasing temperature and resistance decreases with increasing temperature.*		

   A. If there is a nominal resistance value, e.g. greater than **100 Ω**, leave connector **X-9005** disconnected and continue to Step **3**.

   B. If there is not a nominal resistance value, e.g. **0 Ω**, the fuel temperature sensor B-9002 has failed. Replace the fuel temperature sensor B-9002.

3. Check the fuel temperature sensor B-9002 wiring for a short to battery.

   With the key in the OFF position, use the a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9005 pin 1	Chassis ground	There should be no voltage.

   With the key in the ON position, use the a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9005 pin 1	Chassis ground	There should be less than **5.5 V**.

A. If the specified values are measured, leave connector **X-9005** disconnected and continue to Step **4**.

B. If the specified values are not measured, there is a short to battery or switched battery in the fuel temperature sensor B-9002 wiring. Use the appropriate service manual, if necessary, to locate and repair the failed conductor.

4. Check the fuel temperature sensor B-9002 engine harness (EN) wiring for an open circuit condition.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use the a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9005 pin 1	**X-9001 pin A38**	There should be continuity.
X-9005 pin 2	**X-9001 pin A23**	There should be continuity.

A. If there is continuity, leave connectors **X-9005** and **X-9001** disconnected and continue to Step **5**.

B. If there is no continuity, there is an open circuit in the fuel temperature sensor B-9002 wiring in the engine harness (EN). Locate and repair the broken conductor.

5. Check the fuel temperature sensor B-9002 engine harness (EN) wiring for a short circuit condition.

   With the key in the OFF position, use the a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9001 pin A38	All pins in connector **X-9001**	There should be no continuity.

A. If there is continuity, there is a short circuit in the fuel temperature sensor B-9002 wiring in the engine harness (EN). Locate and repair the shorted conductor.

B. If there is no continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 135-04-Fuel temperature sensor voltage is lower than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel temperature sensor B-9002 signal circuit voltage. If the ECU A-9000 detects a voltage less than **198.00 mV** in the signal circuit, this fault will occur. If this fault is not inhibited by another fault, the ECU A-9000 will freeze the fuel temperature value to **39.96 °C** (**103.93 °F**).

Cause:
The fuel temperature sensor B-9002 signal circuit voltage is less than **198.00 mV**.

Possible failure modes:

1. Faulty fuel temperature sensor B-9002 wiring, short to ground condition.
2. Faulty fuel temperature sensor B-9002, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.

2. Check the fuel temperature sensor B-9002 for an internal failure.

   Disconnect the engine harness (EN) from the fuel temperature sensor B-9002 at connector **X-9005**.

   Use a multimeter to measure the resistance of the fuel temperature sensor B-9002 on the sensor pins :

From	To	Value
X-9005 pin 1	**X-9005 pin 2**	At approximately **20.0 °C** (**68.0 °F**), there should be between **2351 - 2648 Ω**.
NOTE: *The fuel temperature sensor B-9002 is a Negative Temperature Coefficient (NTC) thermistor. The thermistor's conductivity increases with increasing temperature and resistance decreases with increasing temperature.*		

   A. If there is a nominal resistance value, e.g. greater than **100 Ω**, leave connector **X-9005** disconnected and continue to Step **3**.

   B. If there is not a nominal resistance value, e.g. **0 Ω**, the fuel temperature sensor B-9002 has failed. Replace the fuel temperature sensor B-9002.

3. Check the fuel temperature sensor B-9002 engine harness (EN) wiring for a short to ground condition.

   With the key in the OFF position, use the a multimeter to perform the following continuity checks for a short to ground condition on the engine harness (EN) side :

From	To	Value
X-9005 pin 1	**X-9005 pin 2**	There should be no continuity.
X-9005 pin 1	Chassis ground	There should be no continuity.

   A. If there is no continuity, leave connector **X-9005** disconnected and continue to Step **4**.

   B. If there is continuity, there is a short to ground in the fuel temperature sensor B-9002 wiring in the engine harness (EN). Locate and repair the failed conductor.

4. Check the fuel temperature sensor B-9002 engine harness (EN) wiring for a short to ground condition.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position use the a multimeter to perform the following continuity checks for a short to ground condition on the engine harness (EN) side :

From	To	Value
X-9005 pin 1	All pins in connector **X-9001**.	There should be no continuity.

   A. If the specified values are not measured, there is a fault in the fuel temperature sensor B-9002 engine harness (EN) wiring. Locate and repair the failed conductor.

   B. If there is no continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 136-03-Fuel rail pressure sensor voltage is higher than expected

Control Module : ECU

NOTE: *If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors the rail pressure sensor B-9004. If the ECU A-9000 detects a voltage greater than **4.90 V** in the rail pressure sensor B-9004 signal circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a voltage greater than **4.90 V** in the rail pressure sensor B-9004 signal circuit.

Possible failure modes:

1. Faulty rail pressure sensor B-9004 wiring, short to a voltage source.
2. Faulty rail pressure sensor B-9004 wiring, open circuit.
3. Faulty rail pressure sensor B-9004, internal failure.
4. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.

2. Check the rail pressure sensor B-9004 wiring for a short circuit condition.

   Disconnect the engine harness (EN) from the rail pressure sensor B-9004 at connector **X-9026**.

   With the key in the OFF position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9026 pin 2	Chassis ground	There should be no voltage.

   With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9026 pin 2	Chassis ground	There should be less than **5.5 V**

   A. If the specified values are not measured, there is a short to battery or switched battery in the rail pressure sensor B-9004 wiring in the engine harness (EN). Locate and repair the broken conductor.

   B. If the specified values are measured, leave connector **X-9026** disconnected and continue to Step **3**.

3. Check the rail pressure sensor B-9004 engine harness (VE) wiring for an open circuit.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9026 pin 2	**X-9001 pin A41**	There should be continuity.
X-9026 pin 3	**X-9001 pin A11**	There should be continuity.

A. If there is no continuity, there is an open circuit in the rail pressure sensor B-9004 engine harness (EN) wiring. Locate and repair the broken conductor.

B. If there is continuity, leave connectors **X-9026** and **X-9001** disconnected and continue to Step **4**.

4. Check the rail pressure sensor B-9004 engine harness (EN) wiring for a short to a voltage source.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9026 pin 2	**X-9026 pin 3**	There should be no continuity.
X-9001 pin A41	All pins in connector **X-9001**	There should be no continuity.

A. If there is continuity, there is a short circuit in the rail pressure sensor B-9004 engine harness (EN) wiring. Locate and repair the shorted conductor.

B. If there is no continuity, leave connector **X-9026** disconnected and continue to Step **5**.

5. Replace the rail pressure sensor B-9004.

   Use the Electronic Service Tool (EST) to check the status of this fault.

A. If the fault is no longer active, return the machine to service.

B. If the fault is still active, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 136-04-Fuel rail pressure sensor voltage is lower than expected

Control Module : ECU

NOTE: *If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors the rail pressure sensor B-9004. If the ECU A-9000 detects a voltage less than **342.20 mV** in the rail pressure sensor B-9004 signal circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a voltage less than **342.20 mV** in the rail pressure sensor B-9004 signal circuit.

Possible failure modes:

1. Faulty rail pressure sensor B-9004 wiring, short to ground condition.
2. Faulty rail pressure sensor B-9004, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check the rail pressure sensor B-9004 engine harness (EN) wiring for a short circuit condition.

   Disconnect the engine harness (EN) from the rail pressure sensor B-9004 at connector **X-9026**.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9026 pin 2	**X-9026 pin 1**	There should be no continuity.
X-9026 pin 2	Chassis ground	There should be no continuity.

   A. If there is continuity, there is a short to ground in the rail pressure sensor B-9004 engine harness (EN) wiring. Locate and repair the shorted conductor.

   B. If there is no continuity, leave connectors **X-9026** and **X-9001** disconnected and continue to Step **3**.
3. Check the rail pressure sensor B-9004 vehicle harness (VE) wiring for a short to ground condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9001 pin A41	All pins in connector **X-9001**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the rail pressure sensor B-9004 engine harness (EN) wiring. Locate and repair the broken conductor.

   B. If there is no continuity, leave connector **X-9026** and continue to Step **4**.

4. Replace the rail pressure sensor B-9004.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 05 – Engine Control Unit (ECU) engine connector (55.100.DP-C.20.E.05)
Wiring harnesses - Electrical schematic sheet 06 – Engine control and fuel injection (55.100.DP-C.20.E.06)

DTC 137-02-Fuel pressure relief valve reached maximum allowed opening count

Control Module : ECU

NOTE: *If the Pressure Relief Valve (PRV) is replaced, it is necessary to perform the Replacement of the Rail Pressure Relief Valve (PRV) - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail Relief valve - Configure - Reset ECU data (10.218)****, if necessary.*

NOTE: *If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel Pressure Relief Valve (PRV). If the ECU A-9000 determines that the PRV has exceeded its maximum open count, 50 times, this fault will occur. If the PRV has opened more than 50 times, the PRV must be replaced. Other active faults may have caused this fault to occur. For more information regarding fuel system troubleshooting, see **Fuel injection system - Troubleshooting (10.218)**.

Cause:
The ECU A-9000 has determined that the PRV has opened more than 50 times.

Possible failure modes:

1. Faulty fuel metering unit Y-9000, stuck open.
2. Faulty rail pressure sensor B-9004, drifted signal.
3. Faulty PRV, opening pressure too low.
4. Faulty fuel back-flow, clogged or damaged.
5. Faulty ECU A-9000, software.

DTC 137-03-Fuel pressure relief valve is open

Control Module : ECU

NOTE: *If the Pressure Relief Valve (PRV) is replaced, it is necessary to perform the Replacement of the Rail Pressure Relief Valve (PRV) - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail Relief valve - Configure - Reset ECU data (10.218)****, if necessary.*

NOTE: *If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors the Pressure Relief Valve (PRV). If the ECU A-9000 commands the PRV to open by a pressure shock, this fault will occur. Other active faults may have caused this fault to occur. For more information regarding fuel system troubleshooting, see **Fuel injection system - Troubleshooting (10.218)**.

Cause:
The ECU A-9000 has determined that the PRV is open.

Possible failure modes:

1. Faulty fuel metering unit Y-9000, stuck open.
2. Faulty fuel injectors.
3. Faulty rail pressure sensor B-9004, drifted signal.
4. Faulty PRV, opening pressure too low.
5. Faulty fuel back-flow, clogged or damaged.
6. Faulty ECU A-9000, software.

DTC 137-04-Fuel pressure relief valve is forced to open, perform pressure increase

Control Module : ECU

NOTE: *If the Pressure Relief Valve (PRV) is replaced, it is necessary to perform the Replacement of the Rail Pressure Relief Valve (PRV) - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail Relief valve - Configure - Reset ECU data (10.218)****, if necessary.*

NOTE: *If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000, if necessary, will set the engine into limp home mode. This process is achieved in two steps by the ECU A-9000, a pressure increase and a pressure shock. The ECU A-9000 will execute step one by a fuel pressure increase. This is achieved by fully opening the fuel metering unit Y-9000, thus allowing maximum fuel delivery. If this fault is active, the ECU A-9000 has performed step one for achieving limp home mode, a fuel pressure increase. Other active faults may have caused this fault to occur. For more information regarding fuel system troubleshooting, see **Fuel injection system - Troubleshooting (10.218)**.

Cause:
The ECU A-9000 has performed a fuel pressure increase to achieve limp home mode.

DTC 137-12-Averaged rail pressure is outside the expected tolerance range

Control Module : ECU

NOTE: *If the Pressure Relief Valve (PRV) is replaced, it is necessary to perform the Replacement of the Rail Pressure Relief Valve (PRV) - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail Relief valve - Configure - Reset ECU data (10.218)****, if necessary.*

NOTE: *If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors fuel rail pressure using the rail pressure sensor B-9004. After a fuel pressure evaluation, if the ECU A-9000 suspects that the Pressure Relief Valve (PRV) should be open but has not opened, this fault occur. If this fault is active, the ECU A-9000 has performed step one for achieving limp home mode, a fuel pressure increase. Other active faults may have caused this fault to occur. For more information regarding fuel system troubleshooting, see **Fuel injection system - Troubleshooting (10.218)**.

Cause:
The ECU A-9000 has determined that the PRV should be open but is not open.

Possible failure modes:

1. Faulty PRV, unable to open or partially open.
2. Faulty PRV fuel back-flow, clogged or damaged.
3. Faulty rail pressure sensor B-9004, drifted signal.
4. Faulty ECU A-9000, software.

DTC 141-02-Crankshaft speed sensor values are not plausible

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the crankshaft position sensor B-9007 characteristics for angle, speed determination, signal plausibility, and quality. If the ECU A-9000 determines that there are no crankshaft position signals detected for at least 4 engine revolutions, this fault will occur.

Cause:
The ECU A-9000 has determined that there is no crankshaft position signals detected for at least 4 engine revolutions.

Possible failure modes:

1. Faulty crankshaft position sensor B-9007, not fully seated or loose.
2. Faulty crankshaft tone wheel, damaged or misaligned.
3. Faulty crankshaft position sensor B-9007 wiring, short circuit.
4. Faulty crankshaft position sensor B-9007, internal failure.
5. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **7**.

2. Check the physical integrity of the crankshaft position sensor B-9007. The sensor should be fully seated and mounted tightly.

   Remove the crankshaft position sensor B-9007 and inspect the crankshaft tool wheel. The tone wheel should not be damaged or loose.

   A. If the sensor or tone wheel is damaged or is not mounted/secured properly, repair as necessary.

   B. If the sensor or tone wheel is not damaged and is mounted/secured properly, continue to Step **3**.

3. Check the crankshaft position sensor B-9007 wiring for a short circuit to battery condition.

   Disconnect the engine harness (EN) from the crankshaft position sensor B-9007 at connector **X-9039**.

   With the key in the OFF position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9039 pin 2	Chassis ground	There should be no voltage.
X-9039 pin 1	Chassis ground	There should be no voltage.

   A. If there is no voltage, leave connector **X-9039** disconnected and continue to Step **4**.

   B. If there is voltage, there is a short circuit to battery in the crankshaft position sensor B-9007 engine harness (EN) wiring. Locate and repair the shorted conductor.

4. Check the crankshaft position sensor B-9007 engine harness (EN) wiring.

   With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9039 pin 2	Chassis ground	There should be between **2.4 - 2.6 V**.
X-9039 pin 1	Chassis ground	There should be between **2.4 - 2.6 V**.

A. If there is between **2.4 - 2.6 V**, leave connector **X-9039** disconnected and continue to Step **6**.

B. If there is not between **2.4 - 2.6 V**, continue to Step **5**.

5. Check the crankshaft position sensor B-9007 engine harness (EN) wiring for an open circuit.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity checks for an open circuit on the engine harness (EN) side :

From	To	Value
X-9039 pin 2	**X-9001 pin A44**	There should be continuity.
X-9039 pin 1	**X-9001 pin A59**	There should be continuity.

   A. If there is continuity, leave connectors **X-9039** and **X-9001** disconnected and continue to Step **5**.

   B. If there is no continuity, there is an open circuit in the crankshaft position sensor B-9007 circuit wiring in the engine harness (EN). Locate and repair the broken conductor.

6. Replace the crankshaft position sensor B-9007.

   Use the Electronic Service Tool (EST) to verify the status of this fault.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

7. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 141-04-Crankshaft speed sensor pattern is not plausible

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the crankshaft position sensor B-9007 characteristics for angle, speed determination, signal plausibility, and quality. If the ECU A-9000 detects greater than 80 crankshaft position signal plausibility errors, this fault will occur.

Cause:
The ECU A-9000 has detected more than 80 crankshaft position signal plausibility errors.

Possible failure modes:

1. Faulty crankshaft position sensor B-9007, not fully seated or loose.
2. Faulty crankshaft tone wheel, damaged or misaligned.
3. Faulty crankshaft position sensor B-9007 wiring, short circuit.
4. Faulty crankshaft position sensor B-9007, internal failure.
5. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **7**.

2. Check the physical integrity of the crankshaft position sensor B-9007. The sensor should be fully seated and mounted tightly.

   Remove the crankshaft position sensor B-9007 and inspect the crankshaft tool wheel. The tone wheel should not be damaged or loose.

   A. If the sensor or tone wheel is damaged or is not mounted/secured properly, repair as necessary.

   B. If the sensor or tone wheel is not damaged and is mounted/secured properly, continue to Step **3**.

3. Check the crankshaft position sensor B-9007 wiring for a short to a voltage source.

   Disconnect the engine harness (EN) from the crankshaft position sensor B-9007 at connector **X-9039**.

   With the key in the OFF position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9039 pin 2	Chassis ground	There should be no voltage.

   With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9039 pin 2	Chassis ground	There should be **2.4 - 2.6 V** voltage.

   A. If there is no voltage, leave connector **X-9039** disconnected and continue to Step **4**.

   B. If there is voltage, there is a short to battery or key switch battery in the crankshaft position sensor B-9007 wiring. Locate and repair the shorted conductor.

4. Check the crankshaft position sensor B-9007 engine harness (EN) wiring for an open circuit.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity checks for an open circuit on the engine harness (EN) side :

From	To	Value
X-9039 pin 2	**X-9001 pin A44**	There should be continuity.
X-9039 pin 1	**X-9001 pin A59**	There should be continuity.
X-9039 pin 3	**X-9001 pin A58**	There should be continuity.

   A. If there is continuity, leave connectors **X-9039** and **X-9001** disconnected and continue to Step **5**.

   B. If there is no continuity, there is an open circuit in the crankshaft position sensor B-9007 circuit wiring in the engine harness (EN). Locate and repair the broken conductor.

5. Check the crankshaft position sensor B-9007 engine harness (EN) wiring for a short circuit.

   With the key in the OFF position, use a multimeter to perform the following continuity checks for a short circuit on the engine harness (EN) side :

From	To	Value
X-9039 pin 2	Chassis ground	There should be no continuity.
X-9039 pin 2	**X-9039 pin 1**	There should be no continuity.
X-9039 pin 2	**X-9039 pin 3**	There should be no continuity.
X-9001 pin A44	All pins in connector **X-9001**	There should be no continuity.

   A. If there is no continuity, leave connector **X-9039** disconnected and continue to Step **6**.

   B. If there is no continuity, there is an open circuit in the crankshaft position sensor B-9007 circuit wiring in the engine harness (EN). Locate and repair the broken conductor.

6. Replace the crankshaft position sensor B-9007.

   Use the Electronic Service Tool (EST) to verify the status of this fault, **DTC 141-Sig - Crankshaft sensor failure**.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

7. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 143-02-Camshaft speed sensor values are not plausible

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the camshaft position sensor B-9017 characteristics for angle, speed determination, signal plausibility, and quality. If the ECU A-9000 determines that no camshaft edge is detected for at least four crankshaft revolutions, this fault will occur.

Cause:
The ECU A-9000 has detected no camshaft edge for at least four crankshaft revolutions.

Possible failure modes:

1. Faulty camshaft position sensor B-9017, wiring.
2. Faulty camshaft position sensor B-9017, improperly seated or mounted.
3. Faulty camshaft position sensor B-9017, internal failure.
4. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check the physical integrity of the camshaft speed sensor B-9017. The sensor should be fully seated and mounted tightly.

   A. If the sensor is not mounted/secured properly, repair as necessary.

   B. If the sensor is not damaged and is mounted/secured properly, continue to Step **3**.
3. Check the camshaft position sensor B-9017 wiring in the engine harness (EN) for an open circuit.

   Disconnect the engine harness (EN) from the camshaft position sensor at connector **X-9008**.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9008 pin 1	**X-9001 pin A28**	There should be continuity.
X-9008 pin 2	**X-9001 pin A14**	There should be continuity.
X-9008 pin 3	**X-9001 pin A13**	There should be continuity.
X-9008 pin 2	Chassis ground	There should be no continuity.
X-9001 pin A14	All other pins on connector **X-9001**	There should be no continuity.

   With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9001 pin A14	Chassis ground	There should be no voltage.

   A. If there is continuity, leave connectors **X-9008** and **X-9001** disconnected and continue to Step **4**.

B. If there is no continuity, there is an open circuit in the camshaft position sensor B-9017 wiring. Locate and repair the broken conductor.

4. Replace the camshaft position sensor B-9017.

   Use the Electronic Service Tool (EST) to verify the status of this fault, **DTC 143-Min - Camshaft sensor failure**.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 143-04-Camshaft speed sensor pattern is not plausible

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the camshaft position sensor B-9017 characteristics for angle, speed determination, signal plausibility, and quality. If the ECU A-9000 determines that the camshaft signal does not match the expected pattern (edge, distance, level) or not all expected camshaft edges are detected during an engine revolution, this fault will occur.

Cause:
The ECU A-9000 has detected a camshaft pattern signal error.

Possible failure modes:

1. Faulty camshaft position sensor B-9017 wiring.
2. Faulty camshaft position sensor B-9017, improperly seated or mounted.
3. Faulty camshaft position sensor B-9017, internal failure.
4. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.
2. Check the physical integrity of the camshaft speed sensor B-9017. The sensor should be fully seated and mounted tightly.

   A. If the sensor is not mounted/secured properly, repair as necessary.

   B. If the sensor is not damaged and is mounted/secured properly, continue to Step **3**.
3. Check the camshaft position sensor B-9017 wiring in the engine harness (EN) for an open circuit.

   Disconnect the engine harness (EN) from the camshaft position sensor at connector **X-9008**.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9008 pin 2	**X-9001 pin A28**	There should be continuity.
X-9008 pin 1	**X-9001 pin A14**	There should be continuity.
X-9008 pin 3	**X-9001 pin A13**	There should be continuity.

   A. If there is continuity, leave connectors **X-9008** and **X-9001** disconnected and continue to Step **4**.

   B. If there is no continuity, there is an open circuit in the camshaft position sensor B-9017 wiring. Locate and repair the broken conductor.
4. Check the camshaft position sensor B-9017 wiring in the engine harness (EN) for a short circuit.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9008 pin 2	Chassis ground	There should be no continuity.
X-9008 pin 2	**X-9008 pin 1**	There should be no continuity.
X-9008 pin 2	**X-9008 pin 3**	There should be no continuity.
X-9001 pin A28	All pins in connector **X-9001**	There should be no continuity.

A. If there is no continuity, leave connector **X-9008** disconnected and continue to Step **5**.

B. If there is continuity, there is a a short circuit in the camshaft position sensor B-9017 wiring. Locate and repair the broken conductor.

5. Replace the camshaft position sensor B-9017.

   Use the Electronic Service Tool (EST) to verify the status of this fault, **DTC 143-Min - Camshaft sensor failure**.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 144-03-Compared camshaft and crankshaft speed sensor values are not plausible

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the camshaft position sensor B-9017 and the crankshaft position sensor B-9007 characteristics for angle, speed determination, signal plausibility, and quality. If the ECU A-9000 determines that the offset between the crankshaft signal and the expected camshaft first edge is less or greater than **10.00 °** for longer than four consecutive cycles, this fault will occur.

Possible failure modes:

1. Faulty camshaft position sensor B-9017, improperly mounted or not fully seated.
2. Faulty crankshaft position sensor B-9007, improperly mounted or not fully seated.
3. Faulty camshaft tone wheel, loose or damaged.
4. Faulty crankshaft tone wheel, loose or damaged.
5. Faulty engine timing, incorrectly timed.
6. Faulty ECU A-9000, software.

DTC 151-03-Fuel rail pressure has exceeded maximum positive deviation limits

Control Module : ECU

NOTE: *If the Pressure Relief Valve (PRV) is replaced, it is necessary to perform the Replacement of the Rail Pressure Relief Valve (PRV) - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail Relief valve - Configure - Reset ECU data (10.218)****, if necessary.*

NOTE: *If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors fuel rail pressure. If the measured rail pressure is lower than the desired pressure by **100 bar** (**1450 psi**) depending on engine speed, this fault will occur. For more information regarding fuel system troubleshooting, see **Fuel injection system - Troubleshooting (10.218)**.

Cause:
The ECU A-9000 has determined that the measured rail pressure is **100 bar** (**1450 psi**) lower than desired fuel pressure based on engine speed.

Possible failure modes:

1. Faulty fuel metering unit Y-9000, internal failure.
2. Faulty charge gear pump, low efficiency.
3. Faulty fuel filters, clogged.
4. Faulty low pressure fuel supply lines, clogged or damaged.
5. Faulty high pressure fuel supply lines, clogged or damaged.
6. Faulty Pressure Relief Valve (PRV), leakage.
7. Faulty high pressure fuel pump, low efficiency.
8. Faulty fuel injectors, worn, clogged or internal leakage.
9. Faulty rail pressure sensor B-9004, drifted or leaking.
10. Faulty ECU A-9000, software.

DTC 153-03-Fuel rail pressure has exceeded maximum negative deviation limits

Control Module : ECU

NOTE: *If the Pressure Relief Valve (PRV) is replaced, it is necessary to perform the Replacement of the Rail Pressure Relief Valve (PRV) - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail Relief valve - Configure - Reset ECU data (10.218)****, if necessary.*

NOTE: *If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors fuel rail pressure. If the ECU A-9000 determines that fuel pressure is higher than the desired fuel pressure, depending on engine speed, this fault will occur. For more information regarding fuel system troubleshooting, see **Fuel injection system - Troubleshooting (10.218)**.

Cause:
The ECU A-9000 has determined that the fuel rail pressure is higher than desired based on engine speed.

Possible failure modes:

1. Faulty fuel metering unit Y-9000 wiring, broken or poor connections.
2. Faulty fuel metering unit Y-9000, stuck open.
3. Faulty fuel back-flow, clogged or damaged.
4. Faulty Pressure Relief Valve (PRV), stuck or blocked.
5. Faulty rail pressure sensor B-9004, drifted.
6. Faulty high pressure pump.
7. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active, continue to Step **5**.
2. Check for other fault codes related to the fuel injection system.

   A. If other fault codes are not present, continue with Step **3**.

   B. If other fault codes are present, resolve them first.
3. Check the condition of the Y-9000 connector **X-9007**.

   Disconnect the engine (EN) harness from the Y-9000 at connector X-9007.

   Inspect the connector **X-9007** contacts for corrosion, damage and proper connection.

   A. If the condition of the **X-9007** contacts are good, leave the **X-9007** disconnected and continue to Step **4**.

   B. If the **X-9007** is faulty, refer to the appropriate service manual to repair or replace the engine (EN) harness as necessary.
4. Check the Y-9000 for an internal failure.

Use a multimeter to perform the following resistance check:

From	To	Value
X-9007 pin 1	**X-9007 pin 2**	There should be between **2.8 - 3.2 Ω**.

A. If the value is in the specified range, see **Fuel injection system - Troubleshooting (10.218)** to diagnose the fuel injection system.

B. If the value is not in the specified range, the Y-9000 has failed internally. Replace the Y-9000 then refer to **Pressure regulating valve - Configure - Reset ECU data (10.218)** if necessary, to perform the Replacement of the Rail Pressure Metering Unit - Reset ECU Data.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 (55.100)

DTC 154-03-Fuel rail pressure has dropped below the minimum limit

Control Module : ECU

NOTE: *If the Pressure Relief Valve (PRV) is replaced, it is necessary to perform the Replacement of the Rail Pressure Relief Valve (PRV) - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail Relief valve - Configure - Reset ECU data (10.218)****, if necessary.*

NOTE: *If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors fuel rail pressure using the rail pressure sensor B-9004. If the ECU A-9000 determines that the measured rail pressure is less than a dependent engine speed value, this fault will occur. Other active faults may have caused this fault to occur. For more information regarding fuel system troubleshooting, see **Fuel injection system - Troubleshooting (10.218)**.

Cause:
The ECU A-9000 has determined that the measured rail pressure is less than a dependent engine speed value.

Possible failure modes:

1. Faulty fuel filters, clogged.
2. Faulty low pressure fuel lines, clogged or damaged.
3. Faulty high pressure fuel lines, clogged or damaged.
4. Faulty electric fuel pump (if equipped).
5. Faulty charge gear pump, low efficiency.
6. Faulty high pressure pump, low efficiency or excessive leak-off.
7. Faulty fuel injectors, excessive or leaking internally.
8. Faulty Pressure Relief Valve (PRV), leaking or stuck open.
9. Faulty rail pressure sensor B-9004 or sensor leaking.
10. Faulty fuel metering unit Y-9000
11. Faulty ECU A-9000, software.

DTC 155-03-Fuel rail pressure has exceeded maximum limit

Control Module : ECU

NOTE: *If the Pressure Relief Valve (PRV) is replaced, it is necessary to perform the Replacement of the Rail Pressure Relief Valve (PRV) - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail Relief valve - Configure - Reset ECU data (10.218)****, if necessary.*

NOTE: *If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors fuel rail pressure using the rail pressure sensor B-9004. If the ECU A-9000 determines that the measured rail pressure is greater than desired by more than a dependent engine speed value, this fault will occur. For more information regarding fuel system troubleshooting, see **Fuel injection system - Troubleshooting (10.218)**.

Cause:
The ECU A-9000 has determined that the measured rail pressure is greater than desired by more than a dependent engine speed value.

Possible failure modes:

1. Faulty fuel metering unit Y-9000 wiring, broken or poor connections.
2. Faulty fuel metering unit Y-9000, stuck open or internal failure.
3. Faulty fuel back-flow lines, blocked or damaged.
4. Faulty Pressure Relief Valve (PRV), stuck closed or mechanically unable to open.
5. Faulty high pressure pump, zero delivery throttle valve clogged.
6. Faulty rail pressure sensor B-9004, drifted signal.
7. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active, continue to Step **5**.
2. Check for other fault codes related to the fuel injection system.

   A. If other fault codes are not present, continue with Step **3**.

   B. If other fault codes are present, resolve them first.
3. Check the condition of the Y-9000 connector **X-9007**.

   Disconnect the engine (EN) harness from the Y-9000 at connector X-9007.

   Inspect the connector **X-9007** contacts for corrosion, damage and proper connection.

   A. If the condition of the **X-9007** contacts are good, leave the **X-9007** disconnected and continue to Step **4**.

   B. If the **X-9007** is faulty, refer to the appropriate service manual to repair or replace the engine (EN) harness as necessary.
4. Check the Y-9000 for an internal failure.

Use a multimeter to perform the following resistance check:

From	To	Value
X-9007 pin 1	**X-9007 pin 2**	There should be between **2.8 - 3.2 Ω** (**2.8 - 3.2 Ω**).

A. If the value is in the specified range, see **Fuel injection system - Troubleshooting (10.218)** to diagnose the fuel injection system.

B. If the value is not in the specified range, the Y-9000 has failed internally. Replace the Y-9000 then refer to **Pressure regulating valve - Configure (10.218)** if necessary, to perform the Replacement of the Rail Pressure Metering Unit - Reset ECU Data.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 (55.100)

DTC 157-03-High pressure pump fuel delivery quantity in over run exceeds a maximum threshold

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the high pressure fuel system for leakage during overrun. If the ECU A-9000 detects that the high pressure pump quantity in overrun exceeds the expected threshold, this fault will occur.

Cause:
The ECU A-9000 has determined that the high pressure fuel pump quantity is higher than the expected fuel quantity threshold.

Possible failure modes:

1. Faulty low pressure fuel system, clogged filter or leakage/blockage.
2. Faulty charge gear pump, low efficiency or line clogged/damaged.
3. Faulty electric fuel pump (if equipped).
4. Faulty fuel metering unit, unable to fully open.
5. Faulty high pressure pump, low efficiency.
6. Faulty fuel injectors, stuck open or internal leakage.
7. Faulty Pressure Relief Valve (PRV), leakage.
8. Faulty rail pressure sensor B-9004 drifted signal or leaking.
9. Faulty ECU A-9000, software.

DTC 158-03-Fuel pump pressure has exceeded desired pressure limits

Control Module : ECU

NOTE: *If the Pressure Relief Valve (PRV) is replaced, it is necessary to perform the Replacement of the Rail Pressure Relief Valve (PRV) - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail Relief valve - Configure - Reset ECU data (10.218)****, if necessary.*

NOTE: *If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)****, if necessary.*

Context:
The Engine Control Unit (ECU) Y-9000 monitors fuel rail pressure. If the ECU A-9000 determines that the requested fuel pressure can not be reached, a leakage in the fuel system is assumed and this fault will occur. For more information regarding fuel system troubleshooting, see **Fuel injection system - Troubleshooting (10.218)**.

Cause:
The ECU A-9000 has determined that a fuel system leakage is present.

Possible failure modes:

1. Faulty fuel filters, clogged.
2. Faulty low pressure fuel lines, clogged or damaged.
3. Faulty high pressure fuel lines, clogged or damaged.
4. Faulty electric fuel pump (if equipped).
5. Faulty charge gear pump, low efficiency.
6. Faulty high pressure pump, low efficiency or excessive leak-off.
7. Faulty fuel injectors, external or internal leakage.
8. Faulty Pressure Relief Valve (PRV), leaking or stuck open.
9. Faulty rail pressure sensor B-9004 or sensor leaking.
10. Faulty fuel metering unit Y-9000
11. Faulty ECU A-9000, software.

DTC 159-02-Fuel metering unit has an open load error

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel metering unit Y-9000 signal circuit. If the ECU A-9000 detects an open load error in the fuel metering unit Y-9000 signal circuit, this fault will occur.

Cause:
There is open load detected in the fuel metering unit Y-9000 signal circuit.

Possible failure modes:

1. Faulty fuel metering unit Y-9000 wiring, open circuit.
2. Faulty fuel metering unit Y-9000, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.

2. Test the fuel metering unit Y-9000 internal resistance.

   Disconnect the engine harness (EN) from the fuel metering unit Y-9000 at connector **X-9007**.

   Use a multimeter to measure the resistance on the fuel metering unit Y-9000 pins :

From	To	Value
X-9007 pin 1	**X-9007 pin 2**	There should be between **2.6 - 3.2 Ω** at approximately **20.0 °C** (**68.0 °F**).

   A. If there is between **2.6 - 3.2 Ω**, leave connector **X-9007** disconnected and continue to Step **3**.

   B. If there is not between **2.6 - 3.2 Ω**, the fuel metering unit Y-9000 has failed. Replace the fuel metering unit Y-9000.

3. Check the fuel metering unit Y-9000 engine harness (EN) wiring for an open circuit.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9007 pin 1	**X-9001 pin A60**	There should be continuity.
X-9007 pin 2	**X-9001 pin A15**	There should be continuity.
NOTE: *Wiggle the harness during the check to promote an intermittent electrical connection.*		

   A. If there is no continuity, there is an open circuit condition in the fuel metering unit Y-9000 engine harness (EN) wiring. Locate and repair the broken conductor.

   B. If there is continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 15D-03-PMCat Inducement less severe derating level

Control Module : ECU

Context:
The Engine Control Unit (ECU) monitors the Particulate Matter (PM) catalytic converter efficiency. If the ECU A-9000 detects an failure of efficiency, inducement will be triggered and this fault will occur. Other active faults may have caused this fault to occur. This fault indicates the least severe level of inducement.

DTC 161-02-Short circuit error of injector in cylinder 1

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel injector power stages for a short circuit condition. If the ECU A-9000 detects a short circuit condition in the injector number 1 Y-9001 circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a short circuit in the fuel injector number 1 Y-9001 circuit.

Possible failure modes:

1. Faulty fuel injector number 1 Y-9001 wiring, short circuit.
2. Faulty fuel injector number 1 Y-9001, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify this fault code is still present and in an active state.

   Use the Easy Engine software provided on the Electronic Service Tool (EST) to check the fault status and to perform the cylinder cut-out test.

   A. If the fault is still present and active, continue with Step **2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with Step **7**.

2. Check the fuel injector number 1 Y-9001 internal resistance.

   Disconnect the engine harness (EN) from the fuel injector number 1 Y-9001 at connector **X-9030** .

   Use a multimeter to measure the resistance of fuel injector number 1 Y-9001 on the injector pins :

From	To	Value
X-9030 pin 1	**X-9030 pin 2**	There should be between **.03 - .05 Ω**

   A. If there is between **.03 - .05 Ω**, leave connector **X-9030** disconnected and continue to Step **3**.

   B. If the resistance is not between **.03 - .05 Ω**, fuel injector number 1 Y-9001 solenoid coil has failed. Replace fuel injector number 1 Y-9001.

3. Check the fuel injector number 1 Y-9001 engine harness (EN) wiring for a short to a voltage source.

   With the key in the OFF position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9030 pin 1	Chassis ground	There should be no voltage.
X-9030 pin 2	Chassis ground	There should be no voltage.

   With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9030 pin 1	Chassis ground	There should be no voltage.
X-9030 pin 2	Chassis ground	There should be no voltage.

   A. If there is no voltage, leave connector **X-9030** disconnected and continue to Step **4**.

B. If there is voltage, there is a short to battery or switched battery in the fuel injector number 1 Y-9001 wiring in the engine harness (EN). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

4. Check the fuel injector number 1 Y-9001 engine harness (EN) wiring for a short to ground condition.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity checks on the engine harness (EN) side :

From	To	Value
X-9030 pin 1	**X-9030 pin 2**	There should be no continuity.
X-9030 pin 1	Chassis ground	There should be no continuity.
X-9030 pin 2	Chassis ground	There should be no continuity.

   A. If there is no continuity, leave connector **X-9001** and **X-9030** disconnected. Continue to Step **5**.

   B. If there is continuity, there is a short circuit in the fuel injector number 1 Y-9001 wiring in the engine harness (EN). Locate and repair the shorted conductor.

5. Check the fuel injector number 1 Y-9001 engine harness (EN) wiring for a short circuit condition.

   With the key in the OFF position, use a multimeter to perform the following continuity checks on engine harness (EN) side :

From	To	Value
X-9001 pin A16	All pins in connector **X-9001**	There should be no continuity.
X-9001 pin A32	All pins in connector **X-9001**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the fuel injector number 1 Y-9001 wiring in the engine harness (EN). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, continue with Step **6**.

6. Check the ECU A-9000 voltage supply wiring.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   Place a jumper wire between **X-9102 pin K28** and chassis ground. This will energize the main relay K-9102.

   Use a multimeter to perform the following voltage checks on the engine harness (EN) side :

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If there is not approximately **12.0 V**, there is a faulty ECU A-9000 voltage supply. Use the appropriate service manual, if necessary, to locate and repair the failed conductor.

