PUMA 165
PUMA 180
PUMA 195
PUMA 210

Tractor with/without Multicontroller

SERVICE MANUAL

Part number 87628095_CNA
English
December 2010
Replaces part number 84225399

CASE IH AGRICULTURE

Contents

INTRODUCTION

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INTRODUCTION

Safety rules

IMPORTANT NOTICE

All maintenance and repair operations described in this manual should be carried out exclusively by authorised workshops. All instructions should be carefully observed and special equipment where indicated should be used.
Anyone who carries out service operations described without carefully observing these instructions will be directly responsible for any damage caused.

NOTES FOR EQUIPMENT

Equipment shown in this manual is:

- designed expressly for use on these tractors;
- necessary to make a reliable repair;
- accurately built and strictly tested to offer efficient and long-lasting working life.

NOTICES

The words “front”, “rear”, “right hand”, and “left hand” refer to the different parts as seen from the operator’s seat oriented to the normal direction of movement of the tractor.

SAFETY RULES

PAY ATTENTION TO THIS SYMBOL

This warning symbol points out important messages involving personal safety. Carefully read the safety rules contained herein and follow advised precautions to avoid potential hazards and safeguard your safety.
In this manual you will find this symbol together with the following key-words:
WARNING -it gives warning about improper repair operations and potential consequences affecting the service technician’s personal safety.
DANGER - it gives specific warning about potential dangers for personal safety of the operator or other persons directly or indirectly involved in the operation.

TO PREVENT ACCIDENTS

Most accidents and personal injuries taking place in workshops are due from non-observance of some essential rules and safety precautions.

The possibility that an accident might occur with any type of machines should not be disregarded, no matter how well the machine in question was designed and built.

A wise and careful service technician is the best precautions against accidents.

Careful observance of this basic precaution would be enough to avoid many severe accidents.

⚠ DANGER ⚠

Never carry out any cleaning, lubrication or maintenance operations when the engine is running.

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SAFETY RULES

Generalities

- Carefully follow specified repair and maintenance procedures.

- Do not wear rings, wristwatches, jewels, unbuttoned or flapping clothing such as ties, torn clothes, scarves, open jackets or shirts with open zips which could get caught on moving parts. Use approved safety clothing such as anti-slipping footwear, gloves, safety goggles, helmets, etc.
- Wear safety glasses with side guards when cleaning parts using compressed air.
- Damaged or frayed wires and chains are unreliable. Do not use them for lifting or towing.
- Wear suitable protection such as approved eye protection, helmets, special clothing, gloves and footwear whenever welding. All persons standing in the vicinity of the welding process should wear approved eye protection. NEVER LOOK AT THE WELDING ARC IF YOUR EYES ARE NOT SUITABLY PROTECTED.
- Never carry out any repair on the machine if someone is sitting on the operator's seat, except if they are qualified operators assisting in the operation to be carried out.
- Never operate the machine or use attachments from a place other than sitting at the operator's seat or at the side of the machine when operating the fender switches.
- Never carry out any operation on the machine when the engine is running, except when specifically indicated. Stop the engine and ensure that all pressure is relieved from hydraulic circuits before removing caps, covers, valves, etc.
- All repair and maintenance operations should be carried out with the greatest care and attention.
- Disconnect the batteries and label all controls to warn that the tractor is being serviced. Block the machine and all equipment which should be raised.
- Never check or fill fuel tanks or batteries, nor use starting liquid if you are smoking or near open flames as such fluids are flammable.
- The fuel filling gun should always remain in contact with the filler neck. Maintain this contact until the fuel stops flowing into the tank to avoid possible sparks due to static electricity build-up.
- To transfer a failed tractor, use a trailer or a low loading platform trolley if available.
- To load and unload the machine from the transportation means, select a flat area providing a firm support to the trailer or truck wheels. Firmly tie the machine to the truck or trailer platform and block wheels as required by the transporter.
- Always use lifting equipment of appropriate capacity to lift or move heavy components.
- Chains should always be safely fastened. Ensure that fastening device is strong enough to hold the load foreseen. No persons should stand near the fastening point.
- The working area should be always kept CLEAN and DRY. Immediately clean any spillage of water or oil.
- Never use gasoline, diesel oil or other flammable liquids as cleaning agents. Use non-flammable non-toxic proprietary solvents.
- Do not pile up grease or oil soaked rags, as they constitute a great fire hazard. Always place them into a metal container.

START UP

- Never run the engine in confined spaces which are not equipped with adequate ventilation for exhaust gas extraction.
- Never bring your head, body, arms, legs, feet, hands, fingers near fans or rotating belts.

ENGINE

- Always loosen the radiator cap very slowly before removing it to allow pressure in the system to dissipate. Coolant should be topped up only when the engine is stopped.
- Do not fill up fuel tank when the engine is running.
- Never adjust the fuel injection pump when the tractor is moving.
- Never lubricate the tractor when the engine is running.

ELECTRICAL SYSTEMS

- If it is necessary to use auxiliary batteries, cables must be connected at both sides as follows: (+) to (+) and (-) to (-). Avoid short-circuiting the terminals. GAS RELEASED FROM BATTERIES IS HIGHLY FLAMMABLE. During

charging, leave the battery compartment uncovered to improve ventilation. Avoid sparks or flames near the battery area. Do no smoke.

- Do not charge batteries in confined spaces.
- Always disconnect the batteries before performing any type of service on the electrical system.

HYDRAULIC SYSTEMS

- Some fluid coming out from a very small port can be almost invisible and be strong enough to penetrate the skin. For this reason, NEVER USE YOUR HANDS TO CHECK FOR LEAKS, but use a piece of cardboard or a piece of wood for this purpose. If any fluid is injected into the skin, seek medical aid immediately. Lack of immediate medical attention may result in serious infections or dermatitis.
- Always take system pressure readings using the appropriate gauges.

WHEELS AND TYRES

- Check that the tyres are correctly inflated at the pressure specified by the manufacturer. Periodically check for possible damage to the rims and tyres.
- Stay at the tyre side when inflating.
- Check the pressure only when the tractor is unloaded and tyres are cold to avoid wrong readings due to over-pressure.
- Never cut, nor weld a rim with the inflated tyre assembled.
- To remove the wheels, block both front and rear tractor wheels. Raise the tractor and install safe and stable supports under the tractor in accordance with regulations in force.
- Deflate the tyre before removing any object caught into the tyre tread.
- Never inflate tyres using flammable gases as they may generate explosions and cause injuries to bystanders.

REMOVAL AND INSTALLATION

- Lift and handle all heavy components using lifting equipment of adequate capacity. Ensure that parts are supported by appropriate slings and hooks. Use lifting eyes provided to this purpose. Take care of the persons near the loads to be lifted.

HEALTH AND SAFETY

CONTENT

HEALTH AND SAFETY PRECAUTIONS

Many of the procedures associated with vehicle maintenance and repair involve physical hazards or other risks to health. This section lists, alphabetically, some of these hazardous operations and the materials and equipment associated with them. The precautions necessary to avoid these hazards are identified.
The list is not exhaustive and all operations and procedures and the handling of materials, should be carried out with health and safety in mind.

ACIDS AND ALKALIS

see Battery acids, e.g. caustic soda, sulphuric acid.
Used in batteries and cleaning materials.

Irritant and corrosive to the skin, eyes, nose and throat. Causes burns.

Avoid splashes to the skin, eyes and clothing. Wear suitable protective gloves and goggles. Can destroy ordinary protective clothing. Do not breathe mists.
Ensure access to water and soap is readily available for splashing accidents.

ADHESIVES AND SEALERS

see Fire
Highly Flammable, Flammable, combustible.
Generally should be stored in “No Smoking” areas; cleanliness and tidiness in use should be observed, e.g. disposable paper covering benches; should be dispensed from applicators where possible; containers, including secondary containers, should be labelled.

Solvent based Adhesives/Sealers

See Solvents.
Follow manufacturers instructions.

Water based Adhesives/Sealers

Those based on polymer emulsions and rubber lattices may contain small amounts of volatile toxic and harmful chemicals. Skin and eye contact should be avoided and adequate ventilation provided during use.
Follow manufacturers instructions.

Resin based Adhesives/Sealers

e.g. epoxide and formaldehyde resin based.
Mixing should only be carried out in well ventilated areas as harmful or toxic volatile chemicals may be released.
Skin contact with uncured resins and hardeners can result in irritation; dermatitis and absorption of toxic or harmful chemicals through the skin. Splashes can damage the eyes.
Provide adequate ventilation and avoid skin and eye contact. Follow manufacturers instructions.

Anaerobic, Cyanoacrylate and other Acrylic Adhesives

Many are irritant, sensitizing or harmful to the skin. Some are eye irritants.

Skin and eye contact should be avoided and the manufacturers instructions followed.
Cyanoacrylate adhesives (super-glues) must not contact the skin or eyes. If skin or eye tissue is bonded cover with a clean moist pad and get medical attention. do not attempt to pull tissue apart. Use in well ventilated areas as vapours can cause irritation of the nose and eyes.
For two-pack systems see Resin based adhesives/sealers.

Isocyanate (Polyurethane) Adhesives/ Sealers

see Resin based Adhesives.
Individuals suffering from asthma or respiratory allergies should not work with or near these materials as sensitivity reactions can occur.
Any spraying should preferably be carried out in exhaust ventilated booths removing vapours and spray droplets from the breathing zone. Individuals working with spray applications should wear supplied air respirators.

ANTIFREEZE

see Fire, Solvents e.g. Isopropanol, Ethylene Glycol, Methanol.
Highly Flammable, Flammable, Combustible.
Used in vehicle coolant systems, brake air pressure systems, screenwash solutions.
Vapours given off from coolant antifreeze (glycol) arise only when heated.
Antifreeze may be absorbed through the skin in toxic or harmful quantities. Antifreeze if swallowed is fatal and medical attention must be found immediately.

ARC WELDING

see Welding.

BATTERY ACIDS

see Acids and Alkalis.
Gases released during charging are explosive.
Never use naked flames or allow sparks near charging or recently charged batteries.

BRAKE AND CLUTCH FLUIDS (Polyalkylene Glycols)

see Fire.
Combustible.
Splashes to the skin and eyes are slightly irritating.
Avoid skin and eye contact as far as possible.
Inhalation of vapour hazards do not arise at ambient temperatures because of the very low vapour pressure.

BRAZING

see Welding.

CHEMICAL MATERIALS - GENERAL

see Legal Aspects.
Chemical materials such as solvents, sealers, adhesives, paints, resin foams, battery acids, antifreeze, brake fluids, oils and grease should always be used with caution and stored and handled with care. They may be toxic, harmful, corrosive, irritant or highly inflammable and give rise to hazardous fumes and dusts.
The effects of excessive exposure to chemicals may be immediate or delayed; briefly experienced or permanent; cumulative; superficial; life threatening; or may reduce life-expectancy.

DO'S

Do remove chemical materials from the skin and clothing as soon as practicable after soiling. Change heavily soiled clothing and have it cleaned.
Do carefully read and observe hazard and precaution warnings given on material containers (labels) and in any accompanying leaflets, poster or other instructions. Material health and safety data sheets can be obtained from Manufacturers.

Do organise work practices and protective clothing to avoid soiling of the skin and eyes; breathing vapours/aerosols/ dusts/fumes; inadequate container labelling; fire and explosion hazards.
Do wash before job breaks; before eating, smoking, drinking or using toilet facilities when handling chemical materials.
Do keep work areas clean, uncluttered and free of spills.
Do store according to national and local regulations.
Do keep chemical materials out of reach of children.

DO NOTS

Do Not mix chemical materials except under the manufacturers instructions; some chemicals can form other toxic or harmful chemicals; give off toxic or harmful fumes; be explosive when mixed together.
Do Not spray chemical materials, particularly those based on solvents, in confined spaces e.g. when people are inside a vehicle.
Do Not apply heat or flame to chemical materials except under the manufacturers' instructions. Some are highly inflammable and some may release toxic or harmful fumes.
Do Not leave containers open. Fumes given off can build up to toxic, harmful or explosive concentrations. Some fumes are heavier than air and will accumulate in confined areas, pits etc.
Do Not transfer chemical materials to unlabeled containers.
Do Not clean hands or clothing with chemical materials. Chemicals, particularly solvents and fuels will dry the skin and may cause irritation with dermatitis. Some can be absorbed through the skin in toxic or harmful quantities.
Do Not use emptied containers for other materials, except when they have been cleaned under supervised conditions.
Do Not sniff or smell chemical materials. Brief exposure to high concentrations of fumes can be toxic or harmful.

Clutch Fluids

see Brake and Clutch Fluids.

Clutch Linings and Pads

see Brake and Clutch Linings and Pads.

CORROSION PROTECTION MATERIALS

see Solvents, Fire.
Highly flammable, flammable.
These materials are varied and the manufacturers instructions should be followed. They may contain solvents, resins, petroleum products etc. Skin and eye contact should be avoided. They should only be sprayed in conditions of adequate ventilation and not in confined spaces.

Cutting

see Welding.

De-Waxing

see Solvents and Fuels (Kerosene).

DUSTS

Powder, dusts or clouds may be irritant, harmful or toxic. Avoid breathing dusts from powdery chemical materials or those arising from dry abrasion operations. Wear respiratory protection if ventilation is inadequate.

ELECTRIC SHOCK

Electric shocks can result from the use of faulty electrical equipment or from the misuse of equipment even in good condition.
Ensure that electrical equipment is maintained in good condition and frequently tested.
Ensure that flexes, cables, plugs and sockets are not frayed, kinked, cut, cracked or otherwise damaged.
Ensure that electric equipment is protected by the correct rated fuse.
Never misuse electrical equipment and never use equipment which is in any way faulty. The results could be fatal.
Use reduced voltage equipment (**110 volt**) for inspection and working lights where possible.

Ensure that the cables of mobile electrical equipment cannot get trapped and damaged, such as in a vehicle hoist.
Use air operated mobile equipment where possible in preference to electrical equipment.

In cases of electrocution:-

- switch off electricity before approaching victim
- if this is not possible, push or drag victim from source of electricity using dry non-conductive material
- commence resuscitation if trained to do so
- SUMMON MEDICAL ASSISTANCE

EXHAUST FUMES

These contain asphyxiating, harmful and toxic chemicals and particles such as carbon oxides, nitrogen oxides, aldehydes, lead and aromatic hydrocarbons. Engines should only be run under conditions of adequate extraction or general ventilation and not in confined spaces.

Gasolene (Petrol) Engine

There may not be adequate warning properties of odour or irritation before immediate and delayed toxic or harmful effects arise.

Diesel Engine

Soot, discomfort and irritation usually give adequate warning of hazardous fume concentrations.

FIBRE INSULATION

see Dusts.
Used in noise and sound insulation.
The fibrous nature of surfaces and cut edges can cause skin irritation. This is usually a physical and not a chemical effect.
Precautions should be taken to avoid excessive skin contact through careful organisation of work practices and the use of gloves.

FIRE

see Welding, Foams, Legal Aspects.
Many of the materials found on or associated with the repair of vehicles are highly flammable. Some give off toxic or harmful fumes if burnt.
Observe strict fire safety when storing and handling flammable materials or solvents, particularly near electrical equipment or welding processes.
Ensure before using electrical or welding equipment but that there is no fire hazard present.
Have a suitable fire extinguisher available when using welding or heating equipment.

FIRST AID

Apart from meeting any legal requirements it is desirable for someone in the workshop to be trained in first aid procedures.
Splashes in the eye should be flushed with clean water for at least ten minutes.
Soiled skin should be washed with soap and water.
Inhalation affected individuals should be removed to fresh air immediately.
If swallowed or if effects persist consult a doctor with information (label) on material used.
Do not induce vomiting (unless indicated by manufacturer).

FOAMS - Polyurethane

see Fire.
Used in sound and noise insulation. Cured foams used in seat and trim cushioning.
Follow manufacturers instructions.
Unreacted components are irritating and may be harmful to the skin and eyes. Wear gloves and goggles.

Individuals with chronic respiratory diseases, asthma, bronchial medical problems or histories of allergic diseases should not work with or near uncured materials.
The components, vapours, spray mists can cause direct irritation, sensitivity reactions and may be toxic or harmful.
Vapours and spray mists must not be breathed. These materials must be applied with adequate ventilation and respiratory protection. Do not remove respirator immediately after spraying, wait until vapour/ mists have cleared.
Burning of the uncured components and the cured foams can generate toxic and harmful fumes.
Smoking, open flames or the use of electrical equipment during foaming operations and until vapours/mists have cleared should not be allowed.
Any heat cutting of cured foams or partially cured foams should be conducted with extraction ventilation (see Body Section 44 Legal and Safety Aspects).

FUELS

see Fire, Legal Aspects, Chemicals - General, Solvents.
Used as fuels and cleaning agents.

Gasolene (Petrol).

Highly flammable.
Swallowing can result in mouth and throat irritation and absorption from the stomach can result in drowsiness and unconsciousness. Small amounts can be fatal to children. Aspiration of liquid into the lungs, e.g. through vomiting, is a very serious hazard.
Gasolene dries the skin and can cause irritation and dermatitis on prolonged or repeated contact. Liquid in the eye causes severe smarting.
Motor gasolene may contain appreciable quantities of benzene, which is toxic upon inhalation and the concentrations of gasolene vapours must be kept very low. High concentrations will cause eye, nose and throat irritation, nausea, headache, depression and symptoms of drunkenness. Very high concentrations will result in rapid loss of consciousness.
Ensure there is adequate ventilation when handling and using gasolene. Great care must be taken to avoid the serious consequences of inhalation in the event of vapour build up arising from spillages in confined spaces.
Special precautions apply to cleaning and maintenance operations on gasolene storage tanks.
Gasolene should not be used as a cleaning agent. It must not be siphoned by mouth.

Kerosene (Paraffin)

Used also as heating fuel, solvent and cleaning agent.
Flammable.
Irritation of the mouth and throat may result from swallowing. The main hazard from swallowing arises if liquid aspiration into the lungs occurs. Liquid contact dries the skin and can cause irritation or dermatitis. Splashes in the eye may be slightly irritating.
In normal circumstances the low volatility does not give rise to harmful vapours. Exposure to mists and vapours from kerosene at elevated temperatures should be avoided (mists may arise in de-waxing).
Avoid skin and eye contact and ensure there is adequate ventilation.

Gas-Oil (Diesel Fuel)

see Fuels (Kerosene).
Combustible.
Gross or prolonged skin contact with high boiling gas oils may also cause serious skin disorders including skin cancer.

GAS CYLINDERS

see Fire.
Gases such as oxygen, acetylene, carbon dioxide, argon and propane are normally stored in cylinders at pressures of up to **140 bar**(**2000 lb/in2**) and great care should be taken in handling these cylinders to avoid mechanical damage to them or to the valve gear attached. The contents of each cylinder should be clearly identified by appropriate markings.
Cylinders should be stored in well ventilated enclosures, and protected from ice and snow, or direct sunlight. Fuel gases (e.g. acetylene and propane) should not be stored in close proximity to oxygen cylinders.
Care should be exercised to prevent leaks from gas cylinders and lines, and to avoid sources of ignition.
Only trained personnel should undertake work involving gas cylinders.

Gases

see Gas Cylinders.

Gas Shielded Welding

see Welding.

Gas Welding

see Welding.

GENERAL WORKSHOP TOOLS AND EQUIPMENT

It is essential that all tools and equipment are maintained in good condition and the correct safety equipment used where required.
Never use tools or equipment for any purpose other than that for which they were designed.
Never overload equipment such as hoists, jacks, axle and chassis stands or lifting slings. Damage caused by overloading is not always immediately apparent and may result in a fatal failure the next time that the equipment is used.
Do not use damaged or defective tools or equipment, particularly high speed equipment such as grinding wheels. A damaged grinding wheel can disintegrate without warning and cause serious injury.
Wear suitable eye protection when using grinding, chiselling or sand blasting equipment.
Wear a suitable breathing mask when using sand blasting equipment, working with asbestos based materials or using spraying equipment.

Glues

see Adhesives and Sealers.

High Pressure Air, Lubrication and Oil Test Equipment accordance with local regulations

see Lubricants and Greases.
Always keep high pressure equipment in good condition and regularly maintained, particularly at joints and unions.
Never direct a high pressure nozzle at the skin as the fluid may penetrate to the underlying tissue etc. and cause serious injury.

LEGAL ASPECTS

Many laws and regulations make requirements relating to health and safety in the use of materials and equipment in workshops. Always conform to the laws and regulations applicable to the country in which you are working.
Workshops should be familiar, in detail, with the associated laws and regulations. Consult the local factory inspectorate or appropriate authority if in any doubt.

LUBRICANTS AND GREASES

Avoid all prolonged and repeated contact with mineral oils, especially used oils. Used oils contaminated during service (e.g. routine service change sump oils) are more irritating and more likely to cause serious effects including skin cancer in the event of gross and prolonged skin contact.
Wash skin thoroughly after work involving oil. Proprietary hand cleaners may be of value provided they can be removed from the skin with water. Do not use petrol, paraffin or other solvents to remove oil from the skin.
Lubricants and greases may be slightly irritating to the eyes.
Repeated or prolonged skin contact should be avoided by wearing protective clothing if necessary. Particular care should be taken with used oils and greases containing lead. Do not allow work clothing to be contaminated with oil. Dry clean or launder such clothing at regular intervals. Discard oil soaked shoes.
Do not employ used engine oils as lubricants or for any application where appreciable skin contact is likely to occur.
Used oils may only be disposed of in accordance with local regulations.

Noise Insulation Materials

see Foams, Fibre Insulation.

PAINTS

see Solvents and Chemical Materials - General.
Highly Flammable, Flammable.
One Pack. Can contain harmful or toxic pigments, driers and other components as well as solvents. Spraying should only be carried out with adequate ventilation.
Two Pack. Can also contain harmful and toxic unreacted resins and resin hardening agents. The manufacturers instructions should be followed and the section of page 5 on resin based adhesives, isocyanate containing Adhesives and Foams should be consulted.
Spraying should preferably be carried out in exhausted ventilated booths removing vapour and spray mists from the breathing zone. Individuals working in booths should wear respiratory protection. Those doing small scale repair work in the open shop should wear supplied air respirators.

Paint Thinners

see Solvents.

Petrol

see Fuels (Gasolene).

Pressurised Equipment

see High Pressure Air, Lubrication and Oil Test Equipment.

Resistance Welding

see Welding.

Sealers

see Adhesives and Sealers.

SOLDER

see Welding.
Solders are mixtures of metals such that the melting point of the mixture is below that of the constituent metals (normally lead and tin). Solder application does not normally give rise to toxic lead fumes, provided a gas/air flame is used. Oxy-acetylene flames should not be used, as they are much hotter and will cause lead fumes to be evolved.
Some fumes may be produced by the application of any flame to surfaces coated with grease etc. and inhalation of these should be avoided.
Removal of excess solder should be undertaken with care, to ensure that fine lead dust is not produced, which can give toxic effects if inhaled. Respiratory protection may be necessary.
Solder spillage and filing should be collected and removed promptly to prevent general air contamination by lead.
High standards of personal hygiene are necessary in order to avoid indigestion of lead or inhalation of solder dust from clothing.

SOLVENTS

see Chemical Materials - General Fuels (Kerosene), Fire.
e.g. Acetone, white spirit, toluene, xylene, trichlorethane.
Used in cleaning materials, de-waxing, paints, plastics, resins, thinners etc.
Highly Inflammable, Flammable.
Skin contact will degrease the skin and may result in irritation and dermatitis following repeated or prolonged contact. Some can be absorbed through the skin in toxic or harmful quantities.
Splashes in the eye may cause severe irritation and could lead to loss of vision.
Brief exposure to high concentrations of vapours or mists will cause eye and throat irritation, drowsiness, dizziness, headaches and in the worst circumstances, unconsciousness.
Repeated or prolonged exposures to excessive but lower concentrations of vapours or mists, for which there might not be adequate warning indications, can cause more serious toxic or harmful effects.
Aspiration into the lungs (e.g. through vomiting) is the most serious consequence of swallowing.

