SB2026E02
Aug. 1999

Specifications
Systems Operation
Testing & Adjusting

Lift Trucks Vehicle Systems

B20S-2, B25S-2, B30S-2

BC20S-2, BC25S-2, BC30S-2

Important Safety Information

Most accidents involving product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

Read and understand all safety precautions and warnings before operating or performing lubrication, maintenance and repair on this product.

Basic safety precautions are listed in the “Safety” section of the Service or Technical Manual. Additional safety precautions are listed in the “Safety” section of the owner/operation/maintenance publication.
Specific safety warnings for all these publications are provided in the description of operations where hazards exist. WARNING labels have also been put on the product to provide instructions and to identify specific hazards. If these hazard warnings are not heeded, bodily injury or death could occur to you or other persons. Warnings in this publication and on the product labels are identified by the following symbol.

⚠ WARNING

Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.
Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.

Operations that may cause product damage are identified by NOTICE labels on the product and in this publication.

DAEWOO cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are therefore not all inclusive. If a tool, procedure, work method or operating technique not specifically recommended by DAEWOO is used, you must satisfy yourself that it is safe for you and others. You should also ensure that the product will not be damaged or made unsafe by the operation, lubrication, maintenance or repair procedures you choose.

The information, specifications, and illustrations in this publication are on the basis of information available at the time it was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service given to the product. Obtain the complete and most current information before starting any job. DAEWOO dealers have the most current information available.

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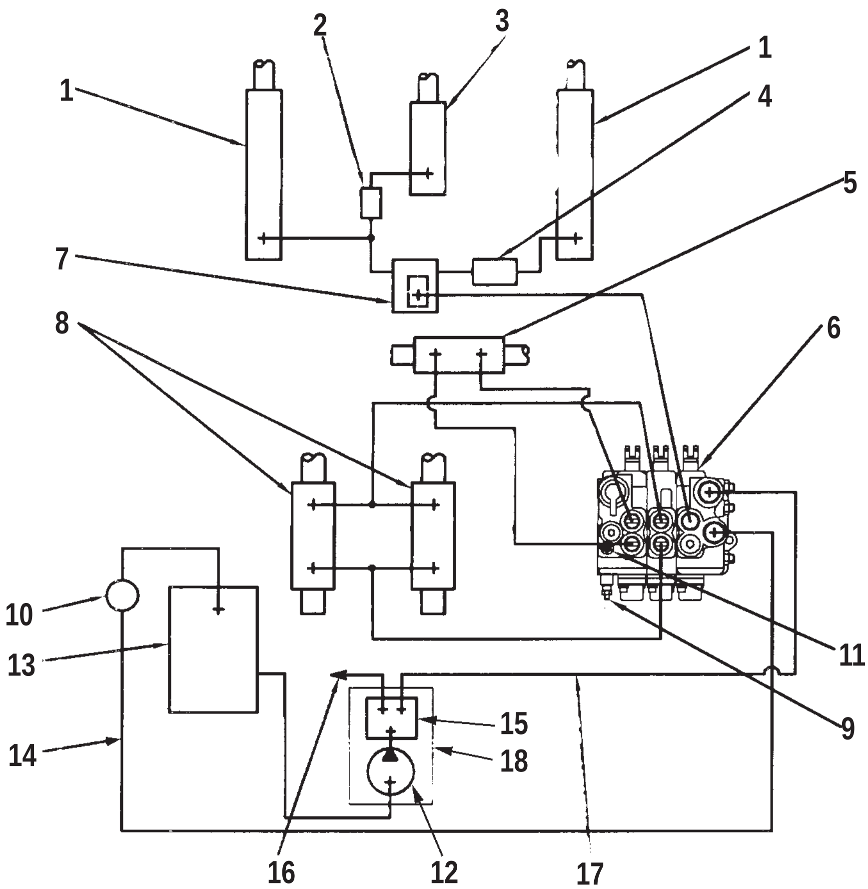
Hydraulic System

Basic Schematic



IDCS101S

Basic Hydraulic Schematic(Lift Truck With Standard Lift and Full Free Lift Or Full Free Triple Lift)
(1) Lift cylinders (primary for STD, secondary for FFL and FFTL). (2) Excess flow protector (FFL and FFTL).
(3) Lift cylinder (primary for FFL and FFTL). (4) Excess flow protector. (5) Sideshift cylinder (if equipped). (6) Hydraulic control valve.
(7) Flow regulator valve. (8) Tilt cylinders. (9) Relief valve poppet(lift). (10) Hydraulic oil filter. Relief valve poppet(sideshift and tilt).
(12) Hydraulic pump(BC20/25/30S-2) (13) Hydraulic oil tank. (14) Oil line. (15) Priority valve (BC20/25/30S-2)
(16) Oil line to steering gear. (17) Oil line. (18) Hydraulic pump with priority valve (B20/25/30S-2)

Basic Oil Flow

The hydraulic system has hydraulic oil tank (13), which holds the oil for gear-type hydraulic pump (12). Hydraulic pump (12) sends pressure oil to the hydraulic and steering systems. Pump oil flows from pump (12) to priority valve (15), where the oil flow divides (BC20/25/30S-2). For B20/25/30S-2 models, the priority valve is incorporated in hydraulic pump (18). Part of the oil goes to the steering gear through line (16). The remaining oil goes to hydraulic control valve (6) through line (17).

The control valve levers move the valve spools in control valve (6). The spools direct control valve oil to lift cylinders (1) and/or (3), tilt cylinders (8) and/or sideshifter cylinder (5).

The return hydraulic oil from the cylinders flows through hydraulic control valve (6), line (14), into filter (10) and hydraulic tank (13). Relief valve poppet (9) will release extra pressure to the hydraulic tank when the pressure in the lift circuits goes higher than relief valve pressure shown in the Control Valve section of SPECIFICATIONS. Relief valve poppet (11) does the same thing for the sideshift or tilt circuit when pressure goes higher than the auxiliary relief valve pressure shown in the Control Valve section of SPECIFICATIONS.

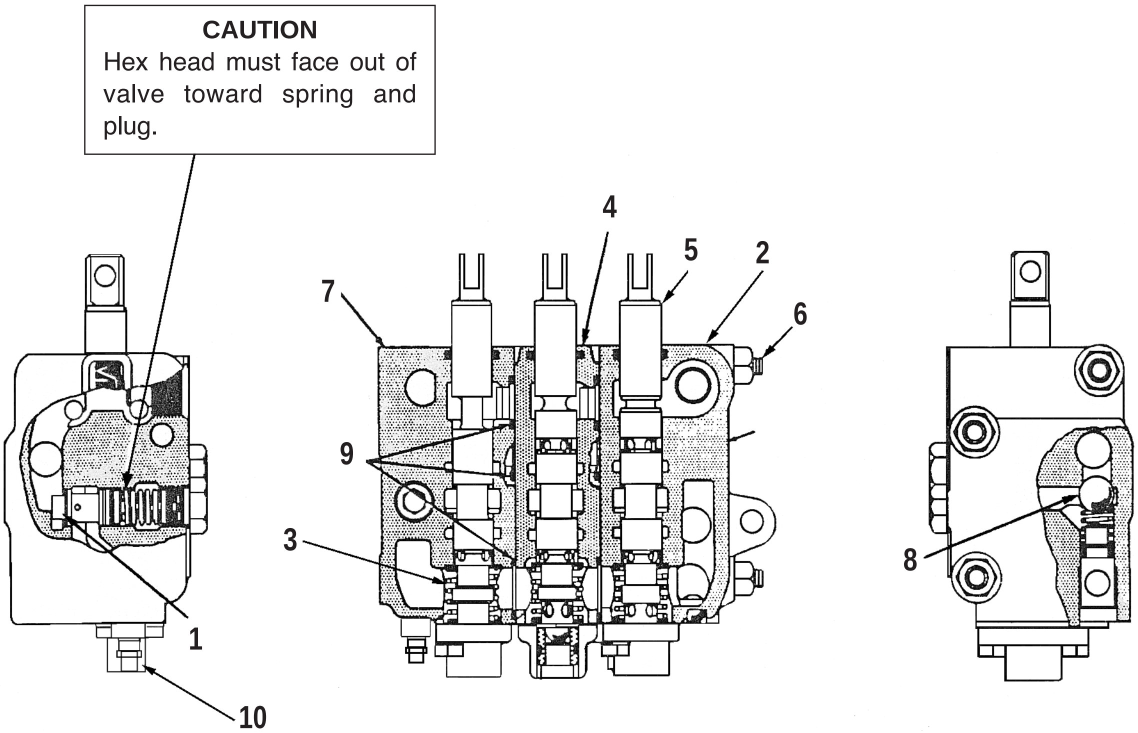
The speed at which the lift cylinder(s) are lowered is controlled by flow regulator (7).

Excess flow protector (2) and (4) will act as a flow control valve if an line between them and flow control valve (7) is broken when the mast is raised or lowered. This prevents a sudden fall of the mast or carriage if an oil line is broken.

The tilt forward, tilt back and sideshifter speed are controlled by flow control valves in hydraulic control valve (6). There is an anti-cavitation valve inside the tilt spool to prevent cavitation (development of air pockets) in tilt cylinders (8).

For a complete hydraulic schematic, see the foldout in the back of this module.

Hydraulic Control Valve



IDCS102S

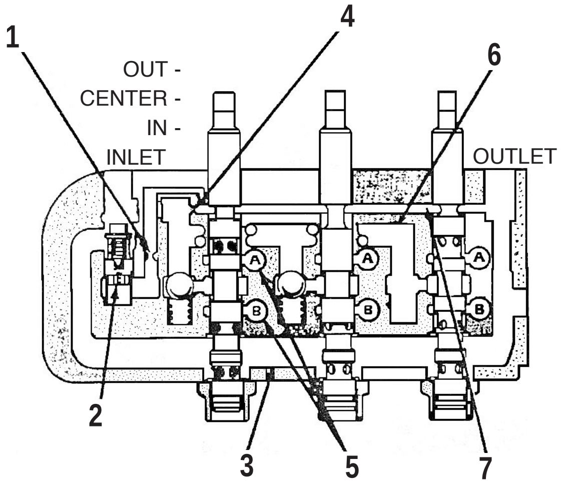
(1) Relief Valve - Hydrostat. (2) Inlet/Outlet Body. (3) Center Spring. (4) Center Body. (5) Spool. (6) Tie Stud.
(7) Quick Disconnect Gauge Body. (8) Check Valve. (9) Seal Rings. (10) Main Relief Valve.

Assembly And Construction

Above figure is a cross-section view showing construction and assembly of a three-section valve.
The Quick Disconnect Gauge Body section also contain a relief valve assembly.

Passages between the bodies connect each section to the common inlet and tank ports.
Seal rings between the sections seal the connecting passages, Sections are held together by studs and nuts.

Valve Operation



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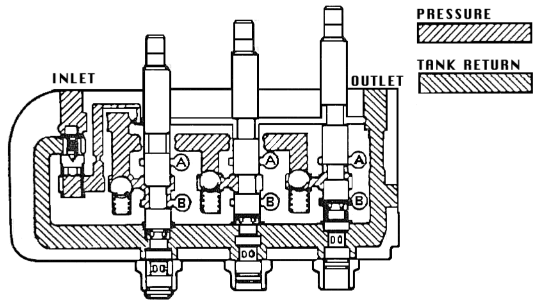
(1) Control Valve Sensing Orifice.
(2) Flow Control And Relief Valve-Hydrostat
(3) Tank Passage.
(4) By-pass Flow Control Orifice.
(5) Cylinder Ports.
(6) Pressure Passage.
(7) By-pass Passage.

Figure IDCS103S is a schematic illustration of a three section valve, showing the inlet and outlet ports and the by-pass, pressure and tank passages.
The pressure passage is used to carry fluid to the cylinder ports when the spools are shifted. The by-pass passage permits flow directly to the outlet when the spools are not being operated. The tank passage also carries fluid to the outlet; either return flow from the cylinder ports or fluid diverted past the flow control and relief valve.

The spools are shown in the centered or neutral position. Under these conditions, fluid in the pressure passage is blocked from the cylinder ports by the spool lands. Flow through the valve is through the by-pass and tank passages to the outlet.

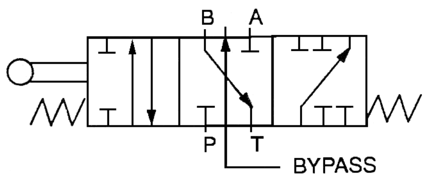
Lift Spool



OUT	Pressure to "A" "B" blocked By-pass blocked
CENTER	"A" and "B" blocked By-pass open
IN	"A" to tank "B" blocked By-pass open

IDCS104S

Lift spool - used for control of single acting cylinder applications. It directs flow to only one end of a cylinder, as in the lift mechanism of a lift truck.
Return flow is from the same end of the cylinder and relies on gravity or mechanical means to retract.



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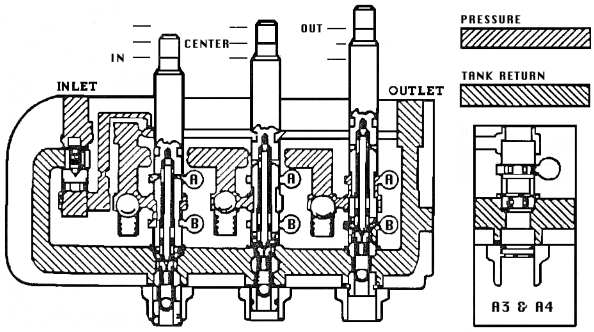
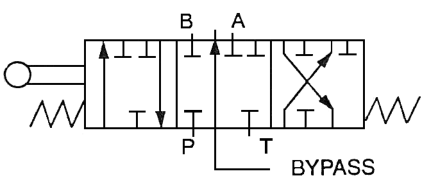
Tilt Spool



IN	Pressure to “B” “A” to tank By-pass blocked
CENTER	“A” and “B” blocked By-pass open
OUT	Pressure to “A” “B” to tank By-pass blocked

IDCS106S

Tilt spool - a counterbalance spool normally used to control the tilt function of a lift truck.
The counterbalance feature prevents the forks from tilting forward faster than pump can supply oil, preventing tilt.



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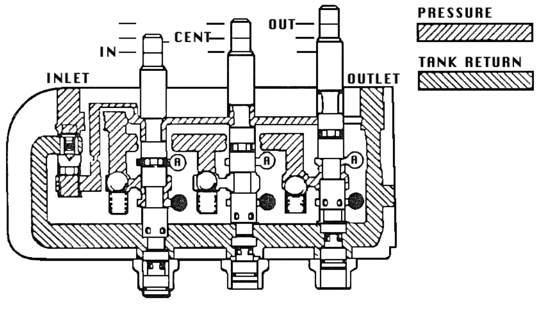
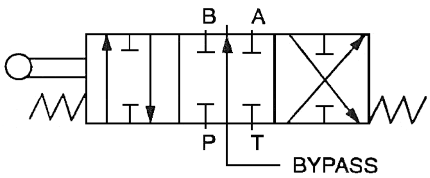
Auxiliary Spool



IN	Pressure to “B” “A” to tank By-pass blocked
CENTER	“A” and “B” blocked By-pass open
OUT	Pressure to “A” “B” to tank By-pass blocked

IDCS108S

Auxiliary spool - directs flow to either end of a double acting cylinder. Flow from the end that is not under pressure is returned to tank via internal coring of the valve section.



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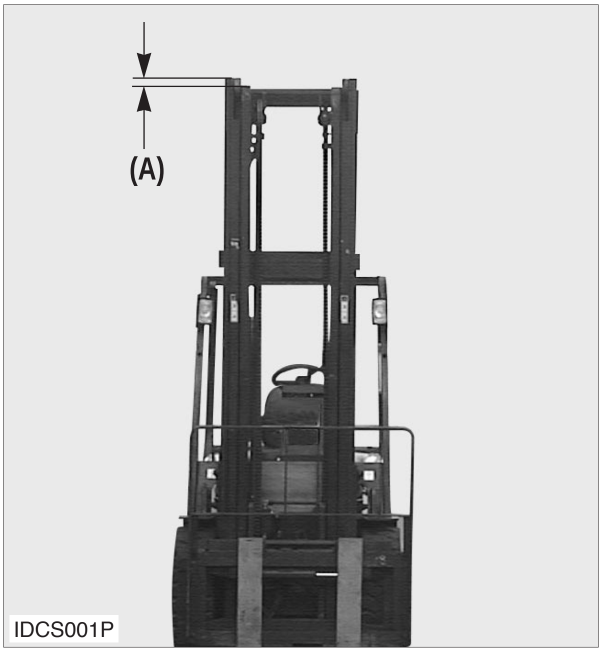
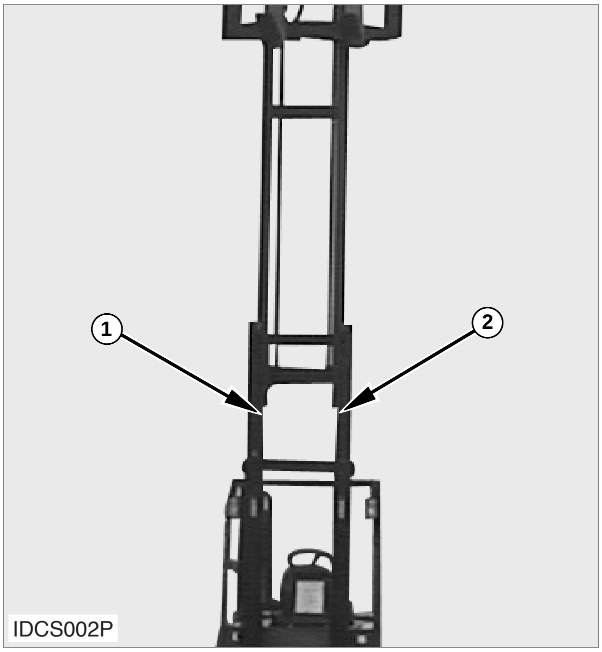
Lift Cylinders and Mast

Standard Lift



Standard Lift Mast
(Typical Example)
(A)Free lift period.



Standard Lift Mast At Full Extension
(Typical Example)
(1) Lift cylinder. (2) Lift cylinder.

The rods of Standard Lift Cylinders (1) and (2) are moved up by oil under pressure and go back to their original position by gravity.

The combination of the single-acting hydraulic lift cylinders with other mechanical lifting components will operate as follows:

When the control valve lift lever is pulled back, the hydraulic oil under pressure, pushes against the rods at the bottom of the lift cylinders. The inner mast crossbar, which is connected to the top of the cylinder rods, begins to move up. At this time, the carriage also starts to move up because it is connected to the inner mast through the lift chains arrangement. From the start of the lift cycle until the top of the inner mast becomes equal height to the top of the outer mast, the carriage and mast are in their free lift period (A).

The inner mast moves at a 1 to 1 ratio and the carriage moves at a 2 to 1 ratio with the rods of the lift cylinders.

The inner mast and carriage will continue to move up until they are in the extended position. If the control valve lift lever is held in the lift position with the mast fully extended, the pressure relief valve in the control valve will release the extra pressure until the lift lever is released. The oil flows through the relief valve and the control valve into the hydraulic tank. The carriage and inner mast will be stationary at this full height until the lift lever is moved to the lowered position.

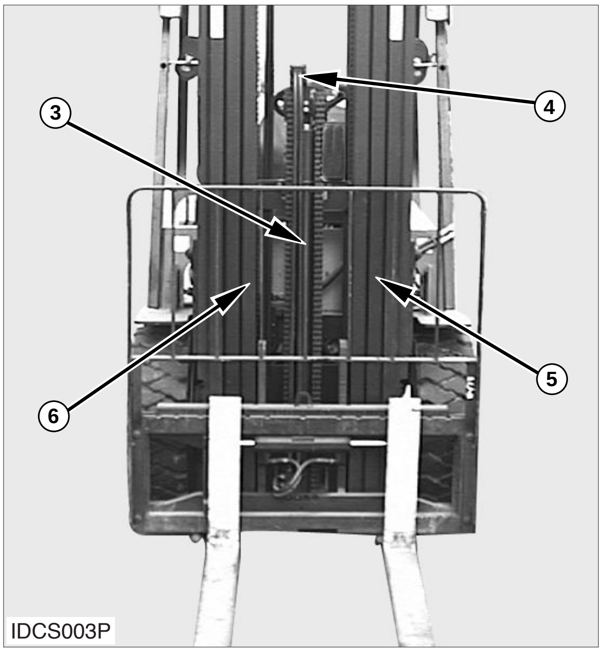
When the lift lever is moved forward, the oil under pressure is released in the lift cylinders. Gravity and the weight of a load will cause the carriage to move down at a 2 to 1 ratio and the inner mast to move down at 1 to 1 ratio with the rods of the lift cylinders until the carriage and mast are completely lowered.

The flow regulator located between the outer mast near the base of the lift cylinders, permits 54 to 66 liter/min (14 to 17 U.S. gpm) of oil flow back through the control valve and into the hydraulic tank.

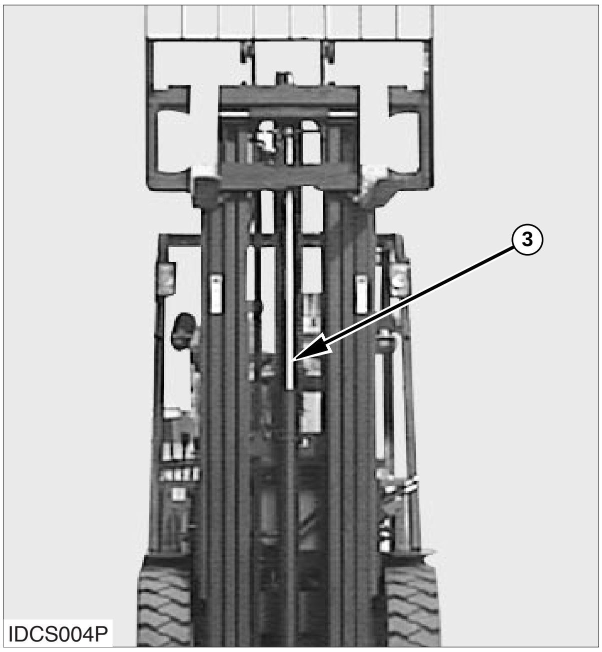
The lift cylinders also have excess flow protectors. These flow protectors act as a lowering flow control valve if an oil line is broken between them and the flow regulator located near the base of the lift cylinders.

The carriage and inner mast move up and down smoothly on load bearings (rollers). Stability of the mast and carriage is controlled by bearing size and shims behind the bearings (rollers).

Full Free Triple Lift Mast



Full Free Triple Lift Mast
(Typical Example)
(3) Primary lift cylinder. (4) Crosshead. (5) Intermediate mast.
(6) Inner mast.



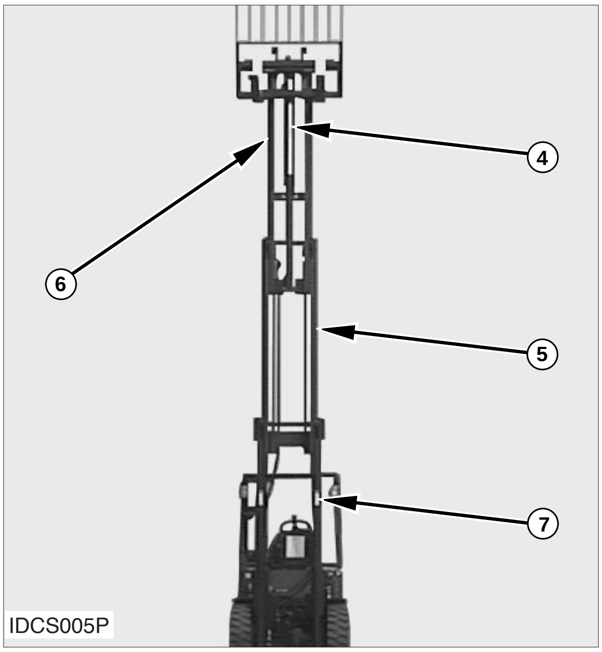
Full Free Triple Lift Mast At Free Lift
(Typical Example)
(3) Primary lift cylinder.

On trucks equipped with a Full Free Lift or Full Free Triple Lift Mast, the carriage can move the full length of inner mast (6) before any increase in height of the inner mast. This is possible because primary lift cylinder (3) moves the carriage only.

The carriage is lifted when the lift control lever is pulled back. Oil under pressure flows from the control valve into the base of primary lift cylinder (3) and secondary lift cylinders (7). Since the primary lift cylinder has the larger diameter for the oil to work against, the primary lift cylinder moves up first. The carriage moves up with the primary lift cylinder, with the assistance of crosshead (4) and the lift chains, until the carriage reaches the top of inner mast (6). From the start of the lift cycle until the carriage reaches the top of the inner mast, the mast is in its free lift period. During this lift cycle, the carriage moves up at a 2 to 1 ratio with the rod movement of primary lift cylinder (3).

When the movement of the primary cylinder is completed, pressure oil then works against the pistons in secondary cylinders (7). The movement of secondary cylinders (7) starts the movement of the inner mast on the Full Free Lift models or intermediate mast (5) and inner mast (6) on the Full Free Triple lift models. The inner mast moves at a 2 to 1 ratio and the intermediate mast moves at a 1 to 1 ratio with the rods of secondary cylinders (7) until they reach the top of their travel.

At this position, the pressure relief valve in the control valve will open if the lift control lever is held back and release the extra pressure until the lift control lever is released. The oil flows through the relief valve and the control valve and then into the hydraulic tank. The carriage will be stationary at this full height until the lift control lever is moved to the lowered position.



Full Free Triple Lift Mast In The Extended Position
(Typical Example)
(3) Primary lift cylinder. (5) Intermediate mast. (6) Inner mast.
(7) Secondary cylinder.

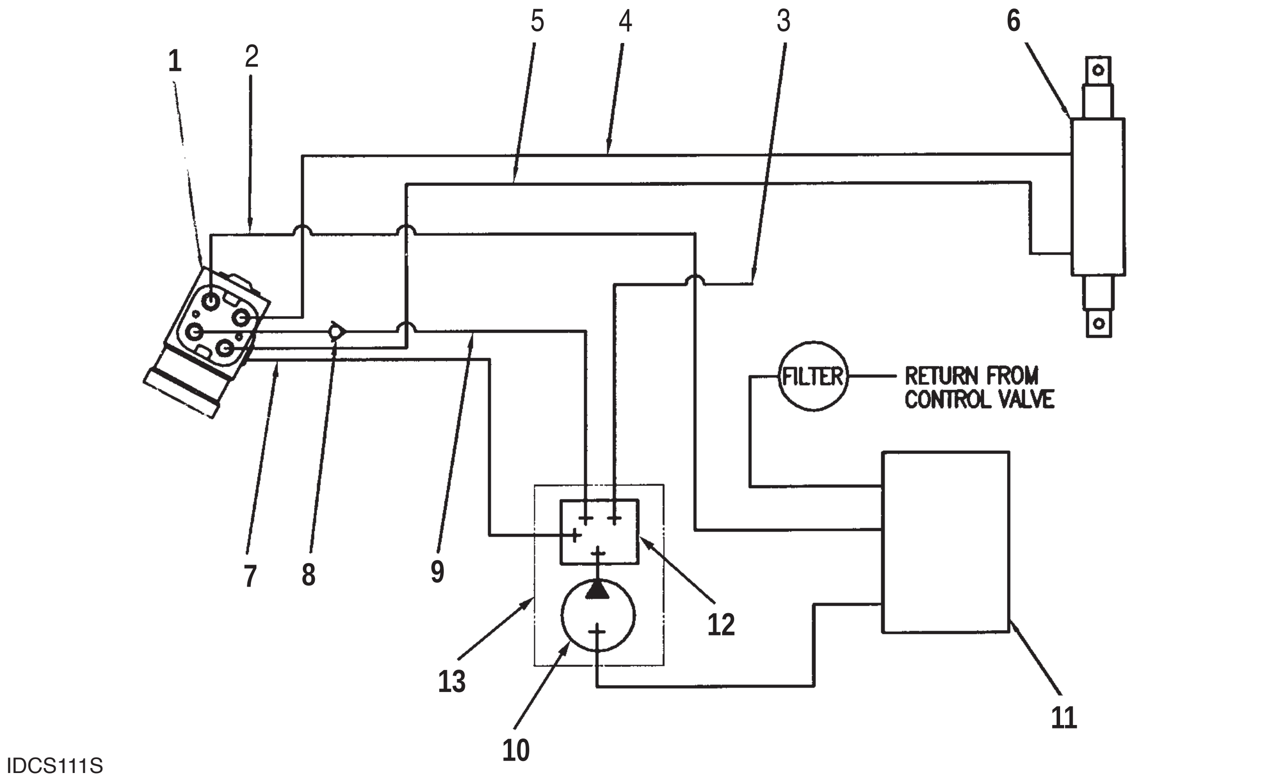
The oil under pressure in the primary and secondary cylinders is released when the lift control lever is moved forward. Gravity and the weight of a load will cause the cylinders to move back into their housings. The secondary cylinders move completely back into their housings before the primary cylinder starts to move down. The flow regulator valve, located between the outer mast near the base of the lift cylinders, permits 54 to 66 liter/min (14 to 17 U.S gpm) of oil to flow back through the control valve and into the hydraulic tank.

