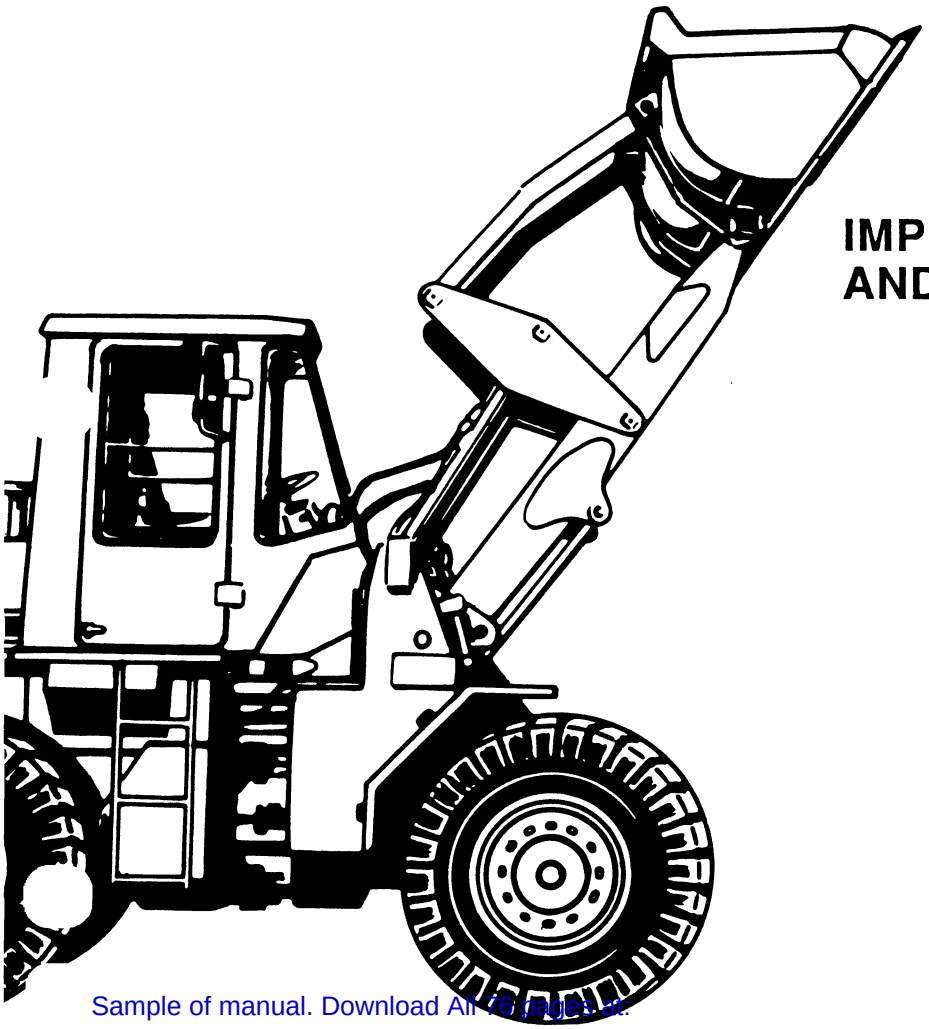
FIATALLIS

FR10
FR12
FR15

WHEEL LOADER



IMPLEMENT HYDRAULICS AND POWER STEERING

Service manual

Form 73142921 English

AVOID ACCIDENTS

Most accidents, whether they occur in industry, on the farm, at home or on the highway, are caused by the failure of some individual to follow simple and fundamental safety rules or precautions. For this reason MOST ACCIDENTS CAN BE PREVENTED by recognizing the real cause and doing something about it before the accident occurs.

Regardless of the care used in the design and construction of any type of equipment there are conditions that cannot be completely safeguarded against without interfering with reasonable accessibility and efficient operation.

A careful operator is the best insurance against an accident.
The complete observance of one simple rule would prevent many thousand serious injuries each year.
That rule is:

Never attempt to clean, oil or adjust a machine while it is in motion.

WARNING

On machines having hydraulically, mechanically, and/or cable controlled equipment (such as shovels, loaders, dozers, scrapers, etc.) be certain the equipment is lowered to the ground before servicing, adjusting and/or repairing. If it is necessary to have the hydraulically, mechanically, and/or cable controlled equipment partially or fully raised to gain access to certain items, be sure the equipment is suitably supported by means other than the hydraulic lift cylinders, cable and/or mechanical devices used for controlling the equipment.

FR 10,12,15

WHEEL LOADER

service manual

IMPLEMENT HYDRAULICS AND POWER STEERING

S/N 46C,78Y,58M00101-UP (FR10)
S/N 79M,59U00101 -UP (FR12)
S/N 80U00101-UP (FR15)

Form 73142921 English

⚠ WARNING

STUDY THE OPERATION AND MAINTENANCE INSTRUCTION MANUAL THROUGH BEFORE STARTING, OPERATING, MAINTAINING, FUELING OR SERVICING THIS MACHINE.

⚠ **WARNING** - The Operation and Maintenance Instruction Manual provides the instructions and procedures for starting, operating, maintaining, fueling, shutdown and servicing that are necessary for properly conducting the procedures for overhaul of the related components outlined in this Service Manual.

⚠ **WARNING** - This symbol is your safety alert sign. It **MEANS ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED.**

⚠ **WARNING** - Read and heed all safety instructions carrying the signal words **WARNING** and **DANGER.**

⚠ **WARNING** - Machine mounted safety signs have been color coded yellow with black borders and lettering for warning and red with white borders and lettering for danger points.

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SAFETY RULES

GENERAL

Study the Operation and Maintenance Instruction Manual before starting, operating, maintaining, fueling, or servicing machine.

Read and heed all machine-mounted safety signs before starting, operating, maintaining, fueling or servicing machine.

Machine-mounted safety signs have been color coded yellow with black border and lettering for WARNING and red with white border and lettering for DANGER points.

Never attempt to operate the machine or its tools from any position other than seated in the operator's seat. Keep head, body, limbs, hands and feet inside operator's compartment at all times to reduce exposure to hazards outside the operator's compartment.

Do not allow unauthorized personnel to operate, service or maintain this machine.

Always check work area for dangerous features. The following are examples of dangerous work areas: slopes, overhangs, timber, demolitions, fire, high walls, dropoff, backfills, rough terrain, ditches, ridges, excavations, heavy traffic, crowded parking, crowded maintenance and closed areas. Use extreme care when in areas such as these.

An operator must know the machine's capabilities. When working on slopes or near dropoffs be alert to avoid loose or soft conditions that could cause sudden tipping or loss of control.

Do not jump on or off machine. Keep two hands and one foot, or two feet and one hand, in contact with steps, grab rails and handles at all times.

Do not use controls or hoses as handholds when climbing on or off machine. Hoses and controls are movable and do not provide a solid support. Controls also may be inadvertently moved causing accidental machine or equipment movement.

Keep operator's compartment, stepping points, grab-rails and handles clear of foreign objects, oil, grease, mud or snow accumulation to minimize the danger of slipping or stumbling. Clean mud or grease from shoes before attempting to mount or operate the machine.

Be careful of slippery conditions on stepping points, hand rails, and on the ground. Wear safety boots or shoes that have a high slip resistant sole material.

For your personal protection, do not attempt to climb on or off machine while machine is in motion.

Never leave the machine unattended with the engine running.

Always lock up machine when leaving it unattended. Return keys to authorized security. Heed all shutdown procedures of the Operation and Maintenance Instruction Manual. Always set the parking brake when leaving the machine for any reason.

Do not wear rings, wrist watches, jewelry, loose or hanging apparel, such as ties, torn clothing, scarves, unbuttoned, or unzipped jackets that can catch on moving parts. Wear proper safety equipment as authorized for the job. Examples: hard hats, safety shoes, heavy gloves, ear protectors, safety glasses or goggles, reflector vests, or respirators. Consult your employer for specific safety equipment requirements.

Do not carry loose objects in pockets that might fall unnoticed into open compartments.

Do not use machine to carry loose objects by means other than attachments for carrying such objects.

DO NOT CARRY RIDERS unless the machine is equipped for carrying people to reduce personal exposure to being thrown off.