Avoid splashes to the skin, eyes and clothing. Wear protective gloves, goggles and clothing if necessary.
Ensure good ventilation when in use, avoid breathing fumes, vapours and spray mists and keep containers tightly sealed. Do not use in confined spaces.
When the spraying material contains solvents, e.g. paints, adhesives, coatings, use extraction ventilation or personal respiratory protection in the absence of adequate general ventilation.
Do not apply heat or flame except under specific and detailed manufacturers instructions.

Sound Insulation

see Fibre Insulation, Foams.

Spot Welding

see Welding.

SUSPENDED LOADS

There is always a danger when loads are lifted or suspended. Never work under an unsupported suspended or raised load, e.g. jacked up vehicle, suspended engine, etc.
Always ensure that lifting equipment such as jacks, hoists, axle stands, slings, etc. are adequate and suitable for the job, in good condition and regularly maintained.
Never improvise lifting tackle.

Underseal

see Corrosion Protection.

WELDING

see Fire, Electric Shock, Gas Cylinders.
Welding processes include Resistance Welding (Spot Welding), Arc Welding and Gas Welding.

Resistance Welding

This process may cause particles of molten metal to be emitted at high velocity and the eyes and skin must be protected.

Arc Welding

This process emits a high level of ultraviolet radiation which may cause eye and skin burns to the welder and to other persons nearby. Gas-shielded welding processes are particularly hazardous in this respect. Personal protection must be worn, and screens used to shield other people.
Metal spatter will also occur and appropriate eye and skin protection is necessary.
The heat of the welding arc will produce fumes and gases from the metals being welded and from any applied coatings or contamination on the surfaces being worked on. These gases and fumes may be toxic and inhalation should always be avoided. The use of extraction ventilation to remove the fumes from the working area may be necessary, particularly in cases where the general ventilation is poor, or where considerable welding work is anticipated. In extreme cases where adequate ventilation cannot be provided, supplied air respirators may be necessary.

Gas Welding

Oxy-acetylene torches may be used for welding and cutting and special care must be taken to prevent leakage of these gases, with consequent risk of fire and explosion.
The process will produce metal spatter and eye and skin protection is necessary.
The flame is bright and eye protection should be used, but the ultra-violet emission is much less than that from arc welding, and lighter filters may be used.
The process itself produces few toxic fumes, but such fumes and gases may be produced from coatings on the work, particularly during cutting away of damaged body parts and inhalation of the fumes should be avoided.
In brazing, toxic fumes may be evolved from the metals in the brazing rod, and a severe hazard may arise if brazing rods containing cadmium are used. In this event particular care must be taken to avoid inhalation of fumes and expert advice may be required.

SPECIAL PRECAUTIONS MUST BE TAKEN BEFORE ANY WELDING OR CUTTING TAKES PLACE ON VESSELS WHICH HAVE CONTAINED COMBUSTIBLE MATERIALS, E.G. BOILING OR STEAMING OUT OF FUEL TANKS.

White Spirit

see Solvents.

ECOLOGY AND THE ENVIRONMENT

Soil, air and water are vital factors of agriculture and life in general. Where 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.

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, anti freeze, 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

1. Avoid filling tanks using unsuitable containers or inappropriate pressurised fuel delivery systems which may cause considerable spillage.
2. In general, avoid skin contact with all fuels, oils, acids, solvents, etc. Most of them contain substances which can be harmful to your health.
3. Modern oils contain additives. Do not burn contaminated fuels and/or waste oils in ordinary heating systems.
4. 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.
5. 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 safely.
6. Do not open the air-conditioning system yourself. It contains gases which should not be released into the atmosphere. Your dealer or air conditioning specialist has a special extractor for this purpose and will have to recharge the system anyway.
7. Repair any leaks or defects in the engine cooling or hydraulic system immediately.
8. Do not increase the pressure in a pressurised circuit as this may lead to the components exploding.
9. Protect hoses during welding as penetrating weld splatter may burn a hole or weaken them, causing the loss of oils, coolant, etc.

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DISTRIBUTION SYSTEMS

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DISTRIBUTION SYSTEMS - A

DISTRIBUTION SYSTEMS - A

PRIMARY HYDRAULIC POWER SYSTEM - 10.A

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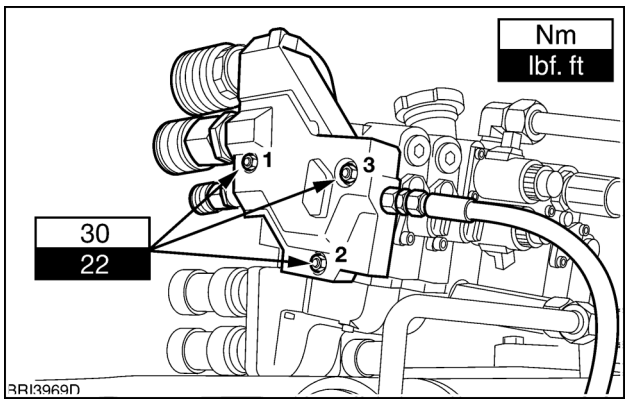
DISTRIBUTION SYSTEMS - A

PRIMARY HYDRAULIC POWER SYSTEM - 10.A

PRIMARY HYDRAULIC POWER SYSTEM - Special tools

DESCRIPTION	PART NUMBER
Tee adaptor 11/16 ORFS female x 11/16 ORFS male x 7/16 UNF female	380000570*
Tee adaptor 7/16 JIC female x 7/16 JIC male x 7/16 UNF female	380000571*
Adaptor M10 banjo x 7/16 UNF female	380000572*
Tee adaptor 9/16 ORFS female x 9/16 ORFS male x 7/16 UNF female	380000572*
Blanking Cap 9/16 ORFS	380000573*
Blanking Cap 7/16 ORFS	380000575*
Adaptor 7/16 UNF female x 1/2 BSP male	380000576*
Adaptor 7/16 UNF female x M12 x 1.5p male	380000577*
Adaptor 7/16 UNF female x M14 x 1.5p male	380000578*
Adaptor M14 banjo x M14 x 1.5p female	380000579*
Tee adaptor 7/16 UNF female x 1/4 BSP hose tail x 1/2 hose	380000580*
7/16 UNF male Quick release adaptor	**380000492***
Adaptor M10 x 1.0p x 7/16 UNF female	**380000493***
Tee adaptor 1” ORFS female x 1” ORFS male x 7/16 UNF female	380000517
Blanking Cap 11/16 ORFS	380000599*
Pressure Gauge 0–10 bar	380000551#
Pressure Gauge 0–40 bar (5 off)	**380000552#**
Pressure Gauge 0–250 bar	380000553#
Remote valve coupling	5101741 or 380000554#
Quick release adaptor	**380000543**
Pressure gauge hose	**380000545#**
1/8 NPT fitting to attach hose 292246 to gauge	**380000544#**
Adaptor M10 x 1.0p x 7/16 JIC male (enables use of gauges with 7/16 JIC hoses if used)	**380000494**
diagnostic switch	**380000488**
Bypass connector	**380000561**
Trailer brake fitting	380000550#
Flow Meter 120 ltr/min minimum (procure locally)	
* Part of hydraulic adaptor kit **380000464**	
# Part of hydraulic pressure test kit **380000240**	
Remote Valve check valve removal tool	**380002720**

Power beyond - Torque



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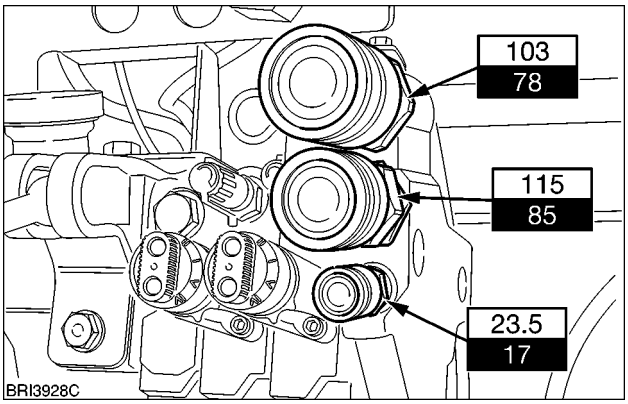
Power Beyond Torque Sequence



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Power Beyond Coupler Torques

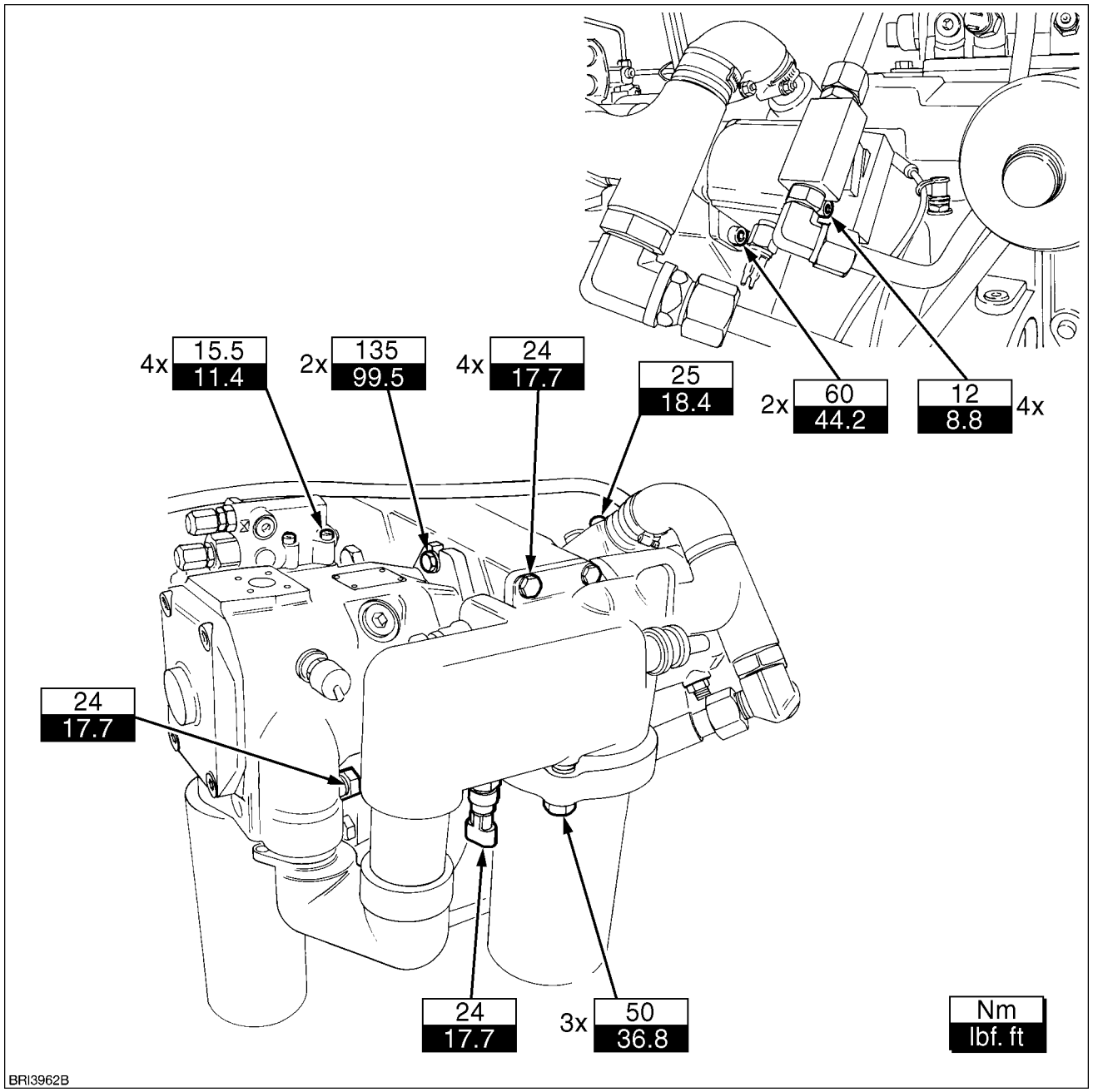
Refer to : **Power beyond - Install (A.10.A)**

Hydraulic pump Variable displacement pump - General specification

Load Sensed Variable Displacement Piston Pump (**120/150 Ltr/Min**)

Type		Variable Flow Piston Pump (Swash Plate Controlled)
Rotation		Clockwise
Pump Speed@ **2200 erpm**		**2662 rpm**
Output @ 2200 erpm	Standard Flow	**120 Ltr/min** **26.4 Imp Galls/min** **31.7 US Galls/min**
Output @ 2200 erpm	Hi- Flow	**150 Ltr/min** **32.9 Imp Galls/min** **39.6 US Galls/min**
Standby Pressure (Low Pressure Standby)		**26±1 bar** (**377±15 lbf.in2**)
Maximum System Pressure (High Pressure Standby)		**210±5 bar** (**3046±73 lbf/in2**)
Charge Pressure Filter Relief Valve		**6 bar**
Charge System Pressure		**3 bar**

Hydraulic pump Variable displacement pump - Torque



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Charge pump - General specification

Charge Pump (**106 Ltr/Min**)	
Type	Gear Type Pump
Charge Pressure Filter Dump Valve	Crack open @ **6.9 bar** (**100 lbf/in2**) Fully Open @ **12.4 bar** (**180 lbf/in2**)
Charge Pressure	Minimum **1.6 - 3.4 bar** (**23 - 50 lbf/in2**) @ **2100 rev/min** and variable flow piston pump 'On Load'
Charge Pressure Switch	Close @ **0.55 - 0.82 bar** (**8 - 12 lbf/in2**) Making charge pressure warning light flash

PRIMARY HYDRAULIC POWER SYSTEM - Static description

The hydraulic system comprises the following oil circuits:-

High pressure circuit

Hydraulic rear powerlift
Remote valves
Trailer brake system (where fitted)
Front axle suspension (where fitted)

Oil circuit of the steering hydraulics

Steering pump and steering cylinder
Control valve of the Turn Assist (where fitted)

Low pressure circuit

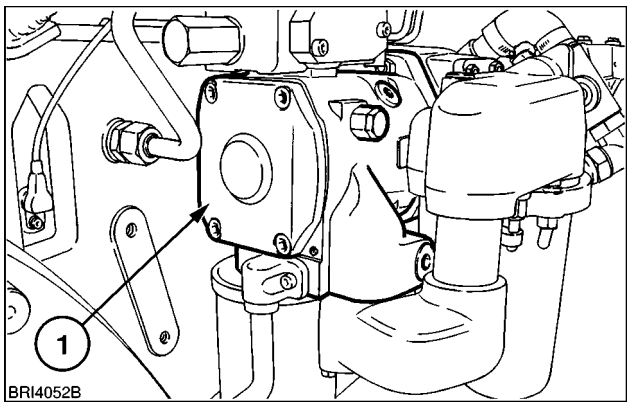
Engine PTO
Differential lock
All wheel drive
Actuation of transmission couplings and synchroniser units
Front axle servobrake
Engagement of the crawler gear
Servo-actuated main brake cylinder
Front PTO (where fitted)

Layout of the lubrication system

PTO coupling
Transmission coupling
Transmission shaft pressure lubrication
Bearing of the pump drive pinion
Lifting shaft of the hydraulic powerlift
The high pressure circuit is a closed Load Sensing system and is configured differently according to the variants in equipment for each tractor model.
Steering circuit, low pressure and lubrication circuits are configured as an open system.

VARIATIONS IN EQUIPMENT IN THE TRACTOR HYDRAULICS				
Transmission	High pressure hydraulic system	Hydraulic pump	Hydraulic powerlift	Remote valves
Full powershift transmission	Closed system	120 L/min CCLS variable displacement pump 150 L/min "Hi Flow" axial piston variable displacement pump	Electronic powerlift control	Closed system

CCLS axial piston variable displacement pump **(1)**.
Figure **1** **2**



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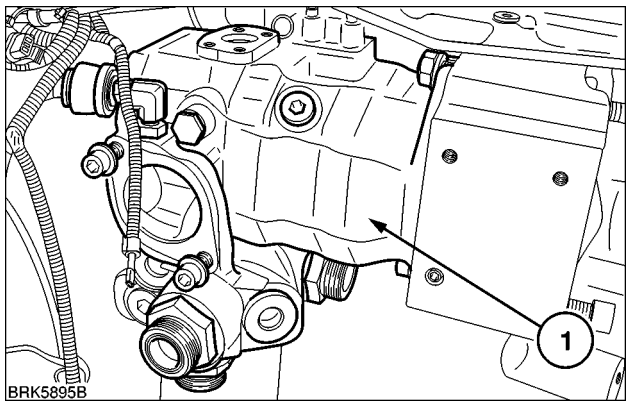
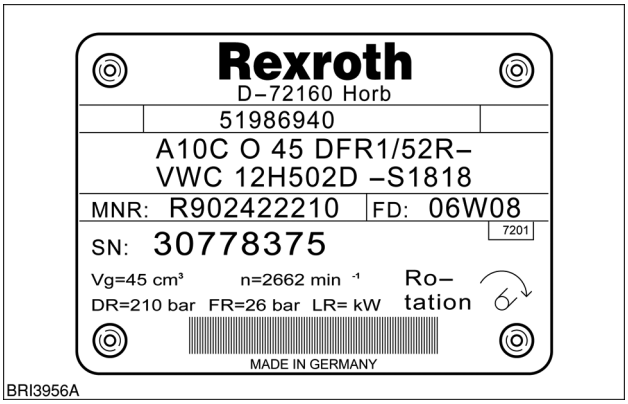


BAIL08CVT085ASA 2

The high-pressure hydraulic pumps in the Load Sensing version with closed circuit can be differentiated by the serial numbers on the plate above the pump:-
Figure **3** shows the rating plate of the **150 l/min** (**39.6 US gpm**) pump.

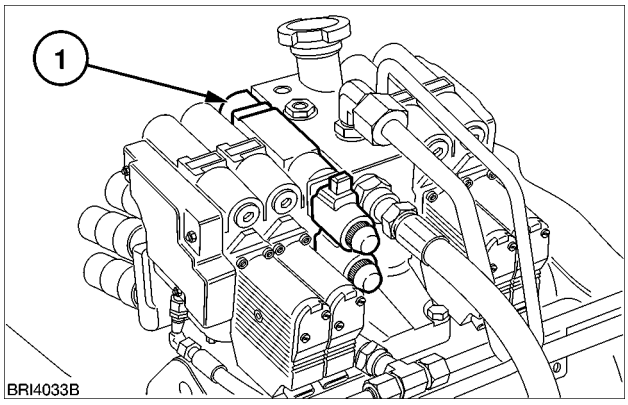
BAIL06CCM082ASA 3

Figure **4** shows the rating plate of the **120 l/min** (**31.7 US gpm**) pump.



BAIL06CCM083ASA 4

Closed Centre remote valves and electronic powerlift control **(1)**.



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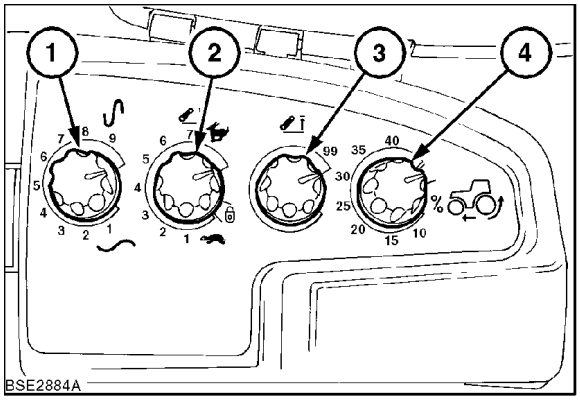
Operating the electronic powerlift control

Operation of PUMA standard:
In tractors that are equipped with an electronic hydraulic powerlift control, all controls for the hydraulics are gathered together on one operating panel.
(1). Rotary control for draft control response sensitivity
(2). Lowering speed rotary control
(3). Rotary control for height limit control
(4). Rotary control for wheel slip control



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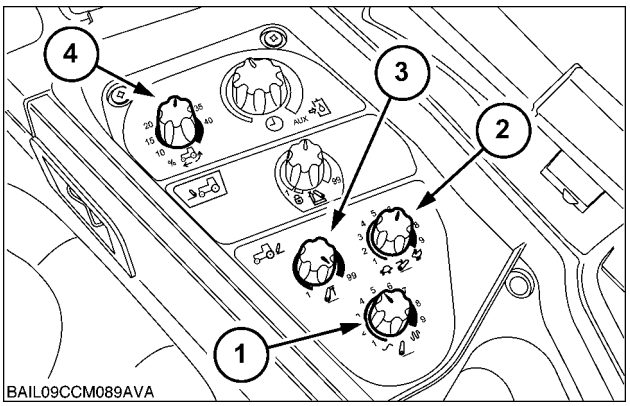
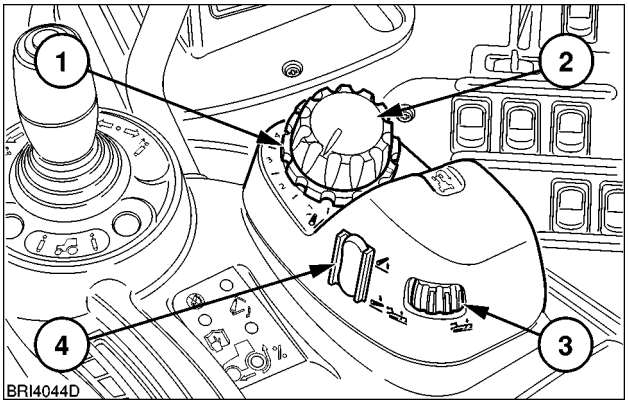


BAIL09CCM089AVA 8

The control for the powerlift position control, the rapid control switch in the cab, and the controls for traction control make operation of the EPC simple.