The Full Free Lift and Full Free Triple Lift Masts also have excess flow protectors connected to the primary lift cylinder and in the inlet of the secondary lift cylinders. They will act as a lowering flow control valve if an oil line is broken between any of them and the flow regulator valve located near the base of the lift cylinders.

The carriage and inner mast move up and down smoothly on load bearings (rollers). Stability of the mast and carriage is controlled by bearing size and shims behind the bearings (rollers).

Steering System

Schematic



Steering System Schematic
(1) Steering gear. (2) Hose. (3) Hose (to hydraulic control valve). (4) Hose. (5) Hose. (6) Steering cylinder.
(7) Load sensing signal hose. (8) Check valve. (9) Hose. (10) Hydraulic pump (BC20/25/30S-2). (11) Hydraulic tank.
(12) Priority valve (BC20/25/30S-2). (13) Hydraulic pump with priority valve (B20/25/30S-2).

The steering system uses hydraulic oil for its operation. The system of BC20/25/30S-2 has priority valve (12) which sends oil to the steering gear as needed before the requirements of the mast are filled. For B20/25/30S-2 models, the priority valve is incorporated in hydraulic pump (13).

Hydraulic oil is pulled from hydraulic tank (11) to hydraulic pump (10). The pump sends the oil through hose to priority valve (12). When the steering gear is in NEUTRAL position, pilot pressure in load sensing signal hose (7) is reduced so the spool in priority valve (12) moves to the left. Oil flows through hose (3) to the hydraulic control valve.

During a right turn, pilot pressure is increased in load sensing signal hose (7) and the spool in priority valve (12) moves to the right. Oil flows through hose (9) to steering gear (1). From the steering gear oil flows through hose (5) to steering cylinder (6) to make a right turn. The displaced (return) oil flows through hose (4) back through the steering gear, hose (2) and into the hydraulic tank.

During a left turn, pilot pressure is again increased in load sensing signal hose (7) which moves the spool in priority valve (12) to the right. Oil flows through hose (9) to steering gear (1). From the steering gear, oil flows through hose (4) to steering cylinder (6) to make a left turn. The displaced (return) oil flows through hose (5) back to the steering gear, hose (2) and into the hydraulic tank.

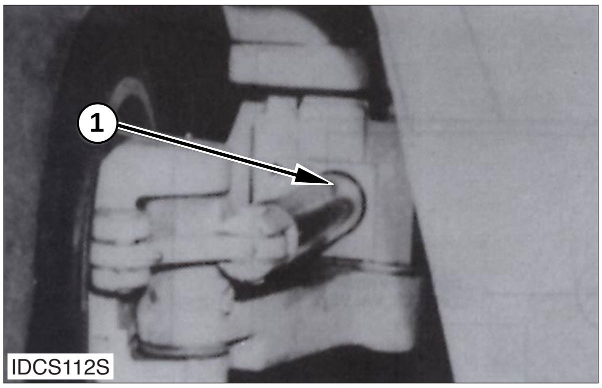
Check valve (8) is in hose (9) near the steering gear to prevent oil flow back to priority valve (12) right after a turn is made.

Relief valve in priority valve will open if the steering pressure goes above 7600 ± 350 kpa(1100 ± 50 Psi) for BC20/25/30S-2 models, or 8000 ± 350 kpa (1160 ± 50 Psi) for B20/25/30S-2 models.

Steering Cylinder

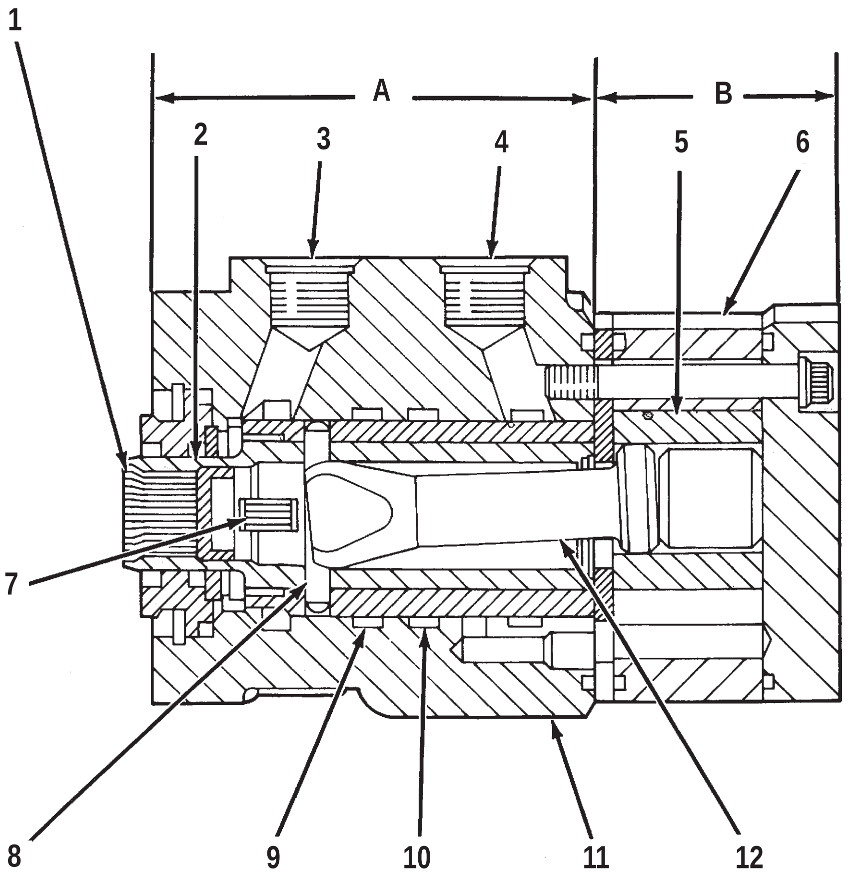
Steering cylinder (1) gives power assistance through the use of pressure oil at either end of the cylinder.

The steering cylinder is double ended and the body of the cylinder is mounted stationary to the steer axle. The rod assemblies at both ends of the cylinder which allows the cylinder to move the link assemblies.



Steering Cylinder
(1) Steering cylinder.

Steering Gear



Steering Gear
(1) Spool. (2) Sleeve. (3) Outlet (to tank). (4) Inlet (for pump oil). (5) Internal pump gear. (6) External pump gear. (7) Centering springs. (8) Pin. (9) Left turn port. (10) Right turn port. (11) Body. (12) Drive. (A) Control section. (B) Metering section.

Lift trucks use the load sensing, closed center (oil flow to steering gear only when needed) steering gear.

All lift truck hydraulic lines serve a dual purpose in that they serve both the steering and cylinder hydraulics through the use of a priority valve. The priority valve sends oil to the steering gear before the needs of the cylinder hydraulics are met.

The steering gear has two main sections: control section (A), and pump or metering section (B). These two sections work together to send oil to the steering cylinder.

Oil from the priority valve goes through inlet (4) into the control section of the steering gear. When the steering wheel is turned, the control section sends the oil to and from the metering section and also to and from the steering cylinder.

The metering section is a small hydraulic pump. It controls (meters) the oil that goes to the steering cylinder. As the steering wheel is turned faster, there is an increase in the flow of oil to the steering cylinder. This increased flow causes the main valve spool to move farther. As the spool moves farther, more oil can flow from the priority valve or power steering pump to the steering cylinder, and a faster turn is made.

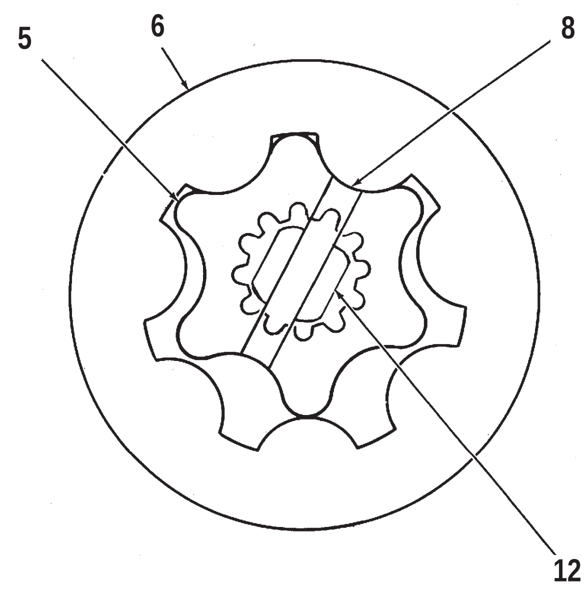
Oil Flow

The oil from the priority valve flows through inlet (4). When the steering wheel is stationary (NEUTRAL), the oil is stopped by spool (1). The oil can not flow through the steering gear to the steering cylinder until the steering wheel is turned.

The steering wheel is connected to spool (1) by a shaft assembly and splines. When the steering wheel is turned, spool (1) turns a small amount until springs (7) are compressed. Then, sleeve (2) starts to turn. As long as the steering wheel is turned, the spool and sleeve both turn as a unit, but they turn a few degrees apart.

When the spool and sleeve are a few degrees apart, oil passages are opened between them. This lets the pump oil from inlet (4) flow through passages in body (11) to the metering section.

When the steering wheel is turned, pin (8) turns with the sleeve and causes drive (12) to turn also. The drive causes a rotation of gear (5) inside gear (6). This rotation of the gear sends a controlled (metered) flow of pilot oil back through body (11). This oil flows to port (9) or (10) and then to the steering cylinder. Port (9) or (10), that is not used for pressure oil to the steering cylinder, is used for return oil from the other end of the steering cylinder.



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Pump Gears In Metering Section
(5) Internal pump gear. (6) External pump gear. (8) Pin. (12) Drive.

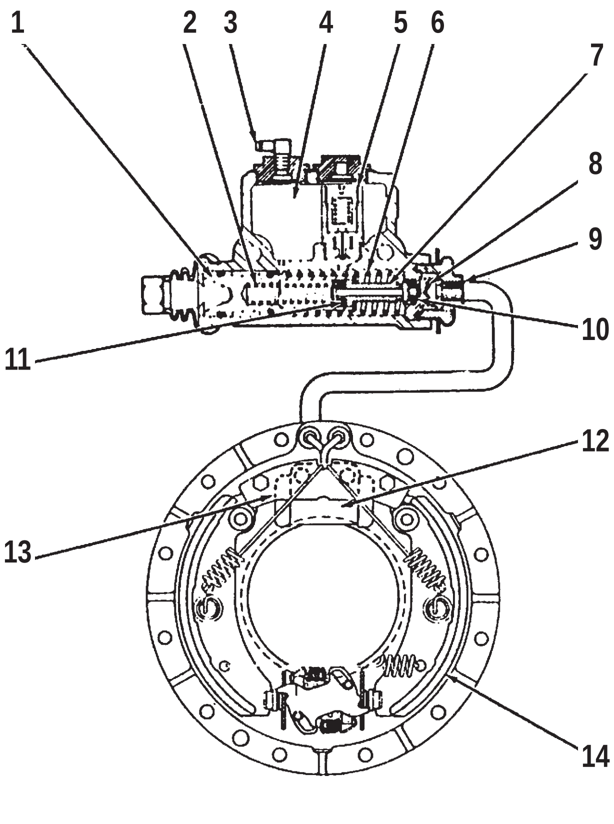
If the steering wheel rotation is stopped, springs (7) will move sleeve (2) back in alignment with spool (1) (NEUTRAL position). This will close passages between the metering section and control section and the steering gear will be in the NEUTRAL position.

When the engine is off, the steering gear can be manually operated. The control section will work as a pump. The oil that is returned from the steering cylinder is not returned to the tank. The suction of the control section will open an internal check valve and let return oil from the steering cylinder go to the inlet side of the control section. During power operation, supply pressure keeps the check valve closed.

Brake System

Master Cylinder

Systems Without Power Brakes



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Master Cylinder And Wheel Cylinder
(1) Piston. (2) Spring. (3) Inlet (4) Master cylinder reservoir.
(5) Relief valve. (6) Spring. (7) Piston. (8) Check valve.
(9) Outlet. (10) Seal. (11) Cup seal. (12) Wheel cylinders.
(13) Wheel cylinder pistons. (14) Brake shoes.

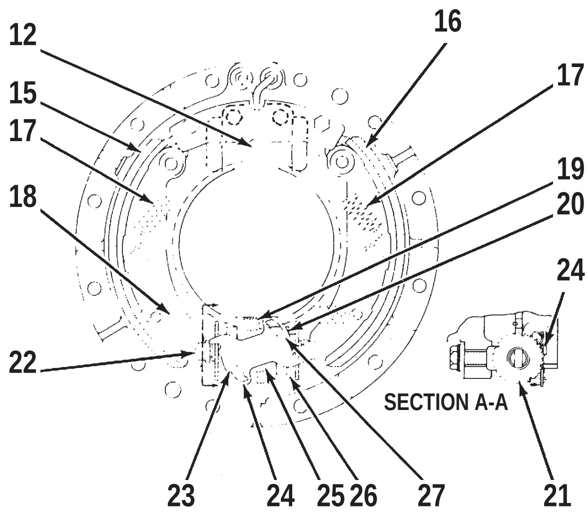
The master cylinder has two pistons (1) and (7) which push brake liquid into the brake lines. The main reservoir, located cowl is connected to inlet (3). The supply lines keep master cylinder reservoir (4) filled so no air enters the system. Reservoir (4) supplies brake liquid to the system.

When the brake pedal is first pushed, both pistons move into the master cylinder and push brake liquid through outlet (9) into the brake lines. when floating piston (7) seats on seal (10), the liquid that is pushed by piston (1) goes around cup seal (11), out through floating piston (7) and outlet (9). This action continues until the liquid pressure in piston (1) bore reaches the pressure that opens relief valve (5). The liquid, being pushed by piston (1), now returns to reservoir (4). Cup seal (11) seals and the liquid inside piston (11) is pushed through piston (7) and outlet (9).

The liquid pushed through outlet (9) goes through the brake lines to wheel cylinders (12)

Check valve (8) keeps a small amount of pressure in the brake lines and wheel cylinders (12) when the pedal is released. This small amount of pressure helps the wheel cylinder piston cup seal seat, which keeps air out of the brake system.

Shoe Type Brakes



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Wheel Brakes
(12) Wheel cylinder. (15) Primary shoe. (16) Secondary shoe.
(17) Return springs. (18) Return spring. (19) Spring.
(20) Guide. (21) Star wheel. (22) Adjustment screw.
(23) Pin. (24) Plate. (25) Spring. (26) Spring. (27) Pin.

When the brake pedal is pushed down, the master cylinder sends brake liquid to wheel cylinder (12). The wheel cylinder pistons are pushed out and move primary shoe (15) and secondary shoe (16). The brake shoes move until they make contact with the brake drum.

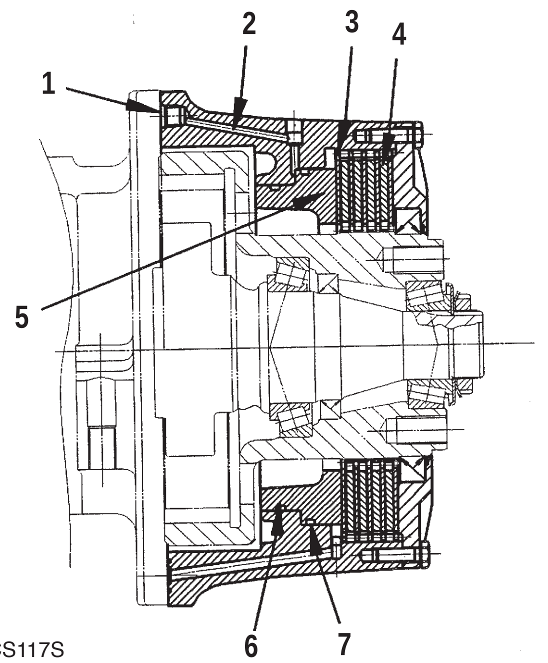
When the brake action first starts, primary shoe (15) comes in contact with the brake drum as it is in rotation. This contact of the primary shoe puts some force on secondary shoe (16) to help put it in position against the drum.

When the brake pedal is released the brake shoe springs pull the brake shoes and push wheel cylinder pistons back into wheel cylinder (12). The liquid is pushed from the wheel cylinder back through master cylinder outlet and into the master cylinder.

The brakes will automatically adjust themselves with a forward or reverse brake application. In the above example. The drum rotation is counterclockwise in forward which causes a counterclockwise rotation of the brake shoes. As the shoes are pushed out against the drum, guide (20) will move axially. This causes a swing movement of plate (24). The distance that the plate swings is controlled by the slots in the plate and pins (23) and (27). If there is enough wear, plate (24) will engage the next tooth of star wheel (21).

When the brakes are released, return springs (17) and (18) will bring the brake shoes back to their rest position. Springs (19), (25) and (26) will bring the adjustor back to its original position. The star wheel is turned one tooth and adjustment screw (21), which is engaged with the primary shoe web, is turned out. The brake shoe has a new position after the adjustment.

Oil Cooled Disc Brakes

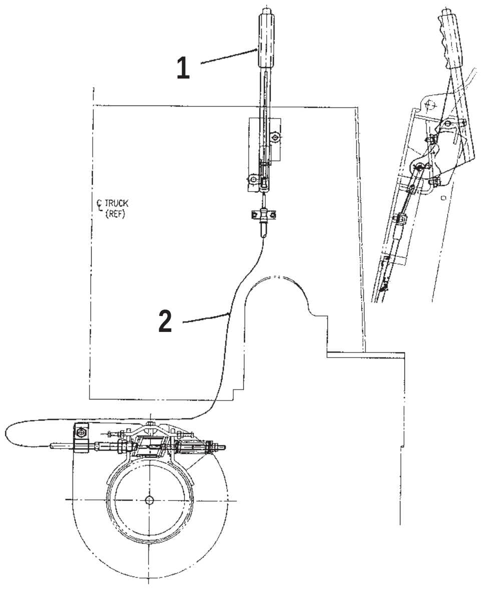


Disc Brake Assembly
(1) Inlet (from master cylinder). (2) Passage. (3) Plates (five). (4) Discs (four). (5) Piston. (6) Seal. (7) Seal.

When the brake lever is pulled, the master cylinder pushes brake liquid through the master cylinder outlet, the brake lines, to inlet (1) of each disc brake assembly. Liquid flows through inlet (1), passage (2) and pushes on piston (5). Piston (5) pushes against plates (3) and friction discs (4) to stop any movement of the lift truck. The five separator plates (3) are splined to the wheel cover and the four friction discs (4) are splined to the hub. During brake activation the piston seals (6) and (7) are deflected by the brake piston movement.

When the brake pedal is released, the brake liquid pressure is released and seals (6) and (7) return to their original position. This seal retraction gives the running clearance needed between plates (3) and discs (4). This action will release the brakes on the lift truck. As the seals retract brake liquid is returned to the master cylinder. The piston automatically slides outward from the cylinder bore as the friction discs wear. This new location then becomes the beginning or at rest position of the seals. This will maintain the proper clearances of the discs and plates.

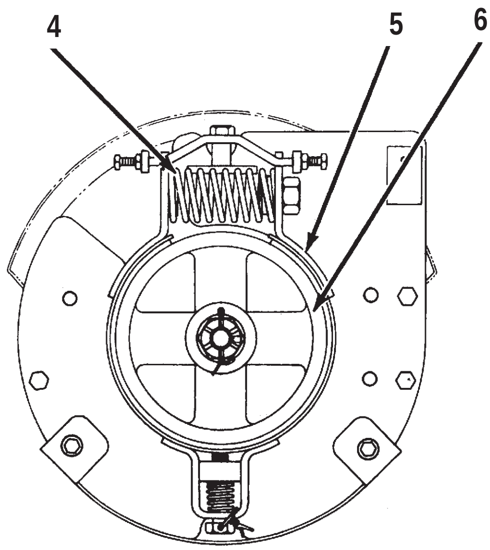
Parking Brake



IDCS118S

(1) Lever. (2) Cable assembly.

The band-type parking brake is installed on the front of the electric drive motor. The parking brake control is actuated with the lever (1), and is released with lever (1). The lever is mounted on the cowl and is connected by a cable assembly to the parking brake.



IDCS119S

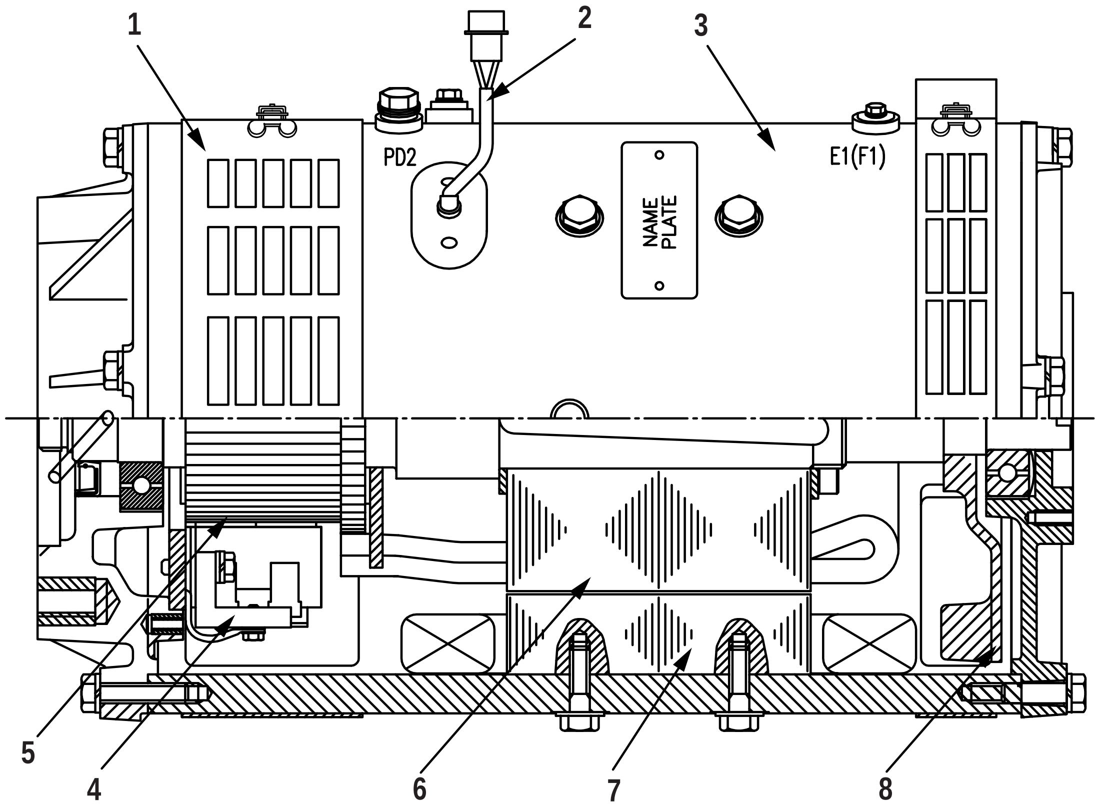
Parking Brake
(4) Spring. (5) Strap assembly. (6) Drum.

When the lever is pulled, cable assembly (3) compresses strap assembly (5) around drum (6). With the drum prevented from turning, all lift truck movement is stopped.

When parking brake lever (1) is depressed, the cable is released and spring (4) forces the strap assembly away from the brake drum.

Electric Motors

Hydraulic Pump Motor



Electric Motor
(1) Cover. (2) Thermal Switch. (3) Motor frame. (4) Brush. (5) Commutator. (6) Armature. (7) Field coil. (8) Fan.

The hydraulic system is operated by a direct current (DC) motor. Electric storage batteries are the source of power for the (DC) motor.

The hydraulic pump motor is a compound wound motor and uses high temperature insulation. Armature (6) is mounted with single row ball bearings at each end. The ball bearings are permanently lubricated with high temperature lubricant.

The electrical connections to the motor are made at corrosion resistant terminals on motor frame (3). On the outside of the motor frame is cover (1) that can be removed for easy access to brushes (4) and commutator (5). Field coils (7) are fastened to the inside of the motor frame.

The motor brushes are held in the four brush holders.
The 72/80V “S” motors have four brushes (4) and springs, while 36/48V “S” motors have eight brushes (4) and springs. The spring holds the brushes against commutator (5) and makes compensation for brush wear.
The parts of armature (6) include the shaft, core, windings and commutator.

The motors are protected from over temperature by thermal switch (2). When the normally closed thermal switch is open, the amount of current through the motor is limited to allow the motor to cool. All motors are fan (8) cooled.

The hydraulic pump motor is activated when the key and seat switches are closed and a lift, tilt or auxiliary lever is moved. In lift operation, the speed of the motor is variable. The larger the distance the lever is moved, the faster the motor will rotate.

The speed of tilt or auxiliary operation could be pre-settable.

Testing and Adjusting

Troubleshooting

Troubleshooting can be difficult. A list of possible problems and corrections are on the pages that follow.

This list of problems and corrections will only give an indication of where a problem can be and what repairs are needed. Normally, more or other repair work is needed beyond the recommendations on the list. Remember that a problem is not necessarily caused only by one part, but by the relation of one part with other parts. This list can not give all possible problems and corrections. The serviceman must find the problem and its source, then make the necessary repairs.

The pressure Gauge Kit or the Tetragauge Group can be used to make the pressure tests of the hydraulic system. Before any test is made, visually inspect the complete hydraulic system for leakage of oil and for parts that have damage.

⚠ WARNING

To prevent personal injury when testing and adjusting the hydraulic system, move the machine to a smooth horizontal location and lower the mast and carriage to the ground, make sure they are blocked correctly to keep them from a fall that is not expected. Move away from machines and personnel that are at work. There must be only one operator. Keep all other personnel away from the machine or where the operator can see the other personnel. Before any hydraulic pressure plug, line or component is removed, make sure all hydraulic pressure is released.

Visual Checks

A visual inspection of the hydraulic system and its components is the first step when a diagnosis of a problem is made. Lower the carriage to the floor and follow these inspections;

1. Measure the oil level. Look for air bubbles in the oil tank.
2. Remove the filter element and look for particles removed from the oil by the filter element. A magnet will separate ferrous particles from nonferrous particles (piston rings, O-ring seals, etc.).
3. Check all oil lines and connections for damage or leaks.
4. Check all the lift chains and the mast and carriage welds for wear or damage.

Hydraulic System and Mast

During a diagnosis of the hydraulic system, remember that correct oil flow and pressure are necessary for correct operation. The output of the pump (oil flow) increases with an increase in motor speed (rpm) and decreases when motor speed (rpm) is decreased. Oil pressure is caused by resistance to the flow of oil.

Visual checks and measurements are the first step when troubleshooting a possible problem. Then do the Operation Checks and finally, do instrument tests with pressure gauges.

Use the Pressure Gauge Kit, a stop watch, a magnet, a thermometer and a mm (inch) ruler for basic test measurements.

1. The pressure of the oil required to open the relief valve. Relief valve pressures that are too low will cause a decrease in the lift and the tilt characteristics of the lift truck. Pressures that are too high will cause a decrease in the life of hoses and components.
2. Drift rates in the cylinders. Cylinder drift is caused by a leakage past cylinder pistons, O-ring seals in the control valve, check valves that do not seat correctly or poor adjustment or fit in the control valve spools.
3. Cycle times in the lift and tilt circuits: Cycle times that are too long are the result of leakage, pump wear and/or pump speed (rpm).

Performance Test

The performance tests can be used to find leakage in the system. They can also be used to find a bad valve or pump. The speed of rod movement when the cylinders move can be used to check the condition of the cylinders and the pump.

Lift, lower, tilt forward and tilt back the forks several times.

1. Watch the cylinders as they are extended and retracted. Movement must be smooth and regular.
2. Listen for noise from the pump.
3. Listen for the sound of the relief valve. It must not open except when the cylinders are fully extended or retracted, when the forks are empty.

Hydraulic Oil Temperature (Too Hot)

When the temperature of the hydraulic oil gets over 98.8℃ (210°F), polyurethane seals in the system start to fail. High oil temperature causes seal failure to become more rapid. There are many reasons why the temperature of the oil will get this hot.