Do not operate machinery in a condition of extreme fatigue or illness. Be especially careful towards the end of the shift.

Roll Over Protective Structures are required on wheel loaders, dozer tractors, track type loaders, graders and scrapers by local or national requirements. DO NOT operate this machine without a Roll over Protective Structure.

Do not operate a machine without a falling object protective structure (FOPS).

Do not operate this machine without a rear canopy screen when machine is equipped with rear mounted towing winch.

Seat belts are required to be provided with roll over protective structures or roll protection cabs by local or national regulations. Keep the safety belt fastened around you during operation.

Where noise exposure exceeds 90 dBA for 8 hours, wear authorized ear protective equipment per local or national requirements that apply.

Keep clutches and brakes on machine and attachments such as power control units, winches and master clutches adjusted according to Operation and Maintenance Instruction Manuals of the manufacturers at all times. DO NOT adjust machine with engine running except as specified.

Do not operate a machine with brakes out of adjustment. See the Operation and Maintenance Instruction Manual.

Move carefully when under, in or near machine or implements. Wear required protective equipment, such as hard hat, safety glasses , safety shoes, ear protectors.

To move a disabled machine, use a trailer or low boy truck if available. If towing is necessary, provide warning signals as required by local rules and regulations and follow Operation and Maintenance Instruction Manual recommendations. Load and unload on a level area that gives full support to the trailer wheels. Use ramps of adequate strength, low angle and proper height. Keep trailer bed clean of clay, oil and all materials that become slippery. Tie machine down securely to truck or trailer bed and block tracks (or wheels) as required by the carrier.

To prevent entrapment in cabs or mounted enclosures, observe and know the mechanics of alternate exit routes.

On machines equipped with suction radiator fans, be sure to periodically check all engine exhaust parts for leaks as exhaust gases are dangerous to the operator. Keep a vent open to outside air at all times when operating within a closed cab.

STARTING FLUID IS FLAMMABLE. Follow the recommendations as outlined in the Operation and Maintenance Instruction Manual and as marked on the containers. Store containers in cool, well-ventilated place secure from unauthorized personnel. DO NOT PUNCTURE OR BURN CONTAINERS. Follow the recommendations of the manufacturer for storage and disposal.

Wire rope develops steel slivers. Use authorized protective equipment such as heavy gloves, safety glasses when handling.

SAFETY RULES

OPERATION

Before starting machine, check, adjust and lock the operator's seat for maximum comfort and control of the machine.

DO NOT START OR OPERATE AN UNSAFE MACHINE. Before working the machine, be sure that any unsafe condition has been satisfactorily remedied. Check brakes, steering and attachment controls before moving. Advise the proper maintenance authority of any malfunctioning part or system. Be sure all protective guards or panels are in place, and all safety devices provided are in place and in good operating condition.

Check instruments at start-up and frequently during operation.

Do not run the engine of this machine in closed areas without proper ventilation to remove deadly exhaust gases.

Be sure exposed personnel in the area of operation are clear of the machine before moving the machine or its attachments. WALK COMPLETELY AROUND machine before mounting. Sound horn. Obey flagman. safety signals and signs.

Know the principles of cross steering of crawler tractors. Read section in Operation and Maintenance Instruction Manual on cross steering.

Keep engine exhaust system and exhaust manifolds clear of combustible material. Equip machine with screens and guards when working under conditions of flying combustible material.

If engine has a tendency to stall for any reason under load or idle, report this for adjustment to a proper maintenance authority immediately. Do not continue to operate machine until condition has been corrected.

Never use bucket as a man-lift.

Use recommended bucket for machine and material loadability and heaping characteristics of material, terrain, and other pertinent job conditions.

Avoid abrupt starts and stops when transporting a loaded bucket.

Inspect your seat belt webbing and hardware at least twice a year for signs of fraying, wear or other weakness that could lead to failure.

Use only designated towing or pulling attachment points. Use care in making attachment. Be sure pins and locks as provided are secure before pulling. Stay clear of drawbars, cables or chains under load.

When pulling or towing through a cable or chain, do not start suddenly at full throttle. Take up slack carefully. Guard against kinking chains or cables. Inspect carefully for flaws before using. Do not pull through a kinked chain or cable due to the high stresses and possibility of failure of the kinked area. Aways wear heavy gloves when handling chain or cable.

Be sure cables are anchored and the anchor point is strong enough to handle the expected load. Keep exposed personnel clear of anchor point and cable or chain. DO NOT PULL OR TOW UNLESS OPERATORS COMPARTMENTS OF MACHINES INVOLVED ARE PROPERLY GUARDED AGAINST POTENTIAL CABLE OR CHAIN BACKLASH.

During operation always carry ripper in full raised position when not in use and lower to ground when parked.

When counterweights have been provided, do not work machine if they have been removed unless their equivalent weight has been replaced. See the Operation and Maintenance Instruction Manual.

When operating a machine know what clearances will be encountered, overhead doors, wires, pipes, aisles, roadways; also the weight limitations of ground, floor, and ramps.

Know bridge and culvert load limits and do not exceed them. Know machine's height, width, and weight. Use a signal person when clearance is close.

Be sure that the exact location of gas lines, utility lines, sewers, overhead and buried power lines, and other obstructions or hazards are known. Such locations should be precisely marked by the proper authorities to reduce the risk of accidents. Obtain shut-down or relocation of any such facilities before starting work, if necessary.

Be certain to comply with all local, state, and federal regulations regarding working in the vicinity of power lines.

When roading find out what conditions are likely to be met - clearances, congestion, type of surface, etc. Be aware of fog, smoke or dust elements that obscure visibility.

When backing, always look to where the machine is to be moved. Be alert to the position of exposed personnel. DO NOT OPERATE if exposed personnel enter the immediate work area.

Never travel a machine on a job site, in a congested area, or around people without a signal person to guide the operator.

In darkness, check area of operation carefully before moving in with machine. Use all lights provided. Do not move into area of restricted visibility.

Maintain clear vision of all areas of travel or work. Keep cab windows clean and repaired. Carry blade low for maximum visibility while traveling. Obtain and use fan blast deflectors where tractors are used as pusher tractors in tandem.

Transport a loaded bucket with the bucket as far tipped back and in as low a position as possible for maximum visibility, stability, and safest transport of the machine. Carry it at a proper speed for the load and ground conditions.

Carry the bucket low when traveling with a load.

Maintain a safe distance from other machines. Provide sufficient clearance for ground and visibility conditions. Yield right-of-way to loaded machines.

Avoid going over obstacles such as rough terrain, rocks, logs, curbs, ditches, ridges, and railroad tracks whenever possible. When obstructions must be crossed, do so with extreme care at an angle if possible. Reduce speed - down-shift. Ease up to the breakover point - pass the balance point slowly on the obstruction and ease down on the other side.

Cross gullies or ditches at an angle with reduced speed after insuring ground conditions will permit a safe traverse.

Be alert to soft ground conditions close to newly constructed walls. The fill material and weight of machine may cause the wall to collapse under the machine.

Operate at speeds slow enough to insure complete control at all times. Travel slowly over rough ground, on slopes or near dropoffs, in congested areas or on ice or slippery surfaces.

SAFETY RULES

Be alert to avoid changes in traction conditions that could cause loss of control. DO NOT drive on ice or frozen ground conditions when working the machine on steep slopes or near dropoffs.

Keep the machine well back from the edge of an excavation.

Be especially careful when traveling up or down slopes. Position the bucket in such a way as to provide a possible anchorage on the ground in case of a slide.

When proceeding across a hillside proceed slowly. Never turn sharply uphill or downhill.

Avoid sidehill travel whenever possible. Drive up and down the slope. Should the machine start slipping sideways on a grade, turn it immediately downhill.

In steep downhill operation, do not allow engine to overspeed. Select proper gear before starting downgrade.

There is no substitute for good judgement when working on slopes.

The grade of slope you should attempt will be limited by such factors as condition of the ground, load being handled, the type of machine, speed of machine and visibility.

NEVER COAST the machine down grades and slopes with the transmission in neutral on power shift machines, or clutch disengaged on manually shifted machines.