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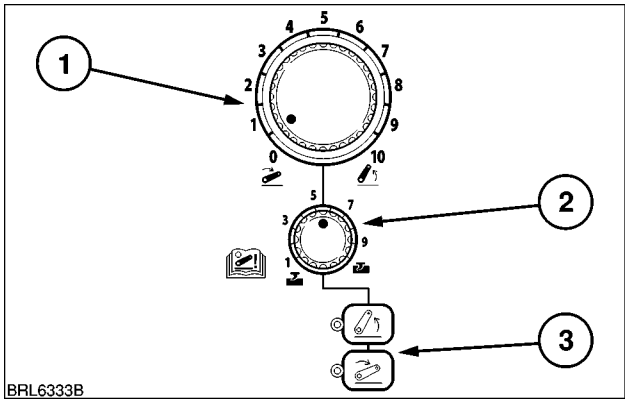

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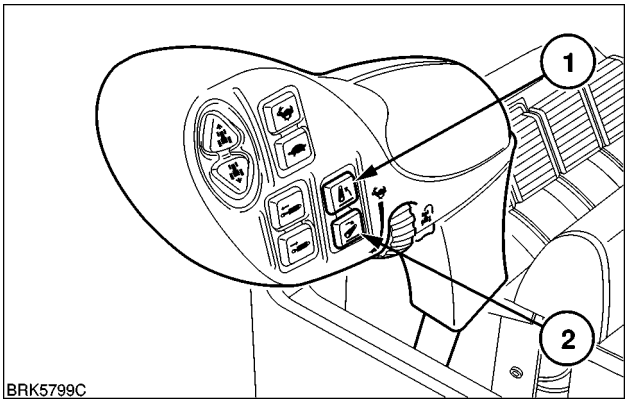
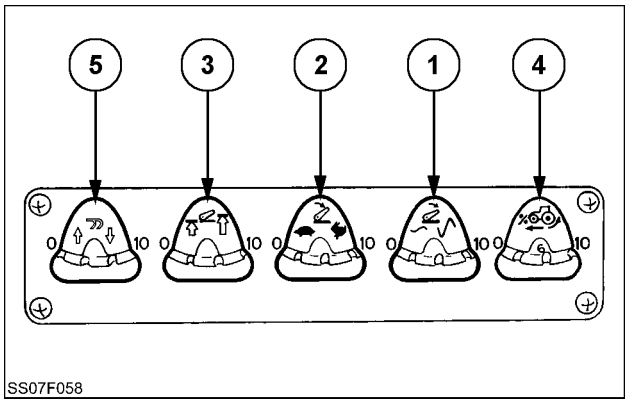


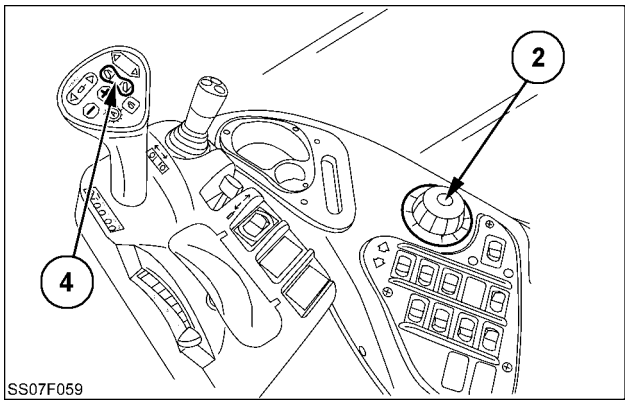
BRK5799C 11

Operation of the PUMA Multicontroller:
With the PUMA Multicontroller, all controls for the hydraulics are gathered together on the right-hand control panel and on the Multicontroller.
(1). Response sensitivity potentiometer (Traction control)
(2). Lowering speed potentiometer
(3). Lift limit control potentiometer
(4). Wheel slip control potentiometer
(5). Traction control potentiometer



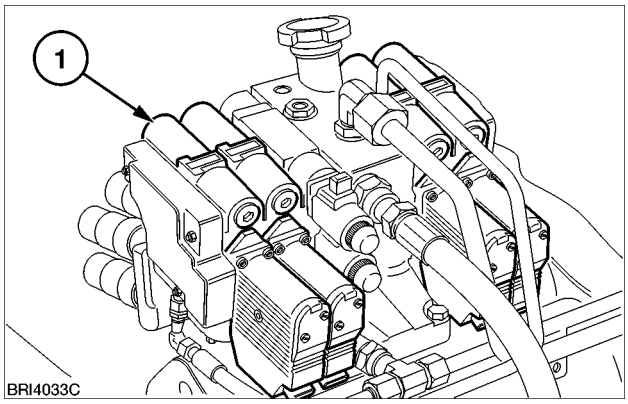
SS07F058 12

The position control potentiometer **(2)** and the CONTROL, TRANSPORT buttons **(4)** make operation of the EPC simple.



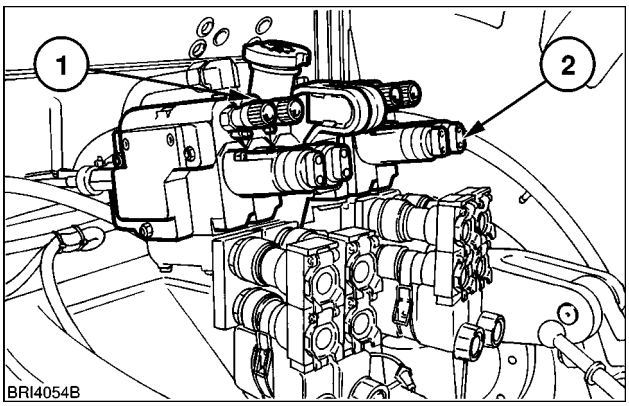
SS07F059 13

The tractors can also be fitted with electrohydraulic remote valves **(1)**.



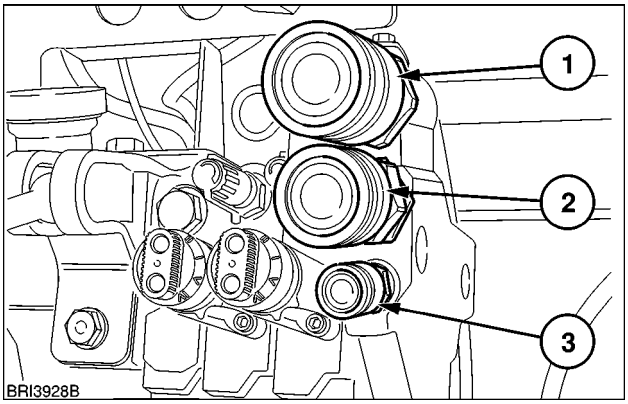
BAIL06CCM085ASA 14

Another optional version is mechanically-operated remote valves with adjustable locking **(2)** and flow rate regulators **(1)**. (does not apply to PUMA Multicontroller)



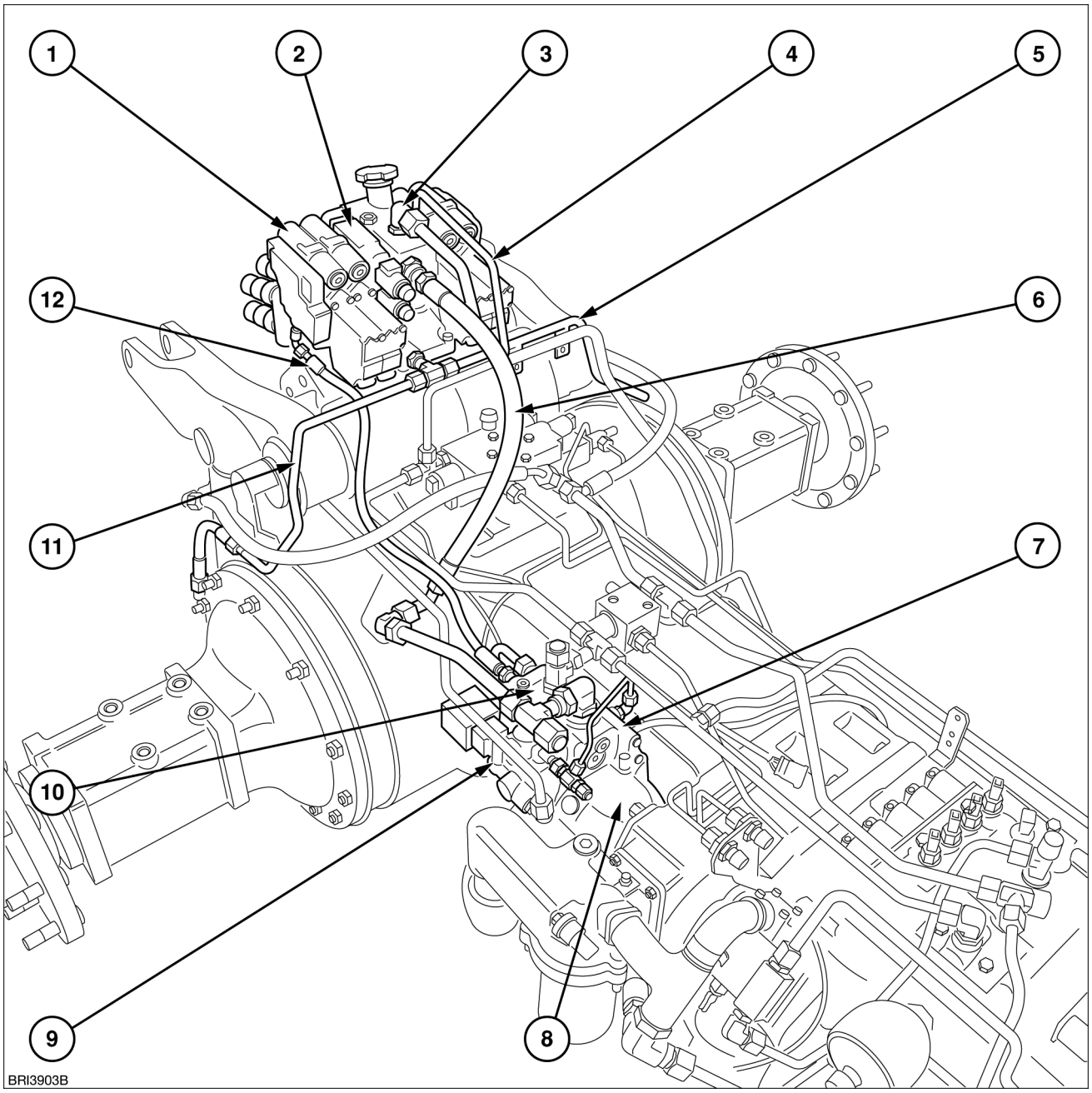
BAIL06CCM086ASA 16

For implements that require a continual oil flow from the tractor's hydraulic system, the connection of a Power-beyond valve segment on the control unit block is provided with oil couplings **(1)**, **(2)** and **(3)**.



BAIL06CCM054ASA 17

HIGH PRESSURE HYDRAULIC SYSTEM IN LOAD SENSING VERSION WITH CLOSED CIRCUIT

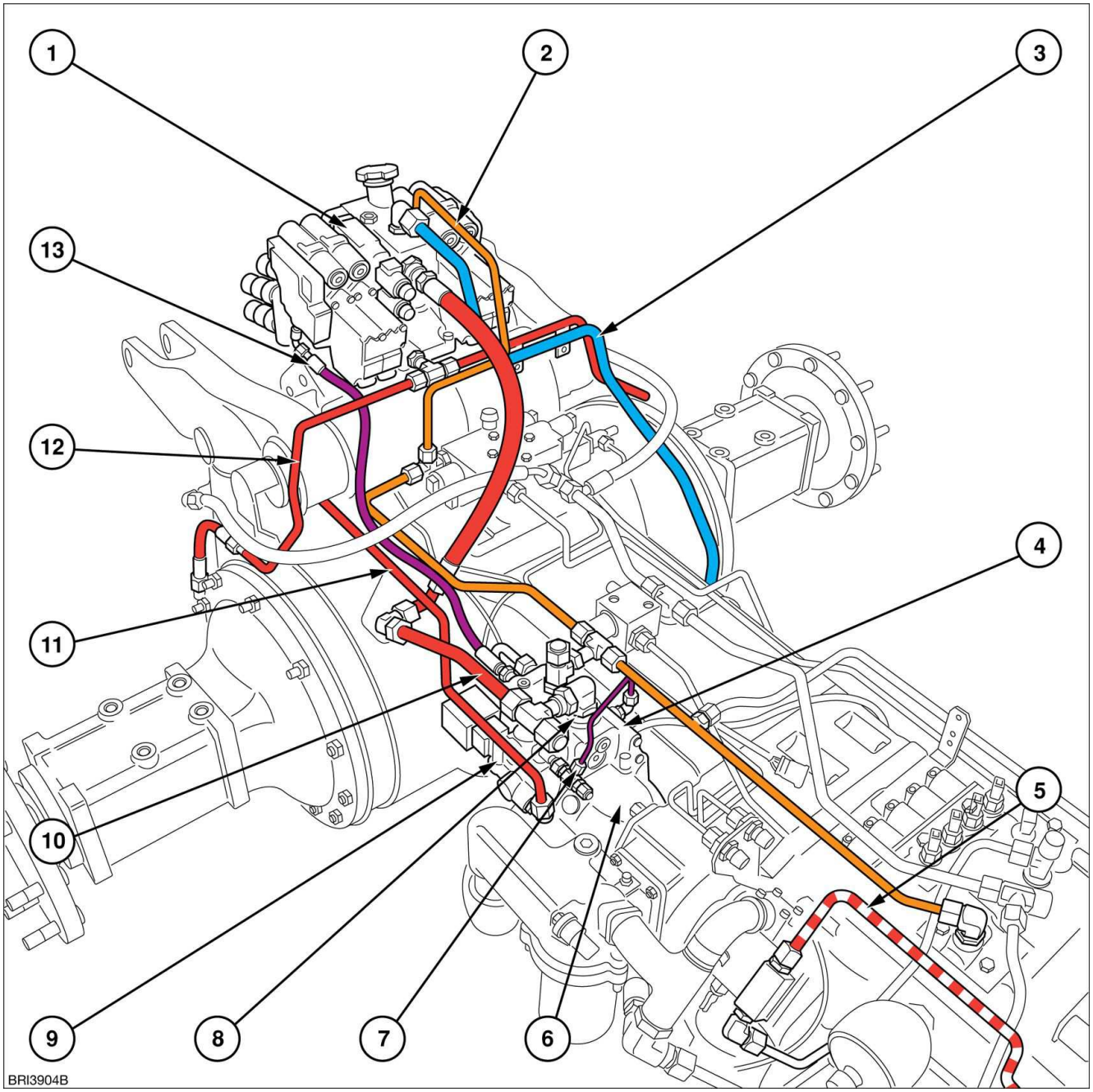


BAIL06CCM010GSA 18

1 Electrohydraulic remote valves
2 EPC control valve
3 Return pipe to the oil reservoir
4 Low pressure oil supply
5 To the lifting cylinders
6 Pump flow to electrohydr. remote valve and EPC
7 Flow control valve
8 Variable displacement pump
9 Trailer brake valve
10 Pressure-reducer priority valve
11 To the lifting cylinders
12 Load Sensing line from EPC control valve and electrohydr. remote valves

The basic principle of the Closed Centre high-pressure hydraulic system in the Load Sensing version with variable displacement pump is the availability of a needs-based oil flow. This makes possible simultaneous actuation of trailer brake system, hydraulic powerlift, remote valves and - where fitted - the front axle suspension. The Load Sensing variable displacement pump offers important advantages with regard to the reduction of engine power loss compared

to open-circuit systems, in which a higher oil volume flow, which is often clearly above the required amount, is continually pumped around the hydraulic system.



BAIL06CCM011GSA 19

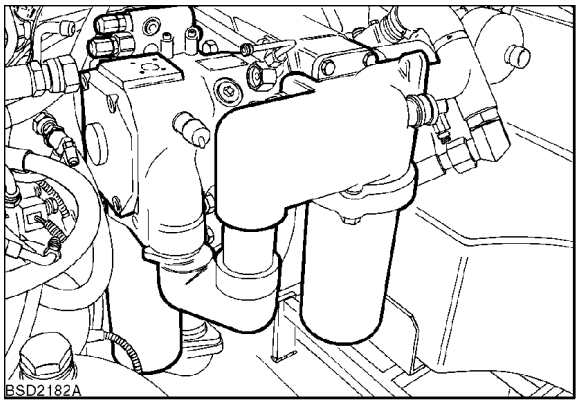
1 EPC control valve
2 Low pressure oil supply
3 Return pipe to the oil reservoir
4 Flow control valve
5 Oil pressure of the steering hydraulics oil pump
6 Variable displacement pump
7 Load Sensing line to the pressure reducer priority valve
8 Pressure-reducer priority valve
9 Trailer brake valve
10 Pump flow to electrohydr. remote valve and EPC
11 To the oil coupling of the trailer brake
12 Oil pressure to the lifting cylinders
13Load Sensing line from EPC control valve and electrohydr. remote valves

The high-pressure circuit illustrated in **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic schema (A.10.A)** comprises the following components:

Hydraulic pump unit

The Load Sensing valve with pressure and oil flow control valves, oil pump and priority valve for the steering hydraulics, intake filter and main oil filter as well as various electrical switches are integrated in the high-pressure variable displacement pump.
Figure **20** shows the main pump unit.

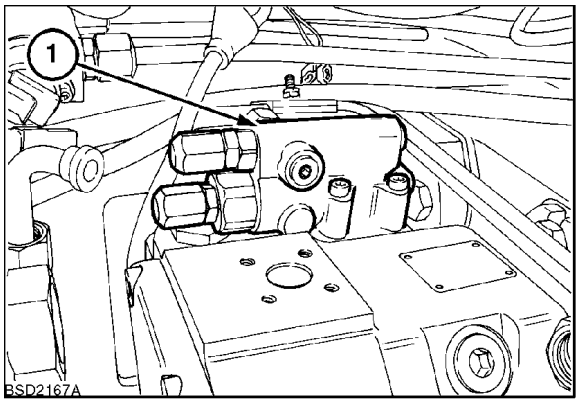
NOTE: *The oil pump for the steering hydraulics is shown separately to the main pump unit.*



BSD2182A_559 20

The Load Sensing valve block consists of a high-pressure control valve **(1)** and an oil flow control valve. The Load Sensing valve receives hydraulic control signals from the driven components and transmits these to the oil pump, which then matches the supply volume to the system's requirement for oil.

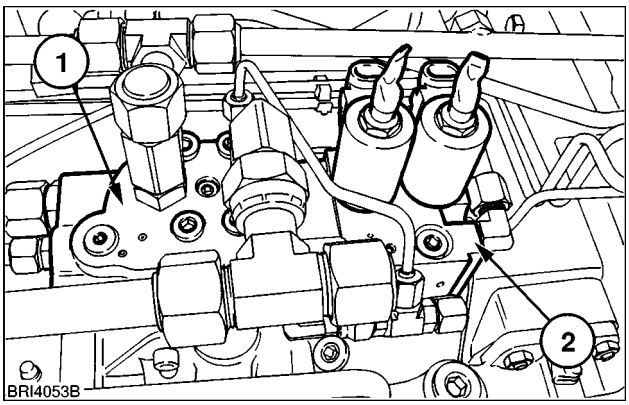
The Load Sensing valve block is illustrated in Figure **21**.



BSD2167A_561 21

Priority valve

The priority valve **(1)** on the top of the main oil pump channels high-pressure oil to the control block and to the trailer brake valve (where fitted). It also supplies the low-pressure control valve with low-pressure oil. If a front axle suspension is installed, a levelling valve **(2)** is mounted on the priority valve, which delivers an oil flow to the control valve for the suspension (Figure **30**) and to the cylinder.



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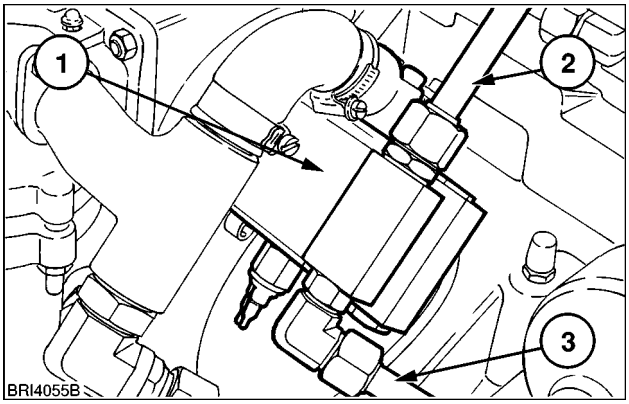
Steering hydraulics oil pump

Figure **23** shows the oil pump for the steering hydraulics.
The oil pump for the steering hydraulics is configured as a separate unit, but it is also driven by the same geared wheel as the main oil pump.

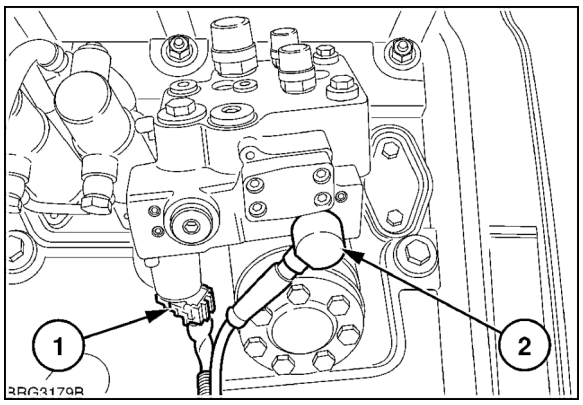
1. Oil pump for the steering hydraulics
2. Connection to the control pump
3. Line to the oil cooler



BAIL06CCM084ASA 23

Control valve of the Turn Assist (where fitted)

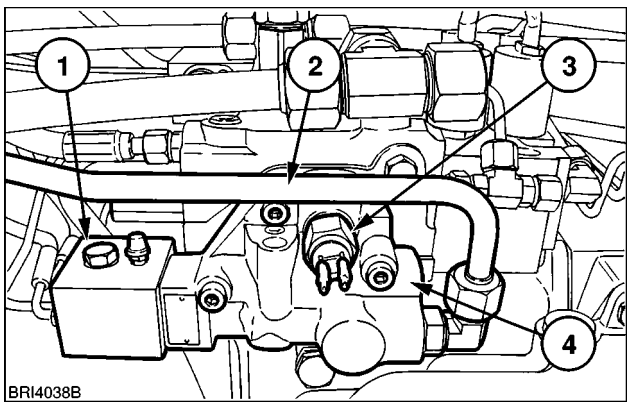
The Turn Assist, which is available as an optional extra, supplies increased responsiveness from the steering, when needed, e. g. during front loader operations.
From the straight ahead position, Turn Assistwill provide full right or left-hand steering lock with a **8 °** movement of the steering wheel.



BAIL06CCM076ASA 24

Trailer brake valve

The trailer brake valve is under the cab and is mounted on the priority valve at the top of the main pump unit. The trailer brake valve allows pressure oil to flow to the trailer brake system, when both of the tractor's brake pedals are depressed.
Figure **25** shows the trailer brake valve.



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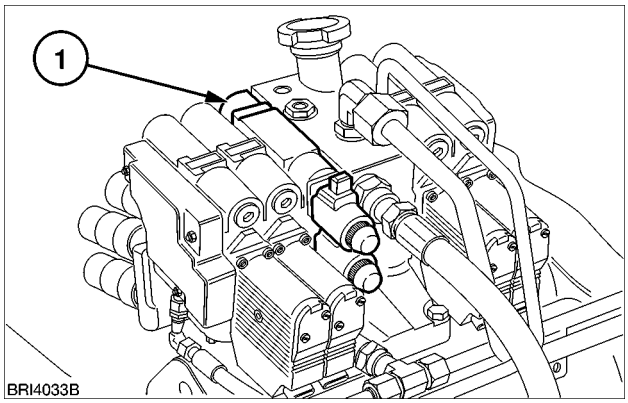
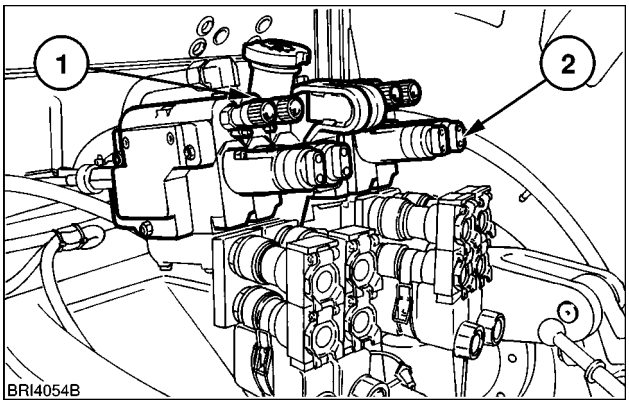
The EPC control valve **(1)** is constructed as a subplate valve and is to be found together with the remote valves at the rear under the driver's cab; the safety valve of the lift cylinder is integrated into it.
The lifting cylinder safety valve protects the lifting cylinder from peaks in pressure and limits the pressure in the cylinder to **230 bar** (**3335.0 psi**).
The EPC control valve is a microcomputer-controlled magnetic control valve, which controls the lifting and lowering of the hydraulic powerlift.