   B. If there is approximately **12.0 V**, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

7. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)
Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)
Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 161-03-Short circuit of low side to high source of injector in cylinder 1

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel injector power stages for a short circuit condition. If the ECU A-9000 detects a short circuit condition in the injector number 1 Y-9001 circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a short circuit between the high side driver and low side driver of the fuel injector number 1 Y-9001.

Possible failure modes:

1. Faulty fuel injector number 1 Y-9001 wiring, short circuit.
2. Faulty fuel injector number 1 Y-9001, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify this fault code is still present and in an active state.

   Use the Easy Engine software provided on the Electronic Service Tool (EST) to check the fault status and to perform the cylinder cut-out test.

   A. If the fault is still present and active, continue with Step **2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.

2. Check the fuel injector number 1 Y-9001 internal resistance.

   Disconnect the engine harness (EN) from the fuel injector number 1 Y-9001 at connector **X-9030**.

   Use a multimeter to measure the resistance of fuel injector number 1 Y-9001 on the injector pins :

From	To	Value
X-9030 pin 1	**X-9030 pin 2**	There should be between **.03 - .05 Ω**

   A. If there is between **.03 - .05 Ω**, leave connector **X-9030** disconnected and continue to Step **3**.

   B. If the resistance is not between **.03 - .05 Ω**, fuel injector number 1 Y-9001 solenoid coil has failed. Replace fuel injector number 1 Y-9001.

3. Check the fuel injector number 1 Y-9001 injector harness (INJ) wiring for a short circuit condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9030 pin 1	**X-9030 pin 2**	There should be no continuity.

   A. If there is no continuity, leave connector **X-9030** disconnected and continue to Step **4**.

   B. If there is continuity, there is a short circuit in the fuel injector number 1 Y-9001 wiring in the engine harness (EN) wiring. Locate and repair the shorted conductor.

4. Check the fuel injector number 1 Y-9001 vehicle harness (VE) wiring for a short circuit condition.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

With the key in the OFF position, use a multimeter to perform the following continuity check on engine harness (EN) side :

From	To	Value
X-9001 pin A16	All pins in connector **X-9001**	There should be no continuity
X-9001 pin A32	All pins in connector **X-9001**	There should be no continuity

A. If there is continuity, there is a short circuit in the fuel injector number 1 Y-9001 wiring in the engine harness (EN). Locate and repair the shorted conductor.

B. If there is no continuity, continue with Step **5**.

5. Check the ECU A-9000 voltage supply wiring.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   Place a jumper wire between **X-9102 pin K28** and chassis ground. This will energize the main relay K-9102.

   Use a multimeter to perform the following voltage checks on the engine harness (EN) side :

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If there is not approximately **12.0 V**, there is a faulty ECU A-9000 voltage supply. Use the appropriate service manual, if necessary, to locate and repair the failed conductor.

   B. If there is approximately **12.0 V**, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)
Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)
Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 162-02-Short circuit error of injector in cylinder 2

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel injector power stages for a short circuit condition. If the ECU A-9000 detects a short circuit condition in the injector number 2 Y-9002 circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a short circuit in the fuel injector number 2 Y-9002 circuit.

Possible failure modes:

1. Faulty fuel injector number 2 Y-9002, wiring.
2. Faulty fuel injector number 2 Y-9002, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify this fault code is still present and in an active state.

   Use the Easy Engine software provided on the Electronic Service Tool (EST) to check the fault status and to perform the cylinder cut-out test.

   A. If the fault is still present and active, continue with Step **2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with Step **7**.
2. Check the fuel injector number 2 Y-9002 internal resistance.

   Disconnect the engine harness (EN) from the fuel injector number 2 Y-9002 at connector **X-9032**.

   Use a multimeter to measure the resistance of fuel injector number 2 Y-9002 on the injector pins :

From	To	Value
X-9032 pin 1	**X-9032 pin 2**	There should be between **.03 - .05 Ω**

   A. If there is between **.03 - .05 Ω**, leave connector **X-9032** disconnected and continue to Step **3**.

   B. If the resistance is not between **.03 - .05 Ω**, fuel injector number 2 Y-9002 solenoid coil has failed. Replace fuel injector number 2 Y-9002.
3. Check the fuel injector number 2 Y-9002 engine harness (EN) wiring for a short to a voltage source.

   With the key in the OFF position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9032 pin 1	Chassis ground	There should be no voltage.
X-9032 pin 2	Chassis ground	There should be no voltage.

   With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9032 pin 1	Chassis ground	There should be no voltage.
X-9032 pin 2	Chassis ground	There should be no voltage.

   A. If there is no voltage, leave connector **X-9032** disconnected and continue to Step **4**.

B. If there is voltage, there is a short to battery or switched battery in the fuel injector number 2 Y-9002 wiring in the engine harness (EN). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

4. Check the fuel injector number 2 Y-9002 engine harness (EN) wiring for a short to ground condition.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity checks on the engine harness (EN) side :

From	To	Value
X-9032 pin 1	**X-9032 pin 2**	There should be no continuity.
X-9032 pin 1	Chassis ground	There should be no continuity.
X-9032 pin 2	Chassis ground	There should be no continuity.

   A. If there is no continuity, leave connector **X-9001** and **X-9032** disconnected. Continue to Step **5**.

   B. If there is continuity, there is a short circuit in the fuel injector number 2 Y-9002 wiring in the engine harness (EN). Locate and repair the shorted conductor.

5. Check the fuel injector number 2 Y-9002 engine harness (EN) wiring for a short circuit condition.

   With the key in the OFF position, use a multimeter to perform the following continuity checks on engine harness (EN) side :

From	To	Value
X-9001 pin A48	All pins in connector **X-9001**	There should be no continuity
X-9001 pin A17	All pins in connector **X-9001**	There should be no continuity

   A. If there is continuity, there is a short circuit in the fuel injector number 2 Y-9002 wiring in the engine harness (EN). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, continue with Step **6**.

6. Check the ECU A-9000 voltage supply wiring.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   Place a jumper wire between **X-9102 pin K28** and chassis ground. This will energize the main relay K-9102.

   Use a multimeter to perform the following voltage checks on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If there is not approximately **12.0 V**, there is a faulty ECU A-9000 voltage supply. Use the appropriate service manual, if necessary, to locate and repair the failed conductor.

   B. If there is approximately **12.0 V**, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

7. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)
Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)
Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 162-03-Short circuit of low side to high source of injector in cylinder 2

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel injector power stages for a short circuit condition. If the ECU A-9000 detects a short circuit condition in the injector number 2 Y-9002 circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a short circuit between the high side driver and low side driver of the fuel injector number 2 Y-9002.

Possible failure modes:

1. Faulty fuel injector number 2 Y-9002, wiring.
2. Faulty fuel injector number 2 Y-9002, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify this fault code is still present and in an active state.

   Use the Easy Engine software provided on the Electronic Service Tool (EST) to check the fault status and to perform the cylinder cut-out test.

   A. If the fault is still present and active, continue with Step **2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.

2. Check the fuel injector number 2 Y-9002 internal resistance.

   Disconnect the engine harness (EN) from the fuel injector number 2 Y-9002 at connector **X-9032**.

   Use a multimeter to measure the resistance of fuel injector number 2 Y-9002 on the injector pins :

From	To	Value
X-9032 pin 1	**X-9032 pin 2**	There should be between **.03 - .05 Ω**

   A. If there is between **.03 - .05 Ω**, leave connector **X-9032** disconnected and continue to Step **3**.

   B. If the resistance is not between **.03 - .05 Ω**, fuel injector number 2 Y-9002 solenoid coil has failed. Replace fuel injector number 2 Y-9002.

3. Check the fuel injector number 2 Y-9002 engine harness (EN) wiring.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9032 pin 1	**X-9032 pin 2**	There should be no continuity.

   A. If there is no continuity, leave connector **X-9032** disconnected and continue to Step **4**.

   B. If there is continuity, there is a short circuit in the fuel injector number 2 Y-9002 wiring in the engine harness (EN). Locate and repair the shorted conductor.

4. Check the fuel injector number 2 Y-9001 vehicle harness (VE) wiring for a short circuit condition.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

With the key in the OFF position, use a multimeter to perform the following continuity check on engine harness (EN) side :

From	To	Value
X-9001 pin A17	All pins in connector **X-9001**	There should be no continuity
X-9001 pin A48	All pins in connector **X-9001**	There should be no continuity

A. If there is continuity, there is a short circuit in the fuel injector number 2 Y-9002 wiring in the engine harness (EN). Locate and repair the shorted conductor.

B. If there is no continuity, continue with Step **5**.

5. Check the ECU A-9000 voltage supply wiring.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   Place a jumper wire between **X-9102 pin K28** and chassis ground. This will energize the main relay K-9102.

   Use a multimeter to perform the following voltage checks on the engine harness (EN) side :

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If there is not approximately **12.0 V**, there is a faulty ECU A-9000 voltage supply. Use the appropriate service manual, if necessary, to locate and repair the failed conductor.

   B. If there is approximately **12.0 V**, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

DTC 163-02-Short circuit error of injector in cylinder 3

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel injector power stages for a short circuit condition. If the ECU A-9000 detects a short circuit condition in the injector number 3 Y-9003 circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a short circuit in the fuel injector number 3 Y-9003 circuit.

Possible failure modes:

1. Faulty fuel injector number 3 Y-9003, wiring.
2. Faulty fuel injector number 3 Y-9003, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify this fault code is still present and in an active state.

   Use the Easy Engine software provided on the Electronic Service Tool (EST) to check the fault status and to perform the cylinder cut-out test.

   A. If the fault is still present and active, continue with Step **2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with Step **7**.

2. Check the fuel injector number 3 Y-9003 internal resistance.

   Disconnect the engine harness (EN) from the fuel injector number 3 Y-9003 at connector **X-9031**.

   Use a multimeter to measure the resistance of fuel injector number 3 Y-9003 on the injector pins :

From	To	Value
X-9031 pin 1	**X-9031 pin 2**	There should be between **.03 - .05 Ω**

   A. If there is between **.03 - .05 Ω**, leave connector **X-9031** disconnected and continue to Step **3**.

   B. If the resistance is not between **.03 - .05 Ω**, fuel injector number 3 Y-9003 solenoid coil has failed. Replace fuel injector number 3 Y-9003.

3. Check the fuel injector number 3 Y-9003 engine harness (EN) wiring for a short to a voltage source.

   With the key in the OFF position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9031 pin 1	Chassis ground	There should be no voltage.
X-9031 pin 2	Chassis ground	There should be no voltage.

   With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9031 pin 1	Chassis ground	There should be no voltage.
X-9031 pin 2	Chassis ground	There should be no voltage.

   A. If there is no voltage, leave connector **X-9031** disconnected and continue to Step **4**.

B. If there is voltage, there is a short to battery or switched battery in the fuel injector number 3 Y-9003 wiring in the engine harness (EN). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

4. Check the fuel injector number 3 Y-9003 engine harness (EN) wiring for a short to ground condition.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity checks on the engine harness (EN) side :

From	To	Value
X-9031 pin 1	**X-9031 pin 2**	There should be no continuity.
X-9031 pin 1	Chassis ground	There should be no continuity.
X-9031 pin 2	Chassis ground	There should be no continuity.

   A. If there is no continuity, continue to Step **5**.

   B. If there is continuity, there is a short circuit in the fuel injector number 3 Y-9003 wiring in the engine harness (EN). Locate and repair the shorted conductor.

5. Check the fuel injector number 2 Y-9002 engine harness (EN) wiring for a short circuit condition.

   With the key in the OFF position, use a multimeter to perform the following continuity checks on engine harness (EN) side :

From	To	Value
X-9001 pin A31	All pins in connector **X-9001**	There should be no continuity
X-9001 pin A01	All pins in connector **X-9001**	There should be no continuity

   A. If there is continuity, there is a short circuit in the fuel injector number 2 Y-9002 wiring in the engine harness (EN). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, continue with Step **6**.

6. Check the ECU A-9000 voltage supply wiring.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   Place a jumper wire between **X-9102 pin K28** and chassis ground. This will energize the main relay K-9102.

   Use a multimeter to perform the following voltage checks on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If there is not approximately **12.0 V**, there is a faulty ECU A-9000 voltage supply. Use the appropriate service manual, if necessary, to locate and repair the failed conductor.

   B. If there is approximately **12.0 V**, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

7. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)
Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)
Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 163-03-Short circuit of low side to high source of injector in cylinder 3

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel injector power stages for a short circuit condition. If the ECU A-9000 detects a short circuit condition in the injector number 3 Y-9003 circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a short circuit between the high side driver and low side driver of the fuel injector number 3 Y-9003.

Possible failure modes:

1. Faulty fuel injector number 3 Y-9003, wiring.
2. Faulty fuel injector number 3 Y-9003, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify this fault code is still present and in an active state.

   Use the Easy Engine software provided on the Electronic Service Tool (EST) to check the fault status and to perform the cylinder cut-out test.

   A. If the fault is still present and active, continue with Step **2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with Step **7**.
2. Check the fuel injector number 3 Y-9003 internal resistance.

   Disconnect the injector harness (INJ) from the fuel injector number 3 Y-9003 at connector **X-9031**.

   Use a multimeter to measure the resistance of fuel injector number 3 Y-9003 on the injector pins :

From	To	Value
X-9031 pin 1	**X-9031 pin 2**	There should be between **.03 - .05 Ω**

   A. If there is between **.03 - .05 Ω**, leave connector **X-9031** disconnected and continue to Step **3**.

   B. If the resistance is not between **.03 - .05 Ω**, fuel injector number 3 Y-9003 solenoid coil has failed. Replace fuel injector number 3 Y-9003.
3. Check the fuel injector number 3 Y-9003 injector harness (INJ) wiring.

   Disconnect the vehicle harness (VE) from the engine interface at connector **X-9139**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the injector harness (INJ) side :

From	To	Value
X-9031 pin 1	**X-9031 pin 2**	There should be no continuity.

   A. If there is no continuity, leave connectors **X-9031** and **X-9139** disconnected and continue to Step **4**.

   B. If there is continuity, there is a short circuit in the fuel injector number 3 Y-9003 wiring in the injector harness (INJ) between wires INJ-270 and INJ-271. Locate and repair the shorted conductor.
4. Check the fuel injector number 3 Y-9003 vehicle harness (VE) wiring for a short circuit condition.

Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9121**.

With the key in the OFF position, use a multimeter to perform the following continuity check on vehicle harness (VE) side :

From	To	Value
X-9139 pin D	**X-9139 pin C**	There should be no continuity

A. If there is continuity, there is a short circuit in the fuel injector number 3 Y-9003 wiring in the vehicle harness (VE) between wires VE-9128 and VE-9127. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no continuity, continue with Step **5**.

5. Check the ECU A-9000 voltage supply wiring.

Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9122**.

With the key in the ON position, use a multimeter to perform the following voltage checks from the vehicle harness (VE) side :

From	To	Value
X-9122 pin K03	chassis ground	There should be approximately **12.0 V**
X-9122 pin K05	chassis ground	There should be approximately **12.0 V**
X-9122 pin K01	chassis ground	There should be approximately **12.0 V**

A. If there is approximately **12.0 V**, leave connector **X-9122** disconnected and continue to Step **6**.

B. If there is not approximately **12.0 V**, there is a faulty ECU A-9000 voltage supply. Use the appropriate service manual, if necessary, to locate and repair the failed conductor.

6. Check the ECU A-9000 ground supply.

With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side : :

From	To	Value
X-9122 pin K02	chassis ground	There should be continuity.
X-9122 pin K04	chassis ground	There should be continuity.
X-9122 pin K06	chassis ground	There should be continuity.

A. If there is no continuity, there is a faulty ECU A-9000 ground supply. Use the appropriate service manual, if necessary, to locate and repair the failed conductor.

B. If there is continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

7. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 04 – Engine Control Unit (ECU) vehicle connector (55.100.DP-C.20.E.04)
Wiring harnesses - Electrical schematic sheet 05 – Engine Control Unit (ECU) engine connector (55.100.DP-C.20.E.05)
Wiring harnesses - Electrical schematic sheet 06 – Engine control and fuel injection (55.100.DP-C.20.E.06)

DTC 167-02-Open load error of injector in cylinder 1

Control Module : ECU

NOTE: *If a fuel injector is replaced, it is necessary to program the new injector IMA code using the Electronic Service Tool (EST). The IMA code may be under the paint on the fuel injector. For more information regarding programming IMA codes, see* ***Fuel injectors - Configure - IMA codes (10.218)****.*

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel injector number 1 Y-9001 circuit. If the ECU A-9000 determines that there is an open circuit condition in the fuel injector number 1 Y-9001 circuit, this fault will occur.

Cause:
The ECU A-9000 has detected an open circuit in the fuel injector number 1 Y-9001 circuit.

Possible failure modes:

1. Faulty fuel injector number 1 Y-9001 wiring, open circuit.
2. Faulty fuel injector number 1 Y-9001, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.
2. Check fuel injector number 1 for an internal failure.

   Disconnect the engine harness (EN) from fuel injector number 1 Y-9001 at connector **X-9030**.

   Use a multimeter to perform the following resistance check on the fuel injector pins :

From	To	Value
X-9030 pin 1	**X-9030 pin 2**	There should be approximately **0.3 - 0.5 Ω**.

   A. If the specified range is not measured, the fuel injector has failed. Replace the fuel injector number 1 Y-9001.

   B. If the specified range is measured, leave connector **X-9030** disconnected and continue to Step **3**.
3. Check the fuel injector number 1 Y-9001 engine harness (EN) wiring for an open circuit.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With they key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side:

From	To	Value
X-9030 pin 1	**X-9001 pin A16**	There should be continuity.
X-9030 pin 2	**X-9001 pin A32**	There should be continuity.

   A. If there is no continuity, there is an open circuit in the fuel injector number 1 Y-9001 engine harness (EN) wiring. Locate and repair the broken conductor.

   B. If there is continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 168-02-Open load error of injector in cylinder 2

Control Module : ECU

NOTE: *If a fuel injector is replaced, it is necessary to program the new injector IMA code using the Electronic Service Tool (EST). The IMA code may be under the paint on the fuel injector. For more information regarding programming IMA codes, see* ***Fuel injectors - Configure - IMA codes (10.218)****.*

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel injector number 2 Y-9002 circuit. If the ECU A-9000 determines that there is an open circuit condition in the fuel injector number 2 Y-9002 circuit, this fault will occur.

Cause:
The ECU A-9000 has detected an open circuit in the fuel injector number 2 Y-9002 circuit.

Possible failure modes:

1. Faulty fuel injector number 2 Y-9002 wiring, open circuit.
2. Faulty fuel injector number 2 Y-9002, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.
2. Check fuel injector number 2 for an internal failure.

   Disconnect the engine harness (EN) from fuel injector number 2 Y-9002 at connector **X-9032**.

   Use a multimeter to perform the following resistance check on the fuel injector pins :

From	To	Value
X-9032 pin 1	**X-9032 pin 2**	There should be approximately **0.3 - 0.5 Ω**.

   A. If the specified range is not measured, the fuel injector has failed. Replace the fuel injector number 2 Y-9002.

   B. If the specified range is measured, leave connector **X-9032** disconnected and continue to Step **3**.
3. Check the fuel injector number 2 Y-9002 engine harness (EN) wiring for an open circuit.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With they key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side:

From	To	Value
X-9032 pin 1	**X-9001 pin A17**	There should be continuity.
X-9032 pin 2	**X-9001 pin A48**	There should be continuity.

   A. If there is no continuity, there is an open circuit in the fuel injector number 2 Y-9002 engine harness (EN) wiring. Locate and repair the broken conductor.

   B. If there is continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 169-02-Open load error of injector in cylinder 3

Control Module : ECU

NOTE: *If a fuel injector is replaced, it is necessary to program the new injector IMA code using the Electronic Service Tool (EST). The IMA code may be under the paint on the fuel injector. For more information regarding programming IMA codes, see* ***Fuel injectors - Configure - IMA codes (10.218)****.*

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel injector number 3 Y-9003 circuit. If the ECU A-9000 determines that there is an open circuit condition in the fuel injector number 3 Y-9003 circuit, this fault will occur.

Cause:
The ECU A-9000 has detected an open circuit in the fuel injector number 3 Y-9003 circuit.

Possible failure modes:

1. Faulty fuel injector number 3 Y-9003 wiring, open circuit.
2. Faulty fuel injector number 3 Y-9003, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.
2. Check fuel injector number 3 for an internal failure.

   Disconnect the engine harness (EN) from fuel injector number 3 Y-9003 at connector **X-9031**.

   Use a multimeter to perform the following resistance check on the fuel injector pins :

From	To	Value
X-9031 pin 1	**X-9031 pin 2**	There should be approximately **0.3 - 0.5 Ω**.

   A. If the specified range is not measured, the fuel injector has failed. Replace the fuel injector number 3 Y-9003.

   B. If the specified range is measured, leave connector **X-9031** disconnected and continue to Step **3**.
3. Check the fuel injector number 3 Y-9003 engine harness (EN) wiring for an open circuit.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With they key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side:

From	To	Value
X-9031 pin 1	**X-9001 pin A31**	There should be continuity.
X-9031 pin 2	**X-9001 pin A01**	There should be continuity.

   A. If there is no continuity, there is an open circuit in the fuel injector number 3 Y-9003 engine harness (EN) wiring. Locate and repair the broken conductor.

   B. If there is continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 171-03-Injection bank 1 short circuit failure (all injectors of the same bank can be affected)

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel injector harness for a short circuit condition. If the ECU A-9000 detects a short circuit pattern in the bank 1 fuel injectors, this fault will occur. Fuel injector number 1 Y-9001 is the only fuel injector for bank 1.

Cause:
The ECU A-9000 has detected a a short circuit pattern in the bank 1 fuel injector harness.

Possible failure modes:

1. Faulty fuel injector bank 1 wiring, short circuit.
2. Fault ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.
2. Use the Electronic Service Tool (EST) to check for other active faults that may have caused this fault to occur.

   A. If any of the related faults are active, diagnose them first and then return to this fault.

   B. If none of the related faults are active, continue to Step **3**.
3. Check the fuel injector 1 Y-9001 harness for a short circuit condition.

   Disconnect the engine harness (EN) from fuel injector number 1 Y-9001 at connector **X-9030**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9030 pin 1	**X-9030 pin 2**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the fuel injector bank 1 harness. Locate and repair the shorted conductor.

   B. If there is no continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.
4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 173-03-Injection bank 2 short circuit failure (all injectors of the same bank can be affected)

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel injector harness for a short circuit condition. If the ECU A-9000 detects a short circuit pattern in the fuel injector harness of both bank 2 fuel injections, this fault will occur. The bank 2 fuel injectors are fuel injector number 2 Y-9002 and fuel injector number 3 Y-9003.

Cause:
The ECU A-9000 has detected a a short circuit pattern between both bank 2 fuel injectors.

Possible failure modes:

1. Faulty bank 2 fuel injector wiring, short circuit.
2. Fault ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.
2. Use the Electronic Service Tool (EST) to check for other active faults that may have caused this fault to occur.

   A. If any of the related faults are active, diagnose them first and then return to this fault.

   B. If none of the related faults are active, continue to Step **3**.
3. Check the fuel injector 2 and 3 harnesses for a short circuit condition.

   Disconnect the engine harness (EN) from fuel injector number 2 Y-9002 at connector **X-9032**.

   Disconnect the engine harness (EN) from fuel injector number 3 Y-9003 at connector **X-9031**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9032 pin 1	**X-9031 pin 2**	There should be no continuity.
X-9032 pin 2	**X-9031 pin 1**	There should be no continuity.
X-9032 pin 1	**X-9031 pin 1**	There should be no continuity.
X-9032 pin 2	**X-9031 pin 2**	There should be no continuity.
X-9032 pin 1	**X-9032 pin 2**	There should be no continuity.
X-9031 pin 1	**X-9031 pin 2**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the fuel injector bank 2 harness. Locate and repair the shorted conductor.

   B. If there is no continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.
4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 17C-12-ECU internal failure - Injector CY33x component

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors diagnostic checks on the fuel injection power stages. This diagnostic procedure uses pattern detection to identify specific errors and can trigger the appropriate reaction. If the ECU A-9000 detects a specific combination of errors in the injection power stages, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 17E-02-Number of desired injections exceeds threshold

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the requested number of fuel injections. If the ECU A-9000 determines that the number of requested injections is greater than the current capability of the fuel injection system, this fault will occur,

Cause:
The ECU A-9000 has determined that the number of requested fuel injections has exceeded the current capability of the fuel injection system.

Possible failure modes:

1. Faulty battery, low voltage.
2. Faulty ECU A-9000 power supply.
3. Faulty ECU A-9000, software.

Solution:

1. Check battery voltage.

   Load test the battery. There should be approximately **12.0 V**.

   A. If the battery passes the load test, continue to Step **2**.

   B. If the battery fails the load test, the battery has failed. Replace the battery.
2. Check the ECU A-9000 voltage supply wiring.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   Place a jumper wire between **X-9102 pin K28** and chassis ground. This will energize the main relay K-9102.

   Use a multimeter to perform the following voltage checks on the engine harness (EN) side :

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If there is not approximately **12.0 V**, there is a faulty ECU A-9000 voltage supply. Use the appropriate service manual, if necessary, to locate and repair the failed conductor.

   B. If there is approximately **12.0 V**, continue to Step **3**.
3. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)
Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 17E-03-Exceeded the number of injections for a given engine speed

Control Module : ECU

Context:
The ECU A-9000 monitors the requested number of fuel injections and the current capability of the injection system fulfilling that request. If the ECU A-9000 determines that the requested number of injections is greater than the current capability of the fuel injection system for the current engine speed, this fault will occur.

Cause:
The ECU A-9000 has determined that the requested number of fuel injections is greater than the capability of the fuel injection system based on engine speed.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 17E - 04-Injection control : Number of injections is limited by system

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the requested number of fuel injections and the current capability of the fuel injection system to fulfill that request. If the ECU A-9000 determines that the requested number of fuel injections can not be reached, this fault will occur.

Cause:
The ECU A-9000 has determined that the requested number of fuel injections is greater than the current capability of the fuel injection system.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 17E-12-Number of injections is limited by quantity balance of high pressure pump

Control Module : ECU

Context:
The ECU A-9000 monitors the requested number of fuel injections and the current capability of the fuel injection system to fulfill that request. If the ECU A-9000 determines that the number of requested fuel injections is greater than the current capability of the fuel injection system, this fault will occur. For more information regarding the troubleshooting of the fuel system, see **Fuel injection system - Troubleshooting (10.218)**.

Cause:
The ECU A-9000 has determined that the number of requested fuel injections is greater than the current capability of the fuel injection system to fulfill that request.

Possible failure modes:

1. Faulty fuel back-flow, excessive.
2. Faulty high pressure pump, worn or ageing.
3. Faulty fuel metering unit, unable to open.
4. Faulty fuel temperature, too high.
5. Faulty fuel injectors, worn or internal leakage.
6. Faulty fuel filters, clogged.
7. Faulty charge gear pump, low efficiency.
8. Faulty Pressure Relief Valve (PRV), leakage.
9. Faulty rail pressure sensor B-9004, drifted signal or leakage.
10. Faulty fuel injection system, leaking or blocked lines.
11. Faulty ECU A-9000, software.

DTC 17F-12-Missing adjustment value programming for injector in cylinder 1

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 uses an IMA code to correct fuel trim for each fuel injector equipped with the engine at every key ON. If the ECU A-9000 determines that this trim correction for fuel injector number 1 Y-9001 can not be performed, this fault will occur. For more information about how to configure injector IMA codes, see **Fuel injectors - Configure - IMA codes (10.218)**.

Cause:
The ECU A-9000 has determined that the fuel injector number 1 Y-9001 fuel trim correction can not be performed.

Solution:

1. Use the Electronic Service Tool (EST) ensure that the correct IMA code is programmed to fuel injector number 1 Y-9001.

   A. If the correct code is not programmed. Use the EST to program the correct code.

   B. If the correct code is programmed, continue to Step **2**.

   NOTE: *The IMA code may be under the paint on the fuel injector.*
2. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 18F-02-Lambda sensor heater power stage open circuit

Control Module : ECU

NOTE: *If the Lambda sensor B-9123 is replaced, it is necessary to perform the Replacement of the Lambda Sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)****, if necessary.*

Context:
The Lambda sensor B-9123 has a heating element encased in ceramic that heats the sensor tip. Whenever the heater is operating, the heater low side driver power stage contained in the Engine Control Unit (ECU) A-9000 is monitored for an open circuit condition. If an open circuit condition exists in the heater control circuit, this fault will occur. For information regarding the functional operation of the Lambda sensor B-9123 see **Lambda sensor - Overview (55.989)**. For more information regarding the technical specifications of the lambda sensor B-9123, see **Lambda sensor - Technical Data (55.989)**.

Cause:
The Lambda sensor B-9123 low side driver heater control circuit is open.

Possible failure modes:

1. Faulty Lambda sensor B-9123 heater control circuit wiring, open circuit.
2. Faulty Lambda sensor B-9123 battery voltage supply wiring, open circuit.
3. Faulty Lambda sensor B-9123, failed internally.
4. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.

2. Check the Lambda sensor B-9123 heater circuit wiring for an open circuit condition.

   Disconnect the vehicle harness (VE) from the Lambda sensor B-9123 at connector **X-9123**.

   With the key switch in the ON position, use a multimeter to perform the following voltage check on the vehicle harness (VE) side :

From	To	Value
X-9123 pin 4	chassis ground	There should be approximately **12.0 V**.

   A. If there is no voltage, there is an failure in the battery voltage supply wiring to the lambda sensor B-9123. Use the appropriate vehicle service manual, if necessary, to locate and repair the failed conductor.

   B. If there is voltage, leave connector **X-9123** disconnected and continue with Step **3**.

3. Check the Lambda sensor B-9123 low side driver wiring for an open circuit.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity check for an open circuit on the vehicle harness (VE) side :

From	To	Value
X-9123 pin 3	**X-9102 pin K07**	There should be continuity.

A. If there is no continuity, there is an open circuit in the Lambda sensor B-9123 low side driver wiring between connector **X-9123 pin 3** and connector **X-9102 pin K07**. Use the appropriate service manual, if necessary, to locate and repair the broken conductor.

B. If there is continuity, leave connector **X-9123** disconnected and continue to Step **4**.

4. Replace the Lambda sensor B-9123.

   Use the EST, see **Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)** if necessary, to perform the Replacement of the Lambda Sensor - Reset ECU Data.

   Use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, return the machine to service.

   B. If this fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires.

   Verify that the connectors are fully installed.

   Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned.

   Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 18F-03-Lambda sensor heater power stage short circuit to battery

Control Module : ECU

NOTE: *If the Lambda sensor B-9123 is replaced, it is necessary to perform the Replacement of the Lambda Sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)****, if necessary.*

Context:
The Lambda sensor B-9123 has a heating element encased in ceramic that heats the sensor tip. Whenever the heater is operating, the heater low side driver power stage contained in the Engine Control Unit (ECU) A-9000 is monitored for a short circuit to battery condition. If a short circuit to a power source condition exists in the heater control circuit, this fault will occur. For information regarding the functional operation of the Lambda sensor B-9123 see **Lambda sensor - Overview (55.989)**. For more information regarding the technical specifications of the lambda sensor B-9123, see **Lambda sensor - Technical Data (55.989)**.

Cause:
The Lambda sensor B-9123 low side driver heater control circuit is shorted to a voltage source.

Possible failure modes:

1. Faulty Lambda sensor B-9123 heater control circuit wiring, short to a voltage source.
2. Faulty Lambda sensor B-9123, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check the Lambda sensor B-9123 heater control circuit wiring for a short to voltage source condition.

   Disconnect the vehicle harness (VE) from the Lambda sensor B-9123 at connector **X-9123**.

   With the key switch in the ON position, use a multimeter to perform the following voltage check on the vehicle harness (VE) side :

From	To	Value
X-9123 pin 3	Chassis ground	There should be no voltage.

   A. If there is voltage, leave connector **X-9123** disconnected and continue to Step **3**.

   B. If there is no voltage, leave connector **X-9123** disconnected and continue to Step **4**.
3. Locate the Lambda sensor B-9123 heater control circuit wiring short to voltage source condition.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K07	to all other pins in connector **X-9102**	There should be no continuity.

A. If there is continuity, there is a short to a voltage source condition in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the shorted conductors.

B. If there is no continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Replace the Lambda sensor B-9123.

   Use the EST, see **Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)** if necessary, to perform the Replacement of the Lambda Sensor - Reset ECU Data.

   Use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, return the machine to service.

   B. If this fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 18F-04-Lambda sensor heater power stage short circuit to ground

Control Module : ECU

NOTE: *If the Lambda sensor B-9123 is replaced, it is necessary to perform the Replacement of the Lambda Sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)****, if necessary.*

Context:
The Lambda sensor B-9123 has a heating element encased in ceramic that heats the sensor tip. Whenever the heater is operating, the heater low side driver power stage contained in the Engine Control Unit (ECU) A-9000 is monitored for a short circuit to ground condition. If a short to ground condition exists in the heater control circuit, this fault will occur. For information regarding the functional operation of the Lambda sensor B-9123 see **Lambda sensor - Overview (55.989)**. For more information regarding the technical specifications of the lambda sensor B-9123, see **Lambda sensor - Technical Data (55.989)**.

Cause:
The Lambda sensor B-9123 low side driver heater control circuit is shorted to ground.

Possible failure modes:

1. Faulty Lambda sensor B-9123 heater control circuit wiring, shorted to ground.
2. Faulty Lambda sensor B-9123, failed internally.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.

2. Check the Lambda sensor B-9123 heater control circuit wiring for a short to ground condition.

   Disconnect the vehicle harness (VE) from the Lambda sensor B-9123 at connector **X-9123**.

   Use a multimeter to check for continuity on the vehicle harness (VE) side :

From	To	Result
X-9123 pin 3	chassis ground	There should be no continuity.

   A. If there is continuity, continue with Step **3**.

   B. If there is no continuity, continue with Step **4**.

3. Locate the Lambda sensor B-9123 heater control circuit wiring short to ground condition.

   Carefully disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   Use a multimeter to check for continuity on the vehicle harness (VE) side :

From	To	Result
X-9102 pin K07	chassis ground	There should be no continuity.

   A. If there is continuity, there is a short to ground condition in the vehicle harness (VE) between connector **X-9123 pin 3** and **X-9102 pin K07**.Use the appropriate vehicle service manual, if necessary, to locate and repair the grounded conductor.

B. If there is no continuity, the ECU A-9000 connector **X-9102** is damaged or the ECU A-9000 has failed. Locate and repair the damage or replace the ECU A-9000.

4. Replace the Lambda sensor B-9123.

   Use the EST, see **Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)** if necessary, to perform the Replacement of the Lambda Sensor - Reset ECU Data.

   Use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, return the machine to service.

   B. If this fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires.

   Verify that the connectors are fully installed.

   Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned.

   Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 18F-04-Lambda sensor heater power stage short circuit to ground

Control Module : ECU

NOTE: *If the Lambda sensor B-9123 is replaced, it is necessary to perform the Replacement of the Lambda Sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)****, if necessary.*

Context:
The Lambda sensor B-9123 has a heating element encased in ceramic that heats the sensor tip. Whenever the heater is operating, the heater low side driver power stage contained in the Engine Control Unit (ECU) A-9000 is monitored for a short circuit to ground condition. If a short to ground condition exists in the heater control circuit, this fault will occur. For information regarding the functional operation of the Lambda sensor B-9123 see **Lambda sensor - Overview (55.989)**. For more information regarding the technical specifications of the lambda sensor B-9123, see **Lambda sensor - Technical Data (55.989)**.

Cause:
The Lambda sensor B-9123 low side driver heater control circuit is shorted to ground.

Possible failure modes:

1. Faulty Lambda sensor B-9123 heater control circuit wiring, short to ground condition.
2. Faulty Lambda sensor B-9123, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.
2. Check the Lambda sensor B-9123 heater control circuit wiring for a short to ground condition.

   Disconnect the vehicle harness (VE) from the Lambda sensor B-9123 at connector **X-9123**.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   Use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9123 pin 3	chassis ground	There should be no continuity.
X-9102 pin K07	All pins in connector **X-9102**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the lambda sensor B-9123 vehicle harness (VE) wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, leave connector **X-9123** disconnected and continue to Step **3**.
3. Replace the Lambda sensor B-9123.

   Use the EST, see **Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)** if necessary, to perform the Replacement of the Lambda Sensor - Reset ECU Data.

   Use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, return the machine to service.

B. If this fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 199-02-Turbocharger boost pressure is higher than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors boost pressure using the intake manifold pressure sensor B-9001. If the ECU A-9000 determines that boost pressure is higher than expected, this fault will occur. For more information regarding the troubleshooting of an over-boost condition, see **Turbocharger - Troubleshooting (10.250)**.

Cause:
The ECU A-9000 has determined that boost pressure is higher than expected.

Possible failure modes:

1. Faulty wastegate, sticking or broken linkage.
2. Faulty intake manifold pressure sensor B-9001, signal drifted.
3. Faulty ECU A-9000, software.

DTC 199-02-Turbocharger boost pressure is higher than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors boost pressure using the intake manifold pressure sensor B-9001. If the ECU A-9000 determines that boost pressure is higher than expected, this fault will occur. For more information regarding the troubleshooting of an over-boost condition, see **Turbocharger - Troubleshooting (10.250)**.

Cause:
The ECU A-9000 has determined that boost pressure is higher than expected.

Possible failure modes:

1. Faulty wastegate pressure modulator valve Y-9008, if applicable.
2. Faulty wastegate, sticking or broken linkage.
3. Faulty intake manifold pressure sensor B-9001, signal drifted.
4. Faulty ECU A-9000, software.

DTC 1B1-03-CAN A Bus off failure

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 is capable of connecting to and communicating on two separate Controller Area Networks (CAN). Proper configuration and monitoring of the two twisted pair configured networks is also a function of the ECU A-9000. CAN Node A Bus is the main vehicle interface bus. The ECU A-9000 provides a CAN termination resistor for the CAN Node A Bus, internal to the ECU A-9000. If the ECU A-9000 senses that CAN Node A Bus is not functioning properly, this fault will occur.

Cause:
ECU A-9000 has sensed a Bus Off state to be present at the CAN Node A.

Possible failure modes:

1. Faulty supply voltage or ground, missing.
2. Faulty CAN circuit wiring, open circuit, short to ground, or short circuit.
3. Faulty ECU A-9000, termination resistor or software.

Solution:

1. Verify fault is present and in active state.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check for other vehicle CAN faults.

   Use the EST to determine if vehicle CAN faults exist.