To reduce the danger of an uncontrolled machine, choose a gear speed before proceeding down grade that will hold machine to proper speeds for conditions.

Operating in virgin rough terrain that includes previously mentioned hazards is called pioneering. Be sure you know how this is done. Danger from falling branches and upturning roots is acute in these areas.

When pushing over trees, the machine must be equipped with proper overhead guarding. Never allow a machine to climb up on the root structure particularly while the tree is being felled. Use extreme care when pushing over any tree with dead branches.

Avoid brushpiles, logs or rocks. DO NOT DRIVE THE MACHINE ONTO BRUSHPILES, LOGS, LARGE ROCKS or other surface irregularities that break traction with the ground especially when on slopes or near dropoffs.

Avoid operating equipment too close to an overhang or highwall either above or below the machine. Be on the lookout for caving edges. falling objects and slides. Beware of concealment by brush and undergrowth of these dangers.

Park in a non-operating and non-traffic area or as instructed. Park on firm level ground if possible. Where not possible, position machine at a right angle to the slope, making sure there is no danger of uncontrolled sliding movement. Set the parking brake.

Never park on an incline without carefully blocking the machine to prevent movement.

If parking in traffic lanes cannot be avoided, provide appropriate flags, barriers, flares and warning signals as required. Also provide advance warning signals in the traffic lane for approaching traffic.

Move the machine away from pits, trenches, overhangs and overhead power lines before shutting down for the day.

When stopping operation of the machine for any reason, always return the transmission or hydrostatic drive control to neutral and engage the control lock to secure the machine for a safe start up. Set parking brake, if so equipped.

Never lower attachments or tools from any position other than seated in operator's seat. Sound the horn. Make sure the area near the attachment is clear. Lower the attachment slowly. DO NOT USE float position to lower hydraulic equipment.

Always before leaving the operator's seat and after making certain all people are clear of the machine, slowly lower the attachments or tools flat to the ground in a positive ground support position. Move any multipurpose tool to positive closed position. Return the controls to hold. Place transmission control in neutral and move engine controls to off position. Engage all control locks, set parking brake, and open and lock the master (key, if so equipped) switch. Consult Operation and Maintenance Instruction Manual.

Always follow the shut-down instructions as outlined in the Operation and Maintenance Instruction Manual.

MAINTENANCE

Do not perform any work on equipment that is not authorized. Follow the Maintenance or Service Manual Procedures.

Machine should not be serviced with anyone in the operator's seat unless they are qualified to operate the machine and are assisting in the servicing.

Shut off engine and disengage the Power Take-Off lever if so equipped before attempting adjustments or service.

Always turn the master switch (key switch if so equipped) to the off position before cleaning, repairing, or servicing and when parking machine to forestall unintended or unauthorized starting.

Disconnect batteries and TAG all controls according to local or national requirements to warn that work is in progress.Block the machine and all attachments that must be raised per local or national requirements.

Never lubricate, service or adjust a machine with the engine running, except as called for in the Operation and Maintenance Instruction Manuals. Do not wear loose clothing or jewelry near moving parts.

Do not run engine when refueling and use care if engine is hot due to the increased possibility of a fire if fuel is spilled.

Do not smoke or permit any open flame or spark near when refueling, or handling highly flammable materials.

Always place the fuel nozzle against the side of the filler opening before starting and during fuel flow. To reduce the chance of a static electricity spark, keep contact until after fuel flow is shut off.

Do not adjust engine fuel pump when the machine is in motion.

Never attempt to check or adjust fan belts when engine is running.

When making equipment checks that require running of the engine, have an operator in the operator's seat at all times with the mechanic in sight. Place the transmission in neutral and set the brakes and lock. KEEP HANDS AND CLOTHING AWAY FROM MOVING PARTS.

SAFETY RULES

Avoid running engine with open unprotected air inlets. If such running is unavoidable for service reasons, place protective screens over all inlet openings before servicing engine.

Do not place head, body, limbs, feet, fingers, or hands near rotating fan or belts. Be especially alert around a pusher fan.

Keep head, body, limbs, feet, hands, and fingers away from bucket, blade or ripper when in raised position.

If movement of an attachment by means of machine's hydraulic system or winches is required for service or maintenance, do not raise or lower attachments from any position other than when seated in the operator's seat. Before starting machine or moving attachments or tools, set brakes, sound horn and call for an all clear. Raise attachments slowly.

Never place head, body, limbs, fingers, feet or hands into an exposed portion between uncontrolled or unguarded scissor points of machine without first providing secure blocking.

Never align holes with fingers or hands - Use the proper aligning tool.

Disconnect batteries before working on electrical system or repair work of any kind.

Check for fuel or battery electrolyte leaks before starting service or maintenance work. Eliminate leaks before proceeding.

BATTERY GAS IS HIGHLY FLAMMABLE. Leave battery box open to improve ventilation when charging batteries. Never check charge by placing metal objects across the posts. Keep sparks or open flame away from batteries. Do not smoke near battery to guard against the possibility of an accidental explosion.

Do not charge batteries in a closed area. Provide proper ventilation to guard against an accidental explosion from an accumulation of explosive gases given off in the charging process.

Be sure to connect the booster cables to the proper terminals (+ to +) and (− to −) at both ends. Avoid shorting clamps. Follow the Operation and Maintenance Instruction Manual procedure.

Due to the presence of flammable fluid, never check or fill fuel tanks, storage batteries, or use starter fluid near lighted smoking materials or open flame or sparks.

Rust inhibitors are volatile and flammable. Prepare parts in well ventilated place. Keep open flame away - DO NOT SMOKE. Store containers in a cool well-ventilated place secured against unauthorized personnel.

Do not use an open flame as a light source to look for leaks or for inspection anywhere on the machine.

DO NOT pile oily or greasy rags - they are a fire hazard. Store in a closed metal container.

Never use gasoline or solvent or other flammable fluid to clean parts. Use authorized commercial, non-flammable, non-toxic solvents.

Never place gasoline or diesel fuel in an open pan.

Shut off engine and be sure all pressure in system has been relieved before removing panels, housings, covers, and caps. See Operation and Maintenance Instruction Manual.

Do not remove hoses or check valves in the hydraulic system without first removing load and relieving pressure on the supporting cylinders.

Turn radiator cap slowly to relieve pressure before removing. Add coolant only with engine stopped or idling if hot. See Operation and Maintenance Instruction Manual.

Fluid escaping under pressure from a very small hole can almost be invisible and can have sufficient force to penetrate the skin. Use a piece of cardboard or wood to search for suspected pressure leaks. DO NOT USE HANDS. If injured by escaping fluid, see a doctor at once. Serious infection or reaction can develop if proper medical treatment is not administered immediately.

Never use any gas other than dry nitrogen to charge accumulators. See Operation and Maintenance Instruction Manual.

When making pressure checks use the correct gauge for expected pressure. See the Operation and Maintenance Instruction Manual or Service Manuals for guidance.

For field service, move machine to level ground if possible and block machine. If work is absolutely necessary on an incline, block machine and its attachments securely. Move the machine to level ground as soon as possible.

Brakes are inoperative when manually released for servicing. Provision must be made to maintain control of the machine by blocking or other means.

Block all wheels before bleeding or disconnecting any brake system lines and cylinders.

Never use makeshift jacks when adjusting track tension. Follow the Undercarriage Service Manual.

Know your jacking equipment and its capacity. Be sure the jacking point used on the machine is appropriate for the load to be applied. Be sure the support of the jack at the machine and under the jack is appropriate and stable. Any equipment up on a jack is dangerous. Transfer load to appropriate blocking as a safety measure before proceeding with service or maintenance work according to local or national requirements.

Always block with external support any linkage or part on machine that requires work under the raised linkage, parts, or machine per local or national requirements. Never allow anyone to walk under or be near unblocked raised equipment. Avoid working or walking under raised blocked equipment unless you are assured of your safety.

When servicing or maintenance requires access to areas that cannot be reached from the ground, use a ladder or step platform that meets local or national requirements to reach the service point. If such ladders or platforms are not available, use the machine handholds and steps as provided. Perform all service or maintenance carefully.

Shop or field service platforms and ladders used to maintain or service machinery should be constructed and maintained according to local or national requirements.