1. Hydraulic pump is badly worn.

2. Heavy hydraulic loads that cause the relief valve to open.

3. The setting on the relief valve is too low.

4. Too many restrictions in the system.

5. Hydraulic oil level in the tank is too low.

6. High Pressure oil leak in one or more circuits.

7. Very dirty oil.

8. Air in the hydraulic oil.

NOTE: If the problem is because of air in the oil, it must be corrected before the system will operate at normal temperatures. There are two things that cause air in the oil (aeration). These are:

a. Return oil to the tank goes in above the level of the oil in the tank.

b. Air leaks in the oil suction line between the pump and the tank.

Mast and Carriage

Problem: The hydraulic system will not lift the load.

Probable Hydraulic Cause:

1. There is an air leak, which lets air into the hydraulic system on the inlet side of the hydraulic pump.

2. The relief valve opens at low oil pressure.

3. The hydraulic pump has too much wear.

4. The load is not correct (too heavy).

Probable Mechanical Cause:

1. The mast is not in alignment with the other lifting components and does not move freely.

2. Not enough lubricant on the parts of the mast that move.

3. The carriage or mast rollers (bearings) are worn and do not move (seized).

Problem: Lift cylinder extends too slowly.

Probable Hydraulic Cause:

1. Not enough oil supply to lift cylinder.

2. Defective lift cylinder seals.

Probable Mechanical Cause:

1. The mast is not in alignment with the other lifting components and does not move freely.

2. Not enough lubricant on the parts of the mast that move.

3. The carriage or mast rollers (bearings) are worn and do not move (seized).

Problem: Mast does not move smoothly.

Probable Hydraulic Cause:

1. Air in the hydraulic system.

2. Relief valve sticks or defective.

Probable Mechanical Cause:

1. Not enough lubricant on the parts of the mast that move.

2. Load rollers (bearings) defective or not adjusted correctly.

Problem: Mast will not lower completely or will not lower at all.

Probable Mechanical Cause:

1. Lift cylinder damaged or bent.

2. Load rollers (bearings) defective or not adjusted correctly.

3. Not enough lubricant on the parts of the mast that move.

Problem: The mast does not tilt correctly or moves too slowly.
Probable Hydraulic Cause:

1. There is an air leak, which lets air into the hydraulic system on the inlet side of the hydraulic pump.

2. The relief valve opens at low oil pressure.

3. The hydraulic pump has too much wear.

4. The internal valve of the tilt spool is stuck.

5. Control valve tilt spool has a restriction.

Probable Mechanical Cause:
1. Damage or failure of the piston rods on the tilt cylinders.

Problem: The carriage will not lower correctly.
Probable Hydraulic Cause:

1. There are restrictions in the lift line.

2. The lift spool in the control valve has a restriction caused by foreign material and does not operate freely.

3. The lift cylinder flow control valve has a restriction.

4. Lift cylinders excess flow protectors have a restriction.

5. Air in the hydraulic system.

Probable Mechanical Cause:

1. The mast is not in alignment with the other lifting components and does not move freely.

2. Carriage chains need an adjustment.

3. Not enough lubricant on the part of the mast that moves.

4. The carriage or mast rollers (bearings) are worn and do not move (seized).

Problem: The lift or tilt cylinders do not hold their position with the valve control levers in neutral position.

Probable Cause:

1. The valve spools do not hold their positions because the springs for the valve spools are weak or broken.

2. Control valve leakage caused by worn valve spools.

3. The check valve or flow control valves in the control valve are bad.

4. Leakage of the cylinder lines or piston seals.

5. There is foreign material in the control valve.

Hydraulic Pump

Problem: Noise in the pump.

Probable Cause:

1. The oil level is low.

2. The oil is thick (viscosity too high).

3. The pump inlet line has a restriction in it.

4. Worn parts in the pump.

5. Oil is dirty.

6. Air leaks into the inlet line.

Problem: The oil temperature is too high.

Probable Cause:

1. The oil level is low.

2. There is a restriction in an oil passage.

3. The relief valve setting is too low.

4. The oil is too thin.

5. There is air leakage in the system.

6. The pump has too much wear.

7. The system operates at too high a pressure.
- **a.** Relief valve setting too high.
- **b.** Attachment components cause a restriction during movement.
- **c.** Restrictions in flow control valve, check valve and in oil lines.

Problem: Leakage at the pump shaft seal.

Probable Cause:

1. The shaft seal is worn.

2. The inner parts of the pump body are worn.

3. Operation with too low oil level in tank causes suction on the seal.

4. Seal cut on shoulder of pump or keyway during installation.

5. Seal lips are dry and hardened from heat.

Problem: There is failure of the pump to deliver fluid.

Probable Cause:

1. Low level of the oil in the tank.

2. There is a restriction in the pump inlet line.

3. There is air leakage in the pump inlet line.
a. Loose bolts.
b. Defects in suction line.

4. The viscosity of the oil is wrong.

5. The pump has too much wear.

6. Failure of the pump shaft.

7. The bolts of the pump do not have the correct torque.

Hydraulic Control Valve

Problem: The control spools do not move freely.

Probable Cause:

1. The temperature of the oil is too high.

2. There is foreign material in the fluid.

3. The fitting connections in the valve body are too tight.

4. The fastening bolts of the valve assembly do not have the correct torque and have twisted the body.

5. Linkage of the lift and tilt levers does not operate smoothly.

6. Bent lift or tilt spools.

7. Damage to the return springs of the spools.

8. The hydraulic oil is not at normal temperature for operation.

Problem: Control valve spools have leakage around the seals.

Probable Cause:

1. There is foreign material under the seal.

2. The valve spools are worn.

3. The seal plates are loose.

4. The seals have damage or are badly worn.

Problem: The load lowers when the lift spool is moved from the NEUTRAL position to the RAISE position.

Probable Cause:

1. There is foreign material in the check valve area.

2. The check valve poppet and seat show wear.

3. Sudden loss of pump oil pressure.

4. Damage to the relief valve which causes low oil pressure.

Problem: Spools do not return to neutral.

Probable Cause:

1. The springs are broken.

2. The spool is bent.

3. The system or valve has foreign particles in it.

4. The control linkage is not in alignment.

5. The fastening bolts of the valve have too much torque.

Problem: No motion or slow, then a too sudden action of the hydraulic system.

Probable Cause:

1. The relief valve is not correctly set, or will not move in base and/or is worn.

2. There is air in the system.

3. Dirt or foreign particles between relief valve control poppet and its seat.

4. Valve body has a crack inside.

5. Spool not moved to a full stroke.

Lift and Tilt Cylinders

Problem: Leakage around the cylinder rod.

Probable Cause:

1. Cylinder head (bearing) seals are worn.

2. Cylinder rod is worn, scratched or bent.

Problem: There is leakage of oil inside the cylinder or loss of lift or tilt power.

Probable Cause:

1. The piston seals are worn and let oil go through.

2. Cylinder has damage.

Problem: The tilt cylinder rods show wear.

Probable Cause:

1. The cylinders are not in correct alignment.

2. Oil is dirty.

Problem: Foreign material behind the wiper rings causing scratches on the cylinder rod.

Probable Cause:

1. The wiper rings shoe wear and do not remove dirt and foreign material.

Steering System

Problem: Too much force needed to turn steering wheel.

Probable Cause:

1. Priority valve (if equipped) releases pressure oil at a low setting.

2. Pump oil pressure is low, worn pump.

3. Steering gear covers are too tight.

4. Steering column not aligned with steering gear.

5. Priority valve spool is held in one position.

6. Steering gear without lubrication.

7. Low fluid level in the hydraulic supply tank.

Problem: Steering wheel does not return to center position correctly.

Probable Cause:

1. Steering gear covers are too tight.

2. Steering column is not in correct alignment.

3. Valve spool in the steering gear has a restriction.

4. Priority valve check valve permits lift and tilt hydraulic oil to affect steering hydraulic circuit.

Problem: Oil leakage at the pump.

Probable Cause:

1. Loose hose connections.

2. Bad shaft seal.

Problem: Low oil pressure.

Probable Cause:

1. Low oil level.

2. Priority valve (if equipped) relief valve spring weak.

3. Relief valve (priority valve) will not move from the open position.

4. Oil leakage inside or outside of the system.

5. Bad pump.

Problem: Pump makes noise and the steering cylinder rod does not move smoothly.

Probable Cause:

1. Air in the steering hydraulic circuit.

2. The pump has too much wear.

3. Loose connection of the oil line on the inlet side of the pump.

4. The viscosity of the oil is wrong.

5. The oil level in the hydraulic tank is low.

Problem: Lift truck does not turn when steering wheel is slowly turned.

Probable Cause:

1. The oil level of the tank is low.

2. There is air in the steering system.

3. The pump operation is not correct.

4. Dirt in the steering system.

5. Steering gear operation is not correct.

6. Steering cylinder has worn parts.

7. Restriction in the steer axle linkage.

Problem: The temperature of the oil is too hot.
Probable Cause:

1. The viscosity of the oil is wrong.

2. Air is mixed with the oil.

3. The relief valve is set too high (priority valve).

4. There is a restriction in the return line circuit.

Brake System

Drum Type Brakes

Problem: Brakes make noise or pull (grab).

Probable Cause:

1. Brake shoe adjustment not correct.

2. Lining surface looks like glass (glazed) or is worn.

3. Oil or brake fluid is on the lining.

4. Dirt on the brake drum lining surface.

5. Brake drum is worn or has grooves (scored).

6. Restriction in the brake line.

7. Brake drum is out of round.

Problem: Both brake shoes will not release all the way (drag).

Probable Cause:

1. Brake shoe adjustment not correct.

2. Brake pedal adjustment not correct.

3. Mechanical resistance at the pedal or shoe.

4. Restriction in the brake line.

5. Bad wheel cylinder.

Problem: Pedal resistance is not solid (spongy).
Probable Cause:

1. Leakage or low fluid level.

2. Air in the brake hydraulic system.

3. Master cylinder is loose.

Problem: Extra (excessive) pedal pressure needed for braking action.

Probable Cause:

1. Mechanical resistance on the pedal or shoe.

2. Brake shoe adjustment not correct.

3. Restriction in the brake line.

4. Bad master cylinder.

5. Lining surface looks like glass (glazed) or is worn.

Problem: Pedal gradually goes to the floor.
Probable Cause:

1. Leakage or low fluid level.

2. Bad master cylinder.

Problem: Extra (excessive) pedal travel.
Probable Cause:

1. Pedal adjustment is not correct.

2. Leakage or low fluid level.

3. Air in the brake hydraulic system.

4. Bad master cylinder.

5. Lining surface is worn.

6. Operation of automatic adjustment is not correct.

Problem: Brake will not make application.

Probable Cause :

1. Leakage or low fluid level.

2. Air in the brake hydraulic system.

3. Master cylinder is loose.

4. Lining surface looks like glass(glazed) or worn.

5. Oil or brake fluid is on the lining.

6. Bad master cylinder.

Problem: Not braking evenly or rough feeling during braking (chatter).

Probable Cause :

1. Lining surface looks like glass(glazed) or worn.

2. Oil or brake fluid is on the lining

3. Bad contact between the lining and drum.

4. Loose lining.

5. Brake drum out of round.

6. Loose wheel Bearing.

7. Bad wheel cylinder.

Brake System (Oil Cooled Disc Type)

NOTE: If excessive force is applied to the brake pedal, the pedal can be forced to the end of the stroke. This is normal and should not be interpreted as a problem.

Problem: Pedal resistance is not solid (spongy) (under normal pedal pressure).

Probable Cause:

1. Leakage or low brake fluid or oil level.

2. Air in the brake hydraulic system.

3. Master cylinder is loose.

Problem: Pedal gradually goes to the floor (under normal pedal pressure).

Probable Cause:

1. Leakage or low brake fluid or oil level.

2. Defective master cylinder.

Problem: Extra (excessive) pedal travel (under normal pedal pressure).

Probable Cause:

1. Pedal adjustment is not correct.

2. Leakage or low brake fluid or oil level.

3. Air in the brake hydraulic system.

4. Defective master cylinder.

Problem: Brake will not make application.

Probable Cause:

1. Leakage or low brake fluid or oil level.

2. Air in the brake hydraulic system.

3. Linkage is not in correct adjustment or is bent.

4. Defective master cylinder.

5. Bent plates or discs.

Problem: Hard pedal.

Probable Cause:

1. Mechanical resistance at pedal or disc assembly.

2. Restriction in the brake line.

3. Defective master cylinder.

4. Brake discs look like glass (glazed) or are worn.

Problem: Both brake disc assemblies will not release all the way (drag).

Probable Cause:

1. Brake disc assemblies defective (pistons stuck).

2. Brake disc uneven (out of flat).

3. Restriction in the brake line.

4. Defective master cylinder.

Problem: Brakes will not make application after being bled.

Probable Cause:

1. Leak in hydraulic line or connection.

2. Damaged cup seal or boot in the master cylinder.

Problem: Brake oil low in master cylinder reservoir, fluid must be added frequently.

Probable Cause:

1. Leak in hydraulic line or connection.

2. Damaged ring seal in the master cylinder.

3. Leak in the disc assemblies.

Parking Brakes

Problem: Brake will not make application.

Probable Cause :

1. Parking brake assembly out.

2. Parking brake control cable out of adjustment.

3. Worn brake band.

Electric Motors

Before an analysis is made of any electric motor problems, always make reference to the troubleshooting section of MicroController Control System Module.

⚠ WARNING

If an electrical failure or an overload of the motor is present, personnel must not breathe the toxic fumes which are a product of the burnt insulation. All power must be disconnected from the motor before any inspection is made to find the failure. The area around the motor must be well ventilated (air flow) and the motor is to be cooled before any repair work is done. Water must not be used on any electrical equipment because of the danger of electrical shock. If a fire is present, disconnect the electrical power and use a carbon dioxide extinguisher to put the flame out.

Do not operate the drive motor without a load as too much speed may cause damage to the motor and injury to personnel.

NOTICE

Never use air pressure that is more than 30 psi (205 kPa) and make sure the air line is equipped with a water filter.

Problem: Hydraulic pump motor will not operate.

Probable Cause :

1. Bad connections or fuses.
Check battery connections. Check battery connector
Check the key fuse.
Check the hydraulic pump motor for possible reasons for a bad fuse.
Some causes are :
a) Operation with too high hydraulic pressures.
b) Operation with too much currect draw.
c) Possible short circuit in motor.

2. Key switch, seat switch or line contactor not closed.
Close the seat and key switch. Use a multimeter(VOM) to check power flow thru the seat switch, key switch, line contactor coil and line contactor. The key switch, seat switch and line contactor must be closed for the power steering pump to operate.

The key switch, seat switch, control valve switch, and the line contactor must be closed for the hydraulic pump motor to operate.

3. Not enough voltage. High resistance in battery cells or cables.
Charge the battery or make a replacement of the battery.
Check all the cells for one or more that has defects.
Check the specific gravity of each cell. The maximum density difference from the highest to lowest cell must not be more than .020 SG (specific gravity).
Check cable terminals for tight fit at battery terminal and control panel connectors. Check for broken inner wires in cables.

4. Brushes are worn.
Disconnect the battery and discharge the capacitors (HEAD CAP). Inspect the pump motor commutator for burnt marks or scoring (scratches).
Make corrections or make a repair of the armature commutator, replace the brushes as necessary.
See Armature Commutator Inspection and Brush Inspection in Testing And Adjusting.
Make reference to Problem: Pump Motor Overheat (Too Much Heat).
Check for opens in the field coil.
Test coils according to procedures in Testing And Adjusting. If there are opens, make a replacement of the coils.

5. Check for short or open circuit in the armature or between armature and field.
Loose field winding pole pieces.
Check poles for damaged insulation, repair or replace damaged insulators.
Failed armature bar insulation or armature bar connector open. Repair or rebuild the insulation, make a replacement of the armature.

NOTE: If armature opens caused commutator bar pitting or burnt areas, armature will need replacement. Heat from the arcing causes the hardened copper commutator bars to be annealed (soft). Just machining (turned to a lesser diameter) of the commutator will not correct the problem from occurring again. The armature must be replaced.

Opens in the armature bar connections must be found and soldered (repaired).

7. Lift and drive system operation not correct.
See troubleshooting section of the MicroController Control System module.

Problem 2: Neither traction or hydraulic will last through a complete normal work period.

Probable cause:

1. Too small a battery installed in the lift truck.
Study and question the use of the lift truck in its complete working conditions, select and purchase appropriate capacity of battery regarding work hours.

2. Battery not being fully charged or equalized during the battery charging operation.
Check the battery cells for an equalization charge (a charge to make the specific gravity the same in all cells).
Check the battery charger for defects.

3. Battery Discharge Indicator (BDI) lift interrupter circuit which protects the battery, shuts off the hydraulic motor circuit too soon.
See Battery Discharge Indicator Operation Adjustment and Troubleshooting in the MicroController Control System module.

4. Battery charge interval is too long or charged battery cooling time is too short. This causes excessive (too much) cell temperatures which decreases the capacity of the battery to supply the rated ampere hours.
Decrease the battery work duration before a change.
Increase the battery cooling time after a charge before it is put to use.

5. Battery has one or more defective cells which can result in much less than the rated capacity and ability of the battery.
Test and locate the defective cells. Replace the defective cell(s).
Battery cells are connected in series, one bad cell causes a high resistance in series with the other cells. This slows down the speed of the motor as the cell resistance increases. This can occur with the other cell almost fully charged.

6. Hydraulic system draws too much battery power because of lifting and tilting arrangements or hydraulic controls are not correct for the duty cycle.
Decrease hydraulic relief valve setting to the capacity that only will be used.
Change to a smaller hydraulic pump (if available).
Check the mast for restriction during operation.
Remove quick disconnects and install fittings with lesser resistances to oil flow.
Check for defective hydraulic control valve, the pilot operated relief valve.

Remove any restrictions in the hydraulic circuit. Make an inspection of the movable hydraulic attachments for restrictions. Check for components that slide, bearing wear, hinges binding and the correct amount of lubrication on necessary components.

Problem 3: Sparks at the commutator and/or rapid brush wear.

Probable Cause:

1. Worn brushes.
Make a replacement of the brushes and make sure the brushes are seated. See New Brush installation and Brush Inspection in Testing And Adjusting.

2. Loose cable connections at the motors terminals cause a high resistance in the circuit. The resistance increases amperage draw (consumption), as a result brushes deteriorate (destroy), there is arcing on the commutator, insulation on wires burns and causes a short circuit to lift truck frame.
Tighten the nuts or bolts that hold the cable connections on the motor terminals.

3. Overheating (too much heat) of the pump motor.
Check for an overload motor or a motor with defects. See Armature Commutator Inspection in Testing And Adjusting.
The duty cycle is too heavy, use the hydraulics only to the limited capacity of the lift truck.
If the motor has EE covers and the duty cycle is heavy and within the lift truck capacity, remove the covers if permitted.

4. Commutator bars burnt in two or more positions at 180°apart because:
Armature bars open, replace armature.
Short circuit in the armature, see Armature Test.
Armature not in balance which causes brush bounce, see Specifications.
Motor was stalled against a heavy load and caused the two bars in contact with the brushes to burn, see Armature Commutator Inspection.

5. Dirty motor that has metallic or carbon dust. This dust is a conductor which causes electrical shorts, increase amp draw and decrease pump motor output.
Remove any dirt with air pressure.

6. Brushes too tight in brush box. Brush springs not strong enough to force one or more brushes in contact with commutator.

a. At installation, pull upon brush leads to make sure they return to contact with commutator correctly. See Brush Installation in Testing And Adjusting.

b. If brushes are too tight remove the brush material with sandpaper until brush movement in brush box is acceptable.

7. Loose movement of the brushes.
Check the brush springs for cracks and overheat signs (bluing).
Compare spring force with a new brush spring.
Check the brush holder for oversize (too much larger than brush size).
Replace the brush spring if necessary.

8. Loose brush leads or motor bus bar connections.
Check the brushes for tight connections. Replace if leads are loose in brush material
Check all cables and wire connections for tightness.

9. Wrong grade of brushes installed that are not adaptable to the motor.
Make sure all the brushes are of DAEWOO standards. Do not use other brands brushes.

10. Replacement brushes are not seated, the current goes through a small contact area with the commutator. As a result the brush temperature increases. Possibly if the contact area is poor the brushes will be destroyed in a few service meter hours.
Always seat new brushes when installed, see New Brush Installation in Testing And Adjusting.

11. Pump motor armature or field windings have a defect that results in high current draw at low torque output.
See Armature Tests and Field Coil and Terminal Tests in Testing And Adjusting.

12. Possible heavy working conditions that cause too much motor heat and rapid brush wear.
Commutator skin is very black which gives an indication of high temperatures.
Make a replacement of the brushes and make sure the brushes are seated. See New Brush Installation and Brush Inspection in Testing And Adjusting.
Install extra heavy duty brushes when available.
Check the brush spring for the correct installation and for the correct spring usage. Too strong a spring rate will increase amperage draw and brush wear rate.
Prevent operation in an overload condition caused by excessive duty cycle which increases motor temperature and gives rapid brush wear.

13. Restriction caused by system components.
Operate the hydraulic and steering systems with an ammeter and a pressure gauge installed. If amperage draw and oil pressure are too high, see Testing And Adjusting and Specifications for the acceptable amperage draws and oil pressure, the system must be inspected for both mechanical and hydraulic restrictions.

Problem 4: Low resistance to ground [battery potential either positive (+) or negative (-) or a medium voltage is in direct contact with truck frame (body) or drive motor body.]

Probable Cause:

1. Dirty battery, electrolyte on top of cells and is in contact with the frame. Current flows through battery box which places a voltage on the truck frame.
Clean off the battery with baking soda and water solution.

2. Battery or control panel wire connections in contact to truck frame.
Make a continuity test to move the wire from contact. Remove wires in sequence until the fault is cleared. The fault will be in the wire last disconnected.

3. Dirty motor.
Remove the metallic or carbon dust with air pressure.

4. Wet pump motor.
Dry the motor with heat to 90°C (190°F).

Problem 5: Commutator surface has groove or extra wear.

Probable Cause:

1. Brushes are worn too low, brush wires caused arcing on commutator.
Inspect the commutator for damage. If the arcing caused light pitting on commutator, install new brushes and seat the brushes with the Brush Seater Stone which will also clean the commutator surface.
Make another inspection, if there is still pitting, commutator surface must be machined only to the minimum diameter as shown in Specifications.

2. Dirty motor, and possibly salt water got inside.
Disassemble motor, remove the debris with air pressure. If necessary, dry the motor with heat to 90°C (190°F).

3. Grade of brushes mixed.
Make sure all of the brushes are of Caterpillar standards. Do not use other brands of brushes.

4. Overload on brushes.
Check the brush springs for the correct installation and make sure the lift truck is operating at a rated capacity.

Problem: Lift truck has slow hydraulic speeds.

Probable Cause:

1. Hydraulic pump motor overheated and pump motor thermal switch opens (if equipped).
Allow the motor to cool so the thermal switch will close. See Specifications for thermal switch will opening and closing temperatures.

2. Pump motor control circuit overheated and thermal switch opens.
Allow the control panel to cool so the Controller thermal switch will close. The thermal switch opens at 85 ± 4 °C (185 ± 7 °F) and close at 73 ± 4 °C (163 ± 7 °F).

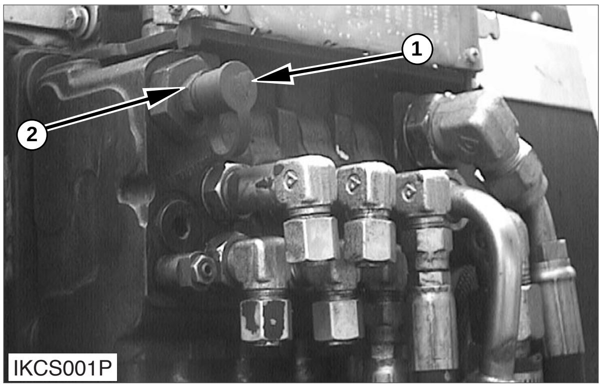
Hydraulic System

Relief Valve Pressure Check

Use the Pressure Gauge Kit to check the relief valve pressure.

⚠ WARNING

Hydraulic oil, under pressure can remain in the hydraulic system after the engine and pump have been stopped. Personal injury can be caused if this pressure is not released before any work is done on the hydraulic system. To prevent possible injury, lower the carriage to the ground, turn the key switch off and move the control levers to make sure all hydraulic pressure is released before any fitting, plug, hose or component is loosened, tightened, removed or adjusted. Always move the lift truck to a clean and level location away from the travel of other machines. Be sure that other personnel are not near the machine when the engine is running and tests or adjustments are made.



Pressure Tap Location
(1) Cap (2) Nipple assembly.

Relief Valve Pressure					
		Main Relief		Tilt, Auxiliary Relief	
Model	Mast	kPa +500,-0	psi +75,-0	kPa ±350	psi ±50
B,BC20S-2	STD FFL FFTL	16600	2400	15500	2250
B,BC25S-2	STD FFL FFTL	19300	2800	15500	2250
B,BC30S-2	STD FFL FFTL	20700	3000	15500	2250

With the key switch off, remove cap (1) from nipple assembly (2) and connect the 28000 kpa (4000 psi) gauge to the nipple assembly.

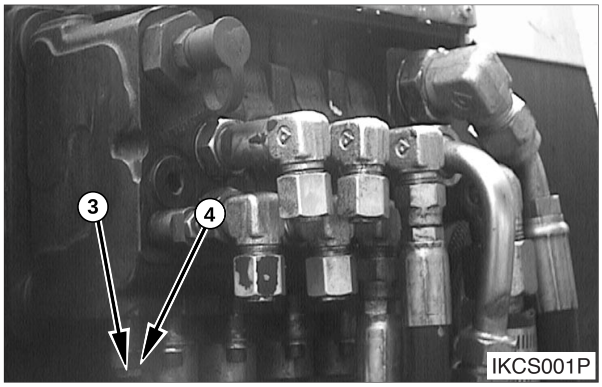
Lift Relief Valve Check and Adjustment

1. Turn the key switch on and activate the hydraulics until the hydraulic oil is at the normal operating temperature.

2. With the motor at fast rpm under unload condition, hold the lift control lever in the lift up position and watch the gauge. The gauge indication is the pressure that opens the relief valve at the end of lift cylinder stroke.

3. The correct pressure setting is shown in the chart.

4. If an adjustment to the relief valve setting is necessary, loosen locknut (3).



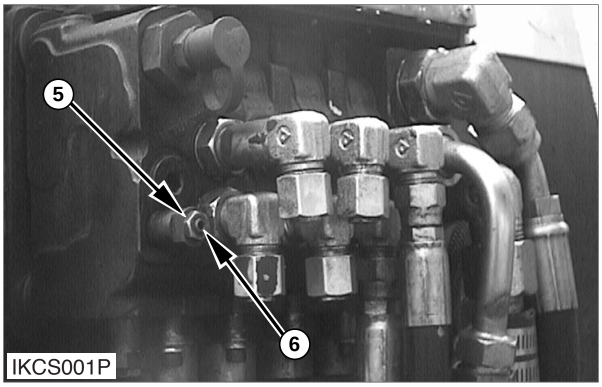
Relief Valve Adjustment
(3) Locknut. (4) Stud

5. Turn stud (4) clockwise to increase or counterclockwise to decrease the pressure setting of the relief valve.

6. Tighten the locknut and check the pressure setting again for correct adjustment.

Tilt and Sideshifter Relief Valve Check and Adjustment

1. Turn the key switch on and activate the hydraulics until the hydraulic oil is at the normal operating temperature. Put the carriage in the full sideshift position.
2. With the motor at fast rpm, hold the sideshift position and watch the gauge. The gauge indication is the pressure that opens the relief valve.
3. The correct pressure setting is shown in the chart.
4. If an adjustment to the relief valve setting is necessary, loosen locknut (5).

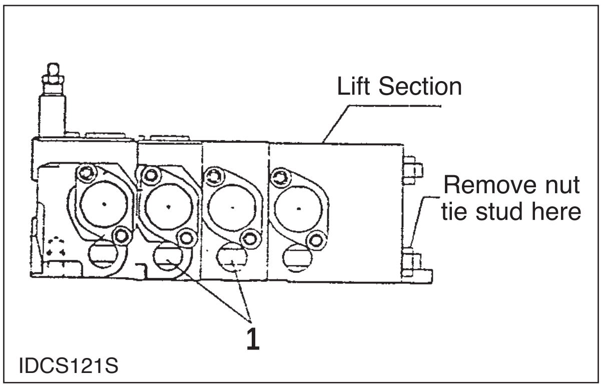


Relief Valve Adjustment
(5) Locknut. (6) Stud

5. Turn stud (6) clockwise to increase or counterclockwise to decrease the pressure setting of the relief valve.
6. Tighten the locknut and check the pressure stting again for correct adjustment.