   A. If other vehicle CAN faults do exist, resolve those vehicle CAN faults first, then check to see that this fault is also resolved.

   B. If other vehicle CAN faults do not exist, continue with Step **3**.
3. Check the ECU A-9000 supply voltage.

   Disconnect the vehicle (VE) harness from the ECU A-9000 at connector **X-9102**.

   To energize the Main relay K-9102, place a jumper wire between the vehicle harness (VE) side of connector **X-9102 pin K28** and chassis ground.

   Use a multimeter to check for voltage on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If the voltage is present on all of the checks, leave connector **X-9102** disconnected and continue with Step **4**.

   B. If the voltage is not present for one or more of the checks, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore supply power to the ECU A-9000.

4. Determine the condition of the ECU A-9000 CAN circuit.

   With the key switch in the OFF position, use a multimeter to measure the resistance of the CAN connection on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.
X-9102 pin K24	chassis ground	There should be no continuity
X-9102 pin K25	chassis ground	There should be no continuity

   Use a multimeter to measure the resistance of the CAN termination resistor, internal to the ECU A-9000:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.

   A. If the measured resistances are correct and neither conductor is grounded, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   B. If the measured resistances are not correct or one or both of the conductors is grounded, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore the termination resistance to the CAN circuit.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 1B1-04-CAN A Bus off passive failure

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 is capable of connecting to and communicating on two separate Controller Area Networks (CAN). Proper configuration and monitoring of the two twisted pair configured networks is also a function of the ECU A-9000. CAN Node A Bus is the main vehicle interface bus. The ECU A-9000 provides a CAN termination resistor for the CAN Node A Bus, internal to the ECU A-9000. If the ECU A-9000 senses that CAN Node A Bus is not functioning properly, this fault will occur.

Cause:
ECU A-9000 has sensed a “Bus Off” state to be present at the CAN Node A.

Possible failure modes:

1. Faulty supply voltage or ground, missing.
2. Faulty CAN circuit wiring, open circuit, short to ground, or short circuit.
3. Faulty ECU A-9000, termination resistor or software.

Solution:

1. Verify fault is present and in active state.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step**2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check for other vehicle CAN faults.

   Use the EST to determine if vehicle CAN faults exist.

   A. If other vehicle CAN faults do exist, resolve those vehicle CAN faults first, then check to see that this fault is also resolved.

   B. If other vehicle CAN faults do not exist, continue with Step **3**.
3. Check the ECU A-9000 supply voltage.

   Disconnect the vehicle (VE) harness from the ECU A-9000 at connector **X-9102**.

   To energize the Main relay K-9102, place a jumper wire between the vehicle harness (VE) side of connector **X-9102 pin K28** and chassis ground.

   Use a multimeter to check for voltage on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If the voltage is present on all of the checks, leave connector **X-9102** disconnected and continue with Step **4**.

   B. If the voltage is not present for one or more of the checks, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore supply power to the ECU A-9000.

4. Determine the condition of the ECU A-9000 CAN circuit.

   With the key switch in the “OFF” position, use a multimeter to measure the resistance of the CAN connection on the vehicle (VE) harness side:

From	To	Value
X-9122 pin K24	**X-9122 pin K25**	There should be **120 Ω**.
X-9122 pin K24	chassis ground	There should be no continuity
X-9122 pin K25	chassis ground	There should be no continuity

   Use a multimeter to measure the resistance of the CAN termination resistor, internal to the ECU A-9000:

From	To	Value
X-9122 pin K24	**X-9122 pin K25**	There should be **120 Ω**.

   A. If the measured resistances are correct and neither conductor is grounded, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   B. If the measured resistances are not correct or one or both of the conductors is grounded, refer to the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore the termination resistance to the CAN circuit.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 1B5-02-CAN communication error between vehicle controller to ECU

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 is capable of connecting to and communicating on two or more separate Controller Area Networks (CAN). Proper configuration and monitoring of these twisted pair configured networks is also a function of the ECU A-9000. CAN Node A Bus is the main vehicle interface bus. The ECU A-9000 provides a CAN termination resistor for the CAN Node A Bus, internal to the ECU A-9000. The ECU A-9000 receives and responds to proprietary information like low and high idle or intermediate speed set points and parameters or feedback. If the ECU A-9000 does not receive the message every **0.050 s**, this fault will occur.

Cause:
ECU A-9000 has sensed a timeout of required vehicle controller data provided on CAN Node A.

Possible failure modes:

1. Faulty vehicle system, related CAN fault.
2. Faulty supply voltage or ground, missing.
3. Faulty CAN circuit wiring, open circuit, short to ground, or short circuit.
4. Faulty ECU A-9000, termination resistor or software.

Solution:

1. Verify fault is present and in active state.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step**2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check for other vehicle CAN faults.

   Use the EST to determine if vehicle CAN faults exist.

   A. If other vehicle CAN faults do exist, resolve the vehicle CAN faults, then check to see that this fault is also resolved.

   B. If other vehicle CAN faults do not exist, continue with Step **3**.
3. Check the ECU A-9000 supply voltage.

   Disconnect the vehicle (VE) harness from the ECU A-9000 at connector **X-9102**.

   To energize the Main relay K-9102, place a jumper wire between the vehicle harness (VE) side of connector **X-9102 pin K28** and chassis ground.

   Use a multimeter to check for voltage on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If the voltage is present on all of the checks, leave connector **X-9102** disconnected and continue with Step **4**.

B. If the voltage is not present for one or more of the checks, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore supply power to the ECU A-9000.

4. Determine the condition of the ECU A-9000 CAN circuit.

   With the key switch in the OFF position, use a multimeter to measure the resistance of the CAN connection on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.
X-9102 pin K24	chassis ground	There should be no continuity
X-9102 pin K25	chassis ground	There should be no continuity

   Use a multimeter to measure the resistance of the CAN termination resistor, internal to the ECU A-9000:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.

   A. If the measured resistances are correct and neither conductor is grounded, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   B. If the measured resistances are not correct or one or both of the conductors is grounded, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore the termination resistance to the CAN circuit.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 1B7-02-CAN transmit error - EEC1 message (Electronic Engine Control 1 message - Torque, accelerator pedal, engine speed, and other signals)

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 is capable of connecting to and communicating on two separate Controller Area Networks (CAN). Proper configuration and monitoring of the two twisted pair configured networks is also a function of the ECU A-9000. CAN Node A Bus is the main vehicle interface bus. The ECU A-9000 provides a CAN termination resistor for the CAN Node A Bus, internal to the ECU A-9000. If the ECU A-9000 senses that CAN Node A Bus is not functioning properly, this fault will occur.

Cause:
ECU A-9000 has sensed a timeout of required vehicle controller data provided on CAN Node A.

Possible failure modes:

1. Faulty supply voltage or ground, missing.
2. Faulty CAN circuit wiring, open circuit, short to ground, or short circuit.
3. Faulty ECU A-9000, termination resistor or software.

Solution:

1. Verify fault is present and in active state.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step**2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check for other vehicle CAN faults.

   Use the EST to determine if vehicle CAN faults exist.

   A. If other vehicle CAN faults do exist, resolve those vehicle CAN faults first, then check to see that this fault is also resolved.

   B. If other vehicle CAN faults do not exist, continue with Step **3**.
3. Check the ECU A-9000 supply voltage.

   Disconnect the vehicle (VE) harness from the ECU A-9000 at connector **X-9102**.

   To energize the Main relay K-9102, place a jumper wire between the vehicle harness (VE) side of connector **X-9102 pin K28** and chassis ground.

   Use a multimeter to check for voltage on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If the voltage is present on all of the checks, leave connector **X-9102** disconnected and continue with Step **4**.

B. If the voltage is not present for one or more of the checks, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore supply power to the ECU A-9000.

4. Determine the condition of the ECU A-9000 CAN circuit.

   With the key switch in the OFF position, use a multimeter to measure the resistance of the CAN connection on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.
X-9102 pin K24	chassis ground	There should be no continuity
X-9102 pin K25	chassis ground	There should be no continuity

   Use a multimeter to measure the resistance of the CAN termination resistor, internal to the ECU A-9000:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.

   A. If the measured resistances are correct and neither conductor is grounded, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   B. If the measured resistances are not correct or one or both of the conductors is grounded, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore the termination resistance to the CAN circuit.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 1C6-03-CAN communication failure between vehicle controller and ECU controller - TSC1_PE message

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 is capable of connecting to and communicating on two separate Controller Area Networks (CAN). Proper configuration and monitoring of the two twisted pair configured networks is also a function of the ECU A-9000. CAN Node A Bus is the main vehicle interface bus. The ECU A-9000 provides a CAN termination resistor for the CAN Node A Bus, internal to the ECU A-9000. If the ECU A-9000 senses that CAN Node A Bus is not functioning properly, this fault will occur.

Cause:
ECU A-9000 has sensed a timeout of vehicle data provided on CAN Node A.

Possible failure modes:

1. Faulty supply voltage or ground, missing.
2. Faulty CAN circuit wiring, open circuit, short to ground, or short circuit.
3. Faulty ECU A-9000, termination resistor or software.

Solution:

1. Verify fault is present and in active state.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step**2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check for other vehicle CAN faults.

   Use the EST to determine if vehicle CAN faults exist.

   A. If other vehicle CAN faults do exist, resolve those vehicle CAN faults first, then check to see that this fault is also resolved.

   B. If other vehicle CAN faults do not exist, continue with Step **3**.
3. Check the ECU A-9000 supply voltage.

   Disconnect the vehicle (VE) harness from the ECU A-9000 at connector **X-9102**.

   To energize the Main relay K-9102, place a jumper wire between the vehicle harness (VE) side of connector **X-9102 pin K28** and chassis ground.

   Use a multimeter to check for voltage on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If the voltage is present on all of the checks, leave connector **X-9102** disconnected and continue with Step **4**.

B. If the voltage is not present for one or more of the checks, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore supply power to the ECU A-9000.

4. Determine the condition of the ECU A-9000 CAN circuit.

   With the key switch in the OFF position, use a multimeter to measure the resistance of the CAN connection on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.
X-9102 pin K24	chassis ground	There should be no continuity
X-9102 pin K25	chassis ground	There should be no continuity

   Use a multimeter to measure the resistance of the CAN termination resistor, internal to the ECU A-9000:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.

   A. If the measured resistances are correct and neither conductor is grounded, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   B. If the measured resistances are not correct or one or both of the conductors is grounded, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore the termination resistance to the CAN circuit.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 1C8-03-CAN communication failure between vehicle controller and ECU controller - TSC1_VE message

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 is capable of connecting to and communicating on two separate Controller Area Networks (CAN). Proper configuration and monitoring of the two twisted pair configured networks is also a function of the ECU A-9000. CAN Node A Bus is the main vehicle interface bus. The ECU A-9000 provides a CAN termination resistor for the CAN Node A Bus, internal to the ECU A-9000. If the ECU A-9000 senses that CAN Node A Bus is not functioning properly, this fault will occur.

Cause:
ECU A-9000 has sensed a timeout of required vehicle controller data provided on CAN Node A.

Possible failure modes:

1. Faulty supply voltage or ground, missing.
2. Faulty CAN circuit wiring, open circuit, short to ground, or short circuit.
3. Faulty ECU A-9000, termination resistor or software.

Solution:

1. Verify fault is present and in active state.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step**2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check for other vehicle CAN faults.

   Use the EST to determine if vehicle CAN faults exist.

   A. If other vehicle CAN faults do exist, resolve those vehicle CAN faults first, then check to see that this fault is also resolved.

   B. If other vehicle CAN faults do not exist, continue with Step **3**.
3. Check the ECU A-9000 supply voltage.

   Disconnect the vehicle (VE) harness from the ECU A-9000 at connector **X-9102**.

   To energize the Main relay K-9102, place a jumper wire between the vehicle harness (VE) side of connector **X-9102 pin K28** and chassis ground.

   Use a multimeter to check for voltage on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If the voltage is present on all of the checks, leave connector **X-9102** disconnected and continue with Step **4**.

B. If the voltage is not present for one or more of the checks, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore supply power to the ECU A-9000.

4. Determine the condition of the ECU A-9000 CAN circuit.

   With the key switch in the OFF position, use a multimeter to measure the resistance of the CAN connection on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.
X-9102 pin K24	chassis ground	There should be no continuity
X-9102 pin K25	chassis ground	There should be no continuity

   Use a multimeter to measure the resistance of the CAN termination resistor, internal to the ECU A-9000:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.

   A. If the measured resistances are correct and neither conductor is grounded, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   B. If the measured resistances are not correct or one or both of the conductors is grounded, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore the termination resistance to the CAN circuit.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 1D1-03-ECU internal failure

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 performs a diagnostic check of the sensor supplies by monitoring the sensor supplies communication. If the ECU A-9000 detects a communication error during this diagnostic check, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 1D2-02-ECU internal failure - EEPROM write error

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 has detected an error during the last EEPROM write operation. The hardware encapsulation of the ECU A-9000 checks each data block of the EEPROM and sets a status flag depending on if an error is found or not found. These flags are processed every 20 milliseconds by the Diagnostic System Management (DSM) and if the value is out of range, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 1D2-03-ECU internal failure - EEPROM erase error

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 has a functionality for reading and erasing values to a memory media (Flash or EEPROM). If the ECU A-9000 determines that this process can not be performed or successfully completed, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 1D2-04-ECU internal failure - EEPROM read error

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 has detected an error during the last EEPROM write operation. The hardware encapsulation of the ECU A-9000 checks each data block of the EEPROM and sets a status flag depending on if an error is found or not found. These flags are processed every 20 milliseconds by the Diagnostic System Management (DSM) and if the value is out of range, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 1D2-12-ECU internal failure - EEPROM write/read error

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 has detected an error during the last EEPROM write operation. The hardware encapsulation of the ECU A-9000 checks each data block of the EEPROM and sets a status flag depending on if an error is found or not found. These flags are processed every 20 milliseconds by the Diagnostic System Management (DSM) and if the value is out of range, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 1D3-12-ECU internal failure - Software resets in DSM 0

Control Module : ECU

Context:
If this fault is active, the Engine Control Unit (ECU) A-9000 has detected an error that has led to a software reset.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 1D4-12-ECU internal failure - Query/response communication errors

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the communication between the ECU A-9000 processor and the power stage controller over the SPI bus. If there is an error in the communication, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 1D8-12-ECU internal failure - SPI communication error

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the communication between the ECU A-9000 processor and the power stage controller over the SPI bus. If there is an error in the communication, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 1D9-02-ECU internal failure - ADC test

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the Analog Digital Converter (ADC) plausibility by performing a fixed input voltage test. If the voltage during the test is out of range, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 1D9-03-ECU internal failure - Voltage ratio in ADC monitoring

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the Analog Digital Converter (ADC) for plausibility by providing a test voltage to be converted. If the converted voltage is out of range, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 1D9-12-ECU internal failure - NTP error in ADC monitoring

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the Analog Digital Converter (ADC) plausibility by running a No-load Test Pulse operation (NTP). If the ECU A-9000 detects an error during this operation, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 1DA-12-ECU internal failure - Fuel calibration

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 checks the map for the conversion from fuel quantity to torque for consistency. If there is an error during this conversion check, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 1E1-03-Starter relay high side driver circuit shorted to battery

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 controls the starter control relay K-9104 using a low side and high side driver. If the ECU A-9000 detects a short circuit to battery in the high side driver circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a short circuit to battery in the starter control relay K-9104 high side driver circuit.

Possible failure modes:

1. Faulty starter control relay K-9104 wiring, short to a voltage source.
2. Faulty starter control relay K-9104, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.

2. Check the starter control relay K-9104 coil for an internal failure.

   Remove the starter control relay K-9104.

   Use a multimeter to measure the relay coil resistance on the starter control relay K-9104 pins :

From	To	Value
X-9120 pin 85	**X-9120 pin 86**	There should be approximately **70 - 130 Ω**.

   A. If there is approximately **70 - 130 Ω**, leave the starter control relay K-9104 disconnected and continue to Step **3**.

   B. If there is not approximately **70 - 130 Ω**, the relay has failed. Replace the starter control relay K-9104.

3. Check the starter control relay K-9104 high side driver vehicle harness (VE) wiring for a short to a voltage source.

   With the key in the OFF position, use a multimeter to perform the following voltage check for short to a voltage source on the vehicle harness (VE) side :

From	To	Value
X-9120 pin 85	Chassis ground	There should be no voltage.

   With the key in the ON position, use a multimeter to perform the following voltage check for short to a voltage source on the vehicle harness (VE) side :

From	To	Value
X-9120 pin 85	Chassis ground	There should be no voltage.

   A. If there is voltage, there is a short to a voltage source in the starter control relay K-9104 wiring in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no voltage, continue to Step **4**.

4. Check the starter control relay K-9104 high side driver vehicle harness (VE) wiring for a short circuit.

Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

With the key in the OFF position, use a multimeter to perform the following continuity check for short circuit on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K53	All pins in connector **X-9102**	There should be no continuity.

A. If there is continuity, there is a short circuit in the starter control relay K-9104 wiring in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no continuity, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)
Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 1E1-04-Starter relay high side driver circuit shorted to ground

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 controls the starter control relay K-9104 using a low side and high side driver. If the ECU A-9000 detects a short circuit to ground in the high side driver circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a short circuit to ground in the starter control relay K-9104 high side driver circuit.

Possible failure modes:

1. Faulty starter control relay K-9104 wiring, short to ground.
2. Faulty starter control relay K-9104, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.

2. Check the starter control relay K-9104 coil for an internal failure.

   Remove the starter control relay K-9104.

   Use a multimeter to measure the relay coil resistance on the starter control relay K-9104 pins :

From	To	Value
X-9120 pin 85	**X-9120 pin 86**	There should be approximately **70 - 130 Ω**.

   A. If there is approximately **70 - 130 Ω**, leave the starter control relay K-9104 disconnected and continue to Step **3**.

   B. If there is not approximately **70 - 130 Ω**, the relay has failed. Replace the starter control relay K-9104.

3. Check the starter control relay K-9104 high side driver vehicle harness (VE) wiring for a short to ground.

   With the key in the OFF position, use a multimeter to perform the following continuity check for a short to ground on the vehicle harness (VE) side :

From	To	Value
X-9120 pin 85	Chassis ground	There should be no continuity.

   A. If there is continuity, there is a short to ground in the starter control relay K-9104 wiring in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, continue to Step **4**.

4. Check the starter control relay K-9104 high side driver vehicle harness (VE) wiring for a short circuit.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity check for a short to ground on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K53	All pins in connector **X-9102**	There should be no continuity.

A. If there is continuity, there is a short to ground in the starter control relay K-9104 wiring in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no continuity, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)
Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 1E3-03-Fuel injection requested during overrun

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000, during after run, monitors fuel injector actuation time by calculating the demanded fuel injection quantity of actual injection and actual fuel pressure. If the ECU A-9000 determines that energizing time is greater than engine speed, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 1E4-03-ECU internal failure - Calculated engine speed

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors engine speed in multiple software levels. If the ECU A-9000 determines that there is plausibility error in the engine speed monitoring, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 1E6-12-ECU 5 volt sensor supply 1 out of range

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 provides three independent five volt sensor supplies. The ECU A-9000 monitors each sensor supply voltage to ensure they operate within a given range. If the ECU A-9000 determines that the voltage for sensor supply 1 is out of range, this fault will occur.

The ECU A-9000 pin numbers associated with sensor supply 1 are A07, A08, A09, A10, A11, A12, and A13.

Cause:
The ECU A-9000 has determined that the sensor supply 1 voltage is out of range.

Possible failure modes:

1. Faulty battery voltage.
2. Faulty ECU A-9000 supply voltage.
3. Faulty ECU A-9000 sensor supply 1 pins.
4. Faulty ECU A-9000 connector **X-9121**, corrosion or damage.
5. Faulty Throttle Valve Actuator (TVA) Z-9001, position sensor wiring or internal failure.
6. Faulty Exhaust Gas Recirculation (EGR) valve Z-9000, position sensor wiring or internal failure.
7. Faulty intake manifold pressure and temperature sensor B-9001, wiring or internal failure.
8. Faulty rail pressure sensor B-9004, wiring or internal failure.
9. Faulty exhaust manifold pressure sensor B-9005, wiring to internal failure.
10. Faulty camshaft speed sensor B-9017, wiring or internal failure.
11. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **11**.
2. Check the battery voltage.

   Charge the battery, then, perform a load test on the battery.

   A. If the battery passes the load test, continue to Step **3**.

   B. If the battery fails the load test, the battery has failed. Replace the battery.
3. Disconnect the ECU A-9000 connector **X-9001**.

   Check the following pins listed below on the ECU A-9000 and in connector **X-9001**.

Pin	Physical condition
X-9001 pin A07	The pin and connector should be free of corrosion or damage.
X-9001 pin A08	The pin and connector should be free of corrosion or damage.

Pin	Physical condition
X-9001 pin A09	The pin and connector should be free of corrosion or damage.
X-9001 pin A10	The pin and connector should be free of corrosion or damage.
X-9001 pin A11	The pin and connector should be free of corrosion or damage.
X-9001 pin A12	The pin and connector should be free of corrosion or damage.
X-9001 pin A13	The pin and connector should be free of corrosion or damage.

A. If a pin or connector shows signs of corrosion or damage, repair as necessary.

B. If a pin or connector shows no signs of corrosion or damage, re-connect the ECU A-9000 at connector **X-9001** and continue to Step **4**.

4. Check the ECU A-9000 supply voltage.

   Disconnect the ECU A-9000 connector **X-9102**.

   Place a jumper wire between **X-9102 pin K28** and chassis ground. This will energize the main relay K-9102.

   With the key in the ON position, use a multimeter to perform the following voltage check on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K03	**X-9102 pin K02**	There should be approximately **12 V**.
X-9102 pin K05	**X-9102 pin K04**	There should be approximately **12 V**.
X-9102 pin K01	**X-9102 pin K06**	There should be approximately **12 V**.

   A. If there is approximately **12 V**, remove the jumper wire and re-connect the ECU A-9000 at connector **X-9102**, then continue to Step **5**.

   B. If there is not approximately **12 V**, there is a failure in the ECU A-9000 supply wiring. Use the appropriate service manual, if necessary, to locate and repair the failed conductor.

5. Disconnect each of the following connectors one at a time. Monitor the status of this fault, **DTC 1E6-NPL - ECU internal failure - Sensor 5 volt supply 1** during the check.

   The TVA Z-9001 connector **X-9011** .

   The intake manifold pressure and temperature sensor B-9001 connector **X-9003**.

   The rail pressure sensor B-9004 connector **X-9026**.

   The camshaft speed sensor B-9017 connector **X-9008**.

   A. If the fault is no longer active after a component disconnection, the relevant component has failed. Replace the component.

   B. If the fault is still active after the component disconnections, leave all of the connectors disconnected and continue to Step **6**.

6. Check the TVA Z-9001 voltage supply wiring.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connectors **X-9102** and **X-9001**.

   With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9011 pin 1	Chassis ground	There should be no voltage.

With the key in the OFF position, use a multimeter to perform the following continuity checks on the engine harness (EN) side :

From	To	Value
X-9011 pin 1	Chassis ground	There should be no continuity.
X-9011 pin 1	**X-9011 pin 3**	There should be no continuity.
X-9011 pin 1	**X-9011 pin 2**	There should be no continuity.
X-9011 pin 1	**X-9011 pin 6**	There should be no continuity.

With the key in the OFF position, use a multimeter to perform the following continuity checks on the vehicle harness (VE) side :

From	To	Value
X-9001 pin A08	All pins in connector **X-9001**.	There should be no continuity.

A. If the specified values are measured, leave the ECU A-9000 connectors **X-9102** and **X-9001** disconnected. Then, continue to Step **7**.

B. If the specified values are not measured, there is a failure in the TVA Z-9001 voltage supply wiring. Use the appropriate service manual, if necessary, to locate and repair the failed conductor.

7. Check the intake manifold pressure and temperature sensor B-9001 voltage supply wiring.

With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9003 pin 3	Chassis ground	There should be no voltage.

With the key in the OFF position, use a multimeter to perform the following continuity checks on the engine harness (EN) side :

From	To	Value
X-9003 pin 3	Chassis ground	There should be no continuity.
X-9003 pin 3	**X-9003 pin 1**	There should be no continuity.

With the key in the OFF position, use a multimeter to perform the following continuity checks on the vehicle harness (VE) side :

From	To	Value
X-9001 pin A10	All pins in connector **X-9001**.	There should be no continuity.

A. If the specified values are measured, leave the ECU A-9000 connectors **X-9102** and **X-9001** disconnected. Then, continue to Step **8**.

B. If the specified values are not measured, there is a failure in the intake manifold pressure and temperature sensor B-9001 voltage supply wiring. Use the appropriate service manual, if necessary, to locate and repair the failed conductor.

8. Check the rail pressure sensor B-9004 voltage supply wiring.

With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9026 pin 3	Chassis ground	There should be no voltage.

With the key in the OFF position, use a multimeter to perform the following continuity checks on the engine harness (EN) side :

From	To	Value
X-9026 pin 3	Chassis ground	There should be no continuity.
X-9026 pin 3	**X-9026 pin 1**	There should be no continuity.

With the key in the OFF position, use a multimeter to perform the following continuity checks on the vehicle harness (VE) side :

From	To	Value
X-9001 pin A11	All pins in connector **X-9001**.	There should be no continuity.

A. If the specified values are measured, leave the ECU A-9000 connectors **X-9102** and **X-9001** disconnected. Then, continue to Step **9**.

B. If the specified values are not measured, there is a failure in the rail pressure sensor B-9004 voltage supply wiring. Use the appropriate service manual, if necessary, to locate and repair the failed conductor.

9. Check the camshaft speed sensor B-9017 voltage supply wiring.

With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9008 pin 3	Chassis ground	There should be no voltage.

With the key in the OFF position, use a multimeter to perform the following continuity checks on the engine harness (EN) side :

From	To	Value
X-9008 pin 3	Chassis ground	There should be no continuity.
X-9008 pin 1	**X-9008 pin 3**	There should be no continuity.

With the key in the OFF position, use a multimeter to perform the following continuity checks on the vehicle harness (VE) side :

From	To	Value
X-9001 pin A13	All pins in connector **X-9001**.	There should be no continuity.

A. If the specified values are measured, re-connect all of the connectors and continue to Step **10**.

B. If the specified values are not measured, there is a failure in the camshaft speed sensor B-9017 voltage supply wiring. Use the appropriate service manual, if necessary, to locate and repair the failed conductor.

10. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

A. If the fault has been resolved, return the machine to service.

B. If the fault has not been resolved, escalate an ASIST concern.

11. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

A. If you find damage or the display indicates other than normal display readings, Then, repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

B. If you do not find damage and the display indicates only normal readings, Then, erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)
Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 1E7-03-ECU 5 volt sensor supply 2 out of range

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 provides three independent five volt sensor supplies. The ECU A-9000 monitors each sensor supply voltage to ensure they operate within a given range. If the ECU A-9000 determines that the voltage for sensor supply 2 is out of range, this fault will occur.

The ECU A-9000 pin numbers associated with sensor supply 2 are K12, K13, K14, K15, and K16.

Cause:
The ECU A-9000 has determined that the sensor supply 2 voltage is out of range.

Possible failure modes:

1. Faulty battery voltage.
2. Faulty ECU A-9000 supply voltage.
3. Faulty ECU A-9000 sensor supply 2 pins.
4. Faulty ECU A-9000 connector **X-9102**, corrosion or damage.
5. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.
2. Check the battery voltage.

   Charge the battery, then, perform a load test on the battery.

   A. If the battery passes the load test, continue to Step **3**.

   B. If the battery fails the load test, the battery has failed. Replace the battery.
3. Check the ECU A-9000 supply voltage.

   Disconnect the ECU A-9000 connector **X-9102**.

   Place a jumper wire between **X-9102 pin K28** and chassis ground. This will energize the main relay K-9102.

   With the key in the ON position, use a multimeter to perform the following voltage check on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K03	**X-9102 pin K02**	There should be approximately **12 V**.
X-9102 pin K05	**X-9102 pin K04**	There should be approximately **12 V**.
X-9102 pin K01	**X-9102 pin K06**	There should be approximately **12 V**.

   A. If there is approximately **12 V**, leave the ECU A-9000 connector **X-9102** disconnected and continue to Step **4**.

   B. If there is not approximately **12 V**, there is a failure in the ECU A-9000 supply wiring. Use the appropriate service manual, if necessary, to locate and repair the failed conductor.

4. Check the following pins listed below on the ECU A-9000 and in connector **X-9102**.

Pin	Physical condition
X-9102 pin K12	The pin and connector should be free of corrosion or damage.
X-9102 pin K13	The pin and connector should be free of corrosion or damage.
X-9102 pin K14	The pin and connector should be free of corrosion or damage.
X-9102 pin K15	The pin and connector should be free of corrosion or damage.
X-9102 pin K16	The pin and connector should be free of corrosion or damage.

   A. If a pin or connector shows signs of corrosion or damage, repair as necessary.

   B. If a pin or connector shows no signs of corrosion or damage, continue to Step **5**.

5. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 1E8-03-ECU 5 volt sensor supply 3 out of range

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 provides three independent five volt sensor supplies. The ECU A-9000 monitors each sensor supply voltage to ensure they operate within a given range. If the ECU A-9000 determines that the voltage for sensor supply 3 is out of range, this fault will occur.

The ECU A-9000 pin numbers associated with sensor supply 3 are K17, K18 and A29.

Cause:
The ECU A-9000 has determined that the sensor supply 3 voltage is out of range.

Possible failure modes:

1. Faulty battery voltage.
2. Faulty ECU A-9000, supply voltage.
3. Faulty ECU A-9000 sensor supply 3 pins.
4. Faulty ECU A-9000 connector **X-9001** or **X-9102**, corrosion or damage.
5. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.
2. Check the battery voltage.

   Charge the battery, then, perform a load test on the battery.

   A. If the battery passes the load test, continue to Step **3**.

   B. If the battery fails the load test, the battery has failed. Replace the battery.
3. Check the ECU A-9000 supply voltage.

   Disconnect the ECU A-9000 connector **X-9102**.

   Place a jumper wire between **X-9102 pin K28** and chassis ground. This will energize the main relay K-9102.

   With the key in the ON position, use a multimeter to perform the following voltage check on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K03	**X-9102 pin K02**	There should be approximately **12 V**.
X-9102 pin K05	**X-9102 pin K04**	There should be approximately **12 V**.
X-9102 pin K01	**X-9102 pin K06**	There should be approximately **12 V**.

   A. If there is approximately **12 V**, leave the ECU A-9000 connector **X-9102** disconnected and continue to Step **4**.

   B. If there is not approximately **12 V**, there is a failure in the ECU A-9000 supply wiring. Use the appropriate service manual, if necessary, to locate and repair the failed conductor.

4. Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   Check the following pins listed below on the ECU A-9000 and in connectors **X-9001** and **X-9102**.

Pin	Physical condition
X-9102 pin K17	The pin and connector should be free of corrosion or damage.
X-9102 pin K18	The pin and connector should be free of corrosion or damage.
X-9001 pin A29	The pin and connector should be free of corrosion or damage.

   A. If a pin or connector shows signs of corrosion or damage, repair as necessary.

   B. If a pin or connector shows no signs of corrosion or damage, continue to Step **5**.

5. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, Then, repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, Then, erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)
Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 1EB-03-ECU internal failure - Ambient pressure sensor voltage is higher than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors atmospheric pressure. The ECU A-9000 performs a signal range check of the atmospheric pressure sensor value. If the ECU A-9000 determines that the value is too high, this fault will occur. The atmospheric pressure sensor is internal to the ECU A-9000.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 1EB-04-ECU internal failure - Ambient pressure sensor voltage is lower than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors atmospheric pressure. The ECU A-9000 performs a signal range check of the atmospheric pressure sensor value. If the ECU A-9000 determines that the value is too low, this fault will occur. The atmospheric pressure sensor is internal to the ECU A-9000.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 1F7-00-PMCat inlet temperature sensor physical range check high

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the Particulate Matter (PM) catalytic converter inlet temperature sensor B-9127. If the ECU A-9000 detects a temperature greater than **1000 °C** (**1832 °F**) from the PM catalytic converter inlet temperature sensor B-9127, this fault will occur. If this fault is active, the last valid temperature value will be frozen for a preliminary failure or set to a fixed replacement value of **99.96 °C** (**211.93 °F**) if the failure is validated. Other active faults may have caused this fault to occur.

Cause:
The ECU A-9000 has detected a temperature too high from the PM catalytic converter inlet temperature sensor B-9127.

Possible failure modes:

1. Faulty PM catalytic converter inlet temperature sensor B-9127.
2. Faulty PM catalytic converter inlet temperature sensor B-9127, wiring harness.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.

2. Check the PM catalytic converter inlet temperature sensor B-9127 for an internal failure.

   Disconnect the vehicle harness from the PM catalytic converter inlet temperature sensor B-9127 at connector **X-9127**.

   Use a multimeter to measure the resistance on the PM catalytic converter inlet temperature sensor B-9127 :

From	To	Value
X-9127 pin 1	**X-9127 pin 2**	There should be between **170.2 - 849.7 Ω**.

   A. If there is between **170.2 - 849.7 Ω**, leave connector **X-9127** disconnected and continue to Step **3**.

   B. If there is between **170.2 - 849.7 Ω**, the PM catalytic converter inlet temperature sensor B-9127 has failed. Replace the PM catalytic converter inlet temperature sensor B-9127.

3. Check the PM catalytic converter inlet temperature sensor B-9127 vehicle harness (VE) wiring for a short circuit to battery.

   With the key in the OFF position, use a multimeter to perform the following voltage check on the vehicle harness side :

From	To	Value
X-9127 pin 1	Chassis ground	There should be no voltage.

   With the key in the ON position, use a multimeter to perform the following voltage check on the vehicle harness side :

From	To	Value
X-9127 pin 1	Chassis ground	There should be less than **5.5 V**

A. If the specified values are not measured, there is a short to battery in the PM catalytic converter inlet temperature sensor B-9127 wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If the specified values are measured, leave connector **X-9127** disconnected and continue to Step **4**.

4. Check the PM catalytic converter inlet temperature sensor B-9127 vehicle harness (VE) wiring for an open circuit condition.

   Disconnect the vehicle harness from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9127 pin 2	**X-9102 pin K83**	There should be continuity.
X-9127 pin 1	**X-9102 pin K84**	There should be continuity.

A. If there is no continuity, there is an open circuit in the PM catalytic converter inlet temperature sensor B-9127 vehicle harness (VE) wiring. Use the appropriate service manual, if necessary, to locate and repair the broken conductor.

B. If there is continuity, leave connectors **X-9102** and **X-9127** disconnected and continue to Step **5**.

5. Check the PM catalytic converter inlet temperature sensor B-9127 vehicle harness (VE) wiring for a short circuit condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K83	All pins in connector **X-9102**	There should be no continuity.
X-9102 pin K84	All pins in connector **X-9102**	There should be no continuity.
X-9127 pin 2	**X-9127 pin 1**	There should be no continuity.
X-9127 pin 1	Chassis ground	There should be no continuity.

A. If there is continuity, there is a short circuit in the PM catalytic converter inlet temperature sensor B-9127 vehicle harness (VE) wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 1F7-03-PMCat inlet temperature sensor voltage is higher than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the Particulate Matter (PM) catalytic converter inlet temperature sensor B-9127. If the ECU A-9000 detects a voltage greater than **3.59 V** in the PM catalytic converter inlet temperature sensor B-9127 signal circuit, this fault will occur. If this fault is active, the last valid temperature value will be frozen for a preliminary failure or set to a fixed replacement value of **99.96 °C** (**211.93 °F**) if the failure is validated.

Cause:
The ECU A-9000 has detected a voltage greater than **3.59 V** in the PM catalytic converter inlet temperature sensor B-9127 signal circuit.

Possible failure modes:

1. Faulty PM catalytic converter inlet temperature sensor B-9127 wiring, short to a voltage source.
2. Faulty PM catalytic converter inlet temperature sensor B-9127, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.
2. Check the PM catalytic converter inlet temperature sensor B-9127 for an internal failure.

   Disconnect the vehicle harness from the PM catalytic converter inlet temperature sensor B-9127 at connector **X-9127**.

   Use a multimeter to measure the resistance on the PM catalytic converter inlet temperature sensor B-9127 :

From	To	Value
X-9127 pin 1	**X-9127 pin 2**	There should be between **170.2 - 849.7 Ω**.

   A. If there is between **170.2 - 849.7 Ω**, leave connector **X-9127** disconnected and continue to Step **3**.

   B. If there is between **170.2 - 849.7 Ω**, the PM catalytic converter inlet temperature sensor B-9127 has failed. Replace the PM catalytic converter inlet temperature sensor B-9127.
3. Check the PM catalytic converter inlet temperature sensor B-9127 vehicle harness (VE) wiring for a short circuit to battery.

   With the key in the OFF position, use a multimeter to perform the following voltage check on the vehicle harness side :

From	To	Value
X-9127 pin 2	Chassis ground	There should be no voltage.

   With the key in the ON position, use a multimeter to perform the following voltage check on the vehicle harness side :

From	To	Value
X-9127 pin 2	Chassis ground	There should be less than **5.5 V**

A. If the specified values are not measured, there is a short to battery in the PM catalytic converter inlet temperature sensor B-9127 wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If the specified values are measured, leave connector **X-9127** disconnected and continue to Step **4**.

4. Check the PM catalytic converter inlet temperature sensor B-9127 vehicle harness (VE) wiring for an open circuit condition.

   Disconnect the vehicle harness from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9127 pin 2	**X-9102 pin K83**	There should be continuity.
X-9127 pin 1	**X-9102 pin K84**	There should be continuity.

   A. If there is no continuity, there is an open circuit in the PM catalytic converter inlet temperature sensor B-9127 vehicle harness (VE) wiring. Use the appropriate service manual, if necessary, to locate and repair the broken conductor.

   B. If there is continuity, leave connectors **X-9102** and **X-9127** disconnected and continue to Step **5**.

5. Check the PM catalytic converter inlet temperature sensor B-9127 vehicle harness (VE) wiring for a short circuit condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K83	All pins in connector **X-9102**	There should be no continuity.
X-9102 pin K84	All pins in connector **X-9102**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the PM catalytic converter inlet temperature sensor B-9127 vehicle harness (VE) wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 1F7-04-PMCat inlet temperature sensor voltage is lower than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the Particulate Matter (PM) catalytic converter inlet temperature sensor B-9127. If the ECU A-9000 detects a voltage less than **459.40 mV** in the PM catalytic converter inlet temperature sensor B-9127 signal circuit, this fault will occur. If this fault is active, the last valid temperature value will be frozen for a preliminary failure or set to a fixed replacement value of **99.96 °C** (**211.93 °F**) if the failure is validated.