Lift and handle all heavy parts with a lifting device of proper capacity. Be sure parts are supported by proper slings and hooks. Use lifting eyes if provided. Watch out for people in the vicinity.

SAFETY RULES

In lifting and handling heavy parts, slings must be of adequate strength for the purpose intended and must be in good condition.

Handle all parts with extreme care. Keep hands and fingers from between parts. Wear authorized protective equipment such as safety glasses, heavy gloves, safety shoes.

When using compressed air for cleaning parts use safety glasses with side shields or goggles. Limit the pressure to 207 kPa (30psi) according to local or national requirements.

Wear welders protective equipment such as dark safety glasses, helmets, protective clothing, gloves and safety shoes when welding or burning. Wear dark safety glasses near welding. DO NOT LOOK AT ARC WITHOUT PROPER EYE PROTECTION.

Wear proper protective equipment such as safety goggles or safety glasses with side shields, hard hat, safety shoes, heavy gloves when metal or other particles are apt to fly or fall.

Use only grounded auxiliary power source for heaters, chargers, pumps and similar equipment to reduce the hazards of electrical shock.

Keep maintenance area CLEAN and DRY. Remove water or oil slicks immediately.

Remove sharp edges and burrs from reworked parts.

Be sure all mechanics tools are in good condition. DO NOT use tools with mushroomed heads. Always wear safety glasses with side shields.

Do not strike hardened steel parts with anything other than a soft iron or non-ferrous hammer.

FOREWORD

Always furnish serial number if making an inquiry to dealer or factory about this machine.

Many equipment owners employ the Dealer's Service Department for all work other than routine lubrication and minor service. This practice is encouraged, as our Dealers are well informed and equipped to render efficient service by factory trained mechanics.

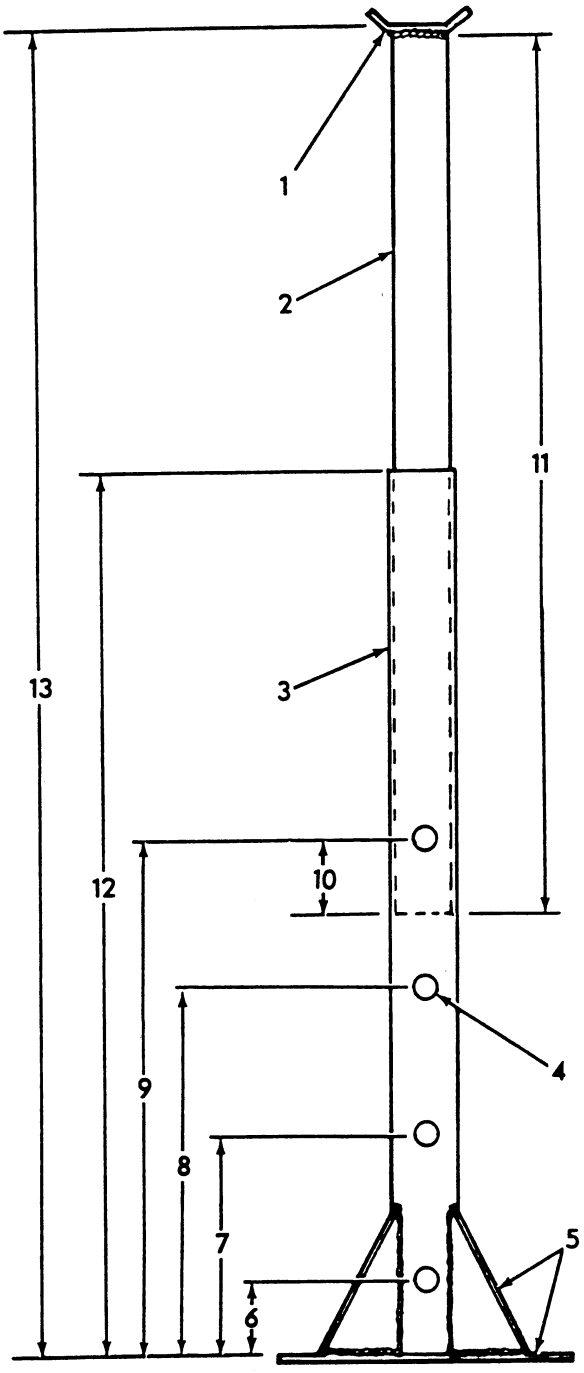
Illustrations show standard and optional items.

IMPORTANT

The information in this manual was current at the time of publication. It is our policy to constantly improve our product and to make available additional optional items. These changes may affect procedures outlined in this manual. If variances are observed, verify the information through your Dealer.

BOOM SUPPORT STAND

If necessary to hold the boom in the raised position, use a boom stand (Part No. 75300989) as shown below -- or fabricate a stand from the given dimensions.



1. Support, 8" x 8" (1/4" weld)
2. Steel pipe (O.D. 4.5")
   (Wall 0.337" min)
3. Steel pipe (O.D. 5.5")
   (Wall 0.375" min)
4. Holes, 1.56" dia.(use 1.5"x6"pin)
   (4 places in 5" pipe)
   (1 place in 4" pipe)
5. Bottom plate, 24" x 24"
   (thickness 0.375")
   Vertical plates (4) 9" x 12"
   (thickness 0.375")
   Weld (3/16") both sides of all four plates.
6. 6.0"
7. 18.0"
8. 30.0"
9. 42.0"
10. 6.0"
11. 72.0"
12. 72.0"
13. 108.0"

FIG.A BOOM STAND T-84262

TOPIC 1 GENERAL DESCRIPTION

1.1 SCOPE OF MANUAL

This manual contains a functional description and service procedures for the model FR10, 12 and 15 Wheel Loader implement hydraulic and power steering systems. The text within this manual is arranged under the following topic headings for ease of access to specific types of information.

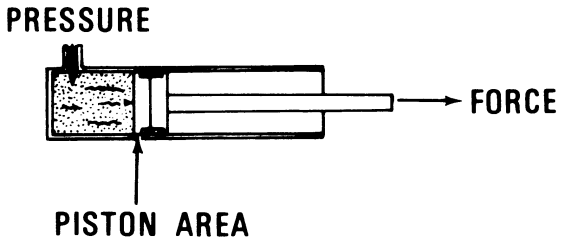
TOPIC	HEADINGS
1	General Description
2	Lubrication Specification
3	Performance Specification
4	Troubleshooting and Testing the Hydraulic System
5	Implement and Steering Pumps
6	Implement and Steering Valves
7	Hydraulic Cylinder Repair
8	Hydraulic Tank
9	Tools

1.2 INTRODUCTION TO HYDRAULICS

The fundamental principle upon which all hydraulic systems are based is known as Pascal's Law, which may be stated as follows:

Pressure applied to any part of a confined liquid is transmitted undiminished in all directions and acts with equal force on all equal areas of the surfaces confining the liquid and at right angles to them.

This principle as applied to a hydraulic cylinder causes a multiplication of hydraulic pressure to exert tremendous force. Oil under pressure is forced into one end of the cylinder and operates against the piston as shown in Fig. 1-1. If oil is introduced at a pressure of 69 bar (1000 psi), this same pressure is transmitted to each square centimeter (inch) area of the piston. If piston area is equal to 182.28 cm^2 (28.27 sq. in.), there is a total force of 12,821 kg (28,270 lbs.) being applied to the piston. The piston in turn transmits this force through mechanical linkage to its attached implement.



T-35095

FIG. 1-1 SINGLE ACTING HYDRAULIC CYLINDER

1.3 IMPLEMENT HYDRAULIC AND POWER STEERING SYSTEM COMPONENTS

1.3.1 GENERAL

The major components of the implement hydraulic system are a hydraulic tank, a tandem hydraulic pump, a demand valve, a control valve and various hydraulic cylinders. The power steering hydraulic system consists of the same hydraulic tank and demand valve, plus a hydraulic pump, a steering control valve and the steering cylinders.

1.3.2 HYDRAULIC TANK

Both the power steering system and the implement hydraulic system utilize the same hydraulic tank as their reservoir. The hydraulic tank contains two full flow filter elements, by-pass valves, a filler strainer and a suction line strainer.