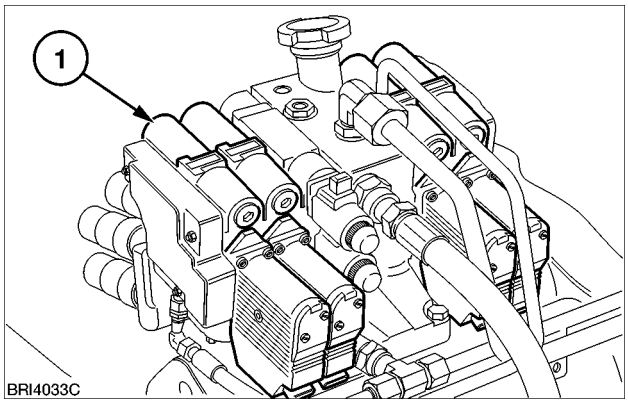


BAIL06CCM057ASA 26

CCLS remote valves
The remote valves for the closed hydraulic system are available in two versions. In the standard version, mechanical control units **(1)**, Fig. **27**) are mounted, which are actuated from the cab via a Bowden cable. As an optional extra, electrohydraulic control units (**(1)**, Fig. **28**) are available for all models, which are operated via electrical switches and are fitted with an electronic control module for flow volume regulation via a solenoid valve.
Up to four mechanically actuated remote valves can be installed, or in the electronic version, as an option, an additional fifth control valve as well.

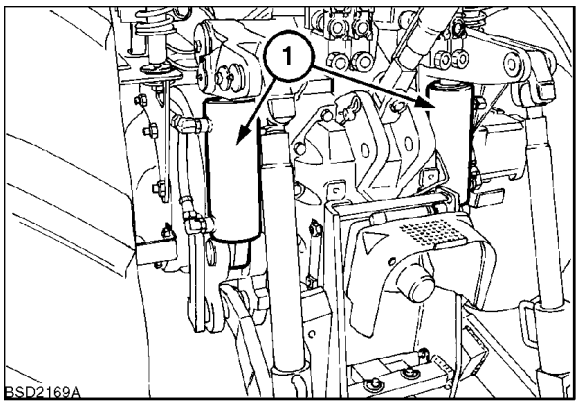


BAIL06CCM086ASA 27



BAIL06CCM085ASA 28

Lifting cylinder for the hydraulic powerlift
Two external lifting cylinders, one per lift arm, are mounted on the mounting points in the cast body of the rear axle mid housing, see Figure **29**. These are available in the three sizes / lifting force classes **80 mm**, **90 mm** and **100 mm**.



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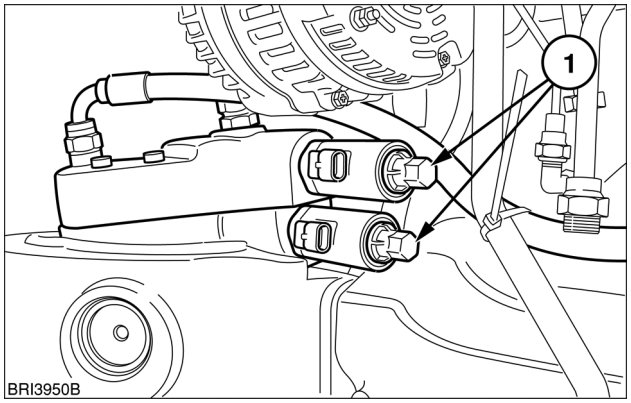
Control valve for the front axle suspension

This is on the left-hand side of the tractor and is fastened to the suspension cylinder. The suspension control valve receives high-pressure oil via the pressure reducer priority valve and the levelling valve. With the help of electronically controlled PWM solenoid valves **(1)**, it controls the oil flow to a working cylinder, which is mounted between the front axle and front axle bearing block. This is how the front axle suspension is hydraulically controlled.



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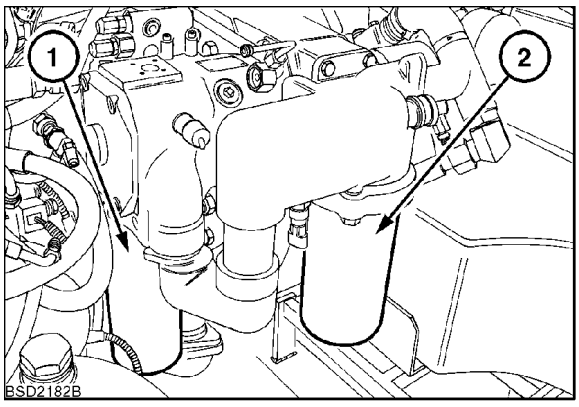
Hydraulic oil filter

There are two different versions of the hydraulic filters, which are used on all tractor models.

(1) Oil filter for the feed pump

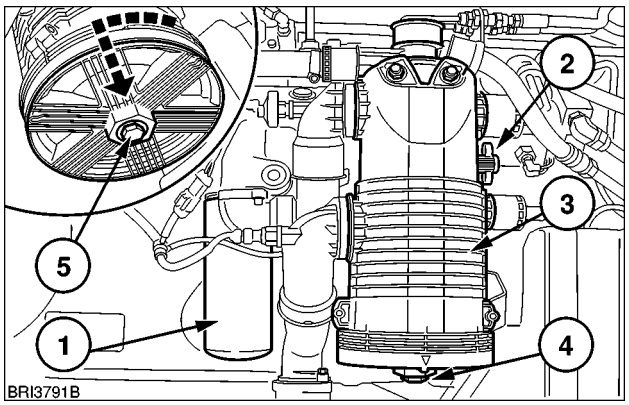
(2) Main flow oil filter



BSD2182B 31

(1) Oil filter for the feed pump

(3) Main flow oil filter



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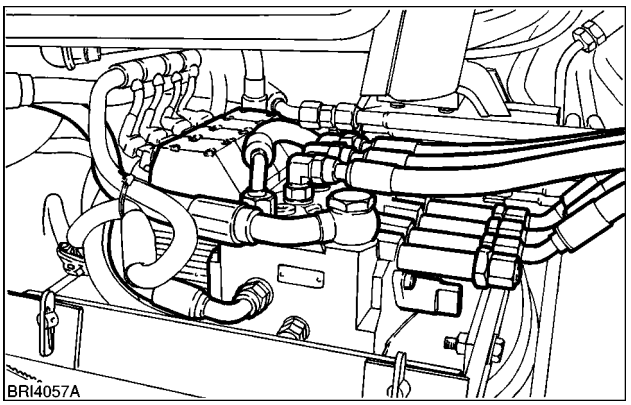
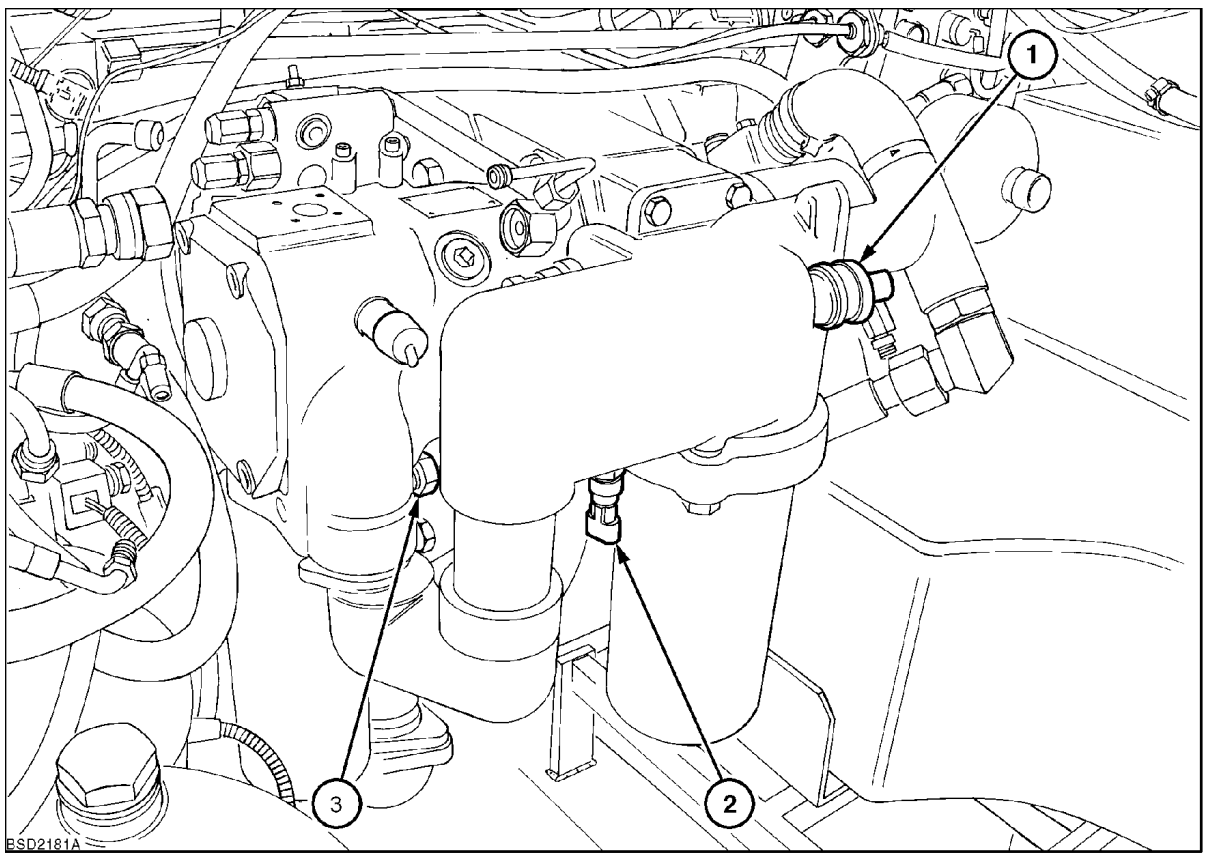
Side-mounted remote valves

As an optional extra, other remote valves can be mounted under the driver's cab. They are installed via T-shaped threaded connections in the high-pressure oil line from the variable displacement pump behind the trailer brake valve and are actuated via a crossgate lever control in the driver's cab.



BAIL06CCM088ASA 33



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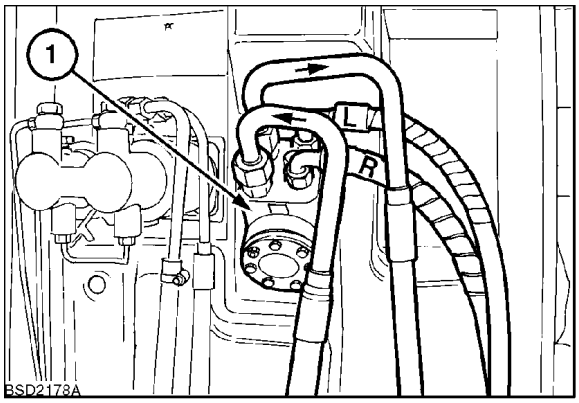
High-pressure hydraulic system - Electrical switches

1. Vacuum switch of the inlet filter
2. Oil temperature switch
3. Pressure switch of the feed pressure telltale

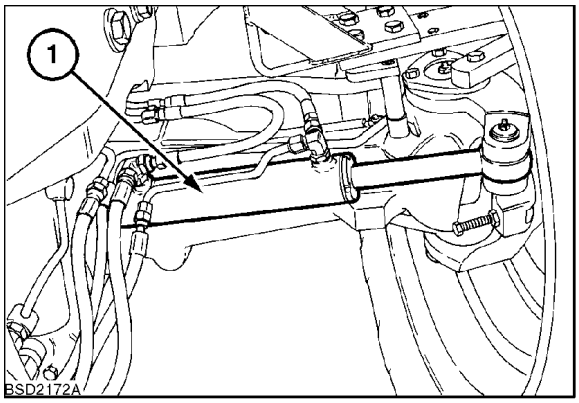
Control pump

. All models are fitted with a control pump with constant displacement volumes.



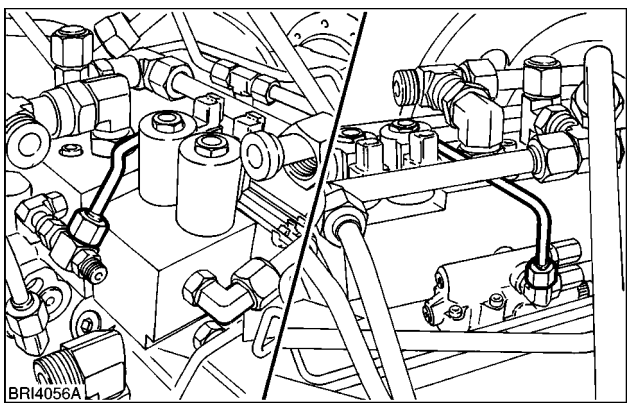
BSD2178A 35

Steering cylinder
The steering cylinders are directly supplied via the control pump with high-pressure oil.



BSD2172A 36

Load Sensing reversing valves
This valve is used in all remote valves, in the EPC control valve and between the trailer brake valve, the control valve of the front axle suspension and, if necessary, the side-mounted remote valves. It ensures that the unit with the highest demand for oil pressure applies pilot oil pressure to the Load Sensing valve of the CCLS variable displacement pump.



BAIL06CCM089ASA 37

The Closed Centre high-pressure oil circuit works in the following way:-

The components of the high pressure oil circuit are connected via Load Sensing lines with the hydraulic Load Sensing valve, which controls the capacity of the hydraulic pump.
If the trailer brake system, the remote valves, the hydraulic powerlift or the front axle suspension (where fitted) are operated, the Load Sensing valve of the variable displacement pump compares the pressure in the Load Sensing line of the components with the delivery pressure of the hydraulic pump.
If the pump pressure is less than the sum of the pressures of Load Sensing line and spring pressure on the oil flow regulator, the pump capacity is increased. As soon as the demand of the oil circuit is fulfilled, the pump pressure exceeds the sum of the pressures from Load Sensing line and spring pressure of the oil flow control valves. This pushes the control pin in the oil flow control valve to the right, whereby the pilot oil is fed to the control cylinder of the variable displacement pump swash plate, which reduces the pump stroke and thus adjusts the capacity to the demand of the oil circuit.
A detailed description of the Load Sensing working principle of the axial piston variable displacement pump can be found in **Hydraulic pump - Static description (A.10.A)**.

High-pressure hydraulic system in Load Sensing version with closed circuit
See **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic schema (A.10.A)**

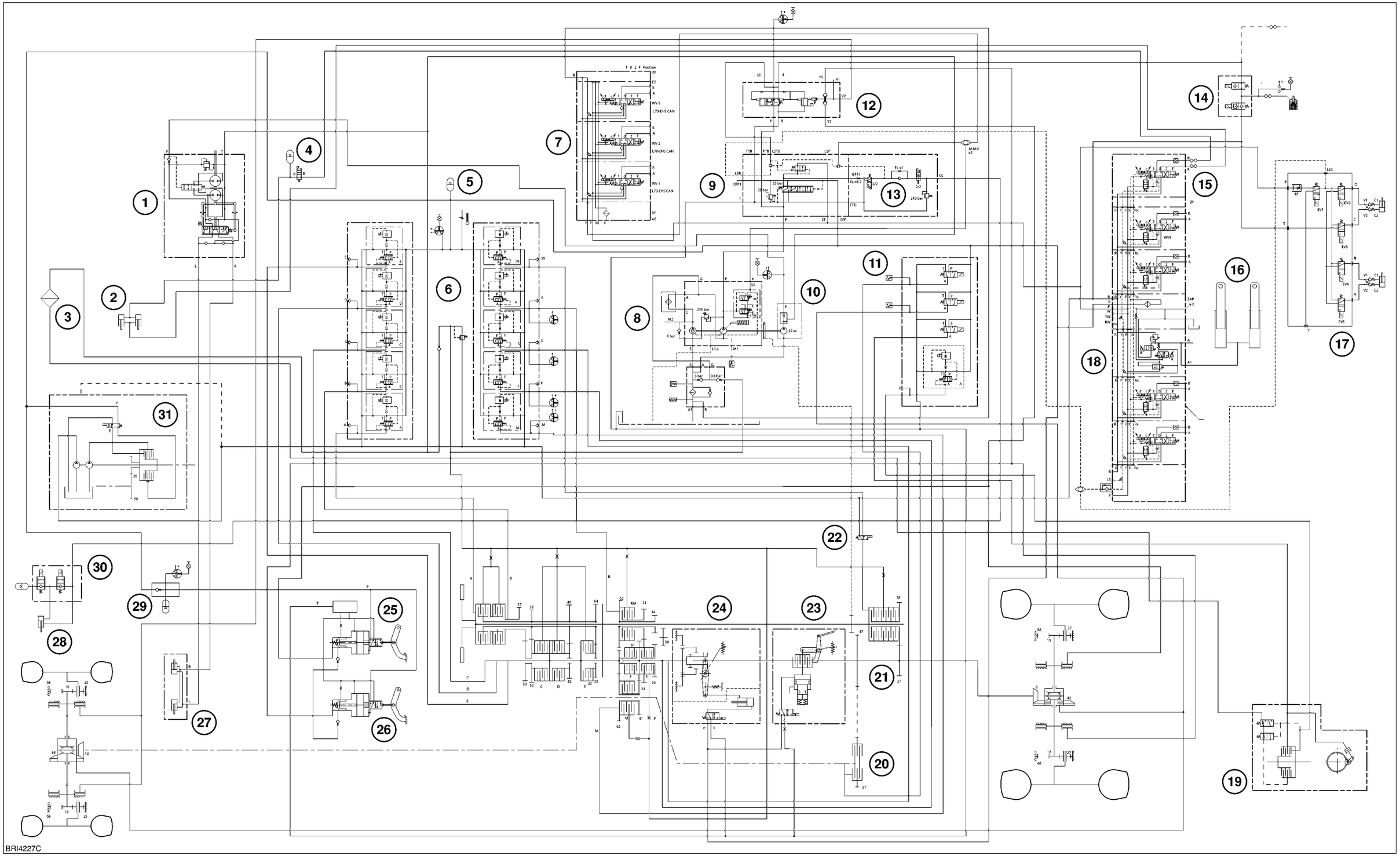
PRIMARY HYDRAULIC POWER SYSTEM - Static description

Pressure test kit **380000464** has been developed for pressure testing and contains adaptors specifically designed for access to test ports.
Refer to **PRIMARY HYDRAULIC POWER SYSTEM - Pressure test (A.10.A)** which describes the procedure for performing the following pressure tests using this kit and other standard fittings already available through CNH Logistics.
High Pressure System
High Pressure Standby
Sensing Line Pressure
Low Pressure Standby
Pump Charge Pressure
Steering
Lift Ram Pressure
Low Pressure System
Lubrication
Brake Boost Valve
Trailer Brake Valve
Before commencing hydraulic pressure testing perform the fault finding checks in **PRIMARY HYDRAULIC POWER SYSTEM - Troubleshooting (A.10.A)** followed by the fault finding procedure for the type of concern identified. Following these checks may identify an obvious cause for the concern and prevent unnecessary component disassembly.
The hydraulic pump is the heart of the hydraulic system and the chapter describes in detail the tests necessary to confirm that pump output is to specification. Once specified pump output has been confirmed attention can be focused on the appropriate pressure testing of individual components in the hydraulic circuit.

PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic schema

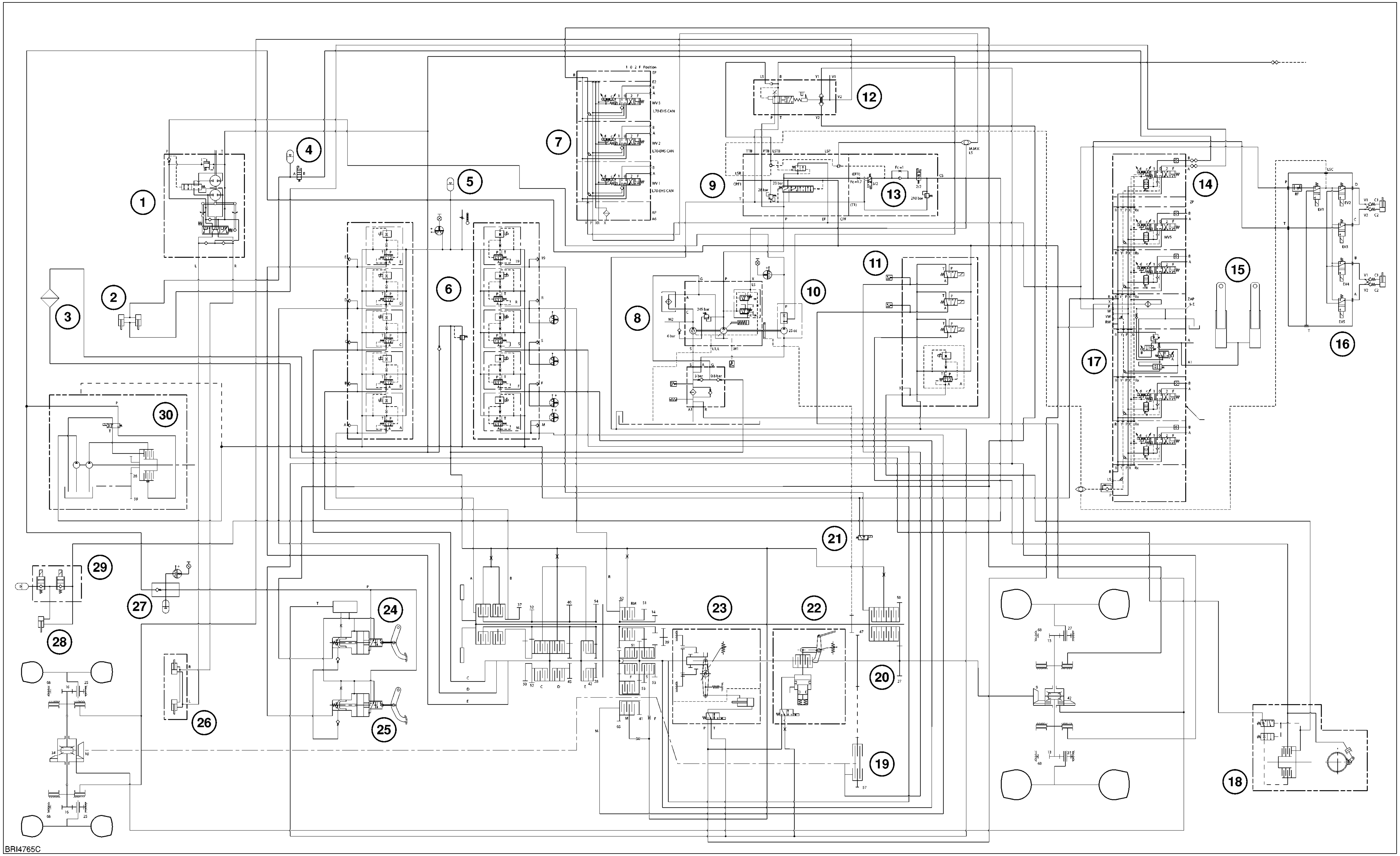
With Italian Trailer Brakes

1.Steering Motor (For Turn Assist Schematic refer to : **Fast steer system - Hydraulic schema (D.20.C)**
2.Front Lift Cylinders
3.Oil Cooler
4.Front Lift Valve
5.Accumulator
6.Transmission Control Valve Assembly
7.Mid Mount Remote Valves
8.Variable Displacement Pump
9.Pressure Reducing Priority Valve
10.Steering Pump
11.Low pressure Distribution Valve
12.Italian Trailer Brake Valve
13.Load Levelling Valve
14.Italian Trailer Brake Valve Solenoid Block
15.Electro Hydraulic Remote Valves (For Mechanical Remote Valves with Power Beyond refer to : **PRIMARY HYDRAULIC POWER SYSTEM Closed center mechanical remote valve - Hydraulic schema (A.10.B)**
16.Hydraulic Lift Cylinders
17.Diverter Valve for Hydraulically Adjustable Top and Right hand Links
18.Electronic Draft Control Valve
19.PTO Clutch and Brake
20.Four Wheel Drive Clutch
21.19th Gear Clutch
22.Dump Valve
23.Parking Brake
24.Creeper Assembly
25.Right Hand Brake
26.Left Hand Brake
27.Steering Cylinders
28.Suspension Cylinder
29.Brake Booster Accumulator
30.Suspension Control Valve
31.Front PTO