Cause:
The ECU A-9000 has detected a voltage less than **459.40 mV** in the PM catalytic converter inlet temperature sensor B-9127 signal circuit.

Possible failure modes:

1. Faulty PM catalytic converter inlet temperature sensor B-9127 wiring, short to ground condition.
2. Faulty PM catalytic converter inlet temperature sensor B-9127, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.

2. Check the PM catalytic converter inlet temperature sensor B-9127 for an internal failure.

   Disconnect the vehicle harness from the PM catalytic converter inlet temperature sensor B-9127 at connector **X-9127**.

   Use a multimeter to measure the resistance on the PM catalytic converter inlet temperature sensor B-9127 pins :

From	To	Value
X-9127 pin 1	**X-9127 pin 2**	There should be between **170.2 - 849.7 Ω**.

   A. If there is between **170.2 - 849.7 Ω**, leave connector **X-9127 pin 2** disconnected and continue to Step **3**.

   B. If there is between **170.2 - 849.7 Ω**, the PM catalytic converter inlet temperature sensor B-9127 has failed. Replace the PM catalytic converter inlet temperature sensor B-9127.

3. Check the PM catalytic converter inlet temperature sensor B-9127 vehicle harness (VE) wiring for a short circuit condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check on vehicle harness (VE) side :

From	To	Value
X-9127 pin 2	**X-9127 pin 1**	There should be no continuity.
X-9127 pin 2	Chassis ground	There should be no continuity.

   A. If there is continuity, there is a short circuit in the PM catalytic converter inlet temperature sensor B-9127 vehicle harness (VE) wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no continuity, leave the connectors disconnected and continue to Step **4**.

4. Check the PM catalytic converter inlet temperature sensor B-9127 vehicle harness (VE) wiring for a short circuit condition.

   Disconnect the vehicle harness from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity check at the vehicle harness (VE) side of the connectors from :

From	To	Value
X-9102 pin K84	All pins in connector **X-9102**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the PM catalytic converter inlet temperature sensor B-9127 vehicle harness (VE) wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 225-03-Main relay stuck error

Control Module : ECU

Context:
The Engine Control Unit A-9000 controls the main relay K-9102. The main relay K-9102 is powered on by the ECU A-9000 to achieve after-run. The main relay K-9102 is powered off once after-run is completed. If the ECU A-9000 determines that the main relay K-9102 is “stuck” or will not shut off as commanded, this fault will occur.

Cause:
The ECU A-9000 has determined that the main relay K-9102 will not shut off as commanded.

Possible failure modes:

1. Faulty main relay K-9102, wiring.
2. Faulty main relay K-9102, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **7**.

2. Check the main relay K-9102 coil for an internal failure.

   Remove the main relay K-9102.

   Use a multimeter to measure the resistance on the main relay K-9102 pins :

From	To	Value
X-9129 pin 85	**X-9129 pin 86**	There should be approximately **70 - 130 Ω**.

   A. If there is approximately **70 - 130 Ω**, leave the main relay K-9102 disconnected and continue to Step **3**.

   B. If there is not approximately **70 - 130 Ω**, the main relay K-9102 has failed. Replace the main relay K-9102.

3. Check the main relay K-9102 low side driver wiring for a short to ground.

   With the key in the OFF position, use a multimeter to perform the following continuity check for a short to ground on the vehicle harness (VE) side :

From	To	Value
X-9129 pin 86	Chassis ground	There should be no continuity.

   A. If there is continuity, there is a short circuit in the main relay K-9102 wiring in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, leave the main relay K-9102 disconnected and continue to Step **4**.

4. Check the main relay K-9102 low side driver wiring for a short circuit.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity checks for a short circuit on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K28	All pins in connector **X-9102**	There should be no continuity.

A. If there is continuity, there is a short circuit in the main relay K-9102 wiring in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no continuity, leave the main relay K-9102 and connector **X-9102** disconnected, then continue to Step **5**.

5. Check the ECU A-9000 voltage supply wiring for a short to a voltage source.

   With the key in the OFF position, use a multimeter to perform the following voltage checks for a short to a voltage source on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K01	Chassis ground	There should be no voltage.
X-9102 pin K03	Chassis ground	There should be no voltage.
X-9102 pin K05	Chassis ground	There should be no voltage.

A. If there is voltage, there is a short to a voltage source in the ECU A-9000 voltage supply wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no voltage, leave the main relay K-9102 and connector **X-9102** disconnected, then continue to Step **6**.

6. Check the ECU A-9000 voltage supply wiring for a short to a voltage source.

   Re-connect the main relay K-9102.

   With the key in the OFF position, use a multimeter to perform the following voltage checks for a short to a voltage source on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K01	Chassis ground	There should be no voltage.
X-9102 pin K03	Chassis ground	There should be no voltage.
X-9102 pin K05	Chassis ground	There should be no voltage.

A. If there is voltage, the main relay K-9102 has failed. Replace the main relay K-9102.

B. If there is no voltage, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

7. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 225-03-Main relay stuck error

Control Module : ECU

Context:
The Engine Control Unit A-9000 controls the main relay K-9102. The main relay K-9102 is powered on by the ECU A-9000 to achieve after-run. The main relay K-9102 is powered off once after-run is completed. If the ECU A-9000 determines that the main relay K-9102 has shut off before commanded, this fault will occur.

Cause:
The ECU A-9000 has determined that the main relay K-9102 has shut off before commanded to shut off.

Possible failure modes:

1. Faulty main relay K-9102, wiring.
2. Faulty main relay K-9102, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **9**.

2. Check the main relay K-9102 coil for an internal failure.

   Remove the main relay K-9102.

   Use a multimeter to measure the resistance on the main relay K-9102 pins :

From	To	Value
X-9129 pin 85	**X-9129 pin 86**	There should be approximately **70 - 130 Ω**.

   A. If there is approximately **70 - 130 Ω**, leave the main relay K-9102 disconnected and continue to Step **3**.

   B. If there is not approximately **70 - 130 Ω**, the main relay K-9102 has failed. Replace the main relay K-9102.

3. Check the main relay K-9102 vehicle harness (VE) wiring for a short to a voltage source.

   With the key in the OFF position, use a multimeter to perform the following voltage check for a short to a voltage source on the vehicle harness (VE) side :

From	To	Value
X-9129 pin 85	Chassis ground	There should be no voltage.
NOTE: *Wiggle the harness during the check to promote an intermittent electrical connection.*		

   With the key in the ON position, use a multimeter to perform the following voltage check for a short to a voltage source on the vehicle harness (VE) side :

From	To	Value
X-9129 pin 85	Chassis ground	There should be no voltage.
NOTE: *Wiggle the harness during the check to promote an intermittent electrical connection.*		

   A. If there is voltage, there is a short to a voltage source in the main relay K-9102 wiring in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no voltage, leave the main relay K-9102 disconnected and continue to Step **4**.

4. Check the main relay K-9102 vehicle harness (VE) wiring for a short to ground.

   With the key in the OFF position, use a multimeter to perform the following continuity check for a short to ground on the vehicle harness (VE) side :

From	To	Value
X-9129 pin 85	Chassis ground	There should be no continuity.
NOTE: *Wiggle the harness during the check to promote an intermittent electrical connection.*		

   A. If there is continuity, there is a short to ground in the main relay K-9102 wiring in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the broken or damaged conductor.

   B. If there is no continuity, leave the main relay K-9102 disconnected and continue to Step **5**.

5. Check the main relay K-9102 vehicle harness (VE) wiring for an open circuit.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity check for an open circuit on the vehicle harness (VE) side :

From	To	Value
X-9129 pin 85	**X-9102 pin K28**	There should be continuity.
NOTE: *Wiggle the harness during the check to promote an intermittent electrical connection.*		

   A. If there is no continuity, there is an open circuit in the main relay K-9102 wiring in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the broken or damaged conductor.

   B. If there is continuity, leave the main relay K-9102 and connector **X-9102** disconnected, then continue to Step **6**.

6. Check the main relay K-9102 wiring for a short circuit condition.

   With the key in the OFF position, use a multimeter to perform the following continuity checks for a short circuit on the vehicle harness (VE) side :

From	To	Value
X-9129 pin 85	**X-9129 pin 86**	There should be no continuity.
X-9102 pin K28	All pins in connector **X-9102**	There should be no continuity.
NOTE: *Wiggle the harness during the check to promote an intermittent electrical connection.*		

   A. If there is continuity, there is a short circuit in the main relay K-9102 vehicle harness (VE) wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, leave the main relay K-9102 and connector **X-9102** disconnected, then continue to Step **7**.

7. Check the main relay K-9102 load-side wiring.

   With the key in the ON position, use a multimeter to perform the following voltage checks on the vehicle harness (VE) side :

From	To	Value
X-9129 pin 86	Chassis ground	There should be approximately **12.0 V**.
X-9129 pin 30	Chassis ground	There should be approximately **12.0 V**.
NOTE: *Wiggle the harness during the check to promote an intermittent electrical connection.*		

   A. If there is not approximately **12.0 V**, there is a failure in the main relay K-9102 load-side wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is approximately **12.0 V**, leave the main relay K-9102 and connector **X-9102** disconnected, then continue to Step **8**.

8. Check the main relay K-9102 load-side wiring.

   With the key in the OFF position, use a multimeter to perform the following continuity checks on the vehicle harness (VE) side :

From	To	Value
X-9129 pin 87	**X-9102 pin K01**	There should be continuity.
X-9129 pin 87	**X-9102 pin K03**	There should be continuity.
X-9129 pin 87	**X-9102 pin K05**	There should be continuity.
NOTE: *Wiggle the harness during the check to promote an intermittent electrical connection.*		

   A. If there is no continuity, there is an open circuit in the main relay K-9102 load-side wiring or fuse. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor or open fuse.

   B. If there is continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

9. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 226-03-Battery voltage is higher than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the battery voltage. If the ECU A-9000 detects a voltage higher than expected, this fault will occur.

Cause:
The ECU A-9000 has detected a battery voltage of greater than **28.8 V**.

Possible failure modes:

1. Faulty alternator, failed regulator.
2. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **3**.

2. Start the engine and raise the Revolutions Per Minute (RPM) to approximately **1500 RPM** for **1.00 min**. Lower the RPM to idle speed and check the battery voltage with the engine running.

   With the engine running, use a multimeter to perform the following voltage check on the battery posts :

From	To	Value
Battery +	Battery -	**14.8 - 16.2 V**

   A. If the voltage is high, out of range (normal engine running operating range is approximately **14.8 - 16.2 V**, the alternator has failed. Replace the alternator.

   B. If the voltage is within range (normal engine running operating range is approximately **14.8 - 16.2 V**, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

3. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

DTC 226-04-Battery voltage is lower than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the battery voltage. If the ECU A-9000 detects a voltage lower than expected, this fault will occur.

Cause:
The ECU A-9000 has detected a battery voltage of less than **8.3 V**.

Possible failure modes:

1. Faulty battery.
2. Faulty alternator, failed regulator.
3. Engine started in extreme cold conditions.
4. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.

2. Charge the battery and perform a battery load test.

   A. If the pass battery does not pass the load test, replace the battery.

   B. If the battery passes the load test, continue to Step **3**.

3. Start the engine and raise the Revolutions Per Minute (RPM) to about **1500 RPM** for **1.00 min**. Lower the RPM to idle speed and check the battery voltage with the engine running.

   With the engine running, use a multimeter to perform the following voltage check on the battery posts :

From	To	Value
Battery +	Battery -	**14.8 - 16.2 V**

   A. If the voltage is low, out of range (normal engine running operating range is approximately **14.8 - 16.2 V**, the alternator has failed. Replace the alternator.

   B. If the voltage is within range (normal engine running operating range is approximately **14.8 - 16.2 V**, continue to Step **4**.

4. Check the ECU A-9000 voltage supply wiring.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   Place a jumper wire between **X-9102 pin K28** and chassis ground. This will energize the main relay K-9102.

   With the key in the ON position, use a multimeter to perform the following voltage check on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K01	Chassis ground	There should be approximately **12 V**.
X-9102 pin K03	Chassis ground	There should be approximately **12 V**.
X-9102 pin K05	Chassis ground	There should be approximately **12 V**.

A. If there is less than approximately **12 V**, continue to Step **5**.

B. If there is approximately **12 V**, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Check the ECU A-9000 voltage supply wiring for a short circuit to ground.

   With the key in the ON position, use a multimeter to perform the following voltage check on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K01	Chassis ground	There should be no continuity.
X-9102 pin K03	Chassis ground	There should be no continuity.
X-9102 pin K05	Chassis ground	There should be no continuity.

   A. If there is continuity, there is a short circuit to ground condition in the ECU A-9000 voltage supply wiring. Use the appropriate service manual to locate and repair the shorted conductor.

   B. If there is no continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 236-03-Rail pressure sensor value is above maximum offset

Control Module : ECU

NOTE: *If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)****, if necessary.*

DTC 236-03-Rail pressure sensor value is above maximum offset

Control Module : ECU

NOTE: *If the Pressure Relief Valve (PRV) is replaced, it is necessary to perform the Replacement of the Rail Pressure Relief Valve (PRV) - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail Relief valve - Configure - Reset ECU data (10.218)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel Pressure Relief Valve (PRV). If the ECU A-9000 determines that the PRV has been open for too long, this fault will occur. The PRV opening duration is monitored by the ECU A-9000 and stored in the EEPROM during after run. This fault is for informational purposes only. If this fault is active, other fuel system faults may be active that caused this fault to occur. Diagnose any faults that may have caused this one to occur first, and then return to this fault, **DTC 237-Max - Open time of PRV for wear out monitoring had exceeded maximum value**. For more information regarding fuel system troubleshooting, see **Fuel injection system - Troubleshooting (10.218)**.

Cause:
The ECU A-9000 has determined that the PRV has reached its maximum allowed open time.

Possible failure modes:

1. Faulty PRV, stuck open or worn.
2. Faulty fuel back-flow, clogged or damaged.
3. Faulty fuel metering unit Y-9000, internal failure.
4. Faulty rail pressure sensor B-9004, internal failure.
5. Faulty ECU A-9000, software.

DTC 236-04-Rail pressure sensor value is below minimum offset

Control Module : ECU

NOTE: *If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)****, if necessary.*

DTC 237-04-Fuel pressure relief valve is forced to open, perform pressure shock

Control Module : ECU

Context:
This fault is intended for information purposes only. Other active faults may have caused this fault to occur. The Engine Control Unit (ECU) A-9000, if necessary, will set the engine into limp home mode. This process is achieved in two steps by the ECU A-9000, a pressure increase and a pressure shock. The ECU A-9000 will execute step two by a fuel pressure shock. This is achieved by setting injection quantity to zero. If this fault is active, the ECU A-9000 has performed step two for achieving limp home mode, a fuel pressure shock.

Cause:
The ECU A-9000 has performed a fuel pressure shock to achieve limp home mode.

DTC 237-04-Fuel pressure relief valve is forced to open, perform pressure shock

Control Module : ECU

Context:
This fault is intended for information purposes only. Other active faults may have caused this fault to occur. The Engine Control Unit (ECU) A-9000, if necessary, will set the engine into limp home mode. This process is achieved in two steps by the ECU A-9000, a pressure increase and a pressure shock. The ECU A-9000 will execute step two by a fuel pressure shock. This is achieved by setting injection quantity to zero. If this fault is active, the ECU A-9000 has performed step two for achieving limp home mode, a fuel pressure shock.

Cause:
The ECU A-9000 has performed a fuel pressure shock to achieve limp home mode.

DTC 237-12-Quantity balance check if a successful PRV opening is ensured

Control Module : ECU

Context:
This fault is intended for information purposes only. Other active faults may have caused this fault to occur. The Engine Control Unit (ECU) A-9000, monitors the fuel Pressure Relief Valve (PRV). To determine mechanical wear-out of the PRV, the ECU A-9000 will perform a fuel pressure increase and pressure shock, thus opening the PRV. Both steps are recorded in the ECU A-9000 failure memory.

DTC 237-12-Quantity balance check if a successful PRV opening is ensured

Control Module : ECU

Context:
This fault is intended for information purposes only. Other active faults may have caused this fault to occur. The Engine Control Unit (ECU) A-9000, monitors the fuel Pressure Relief Valve (PRV). To determine mechanical wear-out of the PRV, the ECU A-9000 will perform a fuel pressure increase and pressure shock, thus opening the PRV. Both steps are recorded in the ECU A-9000 failure memory.

DTC 238-03-Oil pressure switch active with engine off

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the oil pressure switch S-9016 for proper operation. The oil pressure switch S-9016 changes from its off to on state between **0.6 - 0.9 bar** (**8.7 - 13.0 psi**). If the oil pressure switch S-9016 does not return to its off state, once the engine is switched OFF, this fault will occur.

Cause:
The ECU A-9000 has sensed that the oil pressure switch S-9016 did not return to its off state.

Possible failure modes:

1. Faulty oil pressure switch S-9016, failed internally.
2. Faulty oil pressure switch S-9016 circuit wiring, open circuit.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.
2. Check the condition of the oil pressure switch S-9016.

   Disconnect the engine harness (EN) from the oil pressure switch S-9016 at connector **X-9016**.

   Use a multimeter to check for continuity on the component side :

From	To	Value
X-9016 pin 1	chassis ground	There should be continuity.

   A. If there is continuity, leave connector **X-9016** disconnected and continue with Step **3**.

   B. If there is no continuity, the oil pressure switch S-9016 has failed internally, replace the oil pressure switch S-9016.
3. Check the oil pressure switch S-9016 circuit for an open circuit condition.

   Carefully disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   Place a jumper wire between connector **X-9001 pin A06** and chassis ground.

   Use a multimeter to check for continuity on the engine harness (EN) side :

From	To	Value
X-9016 pin 1	chassis ground	There should be continuity.

   A. If there is no continuity, there is an open circuit in the oil pressure switch S-9016 circuit. Locate and repair the broken conductor.

   B. If there is continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.
4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires.
   Verify that the connectors are fully installed.
   Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned.

Operate the machine while you monitor the display.

A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 238-04-Low oil pressure

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the oil pressure switch S-9016 for proper operation. The oil pressure switch S-9016 changes from its off to on state between **0.6 - 0.9 bar** (**8.7 - 13.0 psi**). If the oil pressure switch S-9016 does actuate once the engine has been running for **6.0 s** at greater than **500.0 RPM**, this fault will occur.

Cause:
The ECU A-9000 has determined that the oil pressure switch S-9016 did not actuate.

Possible failure modes:

1. Faulty oil level, too low.
2. Faulty oil pressure switch S-9016, failed internally.
3. Faulty oil pressure switch S-9016 circuit wiring, shorted to chassis ground.
4. Faulty oil pressure, too low or blockage.
5. Faulty ECU A-9000, hardware or software.

Solution:

1. Verify that the fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **7**.

2. Check oil level.

   Use the appropriate operator or service manual, if necessary, to determine if the lubrication system has the appropriate amount of oil.

   There should be at least the minimum acceptable level of oil.

   A. If there is at least the minimum acceptable level of oil, continue with Step **3**.

   B. If there less than the minimum acceptable level of oil, use the appropriate operator or service manual, if necessary, to determine the type and quantity of oil required to re-fill the oil system.

3. Check the condition of the oil pressure switch S-9016.

   Disconnect the engine harness (EN) from the oil pressure switch S-9016 at connector **X-9016**.

   With the engine not running, use a multimeter to check for continuity on the component side :

From	To	Result
X-9016 pin 1	chassis ground	There should be continuity.

   Start the engine and allow it to run at greater than **500 RPM** for at least **6.0 s**.
   While the engine is running at greater than **500 RPM**, use a multimeter to check for continuity on the component side :

From	To	Result
X-9016 pin 1	chassis ground	There should be no continuity.

   A. If the specified values are measured, leave connector **X-9016** disconnected and continue with Step **4**.

B. If the oil pressure switch S-9016 did not change state, leave connector **X-9016** disconnected and continue with Step **6**.

4. Check the oil pressure switch S-9016 circuit for a short to ground condition.

   With the key switch in the OFF position, use a multimeter to check for continuity on the engine harness (EN) side :

From	To	Result
X-9016 pin 1	chassis ground	There should be no continuity.

   A. If there is continuity, leave connector **X-9016** disconnected and continue with Step **5**.

   B. If there is no continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Locate the short to ground condition.

   Carefully disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to check for continuity on the engine harness (EN) side :

From	To	Result
X-9001 pin A06	chassis ground	There should be no continuity.

   A. If there is continuity, the short to chassis ground condition is in the engine harness (EN) between connector **X-9001 pin A06** and connector **X-9016 pin 1**. Use the appropriate service manual, if necessary, to locate and repair the grounded conductor.

   B. If there is no continuity, the ECU A-9000 has failed internally, replace the ECU A-9000.

6. Check lubrication system for blockage.

   See **Engine lubrication system - Test (10.304)**, if necessary, to determine if the lubrication system has the appropriate amount of oil pressure.
   Between **0.6 - 0.9 bar** (**8.7 - 13.0 psi**) is required to actuate the oil pressure switch S-9016.

   There should be at least the minimum acceptable level of oil pressure.

   A. If there is adequate oil pressure, the oil pressure switch S-9016 has failed internally replace the switch.

   B. If there less than the minimum acceptable level of oil pressure, use the appropriate service manual, if necessary, to locate and restore oil pressure to the lubrication system.

7. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires.
   Verify that the connectors are fully installed.
   Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned.
   Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 256-03-Engine speed limitation via fuel injection cut off is active

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 will perform an injection cut-off to limit the engine speed to a controllable range, if needed. Implausible signals from certain parameters such as accelerator pedal signal, fuel injection parameters or engine speed can cause an injection cut-off. If torque or injection quantity are not plausible and engine speed is greater than **1200 RPM**, this fault will occur. Other active faults may have caused this fault to occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 259-03-Fuel metering unit is shorted to battery voltage at the low side

Control Module : ECU

Context:
The Engine Control Unit (ECU) monitors the fuel metering unit Y-9000 signal circuit. If the ECU A-9000 detects a short to a voltage source in the fuel metering unit Y-9000 low side driver circuit, this fault will occur.

Cause:
There is a short to a voltage source in the fuel metering unit Y-9000 low side driver circuit.

Possible failure modes:

1. Faulty fuel metering unit Y-9000 wiring, short to a voltage source.
2. Faulty fuel metering unit Y-9000, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.

2. Test the fuel metering unit Y-9000 internal resistance.

   Disconnect the engine harness (EN) from the fuel metering unit Y-9000 at connector **X-9007**.

   Use a multimeter to measure the resistance on the fuel metering unit Y-9000 pins :

From	To	Value
X-9007 pin 1	**X-9007 pin 2**	There should be between **2.6 - 3.2 Ω** at approximately **20.0 °C** (**68.0 °F**).

   A. If there is between **2.6 - 3.2 Ω**, leave connector **X-9007** disconnected and continue to Step **3**.

   B. If there is not between **2.6 - 3.2 Ω**, the fuel metering unit Y-9000 has failed. Replace the fuel metering unit Y-9000.

3. Check the fuel metering unit Y-9000 low side driver wiring for a short to battery condition.

   With the key in the OFF position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9007 pin 1	Chassis ground	There should be no voltage.

   With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9007 pin 1	Chassis ground	There should be no voltage.

   A. If there is voltage, there is a short circuit to battery or switched battery in the fuel metering unit Y-9000 low side driver circuit wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no voltage, leave connector **X-9007** disconnected and continue to Step **4**.

4. Check the fuel metering unit Y-9000 low side driver engine harness (EN) wiring for a short circuit condition.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check from the engine harness (EN) side :

From	To	Value
X-9001 pin A60	All pins in connector **X-9001 pin A60**	There should be no continuity.

   A. If there is continuity, there is a short circuit condition in the fuel metering unit Y-9000 low side driver engine harness (EN) wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 25A-03-Error in comparing energizing time to maximum value for injector in cylinder 1

Control Module : ECU

Context:
The Zero Fuel Calibration (ZFL) evaluates energizing time for injectors at low idle. The ZFL uses learned calibration values to change the energizing time of the pilot fuel injection. If the Engine Control Unit (ECU) A-9000 determines that there is an error during this process, this fault will occur.

Cause:
The ECU A-9000 has determined that there is an error in the ZFL process for fuel injector number 1 Y-9001.

Solution:

1. Verify that the correct IMA injector code has been programmed to injector number 1.

   A. If the correct IMA code is present, continue to Step **2**.

   B. If the correct IMA code has not been uploaded, program the correct IMA code.

   NOTE: *The IMA code may be under the paint on the fuel injector.*

   NOTE: *For more information regarding programming IMA codes, see* ***Fuel injectors - Configure - IMA codes (10.218)****.*
2. Replace the fuel injector number 1 Y-9001.

   Use the Electronic Service Tool (EST) to verify the status of this fault.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, continue to Step **3**.
3. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 25A-04-Error in comparing energizing time to minimum value for injector in cylinder 1

Control Module : ECU

Context:
The Zero Fuel Calibration (ZFL) evaluates energizing time for injectors at low idle. The ZFL uses learned calibration values to change the energizing time of the pilot fuel injection. If the Engine Control Unit (ECU) A-9000 determines that there is an error during this process, this fault will occur.

Cause:
The ECU A-9000 has determined that there is an error in the ZFL process for fuel injector number 1 Y-9001.

Solution:

1. Verify that the correct IMA injector code has been programmed to injector number 1.

   A. If the correct IMA code is present, continue to Step **2**.

   B. If the correct IMA code has not been uploaded, program the correct IMA code.

   NOTE: *The IMA code may be under the paint on the fuel injector.*

   NOTE: *For more information regarding programming IMA codes, see* ***Fuel injectors - Configure - IMA codes (10.218)****.*
2. Replace the fuel injector number 1 Y-9001.

   Use the Electronic Service Tool (EST) to verify the status of this fault.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, continue to Step **3**.
3. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 25D-03-PMCat Inducement most severe derating level

Control Module : ECU

Context:
The Engine Control Unit (ECU) monitors the Particulate Matter (PM) catalytic converter efficiency. If the ECU A-9000 detects an failure of efficiency, an inducement warning will be triggered and this fault will occur. Other active faults may have caused this fault to occur.

DTC 26F-04-The minimum rail pressure value necessary to allow fuel injection has not been reached

Control Module : ECU

NOTE: *If the Pressure Relief Valve (PRV) is replaced, it is necessary to perform the Replacement of the Rail Pressure Relief Valve (PRV) - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail Relief valve - Configure - Reset ECU data (10.218)****, if necessary.*

NOTE: *If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors fuel rail pressure. If the ECU A-9000 determines that fuel rail pressure is less than **130.0 bar** (**1885.0 psi**) or below a limit value from an ECU A-9000 calculated curve, this fault will occur. Other active faults may have caused this fault to occur. For more information regarding fuel system troubleshooting, see **Fuel injection system - Troubleshooting (10.218)**.

Cause:
The ECU A-9000 has determined that fuel rail pressure is too low to continue engine operation.

Possible failure modes:

1. Faulty fuel metering unit Y-9000, stuck closed or internal failure.
2. Faulty high pressure pump, low efficiency.
3. Faulty charge gear pump, low efficiency.
4. Faulty fuel filters, clogged.
5. Faulty fuel lines, leakage or blockage.
6. Faulty electric fuel pump (if equipped).
7. Faulty fuel injectors, internal leakage or stuck open.
8. Faulty Pressure Relief Valve (PRV), leakage.
9. Faulty rail pressure sensor B-9004 drifted signal or leaking.
10. Faulty ECU A-9000, software.

DTC 27F-12-Missing adjustment value programming for injector in cylinder 2

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 uses an IMA code to correct fuel trim for each fuel injector equipped with the engine at every key ON. If the ECU A-9000 determines that this trim correction for fuel injector number 2 Y-9002 can not be performed, this fault will occur.

Cause:
The ECU A-9000 has determined that the fuel injector number 2 Y-9002 fuel trim correction can not be performed.

Solution:

1. Use the Electronic Service Tool (EST) ensure that the correct IMA code is programmed to fuel injector number 2 Y-9002.

   A. If the correct code is not programmed. Use the EST to program the correct code.

   B. If the correct code is programmed, continue to Step **2**.

   NOTE: *The IMA code may be under the paint on the fuel injector.*

   NOTE: *For more information regarding programming IMA codes, see* ***Fuel injectors - Configure - IMA codes (10.218)****.*
2. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 299-04-Turbocharger boost pressure is lower than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors boost pressure using the intake manifold pressure sensor B-9001. If the ECU A-9000 determines that boost pressure is lower than expected, this fault will occur. For more information regarding the troubleshooting of an under-boost condition, see **Turbocharger - Troubleshooting (10.250)**.

Cause:
The ECU A-9000 has determined that boost pressure is lower than expected.

Possible failure modes:

1. Faulty intake plumbing, boost leakage.
2. Faulty air filter, clogged.
3. Faulty wastegate pressure modulator valve Y-9008, if applicable.
4. Faulty boost pressure accumulator, if applicable.
5. Faulty wastegate, sticking.
6. Faulty turbocharger, low efficiency.
7. Faulty intake manifold pressure sensor B-9001, drifted signal.
8. Faulty ECU A-9000, software.

DTC 2B4-02-CAN communication failure between vehicle controller and ECU - BC2ECU2 message

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 is capable of connecting to and communicating on two separate Controller Area Networks (CAN). Proper configuration and monitoring of the two twisted pair configured networks is also a function of the ECU A-9000. CAN Node A Bus is the main vehicle interface bus. The ECU A-9000 provides a CAN termination resistor for the CAN Node A Bus, internal to the ECU A-9000. If the ECU A-9000 senses that CAN Node A Bus is not functioning properly, this fault will occur.

Cause:
ECU A-9000 has sensed a timeout of required vehicle controller data provided on CAN Node A.

Possible failure modes:

1. Faulty supply voltage or ground, missing.
2. Faulty CAN circuit wiring, open circuit, short to ground, or short circuit.
3. Faulty ECU A-9000, termination resistor or software.

Solution:

1. Verify fault is present and in active state.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check for other vehicle CAN faults.

   Use the EST to determine if vehicle CAN faults exist.

   A. If other vehicle CAN faults do exist, resolve those vehicle CAN faults first, then check to see that this fault is also resolved.

   B. If other vehicle CAN faults do not exist, continue with Step **3**.
3. Check the ECU A-9000 supply voltage.

   Disconnect the vehicle (VE) harness from the ECU A-9000 at connector **X-9102**.

   To energize the Main relay K-9102, place a jumper wire between the vehicle harness (VE) side of connector **X-9102 pin K28** and chassis ground.

   Use a multimeter to check for voltage on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If the voltage is present on all of the checks, leave connector **X-9102** disconnected and continue with Step **4**.

B. If the voltage is not present for one or more of the checks, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore supply power to the ECU A-9000.

4. Determine the condition of the ECU A-9000 CAN circuit.

   With the key switch in the OFF position, use a multimeter to measure the resistance of the CAN connection on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.
X-9102 pin K24	chassis ground	There should be no continuity
X-9102 pin K25	chassis ground	There should be no continuity

   Use a multimeter to measure the resistance of the CAN termination resistor, internal to the ECU A-9000:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.

   A. If the measured resistances are correct and neither conductor is grounded, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   B. If the measured resistances are not correct or one or both of the conductors is grounded, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore the termination resistance to the CAN circuit.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 2C6-02-CAN communication failure between vehicle controller and ECU controller - TSC1_PE message

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 is capable of connecting to and communicating on two separate Controller Area Networks (CAN). Proper configuration and monitoring of the two twisted pair configured networks is also a function of the ECU A-9000. CAN Node A Bus is the main vehicle interface bus. The ECU A-9000 provides a CAN termination resistor for the CAN Node A Bus, internal to the ECU A-9000. If the ECU A-9000 senses that CAN Node A Bus is not functioning properly, this fault will occur.

Cause:
ECU A-9000 has sensed a timeout of vehicle data provided on CAN Node A.

Possible failure modes:

1. Faulty supply voltage or ground, missing.
2. Faulty CAN circuit wiring, open circuit, short to ground, or short circuit.
3. Faulty ECU A-9000, termination resistor or software.

Solution:

1. Verify fault is present and in active state.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check for other vehicle CAN faults.

   Use the EST to determine if vehicle CAN faults exist.

   A. If other vehicle CAN faults do exist, resolve those vehicle CAN faults first, then check to see that this fault is also resolved.

   B. If other vehicle CAN faults do not exist, continue with Step **3**.
3. Check the ECU A-9000 supply voltage.

   Disconnect the vehicle (VE) harness from the ECU A-9000 at connector **X-9102**.

   To energize the Main relay K-9102, place a jumper wire between the vehicle harness (VE) side of connector **X-9102 pin K28** and chassis ground.

   Use a multimeter to check for voltage on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If the voltage is present on all of the checks, leave connector **X-9102** disconnected and continue with Step **4**.

B. If the voltage is not present for one or more of the checks, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore supply power to the ECU A-9000.

4. Determine the condition of the ECU A-9000 CAN circuit.

   With the key switch in the OFF position, use a multimeter to measure the resistance of the CAN connection on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.
X-9102 pin K24	chassis ground	There should be no continuity
X-9102 pin K25	chassis ground	There should be no continuity

   Use a multimeter to measure the resistance of the CAN termination resistor, internal to the ECU A-9000:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.

   A. If the measured resistances are correct and neither conductor is grounded, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   B. If the measured resistances are not correct or one or both of the conductors is grounded, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore the termination resistance to the CAN circuit.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 2CC-00-Engine controller internal temperature out of range (High)

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 has an internal temperature sensor. The ECU A-9000 monitors this sensor. If the ECU A-9000 determines that the temperature sensor value is too high, this fault will occur.

Cause:
The ECU A-9000 has determined that the internal ECU A-9000 temperature sensor value is too high.

Possible failure modes:

1. Machine is operating in extreme environmental conditions.
2. Faulty ECU A-9000, software.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 2CC-01-Engine controller internal temperature out of range (Low)

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 has an internal temperature sensor. The ECU A-9000 monitors this sensor. If the ECU A-9000 determines that the temperature sensor value is too low, this fault will occur.

Cause:
The ECU A-9000 has determined that the internal ECU A-9000 temperature sensor value is too low.

Possible failure modes:

1. Machine is operating in extreme environmental conditions.
2. Faulty ECU A-9000, software.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 2CC-12-Engine controller internal temperature out of range (SPI Error - LM71)

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 has an internal temperature sensor. The ECU A-9000 monitors this sensor and if the ECU A-9000 determines that there is an internal SPI communication error, this fault will occur.

Cause:
The ECU A-9000 has detected an error in the internal ECU A-9000 temperature sensor communication.

Possible failure modes:

1. Faulty ECU A-9000, software.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 2D1-03-ECU internal failure - Error on R2S2 module

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 has detected an error on the R2S2 module (low-level chip driver for the power-stage chips).

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 2D3-12-ECU internal failure - Software resets in DSM 1

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 will perform a software reset if a software failure is detected. If this fault is active, a software failure has been reported and a software reset has occurred.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 2D4-04-ECU internal failure - ROM error

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 runs a diagnostic fault check of the ROM memory. If any checksum errors in ROM-memory blocks are detected, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 2E1-02-Starter relay low side driver circuit open

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 controls the starter control relay K-9104 using a low side and high side driver. If the ECU A-9000 detects an open circuit in the high side driver circuit, this fault will occur.

Cause:
The ECU A-9000 has detected an open circuit in the starter control relay K-9104 high side driver circuit.

Possible failure modes:

1. Faulty starter control relay K-9104 wiring, open circuit.
2. Faulty starter control relay K-9104, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.

2. Check the starter control relay K-9104 coil for an internal failure.

   Remove the starter control relay K-9104.

   Use a multimeter to measure the relay coil resistance on the starter control relay K-9104 pins :

From	To	Value
X-9120 pin 85	**X-9120 pin 86**	There should be approximately **70 - 130 Ω**.

   A. If there is approximately **70 - 130 Ω**, leave the starter control relay K-9104 disconnected and continue to Step **3**.

   B. If there is not approximately **70 - 130 Ω**, the relay has failed. Replace the starter control relay K-9104.

3. Check the starter control relay K-9104 vehicle harness (VE) wiring for an open circuit.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity check for an open circuit on the vehicle harness (VE) side :

From	To	Value
X-9120 pin 86	**X-9102 pin K53**	There should be continuity.
X-9120 pin 85	**X-9102 pin K27**	There should be continuity.
NOTE: *Wiggle the harness during the check to promote an intermittent electrical connection.*		

   A. If there is no continuity, there is an open circuit in the starter control relay K-9104 wiring in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the broken conductor.

   B. If there is continuity, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)
Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 2E1-03-Starter relay low side driver circuit shorted to battery

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 controls the starter control relay K-9104 using a low side and high side driver. If the ECU A-9000 detects a short circuit to battery in the low side driver circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a short circuit to battery in the starter control relay K-9104 low side driver circuit.

Possible failure modes:

1. Faulty starter control relay K-9104 wiring, short to a voltage source.
2. Faulty starter control relay K-9104, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.

2. Check the starter control relay K-9104 coil for an internal failure.

   Remove the starter control relay K-9104.

   Use a multimeter to measure the relay coil resistance on the starter control relay K-9104 pins :

From	To	Value
X-9120 pin 85	**X-9120 pin 86**	There should be approximately **70 - 130 Ω**.

   A. If there is approximately **70 - 130 Ω**, leave the starter control relay K-9104 disconnected and continue to Step **3**.

   B. If there is not approximately **70 - 130 Ω**, the relay has failed. Replace the starter control relay K-9104.

3. Check the starter control relay K-9104 low side driver vehicle harness (VE) wiring for a short to a voltage source.

   With the key in the OFF position, use a multimeter to perform the following voltage check for a short to a voltage source on the vehicle harness (VE) side :

From	To	Value
X-9120 pin 85	Chassis ground	There should be no voltage.

   With the key in the ON position, use a multimeter to perform the following voltage check for a short to a voltage source on the vehicle harness (VE) side :

From	To	Value
X-9120 pin 85	Chassis ground	There should be no voltage.