The full flow oil filters, located inside the hydraulic tank, filters 100% of the oil after the oil reaches operating temperature. The spring loaded by-pass valve permits all or part of the oil to by-pass the filter if the filter elements become clogged or if the oil flow is restricted due to low temperature.

The filler strainer prevents dirt and particles from entering the system as oil is added to the tank. The suction line strainer prevents dirt and metal particles from being recirculated through the system.

1.3.3 IMPLEMENT PUMP

Figs.1-2, 1-3: The dual section, gear type hydraulic pump (19)(20) is externally mounted on the transmission housing and is connected to the engine crankshaft through the accessory drive gear train. The pump is in operation any time the engine is running, and its output volume varies with the speed at which it is driven.

The pump draws oil from the hydraulic tank through the suction line strainer located within the tank. Oil is carried around the outside of the pump gears and flows to two pressure lines. One pressure line is connected to the priority valve (22) and the other to the implement control valve.

1.3.4 STEERING PRIORITY VALVE

Figs.1-2 or 1-3: The priority valve (22) at low idle directs the full flow of the steering pump gear section (20) to the steering system -- while steering. The valve also keeps the steering system fully charged at all times. When not steering, the priority valve diverts the full steering pump flow to the implements. Also, when not steering, check valve (23) traps the steering system oil to maintain a fully charged system.

1.3.5 IMPLEMENT CONTROL VALVE

The implement control valve function is to direct the oil received from the implement hydraulic pump to the various work circuits on the loader. The implement control valve contains the operating spools, a main relief valve, circuit overload relief valves and various load check and anti-cavitation valves.

The main relief valve (17) limits pressure within the hydraulic system when an operating spool is in a "work" position. The circuit overload relief valves (7)(11) protect the bucket and linkage from overloads when excessive pressures are built up during loading, dozing or backdragging while the operating spool is in the neutral or "hold" position. The load check valves (3)(12)(14) prevent a loss of oil from either end of a hydraulic cylinder as the operating spool is being moved from one position to another. The anti-cavitation valve (4) allows oil to be transferred between the rod and tail ends of the boom cylinders to prevent voids or cavitation by ensuring that both ends of the cylinder are full of oil.

1.3.6 STEERING PUMP

The dual section, gear type, hydraulic pump is externally mounted on the transmission housing and connected to the engine crankshaft through the accessory drive gear train. The pump draws oil from the hydraulic tank and applies it to the priority valve.

1.3.7 STEERING CONTROL VALVE (Without Emergency Steering)

Fig. 1-2, oil from pump (20) flows to and through the priority valve (22), opens check valve (23) and flows to the steering control valve (24). If not actually steering (wheel in neutral -- center) the oil is returned to the priority valve (22) to equalize the pressure on each end of valve. This

moves the valve so that all oil from pump (20) joins the implement pump (19) flow to the implement control valve.

NOTE: Although the pump flows (steering and implement sections) combine, they must be flow-checked separately because they combine inside the implement control valve -- after the flow meter check port.

When the steering wheel is being turned, it also turns the "gerator" (meter) valve (25) to direct the oil to the cross-over valves (26), cushion valve (28) and steering cylinders (27). Refer to paragraph 1.3.7 (cross-over valves) and 1.3.8 (cushion valve).

1.3.8 CROSS-OVER RELIEF VALVES

Figs. 1-2, 1-3: The crossover relief valves (26) provide relief for the cylinders and hoses when the steering valve is in the neutral position. The housing is mounted on the steering valve and contains two relief valves and two anti-cavitation valves. The valves are not serviceable and are replaced as an assembly.

When the steering valve is in the neutral position, oil is trapped within the steering cylinders. When a force acts on the cylinders and pressure in the cylinders increases, the relief valve unseats and oil is permitted to flow around the relief through an internal passage to the anti-cavitation valve.

The pressurized oil from the relief opens and flows past the anti-cavitation valve to the opposite ends of the cylinders preventing cavitation.

1.3.9 CUSHION VALVE

Figs. 1-2, 1-3: The cushion valve (28) is located on the right side steering cylinder. The valve acts as a shock absorbing device when the steering valve neutralizes (and stops steering) as well as when steering begins.

MEMO

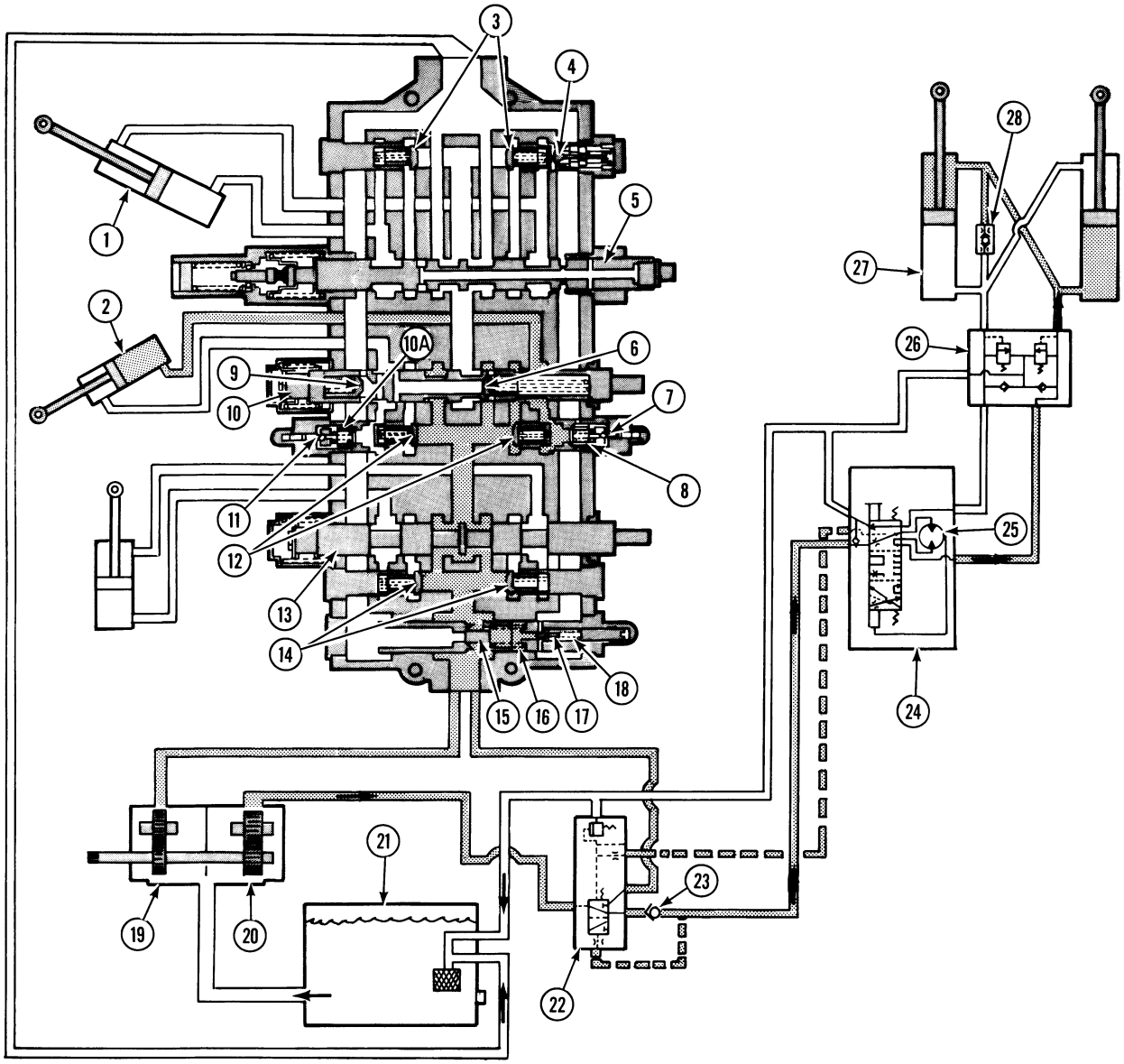


FIG. 1-2 (FR15) IMPLEMENT HYDRAULICS AND POWER STEERING T-83789
-- SCHEMATIC CONDITIONS --

- Engine at low idle
- Bucket dumping
- Boom in hold
- Steering wheel turning
- Not equipped w/emergency steering

1. Boom cylinders
2. Bucket cylinders
3. One-way check valves
4. Anti-cavitation valve
5. Boom Spool
6. Regenerative check valve
7. Backdragging relief valve
8. Relief piston
9. Sump return check valve
10. Bucket spool
10a. Relief piston
11. Dozing relief valve
12. Check valves
13. Special equipment spool
14. Check valves
15. Main relief valve piston
16. Spring
17. Relief piston
18. Spring
19. Implement pump (section)
20. Steering pump (section)
21. Oil tank
22. Main priority valve
23. One way check valve
23a. One way check valve
24. Steering control valve
25. Gerotor (metering valve)
26. Cross-over valves
27. Steering cylinders
28. Cushion valve

1.3.10 EMERGENCY STEERING CONTROL (Fig. 1-3) Special Equipment

NOTE: The conditions under which emergency steering will automatically become effective are:

. Engine off
. Machine moving
. Steering wheel turning

The ground drive pump (29) draws oil from the reservoir (21) through the check valve block (30); the purpose of the block is to allow emergency steering in either a forward or backward direction.

