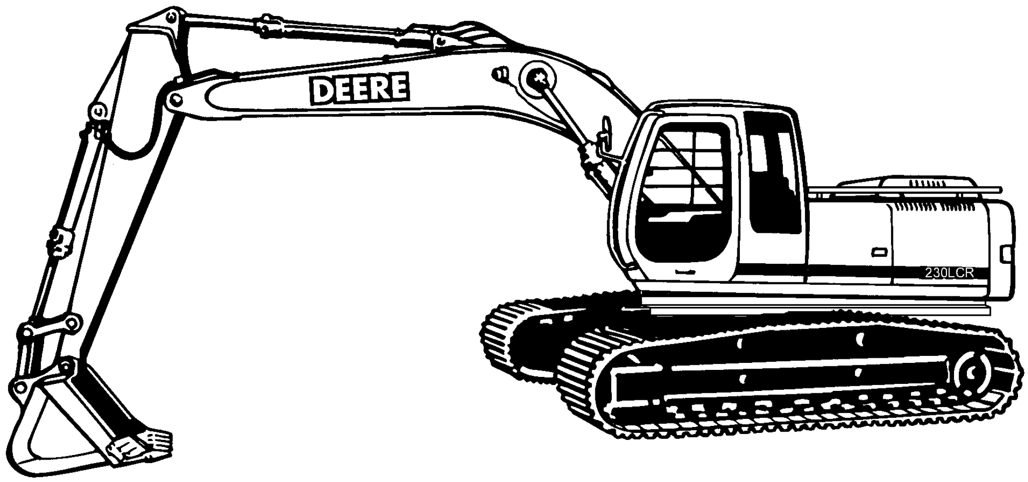
TECHNICAL MANUAL

UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

HYDRAULIC EXCAVATOR
JOHN DEERE
MODEL 230LCR
NSN 3805-01-463-0804

AND

MODEL 230LCRD WITH ROCK DRILL
NSN 3805-01-463-0806



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HEADQUARTERS, DEPARTMENT OF THE ARMY

15 FEBRUARY 2000

INSERT LATEST UPDATED PAGES. DESTROY SUPERSEDED DATA.

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Dates of issue for original and updated pages are:

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Technical Manual
No. 5-3805-280-24-1

HEADQUARTERS,
DEPARTMENT OF THE ARMY
Washington, DC, *15 February 2000*

UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

HYDRAULIC EXCAVATOR
JOHN DEERE
MODEL 230LCR
NSN 3805-01-463-0804

AND

MODEL 230LCRD WITH ROCK DRILL
NSN 3805-01-463-0806

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028-2 (Recommended Changes to Equipment Technical Publications), through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is http://aeps.ria.army.mil. If you need a password, scroll down and click on “ACCESS REQUEST FORM”. The DA Form 2028 is located in the ONLINE FORMS PROCESSING section of the AEPS. Fill out the form and click on SUBMIT. Using this form on the AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax or email your letter, DA Form 2028, or DA Form 2028-2 direct to: Commander, U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-LC-CI, Rock Island, IL 61299-7630. The email address is AMSTA-LC-CI@ria.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.

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WARRANTY

1. **General.** This section explains the contractor's warranty for the Hydraulic Excavator (HYEX), including all of its components and subassemblies. It also contains information, instructions, methods and forms required to obtain services and/or supplies and for processing claims for items covered under warranty for the HYEX. If additional warranty information is required for the HYEX, contact your local Warranty Control Office/Officer (WARCO) or TACOM-WRN Logistics Assistance Representative (LAR). If your WARCO or TACOM LAR is not available, contact TACOM-WRN. The numbers at TACOM to call are DSN 786-7215/(810) 574-7215, DSN 786-7420/(810) 574-7420, or DSN 786-8297/(810) 574-8297. The caller should be prepared to provide: (1) name, (2) telephone number and/or electronic address, (3) complete unit designation, (4) identification of the vehicle to include serial number(s) and (5) a brief description of the problem.

2. **Coverage Specific.** The information and data contained in this Technical Manual applies to the U.S. Army's Hydraulic Excavator (HYEX), model number 230LCR, NSN 3805-01-463-0804 and model number 230LCRD, NSN 3805-01-463-0806. The HYEX is manufactured by Deere & Company, Moline, IL under contract number DAAE07-98-D-S009.

3. **Claim Procedures.** DA Form 2407, along with information and instructions provided by the contractor at time of delivery of the HYEX, shall be used to process warranty claims.

4. **Claim Denial/Disputes.** All denials or disputes will be handled by TACOM. The contact point for warranty claim denials or disputes is:

   Commander
   U.S. Army Tank-Automotive and Armaments Command
   ATTN: AMSTA-LC-CJBB
   Warren, MI 48397-5000

   Telephone: DSN 786-5314
   Commercial: (810) 574-5314

5. **Local WARCO.** Upon completion of warranty actions by the contractor, the WARCO shall complete and provide a copy of DA Form 2407 to TACOM for information and warranty tracking purposes only. **NOTE**: The DA Form 2407 shall be stamped or otherwise clearly marked **"FOR INFORMATION ONLY"**. Send the completed DA Form 2407 to:

   Commander
   U.S. Army Tank-Automotive and Armaments Command
   ATTN: AMSTA-LC-CJCB
   Warren, MI 48397-5000

   Telephone: DSN 786-7215
   Commercial: (810) 574-7215

   Forms may also be faxed to TACOM. Fax the forms to: DSN 786-5605, Commercial - (810) 574-5605. Include ATTN: AMSTA-LC-CJCB on all related materials being faxed to TACOM.

INTRODUCTION

READ THIS MANUAL carefully to learn how to operate and service your machine correctly. Failure to do so could result in personal injury or equipment damage. This manual and safety signs on your machine may also be available in other languages. (See your John Deere dealer to order.)

THIS MANUAL SHOULD BE CONSIDERED a permanent part of your machine and should remain with the machine when you sell it.

MEASUREMENTS in this manual are given in both metric and customary U.S. unit equivalents. Use only correct replacement parts and fasteners. Metric and inch fasteners may require a specific metric or inch wrench.

RIGHT-HAND AND LEFT-HAND sides are determined by facing in the direction of forward travel.

SECTION NUMBERS (e.g., 01, 02, 16) of the Repair Chapters 11 through 24 refer to the John Deere Functional Group Coding system.

WARRANTY is provided as part of John Deere's support program for customers who operate and maintain their equipment as described in this manual. The warranty is explained on the warranty certificate, which you should have received from your dealer.

This warranty provides you the assurance that John Deere will back its products where defects appear within the warranty period. In some circumstances, John Deere also provides field improvements, often without charge to the customer, even if the product is out of warranty. Should the equipment be abused, or modified to change its performance beyond the original factory specifications, the warranty will become void and field improvements may be denied. Setting fuel delivery above specifications or otherwise overpowering machines will result in such action.

CALIFORNIA PROPOSITION 65 WARNING

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

CHAPTER 1

SECTION 9000

GENERAL INFORMATION

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Group 01
Safety

FOLLOW SAFE PROCEDURES

Unsafe work practices are dangerous. Understand service procedure before doing work; do not attempt shortcuts.

TS231 –19–07OCT88

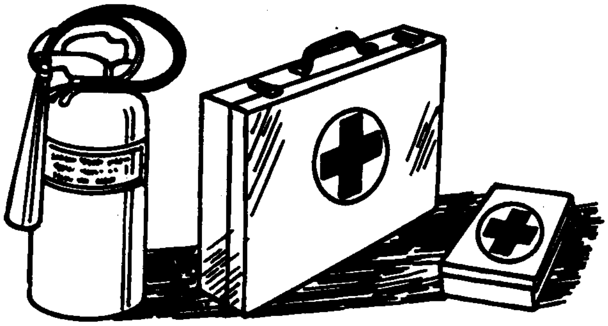
TX,05,FF1611 –19–14JUN90–1/1

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



TS291 –UN–23AUG88

DX,FIRE2 –19–03MAR93–1/1

HANDLE FLUIDS SAFELY—AVOID FIRES

Handle fuel with care; it is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks. Always stop engine before refueling machine. Fill fuel tank outdoors.

TS202 –UN–23AUG88

TX,05,FF1622 –19–14JUN90–1/2

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

Do not store oily rags; they can ignite and burn spontaneously.

TS227 –UN–23AUG88

TX,05,FF1622 –19–14JUN90–2/2

PREVENT BATTERY EXPLOSIONS

TS204 –UN–23AUG88

Keep sparks, lighted matches, and open flame away from the top of battery. Battery gas can explode.

Never check battery charge by placing a metal object across the posts. Use a volt-meter or hydrometer.

Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).

DX,SPARKS –19–03MAR93–1/1

HANDLE CHEMICAL PRODUCTS SAFELY

TS1132 –UN–26NOV90

Direct exposure to hazardous chemicals can cause serious injury. Potentially hazardous chemicals used with your machine include such items as lubricants, coolants, paints, and adhesives.

A Material Safety Data Sheet (MSDS) provides specific details on chemical products: physical and health hazards, safety procedures, and emergency response techniques.

Check the MSDS before you start any job using a hazardous chemical. That way you will know exactly what the risks are and how to do the job safely. Then follow procedures and recommended equipment.

See your authorized dealer for MSDS's on chemical products used with your machine.

TX,05,DH2500 –19–02OCT92–1/1

PREVENT ACID BURNS

Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

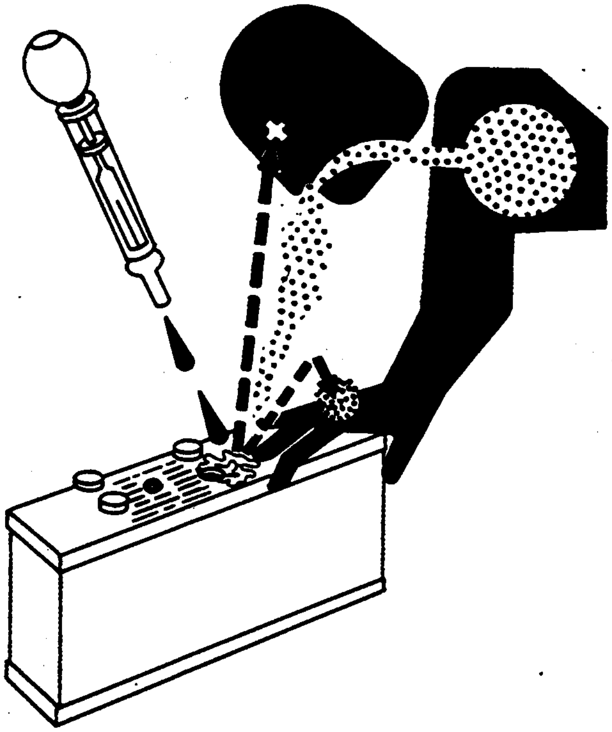
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 15—30 minutes. Get medical attention immediately.

If acid is swallowed:

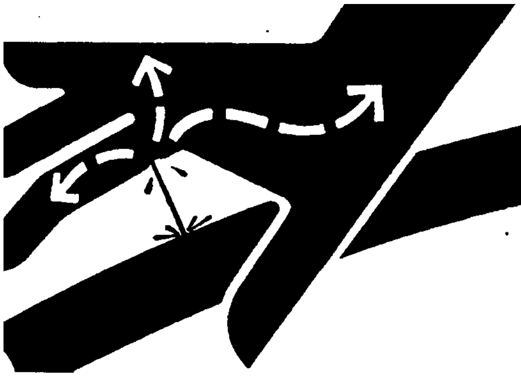
1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 2 L (2 quarts).
3. Get medical attention immediately.



TS203 –UN–23AUG88

DX,POISON –19–21APR93–1/1

AVOID HIGH-PRESSURE FLUIDS



X9811 –UN–23AUG88

Escaping fluid under pressure can penetrate the skin causing serious injury.

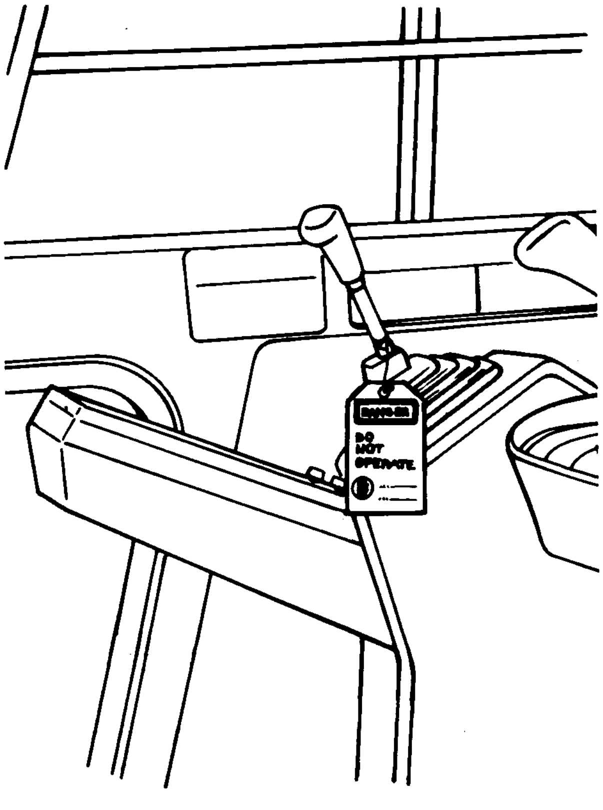
Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.

DX,FLUID –19–03MAR93–1/1

WARN OTHERS OF SERVICE WORK



T7273AP –UN–08JUN90

Unexpected machine movement can cause serious injury.

Before performing any work on the machine, attach a "Do Not Operate" tag on the right control lever.

TX,05,RR,566 –19–23JUL91–1/1

PARK MACHINE SAFELY

Before working on the machine:

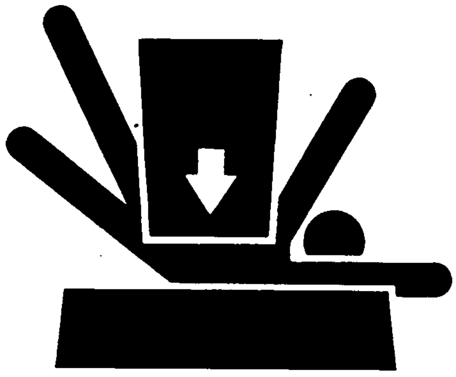
- Park machine on a level surface.
- Lower bucket to the ground.
- Turn auto-idle switch off.
- Run engine with engine RPM dial at 1/3 position for 2 minutes.
- Move engine RPM dial to slow idle position.
- Turn key switch to OFF. Remove key from switch.
- Pull pilot control shutoff lever to locked position.
- Allow engine to cool.

TX,05,DH5002 –19–28MAY96–1/1

SUPPORT MACHINE PROPERLY

Always lower the attachment or implement to the ground before you work on the machine. If you must work on a lifted machine or attachment, securely support the machine or attachment.

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load. Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.



TS229 –UN–23AUG88

DX,LOWER –19–04JUN90–1/1

OPERATE ONLY FROM OPERATOR'S SEAT

Avoid possible injury or machine damage. Do not start engine by shorting across starter terminals.

NEVER start engine while standing on ground. Start engine only from operator's seat.

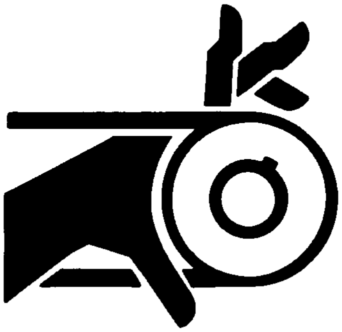
T6607AO –UN–18OCT88

TX,05,FF1615 –19–14JUN90–1/1

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

To prevent accidents, use care when working around rotating parts.



T7273AS –UN–08JUN90

TX,05,RR,572 –19–12JUN90–1/1

AVOID POWER LINES

Serious injury or death can result from contact with electric lines.

Never move any part of the machine or load closer to electric line than 3 m (10 ft) plus twice the line insulator length.

T7273AD –UN–08JUN90

TX,05,RR,594 –19–12JUN90–1/1

USE HANDHOLDS AND STEPS

Falling is one of the major causes of personal injury.

When you get on and off the machine, always maintain a three point contact with the steps and handrails and face the machine. Do not use any controls as handholds.

Never jump on or off the machine. Never mount or dismount a moving machine.

Be careful of slippery conditions on platforms, steps, and handrails when leaving the machine.

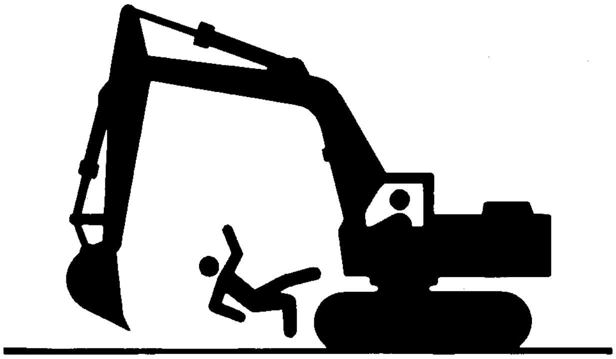
T6981AN –UN–15JUN89

TX,05,DH832 –19–16MAR92–1/1

KEEP RIDERS OFF MACHINE

Only allow the operator on the machine. Keep riders off.

Riders on machine are subject to injury such as being struck by foreign objects and being thrown off the machine. Riders also obstruct the operator’s view resulting in the machine being operated in an unsafe manner.



T7273AH –UN–08JUN90

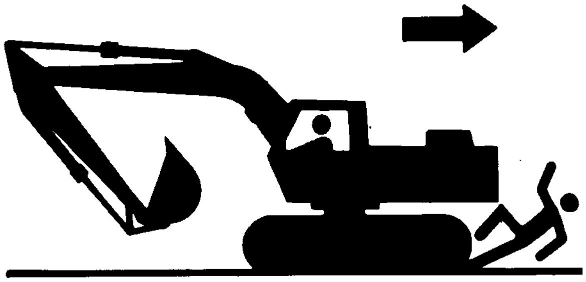
TX,05,RR,560 –19–05OCT90–1/1

MOVE AND OPERATE MACHINE SAFELY

Bystanders can be run over. Know the location of bystanders before moving, swinging, or operating the machine.

Always keep the travel alarm in working condition. It warns people when the machine starts to move.

Use a signal person when moving, swinging, or operating the machine in congested areas. Coordinate hand signals before starting the machine.



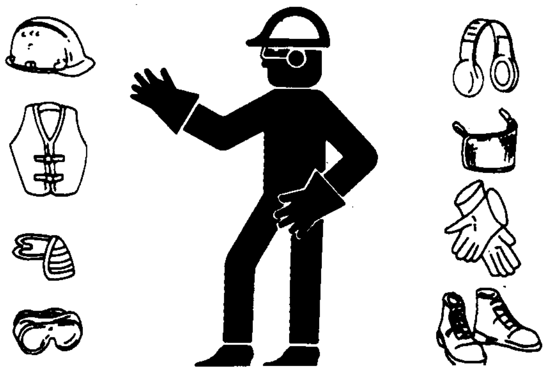
T7273AL –UN–08JUN90

TX,05,FF1806 –19–05OCT90–1/1

WEAR PROTECTIVE CLOTHING

Wear close fitting clothing and safety equipment appropriate to the job.

Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.