   A. If there is voltage, there is a short to a voltage source in the starter control relay K-9104 low side driver wiring in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no voltage, leave the starter control relay K-9104 disconnected and continue to Step **4**.

4. Check the starter control relay K-9104 low side driver vehicle harness (VE) wiring for a short circuit.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9120 pin 86	**X-9120 pin 85**	There should be no continuity.
X-9102 pin K27	All pins in connector **X-9102**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the starter control relay K-9104 wiring in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)
Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 2E1-04-Starter relay low side driver circuit shorted to ground

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 controls the starter control relay K-9104 using a low side and high side driver. If the ECU A-9000 detects a short circuit to ground in the low side driver circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a short circuit to ground in the starter control relay K-9104 low side driver circuit.

Possible failure modes:

1. Faulty starter control relay K-9104 wiring, short to ground.
2. Faulty starter control relay K-9104, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.

2. Check the starter control relay K-9104 coil internal resistance.

   Remove the starter control relay K-9104.

   Use a multimeter to perform the following resistance check on the starter control relay K-9104 pins :

From	To	Value
X-9120 pin 85	**X-9120 pin 86**	There should be approximately **70 - 130 Ω**.

   A. If there is approximately **70 - 130 Ω**, leave the relay disconnected and continue to Step **3**.

   B. If there is not approximately **70 - 130 Ω**, the relay starter control relay K-9104 has failed. Replace the starter control relay K-9104.

3. Check the starter control relay K-9104 low side driver vehicle harness (VE) wiring for a short to ground condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9120 pin 85	Chassis ground	There should be no continuity.

   Disconnect the ECU A-9000 connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K27	All pins in connector **X-9102**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the starter control relay K-9104 vehicle harness (VE) wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)
Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 2E1-12-Starter relay low side ECU driver circuit over temperature

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 controls the starter control relay K-9104 using a low side and high side driver. If the ECU A-9000 detects an over temperature/current condition in the high side driver circuit, this fault will occur.

Cause:
The ECU A-9000 has detected an over temperature/current condition in the starter control relay K-9104 high side driver circuit.

Possible failure modes:

1. Faulty starter control relay K-9104 wiring, short circuit.
2. Faulty starter control relay K-9104, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.
2. Check the starter control relay K-9104 coil for an internal failure.

   Remove the starter control relay K-9104.

   Use a multimeter to measure the relay coil resistance on the starter control relay K-9104 pins :

From	To	Value
X-9120 pin 85	**X-9120 pin 86**	There should be approximately **70 - 130 Ω**.

   A. If there is approximately **70 - 130 Ω**, leave the starter control relay K-9104 disconnected and continue to Step **3**.

   B. If there is not approximately **70 - 130 Ω**, the relay has failed. Replace the starter control relay K-9104.
3. Check the starter control relay K-9104 high side driver vehicle harness (VE) wiring for a short to ground.

   With the key in the OFF position, use a multimeter to perform the following continuity check for short to ground on the vehicle harness (VE) side :

From	To	Value
X-9120 pin 85	**X-9120 pin 86**	There should be no continuity.
X-9120 pin 86	Chassis ground	There should be no continuity.

   A. If there is continuity, there is a short to ground in the starter control relay K-9104 high side driver circuit in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, leave the starter control relay K-9104 disconnected and continue to Step **4**.
4. Check the starter control relay K-9104 high side driver vehicle harness (VE) wiring for a short to a voltage source.

With the key in the OFF position, use a multimeter to perform the following voltage check for a short to a voltage source on the vehicle harness (VE) side :

From	To	Value
X-9120 pin 86	Chassis ground	There should be no voltage.

With the key in the ON position, use a multimeter to perform the following voltage check for a short to a voltage source on the vehicle harness (VE) side :

From	To	Value
X-9120 pin 86	Chassis ground	There should be no voltage.

A. If there is voltage, there is a short to a voltage source in the starter control relay K-9104 high side driver circuit in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no voltage, continue to Step **5**.

5. Check the starter control relay K-9104 low side driver vehicle harness (VE) wiring for a short circuit.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K53	All pins in connector **X-9102**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the starter control relay K-9104 wiring in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)
Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 32B-02-Glow plug control circuits open

Control Module : ECU

Context:
For information regarding the functional operation of the glow plug control module Z-9101 see **Glow plug system Glow plug control module - Overview – Glow plug control module (55.202)**. The Engine Control Unit (ECU) A-9000 requests operation of the glow plug control module Z-9101 via a Pulse Width Modulated (PWM) control circuit and monitors the status of possible electrical defects via a diagnostic feedback signal from the glow plug control module Z-9101. If the ECU A-9000 is notified of an open circuit condition in one or more of the glow plugs or glow plug circuits, this fault will occur.

Cause:
The glow plug control module Z-9101 has communicated to the ECU A-9000, via a diagnostic connection, that an open circuit condition exists in one or more of the glow plugs or glow plug circuits.

Possible failure modes:

1. Faulty glow plug, internal failure.
2. Faulty glow plug control circuit wiring, open circuit.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.

2. Check each of the glow plugs for an open circuit condition.

   Disconnect the vehicle harness (VE) from each of the glow plugs at connectors **X-9034**, **X-9035**, and **X-9036**.

   Use a multimeter to measure the resistance of the glow plugs on the glow plug pin :

From	To	Result
X-9034 pin 1	chassis ground	There should be **0.2 - 5.0 Ω**.
X-9035 pin 1	chassis ground	There should be **0.2 - 5.0 Ω**.
X-9036 pin 1	chassis ground	There should be **0.2 - 5.0 Ω**.

   A. If there is a nominal amount of resistance measured on each of the glow plugs, leave all of the glow plugs disconnected and continue with Step **3**.

   B. If there is infinite resistance measured on any of the glow plugs, that glow plug has failed internally, replace the faulted glow plug.

3. Check the glow plug control circuits for an open circuit condition.

   Disconnect the vehicle harness (VE) from the glow plug control module Z-9101 at connector **X-9113**.

   Use a multimeter to perform the following continuity check for an open circuit on the vehicle harness (VE) side :

From	To	Result
X-9113 pin 2	**X-9034 pin 1**	There should be continuity.
X-9113 pin 7	**X-9035 pin 1**	There should be continuity.
X-9113 pin 1	**X-9036 pin 1**	There should be continuity.

A. If there is continuity on all of the checks, continue to Step **4**.

B. If there is no continuity on one or more of the checks, there is an open circuit condition in the vehicle harness (VE) between the glow plug control module Z-9101 and the respective glow plug. Locate and repair the broken conductor.

4. Replace the glow plug control module Z-9101, then use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)

DTC 32B-03-Glow plug control circuits shorted to battery

Control Module : ECU

Context:
For information regarding the functional operation of the glow plug control module Z-9101 see **Glow plug system Glow plug control module - Overview – Glow plug control module (55.202)**. The Engine Control Unit (ECU) A-9000 requests operation of the glow plug control module Z-9101 via a Pulse Width Modulated (PWM) control circuit and monitors the status of possible electrical defects via a diagnostic feedback signal from the glow plug control module Z-9101. If the ECU A-9000 is notified of a short to a voltage source condition in one or more of the glow plug circuits, this fault will occur.

Cause:
The glow plug control module Z-9101 has communicated to the ECU A-9000, via a diagnostic connection, that a short circuit to a voltage source condition exists in one or more of the glow plug circuits.

Possible failure modes:

1. Faulty glow plug control circuit wiring, short to a voltage source.
2. Faulty glow plug control module Z-9101, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.

2. Check each of the glow plug circuits for a short to a voltage source condition.

   Disconnect the vehicle harness (VE) from the glow plug control module Z-9101 at connector **X-9113**.

   Disconnect the vehicle harness (VE) from each of the glow plugs.

   With the key in the ON position, use a multimeter to perform the following voltage check for a short to a voltage source on the vehicle harness (VE) side :

From	To	Result
X-9034 pin 1	chassis ground	There should be no voltage.
X-9035 pin 1	chassis ground	There should be no voltage.
X-9036 pin 1	chassis ground	There should be no voltage.

   A. If there is voltage measured on any of the checks, there is a short to a voltage source condition in the glow plug circuit wiring in the vehicle harness (VE). Locate and repair the shorted conductor.

   B. If there is no voltage measured on any of the checks, continue to Step **3**.

3. Replace the glow plug control module Z-9101, then use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)

DTC 32B-04-Glow plug control circuits shorted to ground

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 requests operation of the glow plug control module Z-9101 via a Pulse Width Modulated (PWM) control circuit and monitors the status of possible electrical defects via a diagnostic feedback signal from the glow plug control module Z-9101. If the ECU A-9000 is notified of a short to ground condition in one or more of the glow plug circuits, this fault will occur. For information regarding the functional operation of the glow plug control module Z-9101 see **Glow plug system Glow plug control module - Overview – Glow plug control module (55.202)**.

Cause:
The glow plug control module Z-9101 has communicated to the ECU A-9000, via a diagnostic connection, that a short to ground circuit condition exists in one or more of the glow plugs or glow plug circuits.

Possible failure modes:

1. Faulty glow plug, internal failure.
2. Faulty glow plug control circuit wiring, short to ground condition.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.

2. Check each of the glow plugs for a short to ground condition.

   Disconnect the vehicle harness (VE) from each of the glow plugs at connectors **X-9034**, **X-9035**, and **X-9036**.

   Use a multimeter to measure the resistance of each glow plug on the glow plug pin :

From	To	Result
X-9034 pin 1	chassis ground	There should be **0.2 - 5.0 Ω**.
X-9035 pin 1	chassis ground	There should be **0.2 - 5.0 Ω**.
X-9036 pin 1	chassis ground	There should be **0.2 - 5.0 Ω**.

   A. If there is a nominal amount of resistance measured on each of the glow plugs, leave all of the glow plugs disconnected and continue with Step **3**.

   B. If there is less than **0.2 Ω** resistance measured on any of the glow plugs, that glow plug has failed internally, replace the faulted glow plug.

3. Check the glow plug control circuits in the vehicle harness (VE) for a short to ground circuit condition.

   Disconnect the vehicle harness (VE) from the glow plug control module Z-9101 at connector **X-9113**.

   With the key in the OFF position, use a multimeter to check for a short to ground condition on the vehicle harness (VE) side :

From	To	Result
X-9113 pin 2	chassis ground	There should be no continuity.
X-9113 pin 7	chassis ground	There should be no continuity.
X-9113 pin 1	chassis ground	There should be no continuity.

A. If there is continuity, there is a short to ground condition in the glow plug control circuit wiring in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the grounded conductor.

B. If there is no continuity on all of the checks, continue with Step **4**.

4. Replace the glow plug control module Z-9101, then use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)

DTC 32B-12-Glow plug control circuits shorted

Control Module : ECU

Context:
For information regarding the functional operation of the glow plug control module Z-9101 see **Glow plug system Glow plug control module - Overview – Glow plug control module (55.202)**. The Engine Control Unit (ECU) A-9000 requests operation of the glow plug control module Z-9101 via a Pulse Width Modulated (PWM) control circuit and monitors the status of possible electrical defects via a diagnostic feedback signal from the glow plug control module Z-9101. If the ECU A-9000 is notified of a short circuit to ground, over current, condition in one or more of the glow plugs or glow plug circuits, this fault will occur.

Cause:
The glow plug control module Z-9101 has communicated to the ECU A-9000, via a diagnostic connection, that a short to ground circuit condition exists in one or more of the glow plugs or glow plug circuits.

Possible failure modes:

1. Faulty glow plug, internal failure.
2. Faulty glow plug control circuit wiring, short circuit.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.

2. Check each of the glow plugs for a short to ground condition.

   Disconnect the vehicle harness (VE) from each of the glow plugs at connectors **X-9034**, **X-9035**, and **X-9036**.

   Use a multimeter to measure the resistance of each glow plug on the glow plug pin :

From	To	Result
X-9034 pin 1	chassis ground	There should be **0.2 - 5.0 Ω**.
X-9035 pin 1	chassis ground	There should be **0.2 - 5.0 Ω**.
X-9036 pin 1	chassis ground	There should be **0.2 - 5.0 Ω**.

   A. If there is a nominal amount of resistance measured on each of the glow plugs, leave all of the glow plugs disconnected and continue with Step **3**.

   B. If there is less than **0.2 Ω** resistance measured on any of the glow plugs, that glow plug has failed internally, replace the failed glow plug.

3. Check the glow plug control circuits in the vehicle harness (VE) for a short to ground circuit condition.

   Disconnect the vehicle harness (VE) from the glow plug control module Z-9101 at connector **X-9113**.

   With the key in the OFF position, use a multimeter to check for a short to ground condition on the vehicle harness (VE) side :

From	To	Result
X-9113 pin 2	chassis ground	There should be no continuity.
X-9113 pin 7	chassis ground	There should be no continuity.
X-9113 pin 1	chassis ground	There should be no continuity.

A. If there is continuity, there is a short to ground condition in the glow plug control circuit wiring in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the grounded conductor.

B. If there is no continuity on all of the checks, continue with Step **4**.

4. Replace the glow plug control module Z-9101, then use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)

DTC 359-04-Fuel metering unit is shorted to ground at the low side

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel metering unit Y-9000 low side driver circuit. If the ECU A-9000 detects a short to ground in the fuel metering unit Y-9000 low side driver circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a short to ground condition in the fuel metering unit Y-9000 low side driver circuit.

Possible failure modes:

1. Faulty fuel metering unit Y-9000 wiring, short to ground condition.
2. Faulty fuel metering unit Y-9000, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.

2. Test the fuel metering unit Y-9000 internal resistance and for a grounded condition.

   Disconnect the engine harness (EN) from the fuel metering unit Y-9000 at connector **X-9007** .

   Use a multimeter to perform the following continuity and resistance check on the fuel metering unit Y-9000 pins :

From	To	Value
X-9007 pin 2	Chassis ground	There should be no continuity.
X-9007 pin 1	**X-9007 pin 2**	There should be between **2.6 - 3.2 Ω** at approximately **20 °C** (**68 °F**).

   A. If there is between **2.6 - 3.2 Ω** and there is no continuity to ground, leave connector **X-9007** disconnected and continue to Step **3**.

   B. If the specified values are not measured, the fuel metering unit Y-9000 has a grounded condition or has failed internally. Replace the fuel metering unit Y-9000.

3. Check the fuel metering unit Y-9000 engine harness (EN) wiring for a short to ground condition.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9001**.

   With the key switch in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9007 pin 1	Chassis ground	There should be no continuity.
X-9001 pin A60	All pins in connector **X-9001**	There should be no continuity.

   A. If there is continuity, there is a short circuit condition in the fuel metering unit Y-9000 vehicle harness (VE) wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 35A-03-Error in comparing energizing time to maximum value for injector in cylinder 2

Control Module : ECU

Context:
The Zero Fuel Calibration (ZFL) evaluates energizing time for injectors at low idle. The ZFL uses learned calibration values to change the energizing time of the pilot fuel injection. If the Engine Control Unit (ECU) A-9000 determines that there is an error during this process, this fault will occur.

Cause:
The ECU A-9000 has determined that there is an error in the ZFL process for fuel injector number 2 Y-9002.

Solution:

1. Verify that the correct IMA injector code has been programmed to injector number 2.

   A. If the correct IMA code is present, continue to Step **2**.

   B. If the correct IMA code has not been uploaded, program the correct IMA code.

   NOTE: *The IMA code may be under the paint on the fuel injector.*

   NOTE: *For more information regarding programming IMA codes, see* ***Fuel injectors - Configure - IMA codes (10.218)****.*

2. Replace the fuel injector number 2 Y-9002.

   Use the Electronic Service Tool (EST) to verify the status of this fault.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, continue to Step **3**.

3. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 35A-04-Error in comparing energizing time to minimum value for injector in cylinder 2

Control Module : ECU

Context:
The Zero Fuel Calibration (ZFL) evaluates energizing time for injectors at low idle. The ZFL uses learned calibration values to change the energizing time of the pilot fuel injection. If the Engine Control Unit (ECU) A-9000 determines that there is an error during this process, this fault will occur.

Cause:
The ECU A-9000 has determined that there is an error in the ZFL process for fuel injector number 2 Y-9002.

Solution:

1. Verify that the correct IMA injector code has been programmed to injector number 2.

   A. If the correct IMA code is present, continue to Step **2**.

   B. If the correct IMA code has not been uploaded, program the correct IMA code.

   NOTE: *The IMA code may be under the paint on the fuel injector.*

   NOTE: *For more information regarding programming IMA codes, see* ***Fuel injectors - Configure - IMA codes (10.218)****.*
2. Replace the fuel injector number 2 Y-9002.

   Use the Electronic Service Tool (EST) to verify the status of this fault.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, continue to Step **3**.
3. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 35D-03-PMCat Inducement warning

Control Module : ECU

Context:
The Engine Control Unit (ECU) monitors the Particulate Matter (PM) catalytic converter efficiency. If the ECU A-9000 detects an failure of efficiency, an inducement warning will be triggered and this fault will occur. Other active faults may have caused this fault to occur.

DTC 37F-12-Missing adjustment value programming for injector in cylinder 3

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 uses an IMA code to correct fuel trim for each fuel injector equipped with the engine at every key ON. If the ECU A-9000 determines that this trim correction for fuel injector number 3 Y-9003 can not be performed, this fault will occur.

Cause:
The ECU A-9000 has determined that the fuel injector number 3 Y-9003 fuel trim correction can not be performed.

Solution:

1. Use the Electronic Service Tool (EST) ensure that the correct IMA code is programmed to fuel injector number 3 Y-9003.

   A. If the correct code is not programmed. Use the EST to program the correct code.

   B. If the correct code is programmed, continue to Step **2**.

   NOTE: *The IMA code may be under the paint on the fuel injector.*

   NOTE: *For more information regarding programming IMA codes, see* ***Fuel injectors - Configure - IMA codes (10.218)****.*
2. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 3C8-02-CAN communication failure between vehicle controller and ECU controller - TSC1_VE message

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 is capable of connecting to and communicating on two separate Controller Area Networks (CAN). Proper configuration and monitoring of the two twisted pair configured networks is also a function of the ECU A-9000. CAN Node A Bus is the main vehicle interface bus. The ECU A-9000 provides a CAN termination resistor for the CAN Node A Bus, internal to the ECU A-9000. If the ECU A-9000 senses that CAN Node A Bus is not functioning properly, this fault will occur.

Cause:
ECU A-9000 has sensed a timeout of required vehicle controller data provided on CAN Node A.

Possible failure modes:

1. Faulty supply voltage or ground, missing.
2. Faulty CAN circuit wiring, open circuit, short to ground, or short circuit.
3. Faulty ECU A-9000, termination resistor or software.

Solution:

1. Verify fault is present and in active state.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check for other vehicle CAN faults.

   Use the EST to determine if vehicle CAN faults exist.

   A. If other vehicle CAN faults do exist, resolve those vehicle CAN faults first, then check to see that this fault is also resolved.

   B. If other vehicle CAN faults do not exist, continue with Step **3**.
3. Check the ECU A-9000 supply voltage.

   Disconnect the vehicle (VE) harness from the ECU A-9000 at connector **X-9102**.

   To energize the Main relay K-9102, place a jumper wire between the vehicle harness (VE) side of connector **X-9102 pin K28** and chassis ground.

   Use a multimeter to check for voltage on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If the voltage is present on all of the checks, leave connector **X-9102** disconnected and continue with Step **4**.

B. If the voltage is not present for one or more of the checks, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore supply power to the ECU A-9000.

4. Determine the condition of the ECU A-9000 CAN circuit.

   With the key switch in the OFF position, use a multimeter to measure the resistance of the CAN connection on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.
X-9102 pin K24	chassis ground	There should be no continuity
X-9102 pin K25	chassis ground	There should be no continuity

   Use a multimeter to measure the resistance of the CAN termination resistor, internal to the ECU A-9000:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.

   A. If the measured resistances are correct and neither conductor is grounded, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   B. If the measured resistances are not correct or one or both of the conductors is grounded, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore the termination resistance to the CAN circuit.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 3D4-02-ECU internal failure - ECU shutdown test failure

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 performs a series of “shut-off path” tests which deactivates all power stages relevant to fuel injection if certain ECU A-9000 errors are detected. If an incorrect response to the power stage supply (CY320) is detected during this test, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 3D4-03-ECU internal failure - Wrong set response time

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 performs a series of “shut-off path” tests which deactivates all power stages relevant to fuel injection if certain ECU A-9000 errors are detected. If there is a time-out error during this test, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 3D4-04-ECU internal failure - SPI errors during MoCSOP execution

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 performs a series of “shut-off path” tests which deactivates all power stages relevant to fuel injection if certain ECU A-9000 errors are detected. If there is a faulty communication detected during this test, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 3D4-12-ECU internal failure - Loss of synchronization to MM from CPU

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 performs a shut-off path test of the fuel injection power stages. Every time the key is turned ON, this test is performed to verify the correct functioning of the shut-off procedure. If an error is detected during the shut-off test, the fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 3E3-00-ECU internal failure - Fuel injection energizing time is not plausible

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors fuel injector energizing time for plausibility. If the ECU A-9000 determines that this value is implausible for either pilot, main or post injection, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 3E3-01-ECU internal failure - Fuel injection energizing phase is not plausible

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors fuel injector energizing start time for plausibility. If the ECU A-9000 determines that this value is implausible for either pilot, main or post injection, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 3E3-02-Fuel injection correction has exceeded a minimum limit

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 checks the plausibility of the Zero Fuel Quantity Calibration (ZFC) energizing time. The ZFC is used to correct pilot injection quantity. If the ECU A-9000 determines the energizing time of the ZFC is implausible, this fault will occur.

Cause:
The ZFC is used to compensate for aging injectors. If the compensation limit is exceeded, this fault will occur.

Possible failure modes:

1. Faulty fuel injectors, worn.
2. Faulty ECU A-9000, software.

Solution:

1. Use the appropriate service manual to perform a leakage test in the high pressure fuel system. Also, test the fuel injectors for internal and external leakage.

   A. If any faults are found, repair as necessary.

   B. If no faults are found, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

DTC 3E3-03-ECU internal failure - Injection quantity correction

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 checks the plausibility of the Zero Fuel Quantity Calibration (ZFC) energizing time. The ZFC is used to correct pilot injection quantity. If the ECU A-9000 determines the energizing time of the ZFC is implausible, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 3E3-04-ECU internal failure - Rail pressure plausibility

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors fuel pressure in the common rail. This monitoring is performed using two software levels of monitoring because fuel pressure monitoring is a critical functionality. If the ECU A-9000 sees an error in the level two monitoring but not in level one monitoring, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 3E3-12-ECU internal failure - Torque request comparison

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 performs a diagnostic comparison of requested engine torque to allowed engine torque. If the ECU A-9000 determines that requested engine torque is greater than maximum allowed torque, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 3F6-03-DOC inlet temperature sensor voltage is higher than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the Diesel Oxidation Catalyst (DOC) inlet temperature sensor B-9127. If the ECU A-9000 detects a voltage greater than **3.59 V** in the diesel oxidation catalyst inlet temperature sensor B-9127 signal circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a voltage greater than **3.59 V** in the diesel oxidation catalyst inlet temperature sensor B-9127 signal circuit. For more information regarding the technical specifications of the DOC inlet temperature sensor B-9127, see **Exhaust Gas Recirculation (EGR) temperature sensors - Technical Data (55.989)**.

Possible failure modes:

1. Faulty DOC inlet temperature sensor B-9127 wiring, short to voltage source.
2. Faulty DOC inlet temperature sensor B-9127 wiring, open circuit.
3. Faulty DOC inlet temperature sensor B-9127, internal failure.
4. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.

2. Check the DOC inlet temperature sensor B-9127 for an internal failure.

   Disconnect the vehicle harness (VE) from the DOC inlet temperature sensor B-9127 at connector **X-9127**.

   Use a multimeter to measure the resistance on the diesel oxidation catalyst inlet temperature sensor B-9127 :

From	To	Value
X-9127 pin 1	**X-9127 pin 2**	There should be between **170.2 - 849.7 Ω**.

   A. If there is between **170.2 - 849.7 Ω**, leave connector **X-9127** disconnected and continue to Step **3**.

   B. If there is not between **170.2 - 849.7 Ω**, the diesel oxidation catalyst inlet temperature sensor B-9127 has failed. Replace the DOC inlet temperature sensor B-9127.

3. Check the DOC inlet temperature sensor B-9127 vehicle harness (VE) wiring for a short circuit.

   With the key in the OFF position, use a multimeter to perform the following voltage check on the vehicle harness side :

From	To	Value
X-9127 pin 1	Chassis ground	There should be no voltage.

   A. If there is voltage, there is a short to battery in the diesel oxidation catalyst inlet temperature sensor B-9127 wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no voltage, leave connector **X-9127** disconnected and continue to Step **4**.

4. Check the DOC inlet temperature sensor B-9127 vehicle harness (VE) wiring for an open circuit condition.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9127 pin 1	**X-9102 pin K84**	There should be continuity.
X-9127 pin 2	**X-9102 pin K83**	There should be continuity.

   A. If there is no continuity, there is an open circuit in the DOC inlet temperature sensor B-9127 vehicle harness (VE) wiring. Use the appropriate service manual, if necessary, to locate and repair the broken conductor.

   B. If there is continuity, leave connector **X-9102** disconnected and continue to Step **5**.

5. Check the DOC inlet temperature sensor B-9127 vehicle harness (VE) wiring for a short circuit condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K84	All pins in connector **X-9102**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the DOC inlet temperature sensor B-9127 vehicle harness (VE) wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 3F6-04-DOC inlet temperature sensor voltage is lower than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the Diesel Oxidation Catalyst (DOC) inlet temperature sensor B-9127. If the ECU A-9000 detects a voltage less than **459.40 mV** in the DOC inlet temperature sensor B-9127 signal circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a voltage less than **459.40 mV** in the DOC inlet temperature sensor B-9127 signal circuit. For more information regarding the technical specifications of the DOC inlet temperature sensor B-9127, see **Exhaust Gas Recirculation (EGR) temperature sensors - Technical Data (55.989)**.

Possible failure modes:

1. Faulty DOC inlet temperature sensor B-9127 wiring, short circuit to ground.
2. Faulty DOC inlet temperature sensor B-9127, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check the DOC inlet temperature sensor B-9127 for an internal failure.

   Disconnect the vehicle harness (VE) from the DOC inlet temperature sensor B-9127 at connector **X-9127**.

   Use a multimeter to measure the resistance on the DOC inlet temperature sensor B-9127 :

From	To	Value
X-9127 pin 1	**X-9127 pin 2**	There should be between **170.2 - 849.7 Ω**.

   A. If there is between **170.2 - 849.7 Ω**, leave connector **X-9127** disconnected and continue to Step **3**.

   B. If there is not between **170.2 - 849.7 Ω**, the DOC inlet temperature sensor B-9127 has failed. Replace the DOC inlet temperature sensor B-9127.
3. Check the DOC inlet temperature sensor B-9127 vehicle harness (VE) wiring for a short circuit condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9127 pin 1	**X-9127 pin 2**	There should be no continuity.
X-9127 pin 1	Chassis ground	There should be no continuity.

   A. If there is continuity, there is a short circuit in the DOC inlet temperature sensor B-9127 vehicle harness (VE) wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, leave the connector **X-9127** disconnected and continue to Step **4**.
4. Check the DOC inlet temperature sensor B-9127 vehicle harness (VE) wiring for a short circuit condition.

Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9102 pin K84	All pins in connector **X-9102**	There should be no continuity.

A. If there is continuity, there is a short circuit in the DOC inlet temperature sensor B-9127 vehicle harness (VE) wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 426-03-Level 2 Monitoring : Reported Overvoltage of Supply

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the ECU A-9000 internal **5 V** supply. If the **5 V** supply exceeds the maximal limit, this fault will occur.

Cause:
The ECU A-9000 has determined that the **5 V** internal voltage supply is too high.

Possible failure modes:

1. Faulty voltage supply.
2. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **3**.

2. Check the ECU A-9000 supply voltage.

   Disconnect the vehicle (VE) harness from the ECU A-9000 at connector **X-9102**.

   To energize the Main relay K-9102, place a jumper wire between the vehicle harness (VE) side of connector **X-9102 pin K28** and chassis ground.

   Use a multimeter to check for voltage on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If the voltage is not present for one or more of the checks, use the appropriate service manual, if necessary, to repair the faulty conductor.

   B. If the voltage is present on all of the checks, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.

3. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 426-04-Level 2 Monitoring : Reported Under Voltage of Supply

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the ECU A-9000 internal **5 V** supply. If the **5 V** supply is below the minimal limit, this fault will occur.

Cause:
The ECU A-9000 has determined that the **5 V** internal voltage supply is too low.

Possible failure modes:

1. Faulty voltage supply.
2. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **3**.

2. Check the ECU A-9000 supply voltage.

   Disconnect the vehicle (VE) harness from the ECU A-9000 at connector **X-9102**.

   To energize the Main relay K-9102, place a jumper wire between the vehicle harness (VE) side of connector **X-9102 pin K28** and chassis ground.

   Use a multimeter to check for voltage on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If the voltage is not present for one or more of the checks, use the appropriate service manual, if necessary, to repair the faulty conductor.

   B. If the voltage is present on all of the checks, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.

3. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 435-12-Rail pressure sensor value is intermittent

Control Module : ECU

NOTE: *If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors the rail pressure sensor B-9004 If the ECU A-9000 detects more than 5 pressure jumps of greater than **500 bar** (**7250 psi**) and the time between the pressure jumps is less than **3.00 s**, an intermittent connection is assumed and this fault will occur.

Cause:
The ECU A-9000 has detected an intermittent connection in the rail pressure sensor B-9004 signal circuit.

Possible failure modes:

1. Faulty rail pressure sensor B-9004 wiring, intermittent electrical connection.
2. Faulty rail pressure sensor B-9004, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.

2. Check the rail pressure sensor B-9004 engine harness (EN) harness wiring for an open circuit or intermittent open circuit condition.

   Disconnect the engine harness (EN) from the rail pressure sensor B-9004 at connector **X-9026**.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check for an open circuit on the engine harness (EN) side :

From	To	Value
X-9026 pin 2	**X-9001 pin A41**	There should be continuity.
NOTE: *Wiggle the harness during the check to promote an intermittent electrical connection.*		

   A. If there is no continuity, there is an open circuit in the rail pressure sensor B-9004 wiring in the engine harness (EN). Locate and repair the broken conductor.

   B. If there is continuity, leave connector **X-9026** disconnected and continue to Step **3**.

3. Replace the rail pressure sensor B-9004.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 455-03-High pressure pump fuel delivery quantity at low idle is too high

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors fuel rail pressure. If the ECU A-9000 determines that the requested fuel pressure is greater than the actual fuel pressure at idle, leakage is assumed and this fault will occur. Other active faults may have caused this fault to occur. Use the Electronic Service Tool (EST) to check for other active faults. Diagnose any active faults related to the fuel system first and then return to this fault. For more information regarding fuel system troubleshooting, see **Fuel injection system - Troubleshooting (10.218)**.

Cause:
The ECU A-9000 has determined that the requested fuel pressure is greater than the actual fuel pressure at idle.

Possible failure modes:

1. Faulty low pressure fuel system, clogged filter or leakage/blockage.
2. Faulty charge gear pump, low efficiency or line clogged/damaged.
3. Faulty electric fuel pump (if equipped).
4. Faulty fuel metering unit, unable to fully open.
5. Faulty high pressure pump, low efficiency.
6. Faulty fuel injectors, stuck open or internal leakage.
7. Faulty Pressure Relief Valve (PRV), leakage.
8. Faulty rail pressure sensor B-9004 drifted signal or leaking.
9. Faulty ECU A-9000, software.

DTC 459-03-Fuel metering unit intermittent electrical connection failure

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the fuel metering unit Y-9000 signal circuit. If the ECU A-9000 detects an intermittent connection in the fuel metering unit Y-9000 signal circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a intermittent connection in the fuel metering unit Y-9000 signal circuit.

Possible failure modes:

1. Faulty fuel metering unit Y-9000 wiring, open circuit or intermittent open circuit.
2. Faulty fuel metering unit Y-9000, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.

2. Test the fuel metering unit Y-9000 internal resistance.

   Disconnect the engine harness (EN) from the fuel metering unit Y-9000 at connector **X-9007**.

   Use a multimeter to measure the resistance on the fuel metering unit Y-9000 pins :

From	To	Value
X-9007 pin 1	**X-9007 pin 2**	There should be between **2.6 - 3.2 Ω** at approximately **20.0 °C** (**68.0 °F**).

   A. If there is between **2.6 - 3.2 Ω**, leave connector **X-9007** disconnected and continue to Step **3**.

   B. If there is not between **2.6 - 3.2 Ω**, the fuel metering unit Y-9000 has failed. Replace the fuel metering unit Y-9000.

3. Check the fuel metering unit Y-9000 engine harness (EN) wiring for an open circuit or intermittent open circuit.

   With the key in the OFF position, use a multimeter to perform the following continuity check for an open circuit on the engine harness (EN) side :

From	To	Value
X-9007 pin 1	**X-9001 pin A60**	There should be continuity.
X-9007 pin 2	**X-9001 pin A15**	There should be continuity.
NOTE: *Wiggle the harness during the check to promote an intermittent electrical connection.*		

   A. If there is no continuity, there is an open circuit condition in the fuel metering unit Y-9000 engine harness (EN) wiring. Locate and repair the broken conductor.

   B. If there is continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 45A-03-Error in comparing energizing time to maximum value for injector in cylinder 3

Control Module : ECU

Context:
The Zero Fuel Calibration (ZFL) evaluates energizing time for injectors at low idle. The ZFL uses learned calibration values to change the energizing time of the pilot fuel injection. If the Engine Control Unit (ECU) A-9000 determines that there is an error during this process, this fault will occur.

Cause:
The ECU A-9000 has determined that there is an error in the ZFL process for fuel injector number 3 Y-9003.

Solution:

1. Verify that the correct IMA injector code has been programmed to injector number 3.

   A. If the correct IMA code is present, continue to Step **2**.

   B. If the correct IMA code has not been uploaded, program the correct IMA code.

   NOTE: *The IMA code may be under the paint on the fuel injector.*

   NOTE: *For more information regarding programming IMA codes, see* ***Fuel injectors - Configure - IMA codes (10.218)****.*
2. Replace the fuel injector number 3 Y-9003.

   Use the Electronic Service Tool (EST) to verify the status of this fault.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, continue to Step **3**.
3. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 45A-04-Error in comparing energizing time to minimum value for injector in cylinder 3

Control Module : ECU

Context:
The Zero Fuel Calibration (ZFL) evaluates energizing time for injectors at low idle. The ZFL uses learned calibration values to change the energizing time of the pilot fuel injection. If the Engine Control Unit (ECU) A-9000 determines that there is an error during this process, this fault will occur.

Cause:
The ECU A-9000 has determined that there is an error in the ZFL process for fuel injector number 3 Y-9003.

Solution:

1. Verify that the correct IMA injector code has been programmed to injector number 3.

   A. If the correct IMA code is present, continue to Step **2**.

   B. If the correct IMA code has not been uploaded, program the correct IMA code.

   NOTE: *The IMA code may be under the paint on the fuel injector.*

   NOTE: *For more information regarding programming IMA codes, see* ***Fuel injectors - Configure - IMA codes (10.218)****.*

2. Replace the fuel injector number 3 Y-9003.

   Use the Electronic Service Tool (EST) to verify the status of this fault.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, continue to Step **3**.

3. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 48D-02-Throttle valve actuator control circuit open

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the throttle valve actuator Z-9001 output 1 and output 2 h-bridge circuits. If the ECU A-9000 detects a an open circuit in the throttle valve actuator Z-9001 output h-bridge circuits, this fault will occur.

Cause:
The ECU A-9000 has detected an open circuit in the throttle valve actuator Z-9001 output h-bridge circuits.

Possible failure modes:

1. Faulty throttle valve actuator Z-9001 wiring, open circuit.
2. Faulty throttle valve actuator Z-9001 , internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.
2. Check the throttle valve actuator Z-9001 h-bridge engine harness (EN) wiring for an open circuit.

   Disconnect the engine harness (EN) from the throttle valve actuator Z-9001 at connector **X-9011**.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check for an open circuit at the engine harness (EN) side :

From	To	Value
X-9011 pin 6	**X-9001 pin A49**	There should be continuity.
X-9011 pin 2	**X-9001 pin A34**	There should be continuity.
NOTE: *Wiggle the harness during the check to promote an intermittent electrical connection.*		

   A. If there is no continuity, there is an open circuit in the throttle valve actuator Z-9001 engine harness (EN) h-bridge circuit. Locate and repair the broken conductor.

   B. If there is continuity, leave connector **X-9011** disconnected and continue to Step **3**.
3. Replace the throttle valve actuator Z-9001.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.
4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 48D-03-Throttle valve actuator control circuit over current

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the throttle valve actuator Z-9001 output 1 and output 2 h-bridge circuits. If the ECU A-9000 detects an over temperature/current condition in the throttle valve actuator Z-9001 h-bridge circuit, this fault will occur.

Cause:
The ECU A-9000 has detected an over temperature/current condition in the throttle valve actuator Z-9001 h-bridge circuit.

Possible failure modes:

1. Faulty throttle valve actuator Z-9001 wiring, short to ground condition.
2. Faulty throttle valve actuator Z-9001 wiring, short to high source condition.
3. Faulty throttle valve actuator Z-9001, internal failure.
4. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **7**.

2. Check the throttle valve actuator Z-9001 h-bridge wiring for a short to battery condition.

   Disconnect the engine harness (EN) from the throttle valve actuator Z-9001 at connector **X-9011**.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the ON position, use a multimeter to perform the following voltage check for a short to battery on the engine harness (EN) side :

From	To	Value
X-9011 pin 6	Chassis ground	There should be no voltage.
X-9011 pin 2	Chassis ground	There should be no voltage.

   A. If there is voltage, there is a short to battery in the throttle valve actuator Z-9001 h-bridge circuit. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no voltage, leave connectors **X-9011** and **X-9001** disconnected and continue to Step **3**.

3. Check the throttle valve actuator Z-9001 h-bridge wiring for a short to ground condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check for a short to ground on the engine harness (EN) side :

From	To	Value
X-9011 pin 6	Chassis ground	There should be no continuity.
X-9011 pin 2	Chassis ground	There should be no continuity.

   A. If there is continuity, there is a short to ground in the throttle valve actuator Z-9001 h-bridge circuit. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no continuity, leave connectors **X-9011** and **X-9001** disconnected and continue to Step **4**.