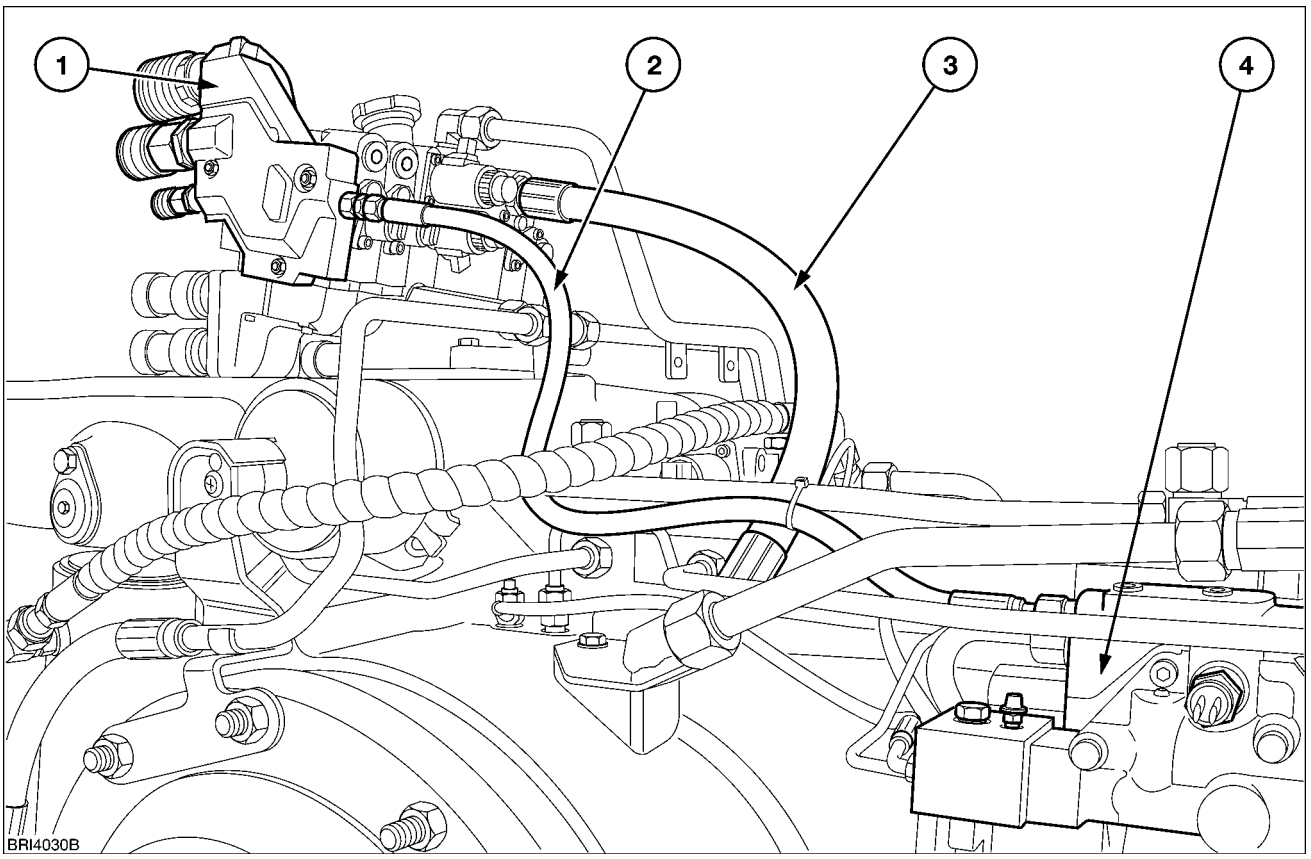
BAIL07CCM270JSA 1

With Universal Trailer Brakes	
1.Steering Motor (For Turn Assist Schematic refer to : **Fast steer system - Hydraulic schema (D.20.C)**	2.Front Lift Cylinders
3.Oil Cooler	4.Front Lift Valve
5.Accumulator	6.Transmission Control Valve Assembly
7.Mid Mount Remote Valves	8.Variable Displacement Pump
9.Pressure Reducing Priority Valve	10.Steering Pump
11.Low pressure Distribution Valve	12.Trailer Brake Valve
13.Load Levelling Valve	14.Electro Hydraulic Remote Valves (For Mechanical Remote Valves with Power Beyond refer to : **PRIMARY HYDRAULIC POWER SYSTEM Closed center mechanical remote valve - Hydraulic schema (A.10.B)**
15.Hydraulic Lift Cylinders	16.Diverter Valve for Hydraulically Adjustable Top and Right hand Links
17.Electronic Draft Control Valve	18.PTO Clutch and Brake
19.Four Wheel Drive Clutch	20.19th Gear Clutch
21.Dump Valve	22.Parking Brake
23.Creeper Assembly	24.Right Hand Brake
25.Left Hand Brake	26.Steering Cylinders
27.Suspension Cylinder	28.Brake Booster Accumulator
29.Suspension Control Valve	30.Front PTO



BAIL07CCM300JSA 2

Power beyond - Static description

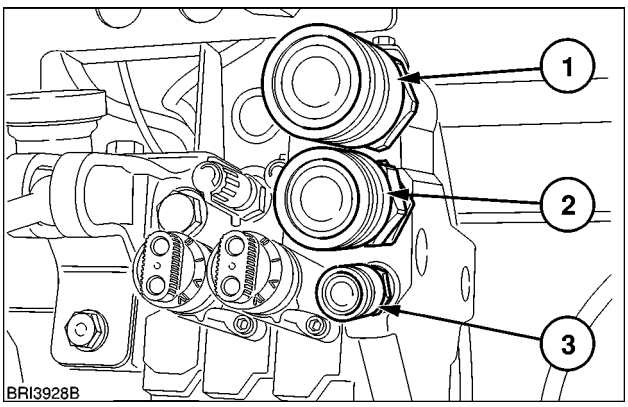


BAIL06CCM050FSA 1

Power Beyond Component Layout

1. Power Beyond Slice
2. Load Sensing Line
3. Pressure Feed Hose
4. Priority Valve

For implements or attachments requiring a continuous oil flow from the tractor hydraulic system, provision is made to connect directly into the main hydraulic circuit at the rear of the tractor.
High pressure oil is fed from the main pump via hose **(3)** (Figure **1**) to the remote valve central manifold and through the pressure gallery to the power beyond slice **(1)**. Pressure is fed through the slice to the coupler and then to the implement or attachment, and is returned to the return coupler. The return oil is fed through the remote valve stack and back to tank.
The power beyond slice incorporates a load sensing port or coupler which allows the pressure compensating valve on the pump to detect the load pressure from the implement and adjust the pump output accordingly.



BAIL06CCM054ASA 2

1.Return Coupler
2.Pressure Coupler
3.Load Sensing Coupler

Hydraulic pump - Static description

The variable flow closed centre load sensing hydraulic pump assembly is mounted on the right hand side of the rear axle centre housing and contains within its body two hydraulic pumps.

- A charge pump of the gear type to supply oil at a charge pressure of **3 bar** (**44 lbf/in2**) to a variable flow closed centre load sensing hydraulic piston pump.
- A variable flow closed centre load sensing piston type hydraulic pump supplying oil to the high pressure circuits for operation of:-
  Trailer Brake
  Hydraulic Lift Assembly
  Remote Control Valves
  Front Axle Suspension
  Front Lift
  Mid Mount remote valves

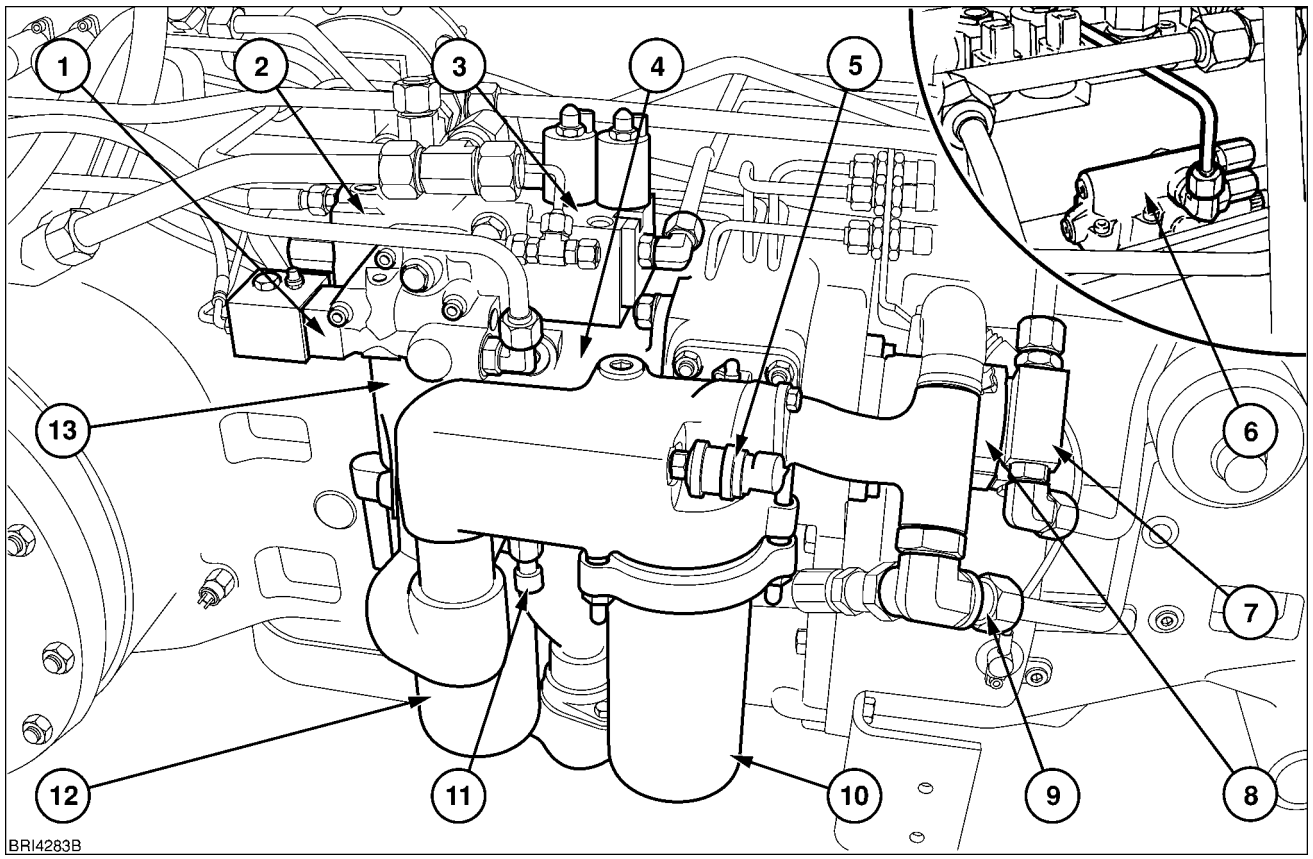
Principal of Operation

Both pumping elements are driven by a 'live' drive gear train directly connected to the PTO clutch input drive shaft and driven by the engine flywheel.
The operating principal of the fixed displacement gear pump is to provide a constant oil flow directly related to the rotation speed of the pump.
The operating principal of a variable flow piston pump is to provide oil flow on demand and minimises the engine power absorbed in driving the hydraulic pump when the hydraulic circuits do not require maximum pump flow.
The variable flow piston pump in hydraulic systems therefore has distinct power loss advantages over fixed displacement gear type pumps, which continually provide oil flow and absorb engine power even when the hydraulic circuits do not require the total pump output.

Variable Displacement Piston Pump
The major components of the variable flow piston pump with closed centre load sensing are:-

- A nine element pumping head.
- A plate mechanism (swash plate) to adjust piston stroke and corresponding pump output.
- A load sensing valve which monitors the requirements of the hydraulic circuits and signals the pump to increase or decrease hydraulic oil flow accordingly.

The nine element pumping head is cylindrical in shape and has nine barrels, into each of which, is installed a piston. On the end of each piston is pressed a slipper which always remains in contact with the face of the swash plate located at the front of the pumping head.
The drive shaft, which is driven by the pump drive gear, rotates the pumping head. As the pumping head rotates, the pistons move in and out of their barrels, following the contour of the swash plate. For every revolution of the drive shaft each piston completes one pumping cycle.
The swash plate, which does not rotate but pivots about the front of the pumping head, is the control mechanism that limits the stroke of each piston and works in conjunction with the pressure and flow compensating valves in the load sensing line.
As the pumping head rotates each barrel passes over the inlet and then the outlet ports of the pump. During the inlet cycle for each piston and barrel, oil is pumped into the barrel pushing the piston forward so that it always remains in contact with the swash plate. The stroke of each piston and volume of oil charged into its barrel is therefore dependent on the angle of the swash plate.
After a piston and barrel has completed the inlet stroke, further rotation of the head aligns the barrel with the outlet port. Oil within the barrel is then forcibly ejected by the piston through the exhaust port to the hydraulic circuits.



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Variable Displacement Hydraulic Pump Installation

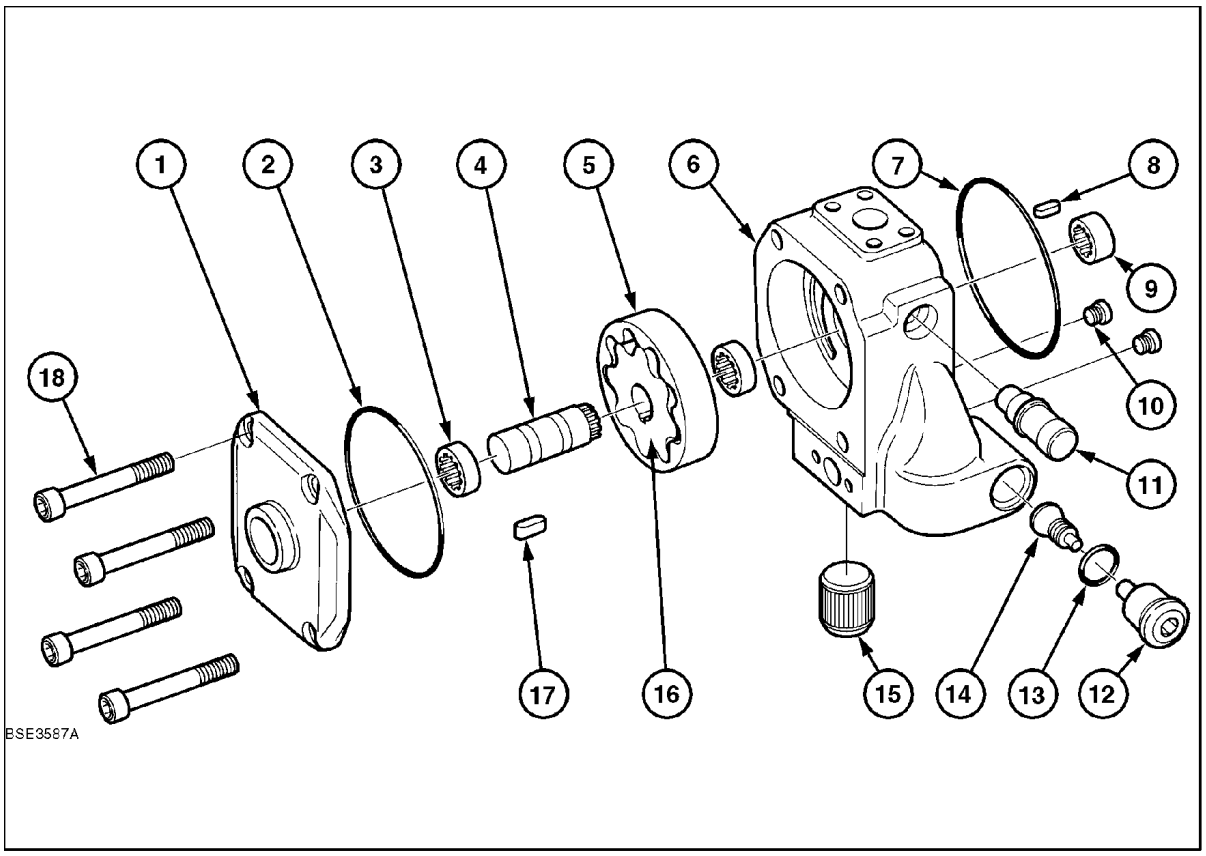
1 Trailer Brake Valve Assembly
2 Pressure Reducing Priority Valve
3 Load Levelling Valve (Where fitted)
4 Variable Displacement Pump
5 Filter Restriction Switch
6 Load Sensing Valve
7 Steering / Lube Priority Valve
8 Steering / lube Supply Pump
9 Supplementary Lube Valve
10 Main Intake Filter
11 Low Oil Temperature Switch
12 Charge Pressure Filter
13 Charge Pump

The location of the principal components in the hydraulic pump assembly are identified above. These items are shown on the hydraulic circuit diagrams which describe the operating modes of the pump. The principal function of the valves and switches is as follows:-

Intake Filter and Restriction Switch

Oil for both the charge and steering pump is drawn from the rear axle centre housing via the intake filter. The filter incorporates a by-pass valve, which is an integral part of the replaceable filter and it is therefore essential that the correct filter is installed at every filter change.
When the filter is blocked the oil filter restriction vacuum switch is activated and illuminates the oil filter restriction warning light on the instrument panel.

Because oil is more viscous (thicker) when cold and can falsely indicate that the filter requires servicing a low temperature oil switch is also used in the filter restriction circuit. This switch ensures that the warning light will not operate if the oil temperature is less than **40 °C**.



BSE3587A 2

Charge Pump Components

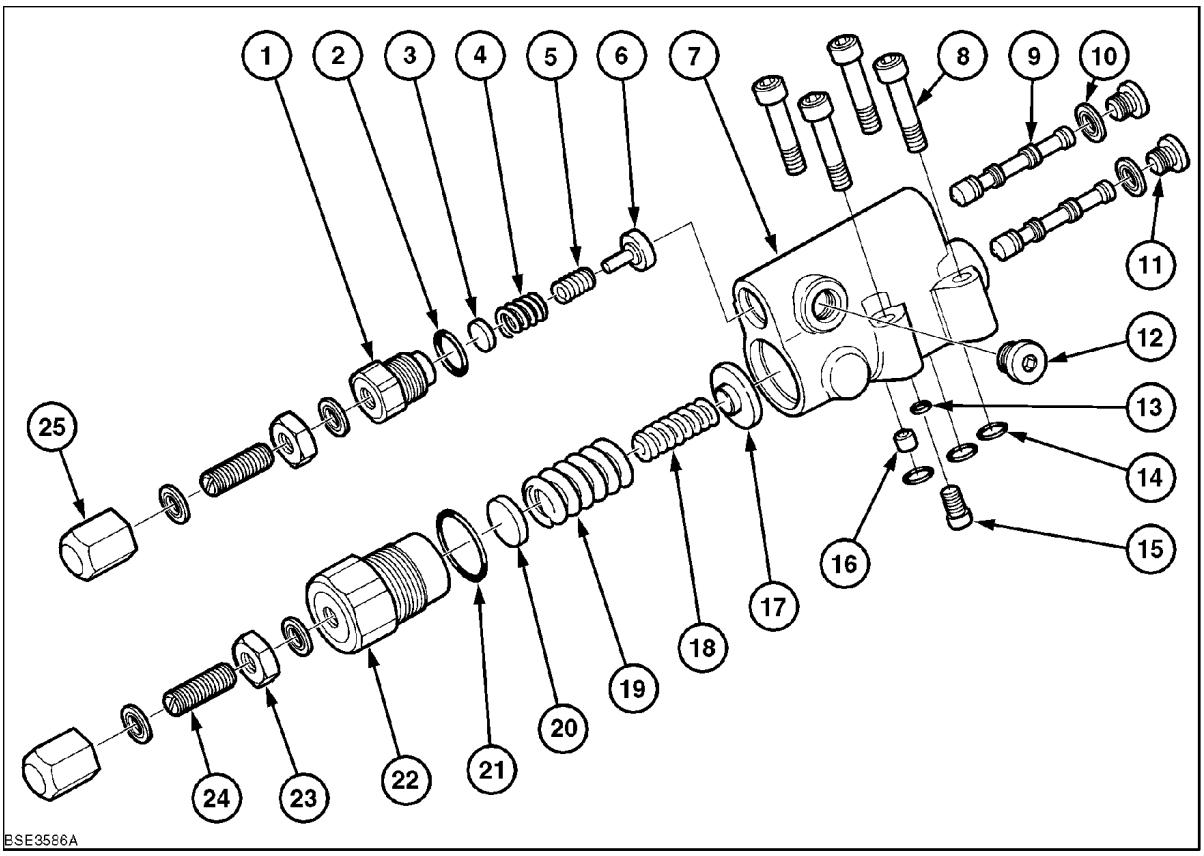
1 EndPlate
2 Seal
3 Coupling
4 Shaft
5 Rotor Housing
6 Charge Pump Housing
7 Seal
8 Pin
9 Hub
10 Screw Plug
11 System Relief Valve (**245 Bar**)
12 Check Valve Plug
13 Seal
14 Charge Pressure Filter Dump Valve Spool
15 Main Charge Filter
16 Pump Rotor
17 Key
18 Screws

Low Charge Pressure Switch

The low charge pressure switch will cause a light to ‘Flash’ on the instrument cluster whenever the charge pressure is less than **0.75 bar** (**11 lbf/in2**)

Charge Pressure Filter Dump Valve

The charge pressure filter dump valve is a safety relief valve for relieving excess pressure on the charge pump should the filter be restricted. This valve will start to operate if the charge pressure exceeds **6 bar** (**87 lbf/in2**).
Charge Pressure Valve
The charge pressure valve diverts excess oil supplied by the charge pump and not required by the variable flow piston pump to the inlet port of the steering and lubrication circuit pump.
This valve starts to operate at a pressure of **1 bar** (**14.5 lbf/in2**) and when fully open limits the charge pressure circuit oil to **3 bar** (**44 lbf/in2**) .