Flow Control Valve Adjustment

The tilt and first attachment speeds can be adjusted at the control valves. They can be adjusted by turning the plug in the hydraulic control valve body. The lift speed can not be adjusted.
Do the procedure that follows to change the flow control assembly.



1. Remove the nut from the slotted tie-stud of main hydraulic valve.
2. Remove the slotted tie-stud from the valve.
3. Use Hex Wrench (6mm or 1/4 inch), turn the flow control adjuster clockwise to increase the flow or counterclockwise to decrease the flow.
4. Assemble the tie stud in the valve. Torque the stud to 40.5 $\pm$ 2.5 N•m (360 $\pm$ 24 lb•in)
5. Reinstall the nut.

⚠ WARNING

Hydraulic oil, under pressure, can remain in the hydraulic system after the motor and pump have been stopped. Personal injury can be caused if this pressure is not released before any work is done on the hydraulic system. To prevent possible injury, lower the carriage to the ground, turn the key switch off and move the control levers to make sure all hydraulic pressure is released before any fitting, plug, hose or component is loosened, tightened, removed or adjusted. Always move the lift truck to a clean and level location away from the travel of other machines. Be sure that other personnel are not near the machine when the engine is running and tests or adjustments are made.

Standard Lift Cylinder Air Removal

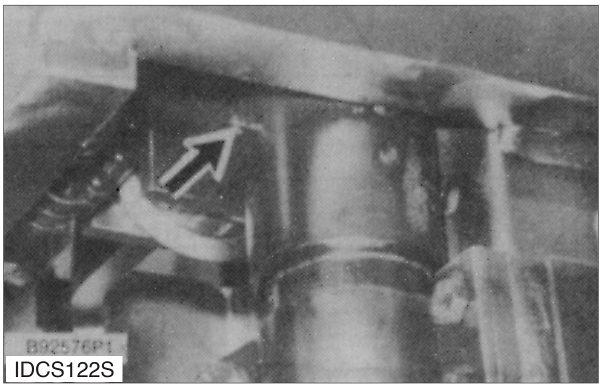
After the standard lift cylinder has been disassembled and then assembled again, it may be necessary to remove the air (bleed) from the cylinder.

1. With no load, lift and lower the mast and carriage through one complete cycle.
2. With the forks on the floor, check the oil level in the hydraulic tank. Add oil (if necessary) to bring the oil level to the full mark.
3. With no load, lift and lower the mast and carriage again through four complete cycles.

⚠ WARNING

The oil will have high pressure present. To prevent personal injury, do not remove the bleed screws completely. Keep hands and feet away from any parts of the truck that move, because the forks will lower when the bleed screw is loosened.

4. Lift the forks high enough to put a load on all stages of the lift cylinders.



Setscrew Locations
(Standard Cylinders)

NOTE: The Standard Lift mast has two secondary cylinders and no primary cylinders. The Full Free and Full Free Triple Lift mast has one primary and two secondary cylinders.

5. Locate the setscrew on each lift cylinder. Slowly open secondary cylinder(s) setscrews no more than one turn. The weight of the carriage will force air and hydraulic oil out of the cylinders through the setscrews. Close the setscrews before all the pressure is out of the cylinders. This will prevent air from entering through the setscrews.

6. Repeat Steps 4 and 5 until there are no air bubbles at the setscrews.

7. After all the air is removed, tighten the setscrews to a torque of 5 to 7 N•m (45 to 60 lb•in).

8. Fill the hydraulic tank to the full mark.

9. Lift and lower the mast and carriage again through one complete cycle. If the mast does not operate smoothly, repeat Steps 3 through 9.

Mast and Carriage

Mast Adjustment

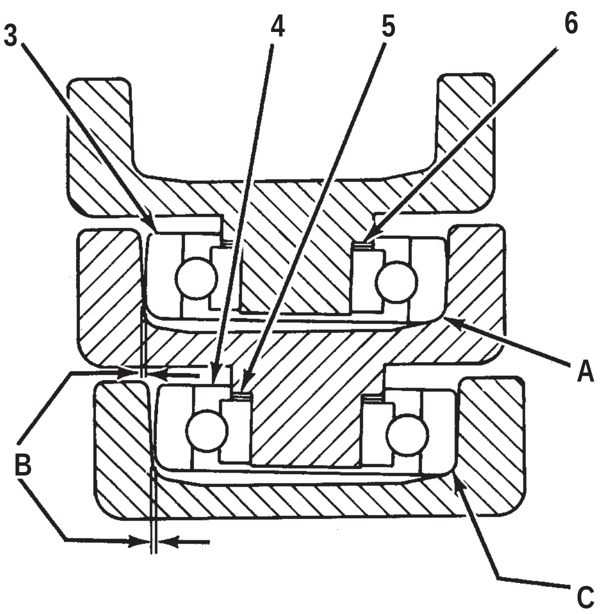
NOTE: The Standard, Full Free Lift and Full Free Triple Lift mast load bearings are all adjusted the same way. The mast shown in the following illustrations is the Full Free Triple Lift mast.

To make the mast clearance adjustments, mast must be removed from the lift truck.

Carriage, chain and lift cylinder must be removed from the mast for easy adjustments.

Use the procedure that follows to adjust the load bearings.

A. Lower Bearing Adjustment of Intermediate Mast



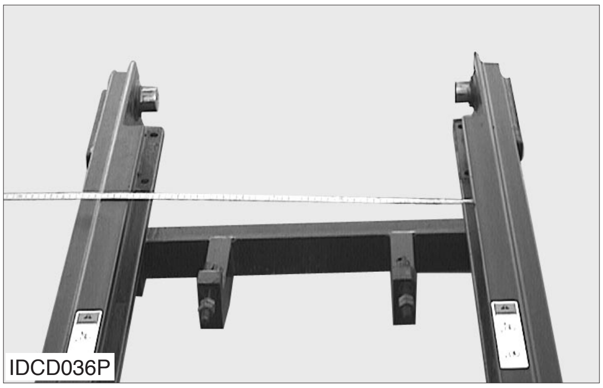
IDCS123S

Mast Adjustment Lower Bearings
(A) Zero clearance. (B) Minimum clearance. (C) Zero clearance.
(3) Bearing. (4) Bearing. (5) Shims. (6) Shims.

1. Select lower bearings (3) and (4) from the chart to obtain minimum clearance (B) between bearing and channel leg for full channel length. Use same bearing on left and right side.

Mast And Carriage Bearings		
Part No.	Bearing Size	Bearing O.D.*
D581814	Under Size	108.6 mm (4.276 in)
D581815	Standard	109.6 mm (4.135 in)
D581816	Over Size	110.7 mm (4.358 in)

* Permissible tolerance ± 0.08mm (.003in)



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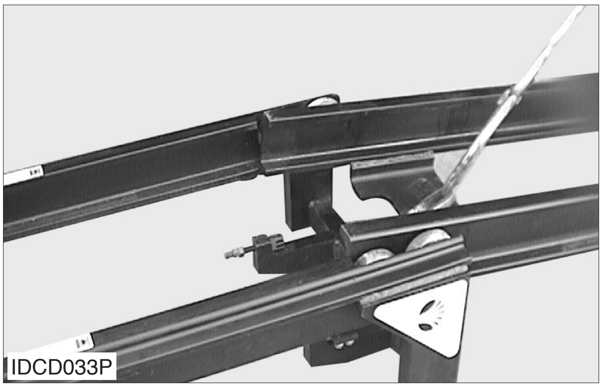
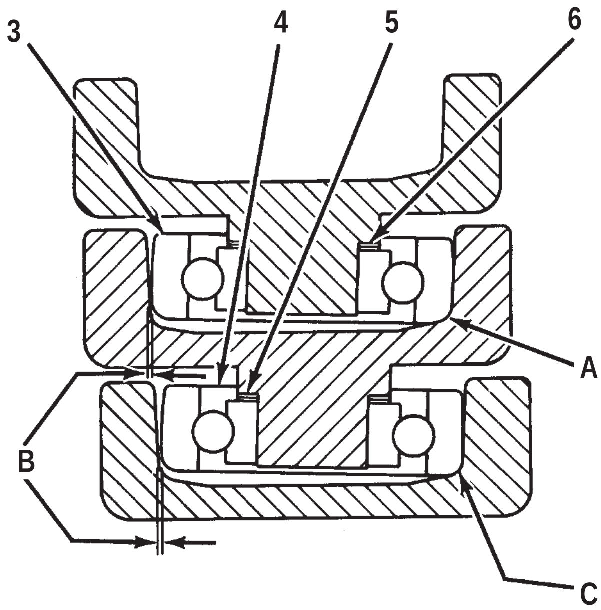
2. Find narrowest point by ruler on the stationary mast in the area where the bearings make contact at 475 mm (18.7 in) channel lap.


IDCD037P


IDCD033P

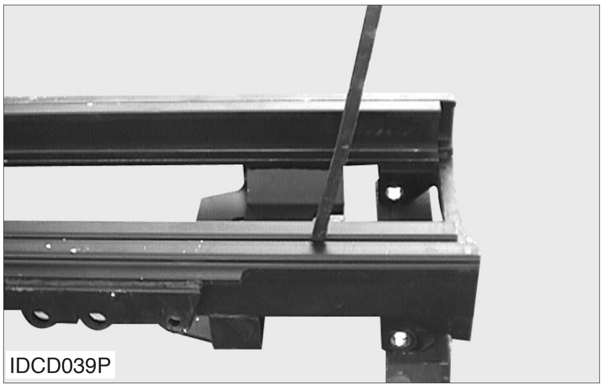
3. Install 1 mm shim to each bearing of intermediate lower and stationary upper basically. Lifting by crane, insert intermediate mast into stationary mast from the upper side.

NOTE: When installing shims (5) behind bearing (4), make sure the amount of shim is divided equally when positioned behind each bearing (4).

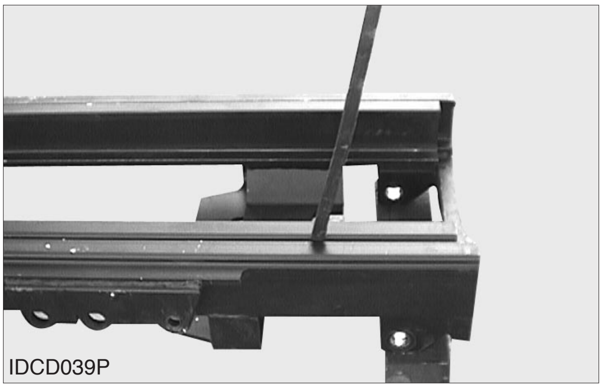


IDCS123S

Mast Adjustment Lower Bearings
(A) Zero clearance. (B) Minimum clearance. (C) Zero clearance.
(3) Bearing. (4) Bearing. (5) Shims. (6) Shims.


IDCD039P

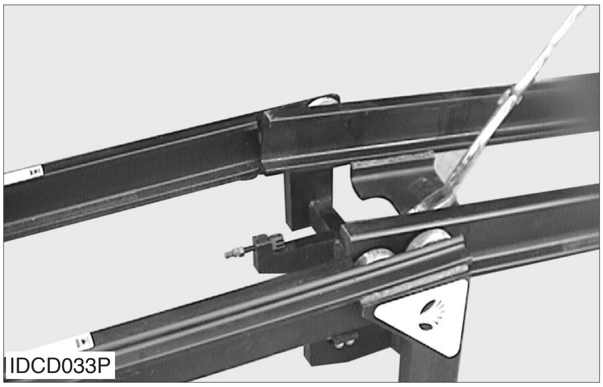
4. Make sure whether intermediate mast lower bearings are properly shimmed in the stationary mast by rolling up and down and moving intermediate mast to right and left. If clearance between both masts can be detected, pull out the intermediate mast from the stationary mast with crane and add shim 0.5 mm or 1 mm to both intermediate lower bearings.



IDCD039P

5. In case of standard and full free mast, inner lower bearings can be easily extruded by pulling down the inner mast from the bottom of stationary mast. If intermediate mast is stuck and do not move rolling up and down, there might be excessive shim. Pull out the intermediate mast from the stationary mast and remove shim 0.5 mm to both intermediate lower bearings. Repeat same procedure of aboves until properly shimmed. There is to be contact zero clearance (C) between intermediate lower bearings and stationary channel at approximately 475 mm (18.7 in) channel lap.

B. Upper Bearing Adjustment of Stationary Mast



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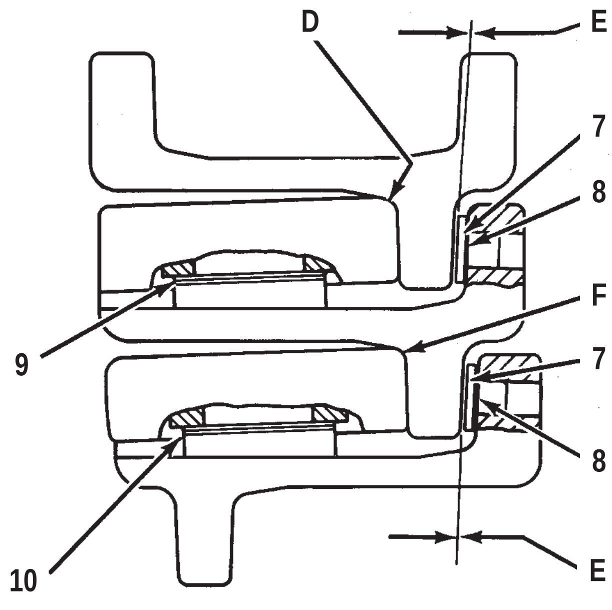
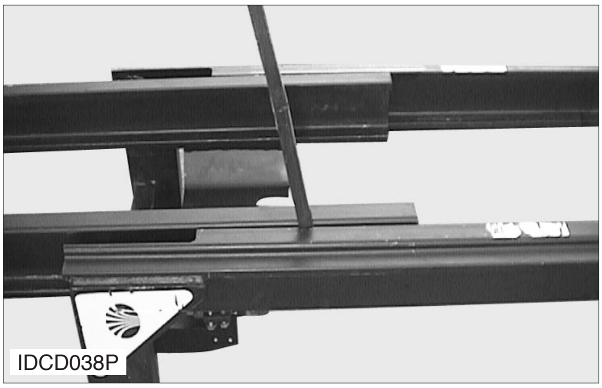
1. Lifting by crane, and pull out intermediate mast from stationary mast. Install 1 mm shim to each bearing of stationary mast upper basically. Bearing should be selected D581814 under size bearing.



IDCS124S

Mast Adjustment Upper Bearings
(D) Zero clearance. (E) 0.80 mm (.031 in) Clearance maximum. (F) Zero clearance. (7) Pads. (8) Shims. (9) Shims. (10) Shims.



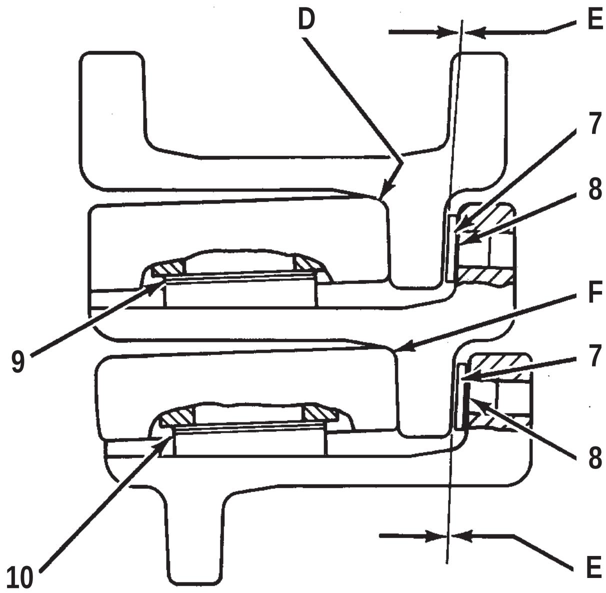
IDCD038P

2. Make sure whether stationary mast upper bearings are properly shimmed by rolling up and down and moving intermediate mast to right and left. If clearance between both masts can be detected, pull out the intermediate mast from the stationary mast with crane and add shim 0.5 mm or 1 mm to both stationary upper bearings.

IDCD014P

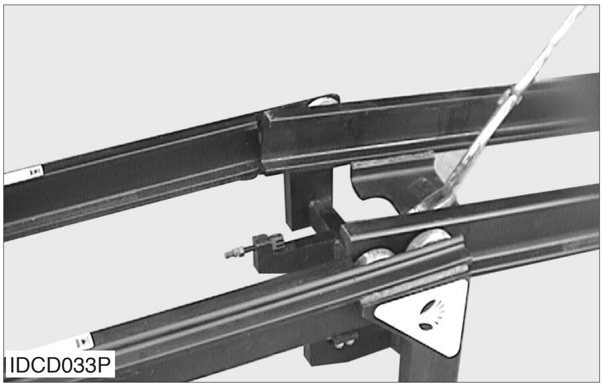
3. In case of standard and full free mast, stationary upper bearings can be easily extruded by pulling down the inner mast from the bottom of stationary mast. If intermediate mast is stuck and do not move rolling up and down, there might be excessive shim. Pull out the intermediate mast from the stationary mast and remove shim 0.5 mm to both stationary upper bearings. Repeat same procedure of aboves until properly shimmed. There is to be contact zero clearance (C) between stationary upper bearings and the widest point of intermediate mast to be checked before.

C. Upper Pad Adjustment



IDCS124S

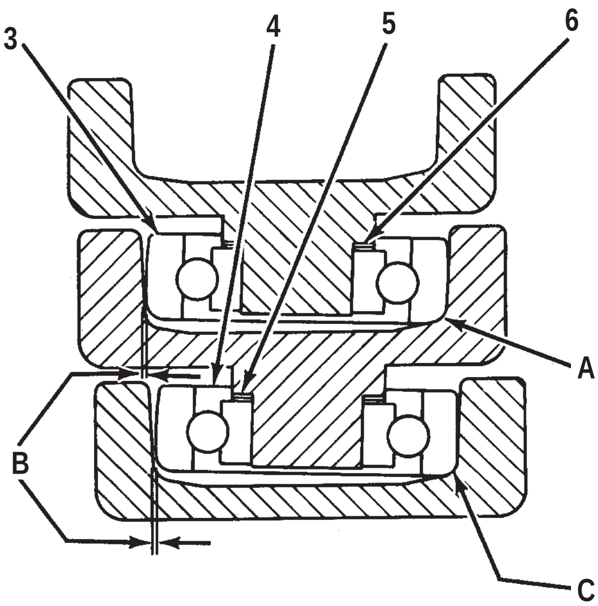
Mast Adjustment Upper Bearings
(D) Zero clearance. (E) 0.80 mm (.031 in) Clearance maximum. (F) Zero clearance. (7) Pads. (8) Shims. (9) Shims. (10) Shims.



IDCD033P

1. Install shims (8) behind each pad (7) until there is 0.80 mm (.031 in) maximum clearance (E) between the pads and the inner and intermediate masts with the masts at full extension. Lifting by crane, and pull out intermediate mast from stationary mast and insert the shims behind each pad. In case of standard and full free mast, the pads of stationary upper can be easily extruded by pulling down the inner mast from the bottom of stationary mast.

D. Lower Bearing Adjustment of Inner Mast



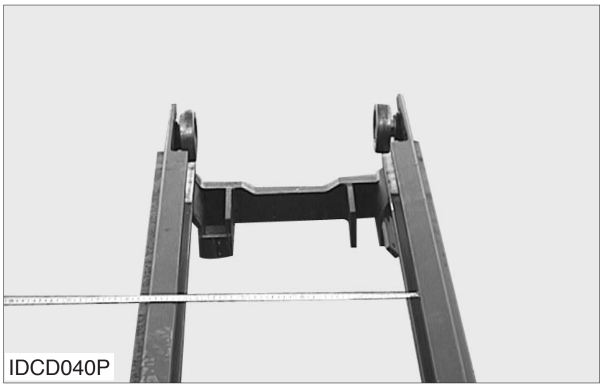
IDCS123S

Mast Adjustment Lower Bearings
(A) Zero clearance. (B) Minimum clearance. (C) Zero clearance.
(3) Bearing. (4) Bearing. (5) Shims. (6) Shims.

1. Select lower bearings (3) and (4) from the chart to obtain minimum clearance (B) between bearing and channel leg for full channel length. Use same bearing on left and right side.

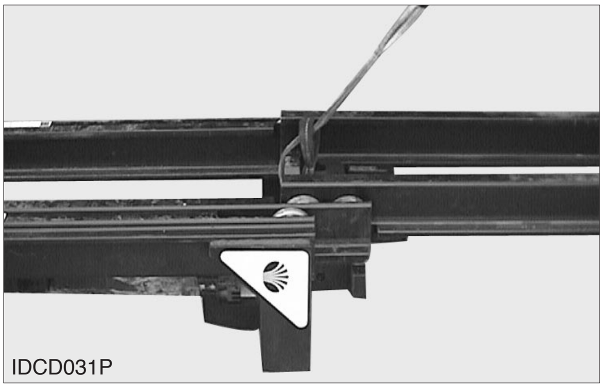
Mast And Carriage Bearings		
Part No.	Bearing Size	Bearing O.D.*
D581814	Under Size	108.6 mm (4.276 in)
D581815	Standard	109.6 mm (4.135 in)
D581816	Over Size	110.7 mm (4.358 in)

* Permissible tolerance ± 0.08mm (.003in)



IDCD040P

2. Find narrowest point by ruler on the intermediate mast in the area where the inner lower bearings make contact full length of intermediate mast excluding minimum channel lap 475 mm (18.7 in).



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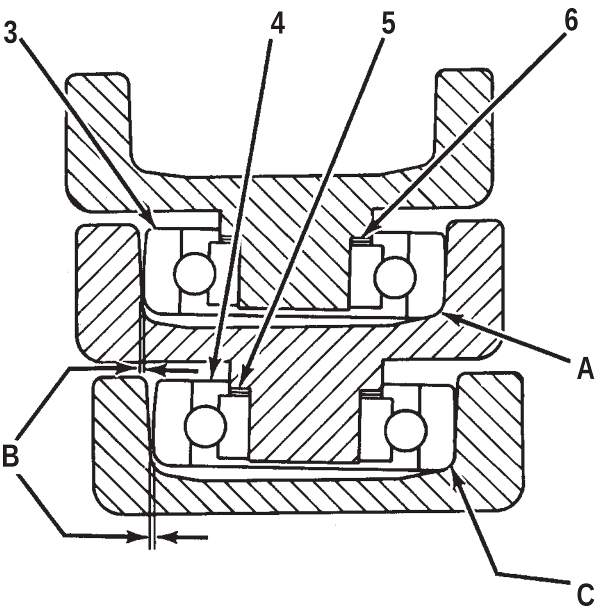
3. Install 1 mm shim to each bearing of inner lower and intermediate upper basically. Lifting by crane, insert inner mast into intermediate mast from the upper side.



IDCS123S

Mast Adjustment Lower Bearings
(A) Zero clearance. (B) Minimum clearance. (C) Zero clearance.
(3) Bearing. (4) Bearing. (5) Shims. (6) Shims.

4. Make sure whether inner mast lower bearings are properly shimmed in the intermediate mast by rolling up and down and moving inner mast to right and left. If clearance between both masts can be detected, pull down the inner mast from the bottom of intermediate mast. Inner lower bearings can be easily extruded. Add shim 0.5 mm or 1 mm to both inner lower bearings. If inner mast is stuck and do not move rolling up and down, there might be excessive shim. Pull out the inner mast from the intermediate mast and remove shim 0.5 mm to both inner lower bearings. Repeat same procedure of aboves until properly shimmed. There is to be contact zero clearance (C) between inner lower bearings and intermediate channel at narrowest point.

E. Upper Bearing Adjustment of intermediate Mast

Follow same procedure with above B.

F. Upper Pad Adjustment of Intermediate Mast

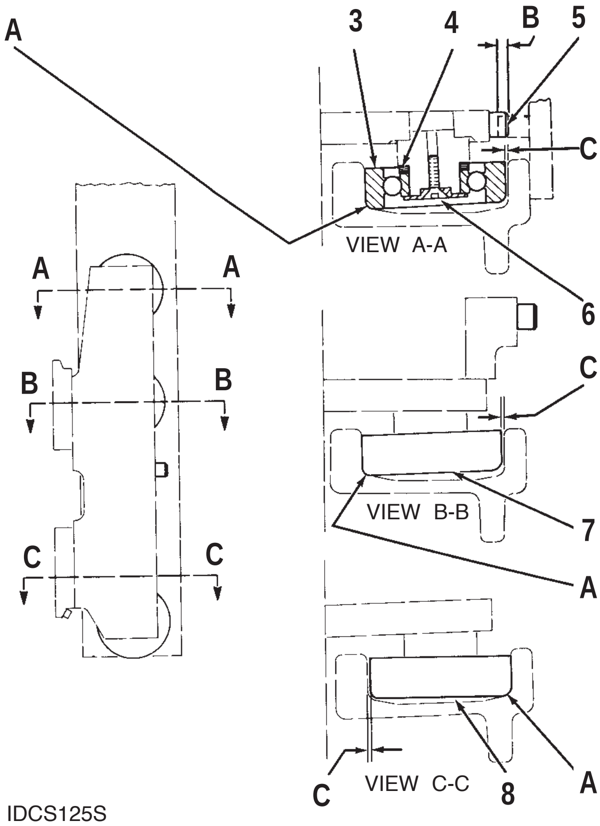
Follow same procedure with above C.

Carriage Adjustment

NOTE: The standard, Full Free Lift and Full Free Triple Lift carriage load bearings are all adjusted the same way. The Full Free Triple Lift carriage is shown in the following illustrations.

To make the carriage clearance adjustments, carriage must be removed from the mast.

Use the procedure that follows to adjust carriage load bearings.



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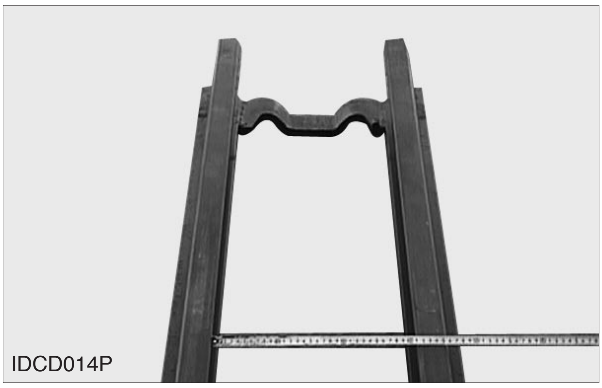
Carriage Adjustment
(3) Upper bearings. (4) Shims. (5) Bolt. (6) Screw.
(7) Middle bearings. (8) Lower bearings. (A) Zero clearance.
(B) 6.0 to 9.0 mm. (.236 to .354 in) clearance.
(C) Minimum clearance.

1. Select lower bearings from the chart to obtain minimum clearance (B) between bearings and channel leg for full channel length. Use same bearing in all six locations.

Mast And Carriage Bearings		
Part No.	Bearing Size	Bearing O.D.
D581814	Under Size	108.6 mm (4.276 in)
D581815	Standard	109.6 mm (4.135 in)
D581816	Over Size	110.7 mm (4.358 in)

* Permissible tolerance ±0.08mm (.003in)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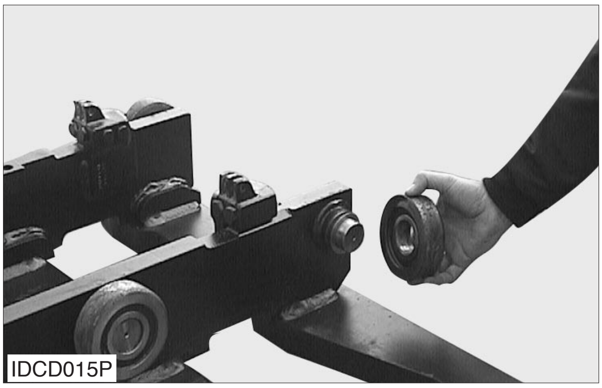
2. Find narrowest point by ruler on the inner mast in the area where the bearings make contact.

3. Install enough shims (4) that have been divided into two equal groups behind bearings (3). At installation, there is to be contact [zero clearance (A)] between the bearings and the narrowest point of inner mast.