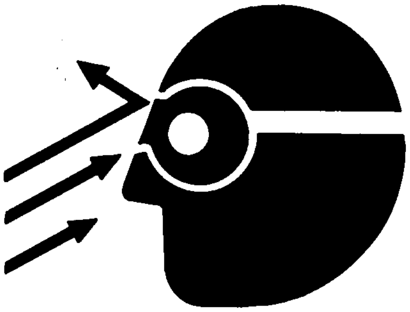


TS206 –UN–23AUG88

DX,WEAR2 –19–03MAR93–1/1

PROTECT AGAINST FLYING DEBRIS

Guard against injury from flying pieces of metal or debris; wear goggles or safety glasses.



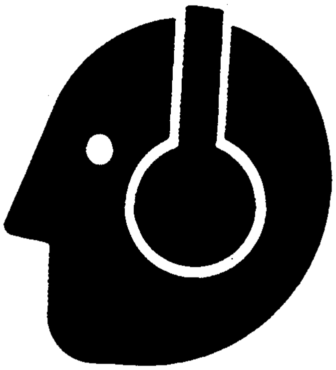
T6642DK –UN–18OCT88

TX,05,FF1613 –19–14JUN90–1/1

PROTECT AGAINST NOISE

Prolonged exposure to loud noise can cause impairment or loss of hearing.

Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

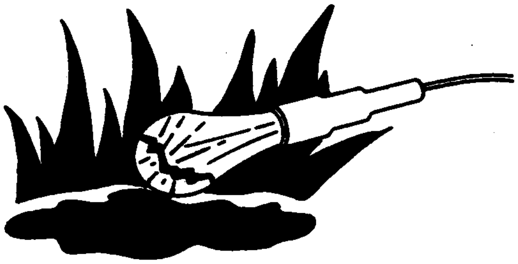


TS207 –UN–23AUG88

DX,NOISE –19–03MAR93–1/1

ILLUMINATE WORK AREA SAFELY

Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.



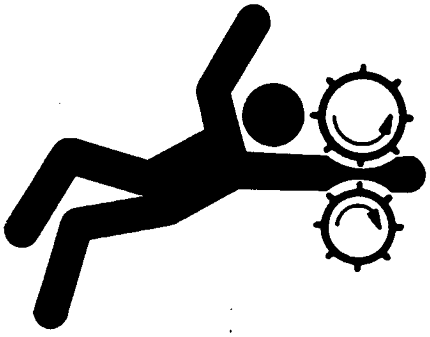
TS223 –UN–23AUG88

TX,05,FF1623D –19–09JUL90–1/1

SERVICE MACHINES SAFELY

Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



TS228 –UN–23AUG88

DX,LOOSE –19–04JUN90–1/1

REMOVE PAINT BEFORE WELDING OR HEATING

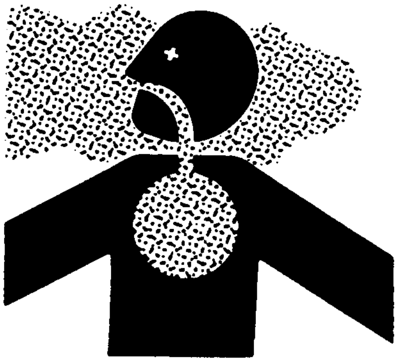
Avoid potentially toxic fumes and dust.

Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

Remove paint before welding or heating:

- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.



TS220 –UN–23AUG88

DX,PAINT –19–03MAR93–1/1

AVOID HEATING NEAR PRESSURIZED FLUID LINES

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area.

TS953 –UN–15MAY90

DX,TORCH –19–03MAR93–1/1

BEWARE OF EXHAUST FUMES

Prevent asphyxiation. Engine exhaust fumes can cause sickness or death.

If you must operate in a building, be positive there is adequate ventilation. Either use an exhaust pipe extension to remove the exhaust fumes or open doors and windows to bring enough outside air into the area.

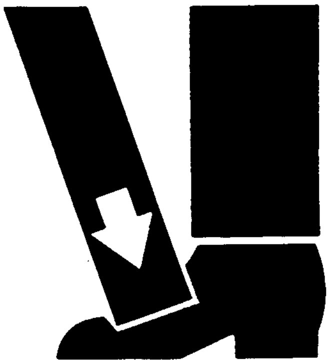
T6458AO –UN–18OCT88

02T,05,J9 –19–07JAN91–1/1

USE PROPER LIFTING EQUIPMENT

Lifting heavy components incorrectly can cause severe injury or machine damage.

Follow recommended procedure for removal and installation of components in the manual.



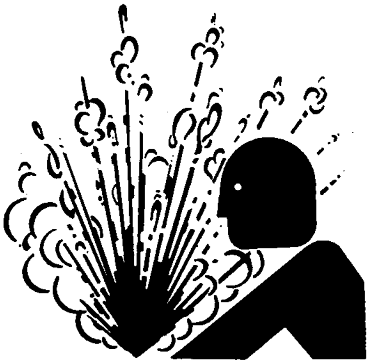
TS226 –UN–23AUG88

DX,LIFT –19–04JUN90–1/1

SERVICE COOLING SYSTEM SAFELY

Explosive release of fluids from pressurized cooling system can cause serious burns.

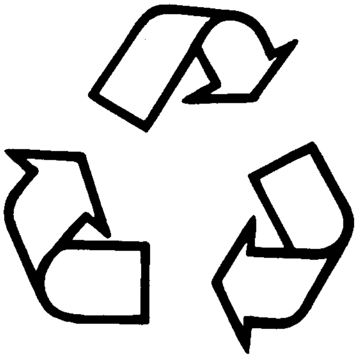
Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.



TS281 –UN–23AUG88

DX,RCAP –19–04JUN90–1/1

DISPOSE OF WASTE PROPERLY



TS1133 –UN–26NOV90

Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with your machine include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

Do not pour waste onto the ground, down a drain, or into any water source.

Air conditioning refrigerants escaping into the air can damage the Earth’s atmosphere. Government regulations may require a certified air conditioning service center to recover and recycle used air conditioning refrigerants.

Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your authorized dealer.

TX,05,DH2502 –19–26AUG92–1/1

WORK IN A CLEAN AREA

Before starting a job, clean the work area. Remove objects that may be a safety hazard to the mechanic or bystanders.

TX,05,FF1624 –19–14JUN90–1/1

USE TOOLS PROPERLY

Use tools appropriate to the work. Makeshift tools, parts, and procedures can create safety hazards.

Use power tools only to loosen threaded tools and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

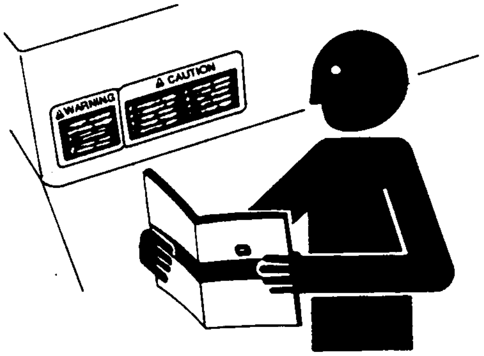
Use only recommended replacement parts. (See Parts Catalog.)

TS779 –UN–08NOV89

TX,05,FF1614 –19–14JUN90–1/1

REPLACE SAFETY SIGNS

Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.



TS201 –UN–23AUG88

DX,SIGNS1 –19–04JUN90–1/1

LIVE WITH SAFETY

Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

TS231 –19–07OCT88

DX,LIVE –19–25SEP92–1/1

BATTERY TERMINALS, LIFTING EQUIPMENT, DRY CLEANING SOLVENT AND COMPRESSED AIR

WARNING: Avoid possible injury. Disconnect the negative terminal first and reconnect the negative terminal last when disconnecting/reconnecting battery terminals.

WARNING: When lifting equipment, ensure that the lifting device is capable of supporting the desired weights and the inspection date stamped on the lifting device has not expired.

WARNING: Dry cleaning solvent PD-680 Type III is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don’t breathe vapors. Do not use near open flames or excessive heat. The flash point is 200°F (93°C). If you become dizzy while using solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

WARNING: Compressed air used for cleaning purposes shall not exceed 30 psi. Use only with effective chip guarding and personnel protective equipment (goggles/shield/gloves, etc.).

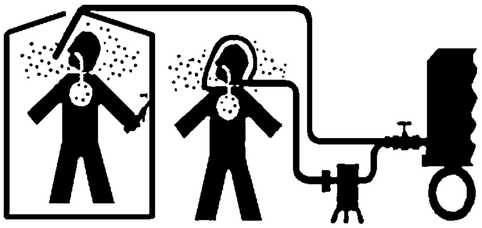
CED,OUOE042,40 –19–18OCT99–1/1

Safety Signs

Look for these signs on machine, which points out potential hazards to the safety of you and others. Read and understand thoroughly. Heed warnings and follow instructions. If you do not understand, inform your supervisor.

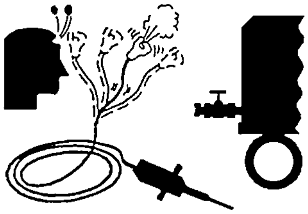
⚠ DANGER **(Red Background)**	Indicates the presence of a hazard which WILL cause serious injury, death or property damage, if ignored.
⚠ WARNING **(Orange Background)**	Indicates the presence of a hazard which CAN cause serious injury, death or property damage, if ignored.
⚠ CAUTION **(Yellow Background)**	Indicates the presence of a hazard which WILL or can cause injury or property damage, if ignored.
NOTICE **(Blue Background)**	Indicates important set-up, operating or maintenance information.

DANGER



Air discharged from this machine can contain carbon monoxide or other contaminants which will cause serious injury or death. Do not breathe this air.

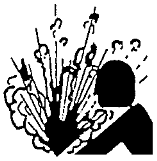
WARNING



Trapped air pressure. Can cause serious injury or death.

Close service valve and operate tool to vent trapped air before performing any service.

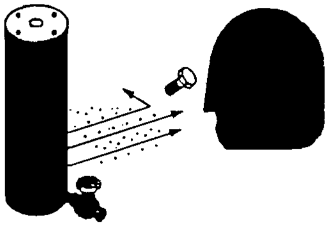
WARNING



Hot pressurized fluid.
Can cause serious burns.

Do not open radiator while hot.

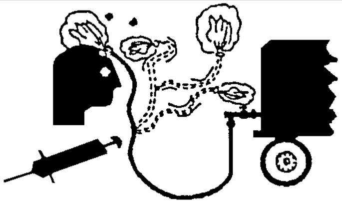
WARNING



High pressure air. Can cause serious injury or death.

Relieve pressure before removing filler plugs/caps, fittings or covers.

WARNING



Disconnected Air Hoses Whip. CAN cause serious injury or death.

When using air tools attach safety device (OSHA Valve) at source of air supply for each tool.

WARNING

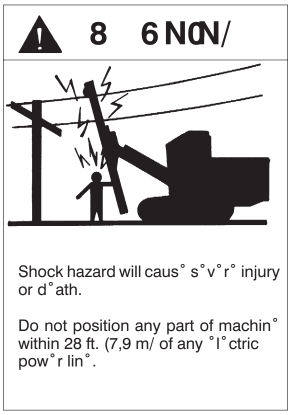
Combustible Gas. CAN cause serious burns, blindness or death.

Keep sparks and open flames away from batteries.

DRILLING

Before starting work, the operator will make sure there are no buried electrical, gas, water or other pipes or lines.

Always be aware of previously drilled holes, and where they are located : any open hole can cause severe injury to the operator or someone else. The loss of tools, drill rods, drill bits or any other item can occur.



When rising the guide, take care of any overhead lines.

Always maintain a minimum distance of 25 Ft. (7.6 m) distance between the machine and any overhead lines during any operation.

The operator will make sure that everybody stands clear from the machine in operation and stays at a distance of 7 meters (25 ft.).

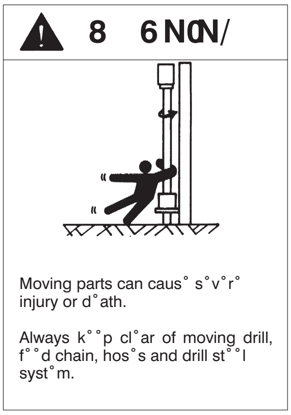
Nevertheless, some operations may need people to enter the restricted area (checking of coupling temperature during feed thrust adjustment for instance).

On such an occasion :

- the operator must supervise, from the cabin, the safety of the service man doing the work. He must be ready to activate the cabin emergency stop if need be.
- communication must be established in a reliable manner.

Make sure any hand signal will be perfectly understood.

- the operator must make sure the following safety decal is affixed on the drill guide to warn the service man of risks incurred.



- the service man must be informed about the use of the emergency stop mounted on the guide.

Always have the cabin door closed and the dust collector running when drilling to prevent respiratory damage.

Keep all work areas clean and orderly.

MAINTENANCE

Keep hands, arms, legs and clothing away from moving or rotating parts.

Only use genuine replacement parts.

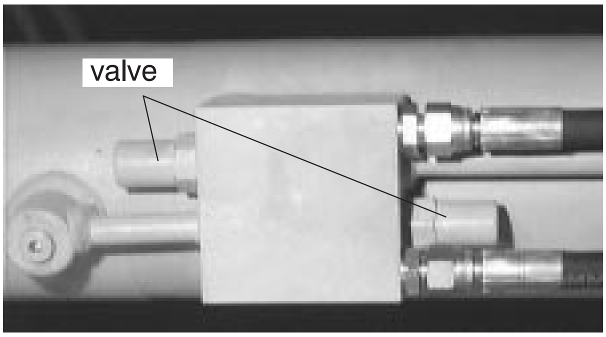
Stopping the drill for maintenance or bit change etc...

Prior to leaving the operators compartment, the excavators hydraulic safety arm must be raised to lock in the machines safety switch. This renders all controls inoperable thus preventing any unwanted movement.

Hydraulic cylinder

The hydraulic cylinder is equipped with 2 load–sustaining valves.

The load–sustaining valves allow the disconnecting of the hydraulic hoses from the cylinder if they need to be changed. But **:**



Never disconnect a valve from the cylinder without supporting the controlled element (drill guide ...).

Burn prevention

At operating temperature, the hydraulic tank, circuit and components are hot and can be under pressure. Any contact can cause severe burns.

Always release the pressure and wait for cooling before intervening on the hydraulic circuit.


W RNING

Hot surfaces.
can cause injury.

Always be sure
surfaces are cool
before touching.

Fire prevention

Fuel or hydraulic oil leaked or spilled onto hot surfaces or electrical components can cause a fire.

Repair immediately any leaks.

Regularly clean the machine to remove all flammable materials such as fuel, oil and other debris.

Always use approved safety solvent when cleaning parts or the machine.

Have all loose electrical wires connected and tight before operating the machine.

Prior to any welding operation, make sure that the surfaces and their environment are free of flammable debris.

Respiratory damage prevention

Dust coming out from the dust collector fan indicates that one or several filter elements are damaged.

Change the damaged elements immediately.

Always dismount all the filters elements to check the functioning of the automatic filter cleaning sequence.

Compressed air

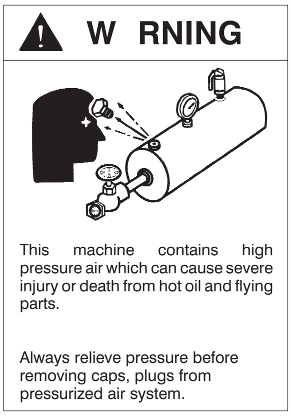
Compressed air can be dangerous.

Never point an air hose at yourself or co–workers.

Be sure all hoses and fittings are tightly secured.

A loose hose not only leaks but can come completely off and while whipping under pressure, can injure the operator and others in the area.

Never disconnect a pressurized air hose.

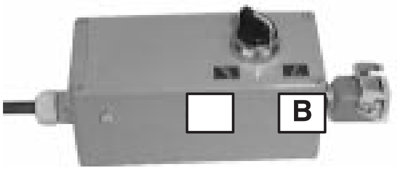

W RNING

This machine contains high pressure air which can cause severe injury or death from hot oil and flying parts.

Always relieve pressure before removing caps, plugs from pressurized air system.

EMERGENCY STOPS

The CPA remote control assembly incorporates an emergency stops selector with allows to connect the CPA emergency stops to the machine circuit.

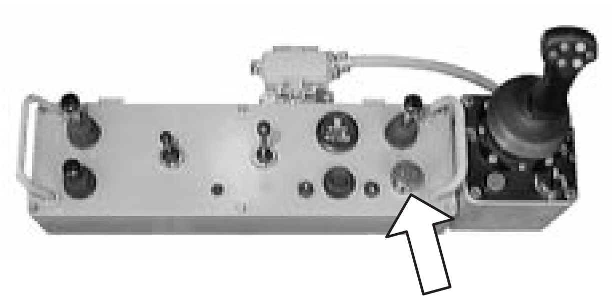


– When the CPA is installed, place the selector on position A to have the CPA emergency stops active.

– Place the selector on position B to refind the normal excavator safety circuit when the CPA is not used.

Safety

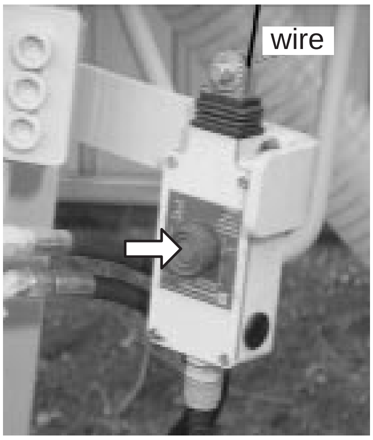
The CPA safety circuit incorporates 2 emergency stops.



One mushroom type push–button is located in the cabin on the remote control panel.

Pressing on this button shuts down the engine.

Unlock the knob by pulling it up to be in position to restart the engine.



The second emergency stop is located on the guide rail, and stops the engine when pulling on the wire attached along the guide.

To unlock the safety device and be in position to restart the engine, press on the button.

WARNING: Take all necessary steps to safely start the engine after emergency stop.

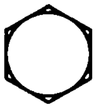
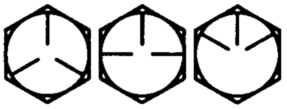
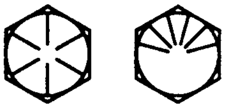
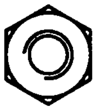
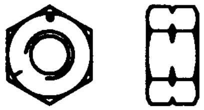
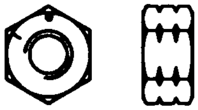
Group 02
General Specifications

Refer to TM 5-3805-280-10 for General Specifications.