BSE3586A 3

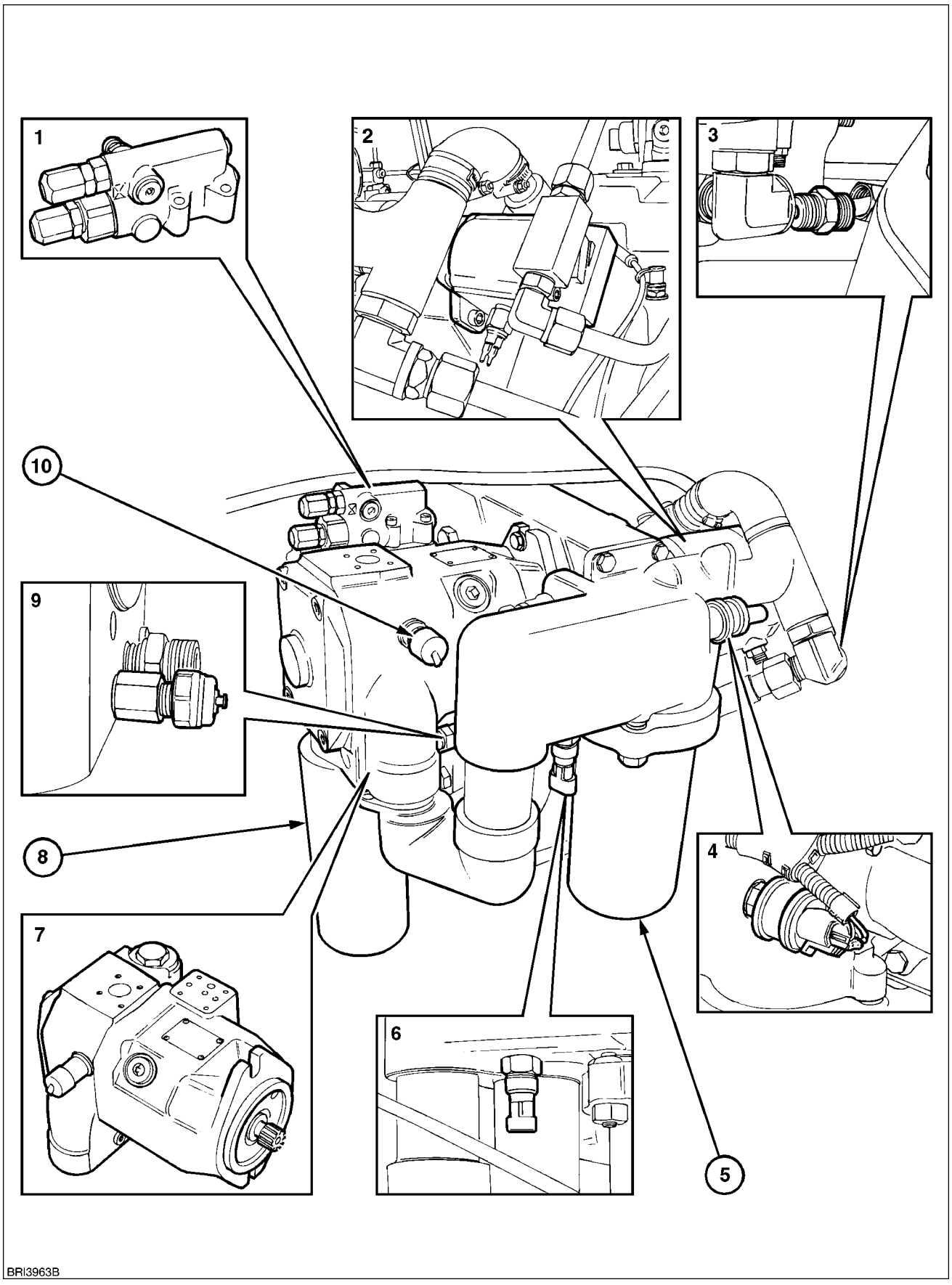
Flow and Pressure Compensating Valves

1 Plug
2 Seal
3 Disc
4 Spring
5 Spring
6 Seat
7 Housing
8 Screw
9 Spool
10 Snap-ring
11 Plug
12 Plug
13 Seal
14 Seal
15 Damper Screw
16 Nozzle
17 Seat
18 Spring
19 Spring
20 Disc
21 Seal
22 Plug
23 Nut
24 Screw
25 Locknut

Flow and Pressure Compensating Valves

Output from the variable flow piston pump is determined by adjusting the angle of the swash plate in the pump. The flow compensating valve senses the circuit operating pressure and adjusts the swash plate angle to control pump output.
If pump output and circuit pressure rises to **205 bar** (**2973 lbf/in2**) the pressure compensating valve overrides the flow compensating valve and adjusts the swash plate angle to limit maximum system pressure.

Hydraulic pump - Overview

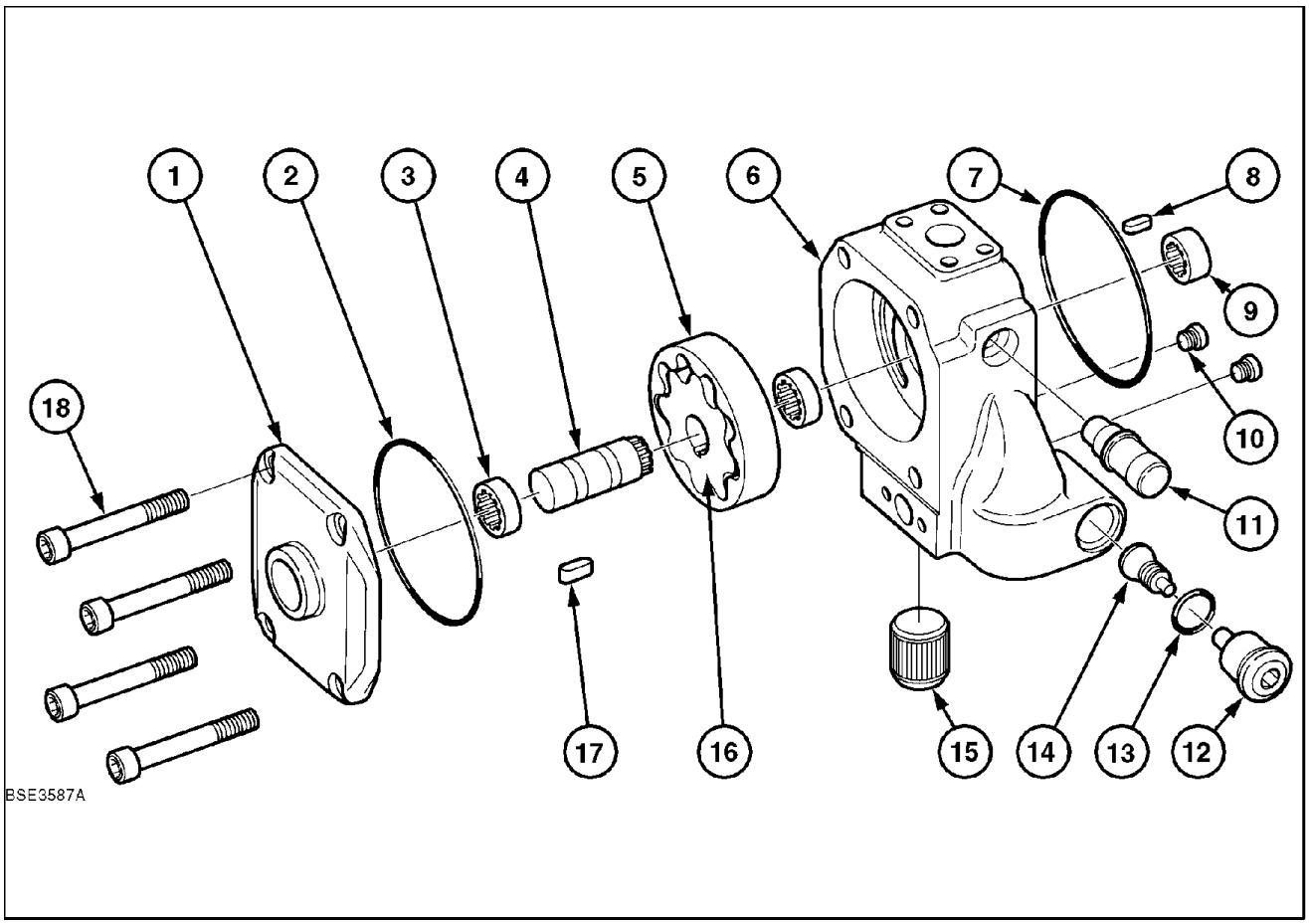


BAIL06CCM042HSA 1

Hydraulic Pump Assembly With Variable Displacement Closed Centre Load Sensing

1 Load Sensing Valve assembly
2 Steering Pump
3 Supplementary Lube valve
4 Main Intake Filter restriction (vacuum) Switch
5 Main Filter
6 Low Oil Temperature Switch
7 Variable Displacement Pump and Charge Pump
8 Charge Pump Filter
9 Low Charge Pressure Warning Switch
10 Main System Relief Valve (**245 bar**)

Charge pump - Exploded view

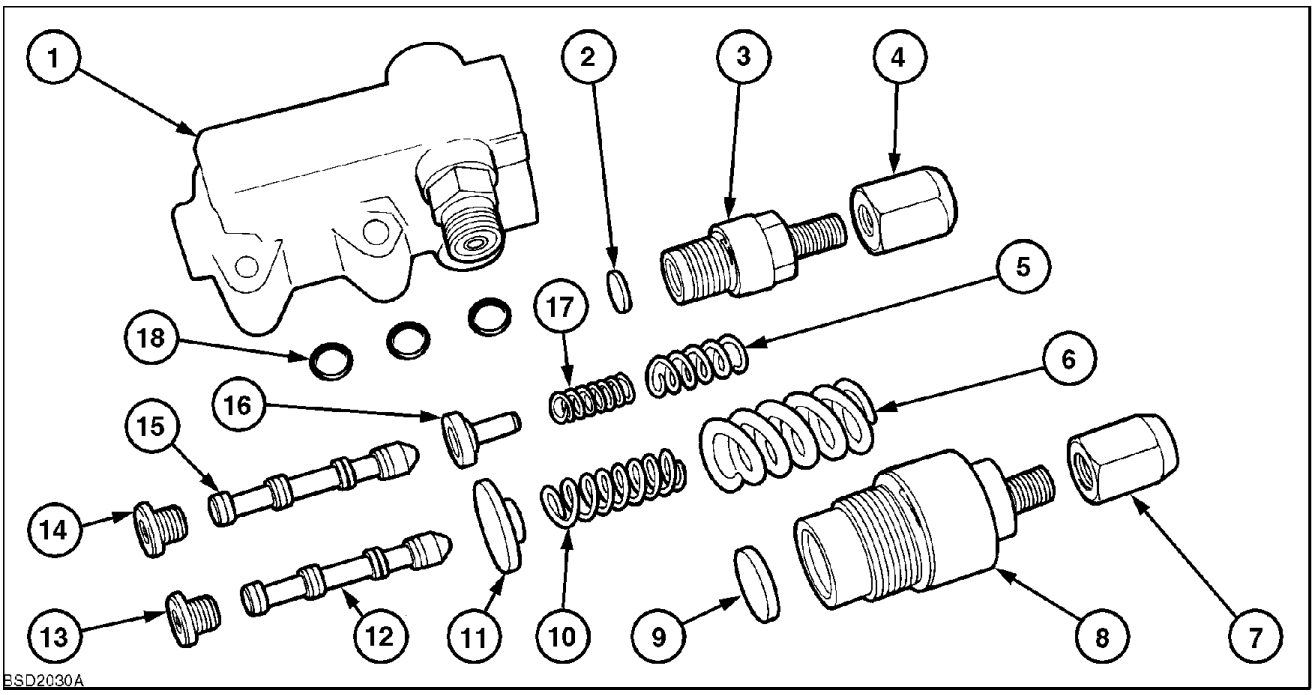


BSE3587A_457 1

Charge Pump Components

1 End Plate
2 Seal
3 Coupling
4 Shaft
5 Rotor Housing
6 Charge Pump Housing
7 Seal
8 Pin
9 Hub
10 Screw Plug
11 System Relief Valve (**245 bar** (**3552.5 psi**))
12 Check Valve Plug
13 Seal
14 Check Valve Spool
15 Main Charge Filter
16 Pump Rotor
17 Key
18 Screws

Compensator - Exploded view



BSD2030A_184 1

Flow and Pressure Compensating Valves

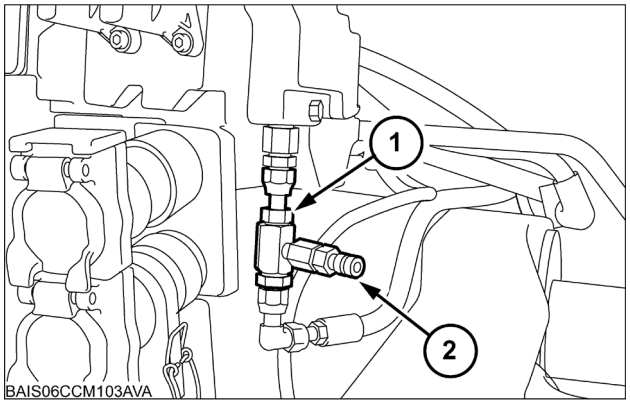
1 Housing
2 Seat
3 Adjuster and ‘O‘ Ring seal
4 Locknut
5 Spring
6 Spring
7 Locknut
8 Adjuster and ‘O‘ Ring seal
9 Seat
10 Spring
11 Seat
12 Pressure Compensator Spool
13 Plug and ‘O’ Ring
14 Plug and ‘O’ Ring
15 Flow Compensating Spool
16 Seat
17 Spring
18 ‘O‘ Ring Seal

Signal valve - Pressure test

IMPORTANT: *Before a pressure test or volume flow measurement, drive the tractor until the transmission oil in the rear axle is warmed up to operating temperature.* ***65 °C*** *(* ***145 °F****).*

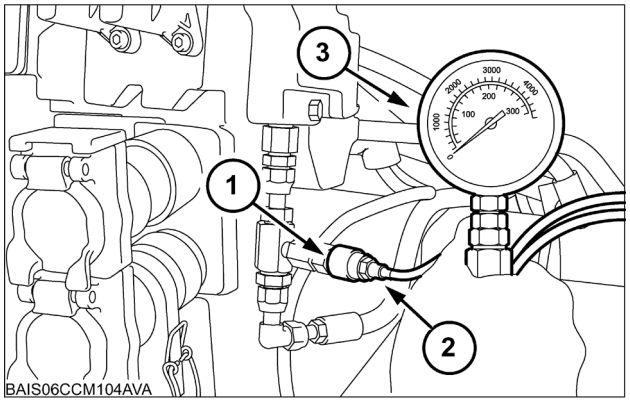
1. This test shows how you test whether the control lines for the displacement volume regulation of the hydraulic pump are working. With the test device installed in the picture, the Load Sensing oil circuit of the hydraulic remote valves is tested. To test other Load Sensing oil circuits, the test device must be installed in the Load Sensing line of the oil circuit to be tested.

2. Install the T piece **(1) 380000573** and the fast coupling sleeve **380000492 (2)** into the load sensing line.



BAIS06CCM103AVA 1

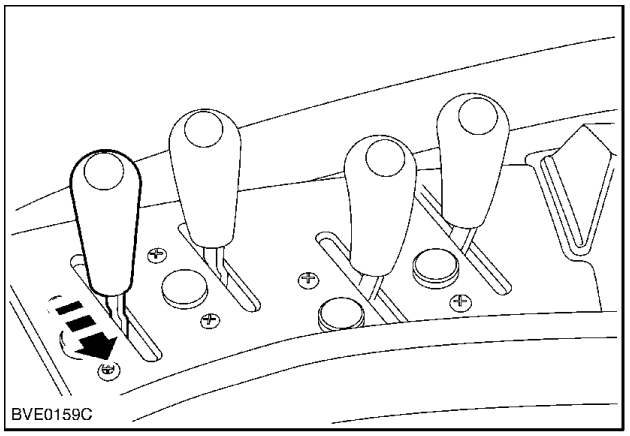
3. Connect the pressure gauge with display range **0 - 250 bar** (**0 - 3600 lbf/in2**) **(3)** 380000553 with hose **(2)** 380000545 and fast coupler **(1)** 380000543 .



BAIS06CCM104AVA 3

4. Set the engine speed to **1500 rev/min**.
   Operate all control units one after the other. When each of the control units is operated, the pressure must rise from **0 bar** (**0 lbf/in2**) to a maximum value of **210±5 bar** (**3046±73 lbf/in2**). Changes in pressure indicate that the Load Sensing line of the relevant control unit is working.

   Operation of the remote valves in PUMA Multicontroller, see **PRIMARY HYDRAULIC POWER SYSTEM Electro-hydraulic remote valve - Static description (A.10.C)**



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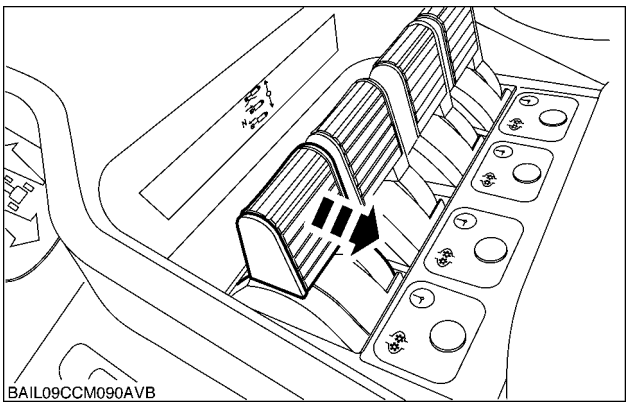
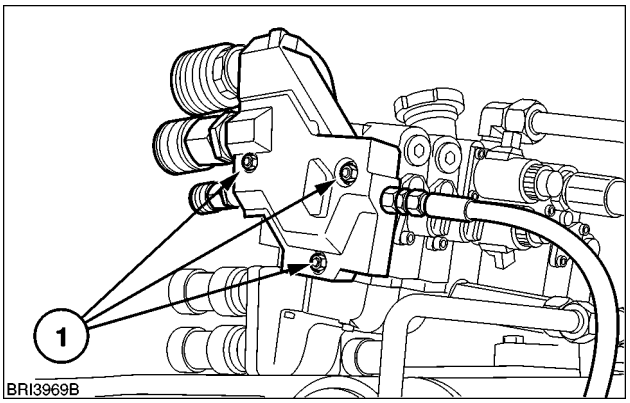


BAIL09CCM090AVB 5

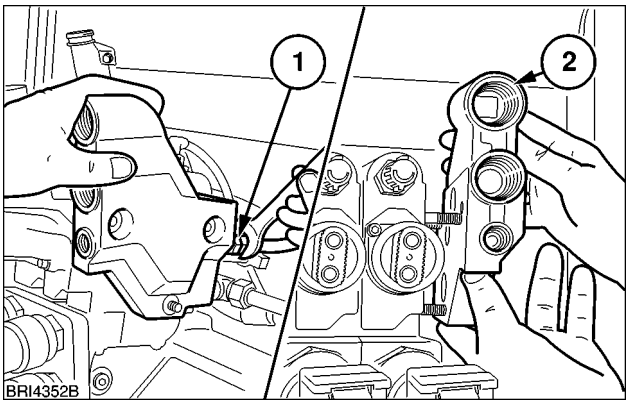
Power beyond - Remove

1. Undo the three retaining nuts **(1)** .



BAIL06CCM051ASA 1

2. Undo the load sensing connection **(1)**, and remove power beyond slice **(2)**.



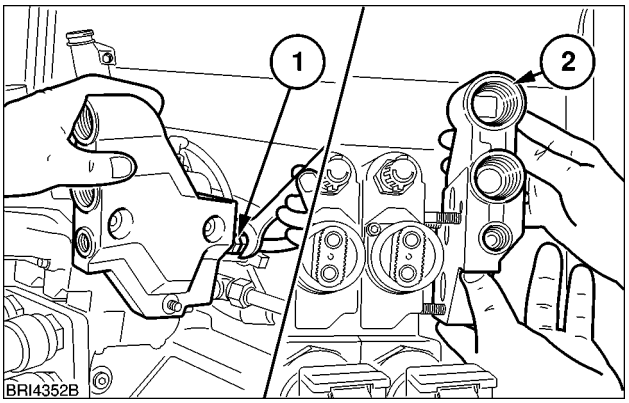
BAIL06CCM242ASA 2

Next operation:
Power beyond - Install (A.10.A)

Power beyond - Install

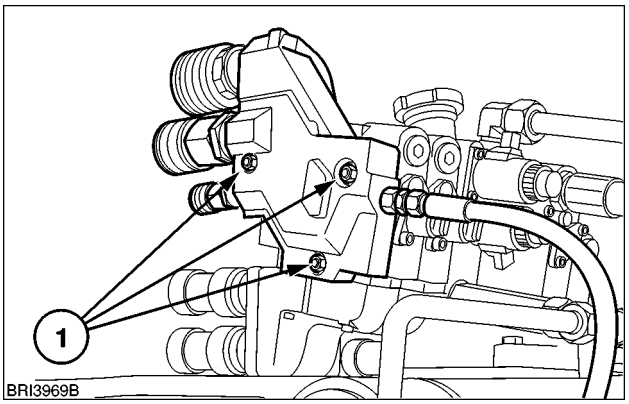
Prior operation:
Power beyond - Remove (A.10.A)

1. Locate the power beyond slice **(2)** onto the three tie rods protruding from the remote valve and connect the load sensing hose **(1)**.



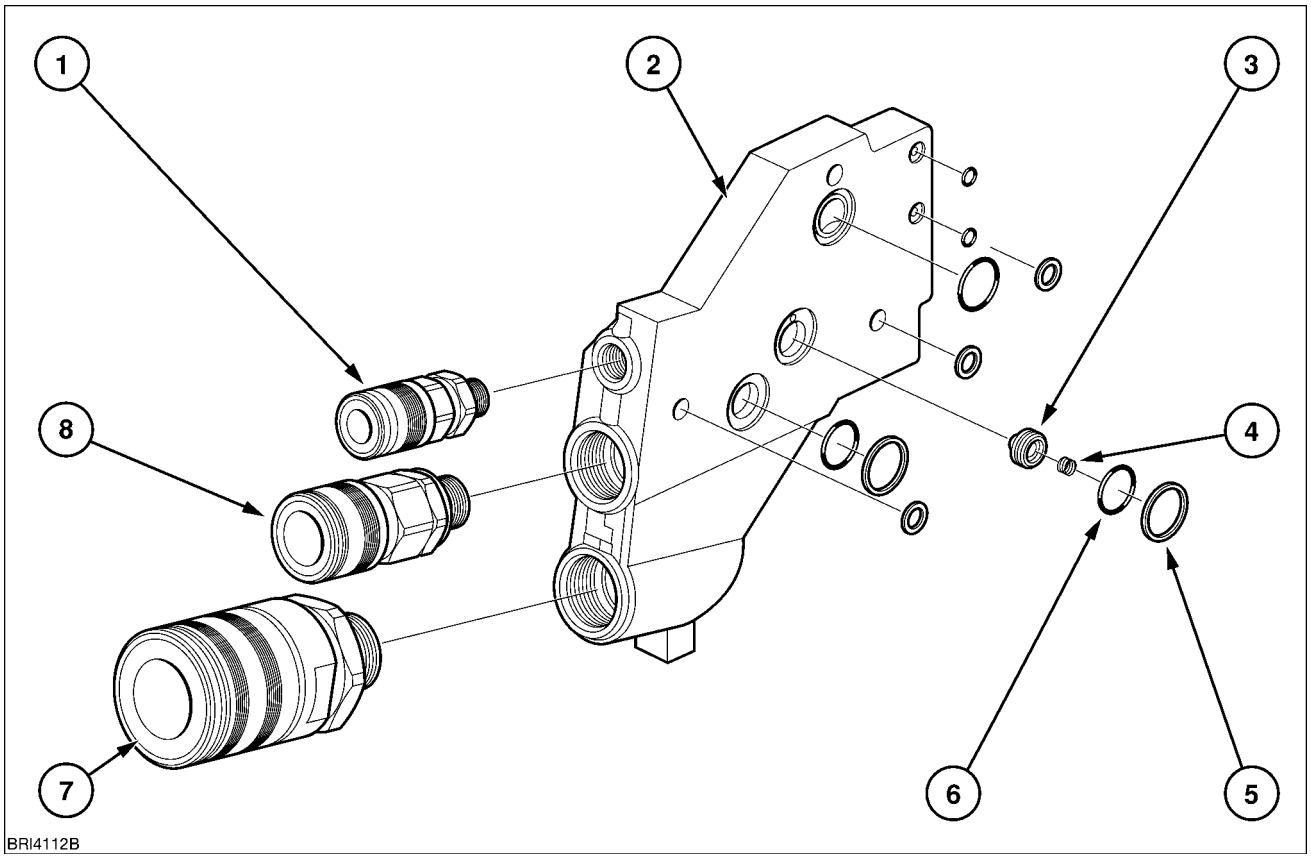
BAIL06CCM242ASA 1

2. Replace the retaining nuts **(1)** and torque in the sequence as specified. Refer to **Power beyond - Torque (A.10.A)**



BAIL06CCM051ASA 2

Power beyond - Assemble



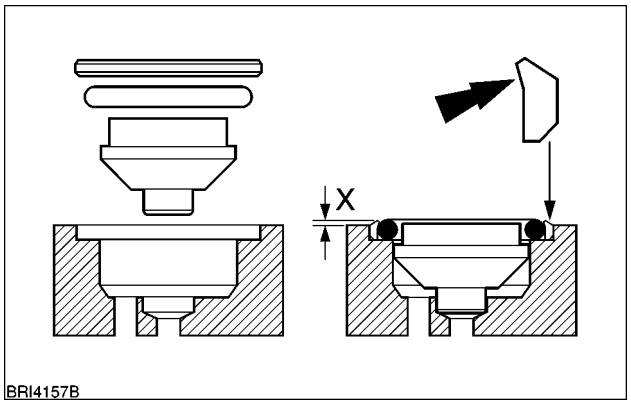
BAIL06CCM170FSA 1

Power Beyond Slice Components

1. Load Sensing Coupler
2. Power Beyond Manifold
3. Load Sensing Shuttle Valve
4. Spring
5. Support Ring
6. 'O' Ring
7. Return Coupler
8. Pressure Coupler

1. Screw the couplers onto the power beyond slice and tighten to the required torque. Refer to **Power beyond - Torque (A.10.A)**
2. Insert load sensing shuttle valve along with the 'O' ring and support ring as shown.