4. Do step 2 through 3 for other sets of bearings.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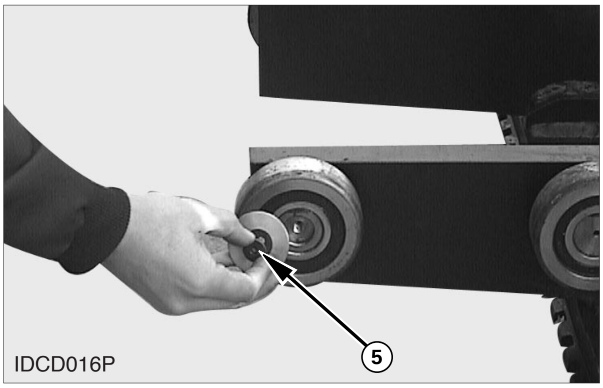

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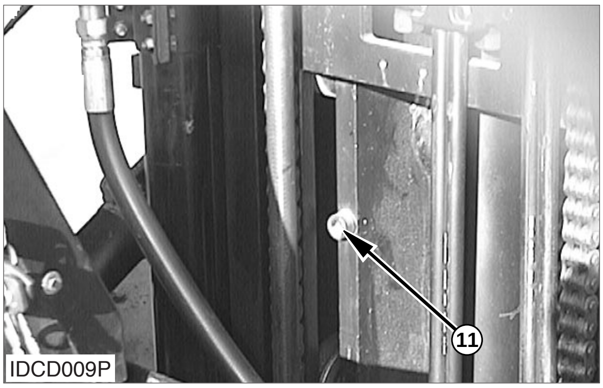
5. Tighten screw (5) that holds the top bearings to the carriage to a torque of 34±7 N•m (25±5 lb• ft)



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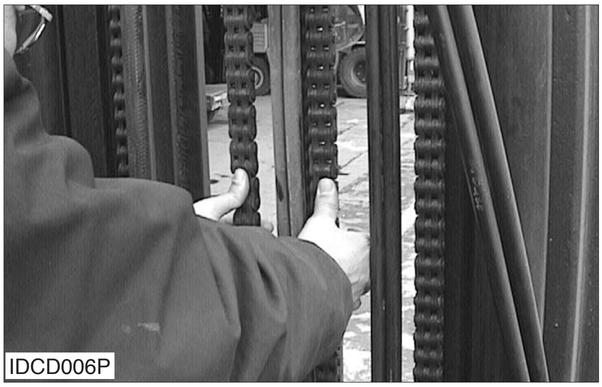
6. Shim stop bolt (11) as required to obtain a 6 to 9 mm (.24 to .35 in) lap with top carriage stop on the inner upright.

Chain Adjustments

Chain Adjustment Check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Chain Adjustment Check

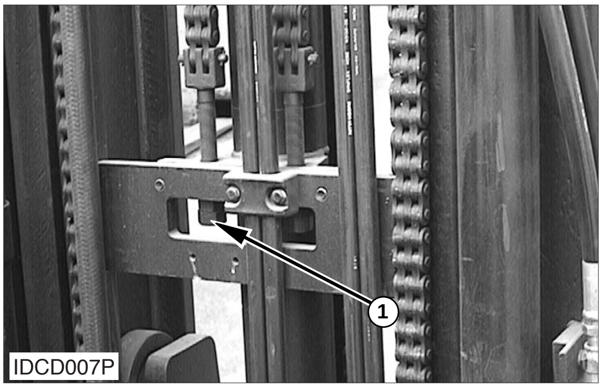
Lift the carriage and mast high enough to put their full weight on the carriage and mast chains. Check the chains, and make sure the tension is the same.

Chain Adjustment

If the tension is not the same on both chains, do the procedure that follows:

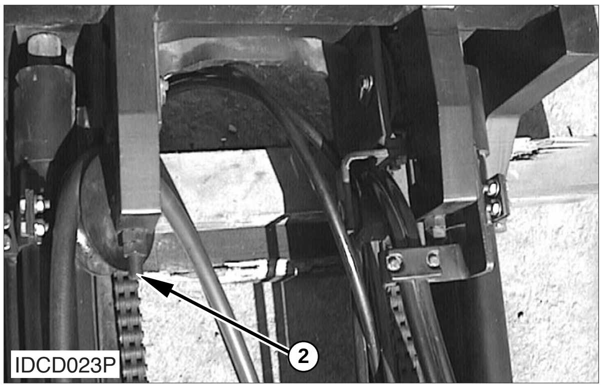
⚠ WARNING

Personal injury can be caused by sudden movement of the mast and carriage. Blocks must be used to prevent the mast and carriage from any movement while the adjustments are made. Keep hands and feet clear of any parts that can move.



Inner Lift Chains
(1) Chain anchor nuts.

1. Lift the mast and carriage and put blocks under the mast and carriage to release the tension from the lift chains.
2. Make adjustments to chain anchor nuts (1) for equal tension of the mast and carriage chains.
3. Put LOCTITE NO.242 Thread Lock on the threads of the locknuts after the adjustment is completed.



Outer Lift Chains
(2) Chain anchor bolts.

Chain Wear Test

Chain wear test is a measurement of wear of the chain links and pins. Do the steps that follow to check chain wear.

1. Lift the mast and carriage enough to put tension on the lift chains.
2. Measure precisely ten links of chain distance at the center of pins in millimeter.
3. Calculate chain wear rate.

   New one pitch = 19.05 mm

   Chain wear rate (%)

   $$= \frac{\text{Actual measurement - 190.5}}{190.5} \times 100$$

⚠ WARNING

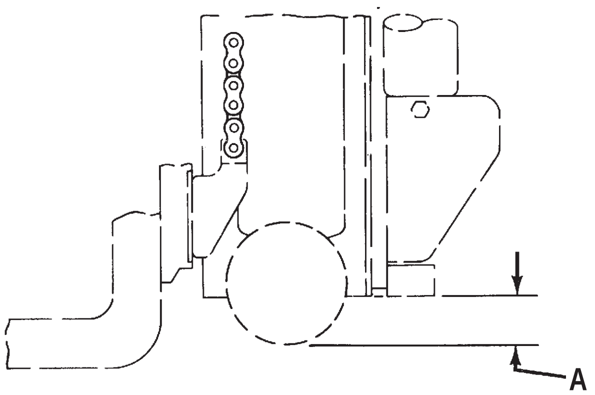
Do not put a lift truck into service if the chain wear indication is 2% or more. A reading of 2% or more could cause damage or injury to persons.

4. If the chain wear indication is 2% or more, replace the lift chain.

Carriage and Mast Height Adjustment

1. Move the mast either forward or backward so it is in the vertical position.

2. Lower the carriage completely.



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3. On Full Free Lift and Full Free Triple Lift models, the bottom of the inner mast must be even with the bottom of the stationary mast.

4. Measure the distance from the bottom of the inner upright to the bottom of carriage bearing.

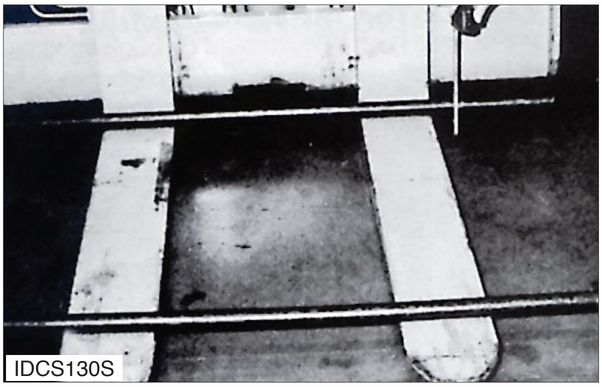
5. The measurement (A) must be as follows:
STD...Zero
FFL & FFTL ....41 ± 1.5 mm (1.61 ± .06 in)

NOTE: On Standard Lift models the bearing must be even (flush) with the inner mast.
If the above measurements are not correct, make adjustments to the chains to get the correct measurement. See Chain Adjustments in TESTING AND ADJUSTING.

Forks Parallel Check

1. Lift the mast and operate the tilt control lever, until the top surface of the forks is parallel with the floor. Place two straight bars, that are the same width as the carriage, across the forks as shown. Measure the distance from the bottom of each end of the two bars to the floor. The forks must be parallel within 3 mm (.12 in) for Full Tapered and Polished (FTP) forks, all other forks 6.4 mm (.25 in), for their complete length.

2. If not parallel put one fork, one third back from the tip, under a fixture that will not move. Then operate the tilt control with caution until the rear of the truck just lifts off of the floor. Follow the same procedure with the second fork, and then check the forks again as in Step 1.



Forks Parallel Check
(Typical Example)

Tilt Cylinder Alignment

If the tilt cylinders are out of alignment, extra stresses in the mast assembly and the mast hinge area will result. To prevent damage, the tilt cylinders must stop evenly at the end of the tilt back and tilt forward strokes.

Tilt Angle Check

Tilt Angle Check (Typical Example)

The tilt angle of the mast must be checked in the full tilt back and full tilt forward positions. A tilt indicator or a protractor can be used to measure the angle. Both sides of the mast must be checked to make sure that the mast is not twisted.

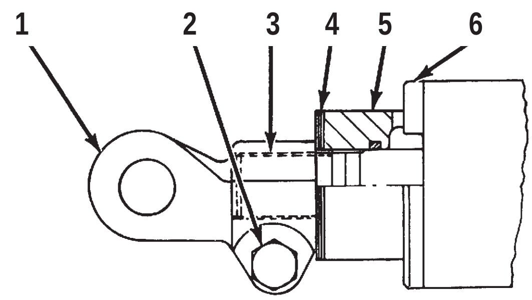
The tilt angle is determined by the tilt cylinders used. See tilt cylinders in specifications to determine the tilt angle from the cylinder being used.

Tilt Cylinder Length Check

Tilt Cylinder Length Check

1. Tilt the mast to full forward position. Measure the extended length of the cylinder rods from the cylinder housing to the mast. The difference of length between the two cylinder rods must be within 3.18 mm (.125 in) of each other.

Tilt Cylinders With Tilt Back Limiting Group



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Tilt Cylinder Adjustment
(1) Pivot eye. (2) Bolt. (3) Rod. (4) Shims. (5) Spacer.
(6) Head.

1. With the mast at full forward tilt, loosen bolt (2).

2. Slide spacer (5) back so rod (3) can be turned into or out of pivot eye (1) to obtain the correct length or angle.

⚠ WARNING

Tilt cylinder pivot eyes can loosen if the torque on the pivot eye clamping bolt is not tight enough. This will let the tilt cylinder rod turn in the tilt cylinder eye. The cylinder rod may then twist our of the pivot eye and the tilt cylinder will be out of alignment or may let the mast fall and cause personal injury or damage. When the rod lengths are made even, the tilt angle differences or the mast alignment will no longer be a problem.

---

3. Tighten bolt (2) and the nut to a torque of 95 ± 15 N•m (70 ± 10 lb•ft).

4. With mast at full back tilt, install shims (4) as required to permit no gap between spacer (5) and head (6). Shim so mast does not twist at full tilt back.

Drift Test

Drift is movement of the mast or carriage that is the result of hydraulic leakage in the cylinders or control valve. Before testing the drift:

⚠ WARNING

Personal injury can be caused by sudden movement of the mast or carriage. Use wood blocks and clamps to hold the mast in this position. Keep hands and feet clear of any parts that can move.

---

1. Check the chain adjustment and tilt cylinder alignment and make necessary adjustments.

2. Lift the mast approximately 762 mm (30 in). Use wood blocks and clamps to hold the mast in this position.

3. Check the mast hinge bolts to make sure they are tight.

4. Remove the blocks and clamps and lower the mast.

Drift Test For Lift System

1. Put a rated capacity load on the forks of the lift truck. Operate the lift truck through a complete lift and tilt cycle until the oil is at normal temperature of operation, 45 to 55°C.

2. Put the mast in a vertical position.
Raise a rated capacity load to a sufficient height to test the lift cylinders.

3. Measure any drift of the carriage for a ten minute period. Drift for all models shall not exceed 100.0 mm (4.00 in).

Drift Test For The Tilt System

1. Put a rated capacity load on the forks on the lift truck. Operate the lift truck through a complete lift and tilt cycle until the oil is at normal temperature for operation, 45 to 55℃.

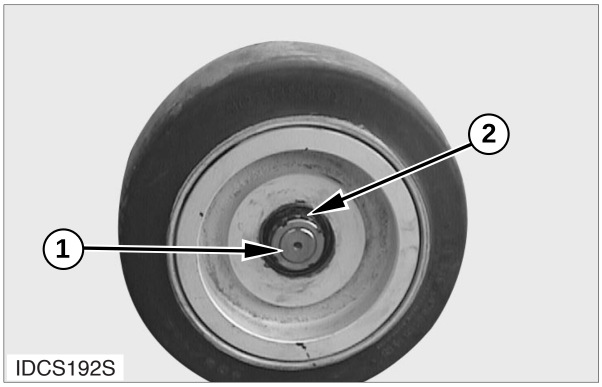
2. Put the mast in a vertical position. Raise a rated capacity load to a height of 2.5 meters (8.2 ft). In the case of trucks with less than 2.5 meters (8.2 ft) height extension, raise the load to the truck's maximum height.

Tilt Drift Check.

3. The tilt drift is measured as the charge in the tilt cylinder stroke. Measure any drift of the mast for ten minute period.
Drift for shall not exceed 35.5 mm (1.40 in).

Steering System

Steer Wheel Bearing Adjustment



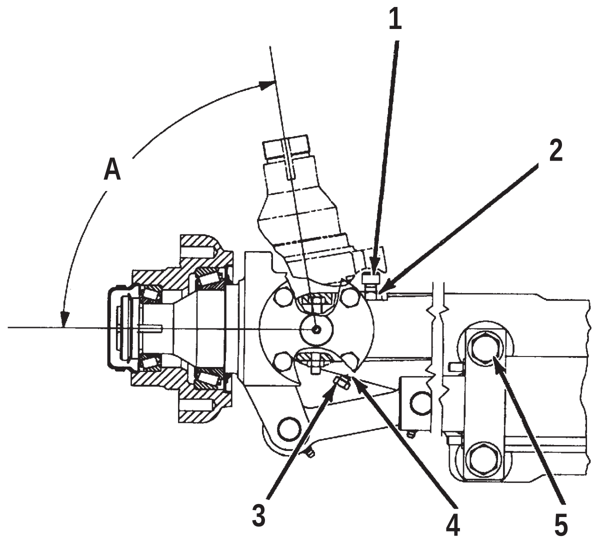
Bearing Adjustment
(1) Nut. (2) Lock

1. Tighten nut (1) slowly to 135 N•m (100 lb•ft) while the wheels is rotated in both directions put the bearings into position.

2. Loosen nut (1) completely. Tighten nut (1) again to 50 ± 5 N•m (37 ± 4 lb•ft) .

3. Bend lock (2) over nut (1) to hold the nut in position.

Steering Axle Stop Adjustment



IDCS132S

Steer Angle
(1) Bolt. (2) Nut. (3) Bolt. (4) Nut. (5) Bolts. (A) 80° angle

Use the procedure that follows to make an adjustment to the steer axle turning angle.

1. Adjust the cylinder rod extension so it is equal on both sides of the axle.

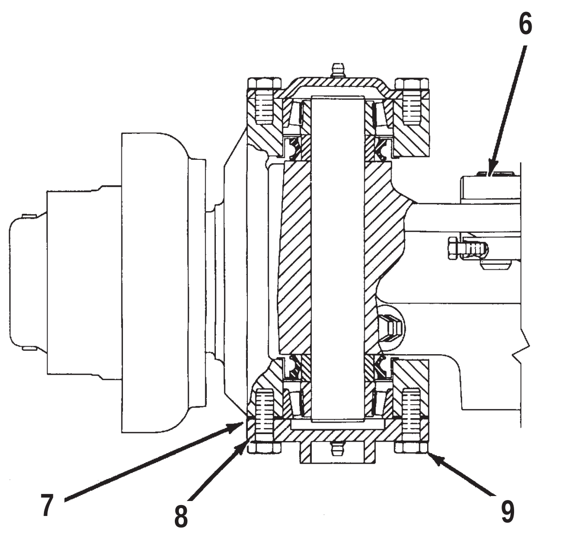
2. Loosen nuts (2) and (4) on both sides of the steer axle.

3. Turn the steer wheel one direction until the steer cylinder rod extension measures 94mm(3.7 in) for B Models and 80mm(3.2in) for BC Models more than the straight ahead measurement.

4. Adjust stop bolt (1) on one side and stop bolt (3) on the other.

5. Tighten nut (2) on one side and nut (4) on the other side. Turn the steer wheel the opposite direction and do the same procedure for the opposite stop bolts. This will give a maximum cramp angle of 80°.

Steering Knuckle Bearing Preload Adjustment



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Steering Knuckle Bearing Preload Adjustment
(6) Steering link. (7) Shims. (8) Cover. (9) Bolts.

1. During assembly of the steering knuckle, install the upper bearing cup, cone and seal.

2. Install lower bearing group cover (8) without shims. Tighten two opposed cover bolts (9) to a torque of 5.6 N•m (50 lb•in) .

3. Measure the clearance between cover (8) and the axle beam at each bolt with a feeler gauge.

4. Take an average of the measurements found in Step 3. Select shims (7) equal in thickness to the average clearance.

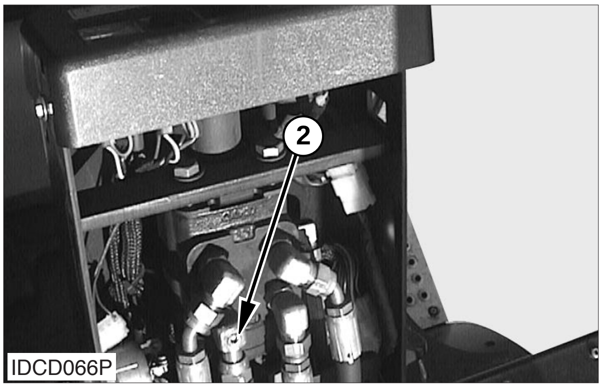
5. Remove the bearing group and install shims (7), cover (8) and bolts (9). Tighten bolts (9) to a torque of 55 ± 6 N•m (40 ± 5 lb•ft) .

6. With steering links (6) disconnected from the steering cylinder, check knuckle for 4.5 to 6.8 N•m(40 to 60 lb•in) of rolling torque. Add or remove shims from cover (8) to obtain the proper rolling torque.

7. Connect links (6) to the steering cylinder. Tighten cylinder mounting bolts (5) to a torque of 460 ± 60 N•m (340 ± 40 lb•ft) .

Steering System Pressure Check

If the steering system does not work correctly, check the hydraulic tank for the correct oil level and the hoses and connections for leakage. If all these items are correct, use the Pressure Gauge Kit to check the steering hydraulic system and its relief pressure setting.



Hydraulic Steering Gear
(2) Pressure line (from priority valve).

⚠ WARNING

Hydraulic pressure can cause personal injury. Before any steering system hydraulic lines or components are disconnected, make sure all hydraulic pressure is released in the steering system. Move the steer wheels to the left and right and then to the straight forward direction.

Check steering system relief pressure as follows:

1. Turn the motor off.

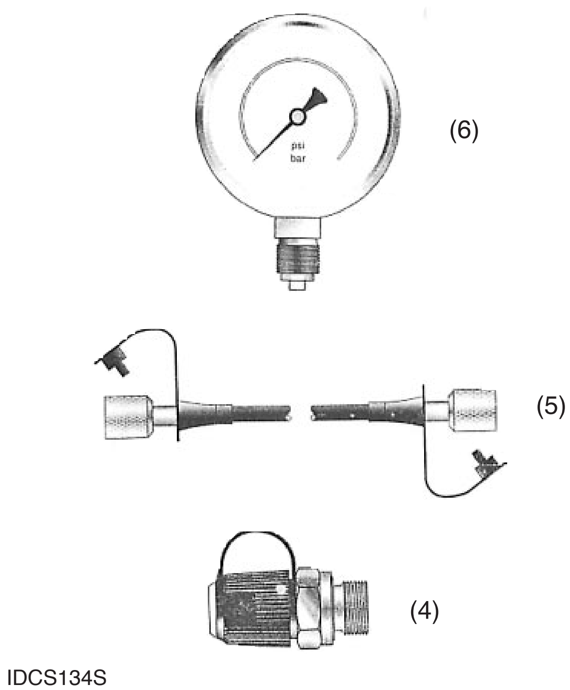
2. Remove plug from elbow(1)
Install pressure-checking adapter(4) and connect pressure-tube (5) and pressure gage (6). Pressure gage(6) has a range of 2800 kpa (4000psi).

3. Move the seat to the normal position for operation, turn the key switch to the ON position and activate the hydraulic controls until the oil is at a temperature for normal operation.

4. Turn the steer wheels to the left or right against the stops and make a note of the indication on the pressure gauge.

5. The indication on the pressure gauge must be the priority valve relief setting of 8000 ± 350 kPa (1160 ± 50 psi). If the indication is correct and a problem exists, then there is possibly a mechanical failure in the steering system.

6. If the indication is not correct, then there is steering hydraulic failure in the components.



(4) Pressure-checking adapter (5) Pressure-tube
(6) Pressure gauge

NOTICE

Do not let Valve be closed for more than 3 or 4 seconds or damage can be caused to the steering system components.

a. With the motor running, turn the steer wheels in any directions and read the indication on pressure gauge (6).

b. If the indication is approximately the pressure shown in Step 5, then the steering gear has a hydraulic failure.

c. If the indication is too low or too high, then the priority valve or its components must be replaced.

7. If the steering gear and the priority valve are working properly, the steering cylinder is defective and must be repaired.

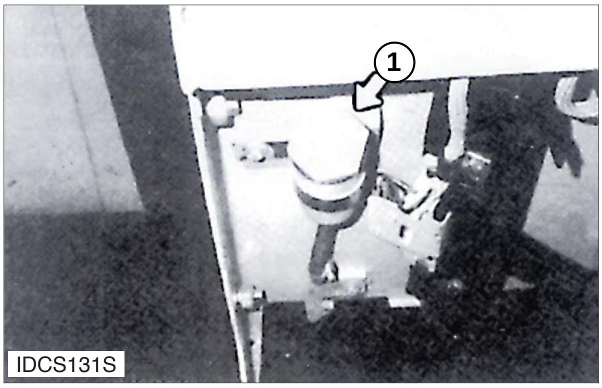
8. Correct the problem and check steering relief valve pressure again.

Brake System

Brake System Air Removal

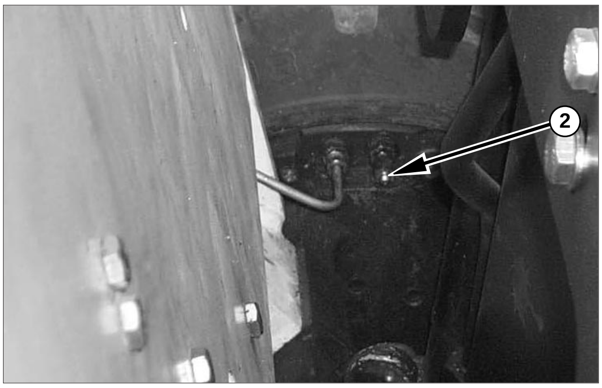
When the brake pedal resistance is spongy (not solid) it is usually an indication that there is air in the brake hydraulic system. The cause may be low fluid or oil level, leakage in the system, a broken brake line or a brake line that is not connected.

To remove air from the brake system, do the procedure that follows.



Reservoir Location
(1) Reservoir.

1. Fill reservoir (1) with the correct fluid to 12.7mm (.50 in) from the filler cap. See the Operation And Maintenance Manual for the correct brake fluid.



Bleed Screw Location
(Standard Lift Truck)
(2) Bleed screw

2. Put pressure on the brake pedal and open bleed screw (2) to let air out of the system. Close bleed screw (2), while pressure is still on the brake pedal, then let the pedal return to the original position.

3. Do step 2 again as many times as necessary until the brake fluid is free of air.

4. (If equipped): Use the procedure in Steps 2 and 3 again, except this time use the other bleed screw(not shown).

5. Fill the reservoir again, with the correct fluid, to the level explained in Step 1.

Brake Adjustment

Drum Type Brakes

The brakes make an adjustment automatically when an application is made in forward and reverse. With each application, there will be an adjustment made until the lining-to-drum clearance is made small enough to stop the movement of automatic adjuster (7).

Manual brake adjustment is necessary only when new brake shoes are installed and the automatic adjustment has been moved.

NOTE: During manual brake adjustment, do not loosen bolt (4). Likewise, do not change the position of adjuster (7). If the position of adjuster (7) is changed, then it will have to be centered on the housing.

To make a manual adjustment to the brakes, do the procedure that follows:

⚠ WARNING

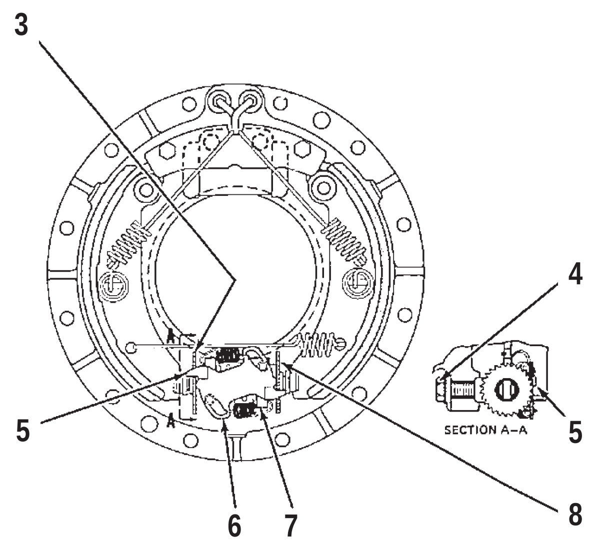
Wood blocks or jack stands of the correct capacity must be used under the machine to prevent the machine from a fall that is not expected. Failure to do so can result in injury or death.

1. Put blocks or jack stands of the correct capacity under the machine.

Brake Adjustment
(1) Hole. (2) Wheel.

2. Turn wheel (2) or brake drum until the hole (1) is in alignment with star wheel (3) of the brakes.

3. Put brake adjustment tool through the hole and into a tooth of star wheel (3).



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Wheel Brakes
(3) Star wheel. (4) Bolt. (5) Tongue. (6) Plate. (7) Adjuster.
(8) Star wheel.

4. Turn star wheel (3) until a heavy resistance (drag) is felt when the wheel is turned.

5. Put a thin blade screwdriver into the hole and hold tongue (5) of plate (6) away from star wheel (3).

NOTE: Tongue (5) must be held away from star wheel (3) as the adjustment wheel is turned backward.

6. Put the brake tool through the hole, into a tooth on star wheel (3) and turn wheel (3) backward until there is no resistance (drag) on the wheel.

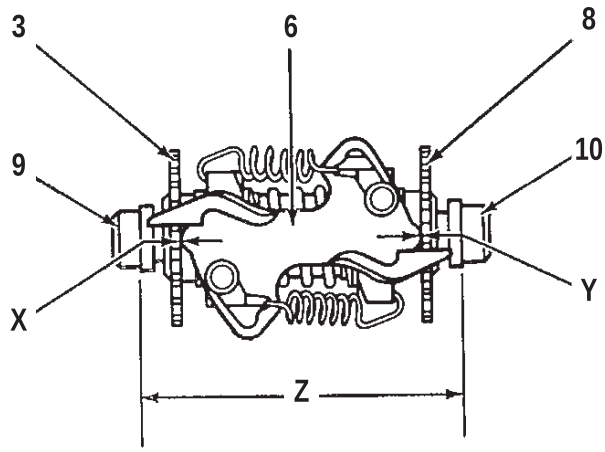
7. Turn wheel (2) until the hole is in alignment with star wheel (8) of the brakes.

8. Do Steps 3 through 7 to adjust the other brake lining-to-drum clearance.

9. Test the brakes to be sure both wheels stop evenly when a brake application is made.

Brake Adjuster Installation

If the adjuster was removed to replace the housing or adjuster, do the procedure that follows to center the adjuster correctly.



IDCS139S

Brake Adjuster
(3) star wheel. (6) Plate (8) Star wheel. (9) Screw. (10) Screw.
(X) Distance 1.05 mm (.041 in).
(Y) Distance 1.05 mm (.041 in). (Z) Distance 85 mm (3.35 in)

1. Check distance (X) and (Y) from the inside edge of star wheels (3) and (8) to the rounded edge of plate (6). Distance (X) or (Y) is 1.05 mm (.041 in) maximum. Distance (X) + (Y) must be 1.0 to 1.6 mm (.039 to .063 in)

NOTE: Distances (X) and (Y) are adjustable with shims behind the star wheels and should have to be adjusted only if the adjuster is disassembled.