Oil from the pump (29) flows through the block to the secondary priority valve (31) and to the pressure switch and warning light (32); the switch is activated (closed) by pressurized oil to turn on the warning light (if the ignition switch is on.).

Oil flows through the secondary priority valve (31), opens the check valve (23a) and flows to the steering control valve (24); a portion of the oil flows through a small check valve (in the control valve) and flows back to the secondary priority valve (to hold it in position for directing oil to the steering valve). The main flow goes to the gerotor (meter) valve (25) which directs the oil to the cross-over valves (26) cushion valve (28) and steering cylinders (27). Refer to paragraph 1.3.7 and 1.3.8 for an explanation of cross-over and cushion valves.

When normal steering is taking place, engine running, the main pump flow is blocked from the secondary priority valve (31) by a one-way check valve (23A). But, the oil can flow to the right end of valve (31) pushing the valve to the left, opening emergency pump flow to sump; this, of course lowers the pressure in the emergency system and the warning light goes out.

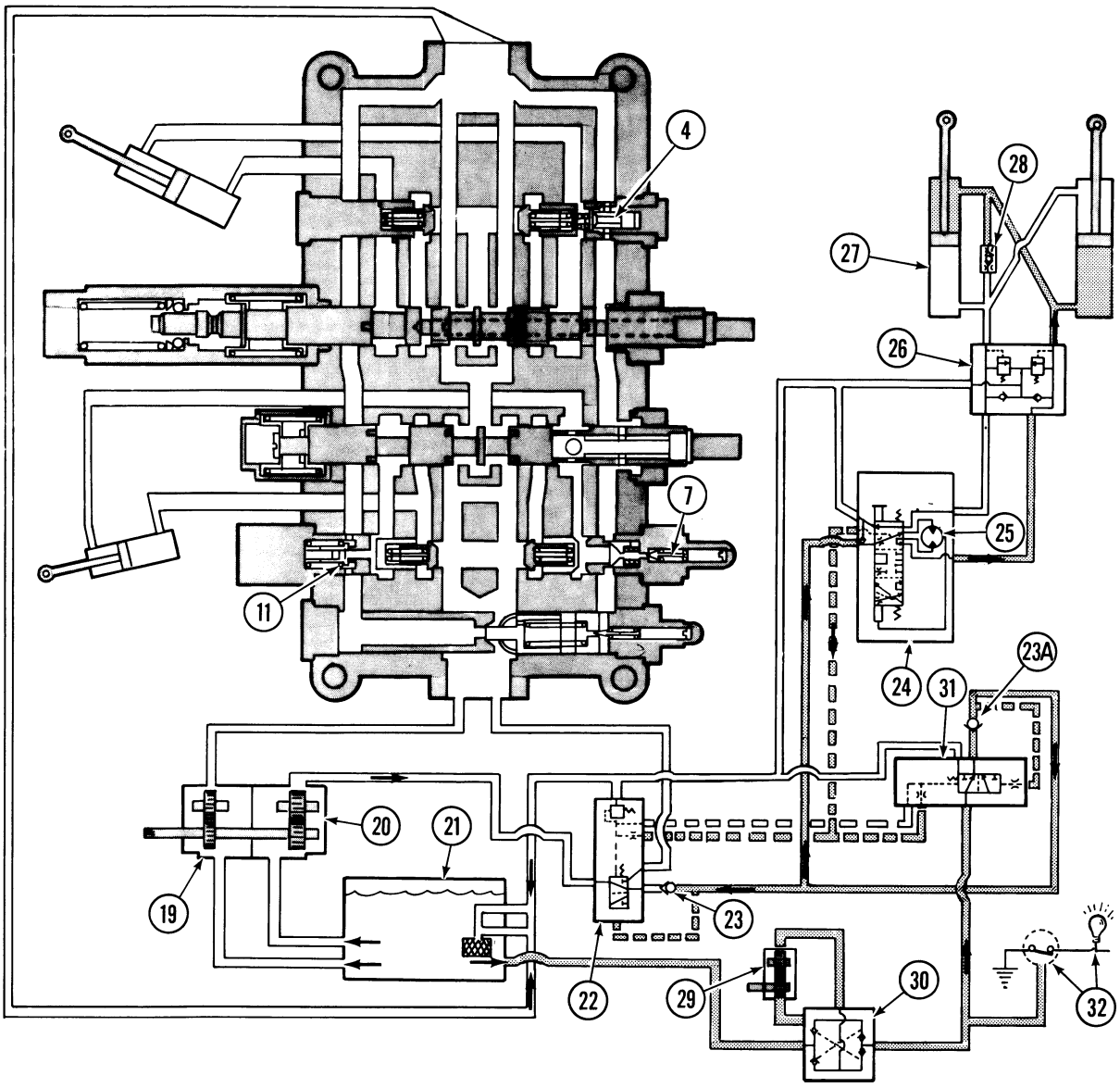


FIG. 1-3 (FR10,12) IMPLEMENT HYDRAULICS AND POWER STEERING T-83790
-- SCHEMATIC CONDITIONS --

- Engine off (ignition on)
- Bucket and boom in hold
- Machine moving (ground pump turning)
- Emergency steering equipped
- Steering wheel turning

4. Anti-cavitation valve
7. Backdragging relief valve
11. Dozing relief valve
19. Implement pump (section)
20. Steering pump (section)
21. Oil tank
22. Main priority valve
23. One-way check valve
24. Steering control valve
25. Gerotor (metering valve)
26. Cross-over valves
27. Steering cylinders
28. Cushion valve
29. Ground drive pump (emerg. steer.)
30. Check valve block
31. Secondary priority valve
32. Pressure switch and warning light

TOPIC 2 LUBRICATION SPECIFICATIONS

2.1 SERVICE

Hydraulic mechanisms are precision units and their continued trouble free operation is dependent on proper care. Dirt, particles of metal and packing can cause considerable trouble. Every precaution must be taken to keep the system clean. Always change filters as a set each (FR10, 12 -- 250 hours) (FR15 -- 500 hours), and drain and refill system each 2000 hours. Check oil level frequently and if necessary, add oil. Use only clean oil that meets specifications.

Refer to Operation and Maintenance Instruction Manual for detailed service instructions.

2.2 HYDRAULIC OIL

Oils used in a hydraulic system perform a dual function of lubrication and transmission of power. Oil must be selected with care. Whenever possible, use the assistance of a reputable supplier in purchasing hydraulic system oil.