4. Check the throttle valve actuator Z-9001 engine harness (EN) wiring for a short circuit condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check for a short circuit on the engine harness (EN) side :

From	To	Value
X-9011 pin 6	**X-9011 pin 2**	There should be no continuity.
X-9011 pin 6	**X-9011 pin 1**	There should be no continuity.
X-9011 pin 2	**X-9011 pin 1**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the throttle valve actuator Z-9001 engine harness (EN) h-bridge circuit. Locate and repair the shorted conductor.

   B. If there is no continuity, leave connectors **X-9011** and **X-9001** disconnected and continue to Step **5**.

5. Check the throttle valve actuator Z-9001 vehicle harness (VE) h-bridge circuit for a short to high source condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9001 pin A49	All pins in connector **X-9001**	There should be no continuity.
X-9001 pin A34	All pins in connector **X-9001**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the throttle valve actuator Z-9001 engine harness (EN) h-bridge circuit. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, leave connector **X-9011** disconnected and continue to Step **6**.

6. Replace the throttle valve actuator Z-9001.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.

7. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 48D-12-Throttle valve actuator control circuit over temperature

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the throttle valve actuator Z-9001 output 1 and output 2 h-bridge circuits. If the ECU A-9000 detects an over temperature/current condition in the throttle valve actuator Z-9001 h-bridge circuit, this fault will occur.

Cause:
The ECU A-9000 has detected an over temperature/current condition in the throttle valve actuator Z-9001 h-bridge circuit.

Possible failure modes:

1. Faulty throttle valve actuator Z-9001 wiring, short to ground condition.
2. Faulty throttle valve actuator Z-9001 wiring, short to high source condition.
3. Faulty throttle valve actuator Z-9001, internal failure.
4. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **7**.

2. Check the throttle valve actuator Z-9001 h-bridge wiring for a short to battery condition.

   Disconnect the engine harness (EN) from the throttle valve actuator Z-9001 at connector **X-9011**.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the ON position, use a multimeter to perform the following voltage check for a short to battery on the engine harness (EN) side :

From	To	Value
X-9011 pin 6	Chassis ground	There should be no voltage.
X-9011 pin 2	Chassis ground	There should be no voltage.

   A. If there is voltage, there is a short to battery in the throttle valve actuator Z-9001 h-bridge circuit. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no voltage, leave connectors **X-9011** and **X-9001** disconnected and continue to Step **3**.

3. Check the throttle valve actuator Z-9001 h-bridge wiring for a short to ground condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check for a short to ground on the engine harness (EN) side :

From	To	Value
X-9011 pin 6	Chassis ground	There should be no continuity.
X-9011 pin 2	Chassis ground	There should be no continuity.

   A. If there is continuity, there is a short to ground in the throttle valve actuator Z-9001 h-bridge circuit. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no continuity, leave connectors **X-9011** and **X-9001** disconnected and continue to Step **4**.

4. Check the throttle valve actuator Z-9001 engine harness (EN) wiring for a short circuit condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check for a short circuit on the engine harness (EN) side :

From	To	Value
X-9011 pin 6	**X-9011 pin 2**	There should be no continuity.
X-9011 pin 6	**X-9011 pin 1**	There should be no continuity.
X-9011 pin 2	**X-9011 pin 1**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the throttle valve actuator Z-9001 engine harness (EN) h-bridge circuit. Locate and repair the shorted conductor.

   B. If there is no continuity, leave connectors **X-9011** and **X-9001** disconnected and continue to Step **5**.

5. Check the throttle valve actuator Z-9001 vehicle harness (VE) h-bridge circuit for a short to high source condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9001 pin A49	All pins in connector **X-9001**	There should be no continuity.
X-9001 pin A34	All pins in connector **X-9001**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the throttle valve actuator Z-9001 engine harness (EN) h-bridge circuit. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, leave connector **X-9011** disconnected and continue to Step **6**.

6. Replace the throttle valve actuator Z-9001.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.

7. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 4D4-03-ECU internal failure - Overvoltage monitoring error

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 performs “shut-off paths” which deactivate all power stages relevant to fuel injection if certain ECU A-9000 errors are detected. If an over-voltage condition is detected during this test, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 4D4-04-ECU internal failure - Undervoltage monitoring error

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 performs “shut-off paths” which deactivate all power stages relevant to fuel injection if certain ECU A-9000 errors are detected. If an under-voltage condition is detected during this test, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 4E3-03-ECU internal failure - Post injection quantity

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 performs a diagnostic fault check for post injection 2 by monitoring start angle and efficiency. If the ECU A-9000 determines that there is an error during this check, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 4E3-04-Level 2 Monitoring : Diagnosis fault check to report the error to demand for an ICO due to an error in the PoI2 shut-off

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 performs a diagnostic fault check for post injection 2. If the ECU A-9000 determines that the post injection 2 quantity has exceeded the expected value, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 4E3-12-Level 2 Monitoring : Diagnosis fault check to report the error to demand for an ICO due to an error in the PoI3 efficiency factor

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 performs a diagnostic fault check for post injection 3. If the ECU A-9000 determines that there is a post injection 3 plausibility error, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 52C-01-Glow Control Unit (GCU) data error

Control Module : ECU

Context:
For information regarding the functional operation of the glow plug control module Z-9101 see **Glow plug system Glow plug control module - Overview – Glow plug control module (55.202)**. For more information regarding glow plugs, see **Glow plug system - Overview (55.202)**. The Engine Control Unit (ECU) A-9000 requests operation of the glow plug control module Z-9101 via a Pulse Width Modulated (PWM) control circuit and monitors the status of possible electrical defects via a diagnostic feedback signal from the glow plug control module Z-9101. If the ECU A-9000 determines the diagnostic data transmission is faulty, this fault will occur.

Cause:
The glow plug control module Z-9101 diagnostic connection with the ECU A-9000 is damaged or the data protocol is incorrect.

Possible failure modes:

1. Faulty glow plug control module Z-9101 diagnostic circuit wiring, open, shorted or grounded circuit.
2. Faulty glow plug control module Z-9101, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.

2. Check for damaged diagnostic circuit wiring.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to check for continuity on the vehicle harness (VE) side :

From	To	Result
X-9102 pin K22	chassis ground	There should be no continuity.
X-9102 pin K22	all other pins in connector **X-9102**	There should be no continuity.

   Carefully disconnect the vehicle harness (VE) from the glow plug control module Z-9101 at connector **X-9113**.

   Place a jumper wire between connector **X-9113 pin 3** and chassis ground.

   With the key in the OFF position, use a multimeter to check for continuity on the vehicle harness (VE) side :

From	To	Result
X-9102 pin K22	chassis ground	There should be continuity.

   A. If there is continuity from connector **X-9102 pin K22** to ground or any other pin in connector **X-9102** there is a short to ground condition. If there is no continuity from **X-9102 pin K22** to connector **X-9113 pin 3**, there is an open circuit condition is in the vehicle harness (VE), wire VE-9073.
   Use the appropriate service manual, if necessary, to locate and repair the damage in the circuit.

   B. If there is no continuity from connector **X-9102 pin K22** to ground or any other pin in connector **X-9102** and there is continuity from **X-9102 pin K22** to connector **X-9113 pin 3**, continue with Step **3**.

3. Replace the glow plug control module Z-9101, then use EST to check to see that this fault has been resolved.

A. If the fault has been resolved, return the machine to service.

B. If the fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)
Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 532-03-Engine coolant temperature has exceeded the warning threshold

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the engine coolant temperature. Two engine temperature thresholds are monitored by the ECU A-9000, a pre-warning, and a warning. If the ECU A-9000 monitors a temperature greater than **111.96 °C** (**233.53 °F**), a warning is set and this fault will occur. For more information regarding cooling system troubleshooting, see **Engine cooling system - Troubleshooting (10.400)**.

Cause:
A coolant temperature level warning has been set by the ECU A-9000.

Possible failure modes:

1. Coolant level low.
2. Faulty cooling system, leakage or blockage.
3. Extremely high environmental temperature or heavy machine use.
4. Faulty coolant temperature sensor B-9003, wiring or internal failure of sensor.
5. Faulty ECU A-9000, software.

DTC 535-03-Maximum rail pressure exceeded

Control Module : ECU

NOTE: *If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)****, if necessary.*

NOTE: *If the Pressure Relief Valve (PRV) is replaced, it is necessary to perform the Replacement of the Rail Pressure Relief Valve (PRV) - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Common rail Relief valve - Configure - Reset ECU data (10.218)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors fuel rail pressure using the rail pressure sensor B-9004. If the ECU A-9000 determines that rail pressure has exceeded **1790 bar** (**25955 psi**), this fault will occur. A Pressure Relief Valve (PRV), integral to the fuel rail, is designed to open in the event of an over-pressure in the fuel rail at approximately **1790 bar** (**25955 psi**). If the ECU A-9000 determines that rail pressure has exceeded this threshold, a PRV failure is assumed. Other active faults may have caused this fault to occur. For more information regarding fuel system troubleshooting, see **Fuel injection system - Troubleshooting (10.218)**.

Cause:
The ECU A-9000 has determined that rail pressure has exceeded **1790 bar** (**25955 psi**).

Possible failure modes:

1. Faulty fuel back-flow, clogged.
2. Faulty PRV, unable to open to clogged return.
3. Faulty fuel metering unit Y-9000, stuck open or internal failure.
4. Faulty rail pressure sensor B-9004, drifted.
5. Faulty ECU A-9000, software.

DTC 54C-03-Engine over speed condition detected

Control Module : ECU

Context:
This fault is intended for information purposes only and does not require any further action. Other active faults may have caused this fault to occur. The Engine Control Unit (ECU) A-9000 monitors for an engine overspeed condition. An engine overspeed condition can occur from such conditions as downhill travel. If an engine speed of at least **3100 RPM** has been detected for at least **0.05 s**, this fault will occur.

DTC 559-12-Fuel metering unit has an over-temperature error

Control Module : ECU

Context:
The Engine Control Unit (ECU) monitors the fuel metering unit Y-9000 signal circuit for an over temperature/current condition. If the ECU A-9000 detects an over temperature/current condition in the fuel metering unit Y-9000 signal circuit, this fault will occur.

Cause:
The ECU A-9000 has detected an over temperature/current condition in the fuel metering unit Y-9000 signal circuit.

Possible failure modes:

1. Faulty fuel metering unit Y-9000 wiring, short to a voltage source.
2. Faulty fuel metering unit Y-9000, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.

2. Test the fuel metering unit Y-9000 internal resistance.

   Disconnect the engine harness (EN) from the fuel metering unit Y-9000 at connector **X-9007**.

   Use a multimeter to measure the resistance on the fuel metering unit Y-9000 pins :

From	To	Value
X-9007 pin 1	**X-9007 pin 2**	There should be between **2.6 - 3.2 Ω** at approximately **20.0 °C** (**68.0 °F**).

   A. If there is between **2.6 - 3.2 Ω**, leave connector **X-9007** disconnected and continue to Step **3**.

   B. If there is not between **2.6 - 3.2 Ω**, the fuel metering unit Y-9000 has failed. Replace the fuel metering unit Y-9000.

3. Check the fuel metering unit Y-9000 low side driver wiring for a short to battery condition.

   With the key in the OFF position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9007 pin 1	Chassis ground	There should be no voltage.

   With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9007 pin 1	Chassis ground	There should be no voltage.

   A. If there is voltage, there is a short circuit to battery or switched battery in the fuel metering unit Y-9000 low side driver circuit wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no voltage, leave connector **X-9007** disconnected and continue to Step **4**.

4. Check the fuel metering unit Y-9000 low side driver engine harness (EN) wiring for a short circuit condition.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check from the engine harness (EN) side :

From	To	Value
X-9001 pin A60	All pins in connector **X-9001**.	There should be no continuity.

   A. If there is continuity, there is a short circuit condition in the fuel metering unit Y-9000 low side driver engine harness (EN) wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 58C-03-Throttle valve actuator will not open to commanded position

Control Module : ECU

NOTE: *Once repaired, this fault may take up to up to* ***10 min*** *of operation to reset.*

Context:
The Engine Control Unit (ECU) A-9000 monitors the Throttle Valve Actuator (TVA) Z-9001. The TVA Z-9001 provides the ECU A-9000 with a feedback using a position sensor. If the ECU A-9000 determines that there is a positive deviation between the required and measured position, this fault will occur. If this fault is active, the ECU A-9000 will command the TVA Z-9001 to open and close at a fast rate in order to attempt to “unblock “ the actuator. This fault is not caused by a wiring failure. It is likely caused by an obstruction to the throttle valve flap or excessive carbon build up on the throttle valve seat. For more information regarding TVA Z-9001 inspection, see **Throttle Valve Actuator (TVA) - Inspect (55.014)**.

Cause:
The ECU A-9000 has detected a positive deviation between the required and measured position of the TVA Z-9001. The desired throttle valve position can not be reached.

Possible failure modes:

1. Faulty throttle valve actuator Z-9001, sticking or blocked.
2. Faulty throttle valve actuator Z-9001, internal failure.
3. Faulty ECU A-9000, software.

DTC 58C-04-Throttle valve actuator will not close to commanded position

Control Module : ECU

NOTE: *Once repaired, this fault may take up to up to* ***10 min*** *of operation to reset.*

Context:
The Engine Control Unit (ECU) A-9000 monitors the Throttle Valve Actuator (TVA) Z-9001. The TVA Z-9001 provides the ECU A-9000 with a feedback using a position sensor. If the ECU A-9000 determines that there is a negative deviation between the required and measured position, this fault will occur. If this fault is active, the ECU A-9000 will command the TVA Z-9001 to open and close at a fast rate in order to attempt to “unblock “ the actuator. This fault is not caused by a wiring failure. It is likely caused by an obstruction to the throttle valve flap or excessive carbon build up on the throttle valve seat.

Cause:
The ECU A-9000 has detected a negative deviation between the required and measured position of the TVA Z-9001. The desired throttle valve position can not be reached. For more information regarding TVA Z-9001 inspection, see **Throttle Valve Actuator (TVA) - Inspect (55.014)**.

Possible failure modes:

1. Faulty throttle valve actuator Z-9001, sticking or blocked.
2. Faulty throttle valve actuator Z-9001, internal failure.
3. Faulty ECU A-9000, software.

DTC 58D-03-Throttle valve actuator control circuit high side shorted to battery

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the throttle valve actuator Z-9001 output 1 and output 2 h-bridge circuits. If the ECU A-9000 detects a short to high source condition in the throttle valve actuator Z-9001 output 1 h-bridge circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a short to high source condition in the throttle valve actuator Z-9001 output 1 h-bridge circuit.

Possible failure modes:

1. Faulty throttle valve actuator Z-9001 wiring, short to a voltage source.
2. Faulty throttle valve actuator Z-9001, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.
2. Check the throttle valve actuator Z-9001 output 1 h-bridge wiring for a short to battery condition.

   Disconnect the engine harness (EN) from the throttle valve actuator Z-9001 at connector **X-9011**.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9011 pin 6	Chassis ground	There should be no voltage.

   A. If there is voltage, there is a short to battery in the throttle valve actuator Z-9001 output 1 h-bridge circuit. Locate and repair the shorted conductor.

   B. If there is no voltage, leave connectors **X-9011** and **X-9001** disconnected and continue to Step **3**.
3. Check the throttle valve actuator Z-9001 engine harness (EN) wiring for a short to high source condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9011 pin 6	**X-9011 pin 1**	There should be no continuity.
X-9011 pin 6	**X-9011 pin 2**	There should be no continuity.
X-9011 pin 6	Chassis ground	There should be no continuity.

   A. If there is continuity, there is a short to high source in the throttle valve actuator Z-9001 output 1 h-bridge circuit. Locate and repair the shorted conductor.

B. If there is no continuity, leave connectors **X-9011** and **X-9001** disconnected and continue to Step **4**.

4. Check the throttle valve actuator Z-9001 engine harness (EN) wiring for a short to high source condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9001 pin A49	All pins in connector **X-9001**	There should be no continuity.

   A. If there is continuity, there is a short to high source in the throttle valve actuator Z-9001 output 1 h-bridge circuit. Locate and repair the shorted conductor.

   B. If there is no continuity, leave connector **X-9011** disconnected and continue to Step **5**.

5. Replace the throttle valve actuator Z-9001.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 58D-04-Throttle valve actuator control circuit high side shorted to ground

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the throttle valve actuator Z-9001 output 1 and output 2 h-bridge circuits. If the ECU A-9000 detects a short to ground condition in the throttle valve actuator Z-9001 output 1 h-bridge circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a short to ground condition in the throttle valve actuator Z-9001 output 1 h-bridge circuit.

Possible failure modes:

1. Faulty throttle valve actuator Z-9001 wiring, short to ground condition.
2. Faulty throttle valve actuator Z-9001, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check the throttle valve actuator Z-9001 output 1 h-bridge engine harness (EN) wiring for a short to ground condition.

   Disconnect the engine harness (EN) from the throttle valve actuator Z-9001 at connector **X-9011**.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9011 pin 6	Chassis ground	There should be no continuity.
X-9011 pin 6	**X-9011 pin 2**	There should be no continuity.
X-9011 pin 6	**X-9011 pin 3**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the throttle valve actuator Z-9001 output 1 h-bridge circuit. Locate and repair the shorted conductor.

   B. If there is no continuity, leave connector **X-9011** disconnected and continue to Step **3**.
3. Check the throttle valve actuator Z-9001 output 1 h-bridge engine harness (EN) wiring for a short to ground condition.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9001 pin A49	All pins in connector **X-9001**	There should be no continuity.

A. If there is continuity, there is a short circuit in the throttle valve actuator Z-9001 output 1 h-bridge circuit. Locate and repair the shorted conductor.

B. If there is no continuity, leave the connector **X-9011** disconnected and continue to Step **4**.

4. Replace the throttle valve actuator Z-9001.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 5D2-03-ECU internal failure - EEPROM memory failure

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 calculates the correction values from the EEPROM. If the ECU A-9000 detects an error n the EEPROM block, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 5D4-02-ECU internal failure - WDA is not working correctly

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 performs “shut-off paths” which deactivate all power stages relevant to fuel injection if certain ECU A-9000 errors are detected. If an implausible response in the power-stage feedback is detected during this test, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 5D4-03-ECU internal failure - Alarm task period error

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 performs “shut-off paths” which deactivate all power stages relevant to fuel injection if certain ECU A-9000 errors are detected. If an alarm task can not be set or reset after having detected a time-out error during this test, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 5D4-04-ECU internal failure - Positive test failed

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 performs “shut-off paths” which deactivate all power stages relevant to fuel injection if certain ECU A-9000 errors are detected. If the ECU A-9000 determines that the test has failed, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 5D4-12-ECU internal failure - Timeout in the shut off path test error

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 performs “shut-off paths” which deactivate all power stages relevant to fuel injection if certain ECU A-9000 errors are detected. If a time-out in the power-stage feedback is detected during this test, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 5E3-03-ECU internal failure - Torque request due to fuel pressure exceeds maximum torque limit

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors “lead torque”, which is the input torque request that is calculated for determining fuel pressure. If the ECU A-9000 determines that “lead torque” is less than the limited maximal torque, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 5E3-04-ECU internal failure - Torque request due to air control exceeds maximum torque limit

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors “lead torque”, which is the input torque request that is calculated for determining fuel pressure. If the ECU A-9000 determines that “lead torque” is less than the limited maximal torque, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 5E3-12-ECU internal failure - Torque request exceeds maximum torque limit

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 calculates and monitors “inner torque”, torque produced by the engine. The ECU A-9000 compares “inner torque” to allowed “inner torque”. If the ECU A-9000 determines that “Inner torque” is greater than allowed “inner torque”, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 601-02-Lambda sensor nernst cell open circuit

Control Module : ECU

NOTE: *If the Lambda sensor B-9123 is replaced, it is necessary to perform the Replacement of the Lambda Sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)****, if necessary.*

Context:
For information regarding the functional operation of the Lambda sensor B-9123 see **Lambda sensor - Overview (55.989)**. The Engine Control Unit (ECU) A-9000 has determined that the Lambda sensor B-9123 nernst signal is not present. The Lambda sensor B-9123 is the primary measurement device for ECU A-9000 fuel control, to determine if the engine is too rich or too lean. For more information regarding the technical specifications of the lambda sensor B-9123, see **Lambda sensor - Technical Data (55.989)**.

Cause:
The ECU A-9000 is sensing an open circuit condition in the Lambda sensor B-9123 nernst signal circuit.

Possible failure modes:

1. Faulty Lambda sensor B-9123 circuit wiring, open circuit.
2. Faulty Lambda sensor B-9123, failed internally.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.

2. Check the Lambda sensor B-9123 nernst signal circuit wiring for an open circuit condition.

   Disconnect the vehicle harness (VE) from the Lambda sensor B-9123 at connector **X-9123**.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity check for an open circuit on the vehicle harness (VE) side :

From	To	Value
X-9123 pin 6	**X-9102 pin K63**	There should be continuity.

   A. If there is no continuity, there is an open circuit condition in the vehicle harness (VE) between connector **X-9123 pin 6** and **X-9102 pin K63**.Use the appropriate vehicle service manual, if necessary, to locate and repair the broken conductor.

   B. If there is continuity, leave connector **X-9123** disconnected and continue to Step **3**.

3. Replace the Lambda sensor B-9123.

   Use the EST, see **Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)** if necessary, to perform the Replacement of the Lambda Sensor - Reset ECU Data.

   Use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, return the machine to service.

   B. If this fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires.

   Verify that the connectors are fully installed.

   Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned.

   Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 602-02-Lambda sensor pump current open circuit

Control Module : ECU

NOTE: *If the Lambda sensor B-9123 is replaced, it is necessary to perform the Replacement of the Lambda Sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 has determined that the Lambda sensor B-9123 pump current is not present. The Lambda sensor B-9123 is the primary measurement device for ECU A-9000 fuel control, to determine if the engine is too rich or too lean. For information regarding the functional operation of the Lambda sensor B-9123 see **Lambda sensor - Overview (55.989)**. For more information regarding the technical specifications of the lambda sensor B-9123, see **Lambda sensor - Technical Data (55.989)**.

Cause:
The ECU A-9000 is sensing an open circuit condition in the Lambda sensor B-9123 pump current control circuit.

Possible failure modes:

1. Faulty Lambda sensor B-9123 pump current control circuit wiring, open circuit.
2. Faulty Lambda sensor B-9123, failed internally.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.

2. Check the Lambda sensor B-9123 pump current control circuit wiring for an open circuit condition.

   Disconnect the vehicle harness (VE) from the Lambda sensor B-9123 at connector **X-9123**.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity check for an open circuit on the vehicle harness (VE) side :

From	To	Result
X-9123 pin 1	**X-9102 pin K64**	There should be continuity.

   A. If there is no continuity, there is an open circuit condition in the vehicle harness (VE) between connector **X-9123 pin 1** and connector **X-9102 pin K64**. Use the appropriate vehicle service manual, if necessary, to locate and repair the broken conductor.

   B. If there is continuity, leave connector **X-9123** disconnected and continue to Step **3**.

3. Replace the Lambda sensor B-9123.

   Use the EST, see **Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)** if necessary, to perform the Replacement of the Lambda Sensor - Reset ECU Data.

   Use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, return the machine to service.

   B. If this fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires.

   Verify that the connectors are fully installed.

   Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned.

   Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 605-03-Lambda sensor O2 value above maximum threshold

Control Module : ECU

NOTE: *If the Lambda sensor B-9123 is replaced, it is necessary to perform the Replacement of the Lambda Sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 has detected a fault associated with the oxygen sensor. This fault is a result of an open circuit condition in the factory installed trim resistor circuit. For information regarding the functional operation of the Lambda sensor B-9123 see **Lambda sensor - Overview (55.989)**. For more information regarding the technical specifications of the lambda sensor B-9123, see **Lambda sensor - Technical Data (55.989)**.

Cause:
The ECU A-9000 is sensing an open circuit condition in the Lambda sensor B-9123 trim resistor circuit.

Possible failure modes:

1. Faulty Lambda sensor B-9123 circuit wiring, open circuit.
2. Faulty Lambda sensor B-9123, failed internally.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.
2. Check the Lambda sensor B-9123 trim resistor circuit wiring for an open or short circuit condition.

   Disconnect the vehicle harness (VE) from the Lambda sensor B-9123 at connector **X-9123**

   Carefully disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to check for continuity on the vehicle harness (VE) side :

From	To	Value
X-9123 pin 5	**X-9102 pin K86**	There should be continuity.
X-9102 pin K86	All other pins on connector **X-9102**	There should be no continuity.

   A. If there is no continuity, there is an open circuit condition in the Lambda sensor B-9123 trim resistor circuit wiring in the vehicle harness (VE). Use the appropriate vehicle service manual, if necessary, to locate and repair the broken conductor.

   B. If there is continuity, continue with Step **3**.
3. Replace the Lambda sensor B-9123.

   Use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, return the machine to service.

   B. If this fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.
4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires.

Verify that the connectors are fully installed.

Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned.

Operate the machine while you monitor the display.

A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 606-02-Lambda sensor virtual ground open circuit

Control Module : ECU

NOTE: *If the Lambda sensor B-9123 is replaced, it is necessary to perform the Replacement of the Lambda Sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)****, if necessary.*

Context:
For information regarding the functional operation of the Lambda sensor B-9123 see **Lambda sensor - Overview (55.989)**. The Engine Control Unit (ECU) A-9000 has determined that the Lambda sensor B-9123 virtual ground circuit is open. The Lambda sensor B-9123 is the primary measurement device for ECU A-9000 fuel control, to determine if the engine is too rich or too lean. For more information regarding the technical specifications of the lambda sensor B-9123, see **Lambda sensor - Technical Data (55.989)**.

Cause:
The ECU A-9000 is sensing an open circuit condition in the Lambda sensor B-9123 virtual ground circuit.

Possible failure modes:

1. Faulty Lambda sensor B-9123 virtual ground circuit wiring, open circuit.
2. Faulty Lambda sensor B-9123, failed internally.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.
2. Check the Lambda sensor B-9123 virtual ground circuit wiring for an open circuit condition.

   Disconnect the vehicle harness (VE) from the Lambda sensor B-9123 at connector **X-9123**.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity check for an open circuit on the vehicle harness (VE) side :

From	To	Value
X-9123 pin 2	**X-9102 pin K85**	There should be continuity.

   A. If there is no continuity, there is an open circuit condition in the vehicle harness (VE) between connector **X-9123 pin 2** and **X-9102 pin K85**.Use the appropriate vehicle service manual, if necessary, to locate and repair the broken conductor.

   B. If there is continuity, continue with Step **3**.
3. Replace the Lambda sensor B-9123.

   Use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, use the EST, see **Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)** if necessary, to perform the Replacement of the Lambda Sensor - Reset ECU Data. Then return the machine to service.

   B. If this fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires.

   Verify that the connectors are fully installed.

   Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned.

   Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 607-03-Lambda sensor O2 calibrator too high error

Control Module : ECU

NOTE: *If the Lambda sensor B-9123 is replaced, it is necessary to perform the Replacement of the Lambda Sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 performs an electrical zero-offset calibration every **10 min** of engine operation on the Lambda sensor B-9123 as long as the engine has been running for longer than **10 s** after start, after-treatment regeneration is not active, the engine is in operating range one (speed between **300 - 1200 RPM** and load between **2.00 - 11.00 mg** per stroke), and the calibration is not inhibited due to a failure. The measured oxygen signal during calibration should be between **- 0.200 - 0.200 V**. If the oxygen signal, during this calibration, is out of range, higher than **0.200 V**, this fault will occur. For more information regarding fuel system troubleshooting, see **Fuel injection system - Troubleshooting (10.218)**. For information regarding the functional operation of the Lambda sensor B-9123 see **Lambda sensor - Overview (55.989)**. For more information regarding the technical specifications of the lambda sensor B-9123, see **Lambda sensor - Technical Data (55.989)**.

Cause:
The Lambda sensor B-9123 oxygen level signal, during calibration, to the ECU A-9000 is greater than **0.200 V**.

Possible failure modes:

1. Faulty injector, leaking.
2. Faulty Exhaust Gas Recirculation (EGR) Z-9000 valve, stuck closed. (If applicable)
3. Faulty Lambda sensor B-9123, contaminated.
4. Faulty ECU A-9000, software.

DTC 607-04-Lambda sensor O2 calibrator too low error

Control Module : ECU

NOTE: *If the Lambda sensor B-9123 is replaced, it is necessary to perform the Replacement of the Lambda Sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 performs an electrical zero-offset calibration every **10 min** of engine operation on the Lambda sensor B-9123 as long as the engine has been running for longer than **10 s** after start, after-treatment regeneration is not active, the engine is in operating range one (speed between **300 - 1200 RPM** and load between **2.00 - 11.00 mg** per stroke), and the calibration is not inhibited due to a failure. The measured oxygen signal during calibration should be between **- 0.200 - 0.200 V**. If the oxygen signal, during this calibration, is out of range, less than **- 0.200 V**, this fault will occur. For more information regarding fuel system troubleshooting, see **Fuel injection system - Troubleshooting (10.218)**. For information regarding the functional operation of the Lambda sensor B-9123 see **Lambda sensor - Overview (55.989)**. For more information regarding the technical specifications of the lambda sensor B-9123, see **Lambda sensor - Technical Data (55.989)**.

Cause:
The Lambda sensor B-9123 oxygen level signal, during calibration, to the ECU A-9000 is less than **– 0.200 V**.

Possible failure modes:

1. Faulty fuel back-flow, excessive.
2. Faulty Exhaust Gas Recirculation (EGR) Z-9000 valve, stuck open. (If applicable)
3. Faulty Lambda sensor B-9123, contaminated.
4. Faulty ECU A-9000, software.

DTC 609-02-ECU internal failure - SPI chip error configuration

Control Module : ECU

Context:
The SPI chip, which is internal to the ECU A-9000, controls the Lambda sensor B-9123 device for the measuring or the calibrating of the inner resistance for temperature evaluation, switches on and off the pump current to measure O2 content and monitors the hardware related to the open load and short circuit monitoring devices. The requests for these listed actions are made by software and result in a configuration of the initialization register, which is hardware controlled. The same configuration is calculated by software. If both configurations are not identical, the SPI is not plausible and this fault will occur. For information regarding the functional operation of the Lambda sensor B-9123 see **Lambda sensor - Overview (55.989)**. For more information regarding the technical specifications of the lambda sensor B-9123, see **Lambda sensor - Technical Data (55.989)**.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 60A-04-Lambda sensor heater battery voltage too low

Control Module : ECU

NOTE: *If the Lambda sensor B-9123 is replaced, it is necessary to perform the Replacement of the Lambda Sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)****, if necessary.*

Context:
The SPI chip, which is internal to the ECU A-9000, controls the Lambda sensor B-9123 device for the measuring or the calibrating of the inner resistance for temperature evaluation, switches on and off the pump current to measure O2 content and monitors the hardware related to the open load and short circuit monitoring devices. If the SPI chip senses a very low battery voltage, less than **9.0 V** this fault will occur. For information regarding the functional operation of the Lambda sensor B-9123 see **Lambda sensor - Overview (55.989)**. For more information regarding the technical specifications of the lambda sensor B-9123, see **Lambda sensor - Technical Data (55.989)**.

Cause:
The ECU has sensed low voltage in the lambda sensor circuit.

Possible failure modes:

1. Low battery voltage.
2. Faulty Lambda sensor B-9123 supply circuit wiring.
3. Faulty Lambda sensor B-9123, failed internally.
4. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check for fault codes related to low battery voltage.

   A. If fault codes are active for low battery voltage, correct other active fault codes first.

   B. If the battery voltage is within specification, continue with Step **3**.

   NOTE: *Normal battery voltage for a* ***12.0 V*** *system is approximately* ***10.0 - 12.5 V****. The low voltage fault range may vary by product.*
3. Check the Lambda sensor B-9123 heater circuit wiring for an open circuit condition.

   Disconnect the vehicle harness (VE) from the Lambda sensor B-9123 at connector **X-9123**.

   With the key switch in the ON position, use a multimeter to check for voltage on the vehicle harness (VE) side :

From	To	Result
X-9123 pin 4	chassis ground	There should be approximately **12.0 V**.

   A. If the voltage reading is incorrect, check the wiring harness between connector **X-9123 pin 4**, and the Main relay K-9102 cavity **X-9129**.

   B. If the voltage reading is correct, continue with Step **4**.
4. Replace the Lambda sensor B-9123.

Use EST to check to see that this fault has been resolved.

A. If the fault has been resolved, return the machine to service.

B. If this fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 (55.100)

DTC 60B-03-Lambda sensor cell circuits short circuit to battery

Control Module : ECU

NOTE: *If the Lambda sensor B-9123 is replaced, it is necessary to perform the Replacement of the Lambda Sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors the condition of the nernst cell, pump cell and virtual ground circuits. If the ECU A-9000 detects a short to a voltage source condition in any of the circuits or an open circuit condition in the virtual ground circuit, this fault will occur. For information regarding the functional operation of the Lambda sensor B-9123 see **Lambda sensor - Overview (55.989)**. For more information regarding the technical specifications of the lambda sensor B-9123, see **Lambda sensor - Technical Data (55.989)**.

Cause:
The ECU A-9000 is sensing an open circuit condition in the Lambda sensor B-9123 virtual ground circuit or a short to a voltage source condition in the nernst cell, pump cell or virtual ground circuit.

Possible failure modes:

1. Faulty Lambda sensor B-9123 nernst cell, pump cell, or virtual ground circuit wiring, short to a voltage source.
2. Faulty Lambda sensor B-9123 virtual ground circuit wiring, open circuit.
3. Faulty Lambda sensor B-9123, internal failure.
4. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.

2. Check the Lambda sensor B-9123 nernst cell, pump cell, and virtual ground circuit wiring for a short to voltage condition.

   Disconnect the vehicle harness (VE) from the Lambda sensor B-9123 at connector **X-9123**.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key switch in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Result
X-9102 pin K64	all pins in connector **X-9102**.	There should be no continuity.
X-9102 pin K85	all pins in connector **X-9102**.	There should be no continuity.
X-9102 pin K63	all pins in connector **X-9102**.	There should be no continuity.
X-9102 pin K86	all pins in connector **X-9102**.	There should be no continuity.

   With the key switch in the ON position, use a multimeter to perform the following voltage check on the vehicle harness (VE) side :

From	To	Result
X-9102 pin K64	chassis ground	There should be no voltage.
X-9102 pin K85	chassis ground	There should be no voltage.
X-9102 pin K63	chassis ground	There should be no voltage.
X-9102 pin K86	chassis ground	There should be no voltage.

A. If there is no continuity or voltage, leave connector **X-9123** and connector **X-9102** disconnected and continue to Step **3**.

B. If there is continuity or voltage, there is a short circuit condition is in the lambda sensor B-9123 wiring in the vehicle harness (VE). Use the appropriate vehicle service manual, if necessary, to locate and repair the damaged conductors.

3. Check the Lambda sensor B-9123 virtual ground circuit wiring for an open circuit condition.

   With the key in the OFF position, use a multimeter to check for continuity on the vehicle harness (VE) side :

From	To	Result
X-9123 pin 2	**X-9102 pin K85**	There should be continuity.

   A. If there is no continuity, there is an open circuit condition in the vehicle harness (VE) between connector **X-9123 pin 2** and **X-9102 pin K85**.Use the appropriate service manual, if necessary, to locate and repair the broken conductor.

   B. If there is continuity, leave connector **X-9123** disconnected and continue to Step **4**.

4. Replace the Lambda sensor B-9123.

   Use the EST, see **Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)** if necessary, to perform the Replacement of the Lambda Sensor - Reset ECU Data.

   Use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, return the machine to service.

   B. If this fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 60B-04-Lambda sensor cell circuits short circuit to ground

Control Module : ECU

NOTE: *If the Lambda sensor B-9123 is replaced, it is necessary to perform the Replacement of the Lambda Sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors the condition of the Lambda sensor B-9123 nernst cell, pump cell and virtual ground circuits. If the ECU A-9000 detects a short to ground in any of the circuits, this fault will occur. For information regarding the functional operation of the Lambda sensor B-9123 see **Lambda sensor - Overview (55.989)**. For information regarding the technical specifications of the lambda sensor B-9123, see **Lambda sensor - Technical Data (55.989)**.

Cause:
The ECU A-9000 is sensing a short to ground condition in the Lambda sensor B-9123 nernst cell, pump cell or virtual ground circuit.

Possible failure modes:

1. Faulty Lambda sensor B-9123 circuit wiring, short to ground condition.
2. Faulty Lambda sensor B-9123, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.

2. Check the Lambda sensor B-9123 circuit wiring for a short to ground condition.

   Disconnect the vehicle harness (VE) from the Lambda sensor B-9123 at connector **X-9123**.

   Disconnect the vehicle harness (VE) from the ECU A-9000 at connector **X-9102**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Result
X-9123 pin 1	chassis ground	There should be no continuity.
X-9123 pin 2	chassis ground	There should be no continuity.
X-9123 pin 6	chassis ground	There should be no continuity.

   A. If there is continuity on any of the checks, there is a short to ground condition in the lambda sensor B-9123 vehicle harness (VE) wiring. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity on any of the checks, leave connector **X-9123** disconnected and continue to Step **3**.

3. Replace the Lambda sensor B-9123.

   Use the EST, see **Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)** if necessary, to perform the Replacement of the Lambda Sensor - Reset ECU Data.

   Use EST to check to see that this fault has been resolved.

A. If the fault has been resolved, return the machine to service.

B. If this fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 60C-03-Lambda sensor estimated temperature higher than threshold

Control Module : ECU

NOTE: *If the Lambda sensor B-9123 is replaced, it is necessary to perform the Replacement of the Lambda Sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors the internal resistance of the nernst cell to estimate the internal temperature of the Lambda sensor B-9123. If the ECU A-9000 calculates the internal temperature to be greater than **929.96 °C** (**1705.9 °F**), this fault will occur. For information regarding the functional operation of the Lambda sensor B-9123 see **Lambda sensor - Overview (55.989)**. For more information regarding the technical specifications of the lambda sensor B-9123, see **Lambda sensor - Technical Data (55.989)**.

Cause:
The ECU A-9000 calculated temperature, based on inner resistance, of the Lambda sensor B-9123 is greater than **929.96 °C** (**1705.9 °F**).