2. Next, check distance (Z) between the slots of screws (9) and (10). Distance (Z) must be 85 mm (3.35 in). Adjust screws (9) and (10) evenly to get the correct distance and make sure the distance between each screw and its star wheel is the same.

3. Put the adjuster in position on the housing. Do not tighten bolt (4) yet.

4. Install the wheel on drum. After installed, tighten bolt (4) to a torque of 72 ± 5 N•m (55 ± 4 lb•ft) and do the manual brake adjustment.

Pedal Adjustment

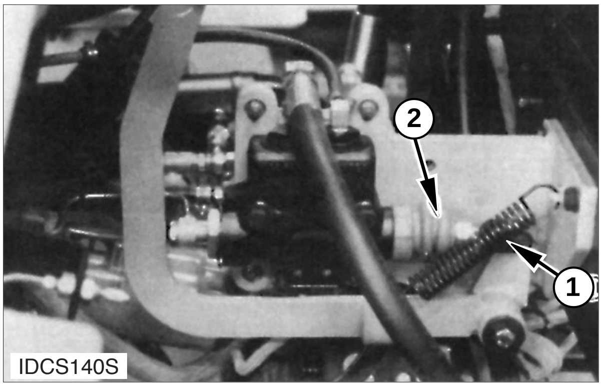
The brake pedal must have enough free play to let the master cylinder piston return to the release position and open the relief outlet.

Hydraulic pressure in the brake lines goes back through the relief opening and releases the brakes. If there is no pedal free play, the pressure can not go back through the relief opening, and the brakes will tighten and not release.

If there is too much free play, the brake pedal will be low even with the correct brake adjustment.

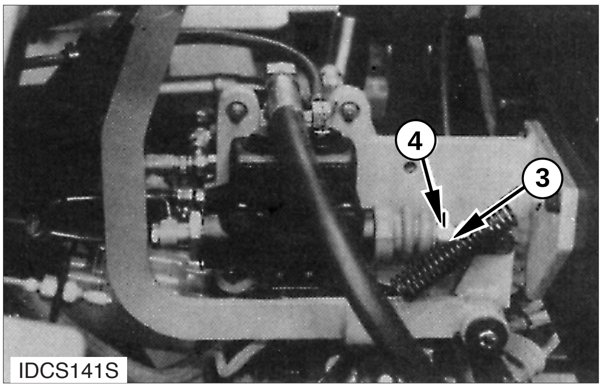
The master cylinder push rod must be adjusted so the brake pedal has 3.0 to 8.0 mm (.118 to .315 in) of free play from the pedal stop to the push rod contact point with the master cylinder piston.

If the pedal free play adjustment is not correct, do the procedure that follows:



Location of Master Cylinder
(1) Pin. (2) Boot.

NOTE: On some trucks the rubber boot may have to be moved to expose the adjustment nuts.



Brake Pedal Adjustment
(3) Jamnut. (4) Nut.

1. Loosen jamnut (3).

2. Adjust nut (4) until there is the correct amount of free play.

3. Hold nut (4) and tighten jamnut (3).

Parking Brake Test

1. Drive the lift truck with a rated load up a 15% incline.

⚠ WARNING

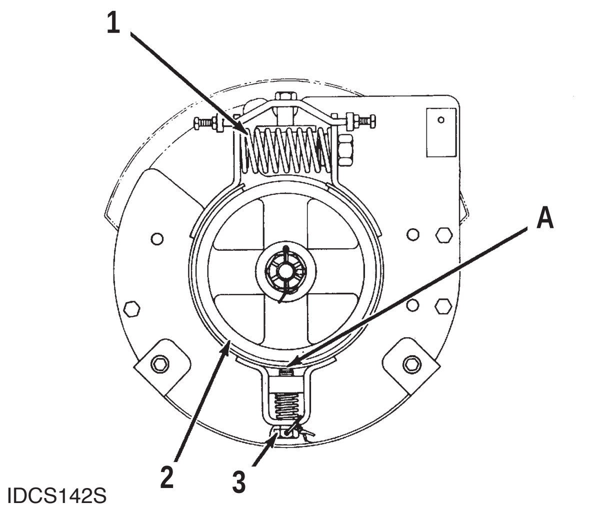
To prevent personal injury, the operator must be ready to use the service brake if the parking brake is not adjusted correctly and the lift truck starts to move.

2. Half way up the incline, stop the lift truck with the service brakes. Make an application of the parking brake.

3. If the parking brake has the correct adjustment, the lift truck will be held in this position.

4. If the parking brake does not hold, do the steps in Parking Brake Adjustment.

Parking Brake Adjustment



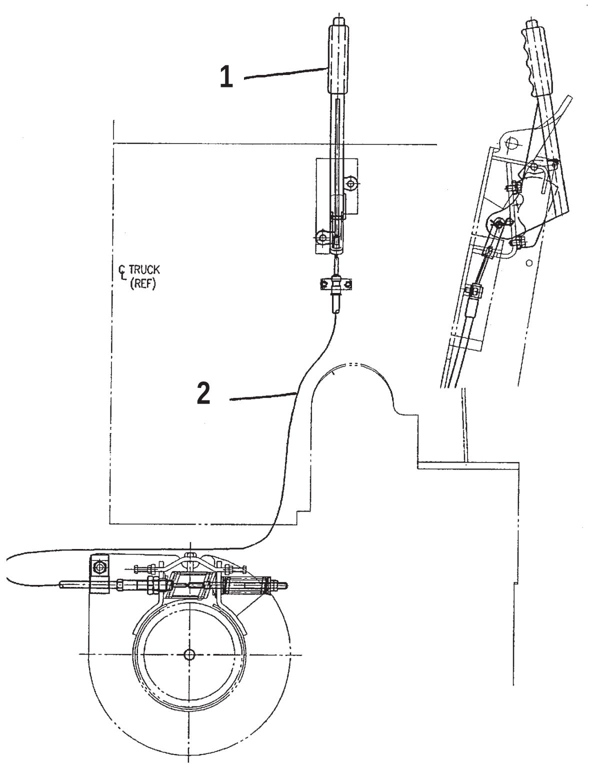
parking Brake
(1) Strap assembly. (2) Brake drum. (3) Adjuster.

1. Put the parking brake in the OFF position.

2. Measure clearance between brake drum (2) and strap assembly (1) at “A”. Set clearance “A” to 0.25 to 0.50 mm (.010 to .020 in) using adjuster (3).

3. Use wire to lock adjuster in position.
Parking Brake Control Group Adjustment.

Parking Brake Control Group Adjustment



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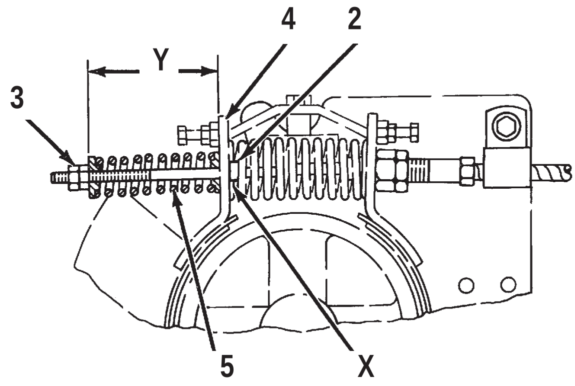
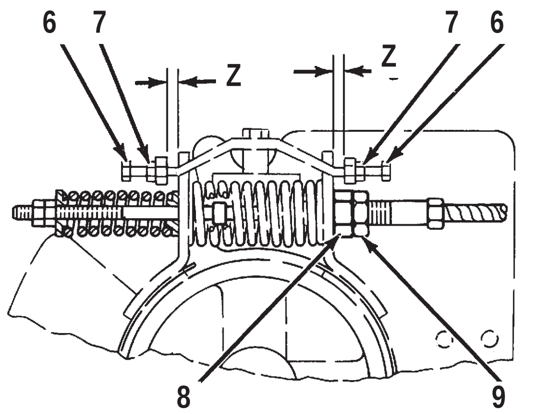
Parking Brake Control Group
(1) Brake lever. (2) Cable assembly.



IDCS144S

Parking Brake Off
(2) Cable assembly. (3) Jamb nut. (4) Brake strap assembly.
(5) Spring. (Y) 70 ± 0.5 mm (2.76 ± 0.2 in).

1. Put the brake lever (1) in the fully raised OFF position. Seat the shoulder of cable assembly (2) against brake strap assembly (4) at "X". Adjust overtravel spring (5) length (Y) to 70.0 ± 0.5 mm (2.76 ± 0.2 in). Tighten jamb nut (3).



IDCS145S

Parking Brake On
(6) Bolt. (7) Nut. (8) Retaining nut. (9) Jamb nut.
(Z) 6 mm(.24 in) maximum.

2. Apply parking brake. Adjust stop bolts (6) to dimension (Z) of 6 mm (.24 in) maximum. Tighten jamb nut (7).

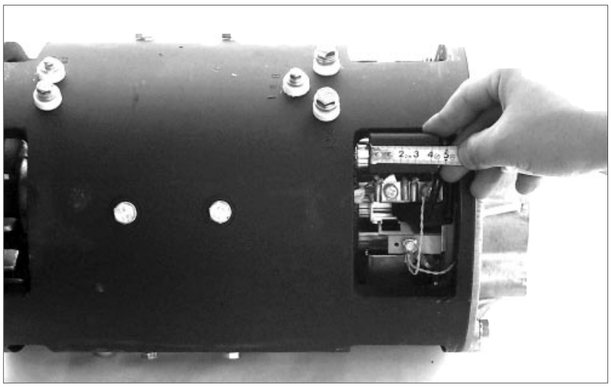
3. Release parking brake. Adjust cable assembly retaining nut (8) so that parking brake pedal (1) returns to full off position and brake strap assembly contacts stop bolt. Tighten jamb nut (9).

Hydraulic Pump Motor

Motor Brushes

Brush Inspection

1. Measure the brush material on the longest side.



Brush Measurement

2. Brush measurement:
If the brush material is less than 19 mm (.75 in) on the longest side, replace the brushes.

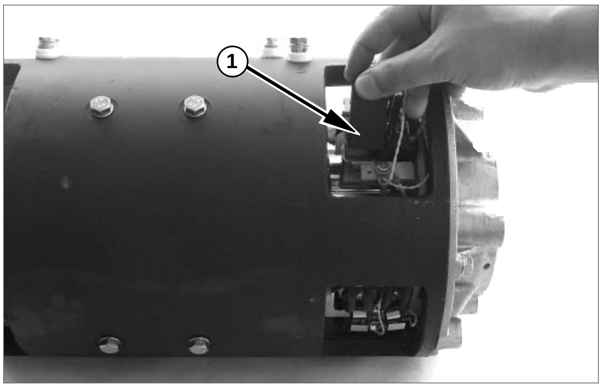
New Brush Installation

NOTE: Installation of new brushes is a two person operation.

1. Disconnect the batteries and remove them from the lift truck. Put the batteries close enough to the truck that the battery connector can be plugged in.

2. Discharge the head capacitor

3. Remove the commutator cover. Remove the old brushes.



Install Brushes
(1) Brushes.

NOTICE

Installation of the wrong brushes can cause early motor failure. Always make sure the correct DAEWOO brushes are installed.

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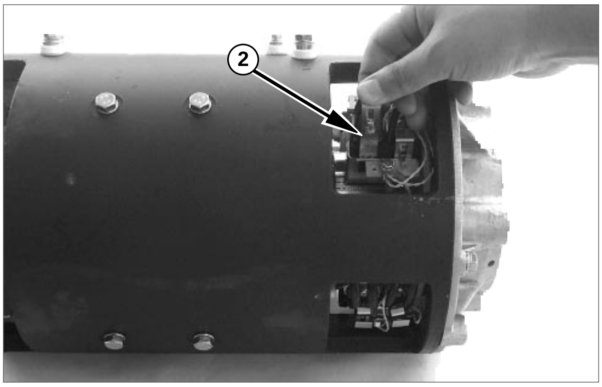
4. Install new brushes (1). Make sure the brushes move freely in the brush holders. Use a piece of plain bond paper to remove brush material if there is a restriction of brush movement.



Install
(2) Spring.

5. Install brush springs (2) and make sure they fasten into the brush holder box.

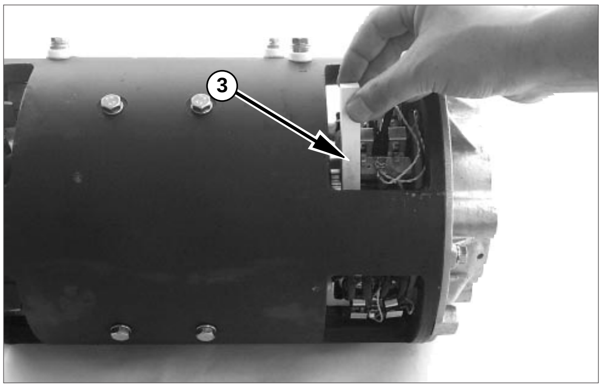
6. Lift the spring into position on the top of the brush.

7. Pull up on the two wires of each brush until the contact end of the brush moves away from the commutator. Release the wires to see if the brush moves smoothly back into contact with the commutator. If it is too difficult to pull out, or it does not move smoothly in the brush holder box, remove the spring and brush. Make an inspection to find and correct the cause of the problem.

8. Connect the batteries to the battery connector.

⚠ WARNING

Wear eye protection when seating, polishing or cleaning the motor with air pressure. During the seating and polishing procedure, keep fingers away from components in rotation. For prevention of injury to finger, do not use a commutator cleaner or seater stone that is shorter than 63.5 mm (2.50 in).



Brush Seating
(3) Brush seater stone.

9. Put ZLX0036 Brush seater Stone (3) on the commutator and operate the motor at a slow speed.

NOTICE
Do not let stone (3) stay in contact with the commutator bar too long a time. This causes more wear than is necessary to the brushes and the commutator.

10. Move stone (3) across the commutator at the back edge of the brushes for a short time. This will take the shiny finish off the commutator and seat the new brushes.

11. Turn the key switch to the OFF position and disconnect the batteries. Check the contact surface of each brush. At least 85% of the brush contact surface of each brush most show wear. If necessary, do Steps 9 through 12 again until the correct wear can be seen on the brush contact surface.

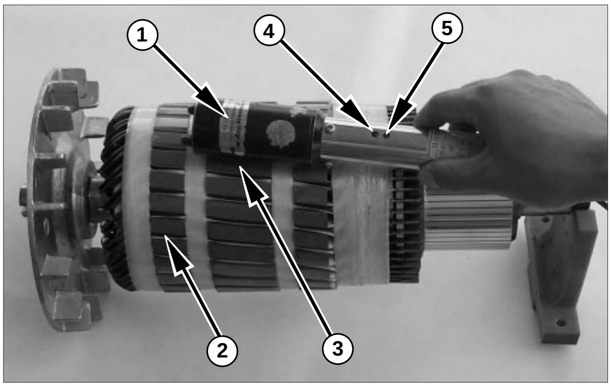
NOTICE
Never use air pressure that is more than 205 kPa (30 psi). Make sure the line is equipped with a water filter.

12. After the brushes have correct seat contact surface, operate the motor at slow speed. Use compressed (pressure) air to remove all dust and abrasive grit.

Armature Tests

Tools Needed	
Digital Multimeter Or Equivalent	1
Growler Tester	1

Short Circuit Test



Short Circuit Test
(1) Growler. (2) Armature. (3) Hacksaw blade. (4) Green light. (5) Red light.

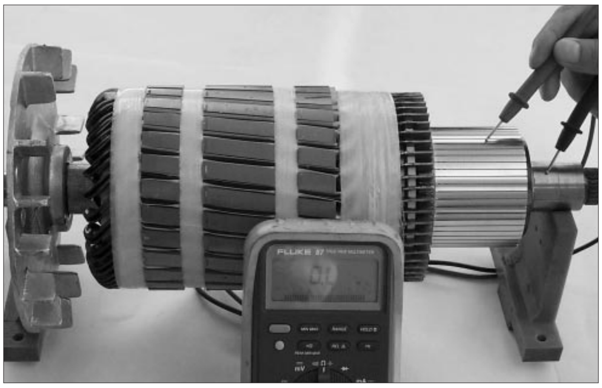
1. Turn the growler(1) on.

2. Slowly turn the growler on the armature (2) while a hacksaw blade (3) is held over the windings.

3. If the windings are shorted, the green light (4) will be on. The red light (5) will be on if the windings do not have a short.

The odor of burned insulation from the pump motor while it is in operation is an indication of a short in the armature.

Ground Test



Ground Test

1. Digital multimeter can also be used to test for grounds. Put the Function/Range Switch on the 2M resistance (Ω) scale. When the test leads are put on the commutator and the shaft, the meter must give an indication of overload (OL). This means that the resistance is more than 2 megohms.

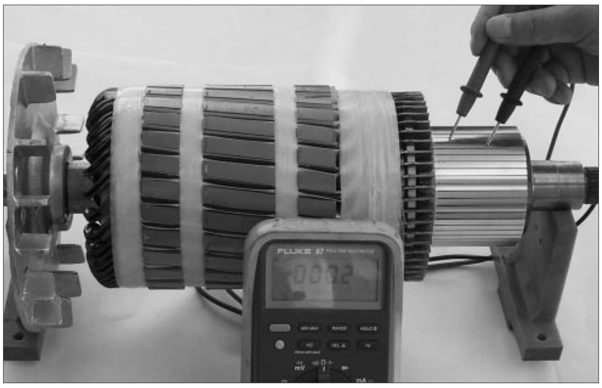
NOTICE

Never use air pressure that is more than 205 kPa (30 psi). Make sure the air line has a water filter.

If there is an indication of a ground in the above test, remove any dirt or debris from the armature with compressed (pressure) air.

Do the ground test again. If there is still an indication of a ground, replace the armature.

Open Circuit Test



Open Circuit Test

1. Put the digital muitimeter Function/Range Switch on the 200 ohm resistance (Ω) scale.

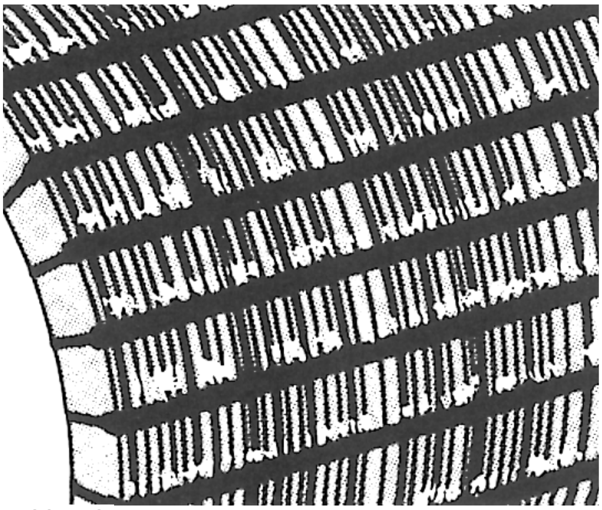
2. Put one test lead on one commutator bar. Put the other test lead on an adjacent (next to) bar and there must be less than one ohm resistance.

This test can also be done with an instrument, such as a Kelvin Double Bridge, that can make a measurement of very low resistance. Do the test the same as above and make a comparison of the resistance measurements.

Two burned areas on opposite sides of the commutator are indications of an open armature winding. These burned areas can cause very rapid brush wear.

Commutator Inspection

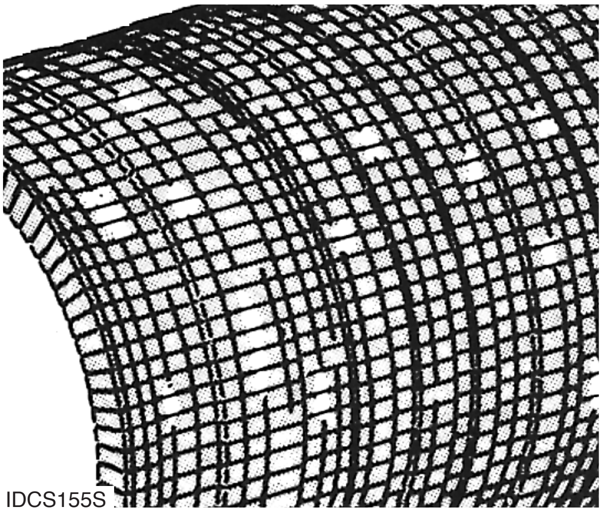
Surfaces of Commutators that need Replacement



IDCS154S

Marks on the Commutator Surface

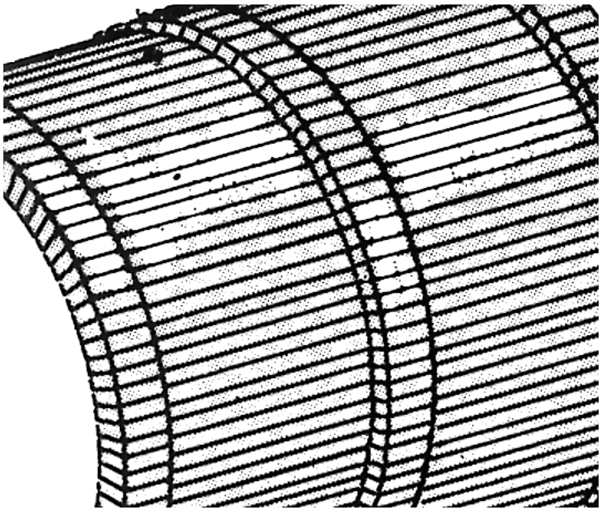
Marks on the commutator surface are an indication that metal has moved from the commutator surface to the carbon brushes. Marks will cause fast brush wear.



IDCS155S

Threads on the commutator Surface

Threads (grooves that look like threads) on the commutator surface, will also cause fast brush wear.



IDCS156S

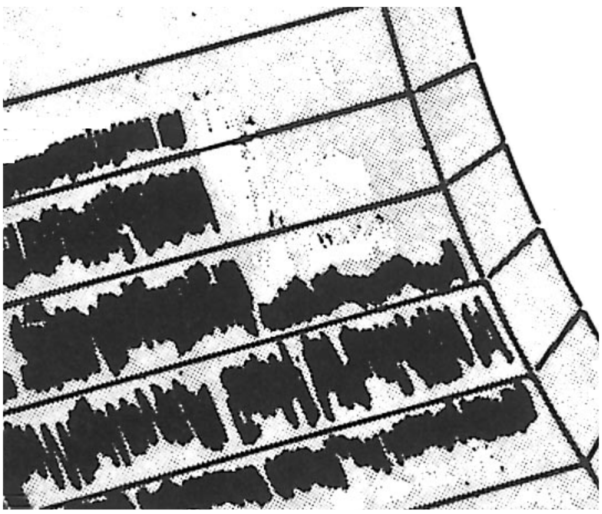
Grooves on the Commutator Surface

Grooves on the commutators surface are caused by a cutting material in the brush or atmosphere.

IDCS157S

Copper Drag on the Commutator Surface

Copper drag is an extra amount of commutator material at the back edge of the commutator bars.



IDCS158S

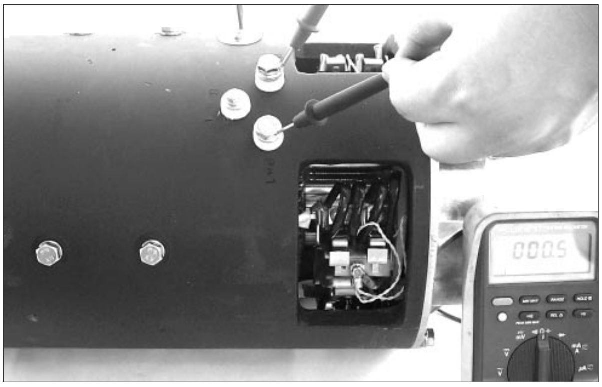
Pitch Bar-Marks on the Commutator Surface

Pitch bar-marks cause low or burnt marks on the commutator surface.

Field Coil and Terminal Tests

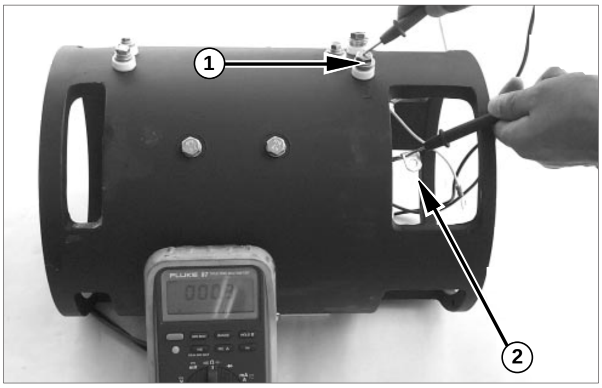
Tools Needed	
Digital Multimeter Or Equivalent	1

Open Circuit Test



Open Circuit Test

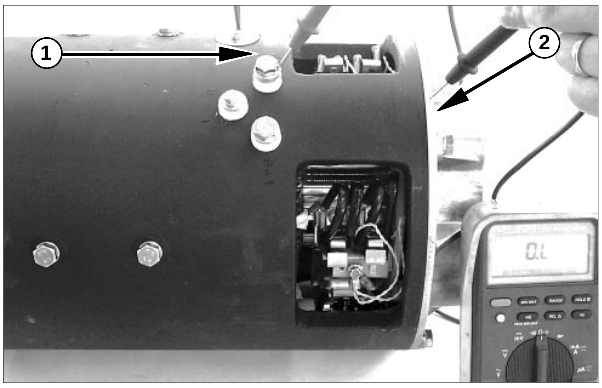
1. Put the digital multimeter Function/Range Switch on the 200 ohm resistance (Ω) scale.
2. Put one test lead to each outer field terminal (P1,P2).
3. The resistance must be less than one ohm. If the resistance is too high, it is an indication of corrosion on the terminals or an open field coil.



Brush Test
(1) Field terminal. (2) Brush leads.

4. Put one test lead to one of outer field terminals (1). Put the other test lead to each of brush leads (2) that connect to the brush holders. There must be continuity to two of the leads with a resistance of less than 1 ohm.
5. Put one test lead the other outer field terminal. There must be continuity from this field terminal to the other two brush holder leads.

Ground Test



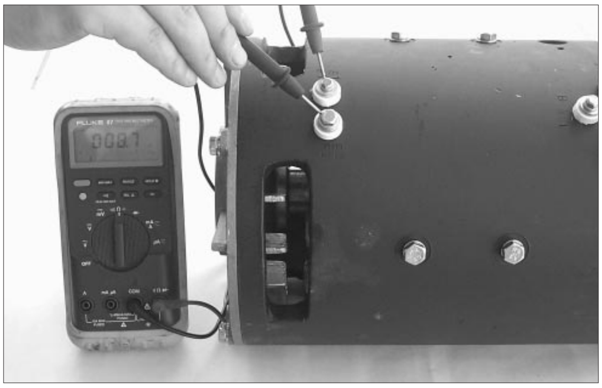
Ground Test
(1) Field terminal. (2) Motor housing.

1. Put the digital multimeter Function/range Switch on the 20M resistance (Ω) scale.
2. Put one test lead to either outer field terminal (1) and the other test lead to motor housing (2). There must be more than one megohm resistance.
3. If there is a measurement of less than one megohm, it can be caused by wet insulation on the field windings or excessive brush dust in housing. Heat the motor at 88℃(190℉) until the resistance goes above one megohm. If the resistance does not go above one megohm, the shell and field assembly must be replaced.

Shunt Field Tests

Open Circuit Test

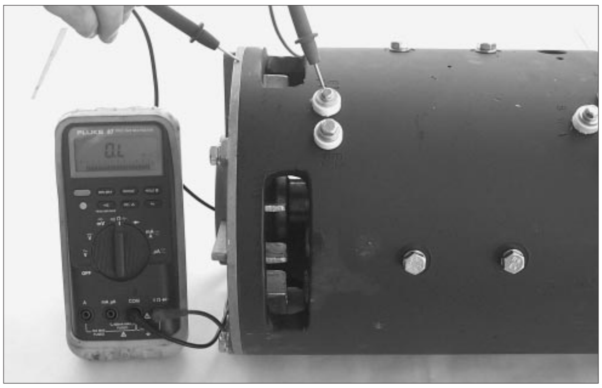
Tools Needed	
Digital Multimeter Or Equivalent	1



Shunt Coil Open Circuit Test

1. Put the Function/range Switch of the digital multimeter on the 200 ohm resistance (Ω) scale.
2. Put the test leads between the shunt terminals.
3. The resistance must be approximately 5 to 10 ohms. If the resistance is more than this, it is an indication of corrosion on the terminals or an open shunt coil.