Use oils meeting or exceeding one of the following specifications:

(1) Type C-3 Transmission Fluid (oil).
(2) Engine Oil T0-2 Qualified, API-CD
(3) MIL-L-2104C, API-CD

SYSTEM
CAPACITY: FR10, 12 -- 113L (30 Gals.)
FR15 -- 178L (47 Gals.)
VISCOSITY: SAE 10W, Year Around; if ambient temperature is consistantly above 38°C(100°F) use S.A.E. 20-20W.
NORMAL OPERATING TEMPERATURE: 82°C (180° F)

TOPIC 3 PERFORMANCE SPECIFICATIONS

FR10 WHEEL LOADER		S/N 46C,78Y and 58M00101-up		
ENGINE		Fiat 8065.24.091		
Firing order		1-3-5-6-2-4		
Low idle, (high idle)	rpm	750-825 (2550-2625)		
Converter stall	rpm	2375 (min.)		
Hydraulic pump stall	rpm	2375 (min.)		
Full stall (converter & implement)	rpm	1800 (min.)		
STEERING/BRAKES				
Steering pressure @low idle	psi	1800 (min.)	bar	124
Steering pressure @high idle	psi	1900-2100 (set)	bar	131-141
Steering pump @ high idle	gpm	See Implement Pump		
IMPLEMENT HYDRAULICS				
Main pressure @ high idle	psi	1750-1900	bar	120-131
Overload valve pressure, Raise	psi	None		
Overload valve pressure, Dump	psi	1250-1350	bar	86-93
Overload valve pressure (on Clam Bkt.)	psi	2150-2250	bar	148-151
Overload valve pressure, Retract	psi	2300-2500	bar	158-172
Pump flow @ high idle @1500 psi	gpm	62.8 (56 min.)Total	L/min	236 (204)
Impl. pump (section)	gpm	31.4 (28 min.)	L/min	118 (102)
Steer. pump (section)	gpm	31.4 (28 min.)	L/min	118 (102)
Impl. response time (empty) high idle				
Full raise	sec	6.3		
Dump @ full raise	sec	2.4		
Power down	sec			
Retract @ full raise	sec	2.1		

FR12 WHEEL LOADER		S/N 79M and 59U00101-up		
ENGINE		Fiat 8065.24.092		
Firing order		1-3-5-6-2-4		
Low idle, (high idle)	rpm	750-825 (2550-2625)		
Converter stall	rpm	2400 (min.)		
Hydraulic pump stall	rpm	2400 (min.)		
Full stall (converter & implement)	rpm	1900 (min.)		
STEERING/BRAKES				
Steering pressure @low idle	psi	1800 (min.)	bar	124
Steering pressure @high idle	psi	1900-2100 (set)	bar	131-141
Steering pump @ high idle	gpm	See Implement Pump		
IMPLEMENT HYDRAULICS				
Main pressure @ high idle	psi	1850-2000	bar	127-138
Overload valve pressure, Raise	psi	None		
Overload valve pressure, Dump	psi	1250-1350	bar	86-93
Overload valve pressure (on Clam Bkt.)	psi	2150-2250	bar	148-151

FR12 (con't)

PERFORMANCE SPECIFICATIONS

FR12 WHEEL LOADER (Con't)	S/N 79M and 59U00101-up			
Overload valve pressure, Retract	psi	2300-2500	bar	158-172
Pump flow @ high idle @1500 psi	gpm	62.8 (54 min.)Total	L/min	236 (204)
Impl. pump (section)	gpm	31.4 (28 min.)	L/min	118 (102)
Steer. pump (section)	gpm	31.4 (28 min.)	L/min	118 (102)
Impl. response time (empty) high idle				
Full raise	sec	6.3		
Dump @ full raise	sec	2.4		
Power down	sec	4.4		
Retract @ full raise	sec	2.1		

FR15 WHEEL LOADER	S/N 80U00101-up			
ENGINE		Fiat 8365.25.580		
Firing order		1-3-5-6-2-4		
Low idle, (high idle)	rpm	750-825 (2360-2460)		
Converter stall	rpm	2225 (min.)		
Hydraulic pump stall	rpm	2225 (min.)		
Full stall (converter & implement)	rpm	1850 (min.)		
STEERING/BRAKES				
Steering pressure @high idle (set)	psi	2450-2550	bar	169-176
Steering pressure @low idle (check)	psi	2200 (min.)	bar	152
Steering pump @ high idle	gpm	See Implement Pump		
IMPLEMENT HYDRAULICS				
Main pressure @ high idle	psi	1850-2000	bar	127-138
Overload valve pressure, Raise	psi	None		
Overload valve pressure, Dump	psi	875-1025	bar	60-71
Overload valve pressure (on Clam Bkt.)	psi	2150-2250	bar	148-151
Overload valve pressure, Retract	psi	2325-2475	bar	160-170
Pump flow @ high idle @1500 psi	gpm	86 (72 min.) Total	L/min	325 (272)
Impl. pump (section)	gpm	48 (43 min.)	L/min	182 (162)
Steer. pump (section)	gpm	38 (34 min.)	L/min	144 (128)
Impl. response time (empty) high idle				
Full raise	sec	6.0		
Dump @ full raise	sec	2.4		
Power down	sec	2.8		
Retract @ full raise	sec			

TOPIC 4 TROUBLESHOOTING AND TESTING THE HYDRAULIC SYSTEMS

4.1 METHODS OF TESTING

The two methods of testing a hydraulic system are by use of a pressure gauge or by use of a flow meter. Flow testing the system is the most advantageous in that more information is presented to the user. This decreases the time and effort involved in the troubleshooting process by eliminating much of the costly guess work.

PRESSURE GAUGE

A pressure gauge is an instrument that measures pressure only. A decrease in pressure will provide an indication of system leakage. The pressure gauge used in testing the loader hydraulic system must have a minimum capacity of 207 bar (211 kg/cm^2) (3000 psi).

FLOW METER

A flow meter is a device used to measure pressure, temperature and the volume of oil being pumped through a hydraulic system or circuit. Pressure is indicated in kilograms per square centimeter (kg/cm^2) or pounds per square inch (psi); temperature is indicated in degrees centigrade (^{o}C) or degrees fahrenheit (^{o}F); volume is indicated in liters per minute (L/min) or gallons per minute (gpm). The flow meter also contains a load valve, used to restrict oil flow through the meter, creating a variable pressure load against the hydraulic system. The temperature of the oil is important when making measurements with a flow meter. For best results, tests should be conducted at an oil temperature of 71-82^{o}C (160-180^{o}F). This temperature has been determined to provide the most accurate readings.

IMPORTANT: All tests must be made at identical temperatures or the value of the test may be inconclusive. Do not move steering wheel when making flow checks.

There are two common types of flow meters, the series type and the parallel type. The series type flow meter may be used in either a series or parallel hook-up; such meters will usually withstand back-pressure in the output line in excess of 207 bar (211 kg/cm^2)(3000 psi). The parallel type flow meter operates on a different principle and usually cannot be used where back-pressure exceeds 13.8-20.7 bar (14.1-21 kg/cm^2) (200-300 psi). The flow meter used in testing the loader hydraulic system must have a capacity of at least 568 L/min (150 gpm) and 207 bar (211 kg/cm^2)(3000 psi). All test hoses must be of the high pressure type, capable of withstanding pressures to the capacity of the flow meter.

IMPORTANT: If a parallel type flow meter is used at back-pressures in excess of the meter manufacturer's recommendations, the meter overload plugs will blow open and may damage the recording mechanism.

4.2 USE OF THE FLOW METER

When used correctly, either type of hook-up (series or parallel) will aid in isolating a problem within the hydraulic system. The parallel hook-up is the most advantageous in that each circuit of the system can be checked with one test hook-up. In a parallel hook-up, the flow meter is connected in parallel with the hydraulic system. This is accomplished by connecting the input line of the flow meter into the pressure line between the pump and the control valve. Since the output of a parallel type flow meter must be connected to an unrestricted return, it cannot be connected to the tank return line, therefore, it is placed into the tank filler hole. In a series hook-up a hydraulic line must be separated and the flow meters input and output lines each connected to one end of the separated line. This means that the meter has to be re-connected each time a different circuit is checked.

NOTE: Since the parallel hook-up is the most advantageous method of flow testing the hydraulic system, the series hook-up will not be discussed.