CED,OUOE003,4 –19–16NOV99–1/1

Group 03
Torque Values

UNIFIED INCH BOLT AND CAP SCREW TORQUE VALUES

SAE Grade and Head Markings	NO MARK 1 or 2[b] 	5 5.1 5.2 	8 8.2 
SAE Grade and Nut Markings	NO MARK 2 	5 	8 

Size	Grade 1				Grade 2[b]				Grade 5, 5.1, or 5.2				Grade 8 or 8.2			
	Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]	
	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft
1/4	3.7	2.8	4.7	3.5	6	4.5	7.5	5.5	9.5	7	12	9	13.5	10	17	12.5
5/16	7.7	5.5	10	7	12	9	15	11	20	15	25	18	28	21	35	26
3/8	14	10	17	13	22	16	27	20	35	26	44	33	50	36	63	46
7/16	22	16	28	20	35	26	44	32	55	41	70	52	80	58	100	75
1/2	33	25	42	31	53	39	67	50	85	63	110	80	120	90	150	115
9/16	48	36	60	45	75	56	95	70	125	90	155	115	175	130	225	160
5/8	67	50	85	62	105	78	135	100	170	125	215	160	240	175	300	225
3/4	120	87	150	110	190	140	240	175	300	225	375	280	425	310	550	400
7/8	190	140	240	175	190	140	240	175	490	360	625	450	700	500	875	650
1	290	210	360	270	290	210	360	270	725	540	925	675	1050	750	1300	975
1-1/8	400	300	510	375	400	300	510	375	900	675	1150	850	1450	1075	1850	1350
1-1/4	570	425	725	530	570	425	725	530	1300	950	1650	1200	2050	1500	2600	1950
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2150	1550	2700	2000	3400	2550
1-1/2	1000	725	1250	925	990	725	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original.

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

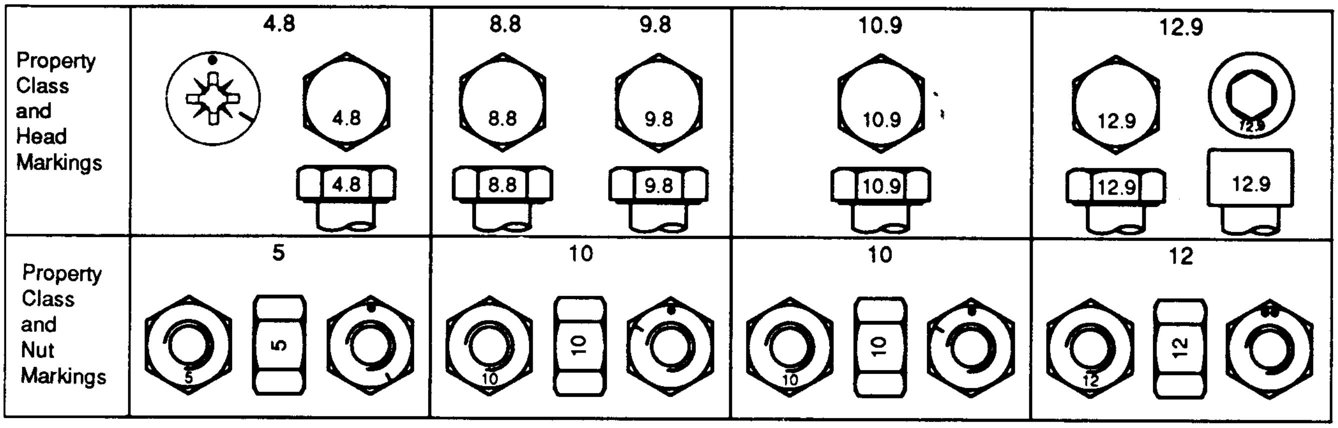
[a] *"Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.*

[b] *Grade 2 applies for hex cap screws (not hex bolts) up to 152 mm (6-in.) long. Grade 1 applies for hex cap screws over 152 mm (6-in.) long, and for all other types of bolts and screws of any length.*

TS1656 –19–02APR97

DX,TORQ1 –19–20JUL94–1/1

METRIC BOLT AND CAP SCREW TORQUE VALUES



Size	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]	
	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft
M6	4.8	3.5	6	4.5	9	6.5	11	8.5	13	9.5	17	12	15	11.5	19	14.5
M8	12	8.5	15	11	22	16	28	20	32	24	40	30	37	28	47	35
M10	23	17	29	21	43	32	55	40	63	47	80	60	75	55	95	70
M12	40	29	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	47	80	60	120	88	150	110	175	130	225	165	205	150	260	190
M16	100	73	125	92	190	140	240	175	275	200	350	255	320	240	400	300
M18	135	100	175	125	260	195	330	250	375	275	475	350	440	325	560	410
M20	190	140	240	180	375	275	475	350	530	400	675	500	625	460	800	580
M22	260	190	330	250	510	375	650	475	725	540	925	675	850	625	1075	800
M24	330	250	425	310	650	475	825	600	925	675	1150	850	1075	800	1350	1000
M27	490	360	625	450	950	700	1200	875	1350	1000	1700	1250	1600	1150	2000	1500
M30	675	490	850	625	1300	950	1650	1200	1850	1350	2300	1700	2150	1600	2700	2000
M33	900	675	1150	850	1750	1300	2200	1650	2500	1850	3150	2350	2900	2150	3700	2750
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2750	4750	3500

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class.

Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original.

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

TS1657 –19–02APR97

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[a] *"Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.*

ADDITIONAL METRIC CAP SCREW TORQUE VALUES

CAUTION: Use only metric tools on metric hardware. Other tools may not fit properly. They may slip and cause injury.

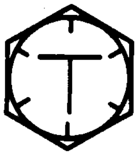
Check tightness of cap screws periodically. Torque values listed are for general use only. Do not use these values if a different torque value or tightening procedure is listed for a specific application.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original.

Make sure fastener threads are clean and you properly start thread engagement. This will prevent them from failing when tightening.

Tighten cap screws having lock nuts to approximately 50 percent of amount shown in chart.


T6873AA

T6873AA –UN–18OCT88


T6873AB

T6873AB –UN–18OCT88


T6873AC

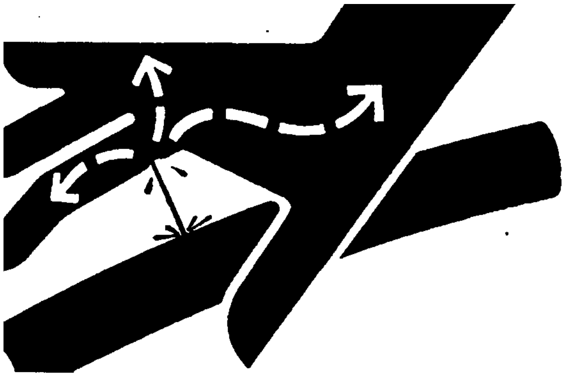
T6873AC –UN–18OCT88

METRIC CAP SCREW TORQUE VALUES[a]

	T-Bolt		H-Bolt		M-Bolt	
Nominal Dia	**N•m**	**lb-ft**	**N•m**	**lb-ft**	**N•m**	**lb-ft**
8	29	21	20	15	10	7
10	63	46	45	33	20	15
12	108	80	88	65	34	25
14	176	130	137	101	54	40
16	265	195	206	152	78	58
18	392	289	294	217	118	87
20	539	398	392	289	167	125
22	735	542	539	398	216	159
24	931	687	686	506	274	202
27	1372	1012	1029	759	392	289
30	1911	1410	1421	1049	539	398
33	2548	1890	1911	1410	735	542
36	3136	2314	2401	1772	931	687

[a] Torque tolerance is ±10%.

CHECK OIL LINES AND FITTINGS



X9811 –UN–23AUG88

T85401 –UN–24JAN89

CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call the Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

Check all oil lines, hoses and fittings regularly for leaks or damage. Make sure all clamps are in position and tight. Make sure hoses are not twisted or touching machine parts which are moving.

Tubing with dents may cause the oil to overheat. If you find tubing with dents, install new tubing immediately.

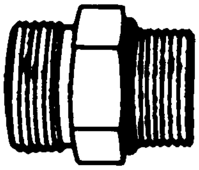
IMPORTANT: Tighten fittings as specified in torque chart.

When you tighten connections, use two wrenches to prevent bending or breaking tubing and fittings.

T82,FLMA,AI –19–14MAR90–1/1

SERVICE RECOMMENDATIONS FOR O-RING BOSS FITTINGS

STRAIGHT FITTING



T6243AE –UN–18OCT88

1. Inspect O-ring boss seat for dirt or defects.
2. Lubricate O-ring with petroleum jelly. Place electrical tape over threads to protect O-ring. Slide O-ring over tape and into O-ring groove of fitting. Remove tape.
3. Tighten fitting to torque value shown on chart.

Continued on next page

04T,90,K66 –19–19MAR96–1/2

ANGLE FITTING

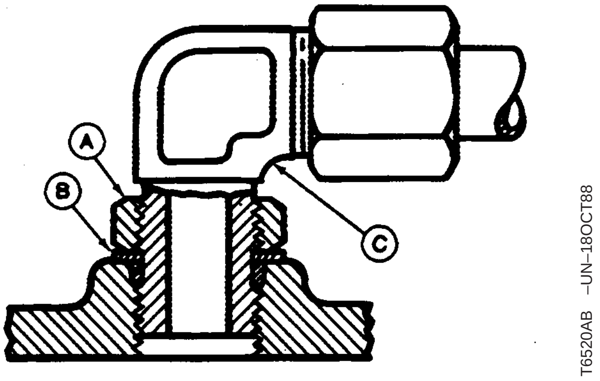
1. Back-off lock nut (A) and back-up washer (B) completely to head-end (C) of fitting.

2. Turn fitting into threaded boss until back-up washer contacts face of boss.

3. Turn fitting head-end counterclockwise to proper index (maximum of one turn).

NOTE: Do not allow hoses to twist when tightening fittings.

4. Hold fitting head-end with a wrench and tighten locknut and back-up washer to proper torque value.

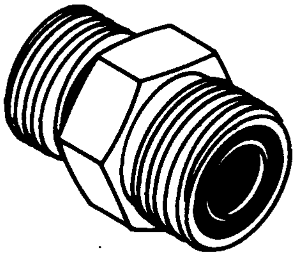


A—Lock Nut
B—Back-Up Washer
C—Fitting Head End

STRAIGHT FITTING OR SPECIAL NUT TORQUE CHART		
Thread Size	**N•m**	**lb-ft**
3/8-24 UNF	8	6
7/16-20 UNF	12	9
1/2-20 UNF	16	12
9/16-18 UNF	24	18
3/4-16 UNF	46	34
7/8-14 UNF	62	46
1-1/16-12 UN	102	75
1-3/16-12 UN	122	90
1-5/16-12 UN	142	105
1-5/8-12 UN	190	140
1-7/8-12 UN	217	160
NOTE: Torque tolerance is ± 10%.		

04T,90,K66 –19–19MAR96–2/2

SERVICE RECOMMENDATIONS FOR FLAT FACE O-RING SEAL FITTINGS



T6243AD –UN–18OCT88

1. Inspect the fitting sealing surfaces. They must be free of dirt or defects.
2. Inspect the O-ring. It must be free of damage or defects.
3. Lubricate O-rings and install into groove using petroleum jelly to hold in place.
4. Push O-ring into the groove with plenty of petroleum jelly so O-ring is not displaced during assembly.
5. Index angle fittings and tighten by hand pressing joint together to insure O-ring remains in place.
6. Tighten fitting or nut to torque value shown on the chart per dash size stamped on the fitting. Do not allow hoses to twist when tightening fittings.

FLAT FACE O-RING SEAL FITTING TORQUE

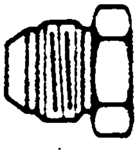
Nominal Tube O.D.				Swivel Nut		Bulkhead Nut	
mm	**in.**	**Dash Size**	**Thread Size in.**	**N•m**	**lb-ft**	**N•m**	**lb-ft**
6.35	0.250	-4	9/16-18	16	12	5.0	3.5
9.52	0.375	-6	11/16-16	24	18	9.0	6.5
12.70	0.500	-8	13/16-16	50	37	17.0	12.5
15.88	0.625	-10	1-14	69	51	17.0	12.5
19.05	0.750	-12	1 3/16-12	102	75	17.0	12.5
22.22	0.875	-14	1 3/16-12	102	75	17.0	12.5
25.40	1.000	-16	1 7/16-12	142	105	17.0	12.5
31.75	1.250	-20	1 11/16-12	190	140	17.0	12.5
38.10	1.500	-24	2-12	217	160	17.0	12.5

NOTE: Torque tolerance is +15 -20%.

04T,90,K67 –19–01AUG94–1/1

9000
03
8

SERVICE RECOMMENDATIONS FOR 37° FLARE AND 30° CONE SEAT CONNECTORS



T6234AC –UN–18OCT88

1. Inspect flare and flare seat. They must be free of dirt or obvious defects.
2. Defects in tube flare cannot be repaired. Overtightening a defective flared fitting will not stop leaks.
3. Align tube with fitting before attempting to start nut.
4. Lubricate male threads with hydraulic fluid or petroleum jelly.
5. Index angle fittings and tighten by hand.
6. Tighten fitting or nut to torque value shown on torque chart. Do not allow hoses to twist when tightening fittings.

STRAIGHT FITTING OR SPECIAL NUT TORQUE CHART

Thread Size	N•m	lb-ft
3/8 - 24 UNF	8	6
7/16 - 20 UNF	12	9
1/2 - 20 UNF	16	12
9/16 - 18 UNF	24	18
3/4 - 16 UNF	46	34
7/8 - 14 UNF	62	46
1-1/16 - 12 UN	102	75
1-3/16 - 12 UN	122	90
1-5/16 - 12 UN	142	105
1-5/8 - 12	190	140
1-7/8 - 12 UN	217	160

NOTE: Torque tolerance is ± 10%.

T82,BHMA,EL –19–19MAR96–1/1

SERVICE RECOMMENDATIONS FOR FLARED CONNECTIONS—STRAIGHT OR TAPERED THREADS

1. Inspect flare and flare seat. They must be free of dirt or obvious defects.

2. Defects in the tube flare cannot be repaired. Overtightening a defective flared fitting will not stop leaks.

3. Align the tube with the fitting before attempting to start the nut.

4. Lubricate the male threads with hydraulic fluid or petroleum jelly.

5. Index angle fittings and tighten by hand.

6. Tighten fitting or nut to torque value shown on the chart. Do not allow hoses to twist when tightening fittings.

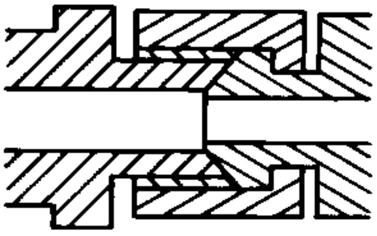
TORQUE CHART[a]

	Straight Thread[b]		Tapered Thread	
Thread Size	**N•m**	**lb-ft**	**N•m**	**lb-ft**
1/8	15	11		
1/4	20	15	45	33
3/8	29	21	69	51
1/2	49	36	93	69
3/4	69	51	176	130
1	157	116	343	253
1-1/2	196	145	539	398
2	255	188	588	434

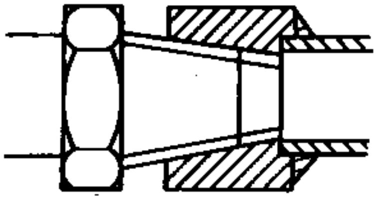
[a] Torque tolerance is ±10%.

[b] With seat face.

NOTE: If female thread is cast iron (control valves, brake valves motors, etc.), torque must be reduced approximately 10%.

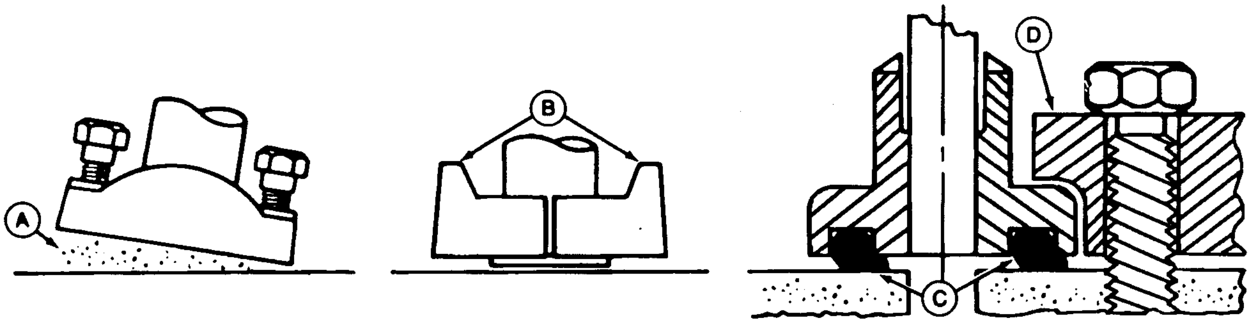


Straight Thread



Tapered Thread

SERVICE RECOMMENDATIONS FOR INCH SERIES FOUR BOLT FLANGE FITTINGS



T6890BB –UN–01MAR90

A—Sealing Surface **B—Split Flange** **C—Pinched O-Ring** **D—Single Piece Flange**

1. Clean sealing surfaces (A). Inspect. Scratches cause leaks. Roughness causes seal wear. Out-of-flat causes seal extrusion. If defects cannot be polished out, replace component.

2. Install O-ring (and backup washer if required) into groove using petroleum jelly to hold it in place.

3. Split flange: Loosely assemble split flange (B) halves. Make sure split is centrally located and perpendicular to port. Hand tighten cap screws to hold parts in place. Do not pinch O-ring (C).

4. Single piece flange (D): Place hydraulic line in center of flange and install cap screws. Flange must be centrally located on port. Hand tighten cap screws to hold flange in place. Do not pinch O-ring.

5. Tighten one cap screw, then tighten the diagonally opposite cap screw. Tighten two remaining cap screws. Tighten all cap screws as specified in the chart below.

   DO NOT use air wrenches. DO NOT tighten one cap screw fully before tightening the others. DO NOT over tighten.

Continued on next page

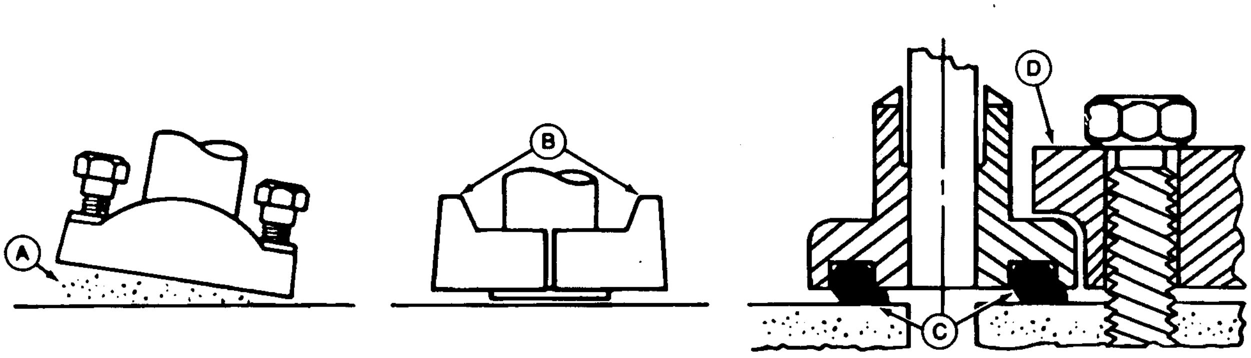
Torque Values

TORQUE CHART[a]					
		N•m		lb-ft	
Nominal Flange Size	**Cap Screw Size**	**Min**	**Max**	**Min**	**Max**
1/2	5/16-18 UNC	20	31	15	23
3/4	3/8-16 UNC	28	54	21	40
1	3/8-16 UNC	37	54	27	40
1-1/4	7/16-14 UNC	47	85	35	63
1-1/2	1/2-13 UNC	62	131	46	97
2	1/2-13 UNC	73	131	54	97
2-1/2	1/2-13 UNC	107	131	79	97
3	5/8-11 UNC	158	264	117	195
3-1/2	5/8-11 UNC	158	264	117	195
4	5/8-11 UNC	158	264	117	195
5	5/8-11 UNC	158	264	117	195

[a] Tolerance ± 10%. The torques given are enough for the given size connection with the recommended working pressure. Torques can be increased to the maximum shown for each cap screw size if desired. Increasing cap screw torque beyond this maximum will result in flange and cap screw bending and connection failures.