NOTE: *Clearance X should be approximately* ***0.5 mm*** *from the flange face of the valve segment to the top edge of the inserted shuttle valve.*



BAIL06CCM139ASA 2

3. Insert new 'O' rings into the rest of the ports.

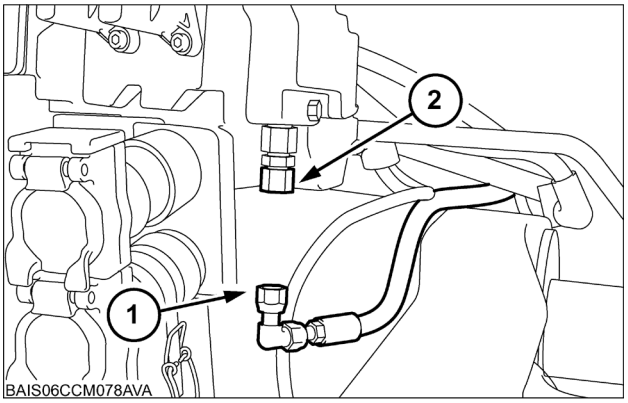
Next operation:
Power beyond - Install (A.10.A)

Hydraulic pump - Pressure test

IMPORTANT: *Before a pressure test or volume flow measurement, drive the tractor until the transmission oil in the rear axle is warmed up to operating temperature.* ***65 °C*** *(* ***145 °F****).*

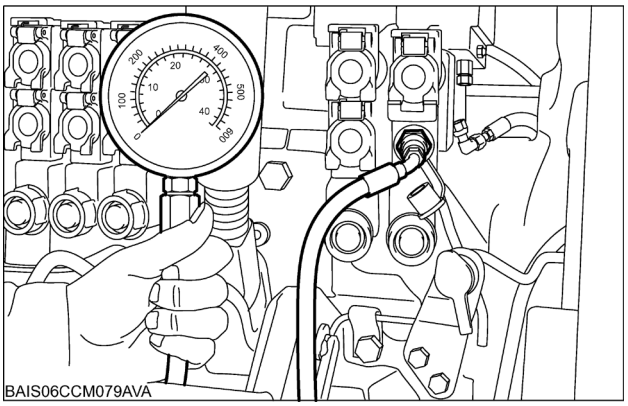
Low pressure standby

1. The following tests constitute a function test of the hydraulic pump and the connected high pressure oil circuits. Unscrew the Load-Sensing line **(1)** of the remote control units and screw on the screw plug **(2)** 380000574.



BAIS06CCM078AVA 1

2. Connect a pressure gauge with display range **0 - 40 bar** (**0 - 600 lbf/in2**) **380000552** to the remote connection of the control unit. Use the oil coupling 380000554, adapter 380000576, fast coupling sleeve **380000492**, fast coupling **380000543** and hose **380000545** to do this.
   Set the engine speed to **1500 rev/min**.

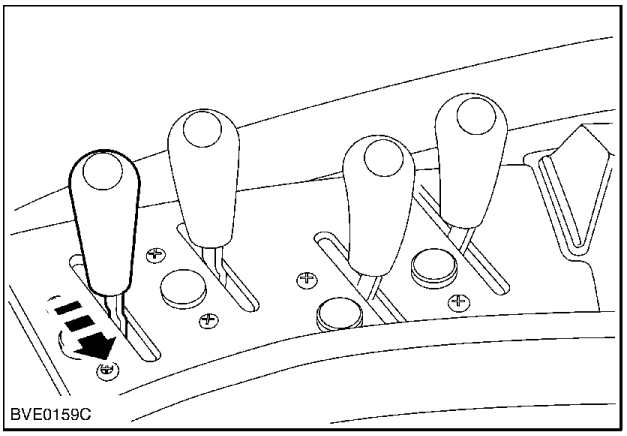


BAIS06CCM079AVA 3

3. Pull the relevant control unit control lever and hold in the Raise position.
   A pressure of **26±1 bar** (**377±15 lbf.in2**) must be displayed. This is the 'Low pressure standby'.

   Operation of the remote valves in PUMA Multicontroller, see **PRIMARY HYDRAULIC POWER SYSTEM Electro-hydraulic remote valve - Static description (A.10.C)**

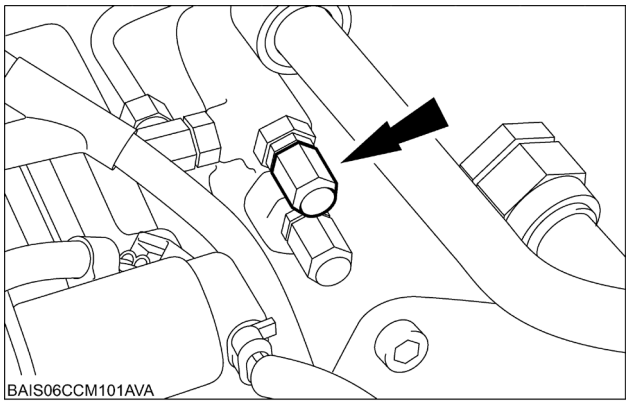
IMPORTANT: *Do not operate the tractor brake, while the control unit lever is in the Work position, because this increases the system pressure to the maximum pressure of* ***120 - 140 bar*** *(* ***1740 - 2031 lbf.in2****) and damages the pressure gauge.*



BVE0159C 4

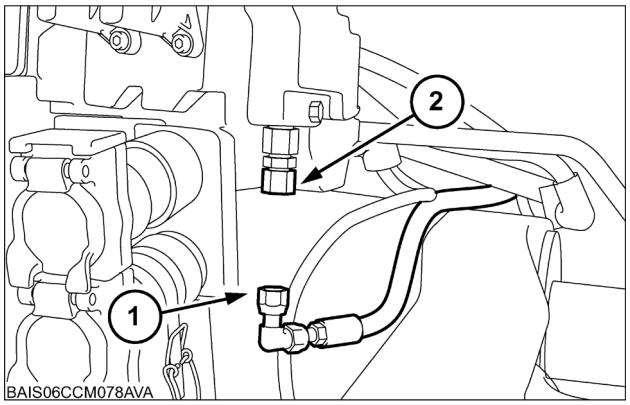
4. If the display value deviates slightly from the desired value, adjust the flow control valve.
   If the display value is too high, check whether the control pin of the flow control valve is sticking.

NOTE: *A full turn changes the pressure by about* ***16 bar*** *(* ***232 lbf.in2****).*



BAIS06CCM101AVA 6

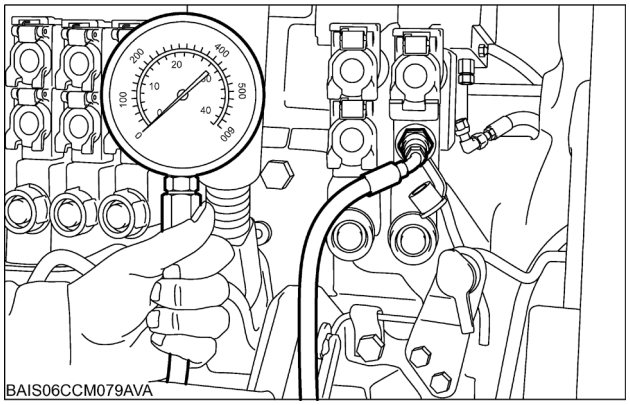
5. Remove the connection **(2)** 380000574. Connect the Load Sensing line **(1)** again.



BAIS06CCM078AVA 7

High pressure standby

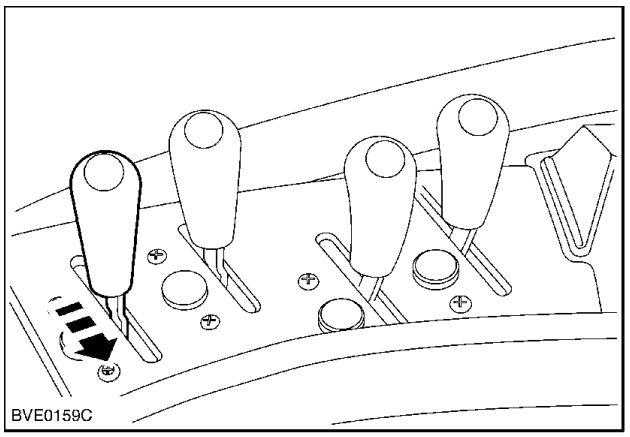
6. Connect a pressure gauge with display range **0 - 255 bar** (**0 - 3600 lbf/in2**) 380000553 to the remote connection of the control unit. Use the oil coupling 5101741, fitting 380000576, fast coupling sleeve **380000492**, fast coupling plug 380000543 and hose **380000545**.
   Set the engine speed to **1500 rev/min**.



BAIS06CCM079AVA 9

7. Pull the relevant control unit control lever and hold in the Raise position.
   The displayed pressure value must rise to **210±5 bar** (**3046±73 lbf.in2**). This is the 'high pressure standby'.

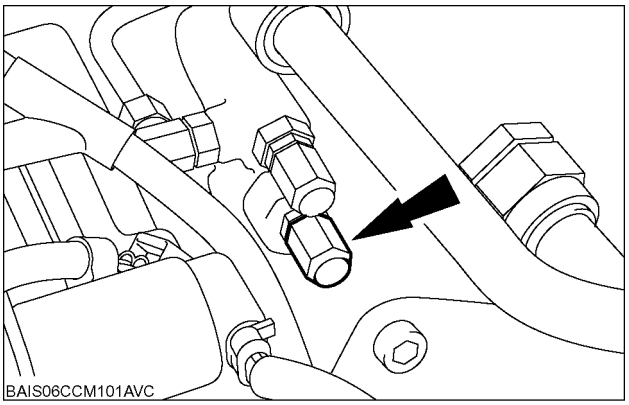
   Operation of the remote valves in PUMA Multicontroller see **PRIMARY HYDRAULIC POWER SYSTEM Electro-hydraulic remote valve - Static description (A.10.C)**



BVE0159C 10

8. If the display value does not match the desired value, adjust the flow control valve.

NOTE: *A full turn changes the pressure by about* ***50 bar*** *(* ***725 lbf.in2****).*

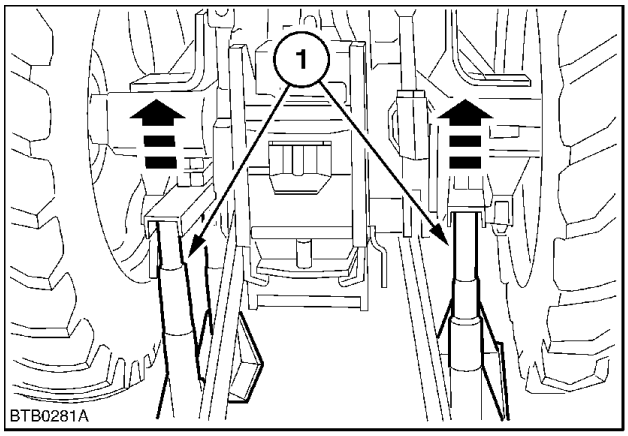


BAIS06CCM101AVC 12

Hydraulic pump Variable displacement pump - Remove

1. Raise the rear of the tractor and place two suitable axle stands **(1)** under the final drive cases.

NOTE: *If required, detach the lift rods from the lower links.*



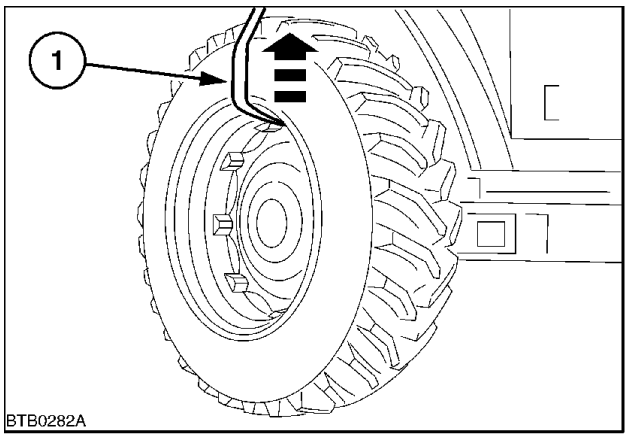
BTB0281A 1

2. Using a suitable sling **(1)**, connect the rear right-hand wheel to a hoist and remove the rear right-hand wheel.

⚠ WARNING ⚠

Tractor wheels are very heavy. Handle with care and ensure, when stored, that they cannot fall and cause injury. Never operate the tractor with a loose wheel rim or disc. Always tighten nuts to the specified torque and at the recommended intervals.

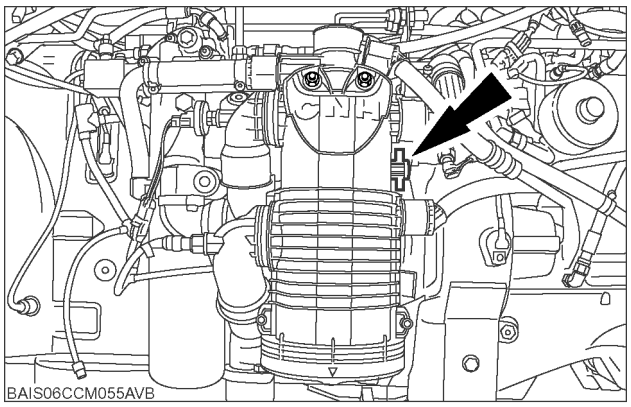
B105



BTB0282A 2

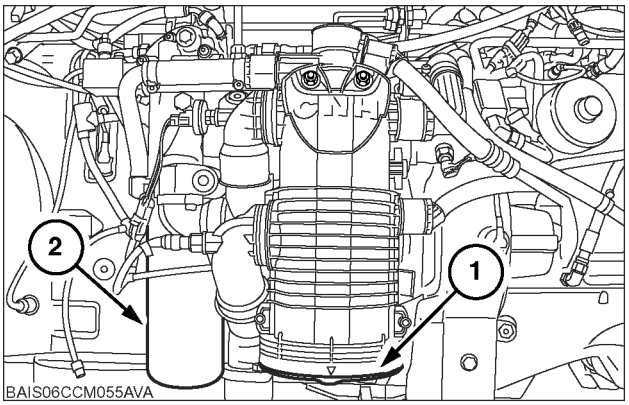
3. Remove the hydraulic oil pump vent cap.

NOTE: *Leave for one minute to allow oil in the filters to drain into the sump.*



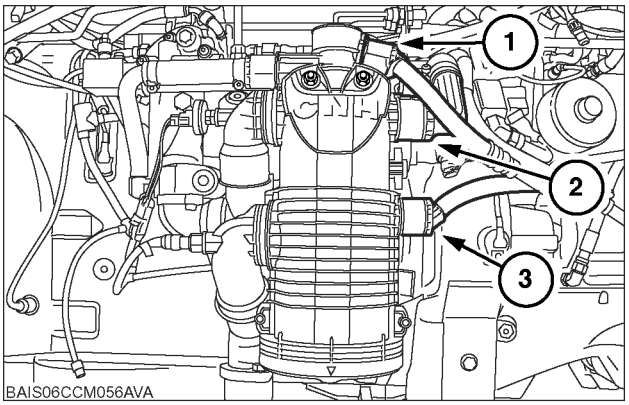
BAIS06CCM055AVB 3

4. Remove the return filter element **(1)** and the pressure filter cartridge **(2)**.



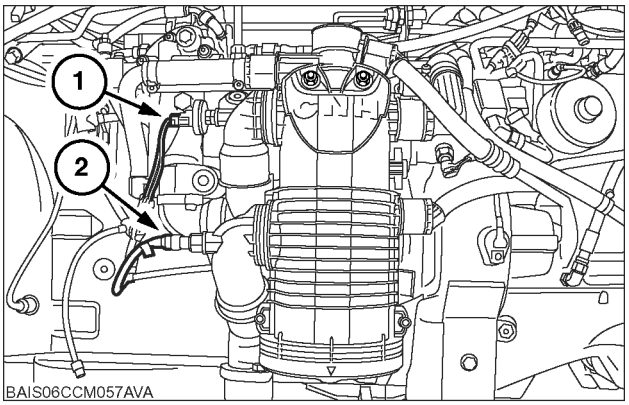
BAIS06CCM055AVA 4

5. Disconnect the transmission control cover return hose **(1)**, steering pump return hose **(2)** and the mid mount valves return hose **(3)**.



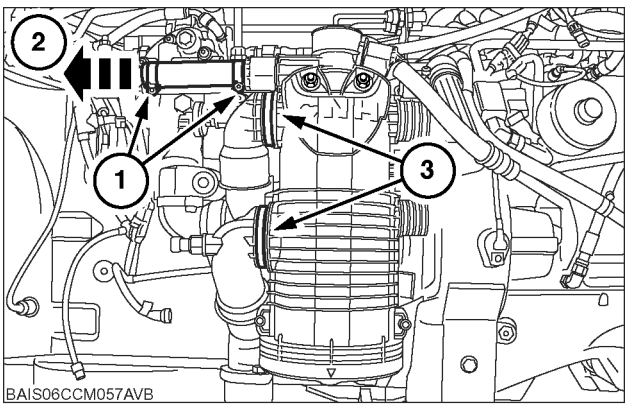
BAIS06CCM056AVA 5

6. Disconnect the electrical connectors **(1)** and **(2)**.



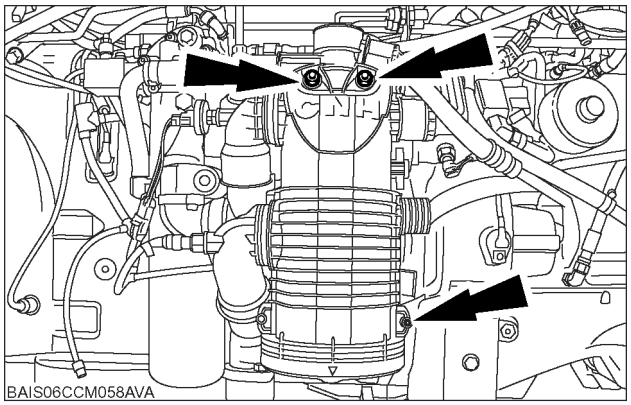
BAIS06CCM057AVA 6

7. Detach the retaining clips **(1)** and disconnect the return pipe **(2)**. Detach the return pipe clips **(3)**.



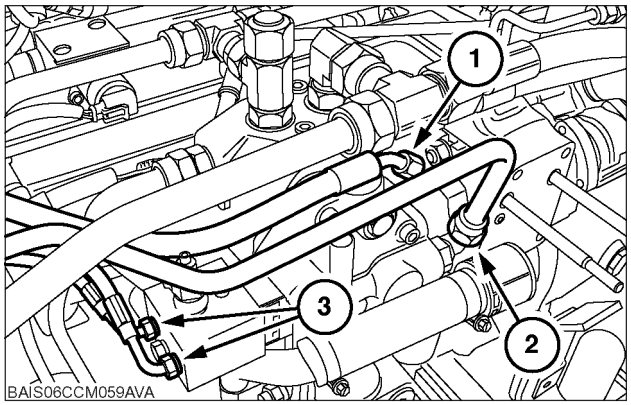
BAIS06CCM057AVB 7

8. Remove the transmission/hydraulic return filter housing.



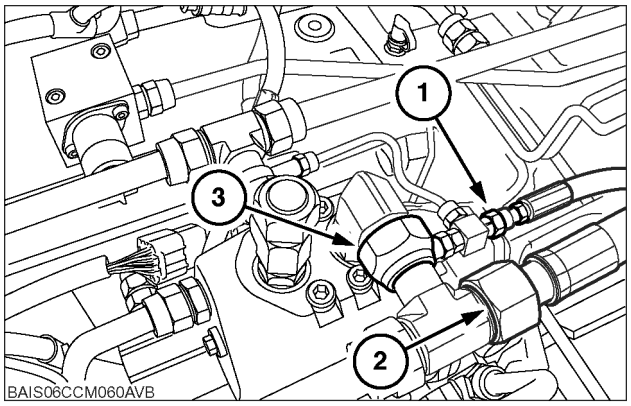
BAIS06CCM058AVA 8

9. Disconnect the load sensing line **(1)**, trailer brake valve supply pipe **(2)** and the left and right trailer brake lines **(3)**.



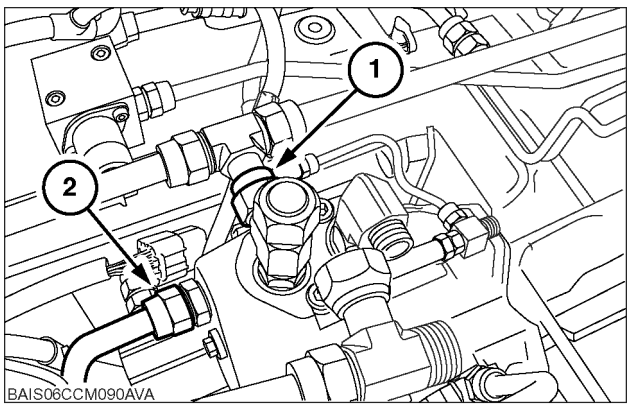
BAIS06CCM059AVA 9

10. Disconnect the mid mount valves load sensing line **(1)** and supply hose **(2)** (If equipped). Disconnect the main supply pipe **(3)**.