Possible failure modes:

1. Faulty Lambda sensor B-9123 nernst cell circuit wiring, shorted to ground.
2. Faulty Lambda sensor B-9123 connection, loose.
3. Faulty Lambda sensor B-9123, failed internally.
4. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Visually inspect the Lambda sensor B-9123 for proper connection.

   A. If the Lambda sensor B-9123 is not properly connected or is loose, repair as necessary.

   B. If the Lambda sensor B-9123 is properly connected, continue to Step **3**.
3. Check the Lambda sensor B-9123 nernst cell circuit wiring for a short to ground condition.

   Disconnect the vehicle harness (VE) from the Lambda sensor B-9123 at connector **X-9123**.

   With the key in the OFF position, use a multimeter to check for continuity on the vehicle harness (VE) side :

From	To	Result
X-9123 pin 6	chassis ground	There should be no continuity.

   A. If there is continuity, there is a short to ground condition in the Lambda sensor B-9123 nernst cell circuit wiring in the vehicle harness (VE). Use the appropriate vehicle service manual, if necessary, to locate and repair the grounded conductor.

   B. If there is no continuity, continue with Step **4**.
4. Replace the Lambda sensor B-9123.

   Use EST to check to see that this fault has been resolved.

A. If the fault has been resolved, return the machine to service.

B. If this fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires.

   Verify that the connectors are fully installed.

   Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned.

   Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 60C-04-Lambda sensor estimated temperature lower than threshold

Control Module : ECU

NOTE: *If the Lambda sensor B-9123 is replaced, it is necessary to perform the Replacement of the Lambda Sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See* ***Lambda sensor - Configure - Reset ECU data (Lambda sensor) (55.989)****, if necessary.*

Context:
The Engine Control Unit (ECU) A-9000 monitors the internal resistance of the nernst cell to estimate the internal temperature of the Lambda sensor B-9123. If the ECU A-9000 calculates the internal temperature to be equal to or less than **719.96 °C** (**1327.9 °F**), this fault will occur. For information regarding the functional operation of the Lambda sensor B-9123 see **Lambda sensor - Overview (55.989)**. For more information regarding the technical specifications of the lambda sensor B-9123, see **Lambda sensor - Technical Data (55.989)**.

Cause:
The ECU A-9000 calculated temperature, based on inner resistance, of the Lambda sensor B-9123 is below or equal to **719.96 °C** (**1327.9 °F**).

Possible failure modes:

1. Faulty Lambda sensor B-9123 nernst cell or virtual ground circuit wiring, open circuit.
2. Faulty Lambda sensor B-9123, failed internally.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.
2. Check the Lambda sensor B-9123 nernst cell and virtual ground circuit wiring for an open circuit condition.

   Disconnect the vehicle harness (VE) from the Lambda sensor B-9123 at connector **X-9123**.

   With the key in the OFF position, use a multimeter to check for continuity on the vehicle harness (VE) side :

From	To	Value
X-9123 pin 2	**X-9102 pin K85**	There should be continuity.
X-9123 pin 6	**X-9102 pin K63**	There should be continuity.

   A. If there is no continuity, there is an open circuit in the Lambda sensor B-9123 nernst cell or virtual ground circuit wiring in the vehicle harness (VE). Use the appropriate vehicle service manual, if necessary, to locate and repair the broken conductor.

   B. If there is continuity on both checks, continue with Step **3**.
3. Replace the Lambda sensor B-9123.

   Use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, return the machine to service.

   B. If this fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires.

   Verify that the connectors are fully installed.

   Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned.

   Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

DTC 68D-03-Throttle valve actuator control circuit low side shorted to battery

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the throttle valve actuator Z-9001 output 1and output 2 h-bridge circuits. If the ECU A-9000 detects a short to high source condition in the throttle valve actuator Z-9001 output 2 h-bridge circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a short to high source condition in the throttle valve actuator Z-9001 output 2 h-bridge circuit.

Possible failure modes:

1. Faulty throttle valve actuator Z-9001 wiring, short to a voltage source.
2. Faulty throttle valve actuator Z-9001, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check the throttle valve actuator Z-9001 output 2 h-bridge wiring for a short to battery condition.

   Disconnect the engine harness (EN) from the throttle valve actuator Z-9001 at connector **X-9011**.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9011 pin 2	Chassis ground	There should be no voltage.

   A. If there is voltage, there is a short to battery in the throttle valve actuator Z-9001 output 2 h-bridge circuit. Locate and repair the shorted conductor.

   B. If there is no voltage, leave connectors **X-9011** and **X-9001** disconnected and continue to Step **3**.
3. Check the throttle valve actuator Z-9001 engine harness (EN) wiring for a short to a voltage source condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9011 pin 2	**X-9011 pin 6**	There should be no continuity.
X-9011 pin 2	**X-9011 pin 1**	There should be no continuity.
X-9011 pin 2	**X-9011 pin 5**	There should be no continuity.
X-9001 pin A34	All pins in connector **X-9001**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the throttle valve actuator Z-9001 output 2 h-bridge circuit. Locate and repair the shorted conductor.

B. If there is no continuity, leave connector **X-9011** disconnected and continue to Step **4**.

4. Replace the throttle valve actuator Z-9001.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 68D-04-Throttle valve actuator control circuit low side shorted to ground

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the throttle valve actuator Z-9001 output 1 and output 2 h-bridge circuits. If the ECU A-9000 detects a short to ground condition in the throttle valve actuator Z-9001 output 2 h-bridge circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a short to ground condition in the throttle valve actuator Z-9001 output 2 h-bridge circuit.

Possible failure modes:

1. Faulty throttle valve actuator Z-9001 wiring, short to ground condition.
2. Faulty throttle valve actuator Z-9001, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.

2. Check the throttle valve actuator Z-9001 output 2 h-bridge engine harness (EN) wiring for a short to ground condition.

   Disconnect the engine harness (EN) from the throttle valve actuator Z-9001 at connector **X-9011**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9011 pin 2	Chassis ground	There should be no continuity.
X-9011 pin 2	**X-9011 pin 3**	There should be no continuity.
X-9011 pin 2	**X-9011 pin 6**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the throttle valve actuator Z-9001 output 2 h-bridge circuit. Locate and repair the shorted conductor.

   B. If there is no continuity, leave connector **X-9011** disconnected and continue to Step **3**.

3. Check the throttle valve actuator Z-9001 output 2 h-bridge engine harness (EN) wiring for a short to ground condition.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9001 pin A34	All pins in connector **X-9001**	There should be no continuity.

A. If there is continuity, there is a short circuit in the throttle valve actuator Z-9001 output 2 h-bridge circuit. Locate and repair the shorted conductor.

B. If there is no continuity, continue to Step **4**.

4. Replace the throttle valve actuator Z-9001.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 6D4-02-ECU internal failure - 'WDA active' reported due to errors in query/response communication

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the communication between CJ945 (power stage chips) and CY320 (power stage voltage supplier). If the ABE wire between the CJ-945 and CY320 becomes active due to an unknown reason, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 6D4-03-ECU internal failure - 'ABE active' reported due to overvoltage detection

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the communication between CJ945 (power stage chips) and CY320 (power stage voltage supplier). If the ABE wire between the CJ-945 and CY320 becomes active due to an over-voltage detection, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 6D4-04-ECU internal failure - 'ABE active' reported due to undervoltage detection

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the communication between CJ945 (power stage chips) and CY320 (power stage voltage supplier). If the ABE wire between the CJ-945 and CY320 becomes active due to an under-voltage detection, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 6D4-12-ECU internal failure - 'WDA/ABE active' reported

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the communication between CJ945 (power stage chips) and CY320 (power stage voltage supplier). If there is an unexpected communication during this process, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

DTC 72C-00-Glow plug 1 control circuit shorted to ground

Control Module : ECU

Context:
For information regarding the functional operation of the glow plug control module Z-9101 see **Glow plug system Glow plug control module - Overview – Glow plug control module (55.202)**. The Engine Control Unit (ECU) A-9000 requests operation of the glow plug control module Z-9101 via a Pulse Width Modulated (PWM) control circuit and monitors the status of possible electrical defects via a diagnostic feedback signal from the glow plug control module Z-9101. If the ECU A-9000 is notified of a short circuit condition in the glow plug 1 R-9001 circuit, this fault will occur.

Cause:
The glow plug control module Z-9101 has communicated to the ECU A-9000, via a diagnostic connection, that a short circuit condition exists in the glow plug 1 R-9001 circuit.

Possible failure modes:

1. Faulty glow plug 1 R-9001, internal failure.
2. Faulty glow plug 1 R-9001 control circuit wiring, shorted to ground.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.

2. Check the glow plug for a short to ground condition.

   Disconnect the engine harness (EN) from glow plug 1 R-9001 at connector **X-9034**.

   Use a multimeter to check on the component for a grounded (shorted) condition :

From	To	Result
X-9034 pin 1	chassis ground	There should be **0.2 - 5.0 Ω**.

   A. If there is greater than **0.2 Ω**, leave connector **X-9034** disconnected and continue with Step **3**.

   B. If there is less than **0.2 Ω**, the glow plug 1 R-9001 has failed internally, replace the glow plug.

3. Check the glow plug 1 R-9001 control circuit for a short to ground condition.

   With the key switch in the OFF position, use a multimeter to check for continuity on the engine harness (EN) side :

From	To	Result
X-9034 pin 1	chassis ground	There should be no continuity.

   A. If there is continuity, continue with Step **4**.

   B. If there is no continuity, continue with Step **5**.

4. Locate the short to ground condition.

   Carefully disconnect the vehicle harness (VE) from the glow plug control module Z-9101 at connector **X-9113**.

   With the key switch in the OFF position, use a multimeter to check for continuity on the vehicle harness (VE) side :

From	To	Result
X-9113 pin 2	chassis ground	There should be no continuity.

A. If there is continuity, the short to chassis ground condition is glow plug wiring in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the grounded conductor.

B. If there is no continuity, continue with Step **6**.

5. Replace the glow plug control module Z-9101, then use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)

DTC 72C-01-Glow plug 3 control circuit shorted to ground

Control Module : ECU

Context:
For information regarding the functional operation of the glow plug control module Z-9101 see **Glow plug system Glow plug control module - Overview – Glow plug control module (55.202)**. The Engine Control Unit (ECU) A-9000 requests operation of the glow plug control module Z-9101 via a Pulse Width Modulated (PWM) control circuit and monitors the status of possible electrical defects via a diagnostic feedback signal from the glow plug control module Z-9101. If the ECU A-9000 is notified of a short circuit condition in the glow plug 3 R-9003 circuit, this fault will occur.

Cause:
The glow plug control module Z-9101 has communicated to the ECU A-9000, via a diagnostic connection, that a short circuit condition exists in the glow plug 3 R-9003 circuit.

Possible failure modes:

1. Faulty glow plug 3 R-9003, internal failure.
2. Faulty glow plug 3 R-9003 control circuit wiring, shorted to ground.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.

2. Check the glow plug for a short to ground condition.

   Disconnect the engine harness (EN) from glow plug 3 R-9003 at connector **X-9036**.

   Use a multimeter to check on the component for a grounded (shorted) condition :

From	To	Result
X-9036 pin 1	chassis ground	There should be **0.2 - 5.0 Ω**.

   A. If there is greater than **0.2 Ω**, leave connector **X-9036** disconnected and continue with Step **3**.

   B. If there is less than **0.2 Ω**, the glow plug 3 R-9003 has failed internally, replace the glow plug.

3. Check the glow plug 3 R-9003 control circuit for a short to ground condition.

   With the key switch in the OFF position, use a multimeter to check for continuity on the engine harness (EN) side :

From	To	Result
X-9036 pin 1	chassis ground	There should be no continuity.

   A. If there is continuity, continue with Step **4**.

   B. If there is no continuity, continue with Step **5**.

4. Locate the short to ground condition.

   Carefully disconnect the vehicle harness (VE) from the glow plug control module Z-9101 at connector **X-9113**.

   With the key switch in the OFF position, use a multimeter to check for continuity on the vehicle harness (VE) side :

From	To	Result
X-9113 pin 1	chassis ground	There should be no continuity.

A. If there is continuity, the short to chassis ground condition is in the glow plug circuit in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the grounded conductor.

B. If there is no continuity, continue with Step **6**.

5. Replace the glow plug control module Z-9101, then use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)

DTC 72C-03-Glow plug 2 control circuit shorted to ground

Control Module : ECU

Context:
For information regarding the functional operation of the glow plug control module Z-9101 see **Glow plug system Glow plug control module - Overview – Glow plug control module (55.202)**. The Engine Control Unit (ECU) A-9000 requests operation of the glow plug control module Z-9101 via a Pulse Width Modulated (PWM) control circuit and monitors the status of possible electrical defects via a diagnostic feedback signal from the glow plug control module Z-9101. If the ECU A-9000 is notified of a short circuit condition in the glow plug 2 R-9002 circuit, this fault will occur.

Cause:
The glow plug control module Z-9101 has communicated to the ECU A-9000, via a diagnostic connection, that a short circuit condition exists in the glow plug 2 R-9002 circuit.

Possible failure modes:

1. Faulty glow plug 2 R-9002, internal failure.
2. Faulty glow plug 2 R-9002 control circuit wiring, shorted to ground.
3. Faulty ECU A-9000, software.

Solution:

1. Verify that the fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **6**.

2. Check the glow plug for a short to ground condition.

   Disconnect the engine harness (EN) from glow plug 2 R-9002 at connector **X-9035**.

   Use a multimeter to check on the component for a grounded (shorted) condition :

From	To	Result
X-9035 pin 1	chassis ground	There should be **0.2 - 5.0 Ω**.

   A. If there is greater than **0.2 Ω**, leave connector **X-9035** disconnected and continue with Step **3**.

   B. If there is less than **0.2 Ω**, the glow plug 2 R-9002 has failed internally, replace the glow plug.

3. Check the glow plug 2 R-9002 control circuit for a short to ground condition.

   With the key switch in the OFF position, use a multimeter to check for continuity on the engine harness (EN) side :

From	To	Result
X-9035 pin 1	chassis ground	There should be no continuity.

   A. If there is continuity, continue with Step **4**.

   B. If there is no continuity, continue with Step **5**.

4. Locate the short to ground condition.

   Carefully disconnect the vehicle harness (VE) from the glow plug control module Z-9101 at connector **X-9113**.

   With the key switch in the OFF position, use a multimeter to check for continuity on the vehicle harness (VE) side :

From	To	Result
X-9113 pin 7	chassis ground	There should be no continuity.

A. If there is continuity, the short to chassis ground condition is in glow plug circuit in the vehicle harness (VE). Use the appropriate service manual, if necessary, to locate and repair the grounded conductor.

B. If there is no continuity, continue with Step **6**.

5. Replace the glow plug control module Z-9101, then use EST to check to see that this fault has been resolved.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

6. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 01 – Power distribution and glow plugs (engine schematics) (55.100.DP-C.20.E.01)

DTC 78B-03-Throttle valve actuator position sensor voltage is higher than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the throttle valve actuator Z-9001 position sensor signal circuit. If the ECU A-9000 detects a voltage greater than **4.75 V** in the throttle valve actuator Z-9001 position sensor signal circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a voltage greater than **4.75 V** in the throttle valve actuator Z-9001 position sensor signal circuit.

Possible failure modes:

1. Faulty throttle valve actuator Z-9001 wiring, short to a voltage source.
2. Faulty throttle valve actuator Z-9001, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **7**.
2. Check the throttle valve actuator Z-9001 position sensor engine harness (EN) wiring for a short to battery condition.

   Disconnect the engine harness (EN) from the throttle valve actuator Z-9001 at connector **X-9011**.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

From	To	Value
X-9011 pin 5	Chassis ground	There should be no voltage.

   A. If there is voltage, there is a short to battery in the throttle valve actuator Z-9001 position sensor signal circuit in the engine harness (EN). Locate and repair the shorted conductor.

   B. If there is no voltage, leave connectors **X-9011** and **X-9001** disconnected and continue to Step **3**.
3. Check the throttle valve actuator Z-9001 position sensor engine harness (EN) wiring for a short circuit condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9011 pin 5	**X-9011 pin 1**	There should be no continuity.
X-9011 pin 5	**X-9011 pin 3**	There should be no continuity.
X-9011 pin 5	**X-9011 pin 6**	There should be no continuity.
X-9011 pin 5	**X-9011 pin 2**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the throttle valve actuator Z-9001 position sensor signal circuit in the engine harness (EN). Locate and repair the shorted conductor.

B. If there is no continuity, leave connectors **X-9011** and **X-9001** disconnected and continue to Step **4**.

4. Check the throttle valve actuator Z-9001 position sensor engine harness (EN) wiring for an open circuit.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9011 pin 5	**X-9001 pin A53**	There should be continuity.
X-9011 pin 1	**X-9001 pin A08**	There should be continuity.
X-9011 pin 3	**X-9001 pin A37**	There should be continuity.
NOTE: *Wiggle the harness during the check to promote an intermittent electrical connection.*		

   A. If there is no continuity, there is an open circuit in the throttle valve actuator Z-9001 position sensor signal circuit in the engine harness (EN). Locate and repair the broken conductor.

   B. If there is continuity, leave connectors **X-9011** and **X-9001** disconnected and continue to Step **5**.

5. Check the throttle valve actuator Z-9001 position sensor vehicle harness (VE) wiring for a short to a voltage source condition.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-9001 pin A53	All pins in connector **X-9001**.	There should be no continuity.

   A. If there is continuity, there is a short to a voltage source in the throttle valve actuator Z-9001 position sensor signal circuit in the engine harness (EN). Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

   B. If there is no continuity, leave connector **X-9011** disconnected and continue to Step **6**.

6. Replace the throttle valve actuator Z-9001.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.

7. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 78B-04-Throttle valve actuator position sensor voltage is lower than expected

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the throttle valve actuator Z-9001 position sensor signal circuit. If the ECU A-9000 detects a voltage less than **0.25 V** in the throttle valve actuator Z-9001 position sensor signal circuit, this fault will occur.

Cause:
The ECU A-9000 has detected a voltage less than **0.25 V** in the throttle valve actuator Z-9001 position sensor signal circuit.

Possible failure modes:

1. Faulty throttle valve actuator Z-9001 wiring, short to ground condition.
2. Faulty throttle valve actuator Z-9001, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check the throttle valve actuator Z-9001 position sensor engine harness (EN) wiring for a short to ground condition.

   Disconnect the engine harness (EN) from the throttle valve actuator Z-9001 at connector **X-9011**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9011 pin 5	Chassis ground	There should be no continuity.
X-9011 pin 5	**X-9011 pin 3**	There should be no continuity.
X-9011 pin 5	**X-9011 pin 2**	There should be no continuity.

   A. If there is continuity, there is a short to ground condition in the throttle valve actuator Z-9001 position sensor signal circuit in the engine harness (EN).Locate and repair the shorted conductor.

   B. If there is no continuity, leave connector **X-9011** disconnected and continue to Step **3**.
3. Check the throttle valve actuator Z-9001 position sensor vehicle harness (VE) wiring for a short to ground condition.

   Disconnect the engine harness (EN) from the ECU A-9000 at connector **X-9001**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9001 pin A53	All pins in connector **X-9001**	There should be no continuity.

   A. If there is continuity, there is a short to ground in the throttle valve actuator Z-9001 engine harness (EN) position sensor signal circuit. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no continuity, leave connector **X-9011** disconnected and continue to Step **4**.

4. Replace the throttle valve actuator Z-9001.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 78D-03-Throttle valve actuator control circuit over load

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 monitors the throttle valve actuator Z-9001 output 1 and output 2 h-bridge circuits. The ECU A-9000 monitors both circuits for a short circuit condition. If the ECU A-9000 determines that the output 1 circuit and output 2 circuits are shorted together, this fault will occur.

Cause:
The ECU A-9000 has detected a short circuit between the throttle valve actuator Z-9001 output 1 and output 2 h-bridge circuits.

Possible failure modes:

1. Faulty throttle valve actuator Z-9001 h-bridge wiring short circuit.
2. Faulty throttle valve actuator Z-9001, internal failure.
3. Faulty ECU A-9000, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.

2. Check the throttle valve actuator Z-9001 h-bridge circuit engine harness (EN) wiring for a short circuit.

   Disconnect the engine harness (EN) from the throttle valve actuator Z-9001 at connector **X-9011**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
X-9011 pin 2	**X-9011 pin 6**	There should be no continuity.

   A. If there is continuity, there is a short circuit in the throttle valve actuator Z-9001 h-bridge wiring. Locate and repair the shorted conductor.

   B. If there is no continuity, leave connector **X-9011** disconnected and continue to Step **3**.

3. Replace the throttle valve actuator Z-9001.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, return the machine to service.

   B. If the fault is still active, check the ECU A-9000 for the appropriate service manual and re-flash, if necessary.

4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 03 – Engine sensors and fuel injection (engine schematics) (55.100.DP-C.20.E.03)

DTC 78D-04-Throttle valve actuator control circuit supply voltage too low

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 internally monitors the operation of the H-bridge Pulse Width Modulated (PWM) control circuit for the Throttle Valve Actuator (TVA) Z-9001 motor actuator for electrical defects. If the ECU A-9000 senses too low an output driver supply voltage, this fault will occur.

Cause:
The ECU A-9000 is sensing too high a system voltage fluctuation.

Solution:

1. Verify that the fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continues with Step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with Step **4**.
2. Check for related faults.

   Use the EST to check for faults relative to low battery, control system voltage level or throttle valve actuator Z-9001.

   A. If low voltage level faults are present, resolve those faults and then return to this fault.

   B. If no low voltage level faults are present, continue with Step **3**.
3. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   A. If the fault has been resolved, return the machine to service.

   B. If the fault has not been resolved, escalate an ASIST concern.
4. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed.

   Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned.

   Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

DTC 7BA-02-Timeout Error of CAN-Receive-Frame CM1BC

Control Module : ECU

Context:
The Engine Control Unit (ECU) A-9000 is capable of connecting to and communicating on two separate Controller Area Networks (CAN). Proper configuration and monitoring of the two twisted pair configured networks is also a function of the ECU A-9000. CAN Node A Bus is the main vehicle interface bus. The ECU A-9000 provides a CAN termination resistor for the CAN Node A Bus, internal to the ECU A-9000. If the ECU A-9000 senses that CAN Node A Bus is not functioning properly, this fault will occur.

Cause:
ECU A-9000 has sensed a timeout of required vehicle controller data provided on CAN Node A.

Possible failure modes:

1. Faulty supply voltage or ground, missing.
2. Faulty CAN circuit wiring, open circuit, short to ground, or short circuit.
3. Faulty ECU A-9000, termination resistor or software.

Solution:

1. Verify fault is present and in active state.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with Step **2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with Step **5**.
2. Check for other vehicle CAN faults.

   Use the EST to determine if vehicle CAN faults exist.

   A. If other vehicle CAN faults do exist, resolve the vehicle CAN faults, then check to see that this fault is also resolved.

   B. If other vehicle CAN faults do not exist, continue with Step **3**.
3. Check the ECU A-9000 supply voltage.

   Disconnect the vehicle (VE) harness from the ECU A-9000 at connector **X-9102**.

   To energize the Main relay K-9102, place a jumper wire between the vehicle harness (VE) side of connector **X-9102 pin K28** and chassis ground.

   With the key switch in the “ON” position, use a multimeter to check for voltage on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K01	**X-9102 pin K02**	There should be approximately **12.0 V**.
X-9102 pin K03	**X-9102 pin K04**	There should be approximately **12.0 V**.
X-9102 pin K05	**X-9102 pin K06**	There should be approximately **12.0 V**.

   A. If the voltage is present on all of the checks, leave connector **X-9102** disconnected and continue with Step **4**.

   B. If the voltage is not present for one or more of the checks, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore supply power to the ECU A-9000.

4. Determine the condition of the ECU A-9000 CAN circuit.

   With the key switch in the OFF position, use a multimeter to measure the resistance of the CAN connection on the vehicle (VE) harness side:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.
X-9102 pin K24	chassis ground	There should be no continuity
X-9102 pin K25	chassis ground	There should be no continuity

   Use a multimeter to measure the resistance of the CAN termination resistor, internal to the ECU A-9000:

From	To	Value
X-9102 pin K24	**X-9102 pin K25**	There should be **120 Ω**.

   A. If the measured resistances are correct and neither conductor is grounded, check the ECU A-9000 for the appropriate software and re-flash, if necessary.

   B. If the measured resistances are not correct or one or both of the conductors is grounded, see the appropriate vehicle service manual and electrical schematics, if necessary, to locate and restore the termination resistance to the CAN circuit.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.

   B. If you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 02 – Engine Control Unit (ECU) power and after treatment system (engine schematics) (55.100.DP-C.20.E.02)

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Index

Electrical systems - 55

FAULT CODES - DTC

DTC 11C-02-Water in fuel sensor or sensor circuit failure 8
DTC 11C-03-Water in fuel detected or water in fuel circuit failure 10
DTC 131-03-Engine coolant temperature sensor voltage is higher than expected 12
DTC 131-04-Engine coolant temperature sensor voltage is lower than expected 14
DTC 133-03-Intake manifold temperature sensor voltage is higher than expected 16
DTC 133-04-Intake manifold temperature sensor voltage is lower than expected 18
DTC 134-00-Intake manifold pressure sensor drifted high 20
DTC 134-01-Intake manifold pressure sensor drifted low 21
DTC 134-03-Intake manifold pressure sensor voltage is higher than expected 22
DTC 134-04-Intake manifold pressure sensor voltage is lower than expected 24
DTC 135-03-Fuel temperature sensor voltage is higher than expected 26
DTC 135-04-Fuel temperature sensor voltage is lower than expected 28
DTC 136-03-Fuel rail pressure sensor voltage is higher than expected 30
DTC 136-04-Fuel rail pressure sensor voltage is lower than expected 32
DTC 137-02-Fuel pressure relief valve reached maximum allowed opening count 34
DTC 137-03-Fuel pressure relief valve is open 35
DTC 137-04-Fuel pressure relief valve is forced to open, perform pressure increase 36
DTC 137-12-Averaged rail pressure is outside the expected tolerance range 37
DTC 141-02-Crankshaft speed sensor values are not plausible 38
DTC 141-04-Crankshaft speed sensor pattern is not plausible 40
DTC 143-02-Camshaft speed sensor values are not plausible 42
DTC 143-04-Camshaft speed sensor pattern is not plausible 44
DTC 144-03-Compared camshaft and crankshaft speed sensor values are not plausible 46
DTC 151-03-Fuel rail pressure has exceeded maximum positive deviation limits 47
DTC 153-03-Fuel rail pressure has exceeded maximum negative deviation limits 48
DTC 154-03-Fuel rail pressure has dropped below the minimum limit 50
DTC 155-03-Fuel rail pressure has exceeded maximum limit 51
DTC 157-03-High pressure pump fuel delivery quantity in over run exceeds a maximum threshold 53
DTC 158-03-Fuel pump pressure has exceeded desired pressure limits 54
DTC 159-02-Fuel metering unit has an open load error 55
DTC 15D-03-PMCat Inducement less severe derating level 57
DTC 161-02-Short circuit error of injector in cylinder 1 58
DTC 161-03-Short circuit of low side to high source of injector in cylinder 1 61
DTC 162-02-Short circuit error of injector in cylinder 2 63

DTC 162-03-Short circuit of low side to high source of injector in cylinder 2 66
DTC 163-02-Short circuit error of injector in cylinder 3 68
DTC 163-03-Short circuit of low side to high source of injector in cylinder 3 71
DTC 167-02-Open load error of injector in cylinder 1 73
DTC 168-02-Open load error of injector in cylinder 2 75
DTC 169-02-Open load error of injector in cylinder 3 77
DTC 171-03-Injection bank 1 short circuit failure (all injectors of the same bank can be affected) . 79
DTC 173-03-Injection bank 2 short circuit failure (all injectors of the same bank can be affected) . 80
DTC 17C-12-ECU internal failure - Injector CY33x component 82
DTC 17E - 04-Injection control : Number of injections is limited by system 85
DTC 17E-02-Number of desired injections exceeds threshold 83
DTC 17E-03-Exceeded the number of injections for a given engine speed 84
DTC 17E-12-Number of injections is limited by quantity balance of high pressure pump 86
DTC 17F-12-Missing adjustment value programming for injector in cylinder 1 87
DTC 18F-02-Lambda sensor heater power stage open circuit 88
DTC 18F-03-Lambda sensor heater power stage short circuit to battery 90
DTC 18F-04-Lambda sensor heater power stage short circuit to ground 94
DTC 18F-04-Lambda sensor heater power stage short circuit to ground 92
DTC 199-02-Turbocharger boost pressure is higher than expected 97
DTC 199-02-Turbocharger boost pressure is higher than expected 96
DTC 1B1-03-CAN A Bus off failure 98
DTC 1B1-04-CAN A Bus off passive failure 100
DTC 1B5-02-CAN communication error between vehicle controller to ECU 102
DTC 1B7-02-CAN transmit error - EEC1 message (Electronic Engine Control 1 message - Torque, accelerator pedal, engine speed, and other signals) 104
DTC 1C6-03-CAN communication failure between vehicle controller and ECU controller - TSC1_PE message 106
DTC 1C8-03-CAN communication failure between vehicle controller and ECU controller - TSC1_VE message 108
DTC 1D1-03-ECU internal failure 110
DTC 1D2-02-ECU internal failure - EEPROM write error 111
DTC 1D2-03-ECU internal failure - EEPROM erase error 112
DTC 1D2-04-ECU internal failure - EEPROM read error 113
DTC 1D2-12-ECU internal failure - EEPROM write/read error 114
DTC 1D3-12-ECU internal failure - Software resets in DSM 0 115
DTC 1D4-12-ECU internal failure - Query/response communication errors 116
DTC 1D8-12-ECU internal failure - SPI communication error 117
DTC 1D9-02-ECU internal failure - ADC test 118
DTC 1D9-03-ECU internal failure - Voltage ratio in ADC monitoring 119
DTC 1D9-12-ECU internal failure - NTP error in ADC monitoring 120
DTC 1DA-12-ECU internal failure - Fuel calibration 121
DTC 1E1-03-Starter relay high side driver circuit shorted to battery 122
DTC 1E1-04-Starter relay high side driver circuit shorted to ground 124

https://truckmanualshub.com/

DTC 1E3-03-Fuel injection requested during overrun 126
DTC 1E4-03-ECU internal failure - Calculated engine speed 127
DTC 1E6-12-ECU 5 volt sensor supply 1 out of range 128
DTC 1E7-03-ECU 5 volt sensor supply 2 out of range 132
DTC 1E8-03-ECU 5 volt sensor supply 3 out of range 134
DTC 1EB-03-ECU internal failure - Ambient pressure sensor voltage is higher than expected 136
DTC 1EB-04-ECU internal failure - Ambient pressure sensor voltage is lower than expected 137
DTC 1F7-00-PMCat inlet temperature sensor physical range check high 138
DTC 1F7-03-PMCat inlet temperature sensor voltage is higher than expected 140
DTC 1F7-04-PMCat inlet temperature sensor voltage is lower than expected 142
DTC 225-03-Main relay stuck error 146
DTC 225-03-Main relay stuck error 144
DTC 226-03-Battery voltage is higher than expected 149
DTC 226-04-Battery voltage is lower than expected 150
DTC 236-03-Rail pressure sensor value is above maximum offset 152
DTC 236-03-Rail pressure sensor value is above maximum offset 153
DTC 236-04-Rail pressure sensor value is below minimum offset 154
DTC 237-04-Fuel pressure relief valve is forced to open, perform pressure shock 156
DTC 237-04-Fuel pressure relief valve is forced to open, perform pressure shock 155
DTC 237-12-Quantity balance check if a successful PRV opening is ensured 158
DTC 237-12-Quantity balance check if a successful PRV opening is ensured 157
DTC 238-03-Oil pressure switch active with engine off 159
DTC 238-04-Low oil pressure 161
DTC 256-03-Engine speed limitation via fuel injection cut off is active 163
DTC 259-03-Fuel metering unit is shorted to battery voltage at the low side 164
DTC 25A-03-Error in comparing energizing time to maximum value for injector in cylinder 1 166
DTC 25A-04-Error in comparing energizing time to minimum value for injector in cylinder 1 167
DTC 25D-03-PMCat Inducement most severe derating level 168
DTC 26F-04-The minimum rail pressure value necessary to allow fuel injection has not been reached 169
DTC 27F-12-Missing adjustment value programming for injector in cylinder 2 170
DTC 299-04-Turbocharger boost pressure is lower than expected 171
DTC 2B4-02-CAN communication failure between vehicle controller and ECU - BC2ECU2 message 172
DTC 2C6-02-CAN communication failure between vehicle controller and ECU controller - TSC1_PE message 174
DTC 2CC-00-Engine controller internal temperature out of range (High) 176
DTC 2CC-01-Engine controller internal temperature out of range (Low) 177
DTC 2CC-12-Engine controller internal temperature out of range (SPI Error - LM71) 178
DTC 2D1-03-ECU internal failure - Error on R2S2 module 179
DTC 2D3-12-ECU internal failure - Software resets in DSM 1 180
DTC 2D4-04-ECU internal failure - ROM error 181
DTC 2E1-02-Starter relay low side driver circuit open 182

DTC 2E1-03-Starter relay low side driver circuit shorted to battery 184
DTC 2E1-04-Starter relay low side driver circuit shorted to ground 186
DTC 2E1-12-Starter relay low side ECU driver circuit over temperature 188
DTC 32B-02-Glow plug control circuits open 190
DTC 32B-03-Glow plug control circuits shorted to battery 192
DTC 32B-04-Glow plug control circuits shorted to ground 194
DTC 32B-12-Glow plug control circuits shorted 196
DTC 359-04-Fuel metering unit is shorted to ground at the low side 198
DTC 35A-03-Error in comparing energizing time to maximum value for injector in cylinder 2 200
DTC 35A-04-Error in comparing energizing time to minimum value for injector in cylinder 2 201
DTC 35D-03-PMCat Inducement warning 202
DTC 37F-12-Missing adjustment value programming for injector in cylinder 3 203
DTC 3C8-02-CAN communication failure between vehicle controller and ECU controller - TSC1_VE message 204
DTC 3D4-02-ECU internal failure - ECU shutdown test failure 206
DTC 3D4-03-ECU internal failure - Wrong set response time 207
DTC 3D4-04-ECU internal failure - SPI errors during MoCSOP execution 208
DTC 3D4-12-ECU internal failure - Loss of synchronization to MM from CPU 209
DTC 3E3-00-ECU internal failure - Fuel injection energizing time is not plausible 210
DTC 3E3-01-ECU internal failure - Fuel injection energizing phase is not plausible 211
DTC 3E3-02-Fuel injection correction has exceeded a minimum limit 212
DTC 3E3-03-ECU internal failure - Injection quantity correction 213
DTC 3E3-04-ECU internal failure - Rail pressure plausibility 214
DTC 3E3-12-ECU internal failure - Torque request comparison 215
DTC 3F6-03-DOC inlet temperature sensor voltage is higher than expected 216
DTC 3F6-04-DOC inlet temperature sensor voltage is lower than expected 218
DTC 426-03-Level 2 Monitoring : Reported Overvoltage of Supply 220
DTC 426-04-Level 2 Monitoring : Reported Under Voltage of Supply 221
DTC 435-12-Rail pressure sensor value is intermittent 222
DTC 455-03-High pressure pump fuel delivery quantity at low idle is too high 224
DTC 459-03-Fuel metering unit intermittent electrical connection failure 225
DTC 45A-03-Error in comparing energizing time to maximum value for injector in cylinder 3 227
DTC 45A-04-Error in comparing energizing time to minimum value for injector in cylinder 3 228
DTC 48D-02-Throttle valve actuator control circuit open 229
DTC 48D-03-Throttle valve actuator control circuit over current 231
DTC 48D-12-Throttle valve actuator control circuit over temperature 233
DTC 4D4-03-ECU internal failure - Overvoltage monitoring error 235
DTC 4D4-04-ECU internal failure - Undervoltage monitoring error 236
DTC 4E3-03-ECU internal failure - Post injection quantity 237
DTC 4E3-04-Level 2 Monitoring : Diagnosis fault check to report the error to demand for an ICO due to an error in the PoI2 shut-off 238
DTC 4E3-12-Level 2 Monitoring : Diagnosis fault check to report the error to demand for an ICO due to an error in the PoI3 efficiency factor 239

DTC 52C-01-Glow Control Unit (GCU) data error 240
DTC 532-03-Engine coolant temperature has exceeded the warning threshold 242
DTC 535-03-Maximum rail pressure exceeded 243
DTC 54C-03-Engine over speed condition detected 244
DTC 559-12-Fuel metering unit has an over-temperature error 245
DTC 58C-03-Throttle valve actuator will not open to commanded position 247
DTC 58C-04-Throttle valve actuator will not close to commanded position 248
DTC 58D-03-Throttle valve actuator control circuit high side shorted to battery 249
DTC 58D-04-Throttle valve actuator control circuit high side shorted to ground 251
DTC 5D2-03-ECU internal failure - EEPROM memory failure 253
DTC 5D4-02-ECU internal failure - WDA is not working correctly 254
DTC 5D4-03-ECU internal failure - Alarm task period error 255
DTC 5D4-04-ECU internal failure - Positive test failed 256
DTC 5D4-12-ECU internal failure - Timeout in the shut off path test error 257
DTC 5E3-03-ECU internal failure - Torque request due to fuel pressure exceeds maximum torque limit 258
DTC 5E3-04-ECU internal failure - Torque request due to air control exceeds maximum torque limit 259
DTC 5E3-12-ECU internal failure - Torque request exceeds maximum torque limit 260
DTC 601-02-Lambda sensor nernst cell open circuit 261
DTC 602-02-Lambda sensor pump current open circuit 263
DTC 605-03-Lambda sensor O2 value above maximum threshold 265
DTC 606-02-Lambda sensor virtual ground open circuit 267
DTC 607-03-Lambda sensor O2 calibrator too high error 269
DTC 607-04-Lambda sensor O2 calibrator too low error 270
DTC 609-02-ECU internal failure - SPI chip error configuration 271
DTC 60A-04-Lambda sensor heater battery voltage too low 272
DTC 60B-03-Lambda sensor cell circuits short circuit to battery 274
DTC 60B-04-Lambda sensor cell circuits short circuit to ground 276
DTC 60C-03-Lambda sensor estimated temperature higher than threshold 278
DTC 60C-04-Lambda sensor estimated temperature lower than threshold 280
DTC 68D-03-Throttle valve actuator control circuit low side shorted to battery 282
DTC 68D-04-Throttle valve actuator control circuit low side shorted to ground 284
DTC 6D4-02-ECU internal failure - 'WDA active' reported due to errors in query/response communication 286
DTC 6D4-03-ECU internal failure - 'ABE active' reported due to overvoltage detection 287
DTC 6D4-04-ECU internal failure - 'ABE active' reported due to undervoltage detection 288
DTC 6D4-12-ECU internal failure - 'WDA/ABE active' reported 289
DTC 72C-00-Glow plug 1 control circuit shorted to ground 290
DTC 72C-01-Glow plug 3 control circuit shorted to ground 292
DTC 72C-03-Glow plug 2 control circuit shorted to ground 294
DTC 78B-03-Throttle valve actuator position sensor voltage is higher than expected 296
DTC 78B-04-Throttle valve actuator position sensor voltage is lower than expected 298

https://truckmanualshub.com/

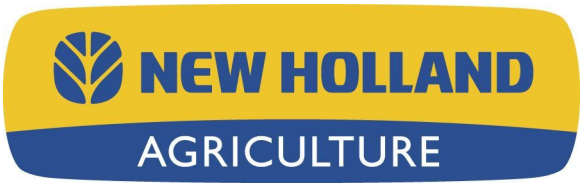
DTC 78D-03-Throttle valve actuator control circuit over load 300
DTC 78D-04-Throttle valve actuator control circuit supply voltage too low 302
DTC 7BA-02-Timeout Error of CAN-Receive-Frame CM1BC 303

https://truckmanualshub.com/

https://truckmanualshub.com/

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SERVICE - Technical Publications & Tools



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https://truckmanualshub.com/

SERVICE MANUAL

Platform, cab, bodywork, and decals

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Platform, cab, bodywork, and decals - 90

[90.100] Engine hood and panels 90.1

[90.110] Operator platform less cab 90.2

[90.116] Fenders and guards 90.3

[90.118] Protections and footboards 90.4

https://truckmanualshub.com/

Platform, cab, bodywork, and decals - 90

Engine hood and panels - 100

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Platform, cab, bodywork, and decals - 90

Engine hood and panels - 100

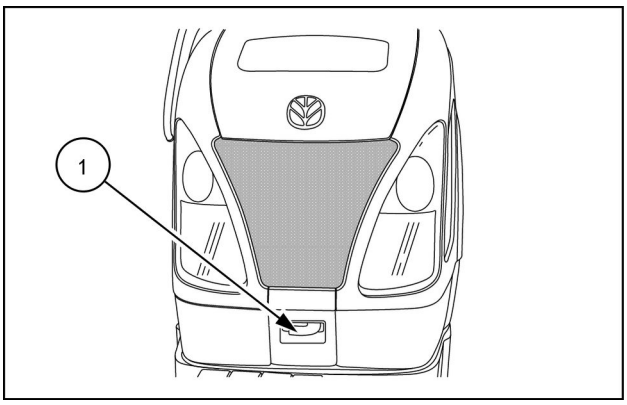
SERVICE

Hood
Remove 3
Install 7

Hood - Remove

Front Hood Removal

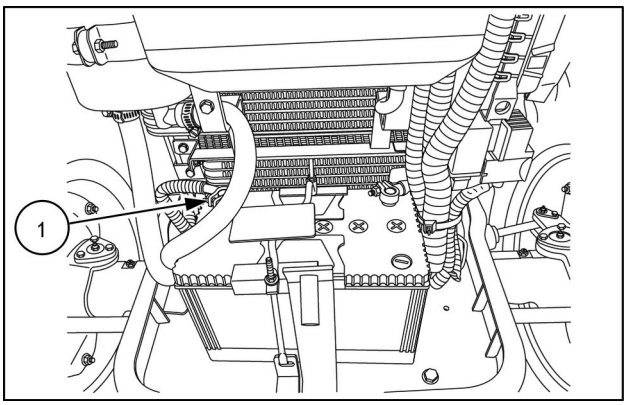
1. Slide the lock **(1)** to right, hold and raise the hood.