04T,90,K174 –19–01AUG94–2/2

SERVICE RECOMMENDATIONS FOR METRIC SERIES FOUR BOLT FLANGE FITTING



A—Sealing Surface **B—Split Flange** **C—Pinched O-Ring** **D—Single Piece Flange**

1. Clean sealing surfaces (A). Inspect. Scratches cause leaks. Roughness causes seal wear. Out-of-flat causes seal extrusion. If defects cannot be polished out, replace component.

2. Install the correct O-ring (and back-up washer if required) into groove using petroleum jelly to hold it in place.

3. Split flange: Loosely assemble split flange (B) halves. Make sure split is centrally located and perpendicular to the port. Hand tighten cap screws to hold parts in place. Do not pinch O-ring (C).

4. Single piece flange (D): Place hydraulic line in center of flange and install four cap screws. Flange must be centrally located on port. Hand tighten cap screws to hold flange in place. Do not pinch O-ring.

5. After components are properly positioned and cap screws are hand tightened, tighten one cap screw, then tighten the diagonally opposite cap screw. Tighten two remaining cap screws. Tighten all cap screws as specified in the chart below.

DO NOT use air wrenches. DO NOT tighten one cap screw fully before tightening the others. DO NOT over tighten.

TORQUE CHART[a]

Thread[b]	N•m	lb-ft
M6	12	9
M8	30	22
M10	57	42
M12	95	70
M14	157	116
M16	217	160
M18	334	246
M20	421	318

[a] Tolerance ± 10%. The torques given are enough for the given size connection with the recommended working pressure. Increasing cap screw torque beyond these amounts will result in flange and cap screw bending and connection failures.

[b] Metric standard thread.

Group 04
Fuels and Lubricants

DIESEL FUEL

Consult your local fuel distributor for properties of the diesel fuel available in your area.

In general, diesel fuels are blended to satisfy the low temperature requirements of the geographical area in which they are marketed.

Diesel fuels specified to A-A-52557, EN 590 or ASTM D975 are recommended.

In all cases, the fuel shall meet the following properties:

- **Cetane Number 40** minimum. Cetane number greater than 50 is preferred, especially for temperatures below -20°C (-4°F) or elevations above 1500 m (5000 ft).
- **Cold Filter Plugging Point**(CFPP) below the expected low temperature OR **Cloud Point** at least 5°C (9°F) below the expected low temperature.
- **Fuel Lubricity** should pass a minimum of 3100 gram load level as measured by the SL BOCLE scuffing test.
- **Sulfur content:**
  - Sulfur content should not exceed 0.5% Sulfur content less than 0.05% is preferred.
  - If diesel fuel with sulfur content greater than 0.5% sulfur content is used, reduce the service interval for engine oil and filter by 50%.
  - DO NOT use diesel fuel with sulfur content greater than 1.0%.

Bio-diesel fuels with properties and meeting DIN 51606 or equivalent specifications may be used.

Aviation fuel Grade JP-8 may be used.

DO NOT mix used engine oil or any other type of lubricant with diesel fuel.

CED,OUOE020,2 –19–11FEB99–1/1

LUBRICITY OF DIESEL FUELS

Diesel fuel must have adequate lubricity to ensure proper operation and durability of fuel injection system components.

Diesel fuels for highway use in the United States and Canada now require sulfur content less than 0.05%. Diesel fuel in the European Union will require sulfur content less than 0.05% by 1 October 1996.

Experience shows that some low sulfur diesel fuels may have inadequate lubricity and their use may reduce performance in fuel injection systems due to inadequate lubrication of injection pump components. The lower concentration of aromatic compounds in these fuels also adversely affects injection pump seals and may result in leaks.

Use of low lubricity diesel fuels may also cause accelerated wear, injection nozzle erosion or corrosion, engine speed instability, hard starting, low power, and engine smoke.

Fuel lubricity should pass a minimum of 3100 gram load level as measured by the SL BOCLE scuffing test.

A-A-52557, ASTM D975 and EN 590 specifications do not require fuels to pass a fuel lubricity test.

If fuel of low or unknown lubricity is used, add John Deere PREMIUM DIESEL FUEL CONDITIONER or Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (MIL-PRF-25017) at the recommended concentration. John Deere PREMIUM DIESEL FUEL CONDITIONER is available in winter and summer formulas. Consult your John Deere engine distributor or servicing dealer for more information.

TX,45,JC1771 –19–08JAN97–1/1

LOW SULFUR DIESEL FUEL CONDITIONER

When possible, use existing fuel formulations for engines used off-highway. This fuel will not require any additives to provide good performance and engine reliability. However, many local fuel distributors will not carry both low and regular sulfur diesel fuels.

If only low sulfur fuel is available, Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble should be added at the recommended concentration (MIL-PRF-25017). Nearly all other diesel fuel conditioners only improve cold weather flow and stabilize long-term fuel storage. They do not contain the lubrication additives needed by rotary fuel injection pumps.

TX,45,DH5857 –19–15AUG97–1/1

DIESEL FUEL STORAGE

Proper fuel storage is critically important. Use clean storage and transfer tanks. Periodically drain water and sediment from bottom of tank. Store fuel in a convenient place away from buildings.

IMPORTANT: DO NOT store diesel fuel in galvanized containers. Diesel fuel stored in galvanized containers reacts with zinc coating on container to form zinc flakes. If fuel contains water, a zinc gel will also form. The gel and flakes will quickly plug fuel filters, damage injection nozzles and injection pump.

DO NOT use brass-coated containers for fuel storage. Brass is an alloy of copper and zinc.

Store diesel fuel in plastic, aluminum, and steel containers specially coated for diesel fuel storage.

Avoid storing fuel over long periods of time. If fuel is stored for more than a month prior to use, or there is a slow turnover in fuel tank or supply tank, add a fuel conditioner such as John Deere PREMIUM DIESEL FUEL CONDITIONER or fuel conditioner meeting MIL-S-53021 to stabilize the fuel and prevent microbial growth in the fuel. John Deere PREMIUM DIESEL FUEL CONDITIONER is available in winter and summer formulas. Fuel conditioner also reduces fuel gelling and controls wax separation during cold weather.

Consult your John Deere engine distributor or servicing dealer for recommendations and local availability. Always follow manufacturer's directions on label.

TX,45,JC1772 –19–08JAN97–1/1

FUEL TANK

CAUTION: Handle fuel carefully. If the engine is hot or running, do not fill the fuel tank. Do not smoke while you fill fuel tank or work on fuel system.

To avoid condensation, fill the fuel tank at the end of each day's operation. Capacity is 560 L (148 gal).

Fuel Tank—Specification

Capacity.. 560 L (148 gal)

CED,TX14740,6018 –19–28JAN98–1/1

DO NOT USE GALVANIZED CONTAINERS

IMPORTANT: Diesel fuel stored in galvanized containers reacts with zinc coating on the container to form zinc flakes. If fuel contains water, a zinc gel will also form. The gel and flakes will quickly plug fuel filters and damage fuel injectors and fuel pumps.

DO NOT USE a galvanized container to store diesel fuel.

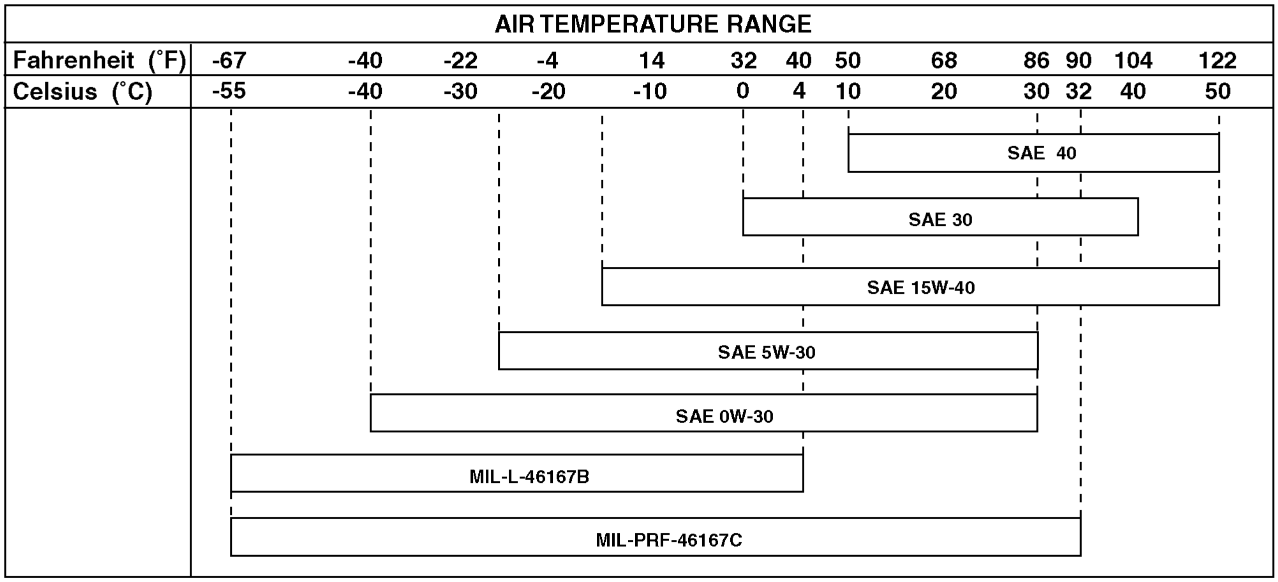
Store fuel in:

- plastic containers.
- aluminum containers.
- specially coated steel containers made for diesel fuel.

DO NOT USE brass-coated containers: brass is an alloy of copper and zinc.

DX,FLBT,C –19–04JUN90–1/1

DIESEL ENGINE AND PUMP GEARBOX OILS



T125427

T125427 –19–28OCT99

Use oil viscosity based on the expected air temperature range during the period between oil changes.

Other oils may be used if they meet one or more of the following:

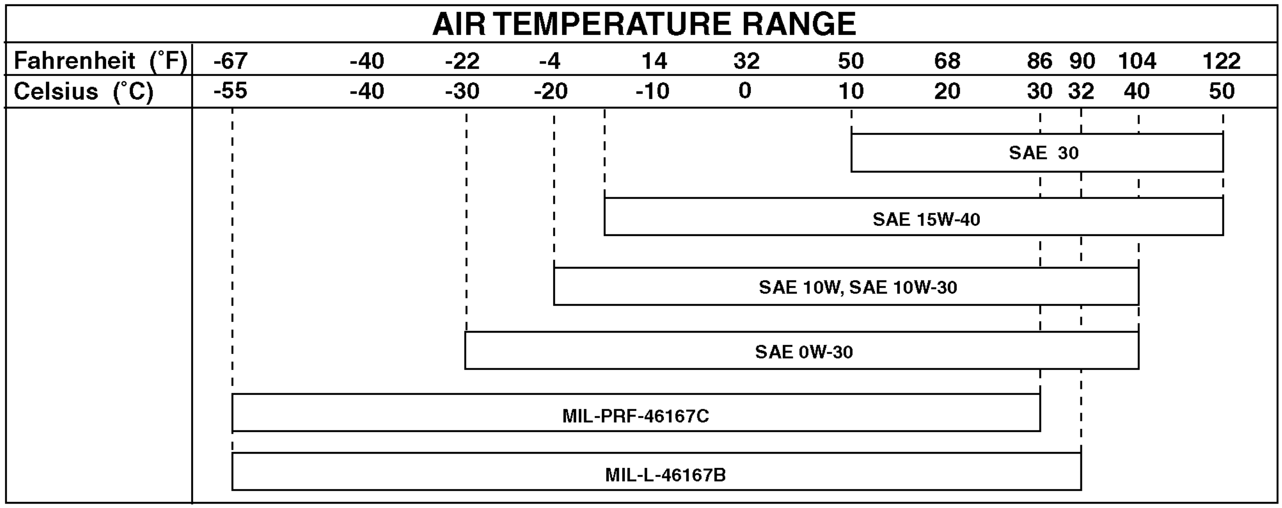
- MIL-PRF-2104G
- MIL-L-46167B
- MIL-PRF-46167C
- API CG-4
- API CF-4

Multi-viscosity diesel engine oils are preferred.

If diesel fuel with sulfur content greater than 0.5% is used, reduce the service interval by 50%.

CED,OUOE020,3 –19–12FEB99–1/1

HYDRAULIC OIL



T125428

T125428 –19–12NOV99

Depending upon the expected air temperature range between oil changes, use oil viscosity shown on the temperature chart above.

Use oils meeting one or more of the following:

- MIL-PRF-2104G[1]
- MIL-L-46167B
- MIL-PRF-46167C
- API CG-4[1]
- API CF-4[1]

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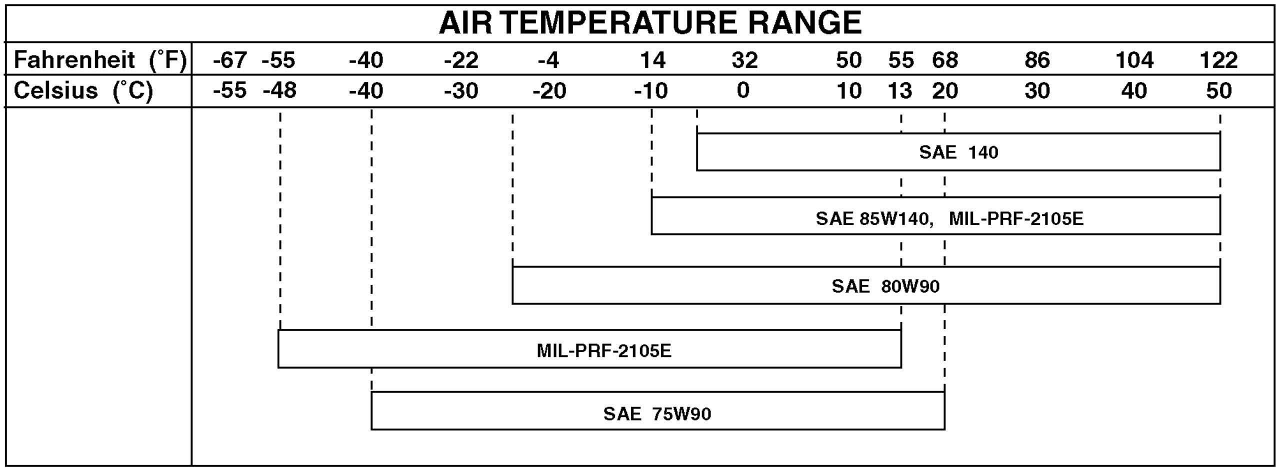
[1] *Must contain a minimum zinc additive of 0.09 percent.*

CED,OUOE020,4 –19–12FEB99–1/1

SWING GEARBOX AND PROPEL GEARBOX OILS



T125429

T125429 –19–12NOV99

Depending upon the expected air temperature range between oil changes, use oil viscosity shown on the temperature chart above.

The following oils are recommended:

- Oils meeting MIL-PRF-2105. MIL-PRF-2105E is updated.
- Oils meeting API Service GL-5 (MIL-L-2105E).

CED,OUOE020,5 –19–12FEB99–1/1

TRACK ROLLER, FRONT IDLER, AND CARRIER ROLLER OIL

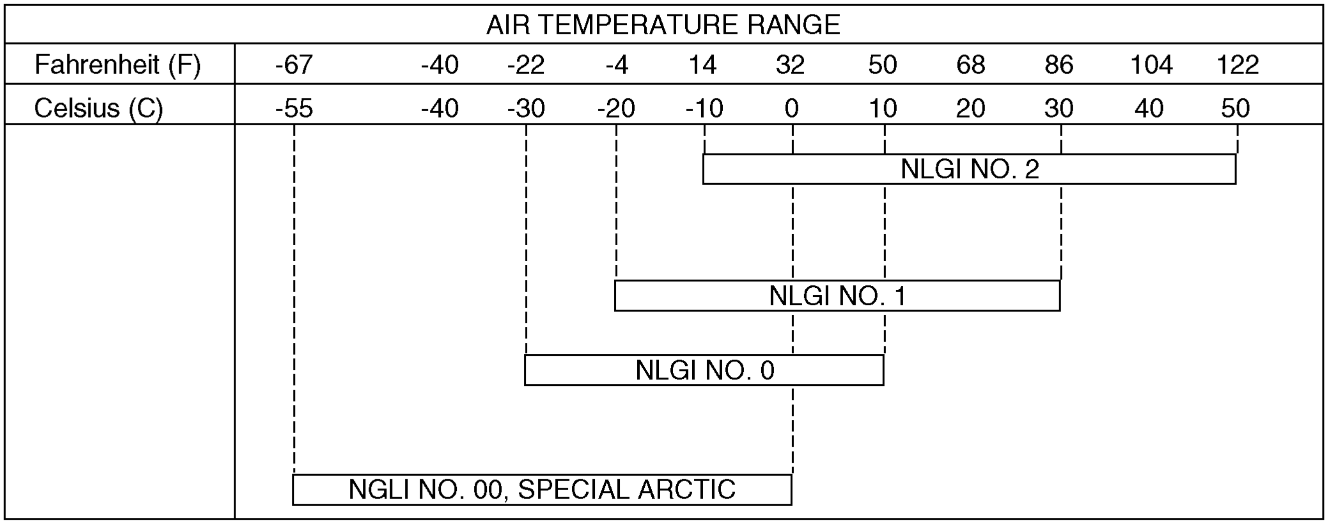
Use oil viscosity based on the expected air temperature range during the period between oil changes.

The following oils are recommended:

- MIL-PRF-2105E (80W90).
- API Service Classification GL-5 gear oil (SAE 80W90).
- Arctic oil such as MIL-PRF-2105E (75W) should be used at temperatures below -30°C (-11°F).

CED,OUOE020,6 –19–12FEB99–1/1

TRACK ADJUSTER, WORKING TOOL PIVOT, SWING BEARING, AND SWING BEARING GEAR GREASE



T120320

T120320 –19–25MAR99

Use grease based on NLGI consistency numbers and the expected air temperature range during the service interval.

Use greases meeting MIL-PRF-10924G.

Lithium complex grease containing high temperature, extreme pressure properties with 3-5 percent molybdenum disulfide is preferred, although those without the molybdenum disulfide are acceptable.

CED,OUOE020,7 –19–12FEB99–1/1

OIL FILTERS

Filtration of oils is critical to proper operation and lubrication. Always change filters regularly as specified in this manual.

Use filters meeting John Deere performance specifications.

DX,FILT –19–18MAR96–1/1

ROCK DRILL LUBRICANTS SPECIFICATIONS

We recommend the use of the **MOBIL** lubricants. These are selected to get the best performances out of our equipments.

If the **MOBIL** products are not available, our warranty will apply only if high quality lubricants are used according to the following specifications and under the responsability of your supplier.