Ground Test

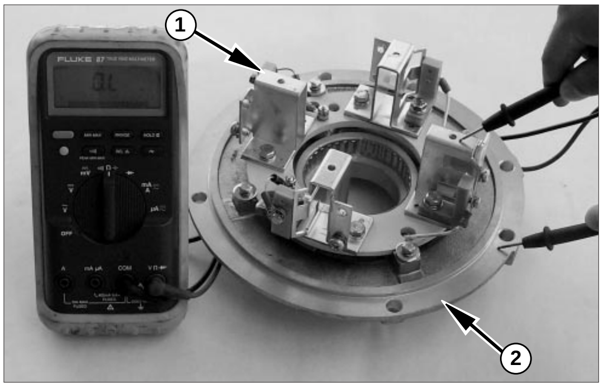


Shunt Coil Ground Test

1. Put the Function/Range Switch Switch of the digital multimeter on the 20M resistance (Ω) scale.
2. Put one test lead to either shunt coil terminal. Put the other test lead to the motor housing. There must be more than one megohm resistance. Check both shunt coil terminals.
3. If the indication is less than one megohm, the shunt coil is grounded and must be replaced.

Brush Holder Test

Tools Needed	
Digital Multimeter Or Equivalent	1



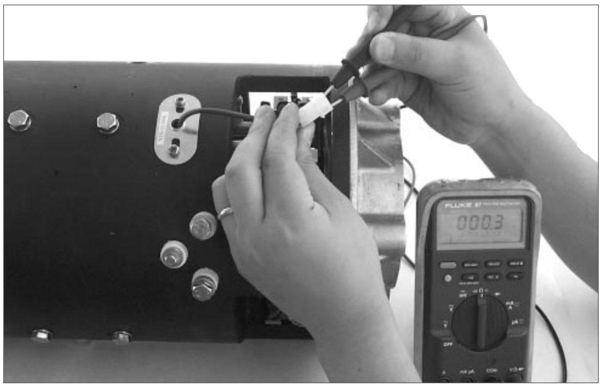
Brush Holder Test
(1) Brush holder. (2) End bell.

1. The brush holders are mounted on an insulator at the commutator end of the motor. Make a visual inspection of the brush holders and insulator.
2. Put digital multimeter. Function/Range Switch on the 200 ohm resistance (Ω) scale. Put one test lead to brush holder (1) and the other test lead to the end bell (2). The meter must show overload (OL).
3. Check each brush holder. If meter reading is low, the brush holder is grounded. Replace the insulator.

Thermal Switch (Thermostat) Tests

Tools Needed	
Digital Multimeter Or Equivalent	1

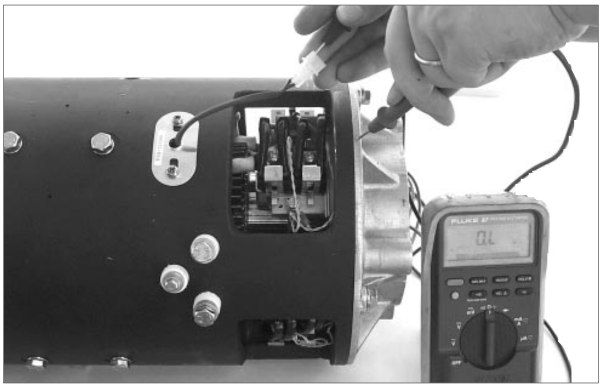
Open Circuit Test



Open Circuit Test(Typical Example)

1. Put the digital multimeter Function/Range Switch on the 200 ohm resistance (Ω) scale.
2. Put one test lead to each side of the thermal switch harness.
3. The resistance must be less than one ohm.

Ground Test



Ground Test (Typical Example)

1. Put the digital multimeter Function/Range Switch on the 20M resistance (Ω) scale.
2. Put one test lead to either of the plug prongs. The other test lead must be grounded to the motor housing. There must be more than one megohm resistance.

Brush Life Estimate

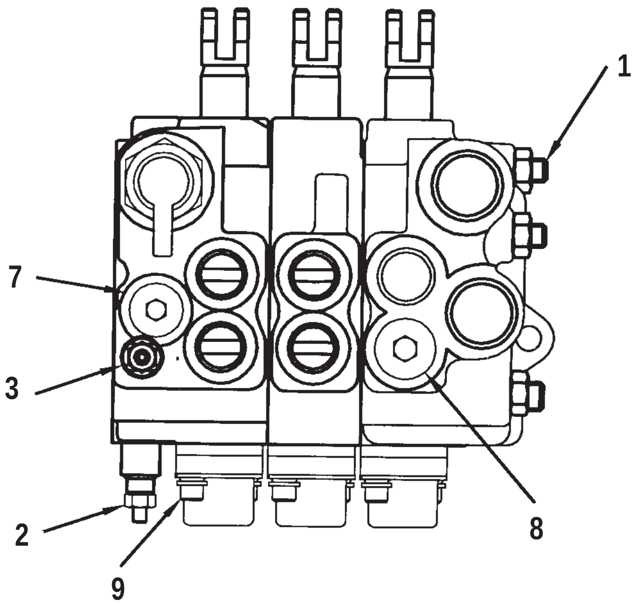
1. Before installation of new brushes, inspect the armature commutator. See Armature Commutator Inspection in Testing and Adjusting.
2. Do the steps and procedures for New Brush Installation in Testing and Adjusting.
3. Make the initial (first) inspection of brush wear between 250 smh and 500 smh. The reason for this initial inspection is to see if the brush wear rate is normal and not too fast. The measurement will help make an estimate of the length of brush life to be expected.

NOTE: If there is an indication that brush wear is too fast, see Troubleshooting, Problem: Sparks at the commutator and/or rapid brush wear.

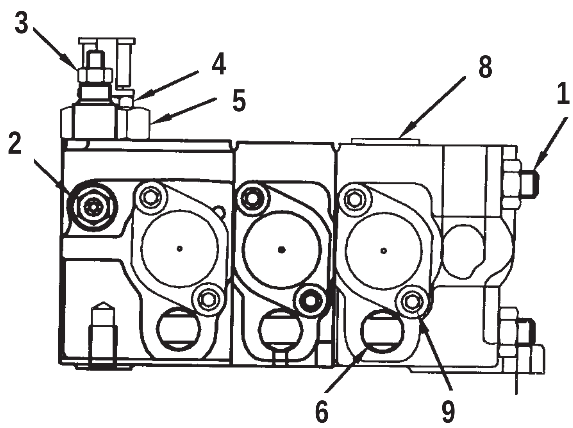
4. Inspect all brushes in the motors. Measure and record each brush length. See Hydraulic Pump or Steering Pump Motor in Specifications for new and minimum brush length.
5. Estimate expected brush life (hours). Use the shortest measurement from Step 4 and the following Sample Procedure:
   Length of new brush ....45.8 mm (1.803 in)
   Minimum length of brush.....................19 mm (.75 in)
   New brush length [45.8 mm(1.803 in)] - Minimum brush length [19 mm (.75 in)] = Total amount of usable brush wear [26.8 mm (1.055 in)].
   Length of shortest brush at 500 smh is 43.3 mm (1.703 in)
   New brush length [45.8 mm (1.803 in)] - Length of shortest brush at 500 smh [43.3 mm (1.703 in)] = Amount of brush wear at 500 smh [2.5 mm (.10 in)].
   Amount of brush wear at 500 smh [2.5 mm (.10 in)]   Total amount of usable brush wear [26.8 mm (1.055 in)] = Portion of brush used at 500 smh (.1).
   Service Meter Hours (smh) at brush wear measurement (500 smh)   Portion of brush used (.1) = Approximate total brush life of a new brush (5000 smh).
   Approximate total brush life of a new brush (5000 smh) - Amount of smh at brush life estimate (500 smh) = Remainder of usable brush life (4500 smh).
6. The smh estimate of brush life can be used if the machine is to work at the same rate (duty cycle), the battery is not discharged too much or the battery cells have not become damaged. If the machine is made to work harder, the battery is discharged too much, or the battery cells become damaged, the motor temperature will get hot very fast. This will cause rapid wear of the brushes.
7. It is important to check brush length and brush condition at a specific time, such as during the preventive maintenance check. If an inspection shows that brush life will not extend to the next preventive maintenance check, install new brushes.

Specifications

Hydraulic Control Valve



IDCS167S



IDCS168S

(1) Torque for bolts that hold control valve sections together ....40.5 ± 2.5 N•m (360 ± 24 lb•in).

(2) Adjust main system relief valve pressure for lift as shown above. See Relief Valve Pressure Check in Testing And Adjusting

(3) Adjust secondary relief valve pressure for tilt and sideshift as shown above. See Relief Valve Pressure Check in Testing And Adjusting.

(4) Torque for plug ..29.5 ± 1.5 N•m (264 ± 12 lb•in) .

(5) Torque for plug ..101 ± 5 N•m (894 ± 42 lb•in) .

(6) Adjust tilt and sideshift flow rate by using 1/4 inch hex-wrench if required. See Flow Control Valve Adjustment in Testing And Adjusting.

(7) Torque for plug ..55.5 ± 2.5 N•m (492 ± 24 lb•in) .

(8) Torque for plug ....79 ± 4 N•m (696 ± 36 lb•in) .

(9) Torque for screws

...........................5.4 ± 2.7 N•m (48 ± 24 lb•in) .

Control Valve Pressure to Open Relief Valve and Current Draw (Amps) of Pump Motor

Model	Mast	Relief Pressure +500, -0 kPa (+75, -0psi)	Current Draw (Type E) 36Volt Min.	36Volt Max.	48Volt Min.	48Volt Max.
B20S-2 BC20S-2	STD FFL FFTL	16600 kPa (2400 psi)	335	390	335	390
B25S-2 BC25S-2	STD FFL FFTL	19300kPa (2800 psi)	390	450	385	445
B30S-2 BC30S-2	STD FFL FFTL	20700 kPa (3000 psi)	480	555	470	545

*Main relief is for the lift valves (first levers).

Control Valve Pressure to Open Relief Valve and Current Draw (Amps) of Pump Motor

Model	Mast	Relief Pressure +500, -0 kPa (+75, -0psi)	Current Draw (Type EE) 36Volt Min.	36Volt Max.	48Volt Min.	48Volt Max.
B20S-2 BC20S-2	STD FFL FFTL	16600 kPa (2400 psi)	310	360	310	360
B25S-2 BC25S-2	STD FFL FFTL	19300kPa (2800 psi)	350	410	350	410

*Main relief is for the lift valves (first levers).

Control Valve Pressure to Open Relief Valve and Current Draw (Amps) of Pump Motor						
Model	Mast	Relief Pressure +500, -0 kPa (+75, -0psi)	Current Draw (Type E)			
			36Volt		48Volt	
			Min.	Max.	Min.	Max.
B20S-2 BC20S-2	STD FFL FFTL	16600 kPa (2400 psi)	235	270	235	270
B25S-2 BC25S-2	STD FFL FFTL	19300kPa (2800 psi)	270	310	265	310
B30S-2 BC30S-2	STD FFL FFTL	20700 kPa (3000 psi)	285	330	280	325

*Main relief is for the lift valves(first levers).

Relief Valve Pressure					
Model	Mast	Main Relief		Tilt, Auxiliary Relief	
		kPa +500,-0	psi +75,-0	kPa ±350	psi ±50
B,BC20S-2	STD FFL FFTL	16600	2400	15500	2250
B,BC25S-2	STD FFL FFTL	19300	2800	15500	2250
B,BC30S-2	STD FFL FFTL	20700	3000	15500	2250

Hydraulic Pumps

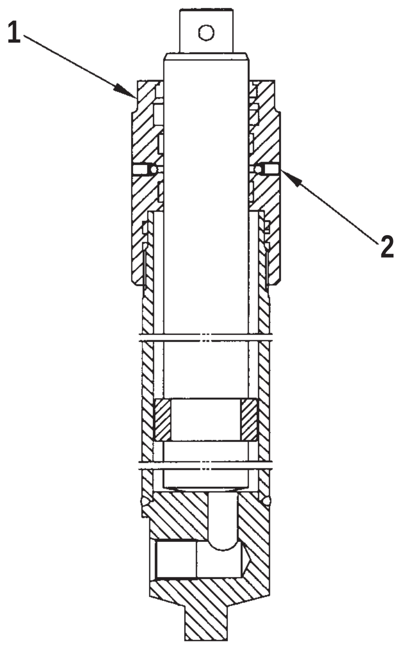
Rotation is clockwise when seen from drive end.

Type of pump: Gear

Displacement : 33 cc/rev

Lift Cylinders

Standard



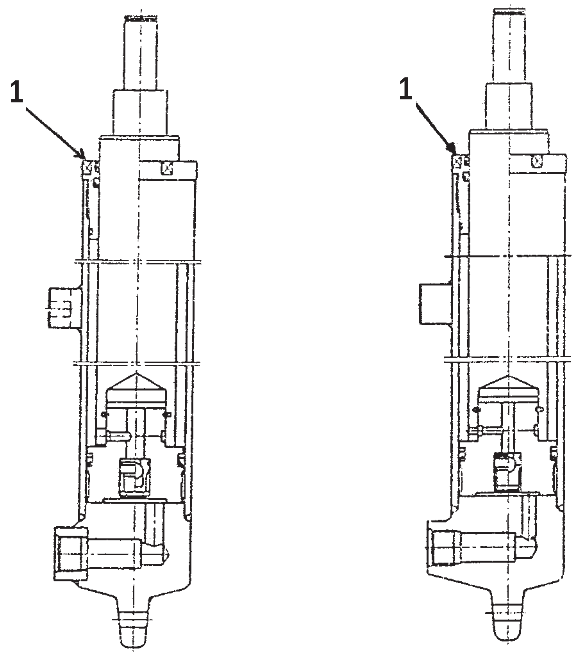
IDCS169S

(1) Put pipe sealant on the lost three threads of bearing.

(2) Torque for setscrews....6 ± 1 N•m (53 ± 9 lb•in)

NOTE: All seals to be lubricated with hydraulic oil.

Full Free Triple Lift and Full Free Lift Primary

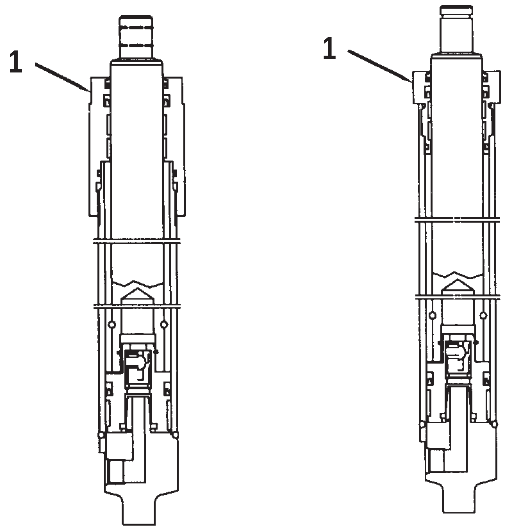


IDCS170S

(1) Put Thread Lock on the last three threads of bearing.

NOTE: All seals to be lubricated with hydraulic oil.

Full Free Triple Lift And Full Free Lift Secondary

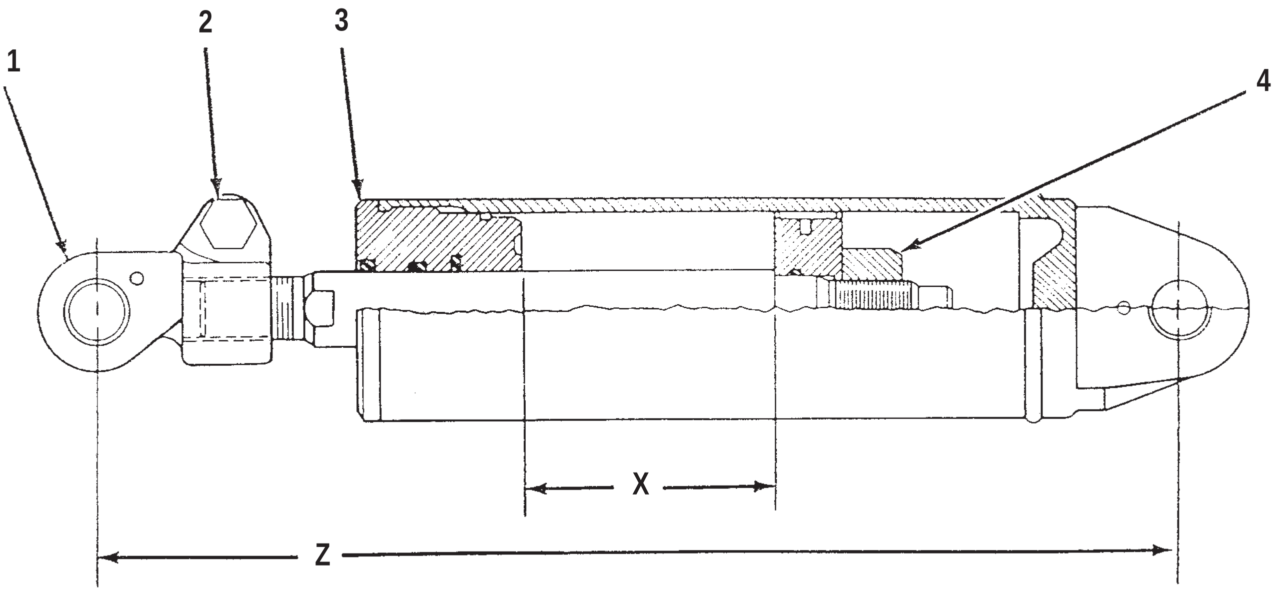


IDCS171S

(1) Put Thread Lock on the last three threads of bearing.

NOTE: All seals to be lubricated with hydraulic oil.

Tilt Cylinders

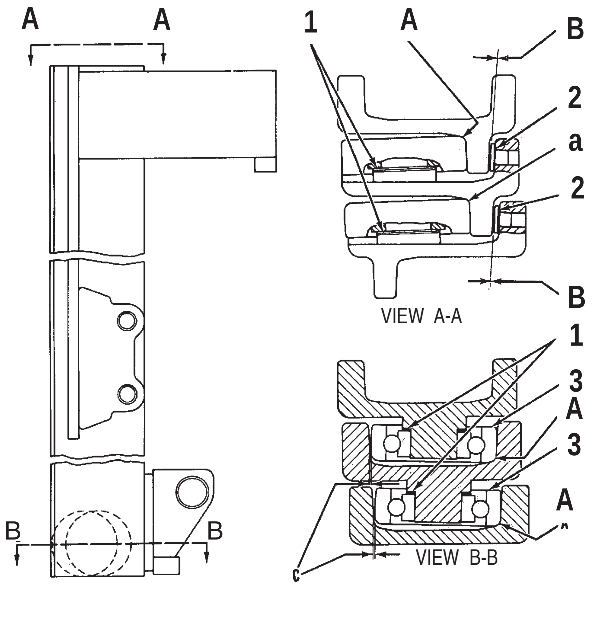


IDCS189S

TILT CYLINDER CHART					
Model	**Tilt Gp Part No.**	**Forward Tilt Angle***	**Backward Tilt Angle***	**Cyl.Stroke(X) mm(in)**	**Cyl. Closed (z) mm(in)**
B20S-2 B25S-2 B30S-2	A215207	3	3	43.5(1.71)	525.0 (20.67)
	A215230	6	3	65.0 (2.56)	525.0 (20.67)
	A215206	3	5	58.0 (2.28)	510.3 (20.08)
	A215202	6	5	79.5 (3.13)	510.3 (20.08)
	A215209	10	5	107.0 (4.21)	510.3 (20.08)
BC20S-2 BC25S-2 BC30S-2	A215205	3	8	81.0 (3.19)	487.8 (19.21)
	A215201	6	8	102.0 (4.02)	487.8 (19.21)
	A215204	3	10	96.0 (3.78)	473.0 (18.62)
	A215200	6	10	117.0 (4.61)	473.0 (18.62)
	A215208	10	10	145.0 (5.71)	473.0 (18.62)

* Permissible tolerance of $^1/_2$°
(1) Adjust pivot eye to dimension (Z) with cylinder closed.
(2) Torque for bolt..........................95 ± 15 N•m (70 ± 10 lb•ft)
(3) Torque for head ....270 ± 30 N•m (200 ± 22 lb•ft)
(4) Torque for piston nut............270 ± 30 N•m (200 ± 22 lb•ft)

Mast



IDCS172S

(1) With mast at 475 mm (18.7 in) channel lap, equally shim both sides until contact (A) is made (zero clearance) between bearings and mast uprights.

(2) With mast at full extension, shim behind pads until there is clearance (B) between the mast uprights and the pads of ....0.80 mm (.031 in)

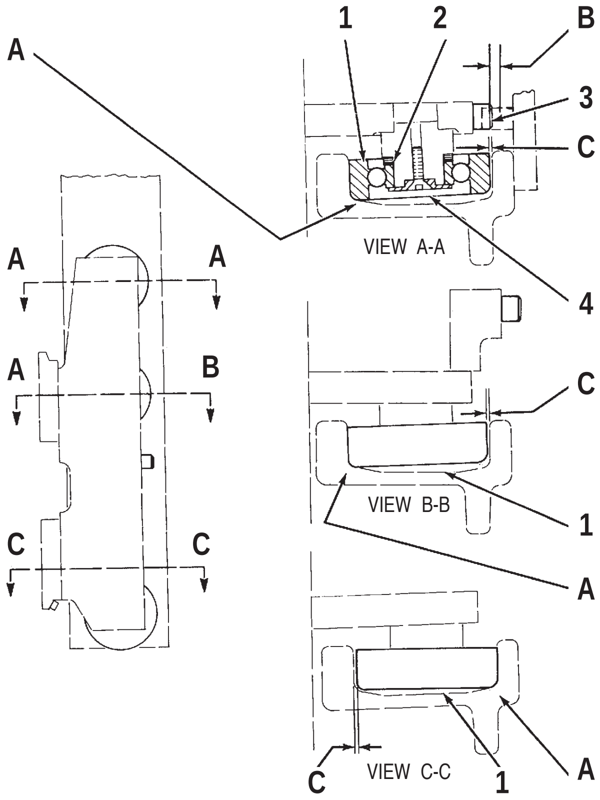
(3) Select lower bearings from the chart to obtain minimum clearance (c) between bearing and channel leg for full channel length. Must use same bearing on left and right side.

(See Mast Adjustment in Testing And Adjusting).

MAST BEARING CHART		
D581814	Undersize	108.60mm (4.276in)
D581815	Standerd	109.60mm (4.315in)
D581816	Oversize	110.70mm (4.358in)

* Permissible tolerance of ±0.08 mm (.003 in).

Carriage



IDCS173S

(1) Select bearings from the chart to obtain minimum clearance (C) between bearings and channel leg for full channel length. Must use same bearing at all six locations.

(2) Equally shim both sides until contact (A) is made (zero clearance) between bearings and inner mast at narrowest point.

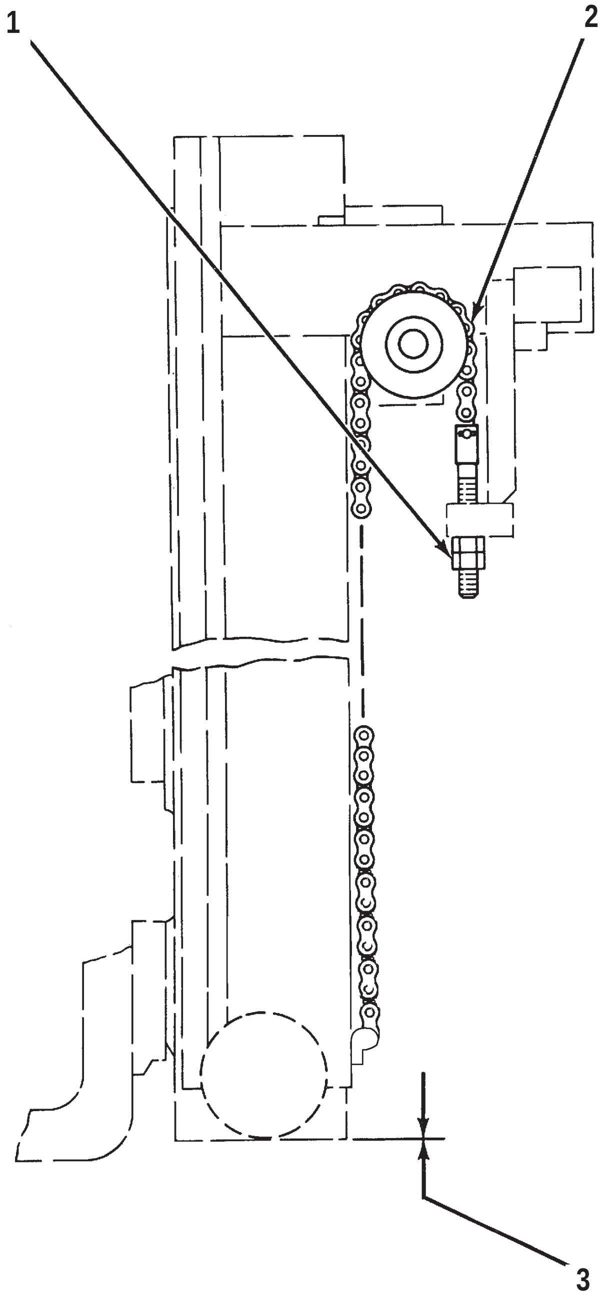
(3) Shim bolt as needed to obtain a 6.0 to 9.0 mm (.236 to .354 in) overlap (B) between bolt (3) and the carriage stop on the inner upright.
(See Carriage Adjustment in Testing and Adjusting.)

(4) Torque for screw .....34 ± 7 N•m (360 ± 24 lb•in)

CARRIAGE BEARING CHART		
Part No.	Bearing Size	Bearing OD*
D581814	Undersize	108.60 mm (4.276 in)
D581815	Standard	109.60 mm (4.315 in)
D581816	Oversize	110.70 mm (4.358 in)

*Permissible tolerance of ±0.08 mm (.003 in).

Lift Relay Group - Standard Lift



IDCS174S

⚠ WARNING

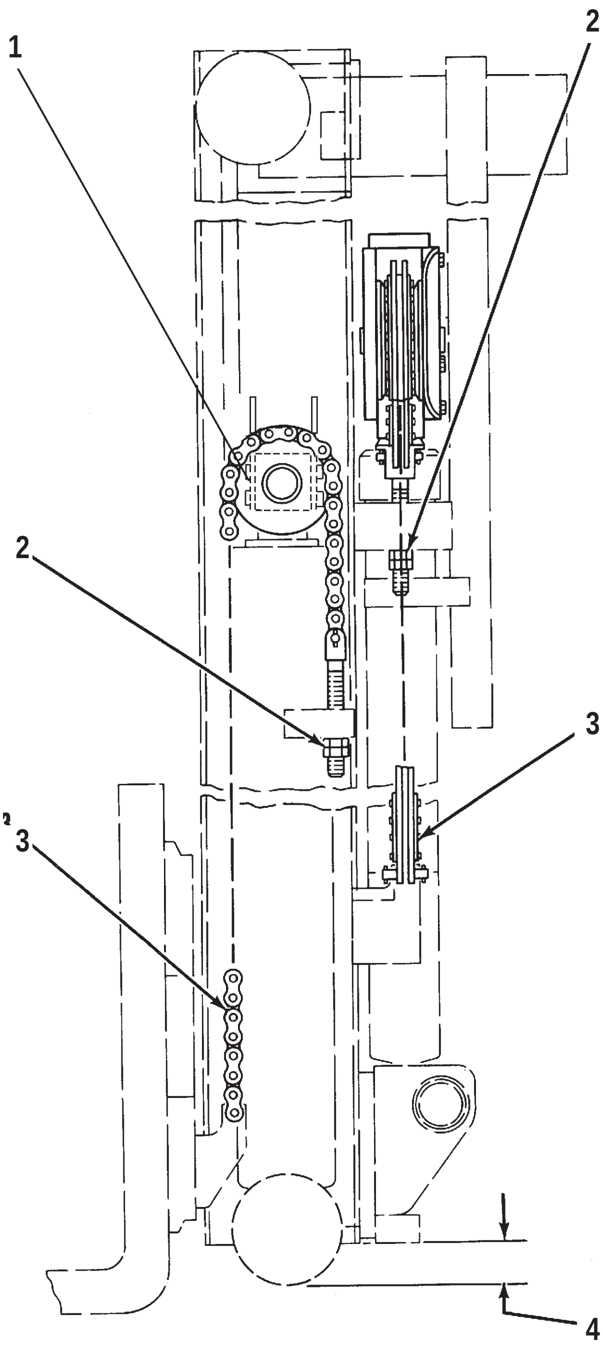
Do not put a lift truck into service if the chain wear indication is 2% or more. A reading of 2% or more could cause damage or injury to persons.