GNIL14TR00533AA 1

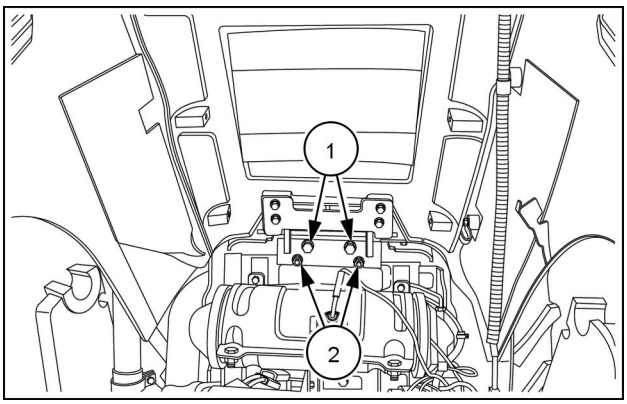
2. Disconnect the battery terminals.

NOTE: *Always disconnect the negative cable **(1)** first.*



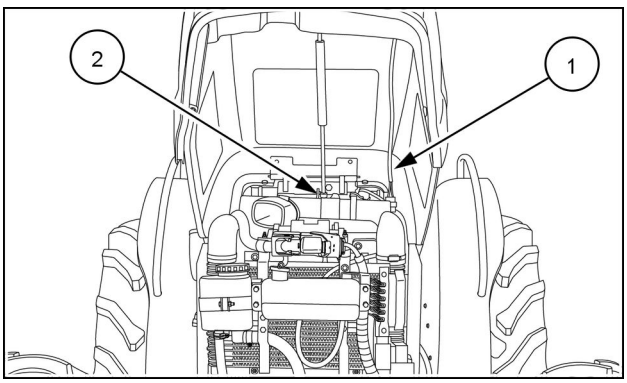
GNIL14TR00784AA 2

3. Unscrew hood mounting bracket bolts **(1)** and nuts **(2)** from engine frame.



GNIL14TR00856AA 3

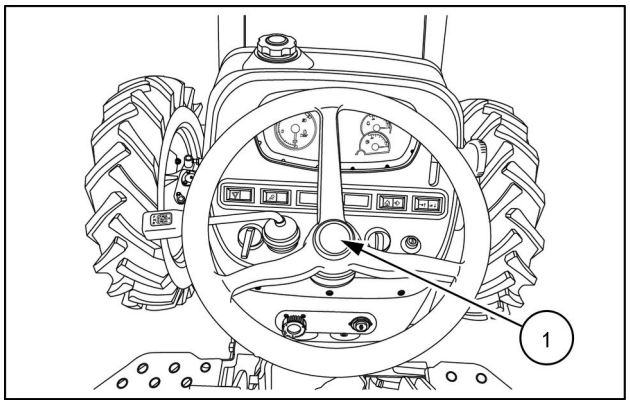
4. Disconnect headlight harness connection and horn wirings **(1)**. Unscrew gas strut bolt **(2)** and remove the front hood.



GNIL14TR00822AA 4

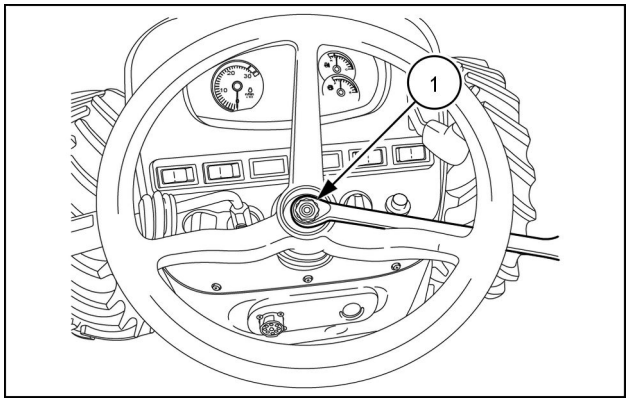
Rear Hood Removal

5. Remove the steering wheel cover **(1)**.



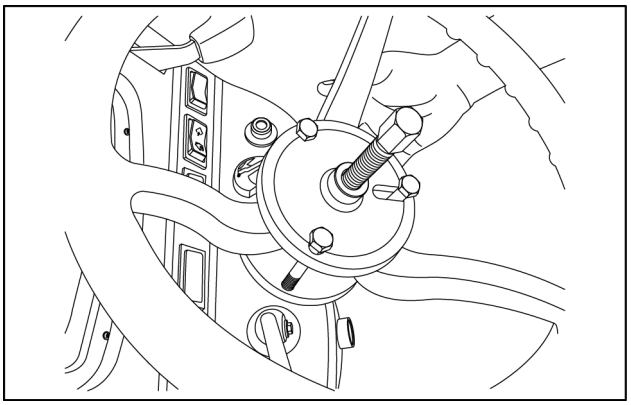
GNIL14TR00512AA 5

6. Remove the steering wheel nut **(1)**.



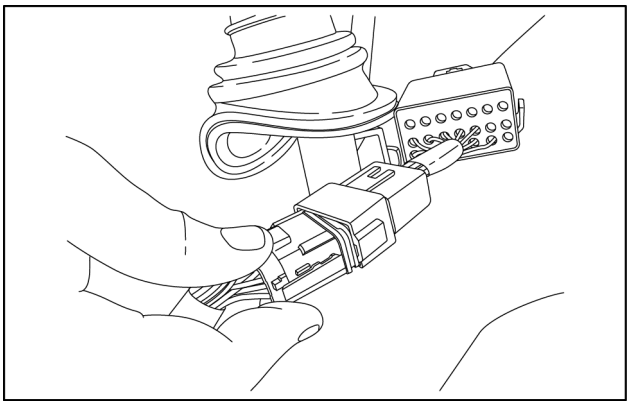
GNIL14TR00846AA 6

7. Loosen the steering wheel securing nut and remove the steering wheel using tool number 82834312 and 9971375.



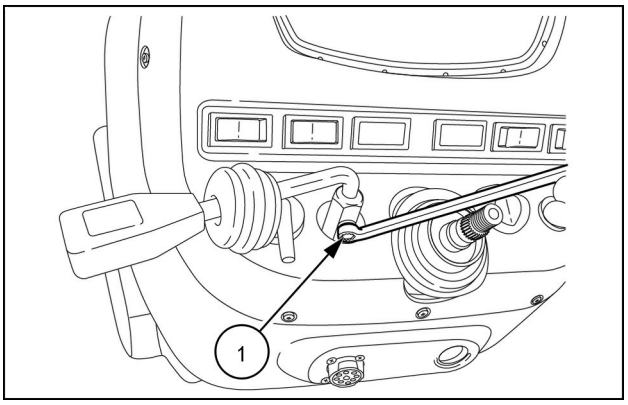
GNIL14TR00704AA 7

8. Disconnect the wiring connection **(1)**.



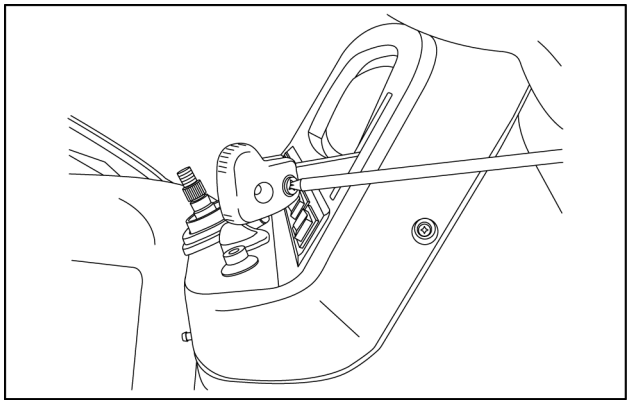
GNIL14TR00711AA 8

9. Loosen the bolts **(1)** and remove the shuttle lever.



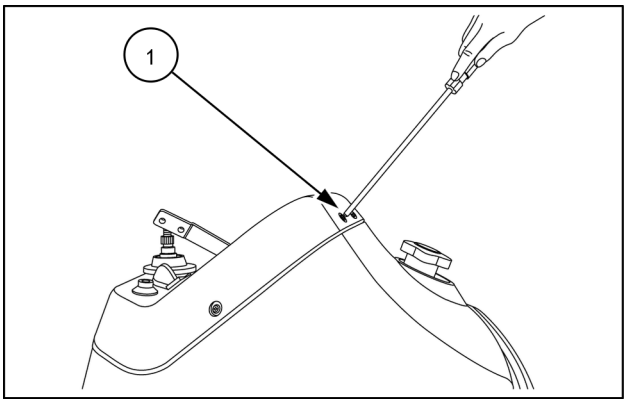
GNIL14TR00705AA 9

10. Remove the hand throttle knob.



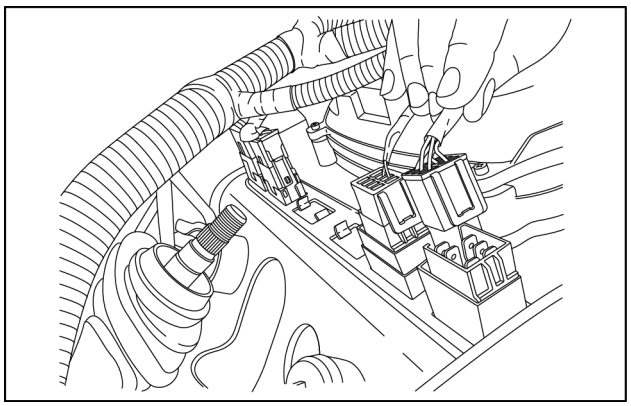
GNIL14TR00706AA 10

11. Unscrew all the screws **(1)** of instrument panel.



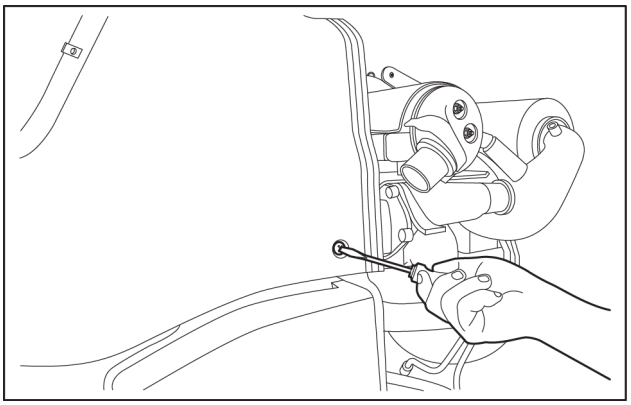
GNIL14TR00707AA 11

12. Pull out the instrument panel from rear hood. Disconnect all electric wire connections of the switches and hourmeter cable from instrument cluster. Also remove fuel tank cap.



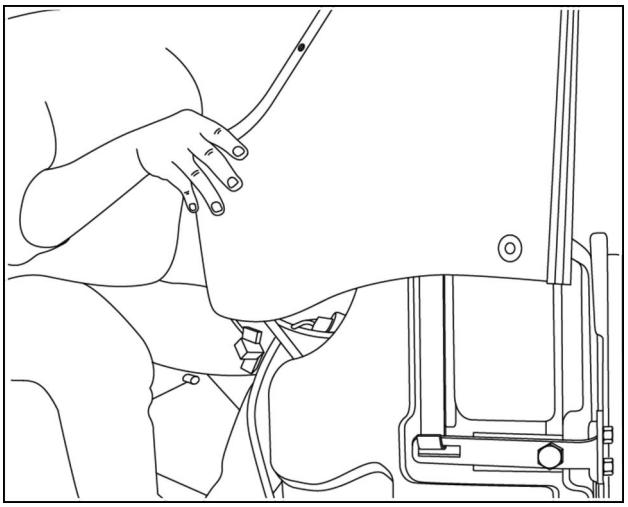
GNIL14TR00714AA 12

13. Remove pull to stop knob. Unscrew all rear hood securing screws and bolts.



GNIL14TR00849AA 13

14. Remove pull to stop knob and then centre panel. Unscrew all rear hood securing bolts lift and remove rear hood.



GNIL14TR00715AA 14

Hood - Install

For installation, follow the removal process in reverse order.

https://truckmanualshub.com/

Index

Platform, cab, bodywork, and decals - 90

Engine hood and panels - 100

Hood - Install 7
Hood - Remove 3

https://truckmanualshub.com/

Platform, cab, bodywork, and decals - 90

Operator platform less cab - 110

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Platform, cab, bodywork, and decals - 90

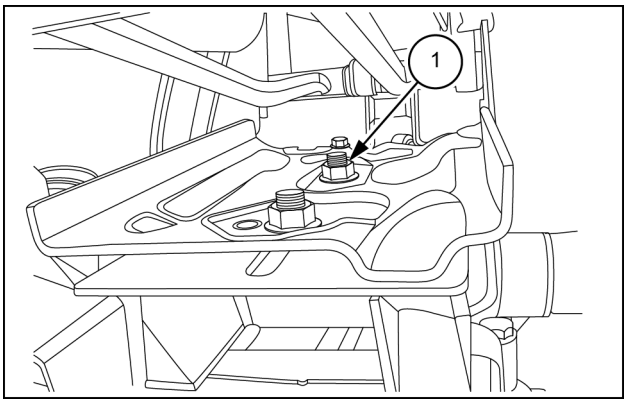
Operator platform less cab - 110

SERVICE

Platform
Remove 3
Install 4

Platform - Remove

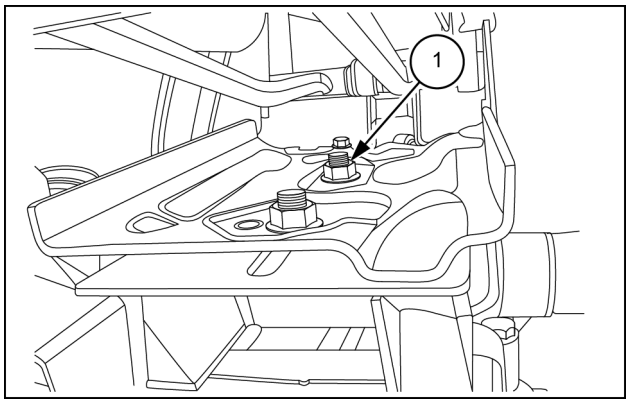
1. Disconnect the wiring coupler of the operator’s seat. Loosen the bolts **(1)** and remove the operator’s seat from the hydraulic lift assembly.



GNIL14TR04607AB 1

Platform - Install

1. Install the operator’s seat on the hydraulic lift assembly and tighten the bolts **(1)**. Connect the wiring coupler of the operator’s seat.



GNIL14TR04607AB 1

https://truckmanualshub.com/

Index

Platform, cab, bodywork, and decals - 90

Operator platform less cab - 110

Platform - Install 4
Platform - Remove 3

https://truckmanualshub.com/

https://truckmanualshub.com/

Platform, cab, bodywork, and decals - 90

Fenders and guards - 116

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Platform, cab, bodywork, and decals - 90

Fenders and guards - 116

SERVICE

Fenders and guards
Remove 3
Install 5

Fenders and guards - Remove

⚠ WARNING

Avoid injury!
Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

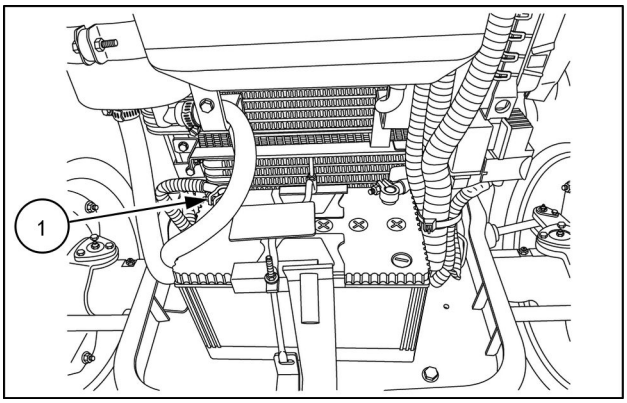
W0208A

⚠ DANGER

Heavy objects!
Lift and handle all heavy components using lifting equipment with adequate capacity. Always support units or parts with suitable slings or hooks. Make sure the work area is clear of all bystanders.
Failure to comply will result in death or serious injury.

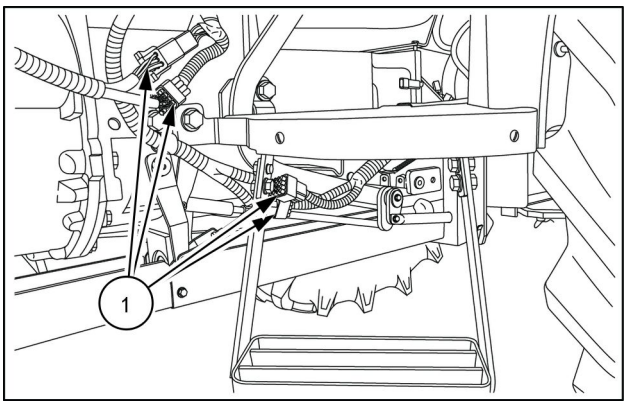
D0076A

1. Lift the front hood.
2. Disconnect battery negative terminal **(1)** and insulate.



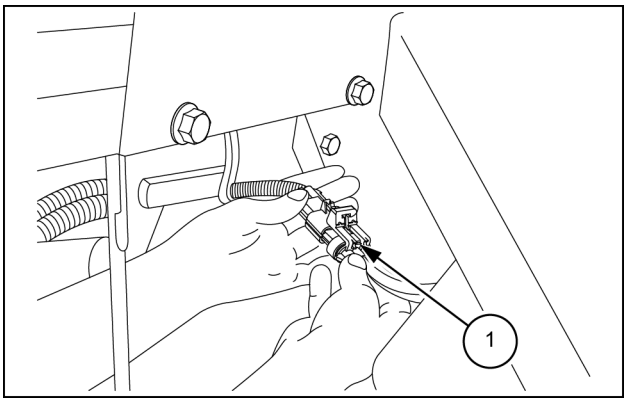
GNIL14TR00784AA 1

3. Disconnect the electrical couplings **(1)**.



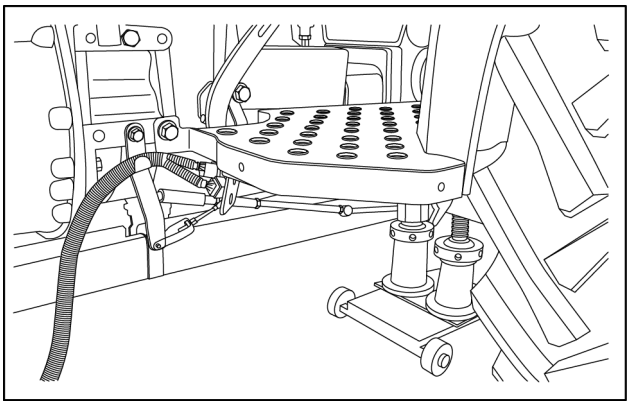
GNIL14TR00797AA 2

4. Detach electric connections **(1)** between left and right-hand side fenders.



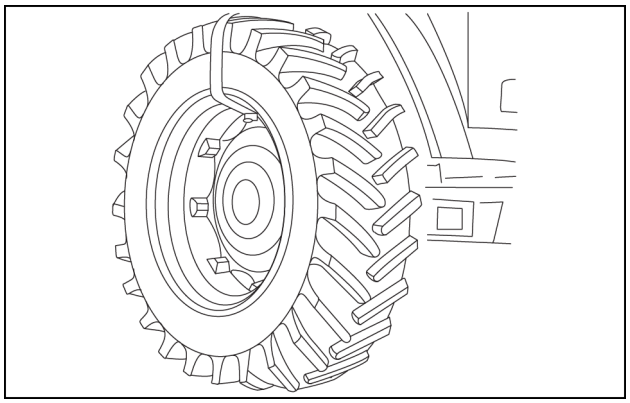
GNIL14TR04012AB 3

5. Support the rear axle on a screw jack.



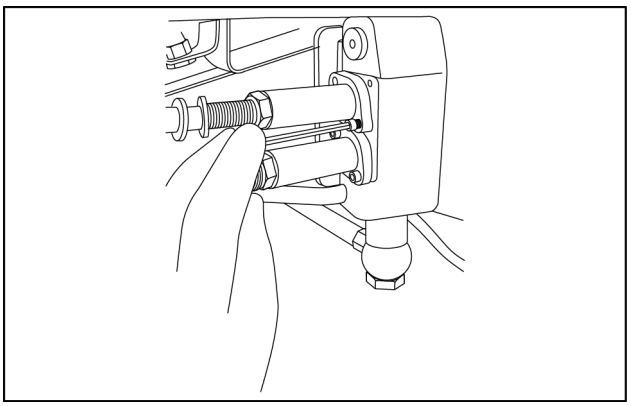
GNIL14TR00765AA 4

6. Remove both left and right-hand side wheels.



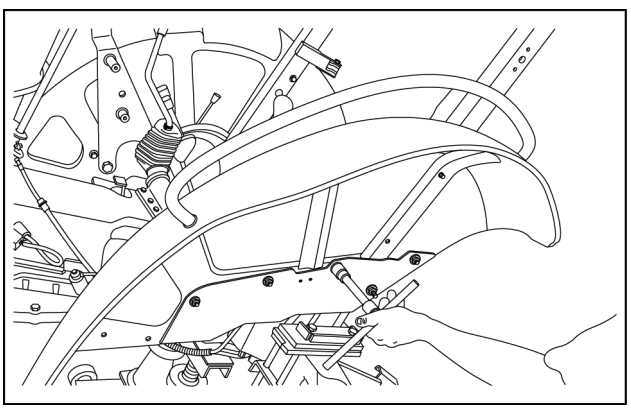
GNIL14TR04016AB 5

7. On RH side, loosen two Allen screws, one each on both the connectors of joystick cable. Loosen two nuts on joystick connecting cable. Remove connector pipe. Remove the locking roll pin from the cable and remove the joystick cable.



GNIL14TR00764AA 6

8. Loosen bolts securing fenders. Disconnect all the wirings. Remove the fenders.



GNIL14TR00790AA 7

Fenders and guards - Install

1. For installation, follow the reverse order of removal.

https://truckmanualshub.com/

Index

Platform, cab, bodywork, and decals - 90

Fenders and guards - 116

Fenders and guards - Install 5
Fenders and guards - Remove 3

https://truckmanualshub.com/

Platform, cab, bodywork, and decals - 90

Protections and footboards - 118

Workmaster™ 50
Workmaster™ 60
Workmaster™ 70

https://truckmanualshub.com/

Contents

Platform, cab, bodywork, and decals - 90

Protections and footboards - 118

SERVICE

Protections and footboards
Remove 3
Install 5

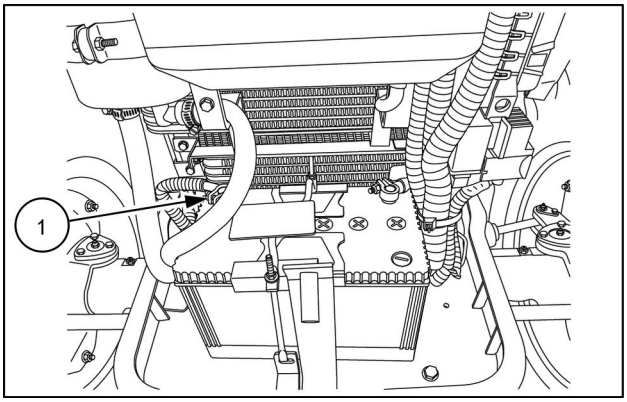
Protections and footboards - Remove

⚠ WARNING

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Handle all parts carefully. Do not place your hands or fingers between parts. Use Personal Protective Equipment (PPE) as indicated in this manual, including protective goggles, gloves, and safety footwear.
Failure to comply could result in death or serious injury.

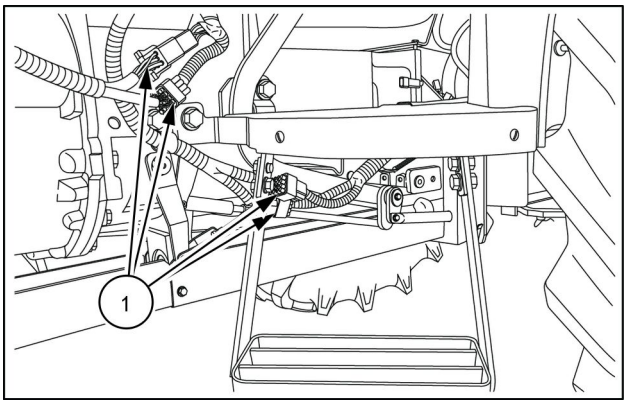
W0208A

1. Disconnect battery negative terminal **(1)** and insulate.



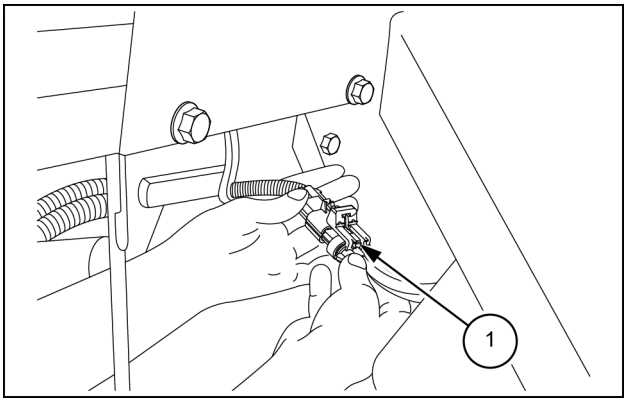
GNIL14TR00784AA 1

2. Disconnect the electrical couplings **(1)**.



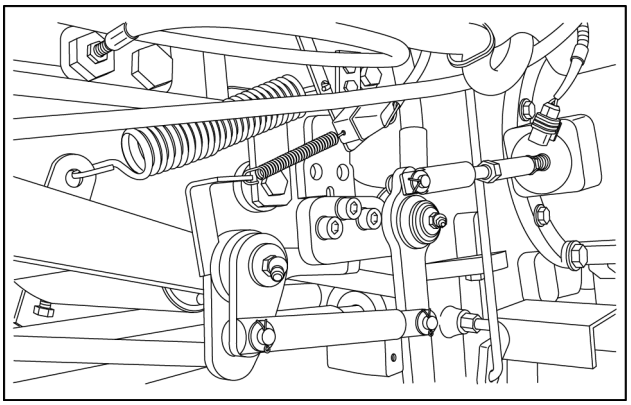
GNIL14TR00797AA 2

3. Detach electric connections **(1)** between left and right-hand side fenders.



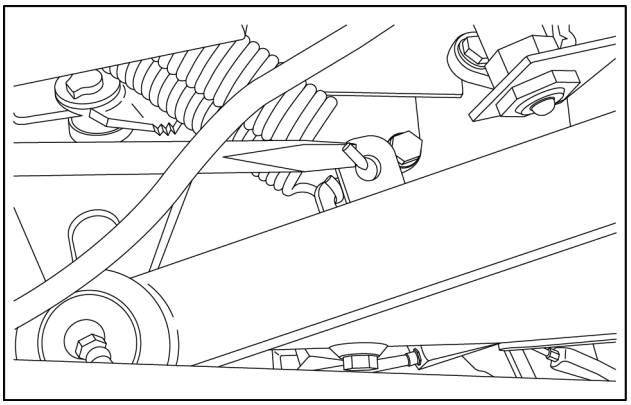
GNIL14TR04012AB 3

4. Disconnect all the wirings on the left side of the tractor. Remove the clutch pedal spring.



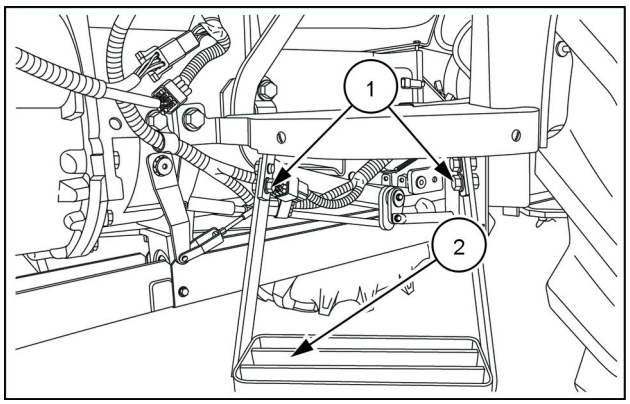
GNIL14TR00766AA 4

5. Similarly disconnect all the wirings from the right side of the tractor. Remove both the brake pedal springs. Remove parking brake linkages.



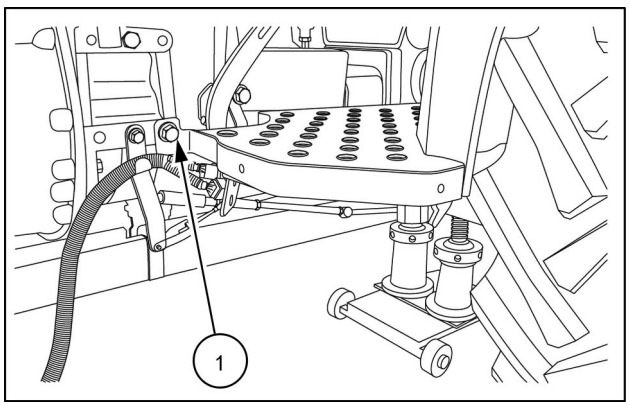
GNIL14TR00782AA 5

6. Loosen the bolts **(1)** and remove the footstep **(2)**.



GNIL14TR00797AA 6

7. Make sure that all the electrical couplings are disconnected.
   Loosen all the bolts **(1)** securing foot boards on left-hand side and right-hand side fenders and transmission housing. Remove the footboards.



GNIL14TR00767AA 7

Protections and footboards - Install

1. For installation, follow the reverse order of removal.

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Index

Platform, cab, bodywork, and decals - 90

Protections and footboards - 118

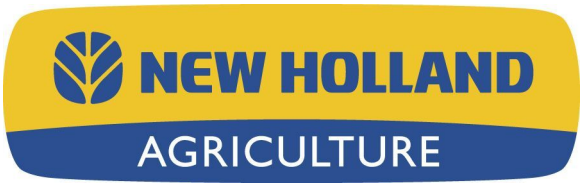
Protections and footboards - Install 5
Protections and footboards - Remove 3

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SPECIAL TOOL INDEX

Genuine	Reference	PAGE
380001672 [Steering Wheel Puller With Height Adjustment]	Engine - Remove	10.1 / 6
380003008 [Steering Wheel puller]	Engine - Remove	10.1 / 6
380000612 [Clutch Centralizer and Clutch Registers (2) for the 11" clutch]	Engine flywheel - Remove	10.2 / 3
380000612 [Clutch Centralizer and Clutch Registers (2) for the 11" clutch]	Clutch - Special tools	18.2 / 4
380000256 [Clutch Adjusting Wrench Set]	Clutch - Special tools	18.2 / 4
380000612 [Clutch Centralizer and Clutch Registers (2) for the 11" clutch]	Clutch - Remove	18.2 / 9
380000612 [Clutch Centralizer and Clutch Registers (2) for the 11" clutch]	Clutch - Assemble	18.2 / 15
380000612 [Clutch Centralizer and Clutch Registers (2) for the 11" clutch]	Clutch - Adjust	18.2 / 16
380000612 [Clutch Centralizer and Clutch Registers (2) for the 11" clutch]	Clutch - Service instruction	18.2 / 17
380002985 [Pinion Locking Tool]	Mechanical transmission - Special tools	21.1 / 6
380000295 [Wheel Hub Bearing Slotted Nut Socket]	Four-Wheel Drive	25.1 / 21
380000268 [Bevel Pinion Ring Nut Wrench]	Four-Wheel Drive	25.1 / 24
380000257 [Bevel Gear Pinion Splined Retainer Deep Socket]	Four-Wheel Drive	25.1 / 24
380000252 [Front Axle Ring Nut Wrench]	Four-Wheel Drive	25.1 / 27
380000252 [Front Axle Ring Nut Wrench]	Four-Wheel Drive	25.1 / 28
380000257 [Bevel Gear Pinion Splined Retainer Deep Socket]	Four-Wheel Drive	25.1 / 28
380000265 [Swivel Housing Pin Pivot Puller]	Steering knuckle and king pin - Remove	25.3 / 3
380000234 [Swivel Pin Bearing Outer Race Puller]	Steering knuckle and king pin - Remove	25.3 / 3
380000235 [Swivel Housing Torque Check Adapter]	Steering knuckle and king pin - Adjust	25.3 / 4
380000235 [Swivel Housing Torque Check Adapter]	Steering knuckle and king pin - Adjust	25.3 / 4
380000248 [Bevel Pinion Bearings Adjusting Guage]	Final drive driving pinion - Preload –	25.4 / 3
380000248 [Bevel Pinion Bearings Adjusting Guage]	Final drive driving pinion - Preload –	25.4 / 3
380000248 [Bevel Pinion Bearings Adjusting Guage]	Final drive driving pinion - Preload –	25.4 / 3
380000249 [Universal Pinion Installation Tool Kit]	Final drive driving pinion - Adjust –	25.4 / 5

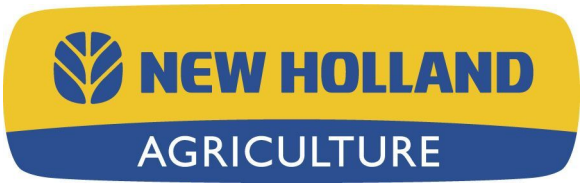
Genuine	Reference	PAGE
380000249 [Universal Pinion Installation Tool Kit]	Final drive driving pinion - Adjust –	25.4 / 5
380000248 [Bevel Pinion Bearings Adjusting Guage]	Final drive driving pinion - Adjust –	25.4 / 5
380000249 [Universal Pinion Installation Tool Kit]	Final drive driving pinion - Adjust –	25.4 / 5
380000257 [Bevel Gear Pinion Splined Retainer Deep Socket]	Final drive driving pinion - Adjust –	25.4 / 6
380000268 [Bevel Pinion Ring Nut Wrench]	Final drive driving pinion - Adjust –	25.4 / 6
380000257 [Bevel Gear Pinion Splined Retainer Deep Socket]	Final drive driving pinion - Adjust –	25.4 / 6
380000257 [Bevel Gear Pinion Splined Retainer Deep Socket]	Final drive driving pinion - Adjust –	25.4 / 6
380001545 [Slide Hammer Puller Adapter]	Non-powered front axle - Special tools	25.5 / 4
380001545 [Slide Hammer Puller Adapter]	Non-powered front axle - Remove	25.5 / 9
9971349 [Bevel wheel adjuster]	Rear bevel gear set and differential - Special tools	27.2 / 4
380001672 [Steering Wheel Puller With Height Adjustment]	Steering control - Special tools	41.1 / 3
380003008 [Steering Wheel puller]	Steering control - Special tools	41.1 / 3

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