HYDRAULIC CIRCUIT

Oil ISO VG 32 (*ISO VG 46 when 10ºC <t<45º C*) with stabilized anti–wear additive

Specifications :

Viscosity at 40ºC: 30 to 33 cSt (*46 cSt*)

Viscosity index VI: $\geq$ 150 (*140*)

Pour point: < – 40ºC

De airing: $\leq$ 5 mn

Performances :

Homologation: DENISON HFO

Anti wear: FZG $\geq$ 12

VICKERS 35 VQ 25 : total wear < 50 mg

ASTM D 130 : cotation 1 a

Anti corrosion: CINCINNATI P 70 – pass

Filterability: DENISON TP 02–100 : t < 200 seconds with water 2%

Oxydation stability NFT 60150 t > 2200 h for 1 a $\leq$ 2 ASTM D 943

Performances :

specifications: MIL-PRF-2105E

PNEUMATIC CIRCUIT

Anti wear oils for pneumatic equipment

ISO VG 46 for : t $\leq$ 0ºC

ISO VG 100 for : t > 0ºC

Performances :

film resistance

reinforced anti–wear

anti–corrosion

anti–freeze (for : t $\leq$ OºC)

Specifications :

Pour point <–24º C

Flash point 218º C

Viscosity at 40º C: 150 cSt

Viscosity index Vi: 140

GEAR BOX

High pressure oil SAE 80 W 90 for transmissions.

Performances :

specifications: MIL-PRF-2105E

GREASE

MIL-PRF-10924G

SECTOR	**0°C to -45°C PRODUCT**	**+30°C to -20°C PRODUCT**	**+45°C to +10°C PRODUCT**
Hydraulic	MOBIL SHC 524	MOBIL DTE 13 M	MOBIL DTE 15 M
Pneumatic	MOBIL SHC 524	MOBIL ALMO 527 (t > 0°C) ALMO 325 (t < 0°C)	ALMO 527
Grease	MOBILTEMP SHC 100 SPECIAL	MOBILGREASE SPECIAL	MOBILGREASE SPECIAL
GCL/GCX reducer	MOBIL SHC 630	MOBIL SHC 630	MOBILGEAR 629 MOBIL SHC 630

LUBRICANT STORAGE

Your equipment can operate at top efficiency only when clean lubricants are used.

Use clean containers to handle all lubricants.

Whenever possible, store lubricants and containers in an area protected from dust, moisture, and other contamination. Store containers on their side to avoid water and dirt accumulation.

Make certain that all containers are properly marked to identify their contents.

Properly dispose of all old containers and any residual lubricant they may contain.

DX,LUBST –19–18MAR96–1/1

ALTERNATIVE AND SYNTHETIC LUBRICANTS

Conditions in certain geographical areas may require lubricant recommendations different from those printed in this manual. Some John Deere brand coolants and lubricants may not be available in your location. Consult your John Deere dealer to obtain information and recommendations.

Synthetic lubricants may be used if they meet the performance requirements as shown in this manual.

The temperature limits and service intervals shown in this manual apply to both conventional and synthetic oils.

Re-refined base stock products may be used if the finished lubricant meets the performance requirements.

DX,ALTER –19–18MAR96–1/1

MIXING OF LUBRICANTS

In general, avoid mixing different brands or types of oil. Oil manufacturers blend additives in their oils to meet certain specifications and performance requirements. Mixing different oils can interfere with the proper functioning of these additives and degrade lubricant performance.

Consult your John Deere dealer to obtain specific information and recommendations.

DX,LUBMIX –19–18MAR96–1/1

AIR COMPRESSOR - LUBRICATION

GENERAL INFORMATION

Lubrication is an essential part of preventive maintenance, affecting to a great extent the useful life of the unit. Different lubricants are needed and some components in the unit require more frequent lubrication than others. Therefore, it is important that the instructions regarding types of lubricants and the frequency of their application be explicitly followed. Periodic lubrication of the moving parts reduces to a minimum the possibility of mechanical failures.

The Preventive Maintenance Schedule shows those items requiring regular service and the interval in which they should be performed. A regular service program should be developed to include all items and fluids. These intervals are based on average operating conditions. In the event of extremely severe (hot, cold, dusty or wet) operating conditions, more frequent lubrication than specified may be necessary. Details concerning lubrication of the running gear are in Maintenance Section.

All filters and filter elements for air and compressor lubricant must be obtained through Ingersoll-Rand to assure the proper size and filtration for the compressor.

COMPRESSOR OIL CHANGE

These units are normally furnished with an initial supply of oil sufficient to allow operation of the unit for approximately 6 months or 1000 hours, whichever comes first. If a unit has been completely drained of all oil, it must be refilled with new oil before it is placed in operation. Refer to specifications in Lubrication Table.

NOTICE

Some oil types are incompatible when mixed and result in the formation of varnishes, shellacs, or lacquers which may be insoluble. Such deposits can cause serious troubles including clogging of the filters. Where possible, do NOT mix oils of different types and avoid mixing different brands. A type or brand change is best made at the time of a complete oil drain and refill.

If the unit has been operated for the time/ hours mentioned above, it should be completely drained of oil. If the unit has been operated under adverse conditions, or after long periods in storage, an earlier change period may be necessary as oil deteriorates with time as well as by operating conditions.

WARNING

High pressure air can cause severe injury or death from hot oil and flying parts. Always relieve pressure before removing caps, plugs, covers or other parts from pressurized air system. Ensure the following conditions are met:

- Discharge air pressure gauge reads zero (0).
- No air discharging from an “open” manual blowdown valve.

An oil change is good insurance against the accumulation of dirt, sludge, or oxidized oil products.

Completely drain the receiver- separator, piping, and oil cooler. If the oil is drained immediately after the unit has been run for some time, most of the sediment will be in suspension and, therefore, will drain more readily. However, the fluid will be hot and care must be taken to avoid contact with the skin or eyes.

After the unit has been completely drained of all old oil, close the drain valve. Add oil in the specified quantity at the filler plug. Tighten the filler plug and run the machine to circulate the oil. Check the oil level WHEN RUNNING AT FULL LOAD. If not near the middle of the sight tube, stop the unit and make corrections. DO NOT OVERFILL.

NOTICE

Ingersoll-Rand provides compressor oil specifically formulated for Portable Compressors and requires the use of these fluids in order to obtain extended limited airend warranty. Refer to Section 2 and 6, Warranty and Compressor Oil respectively.

AIR COMPRESSOR LUBRICANTS

FLUIDS AND LUBRICANTS TABLE

ITEM	FLUID	AMBIENT TEMP.	SPECIFICATION
Compressor Models: VHP - (200 + psi) HP - (150 psi) XP - (125 psi) P - (100 psi)	Airend Lubricant	-10°F to 125°F (-23°C to 52°C)	★ IR Pro-Tec™ MIL-PRF-2104G • A-A-52039 SAE 10W
		-40°F to 125°F (-40°C to 52°C)	★ IR Performance 500
		-40°F to 65°F (-40°C to 18°C)	• MIL-PRF-46167
NXP (Oil Free)	Refer to Operator's Manual		
★ Recommended Ingersoll-Rand Fluids - Use of these fluids with original I-R filters can extend airend warranty. Refer to operator's manual warranty section for details or contact your I-R representative.			
Recommended Fluid	1 Gal. (3.8 litre)	5 Gal. (19.0 litre)	55 Gal. (208.2 litre)
IR Pro-TecR	36899698	36899706	36899714
IR Performance 500	35382928	35382936	35382944

DexronR - Reg. T.M. of General Motors Corp. Pro-Tec™ - T.M. of Ingersoll-Rand

For Parts, Service & nearest Distributor call 1-800-633-5206

CHAPTER 2

SECTION 9005

OPERATIONAL CHECKOUT PROCEDURE

BLANK

Group 10
Operational Checkout Procedure

OPERATIONAL CHECKOUT

Use this procedure to check all systems and functions on the machine. It is designed so you can make a quick check of machine operation while doing a walk around inspection and performing specific checks from the operator’s seat.

Should you experience a problem with your machine, you will find helpful diagnostic information in this checkout that will pinpoint the cause. This information may allow you to perform a simple adjustment yourself which will reduce the down time of your machine. Use the table of contents to help find adjustment procedures.

The information you provide after completing the operational checkout will allow you or your authorized dealer to pinpoint a specific test or repair needed to restore the machine to design specifications.

A location will be required which is level and has adequate space to complete the checks. No tools or equipment are needed to perform the checkout.

Complete the necessary visual checks (oil levels, oil condition, external leaks, loose hardware, linkage, wiring, etc.) prior to doing the checkout. The machine must be at operating temperature for many of the checks.

Start at the top of the left column and read completely down column before performing check. Follow this sequence from left to right. In the far right column, if no problem is found, you will be instructed to go to next check. If a problem is indicated, you will be referred to either a section in this manual or to your authorized dealer for repair.

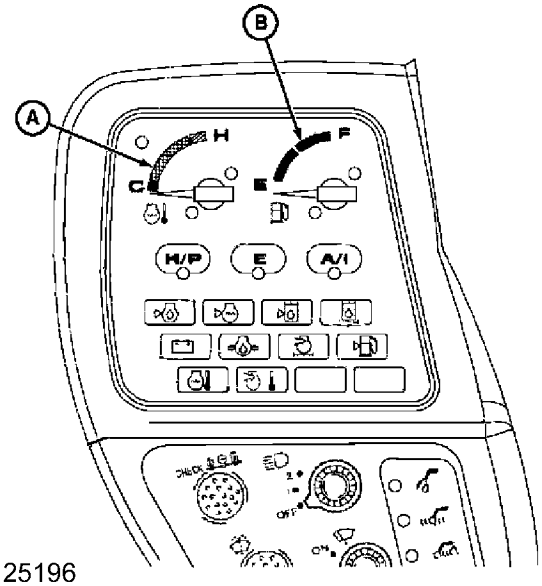
TX,9005,GG2708 –19–11AUG98–1/1

Operational Checkout Procedure

❶ OPERATOR STATION CHECKS—KEY SWITCH ON, ENGINE OFF

– – –1/1

GAUGES, MONITOR, AND BATTERY DISCONNECT RELAY CHECKS



T125196

T125196 –UN–29OCT99

A—Engine Temperature Gauge
B—Fuel Gauge

NOTE: Monitor buzzer is not checked during this procedure.

If engine coolant temperature is below 30°C (86°F), engine temperature gauge needle may not move to the right. Run engine a few minutes to warm coolant before check.

Engine OFF.

Key switch ON.

Does battery relay click?

Do engine temperature gauge (A) and fuel gauge (B) needles move to the right?

Do all 10 monitor lights come on and after 2—3 seconds only the alternator indicator and engine oil pressure indicator remain on?

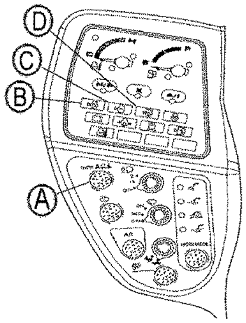
YES: Go to next check.

NO: Check monitor fuse.

NO: Check and replace bulb if any bulb fails to come on. Go to Group 9015-15.

– – –1/1

FLUID LEVEL (COOLANT, HYDRAULIC OIL, AND ENGINE OIL) INDICATOR CIRCUIT CHECKS



T102097 –UN–26JUL96

A—Level Check Switch
B—Engine Oil Level Indicator
C—Engine Coolant Level Indicator
D—Hydraulic Oil level Indicator

Engine OFF.

Key switch ON.

Push and hold level check switch (A).

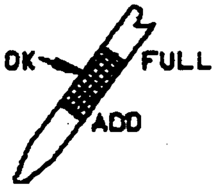
Are the hydraulic oil level (D), coolant level (C), and engine oil level (B) indicator lights ON?

YES: Go to next check.

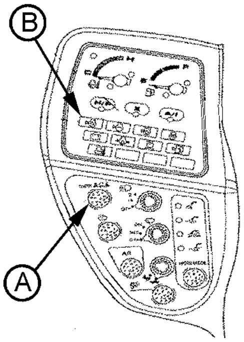
NO: Check monitor fuse. If OK, check fluid levels in radiator, recovery tank, hydraulic oil tank, or engine. If OK, check fluid level switch or wiring. Go to Group 9015-15.

– – –1/1

ENGINE OIL LEVEL AND CONDITION CHECK



T6488GH –19–23FEB89



T103525 –UN–10SEP96

A—Pre-Operation Level Check Switch
B—Engine Oil Level Indicator

Engine OFF.

Remove dipstick and check oil level and condition.

Is oil above “full” mark or below “add” mark on dipstick?

Does the oil look milky or grainy?

If oil level is high, check for fuel or anti-freeze. Drain a small amount of engine oil into a clear container. Watch oil in container to see if anti-freeze or water accumulates at the bottom. If oil is milky, moisture or anti-freeze may be present.

If oil is grainy, carbon may be present. Carbon in oil may result when engine runs at slow idle too long.

If oil level is low, check for oil leaks or oil seal problems in engine.

Adjust oil level to between “add” and “full” marks on dipstick.

Key switch ON.

Push pre-operation level check switch (A).

Is green light for engine oil level indicator (B) ON?

YES: Add oil if low.

Change oil and filter if too high, milky or grainy. Go to Group 9000-04. Check oil level after a few hours operation to determine if a problem exists. Go to Diagnose Engine Malfunctions Group 9010-15.

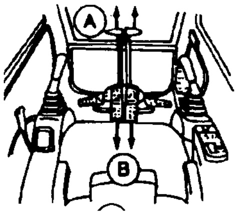
NO: If engine oil level indicator does not come ON, go to Monitor Diagnostic Information in Group 9015-15.

If oil level is OK, go to next check.

– – –1/1

Operational Checkout Procedure

PROPEL LEVER AND PEDAL CUSHION CYLINDER CHECKS



T7531AO –UN–07JUN91

A—Propel Lever and Pedal Forward
B—Propel Lever and Pedal Rearward

Engine OFF.

Push each propel lever and pedal forward (A), then release.

Pull each propel lever and pedal rearward (B), then release.

Does each lever and pedal have equal effort to operate forward and reverse?

Does each lever and pedal return to neutral at the same time when released?

YES: Go to next check.

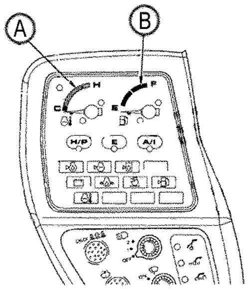
NO: Repair or repair cushion cylinders. Go to Group 3360.

– – –1/1

❷ OPERATOR STATION CHECKS—ENGINE ON

– – –1/1

MONITOR CIRCUIT, GAUGE CHECKS



T102096 –UN–26JUL96

A—Coolant Temperature Gauge
B—Fuel Gauge

Start engine.

Are all monitor indicator lights OFF after engine starts?

Is coolant temperature gauge needle (A) in normal operating zone after a few minutes?

Does fuel gauge (B) indicate fuel level?

Stop engine.

YES: Go to next check.

NO: Check engine lubrication system if engine oil pressure indicator is on after engine starts. Go to Group 9010-15 or Engine Repair chapter.

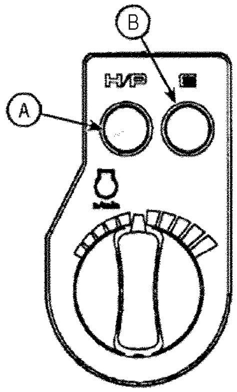
Check alternator belt if battery light is on after engine starts. Go to Group 0510. If OK, check fuses, alternator, and gauges. Go to Group 9015-15.

Check switches, sensors, and gauges. Go to Group 9015-15.

Check fluid levels.

– – –1/1

POWER MODE INDICATORS CIRCUIT CHECKS



T102098 –UN–26JUL96

A—HP (High Power) Mode Switch
B—E (Economy) Mode Switch

Start engine.

Auto-idle switch OFF.

Pilot shutoff lever in LOCKED position.

Push HP (high power) mode (A) and E (economy) mode (B) select switches one at a time.

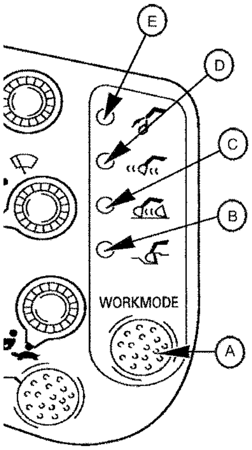
Do corresponding indicator lights come on as each switch is pushed?

YES: Go to next check.

NO: Check controller fuse. Go to Group 9015-15.

– – –1/1

WORK MODE CIRCUIT CHECKS



T102099 –UN–26JUL96

A—Work Mode Switch
B—Dig Mode Indicator
C—Grading Mode Indicator
D—Precision Mode Indicator
E—Attachment Mode Indicator

Start engine.

Auto-idle switch OFF.

Pilot shutoff lever in LOCKED position.

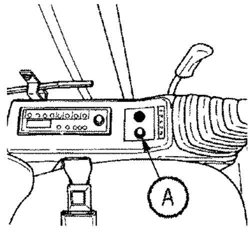
Push work mode select switch (A) to select desired work mode.

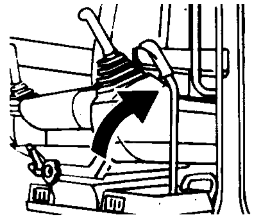
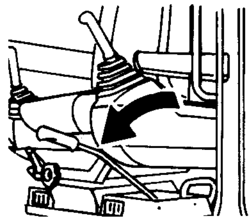
Do corresponding indicator lights come on as switch is pushed?

YES: Go to next check.

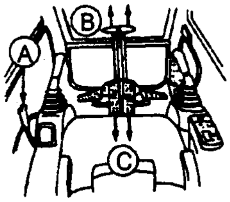
NO: Check fuse. If OK, check monitor and wiring harness. Go to Group 9015-15.

– – –1/1

TRAVEL ALARM STOP CIRCUIT CHECK	 T102919 –UN–08AUG96	**A—Travel Alarm Cancel Switch** **CAUTION: Machine will move during this check. Make sure area is clear, and large enough to operate the machine.** *NOTE: Travel alarm must operate for this check.* Push propel pedals or levers and allow travel alarm to operate for a minimum of 12 seconds. While continuing travel, push travel alarm cancel switch (A). Does travel alarm stop sounding?	**YES:** Go to next check. **NO:** Check switch and wiring harness. Go to Group 9015-15. – – –1/1

PILOT SHUT-OFF VALVE CHECKS	 T7351CC –UN–22AUG90	**CAUTION: Machine may move during this check. Make sure area is clear and large enough to operate all machine functions.** Run engine at slow idle. Pilot shut-off lever in LOCKED (rearward) position. Actuate controls for dig and propel functions. Do any dig or propel functions operate?	**YES:** Check adjustment. Go to Group 9025-20. Repair or replace pilot shut-off valve. Go to Group 3360. **NO:** Continue check.
	 T7351CB –UN–22AUG90	Push pilot shut-off lever to UNLOCKED position (forward). Actuate controls for dig and propel functions. Do all functions operate?	**YES:** Go to next check. **NO:** Check adjustment. Go to Group 9025-20. Repair or replace pilot shut-off valve. Go to Group 3360. – – –1/1

TRAVEL ALARM CHECK



T7850AF –UN–22OCT92

A—Pilot Shut-Off Lever
B—Propel Pedals or Levers Forward
C—Propel Pedals or Levers Rearward

CAUTION: Machine will move during this check. Make sure area is clear and large enough to operate the machine.

Engine running.