BAIS06CCM060AVB 10

11. Disconnect the remote valve pipes **(1)** and **(2)**.



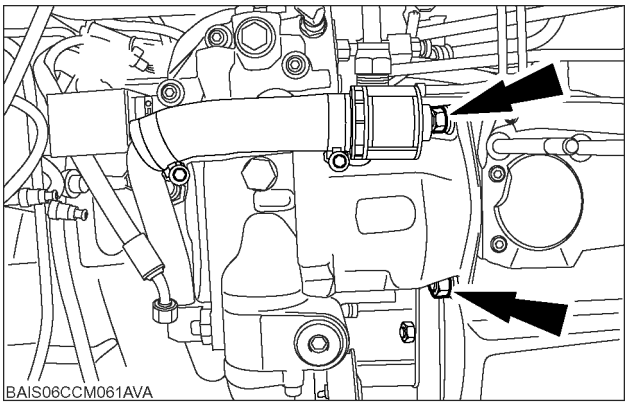
BAIS06CCM090AVA 11

12. Remove the variable displacement hydraulic pump.

⚠ WARNING ⚠

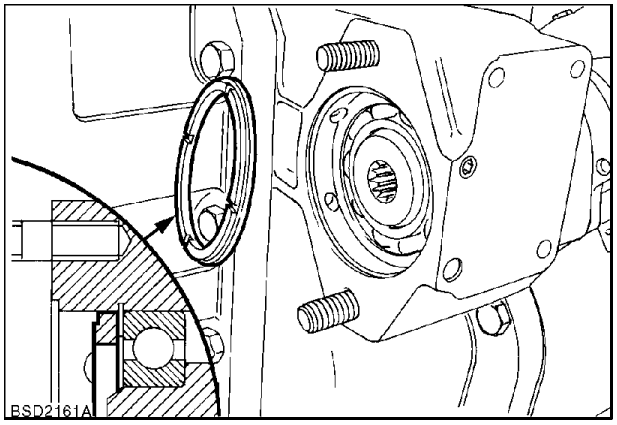
The component is heavy. ALWAYS use a hoist or get assistance to lift the component. Failure to comply could result in serious injury or death.

M944



BAIS06CCM061AVA 12

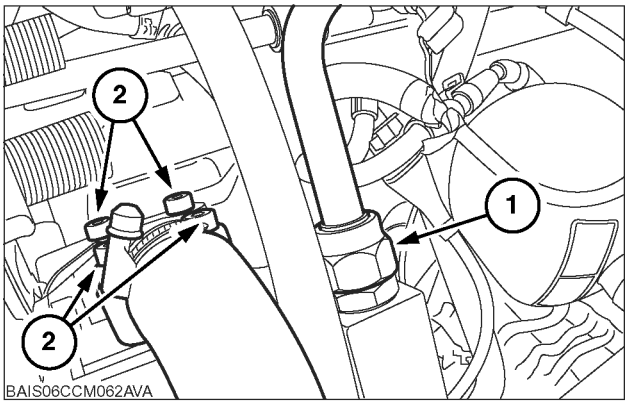
13. Make a note of pump spacer position for correct re-assembly.



BSD2161A 13

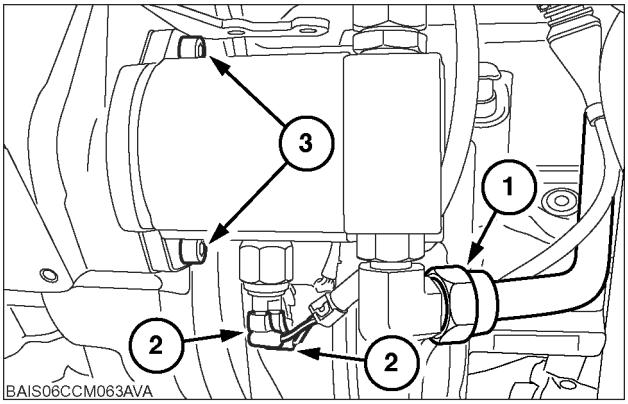
Steering Pump

14. Disconnect the steering pump return pipe **(1)** and detach the steering pump supply pipe housing **(2)**.



BAIS06CCM062AVA 14

15. Disconnect the steering motor supply pipe **(1)**, and the electrical connectors **(2)**. Remove the steering pump **(3)**.



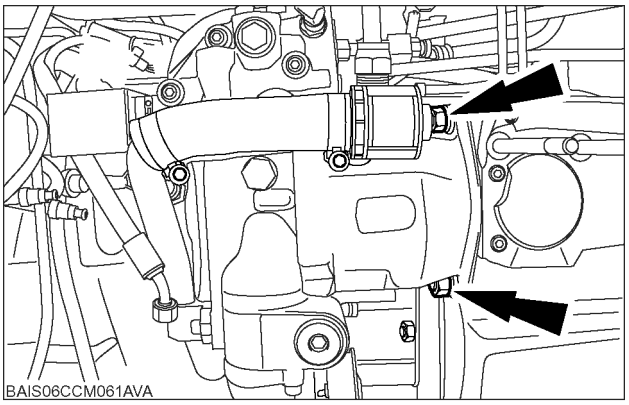
BAIS06CCM063AVA 15

Next operation:
Hydraulic pump Variable displacement pump - Overhaul (A.10.A).

Hydraulic pump Variable displacement pump - Overhaul

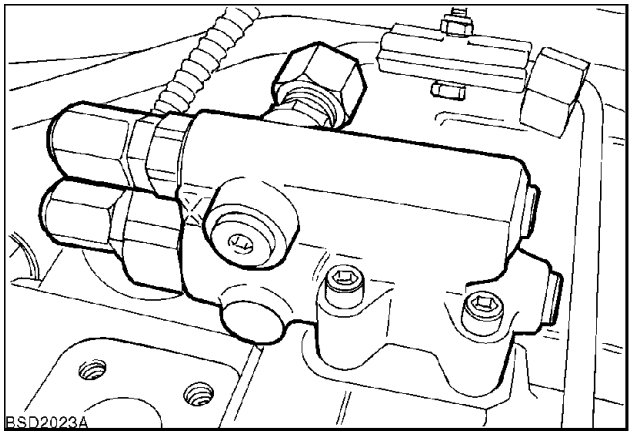
This procedure describes the overhaul of the Load Sensed Variable Displacement pump assembly when removed from the tractor. Refer to **Hydraulic pump Variable displacement pump - Remove (A.10.A)** The following items however can be serviced with the pump installed on the tractor.

1. Blocked Filter Dump Valve
2. Pressure and Flow Compensating Valves
3. Steering Pump Assembly
4. Steering Flow Control Valve (Priority Valve)
5. Remove hydraulic pump assembly from tractor as described in . **Hydraulic pump Variable displacement pump - Remove (A.10.A)**



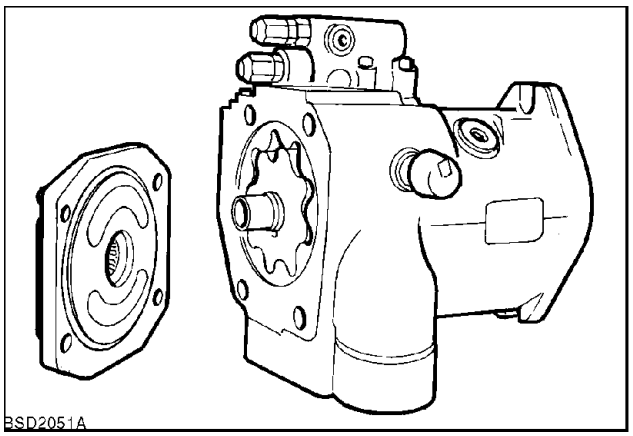
BAIS06CCM061AVA 1

6. Remove pressure and flow compensating valves assembly.



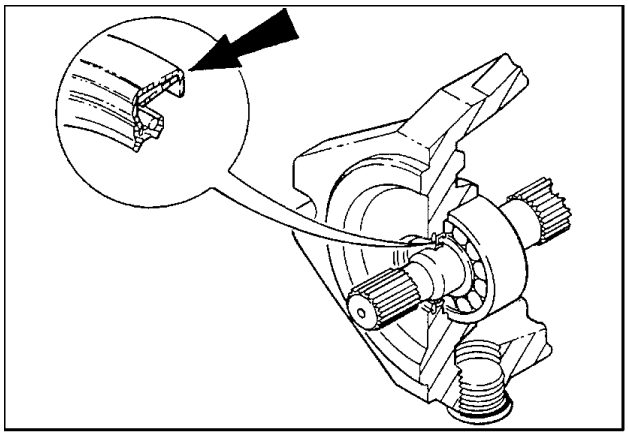
BSD2023A 2

7. Undo the 4 retaining bolts and remove circlip from opposite end of pump.Gently remove charge Pump from main pump assembly.



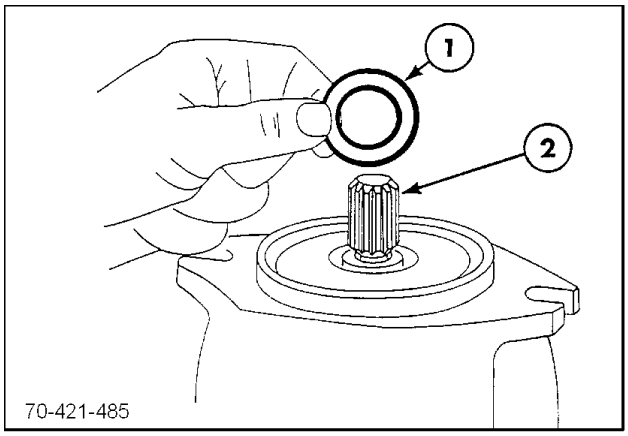
BSD2051A 3

8. When replacing the input shaft seal, make sure the pump housings mounting flange is clean. Use circlip pliers to remove the input shaft seal retaining ring.



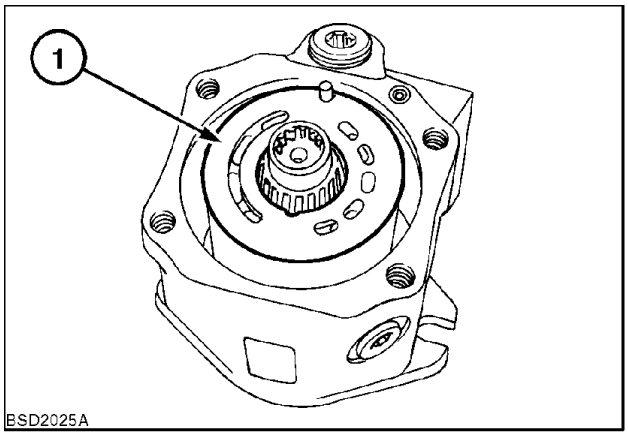
1b0o2004061061 4

9. With the retaining ring removed, use a punch or similar tool, and carefully pierce the top of the lip seal. Using the punch, pry the seal from its bore.



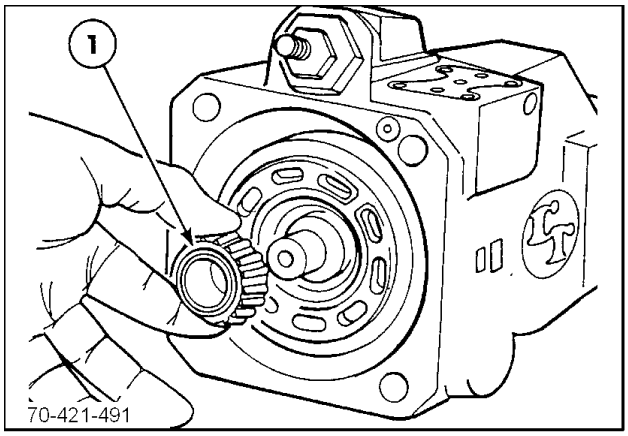
70-421-485 5

10. Examine valve plate **(1)**. Check to see if it is scored, nicked, warped or damaged by cavitation. Look for score marks or damage around the bearing surface area. Check the inlet and discharge port area for signs of contamination. This contamination may show as grooves starting in the feathering notch,



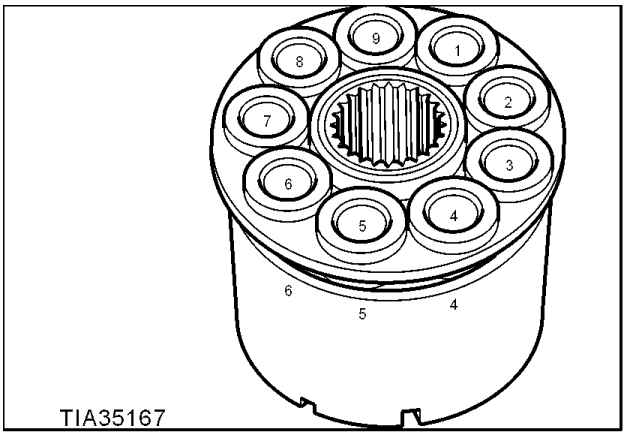
BSD2025A 6

11. Remove bearing cone **(1)** and splined connector.



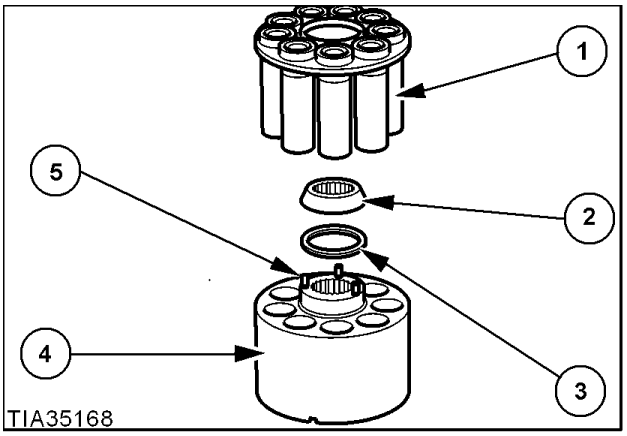
70-421-491 7

12. Remove preload spacer from driveshaft. Remove pumping head and piston from housing. Using a suitable marker identify each piston and slipper to their corresponding barrel in the pumping head.



TIA35167 8

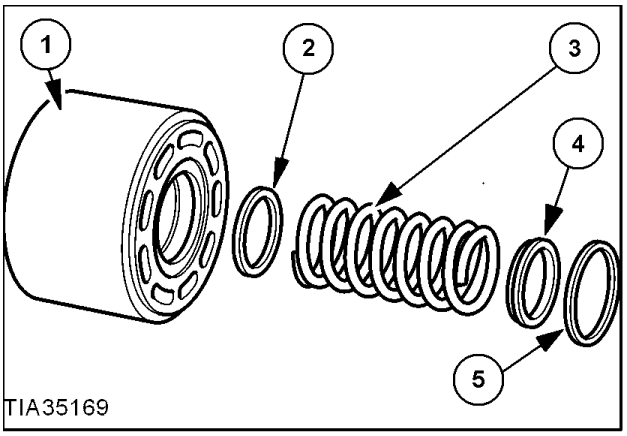
13. Separate pumping head and slipper assembly and inspect for damage. Where damage is identified the pumping element must be replaced.
Pumping Head and Slipper Assembly
1. Pistons and Slippers
2. Cone
3. Washer
4. Pumping Head
5. Pins (3 off)



TIA35168 9

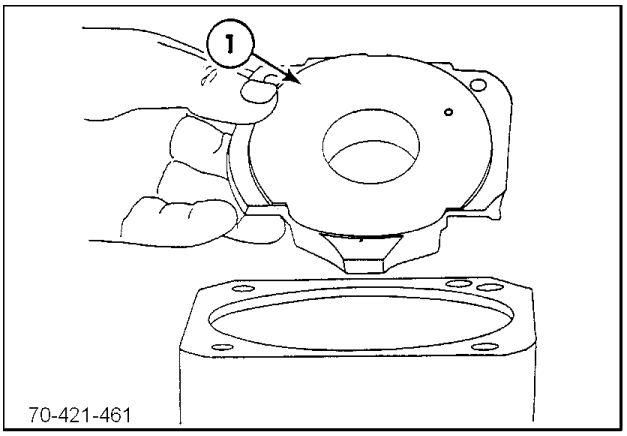
14. If necessary disassemble pumping head spring assembly by compressing the collar against the spring.
Pumping Head Spring Assembly
1. Pumping Head
2. Washer
3. Spring
4. Collar
5. Retaining Ring

IMPORTANT: *Due to high spring pressure take care when removing retaining ring.*



TIA35169 10

15. Remove swash plate (1) assembly.
Inspect components for wear and replace if damaged.



70-421-461 11

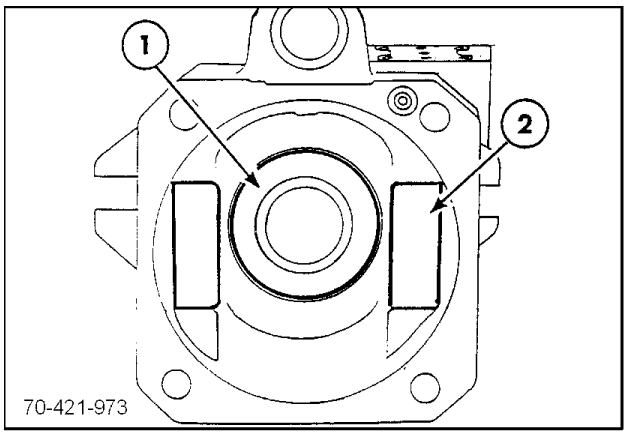
Next operation:
Hydraulic pump Variable displacement pump - Assemble (A.10.A)

Hydraulic pump Variable displacement pump - Assemble

Prior operation:
Hydraulic pump Variable displacement pump - Overhaul (A.10.A)

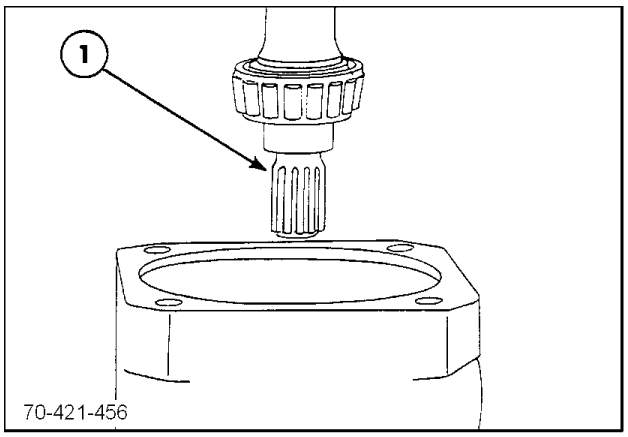
Pump Reassembly

1. Before reassembling the load sensed variable displacement pump, replace all worn and damaged parts and assemblies and all seals and O rings. Lubricate the seals and O rings with petroleum jelly to retain them during reassembly and provide lubrication to the dust and shaft seals. Also lubricate all part surfaces freely with clean hydraulic fluid.
   Install a new input shaft bearing cup, **(1)** , and swash plate bearings **(2)**.



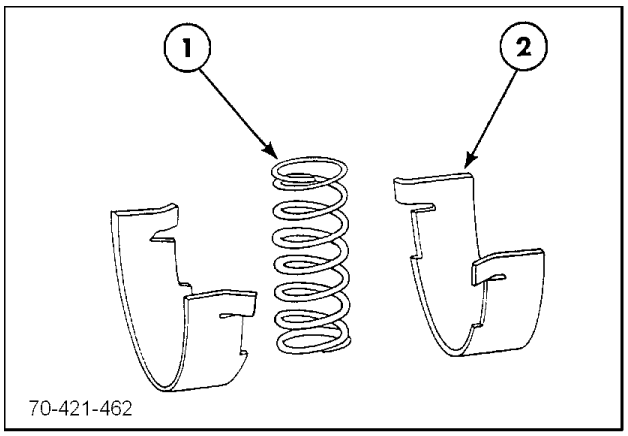
70-421-973 1

2. Install input shaft into housing.



70-421-456 2

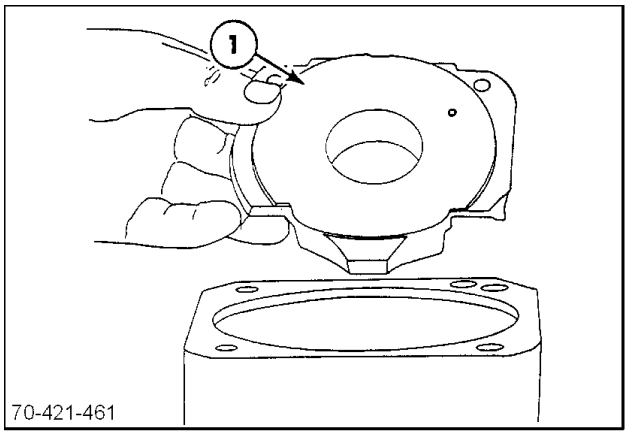
3. Install swash plate control spring and swash plate bearings.



70-421-462 3

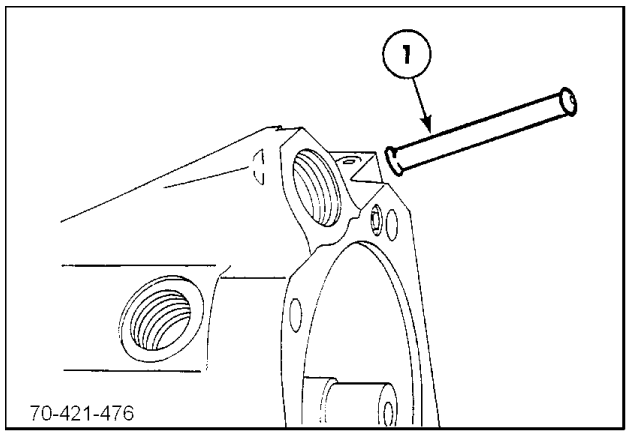
4. Reassemble the swash plate, 1, into the housing by tilting the swash plate with the push rod socket up slightly and installing.

NOTE: *Caution must be used when installing the complete swash plate so as not to dislodge the swash plate spring or the saddle bearings.*



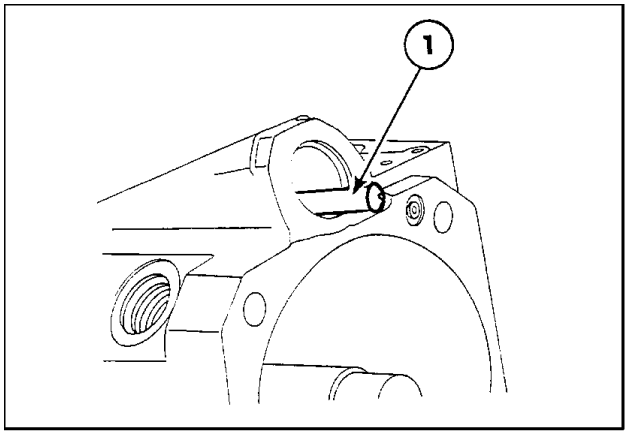
70-421-461_460 4

5. Insert the push rod, 1, through the stroke piston bore and reengage the end of the tube into the swash plate socket.



70-421-476 5

6. Tilt the swash plate up and insert the push rod, 1, down and into the socket. Make sure the push rod is engaged in the socket correctly.



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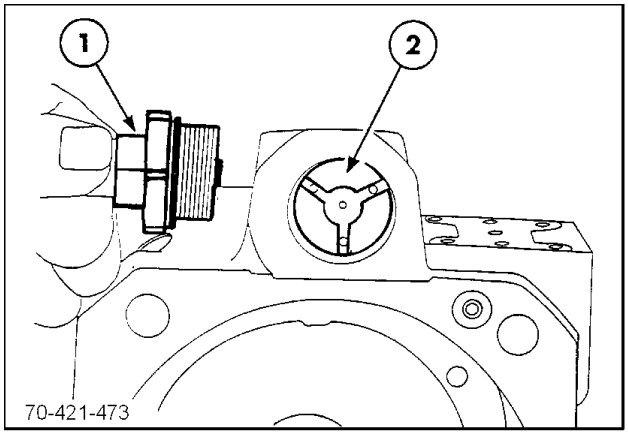
7. Install the stroke control piston, 2, in the bore. Screw the plug, 1, back on.



70-421-473 7