With the flow meter load valve open, and all control spools in "hold", oil will flow unrestricted, through the control valve to the tank return and through the flow meter to the tank filler hole. Placing one of the control spools in a work position will block the flow of oil through the control valve and force all of the oil through the flow meter. Partially closing the flow meter load valve will create a restriction through the meter, causing pressure in the circuit to raise and force some of the oil through the control spool to the work cylinder. When the cylinder piston reaches the extent of its travel all oil is again forced through the flow meter. When flow checks are made at various pressures, the flow meter will indicate the amount of system leakage and/or the amount of pump slippage by showing decreasing volume as pressure is raised with the meter load valve. For example: If a pump is capable of producing 322 L/min (85 gpm) at zero pressure, and is producing this amount, it means nothing. However, if the pump will produce 322 L/min (85 gpm) at zero pressure and 284 L/min (75 gpm) at near main relief valve pressure, the pump is good (within 20%) and that the work circuit under test is good. Suppose we then test with the control spool in the other position and the flow meter reading drops off to 246 L/min (65 gpm). By comparison of readings, we know that leakage is occuring in the second circuit. Further comparisons or analysis of the circuit will indicate the faulty part.

4.3 COMMON HYDRAULIC PROBLEMS

Some of the more common complaints about a faulty hydraulic circuit are that the implement is slow in functioning, the implement lacks power, or a combination of both. The speed at which an implement will function is directly proportional to the volume of oil applied to the implement cylinder. Power of the implement is directly proportional to pressure in the circuit.

In a hydraulic circuit, oil flow (or volume) is supplied by a hydraulic pump; pressure in the circuit is caused by restricting the flow of oil provided by the pump.

Since the pumps only function is to supply oil to the hydraulic circuit, it might be assumed that all implement speed problems are a direct result of pump failure. This, however, is not usually the case. Oil flow, or volume, from a pump is also dependent upon the speed (rpm) of the pump. Since the pump is driven by the engine of the machine, low engine rpm will result in a slow hydraulic system. The inability of the pump to obtain enough oil is another probability. This could be caused by a clogged screen or filter, a leak in the suction line, or by not enough oil in the hydraulic tank. A badly worn hydraulic pump is capable of supplying normal volume at low pressure; however, as pressure is raised, volume will decrease. Generally the pump is designated as having failed if volume falls off 20%, or more, when operating at 75% of relief valve pressure. Since oil cannot be compressed, pressure problems are not related to the pump if the pump is capable of supplying any oil at all to the pressurized circuit.

Power (pressure) problems are caused by an internal or external leak in the hydraulic circuit. An internal leak may be due to such things as faulty piston packing in a hydraulic cylinder, a scored or worn control valve, or a defective or misadjusted relief valve, allowing oil to leak past the work unit to the tank. An external leak is obvious as oil is leaking from a component or hydraulic line onto the ground. Since oil will follow the path of least resistance, both implement speed and power will be affected if the leak is large enough.

4.4 ISOLATION OF PROBLEMS

Problems that occur within a hydraulic system can be catagorized as those that affect overall operation of the system, or those that affect a particular circuit (or circuits) within the system.

When diagnosing a hydraulic problem, it is best to list all components of the hydraulic system that are common to the circuit or circuits with the problem. Priority should then be assigned to all components listed as to their probability of failure, misadjustment, etc. Components with the highest priority should be checked first and those with the lowest priority checked last.

When establishing priority, consideration should also be given as to the ease in which a component can be checked. Make the easy checks first, even if the component is the least suspect. While it is possible that two components could fail and cause the same symptoms in two different circuits, the probability is slight. Using this approach to isolate problems will provide you with a logical step-by-step troubleshooting procedure.

4.5 SYSTEM TESTS

The following paragraphs are checks of various items that will cause system related problems.

CHECKING ENGINE POWER UNDERLOAD

This check will determine if the engine, under load, will turn the hydraulic pump fast enough to supply the specified volume.

NOTE: Hydraulic pump volume and efficiency rise as engine rpm rises. Therefore, if implement action is slow the engine may be at fault.

==========

⚠ WARNING **Warn all people who may be servicing or working around machine before starting engine.**

==========

.. Never attempt to operate machine or attachment except when seated in the operator's seat. Keep head, body, limbs, hands and feet inside the operator's compartment to reduce exposure to hazards outside the operator's compartment.

==========

⚠ WARNING **Do not run the engine of this machine in closed areas with out proper ventilation to remove deadly exhaust gases.**

==========

⚠ WARNING **Observe all start up and shut down procedures and WARNINGS listed in the Operation and Maintenance Instruction Manual.**

Check the torque converter/transmission operating temperature. Check engine high idle rpm and adjust it to:

FR10, 12 --- 2550-2625 rpm
FR15 ------- 2360-2460 rpm

With right brake (left neutralizes transmission) fully applied, place transmission control lever in high forward, gradually increase engine rpm to full throttle. Decrease engine speed and return transmission lever to neutral. The rpm obtained at full throttle in this manner is known as the converter stall speed.

If specified converter stall speed cannot be attained, troubleshoot engine and/or torque converter and transmission before proceeding.

FR10 --- 2375 rpm (min.)
FR12 --- 2400 rpm (min.)
FR15 --- 2225 rpm (min.)

CHECK HYDRAULIC OIL LEVEL

Check the oil level of the hydraulic system. The oil must be visible about midway in the sight gauge.

CHECK CONDITION OF HYDRAULIC OIL

Check hydraulic oil for foaming. If foaming is present, check all suction lines for leaks. Make certain that all clamps are tight. If suction lines are alright, replace the oil with a non-foaming oil that meets specifications. Foaming will cause erratic operation of all implements and shorten pump life.

CHECK FILTER AND CONTAMINANT SEPARATORS

Replace filter and clean contaminant separator, screens and magnets in the hydraulic tank. Refer to the Operation and Maintenance Instruction Manual for replacement and cleaning procedures.

4.6 FLOW TESTING THE IMPLEMENT HYDRAULIC SYSTEM

NOTE: Although the implement and steering pump flows combine, the system flows must be checked separately. For steering flow checking, refer to paragraph 4.8.

TEST CONNECTIONS

Provisions are built into the wheel loaders for flow meter test connections, Fig. 4-1.

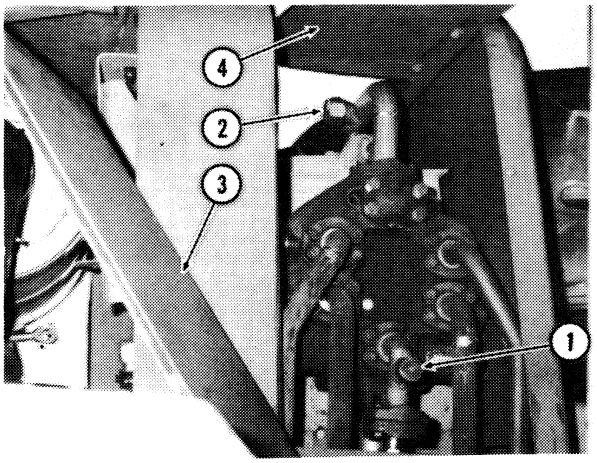


FIG. 4-1 IMPLEMENT CIRCUIT, FLOW METER CONNECTIONS T-84122

1. Implement flow meter connection (pressure side)
2. Implement flow meter connection (return side)
3. Access panel (side)
4. Access panel (top)

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⚠ DANGER **Fluid under pressure. Always lower hydraulic equipment to ground. Shut off engine, move control levers to each position several times and loosen and retighten hydraulic tank filler cap to relieve trapped pressure before loosening hydraulic connections.**

Connect the inlet hose of the flow meter to the port in control valve inlet elbow (1). Remove the hydraulic tank filler cap and filler strainer. Place the outlet hose of the flow meter in hydraulic tank return line port (2).

FLOW TESTS

Make certain the flow meter is connected properly and be sure flow meter load valve is fully opened.

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⚠ WARNING **Before moving machine or attachments be sure exposed people in the area are clear of the machine. Walk completely around machine before mounting. Sound horn.**

==========

⚠ WARNING **Never attempt to operate machine or attachment except when seated in the operator's seat. Keep head, body, limbs, hands and feet inside the operator's compartment to reduce exposure to hazards outside the operator's compartment.**

==========

⚠ WARNING **Warn all people who may be servicing or working around machine before starting engine.**

==========

.. Do not run engine of this machine in closed areas without proper ventilation to remove deadly exhaust gases.

==========

⚠ WARNING **Keep people clear of attachments and tools while in raised position, to prevent possible injury.**