Pilot shut-off lever (A) in UNLOCKED position (forward).

Push propel pedals or levers forward (B) for forward travel.

Does travel alarm sound?

Push propel pedals or pull levers rearward (C) for reverse travel.

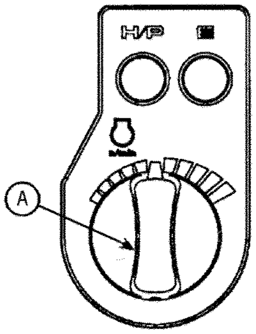
Does travel alarm sound?

YES: Go to next check.

NO: Check travel (motion) alarm fuse. Check motion alarm and wiring harness. Go to Group 9015-15.

– – –1/1

ENGINE RPM DIAL CHECKS



T102100 –UN–26JUL96

A—Engine RPM Dial

Start engine.

Auto-idle switch OFF.

Pilot shutoff lever in LOCKED position.

Turn engine rpm dial (A) clockwise.

Does engine speed increase?

Turn engine rpm dial counterclockwise.

Does engine speed decrease?

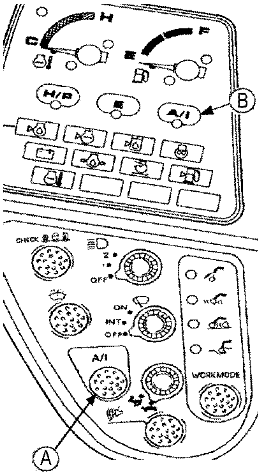
YES: Go to next check.

NO: Check dial and wiring harness. Go to Group 9015-15. If OK, check for control signal to EC motor. Go to harness test in Group 9025-25. Check that cable from EC motor to injection pump lever moves freely. Go to Group 0515.

– – –1/1

Operational Checkout Procedure

AUTO-IDLE CIRCUIT CHECK



T102101 –UN–26JUL96

A—Auto-Idle Switch
B—Auto-Idle Indicator

Engine at fast idle.

HP and E mode switches OFF.

Auto-idle switch OFF.

Pilot shutoff lever in UNLOCKED position.

Push auto-idle switch (A) to ON.

Does auto-idle indicator (B) come on?

Does engine speed decrease after 4—6 seconds?

Slowly actuate any dig function control lever.

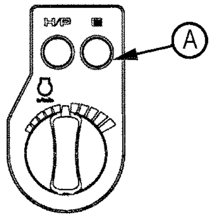
Does engine speed return to fast idle?

YES: Go to next check.

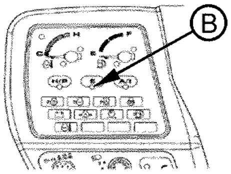
NO: Check fuse. Check switches and wiring harness. Go to Group 9015-15.

– – –1/1

E (ECONOMY) MODE CHECK



T103545 –UN–09SEP96



T103546 –UN–09SEP96

A—E (Economy) Mode Switch
B—E (Economy) Mode Indicator

Start the engine.

Auto-idle switch OFF.

Turn engine rpm dial clockwise to fast idle.

Push E (economy) mode switch (A) on.

Did you hear a decrease in engine speed?

Did the E (economy) mode indicator (B) come on?

Push the E mode switch again to turn it OFF.

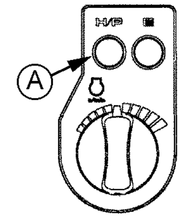
Did E mode indicator go out and engine speed increase to fast idle?

YES: Go to next check.

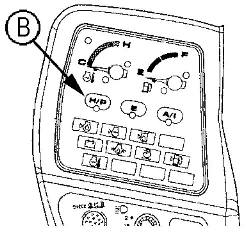
NO: Check switch, indicator, and harness. Go to Group 9015-15.

– – –1/1

HP (HIGH POWER) MODE CHECK



T111983 –UN–27OCT97



T112183 –UN–13NOV97

A—HP (High Power) Mode Switch
B—HP (High Power) Mode Indicator

Start the engine.

Auto-idle switch OFF.

Turn engine rpm dial clockwise to fast idle.

Push HP (high power) mode switch (A) on.

Did HP (high power) mode indicator (B) come on?

Operate the arm in function over relief (arm cylinder fully extended).

Is there some engine speed increase?

Push HP mode switch again to turn it OFF.

Does HP mode indicator go out?

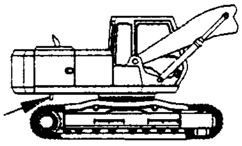
YES: Go to next check.

NO: Check switch, indicator, arm in sensor, pump pressure sensor, and harness. Go to Group 9015-15.

Check linkage and fast idle speed stop at the injection pump. Go to Group 9010-20.

– – –1/1

ENGINE BLOW-BY CHECK



T7700AC –UN–10FEB92

Run engine at fast idle and check engine blow-by tube.

Are fumes barely visible at the blow-by tube at fast idle, with no load?

NOTE: Excessive blow-by indicates that piston rings and cylinder liners do not seal off the combustion chamber. This is a comparative check that requires some experience to determine excessive blow-by.

YES: Go to next check.

NO: If blow-by is excessive. Go to Compression Pressure Test in Group 9010-25.

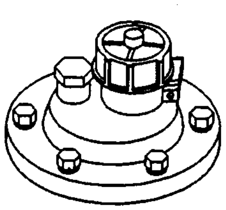
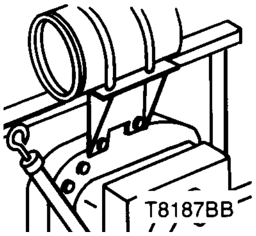
– – –1/1

Operational Checkout Procedure

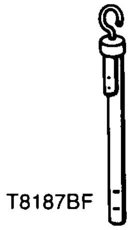
ENGINE PARTS LOOSE OR WORN CHECK	Run engine at slow idle. Move hydraulic control lever to operate a hydraulic function over relief to put engine under load. Does engine run smooth, no knocking or rattling noise?	**YES:** Operational Checkout complete. **NO:** Go to Abnormal Engine Noise, in Group 9010-15. – – –1/1

HYDRAULIC SYSTEM CHECKS

– – –1/1

HYDRAULIC OIL TANK PRESSURIZATION CHECK	 T7884AG –UN–12NOV92 Raise boom to full height, then lower boom to ground. *NOTE: Ensure that engine is properly shut down.* Slowly loosen vent plug on hydraulic oil tank. Is air heard escaping from vent plug? *NOTE: The pressurized oil tank creates pressure at the inlet to the hydraulic pumps. If filler cap does not seal, hydraulic pumps could cavitate and be damaged.*	**YES:** Go to next check. **NO:** Replace cap. – – –1/1
PUMP GEARBOX OIL LEVEL CHECK	 T8187BB –UN–08MAR94 *NOTE: Ensure that engine is properly shut down.* Pull dipstick from tube, check oil level. Is oil level between marks?	**YES:** Go to next check. **NO:** Add oil if low. – – –1/1

SWING GEARBOX OIL LEVEL CHECK



T8187BF –UN–08MAR94

NOTE: Ensure that engine is properly shut down.

Pull dipstick from tube, check oil level.

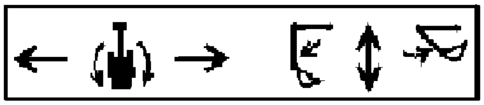
Is oil between marks?

YES: Go to next check.

NO: Add oil if low.

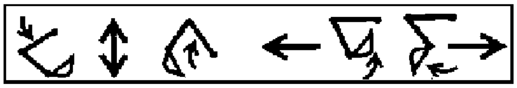
– – –1/1

PILOT CONTROLLER PATTERN CHECK—SAE PATTERN



T102070 –UN–16JUL96

Left Control Lever



T102071 –UN–16JUL96

Right Control Lever

Run engine at slow idle.

Operate machine in clear area.

Push pilot shutoff lever to UNLOCKED position. Slowly move control levers to all positions on decals.

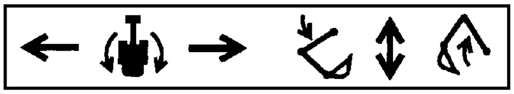
Do bucket, boom, arm, and swing move as decals show?

YES: Go to next check.

NO: Install correct decals for control pattern. To change control pattern, go to Control Lever Pattern Conversion in Group 9025-15.

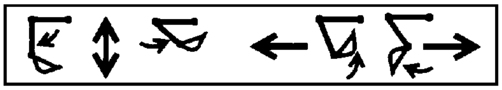
– – –1/1

PILOT CONTROLLER PATTERN CHECK—JOHN DEERE PATTERN



T102197 –UN–19JUL96

Left Control Lever



T102198 –UN–19JUL96

Run engine at slow idle.

Operate machine in clear area.

Push pilot shutoff lever to UNLOCKED position. Slowly move hydraulic levers to all positions on decals.

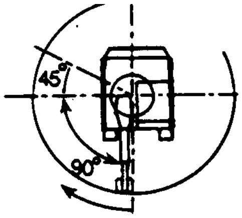
Do bucket, boom, arm, and swing move as decals show?

YES: Go to next check.

NO: Install correct decals for control pattern. To change control pattern, go to Control Lever Pattern Conversion in Group 9025-15.

– – –1/1

SWING DYNAMIC BRAKE CHECK



T6479AY –UN–19OCT88

CAUTION: Make sure area is clear and large enough to swing extended arm and bucket. Machine must be on level ground.

Position upperstructure with boom in front.

Put arm and bucket in fully extended position with bucket 900 mm (3 ft) above ground level.

Operate engine at fast idle.

Actuate swing control valve to full stroke. Swing around 90 degrees and release lever.

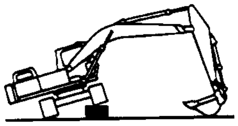
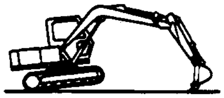
Does upperstructure stop within 45 degrees (1/8 turn) after releasing lever?

Repeat procedure in opposite direction.

YES: Go to next check.

NO: Check swing motor leakage. Check swing motor crossover relief valve. Go to Group 9025-25. Check swing valve spool. Go to Group 3360.

– – –1/1

SWING CIRCUIT LEAKAGE CHECK	 T6479AZ –UN–19OCT88	Run engine at slow idle. Position machine on a side hill or raise one side of machine 300 mm (1 ft) with the boom and put blocks under track. Position bucket 300 mm (1 ft) off the ground at maximum reach. Actuate bucket curl function over relief. *NOTE: Actuating the bucket function releases the mechanical swing park brake.* Does upperstructure move only slightly?	**YES:** Go to next check. **NO:** Check swing circuit leakage. Go to Group 9025-25. – – –1/1
DIG FUNCTION DRIFT CHECK	 T6290AF –UN–19OCT88	Run engine at slow idle. Fill bucket with dirt. Position bucket at maximum reach with bucket 2 in. (50 mm) above ground. Observe bucket for 1 minute. Does bucket drift down to ground within 1 minute?	**YES:** Check cylinder drift. Go to Group 9025-25. Inspect reduced leakage valves for boom down and arm in functions. Go to Group 3360. **NO:** Go to next check. – – –1/1
CONTROL VALVE LIFT CHECK TEST	 T6292AZ –UN–19OCT88	Run engine at slow idle. Position machine as illustrated. Slowly actuate pilot controller to lower boom, extend arm (retract cylinder), and dump bucket (retract cylinder). Do functions move in opposite direction as control levers are moved, then change direction as levers are moved further?	**YES:** If functions move in opposite direction first, a leak at the lift check valve is indicated. Inspect lift check valves. Go to Group 3360. **NO:** Go to next check. – – –1/1

Operational Checkout Procedure

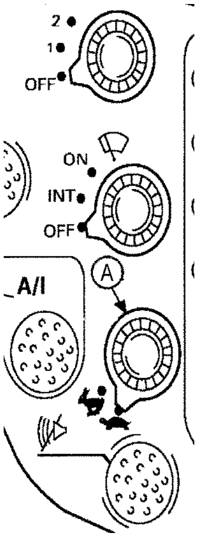
BOOM UP, ARM IN, AND BUCKET COMBINED OPERATION CHECK	Engine at fast idle. Work mode selector in dig mode. Actuate the boom up function, arm in function and then the bucket function. Does boom continue to move at approximately the same speed after bucket function is actuated?	**YES:** Go to next check. **NO:** Inspect bucket flow control valve in control valve if boom speed slows excessively. Go to Group 3360. – – –1/1

ARM REGENERATIVE VALVE OPERATION CHECK	Engine at fast idle Work mode selector in dig mode. Extend the arm to full extension and then lower boom so bucket is on the ground. Actuate the boom up and arm in functions in combined operation. Does the arm move smoothly through the complete cycle and not hesitate when it goes through the vertical position?	**YES:** Go to next check. **NO:** Check the rear pump pressure sensor, arm in pressure sensor, boom up pressure switch, and arm regenerative solenoid valve. Go to Group 9015-15. **IF OK:** Check the arm regenerative valve in the control valve. Go to Group 3360. – – –1/1

PROPEL SYSTEM TRACKING CHECKS WHILE PROPELLING	Engine at fast idle. Propel speed switch in fast speed (rabbit). Propel machine at full speed forward on a flat and level area. Repeat procedure in reverse. Do both tracks move and machine does not mistrack excessively in forward or reverse?	**YES:** Go to next check. **NO:** Note which track does not move or if machine mistracks and the mistrack pattern. Go to Propel System Tracking Test in Group 9025-25. – – –1/1

PROPEL SYSTEM TRACKING CHECKS WHILE OPERATING A DIGGING FUNCTION	Engine at fast idle. Propel speed switch in fast speed (rabbit). Propel machine at full speed forward on a flat and level area. After machine is moving, slowly move the arm control lever from neutral to full actuation to extend the arm. Does machine mistrack excessively when the arm is extended? *NOTE: Machine will slow down during this test.*	**YES:** Inspect flow combiner valve, propel flow control valve, and propel-boom down selector valve in the control valve. Go to Group 3360. **NO:** Go to next check. – – –1/1

PROPEL SYSTEM MANEUVERABILITY CHECK	Engine at fast idle. Propel speed switch in fast speed (rabbit). Propel machine at full speed forward down a slope. Turn in each direction. Repeat the procedure in reverse. Does each track slow down in response to pedal or lever movement in order to turn?	**YES:** Go to next check. **NO:** Inspect counterbalance valve. Go to Group 0260. – – –1/1

PROPEL SPEED SELECTION CHECK	 T102104 –UN–26JUL96	**A—Propel Speed Switch** Engine at fast idle. Turn propel speed switch (A) to slow speed (turtle). Actuate propel function to full speed. Turn propel speed switch to fast speed (rabbit). Does machine travel speed increase? Actuate a dig function and then return to neutral. Does machine travel speed decrease and then increase? Turn propel speed switch to slow speed (turtle). Does machine travel speed decrease?	**YES:** Go to next check. **NO:** Check propel pressure switches and sensors. Go to Group 9015-15. Go to Propel Motor Speed Change Circuit Operation in Group 9025-05. – – –1/1

CYCLE TIMES CHECK

CAUTION: Make sure area is clear and large enough to operate all functions of machine.

IMPORTANT: Warm hydraulic oil to operating temperature for this check.

Engine at fast idle.

Auto-idle switch OFF.

T6477AQ –UN–19OCT88

Boom

– – –1/2

Operational Checkout Procedure

T7884AE –UN–10NOV92

Arm, Bucket, Swing, Propel

Move machine to position shown for each test.

Record cycle time for each function.

Boom Up—Specification

Cycle Time .... 3.1 ± 0.3 sec

Boom Down—Specification

Cycle Time .... 2.5 ± 0.3 sec

Arm In—Specification

Cycle Time .... 3.9 ± 0.3 sec

Arm Out—Specification

Cycle Time .... 2.6 ± 0.3 sec

Bucket Load—Specification

Cycle Time .... 4.1 ± 0.3 sec

Bucket Dump—Specification

Cycle Time .... 2.5 ± 0.3 sec

Swing 3 Revolutions From a Running Start—Check Time Left and Right—Specification

Cycle Time .... 14.4 ± 1.0 sec

Fast Speed Propel 20 m (65 ft) From a Running Start—Check Time Forward and Reverse—Specification

Cycle Time .... 13.4 ± 1.0 sec

Slow Speed Propel 20 m (65 ft) From a Running Start—Check Forward and Reverse—Specification

Cycle Time .... 20.6 ± 2.0 sec

Does machine perform within specifications?

YES: Go to next check.

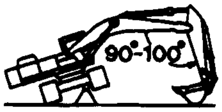
NO: Check engine speed. Check hydraulic pump flow. Go to Group 9010-20 and 9025-25.

– – –2/2

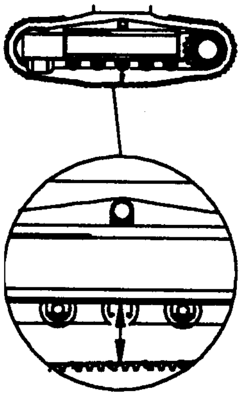
❹ UNDERCARRIAGE CHECKS

– – –1/1

TRACK SAG ROLLER AND IDLER LEAKAGE CHECKS



T6915AN –UN–07APR89



T7850AI –UN–22OCT92

Swing upperstructure to side and raise track off ground.

Operate track in reverse.

Stop engine.

Measure distance between top of track shoe to center of lower surface of track frame.

Track sag specifications:

Normal Soil—Specification

Track Sag .... 300—335 mm (11-13/16—13-3/16 in.)

Check rollers and idlers for oil leaks.

Is oil leaking from rollers or idlers?

Raise other side of machine and repeat checks.

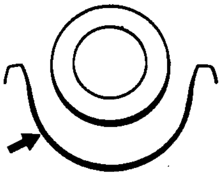
NOTE: If track sag is less than specified, track chain wear will be accelerated. If it is more or less than specified on one side only, the machine may mistrack.

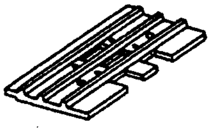
YES: Repair or replace idlers or rollers that are leaking. Go to Group 0130.

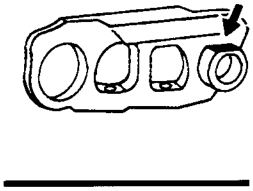
NO: Go to next check.

– – –1/1

Operational Checkout Procedure

SPROCKET WEAR CHECK	 T6981AC –UN–13MAR89	Inspect drive sprocket. Is tooth wear excessive? *NOTE: Do not evaluate sprocket by condition of tooth tip. Tooth tip wear does not affect sprocket operation if it does not extend into the bushing contact area.* *NOTE: Reverse drive side wear is generally more than forward drive side wear.*	**YES:** Replace sprocket. Go to Group 0130. **NO:** Go to next check. – – –1/1

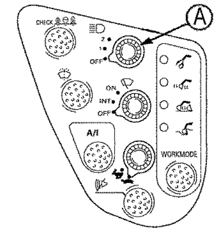
GROUSER WEAR, BENT TRACK SHOE, AND LOOSE HARDWARE CHECKS	 T7322AF –UN–21JUN90	Inspect for worn grousers, bent track shoes, and loose shoe hardware. Are grouser bars worn excessively? Are track shoes bent? Is track shoe width appropriate for ground condition? Is track shoe hardware tight? *NOTE: Excessive grouser wear weakens track shoes and may result in track shoes bending.*	**YES:** If shoe hardware is loose, remove shoe and clean joint before tightening. Go to Remove and Install Track Shoe in Group 0130. **NO:** Go to next check. – – –1/1

TRACK LINK ROLLER AND FRONT IDLER WEAR CHECKS	 T6484AZ –UN–19OCT88	Inspect track links for pin boss wear. Do link pin boss areas indicate contact with roller flanges or track guides? *NOTE: Some contact or wear is normal. Excessive contact or wear indicates excessive rail wear.* Inspect front idler flanges. Do idler flanges contact bushings? *NOTE: Idler contact with bushings indicates excessive chain rail wear and idler tread surface wear.*	**YES:** Go to Undercarriage Appraisal Manual SP326 for more information and specifications. **NO:** Go to next check. – – –1/1

⑤ ACCESSORIES CHECKS

– – –1/1

LIGHT CIRCUIT CHECKS



T102105 –UN–26JUL96

A—Light Switch

NOTE: All accessories are powered from the fuse block. If any accessories do not function, check fuses in fuse block.