(1) Put LOCTITE NO. 242 Thread Lock on the threads of the relay group locknuts after adjustment of the lift chains is completed.

(2) Maximum chain wea........................Less than 2% (See Chain Wear Test in TESTING AND ADJUSTING).

(3) Distance from bottom of inner mast to bottom of lower bearing on carriage must be even (flush) with the inner mast.

Lift Relay Group - Full Free Lift



IDCS175S

⚠ WARNING

Do not put a lift truck into service if the chain wear indication is 2% or more. A reading of 2% or more could cause damage or injury to persons.

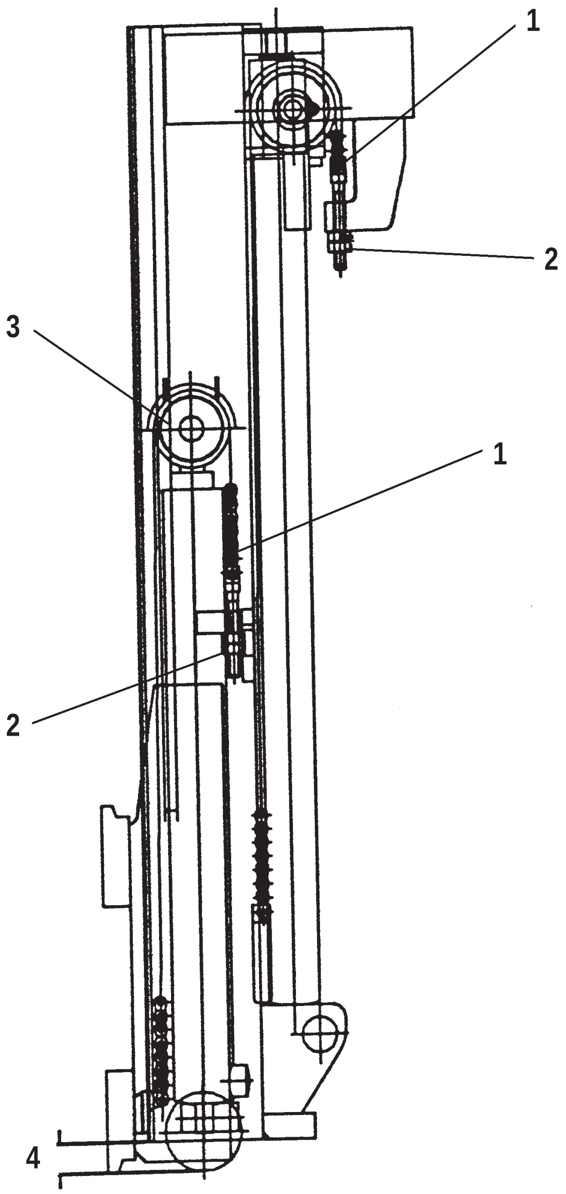
(1) Tighten bolts until contact is made with guard.

(2) Put LOCTITE NO. 242 Thread Lock on the threads of the relay group locknuts after adjustment of the lift chains is completed.

(3) Maximum chain wear Less than 2%(See Chain Wear Test in TESTING AND ADJUSTING).

(4) Distance from bottom of inner mast to bottom of lower bearing on carriage must be 41 ±1.5 mm (1.61 ± 0.6 in).
Bottom of inner mast must be even (flush) with bottom of stationary mast. Adjust inner first.

Lift Relay Group - Full Free Triple Lift



IDCS193S

⚠ WARNING

Do not put a lift truck into service if the chain wear indication is 2% or more. A Reading of 2% or more could cause damage or injury to persons.

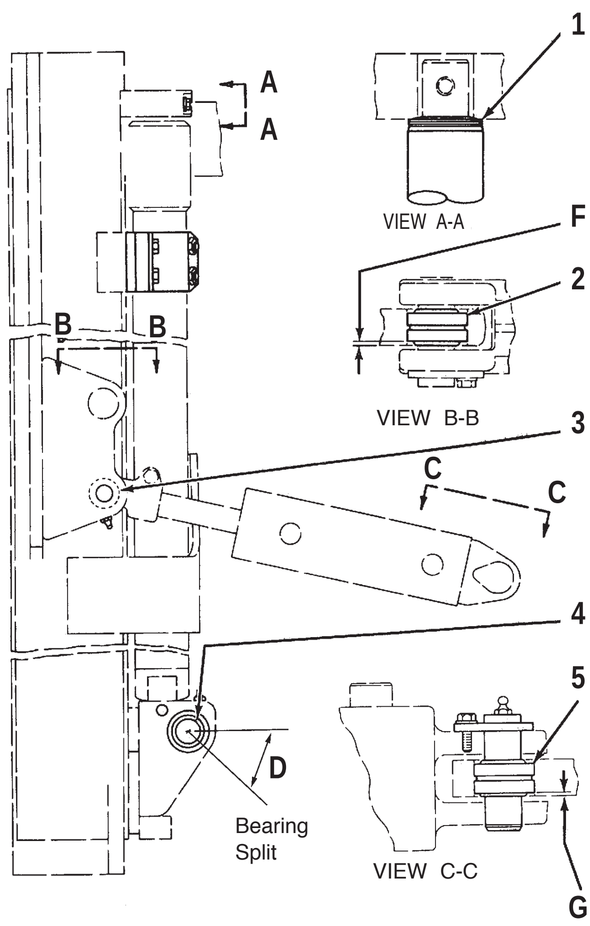
(1) Maximum chain wear Less than 2%(See Chain Wear in TESTING AND ADJUSTING).

(2) Put LOCTITE NO. 242 Thread Lock on the threads of the relay group locknuts after adjustment of the lift chains is completed.

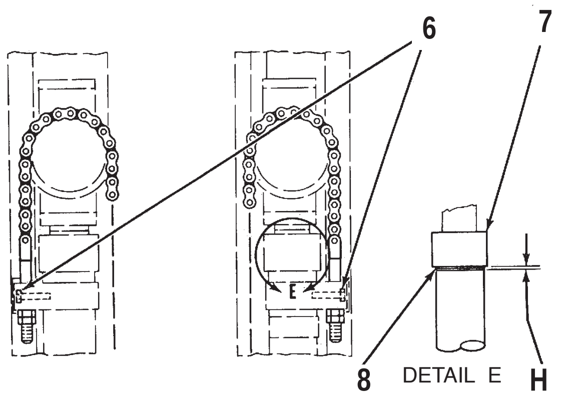
(3) Tighten bolts until contact is made with guide assembly.

(4) Distance from bottom of inner mast to bottom of lower bearing on carriage must be 41 $\pm$1.5 mm (1.61 $\pm$ 0.6 in).
Bottom of inner mast be even (flush) with bottom of stationary mast. Adjust inner mast first.

Lift and Tilt Mounting Group



IDCS176S



IDCS177S

(1) (Standard Mast or Full Free Triple Lift mast Only): With chains adjusted for equal tension, run mast to full lift. If mast does not kick (move) to one side, no shims are needed. If mast does kick (move) to one side, disconnect cylinder from the bar on that side. Add shim, connect cylinder, adjust chains and run mast to full lift to check for kick. Repeat process if necessary. The total shim pack must not be more than three shims maximum.

(2) Install bearing outer race to a depth of (F) 4.5 ± 0.8 mm (.177 ± .031 in).

(3) Tilt cylinder installation shown for M40D thru MC60d models.

(4) Bearing split to be located at angle (d) 45 ±15°

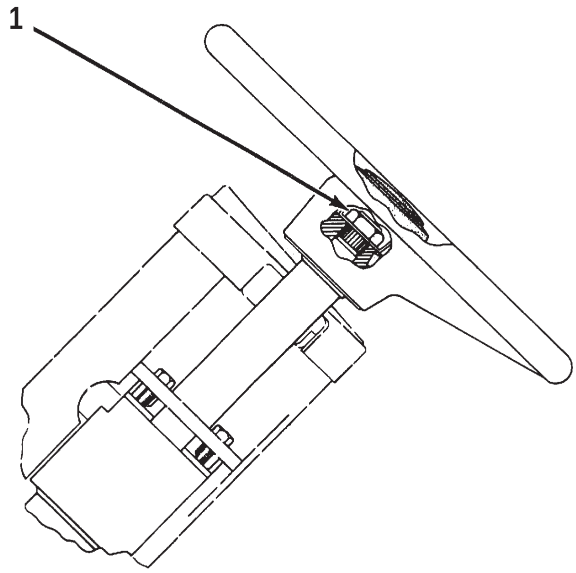
(5) Install bearing outer race to a depth of (G) ....4.5 ± 0.8 mm (.177 ± .031 in).

(6) (Full Free Lift Mast Only): Tighten nuts until U-bolts is firm against cylinder, do not apply standard torque.

(7) (Full Free Lift Mast Only): With chains adjusted for equal tension run mast to full lift. If mast does not kick (move) to one side, no shims are needed. If mast does kick (move) to one side, hold lift cylinder tube on that side and loosen bearing 1/4 turn and check mast again. Loosen bearing until kicking (movement) stops or gap (H) reaches 3.0 mm (.12 in) (approximately 1.5 turns)), whichever is less. Insert shims (8) under bearing (it may be necessary to loosen bearing an additional amount of turns to install shims). Tighten bearing again.

NOTE: Tighten the cylinder clamp bolts to a maximum torque of 35 N•m (26 lb ft) to prevent cylinder rotation.

Steering Wheel

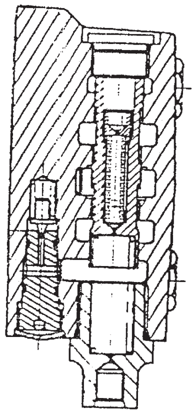


IDCS178S

(1) Torque for steering wheel nut...........75 to 88 N•m
(55 to 65 lb•ft)

Priority Valve (Incorporated with hydraulic pump)

:B20/25/30S-2



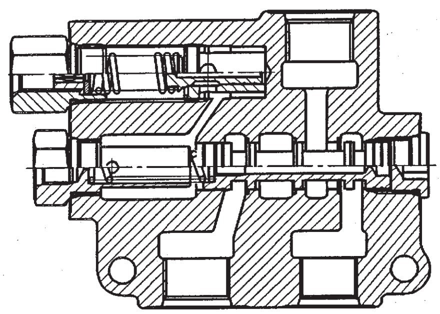
IDCS179S

Flow ....Load sensing

Relief valve (no adjustment) opens at:
.............................8000 ± 350 kPa (1160 ± 50 psi)

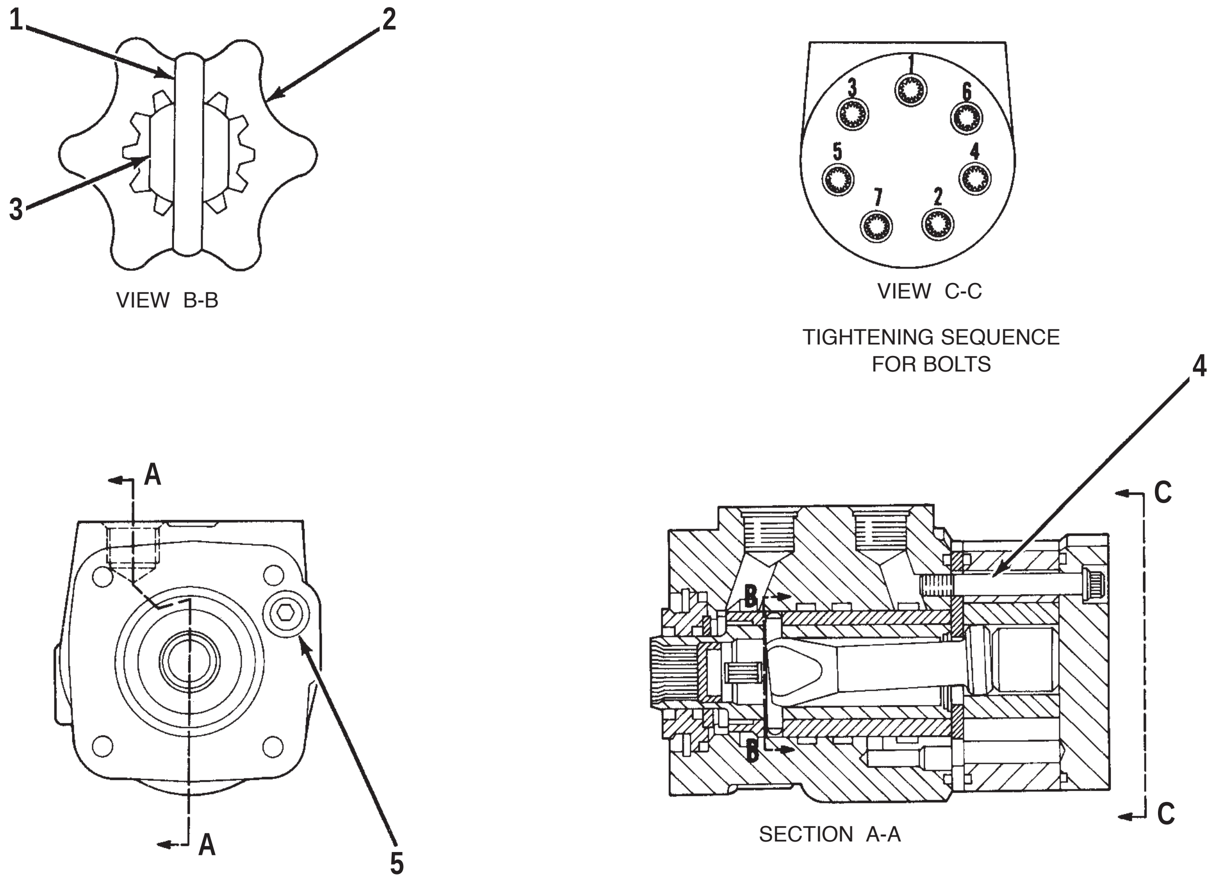
Priority Valve

:BC20/25/30S-2



Flow ....Load sensing

Relief valve (no adjustment) opens at:
............................7600 ± 350 kPa (1100 ± 50 psi)



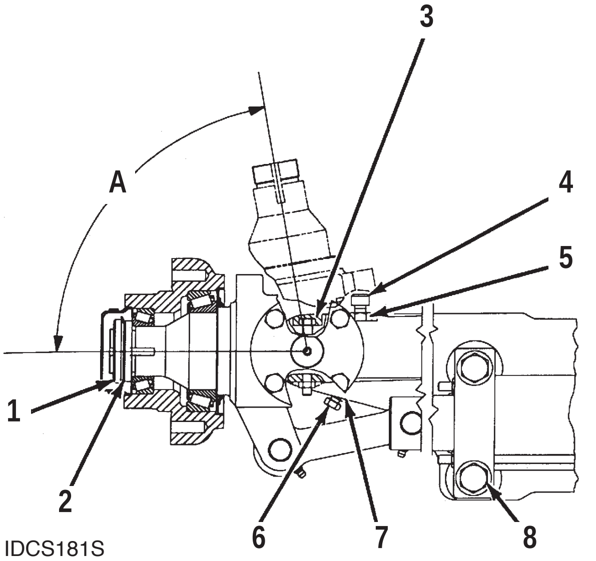
IDCS180S

(1) Pin (1) in the body must be aligned with internal pump gear (gerotor) (2) and drive (3) as shown.

(4) Tighten bolts in sequence shown.
Tighten to a first torque of 14.1 ± 2.8 N•m (125 ± 25 lb•in)
Tighten to a final torque of 28.2 ± 2.8 N•m(250 ± 25 lb•in)

(5) Torque for plug 11.3 N•m(100 lb•in)
Plug to be flush (even) with or below mounting surface.

Steer Axle and Wheel



IDCS181S

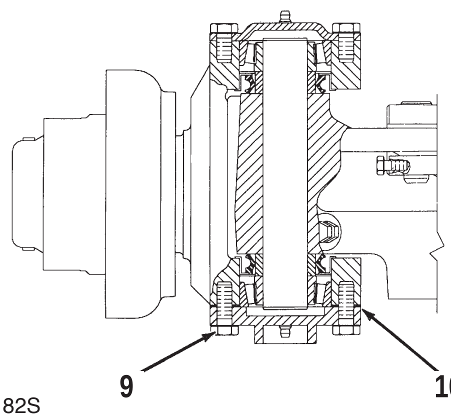
NOTE: Steer axles with tapered roller bearings shown.

(1) Do the steps that follow for steer wheel bearing adjustment.
a. tighten nut (1) slowly to 135 N•m(100 lb ft) while turning the wheel.
b. Loosen nut 91) completely. Tighten it again to ....50 ± 5 N•m(37 ± 4 lb•ft)
c. Bend lock (2) over nut (1).

(3) torque for bolt that holds pin ....11 ± 1 N•m (100 ± 9 lb•ft)

(4), (6) Loosen nuts (5) and (7) on both sides. Adjust bolts to get steering knuckle turning angle (A) of 78 to 80° See Steering Axle Stop Adjustment in Testing And Adjusting section.

(8) Tapered Roller Bearing Axles Only:
Torque for bolts that hold steer cylinder to axle beam.....................300 ± 40 N•m(220 ± 30 lb•ft)



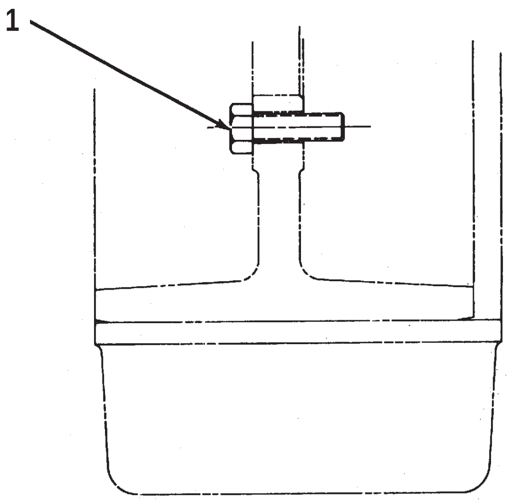
IDCS182S

(9) tapered Roller Bearing Axles Only:
Torque for bolts that hold cover ....55 ± 6 N•m(40 ± 5 lb•in)

(10) Add or remove shims under cover until torque required to turn knuckle assembly is ...4.5 to 6.8 N•m (40 to 60 lb in) See Steering Knuckle Bearing Preload Adjustment in Testing And Adjusting section.

Steer Tire Installation

B20/25/30S Models



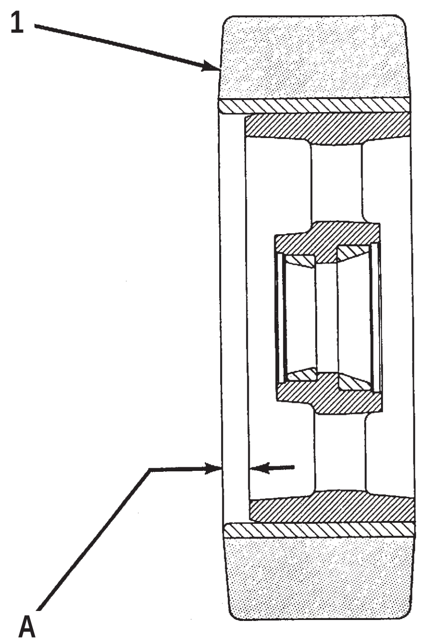
IDCS183S

⚠ WARNING

The cushion steer tire must be installed as shown. Failure to do so will decrease machine stability.

Install the cushion tire so that the edge of the tire is even with the outside edge of the wheel.
Tighten the cushion tire wheel mounting bolts (1) to a torque of.........................95 ± 15 N•m(70 ± 10 lb•ft)

BC Models

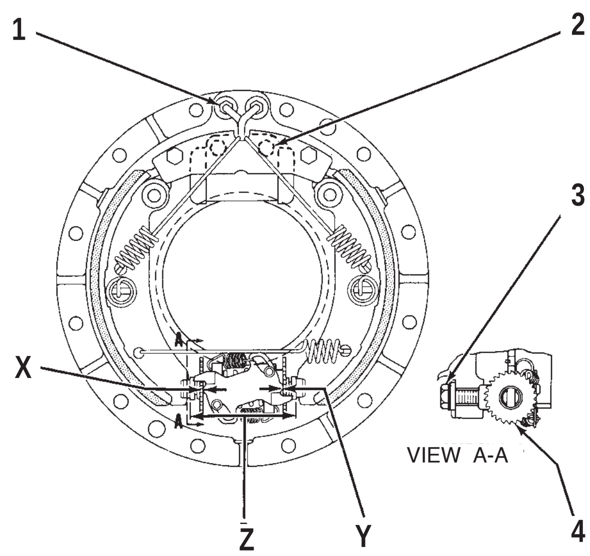


IDCS184S

(1) When there is a tire replacement, the new tire must be installed to dimension (A). (A) is...17 ± 2 mm ....(.67 ± .08 in)

Brakes

Shoe Type Brakes



IDCS185S

(1) Torque for for brake line nuts ....14 ± 2 N•m(10 ± 1 lb•ft)

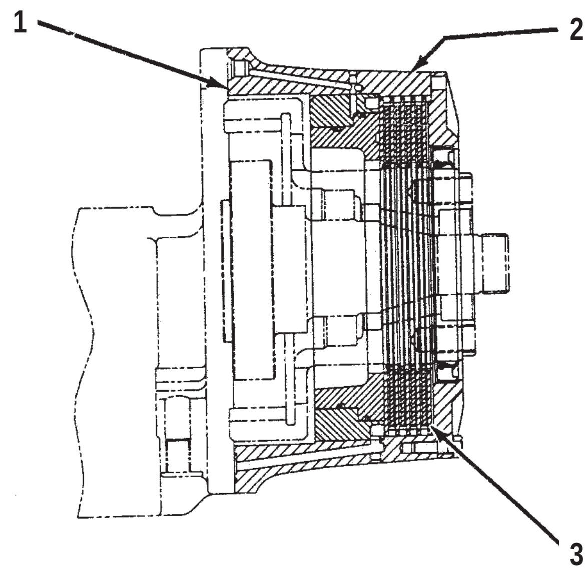
(2) Torque for wheel cylinder mounting bolts ....15 ± 2 N•m(11 ± 1 lb ft)

(3) Torque for adjuster mounting bolt (after it is centered) ....72 ± 5 N•m(55 ± 4 lb•ft)

(4) Adjuster dimensions:
(X) or (Y) ....1.05 mm (.041 in) maximum
(X) + (Y).....................1.3 ± 0.3 mm(.051 ± 0.12 in)
(Z) ....85 mm(3.35 in)
(See Brake Adjuster Installation in Testing And Adjusting).
Brake drum diameter (not shown) ....245 to 245 mm(9.646 to 9.657 in)

Maximum total diameter brake drum can be machined from the original diameter ....1.52 mm (.060 in)

Oil Cooled Disc Brakes



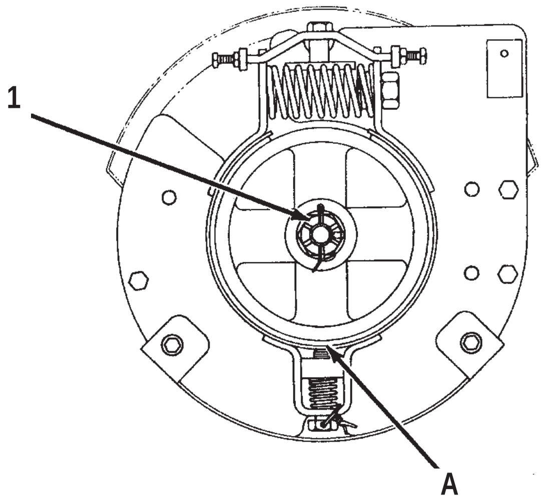
IDCS186S

(1), (2) Put #17430 Liquid Gasket on contact surface area of the ax.e flange cover assembly and cover before installation.

(3) Thickness of one new D700251 Plate ....2.50 ± .064 mm (.100 ± .0025 in)
Thickness of one new friction disc:
D141112 ....4.59 ± .13 mm(.181 ± .005 in)

Minimum depth of grooves before replacement is necessary:
D141112 ....0.32 mm (.013 in)
Soak new discs in transmission drive train oil for one hour before installing.

Parking Brake

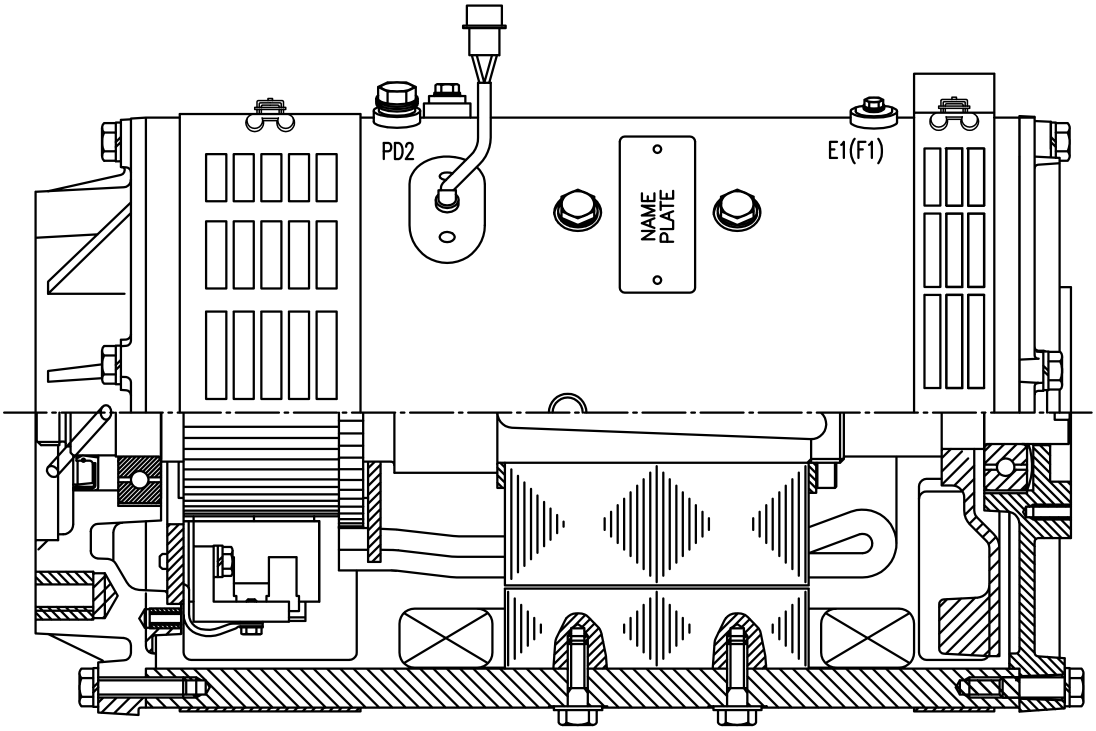


IDCS187S

(1) Torque for brake drum retaining nut 50 ± 20 N•m(37 ± 15 ft•lb)

(2) Clearance for brake drum and brake strap assembly at location marked (A) 0.25 - 0.50 mm (.010 - .020 in)
See Parking Brake and Parking Brake Control Gp in Testing and Adjusting for brake and cable adjustment procedure.

Hydraulic Pump Motor



HYDRAULIC PUMP MOTORS			
Voltage	**New Brush Size Thickness** x **Width** x **Length**	**Minimum Brush Length ***	**Minimum Commutator Diameter****
36/48	12.5 mm x 40.0 mm x 45.8 mm (.5 in x 1.57 in x 1.8 in)	19.0 mm (.75 in)	78 mm (3.07 in)
72/80	10.0 mm x 40.0 mm x 45.8 mm (.39 in x 1.57 in x 1.8 in)	20.0 mm (.75 in)	

*Measured on longest side.

** All rough edges (burrs) must be removed after the commutator is machined.

Machine chamfer on the commutator bars
....0.40 mm (.016 in)
Torque for the terminal bolts (not shown) that hold cable connection..............................14 N•m (10 lb•ft)
Depth of the insulation below commutator bars
....1.0 mm (.04 in)
Width of the insulation below commutator bars
....0.76 mm (.030 in)
Maximum difference between commutator high and low point (out of round) 0.03 mm (.001 in)
Maximum difference between bar to bar
....0.005 mm (.0002 in) TIR
Thermal switch (not shown) : (If equipped)
Opening temperature 135 ±4℃..............(275 ±7℉)
Closing temperature 135 ±4℃ ....(244 ±11℉)
Thermal switch (not shown)
Opening temperature 150 ±6℃...........(302 ±11℉)
Closing temperature 130 ±7℃ ....(275 ±13℉)