Turn key switch ON.

Turn light switch (A) to 1st position.

Are monitor panel back lights and front driving lights on?

Turn light switch to 2nd position.

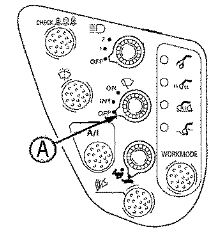
Do work lights on boom come on also?

YES: Go to next check.

NO: Check fuses, monitor panel back light bulbs, switches, and wiring. Go to Group 9015-15.

– – –1/1

WINDSHIELD WIPER CIRCUIT CHECK



T102106 –UN–26JUL96

A—Windshield Wiper Switch

Key switch ON.

Turn wiper switch (A) to INT position.

Does wiper operate intermittently?

Turn wiper switch to ON position.

Does wiper operate continuously?

Move wiper switch to OFF position.

Does wiper arm stop in park position?

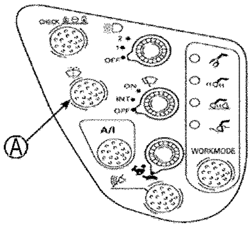
YES: Go to next check.

NO: Check that upper right window lock pin engages hole in cab frame and is turned to engage the lock to close windshield enable switch. Check fuse, switch, and wiper harness. Go to Group 9015-15.

– – –1/1

Operational Checkout Procedure

WINDSHIELD WASHER CIRCUIT CHECK



T102107 –UN–26JUL96

A—Windshield Washer Switch

IMPORTANT: Washer motor may be damaged if washer switch is held for more than 20 seconds, or continually operated with no fluid in the windshield washer tank.

Key switch ON

Push washer switch (A).

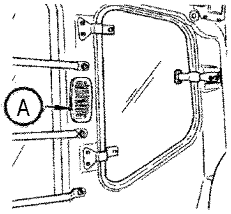
Does washer fluid squirt on windshield?

YES: Go to next check.

NO: Check washer fluid level. Check wiper fuse and wiring harness. Go to Group 9015-15.

– – –1/1

CAB DOME LIGHT CIRCUIT CHECK



T102183 –UN–26JUL96

A—Cab Dome Light Switch

Key switch ON.

Move switch (A) to on position.

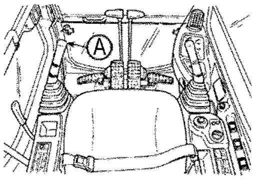
Does cab dome light come on?

YES: Go to next check.

NO: Check fuse and wiring harness. Go to Group 9015-15.

– – –1/1

HORN CIRCUIT CHECK



T102195 –UN–26JUL96

A—Horn Button

Key switch ON.

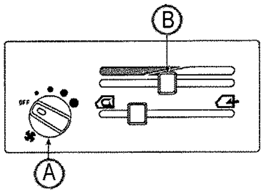
Push horn button (A) on top of left control lever.

Does horn sound?

YES: Go to next check.

NO: Check fuse and wiring harness. Go to Group 9015-15.

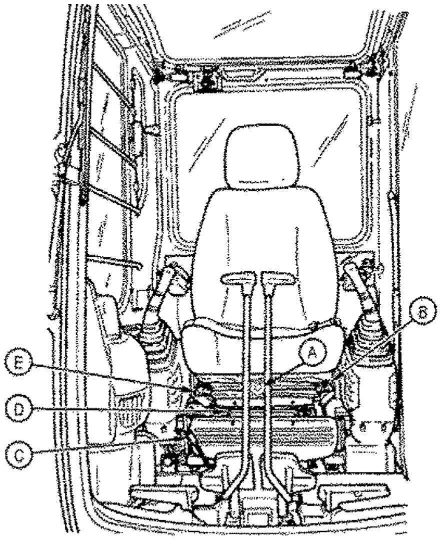
– – –1/1

HEATER CONTROLS CHECK	 T102108 –UN–26JUL96 **A—Blower Control Switch** **B—Temperature Control Lever** Engine running and at normal operating temperature. Turn blower control switch (A) to all four speed positions, then back to OFF. Does fan run in all four positions, then stop in OFF position. With fan running at any speed, move temperature control lever (B) to warm temperature position (rearward). Does warm air exit from vents?	**YES:** Go to next check. **NO:** Check heater fuse, wiring harness, and motor. Go to Group 9015-15. – – –1/1

❻ SEAT, DOORS, WINDOWS, LATCHES, AND LOCKS CHECKS

– – –1/1

SEAT CONTROL CHECKS



T102507 –UN–29JUL96

A—Weight Adjustment Knob
B—Seat Height and Angle Adjustment Lever
C—Console and Seat Fore-Aft Adjustment Lever
D—Seat Fore-Aft Adjustment Lever
E—Backrest Adjustment Lever

Push down lever (B) and raise and lower seat.

Does seat raise and lower easily?

Push down lever (B) and adjust angle of seat.

Does seat angle change easily?

Push down lever (C). Move seat and both side consoles forward and rearward. Release lever to lock seat and side consoles in position.

Does lever unlock easily and then lock to hold seat and consoles in position?

Pull up lever (D). Move seat forward and rearward. Release lever to lock seat in any position.

Does lever move easily to unlock seat support?

Does seat move forward and rearward easily?

Does lever lock seat support in position when released?

Pull up lever (E). Tilt seat back forward and rearward. Release lever to lock seat back in any position.

Does seat back tilt forward and rearward easily?

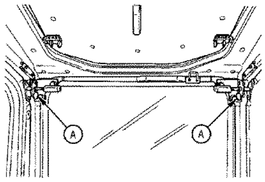
Does lever unlock and lock easily to hold seat back in position?

YES: Go to next check.

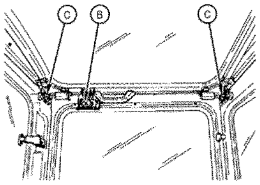
NO: Inspect and repair or replace any parts that do not operate properly. Go to Group 1821.

– – –1/1

UPPER FRONT WINDOW CHECK



T102109 –UN–26JUL96



T102110 –UN–26JUL96

A—Lock Pins
B—Rear Latch
C—Cab Frame Rear Holes

Move lock pins (A) toward center of window.

Pull window up and back until it catches in latch (B) for convenient storage overhead.

Slide the two lick pins (C) into the cab frame boss holes and turn to lock.

Do pins move smoothly to lock and unlock window?

Does rear latch operate freely?

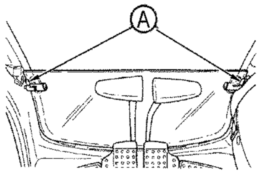
Do pins engage rear holes and lock window securely in full open position?

YES: Go to next check.

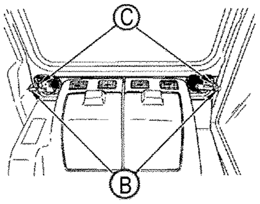
NO: Inspect. Repair. Go to Group 1810.

– – –1/1

LOWER FRONT WINDOW STORAGE CHECK



T102111 –UN–26JUL96



T102112 –UN–26JUL96

A—Lock Pins
B—Brackets
C—Holes

NOTE: Upper front window must be raised before lower window can be removed from window frame.

Pull in on lock pins (A) to unlock window.

Lift the lower front window from the frame.

Store window behind rear console. Slide lock pins into hole (C) in brackets (B).

Do the springs push the lock pins out?

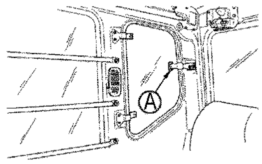
Does window lock securely into bracket?

YES: Go to next check.

NO: Inspect. Repair. Go to Group 1810.

– – –1/1

RIGHT REAR SIDE AND LEFT SIDE WINDOW CHECKS



T102113 –UN–26JUL96

A—Latch

Right rear side window: Unlatch lock (A). Push joint part of lock to open window.

Does latch operate smoothly?

Does window remain opened when latched open?

Left side cab window: Slide both window panes open and closed?

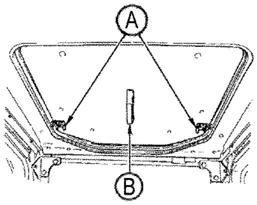
Do both windowpanes slide freely to left and right?

YES: Go to next check.

NO: Inspect. Repair. Go to Group 1810.

– – –1/1

ROOF EXIT COVER CHECK



T102205 –UN–26JUL96

A—Lock Pins
B—Handle

Move lock pins (A) toward center of roof exit.

Push on handle (B) until cover is held in open position by air cylinders.

Pull on handle to pull cover down until lock pins “click” into position and hold cover closed.

Does cover open and close freely?

Does air cylinder hold cover in the open position?

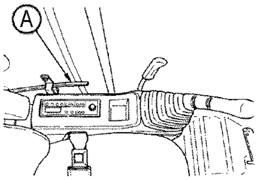
Do lock pins “click” into position and hold cover closed?

YES: Go to next check.

NO: Inspect. Repair. Go to Group 1810.

– – –1/1

CAB DOOR LATCH CHECK



T102114 –UN–26JUL96

A—Lever

Open cab door.

Lock cab door in open position.

Push down on lever (A) to release door from locked open position.

Close door.

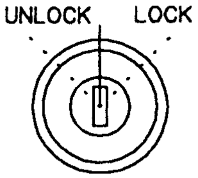
Does door unlatch easily, lock in open position securely, unlock from open position easily, and latch closed securely?

YES: Go to next check.

NO: Inspect. Repair. Go to Group 1810.

– – –1/1

CAB DOOR LOCK CHECK



T7425AH –UN–10DEC90

From outside cab, close cab door.

Insert ignition key into door lock, turn clockwise 1/4 turn to lock.

Allow key to return to vertical.

Try to open door.

Turn key 1/4 turn counterclockwise to unlock.

Allow key to return to vertical.

Remove key from lock.

Does lock turn easily?

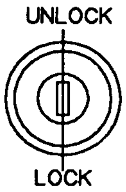
Does lock prevent door from opening when locked?

YES: Go to next check.

NO: Inspect. Repair.

– – –1/1

LEFT AND RIGHT ACCESS DOORS LOCK CHECK



T7425AG –UN–28NOV90

Insert ignition key into lock and turn 180° clockwise to lock.

Turn key 180° counterclockwise to unlock.

Does lock turn easily and lock door and cap in position?

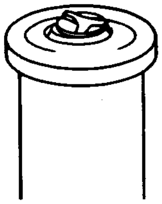
Are all parts free of any visible damage?

YES: Go to next check.

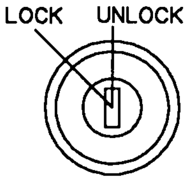
NO: Inspect. Repair.

– – –1/1

FUEL CAP LOCK CHECK



T7351AH –UN–22AUG90



T7425AF –UN–04DEC90

Turn lock cover to expose lock.

Insert ignition key into fuel cap lock.

Turn key 45° counterclockwise to lock fuel cap.

Does lock prevent cap from being removed?

Turn key 45° clockwise to unlock fuel cap.

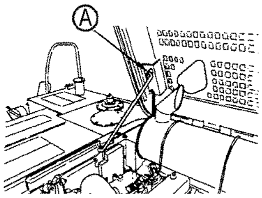
Does lock turn easily to lock and unlock?

YES: Go to next check.

NO: Replace fuel cap.

– – –1/1

HOOD CHECK



T102128 –UN–26JUL96

A—Hood Hold-Open Rod

Unlock hood latch with ignition key.

Release latches.

Open hood.

Engage hold-open rod (A).

Does rod hold hood open?

Close hood and engage latches.

Do latches operate easily?

Do latches hold hood closed?

YES: Go to next check.

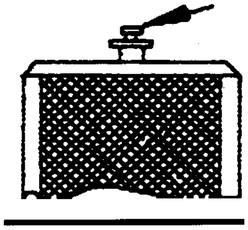
NO: Inspect. Repair.

– – –1/1

❼ ENGINE COOLING SYSTEM CHECKS

– – –1/1

RADIATOR CAP CHECK



T6488FY –UN–19OCT88

⚠ **CAUTION: Prevent possible injury. DO NOT remove radiator cap unless engine is cool. When engine is hot and cap is removed, hot coolant or steam will spray out causing serious burns.**

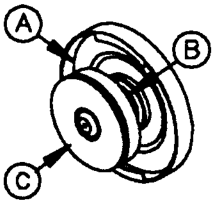
Engine OFF and cool.

Remove radiator cap.

If coolant is warmer than surrounding air temperature, is a "whoosh" sound heard when cap is loosened?

Does cap have a stop position that requires it to be pushed down to remove?

Is spring (B) in good condition?



T7690AB –UN–23JAN92

A—Gasket
B—Spring
C—Seal

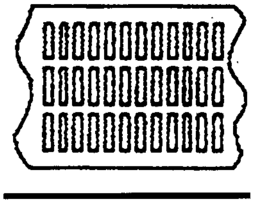
Does cap have a good seal (C) and gasket (A)?
Is spring (B) in good condition?

YES: Go to next check.

NO: Replace radiator cap.

– – –1/1

RADIATOR INTERNAL CORE CHECK



T6488FZ –UN–19OCT88

⚠ **CAUTION: Prevent personal injury, DO NOT remove radiator cap unless engine is cool. When engine is hot and cap is removed, hot coolant or steam will spray out causing serious burns.**

Raise engine access door.

Remove radiator cap.

Drain coolant into a clean container until core tubes are visible.

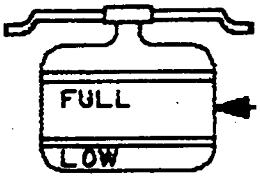
Is radiator core free of rust, lime, or corrosion? Are passages in core clean, not plugged?

YES: Go to next check.

NO: Remove and clean or replace radiator. Fill cooling system with clean coolant.

– – –1/1

COOLANT LEVEL AND CONDITION IN RECOVERY TANK CHECKS



T6488FX –19–21MAR89

Engine OFF and cool.

Open radiator access door.

Inspect coolant level and coolant condition in recovery tank.

Is coolant level between FULL and LOW marks on recovery tank?

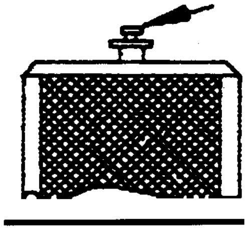
Is coolant clear, not oily, foamy, or rust colored?

YES: Go to next check.

NO: Add or replace coolant.

– – –1/1

COOLANT LEVEL AND CONDITION IN RADIATOR CHECKS



T6488FY –UN–19OCT88

⚠ **CAUTION: Prevent possible injury. DO NOT remove radiator cap unless engine is cool. When engine is hot and cap is removed, hot coolant or steam will spray out causing serious burns.**

Engine OFF and cool.

Remove radiator cap.

Inspect coolant level.

Inspect coolant condition.

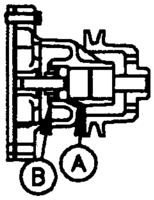
Is coolant level at bottom of fill neck on radiator?

Is coolant clear, not oily, foamy or rust colored?

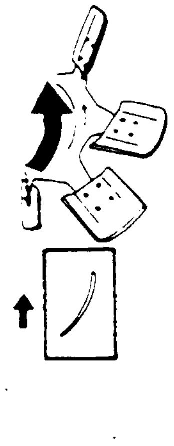
YES: Go to next check.

NO: Add coolant if low. Check hose to coolant recovery tank. Flush radiator and engine if coolant is dirty or rusty. Add clean coolant. If coolant is oily check for hydraulic or engine oil leaks into cooling system. Go to Engine Repair chapter.

– – –1/1

COOLANT HOSES AND CLAMPS CHECKS	Are radiator and heater hoses free of twists, kinks, cracks, leaks, or wear from rubbing on adjacent parts? Are hose clamps tight and installed correctly?	**YES:** Go to next check. **NO:** Replace hoses as required. Install and tighten hose clamps. – – –1/1
FAN SHROUD AND FAN GUARD CHECKS	 T6488GN –UN–19OCT88 Check fan to fan shroud clearance. Is fan centered in shroud? Is guard free of damage? Are all mounting brackets and hardware tight?	**YES:** Go to next check. **NO:** Adjust fan shroud to center fan. Repair or replace guard. Tighten loose hardware. Replace fan shroud if needed. Go to Group 0510. – – –1/1
WATER PUMP CHECK	 T7690AC –UN–27JAN92 **A—Weep Hole** **B—Seal** Engine stopped. Is coolant leaking from weep hole (A)?	**YES:** Seal (B) has failed. Replace seal or water pump. Go to Engine Repair chapter. **NO:** Go to next check. – – –1/1

FAN DIRECTION CHECK



T6171CB –UN–25MAY89

Is fan installed correctly with concave (cupped) side (Arrow) of fan blade towards engine?

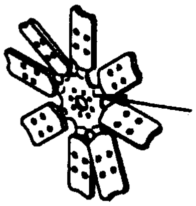
NOTE: If fan is installed backwards, about 50% of its capacity is lost.

YES: Check complete.

NO: Install fan correctly. (See Remove and Install Fan Guard in Group 0510.)

– – –1/1

FAN BLADES CHECK



T7694AH –UN–03FEB92

Are fan blades bent or twisted?

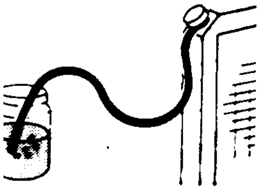
Are fan blades cracked or nicked?

YES: Replace fan.

NO: Go to next check.

– – –1/1

ENGINE HEAD GASKET SEAL CHECK



T6171AR –UN–25MAY89

Engine at normal temperature.

Radiator full.

Install radiator cap and tighten.

Place end of radiator overflow hose into a container of clear water.

Operate engine at fast idle. Load engine by holding a hydraulic function over relief.

Look for bubbles coming from overflow tube. Do bubbles flow from tube intermittently?

YES: Head gasket is OK. Go to next check.

NO: If there is a constant flow of bubbles from tube, loose or damaged cylinder head or a leaking head gasket may be indicated. Go to Engine Repair chapter.

– – –1/1

Operational Checkout Procedure

RADIATOR OUTSIDE AIR FLOW CHECK	Inspect radiator screen for mud and debris. Inspect radiator fins for mud and debris. Inspect radiator for bent or damaged fins. Are radiator fins free of mud, leaves, grass, and other debris? Are fins straight, not broken or cracked?	**YES:** Go to next check. **NO:** Clean screen. Clean outside of radiator. Straighten fins. Replace radiator if severely damaged.

– – –1/1

FAN BELT CHECK	Is fan belt free of oil or grease? Is inside surface of belt free of cracks or frayed edges? Is belt aligned with pulleys?	**YES:** Check complete. **NO:** Replace belt if oily, greasy, cracked, or otherwise damaged.

– – –1/1

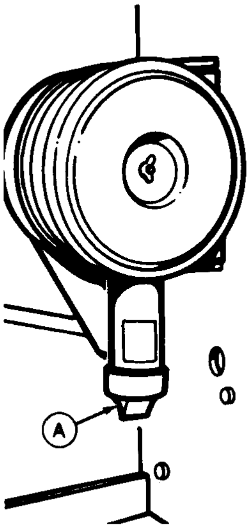
AIR INTAKE SYSTEM CHECKS

– – –1/1

AIR FILTER RESTRICTION INDICATOR AND SWITCH CHECK	Run engine at slow idle. Slowly cover air intake tube. Does air filter restriction indicator light in cab come ON?	**YES:** Go to next check. **NO:** Check monitor circuit fuse, air filter restriction indicator light and switch. Go to Group 9015-15.

– – –1/1

AIR CLEANER UNLOADER VALVE CHECK



T7531BF –UN–07JUN91

A—Air Cleaner Unloader Valve

Open left front access door.

Inspect air cleaner unloader valve (A).

Is unloader valve slightly open when the engine is not running?

Is rubber flexible and showing no sign of becoming hard or brittle?

Engine running.

Turn auto-idle switch off and turn engine rpm dial to fast idle.

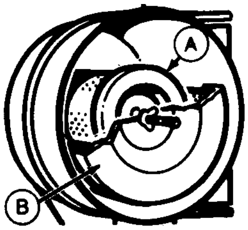
Does unloader valve close?

YES: Go to next check.

NO: Replace unloader valve.

– – –1/1

AIR CLEANER ELEMENTS CHECK



T7531BG –UN–07JUN91

A—Secondary Element
B—Primary Element

Remove air cleaner cover.

Inspect primary element (B).

Is element clean and in good condition?

Remove wing nut to remove primary element.

Inspect secondary element (A).

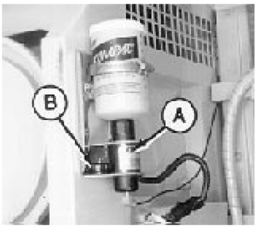
Is element clean and in good condition?

YES: Go to next check.

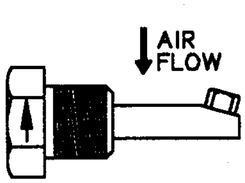
NO: Clean or replace primary element. Replace secondary element if primary element is damaged. Do not clean secondary element. Replace if dirty.

– – –1/1

COLD WEATHER STARTING AID CHECKS



T103516 –UN–04SEP96



T7699AL –UN–03FEB92

A—Starting Aid Solenoid
B—Dust Cover

Raise engine access door.

Open left rear service door.

Check that starting fluid can is installed in starting aid solenoid (A).

If starting fluid can is NOT installed, check that dust cover (B) is installed.

Is starting fluid line from starting aid solenoid to air intake manifold straight—NOT kinked or broken?

Is arrow on starting aid nozzle pointing AGAINST air flow of air intake manifold?

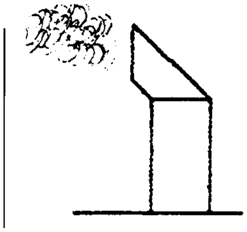
NOTE: It may be necessary to scrape paint from nozzle to see arrow.

YES: Go to next check.

NO: Install a starting fluid can or the dust cover. Replace plastic line. Tighten nozzle until arrow is in correct position—pointing AGAINST incoming air flow.

– – –1/1

EXHAUST SMOKE CHECK



T6488GF –UN–19OCT88

Operate engine until coolant temperature gauge needle is in the “GREEN” zone before doing this check.

Run engine at fast idle.

Counter rotate tracks to put load to engine.

Observe exhaust smoke.

Is exhaust smoke dark black or blue smoke? Is exhaust smoke gray or white?

NOTE: Dark black smoke can be caused by dirty air filter or poor fuel delivery. Blue smoke can be caused by worn or damaged piston rings or cylinder liners. Gray or white smoke can be caused by a cold engine, dirty injection nozzles, or both.

YES: Go to Diagnose Engine Malfunctions, Group 9010-15.

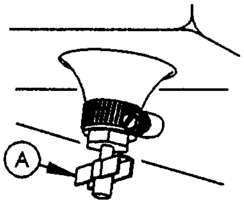
NO: Go to next check.

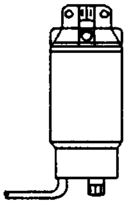
– – –1/1

⑨ FUEL SYSTEM CHECKS

– – –1/1

FUEL TANK INTERIOR CHECK	**IMPORTANT: Be careful not to damage fuel gauge sender float or low fuel level sending unit.** Remove fuel cap. Use a flashlight to inspect bottom of fuel tank by shining light through the fuel. Is dirt, debris, or contamination seen in tank?	**YES:** Drain fuel, dispose of contaminated fuel properly. Remove debris, clean bottom of tank. Replace fuel filters. Check water separator. **NO:** Go to next check. – – –1/1

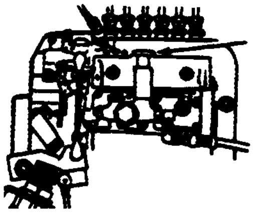
FUEL TANK SUMP CHECK	 T7700AA –UN–18FEB92 **A—Fuel Tank Drain Valve** Hold a clean container under fuel tank drain valve (A). Remove recessed hex plug. Open drain valve for a few seconds and catch fuel in container. Check condition of fuel in container. Is water present or is fuel cloudy?	**YES:** Drain until clear fuel flows or drain all fuel from tank, dispose of contaminated fuel properly. Replace fuel filters, check water separator. **NO:** Go to next check. – – –1/1

PRIMARY FUEL FILTER (WATER SEPARATOR) CHECK	 T7700AB –UN–25FEB92 Inspect fuel in primary fuel filter (water separator). Is water or other contamination present?	**YES:** Replace primary fuel filter element. **NO:** Go to next check. – – –1/1

Operational Checkout Procedure

FUEL TRANSFER PUMP CHECK

T103528 –UN–04SEP96



T6493AA –UN–19OCT88

A—Bleed Screw

Open bleed screw (A) on fuel filter and operate hand primer on fuel transfer pump.

Does fuel come out of bleed screw when hand primer is operated?

Tighten bleed screw and again operate hand primer.

Is resistance felt when hand primer is initially pumped but resistance decreases as system pressure increases?

YES: Go to next check.

NO: Be certain fuel filter is clean. If not, replace filter and recheck fuel supply pump.

– – –1/1

FUEL SYSTEM CHECK

Engine OFF.

Disconnect fuel return hose from leak-off line.

Connect a hose to leak-off line to route excess fuel into a container.

Start engine and run at fast idle.

Put engine under load by operating a hydraulic function over relief.

Observe fuel flow from leak-off line.

Does fuel flow from leak-off line with engine at full load?

NOTE: Fuel that flows from leak-off line is excess fuel not required by the engine and flows back to the fuel tank.

YES: Operational checkout complete.

NO: Fuel supply is restricted, check for plugged fuel filters, plugged fuel tank cap vent, restricted lines, stuck injection pump overflow valve, or a malfunctioning fuel transfer pump. Repair or replace as necessary.

– – –1/1

⑩ VISUAL INSPECTION

– – –1/1

VISUAL INSPECTION	 T6477AQ –UN–19OCT88	Park machine on a level surface. Extend the bucket cylinder. Retract bucket cylinder. Lower the boom so bucket is on the ground. Stop the engine. Inspect oil lines and hydraulic components for leaks or damage. Are lines or components damaged or leaking?	**YES:** Replace damaged O-rings or gaskets. Tighten fittings or cap screws. Repair or replace bent or damaged lines. Repair or replace damaged components. **NO:** Operational checkout is complete.

– – –1/1

CHAPTER 3

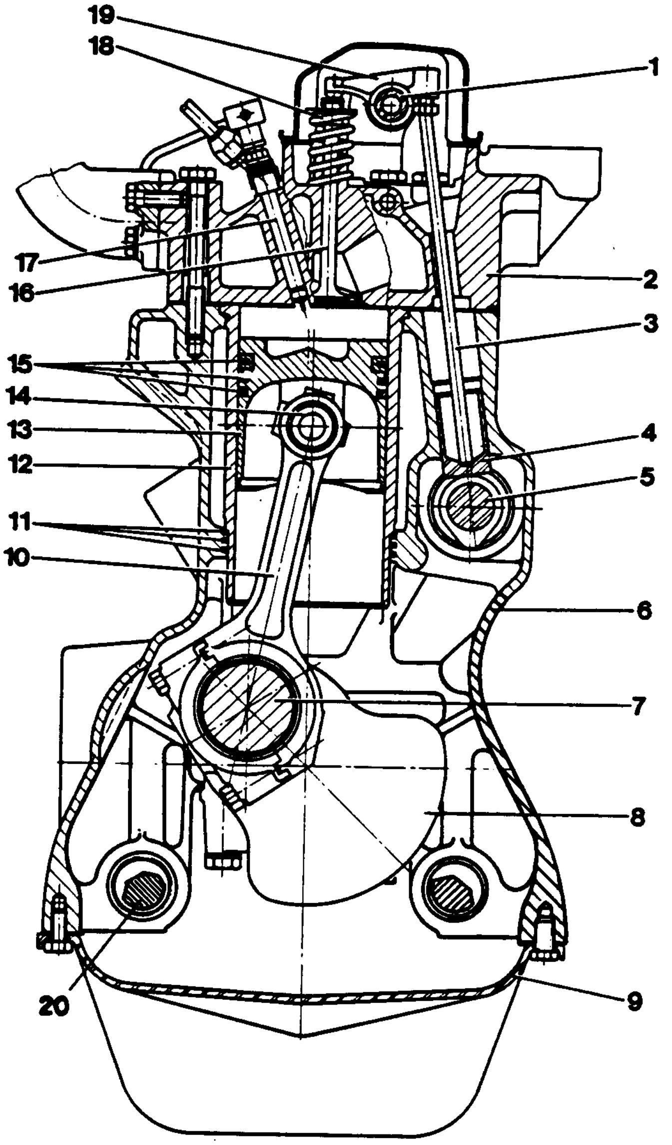
SECTION 9010

ENGINE

BLANK

Group 05
Theory of Operation

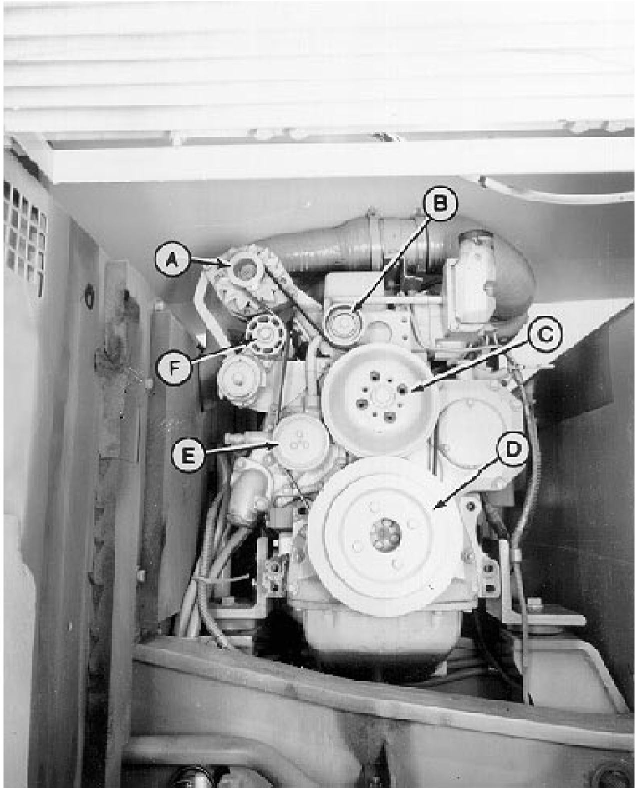
ENGINE—SECTIONAL VIEW



1—Rocker Arm Shaft	7—Crankshaft	12—Cylinder Liner	18—Valve Spring
2—Cylinder Head	8—Crankshaft Counterweight	13—Piston	19—Rocker Arm
3—Push Rod	9—Oil Pan	14—Piston Pin	20—Balancer Shafts (some 4-cylinder engines only)
4—Cam Follower	10—Connecting Rod	15—Piston Rings	
5—Camshaft	11—Liner Packing Rings	16—Valve	
6—Cylinder Block		17—Fuel Injection Nozzle	

FAN DRIVE OPERATION

The fan drive (C), driven by one fan belt from the engine crankshaft (D), is self adjustable. The fan belt tension adjuster (F) automatically adjusts the belt to correct tension.

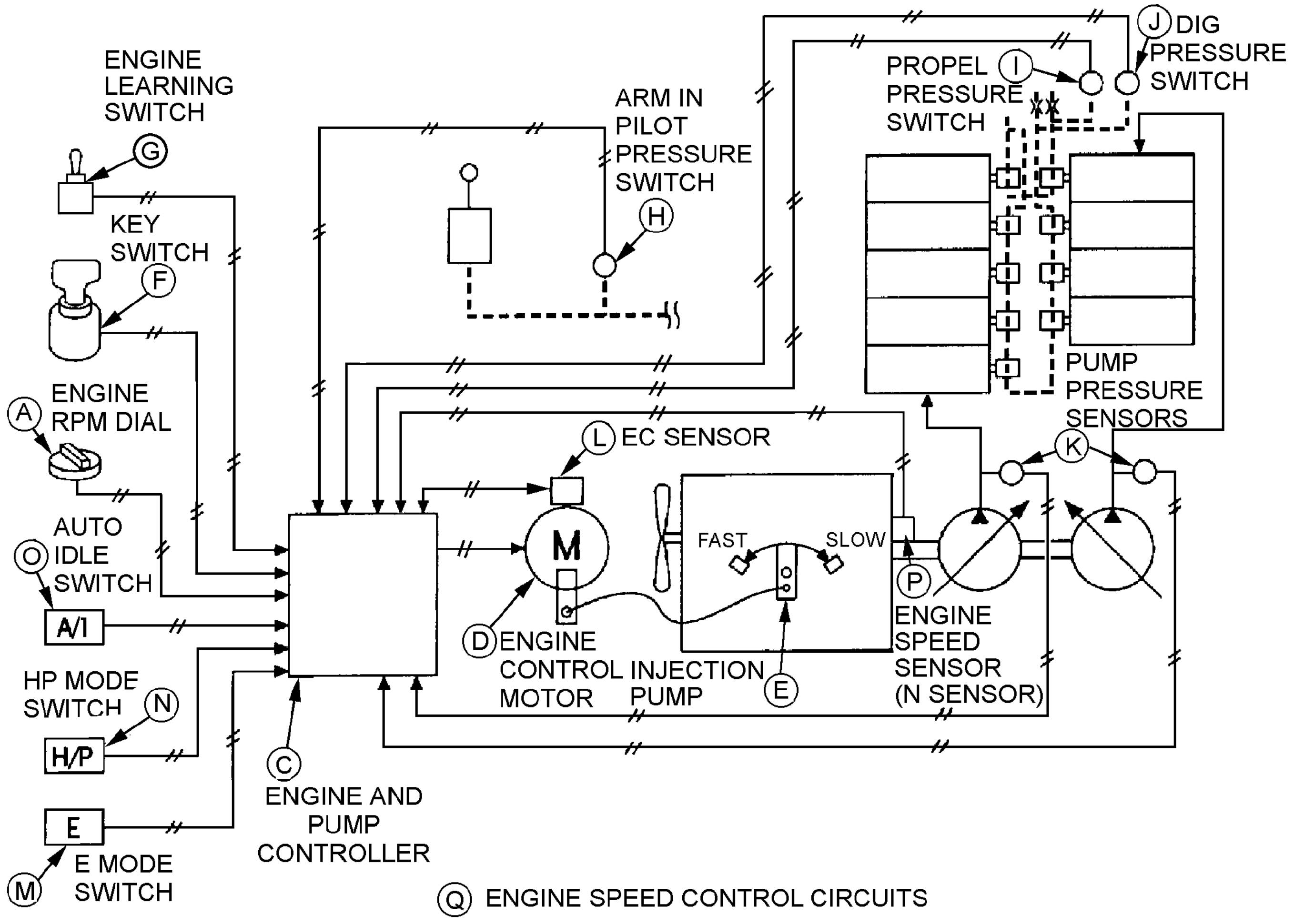


T103369 –UN–29AUG96

A—Alternator Pulley
B—Idler Pulley
C—Fan Pulley
D—Crankshaft Pulley
E—Water Pump Pulley
F—Tension Adjuster

TX,9010,SB106 –19–06SEP96–1/1

ENGINE SPEED CONTROL SYSTEM OPERATION



T115408

The engine speed control circuits (Q) have the following control functions:

- Slow to fast idle in standard mode
- HP (high power) mode control
- E (economy) mode control
- Auto-idle mode
- Engine learning control

Continued on next page

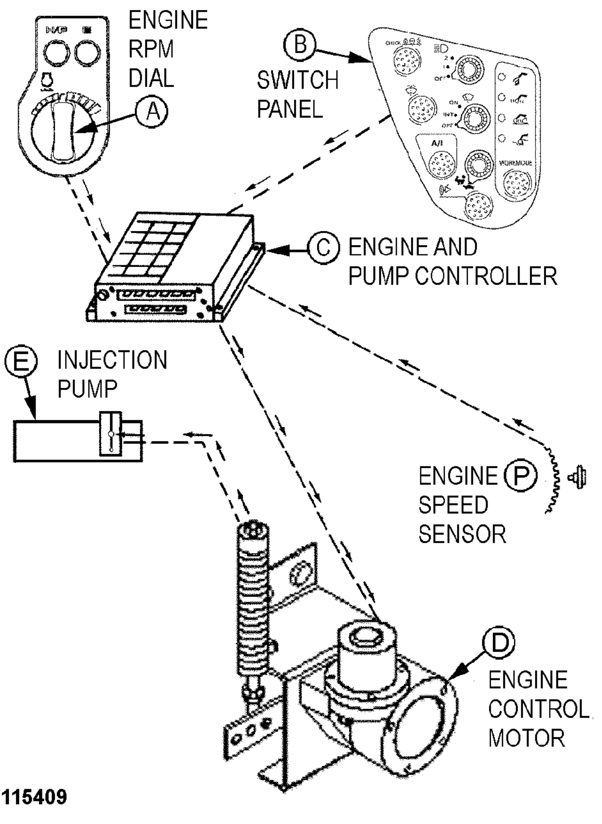
The engine speed control components allows the operator to choose engine speeds to match operating conditions and to operate the engine as efficiently as possible.

Engine speeds from slow idle to fast idle in standard mode are selected by the engine rpm dial (A) located in the right console panel in cab. The E (economy) mode and HP (high power) mode are selected by switches located in the right console panel just above the engine rpm dial. The auto idle mode is selected by a switch located in the switch panel (B). Indicators in the monitor panel are lit to indicate when the E mode, HP mode, and auto-idle mode switches are pushed to activate the function.

- AI=Auto Idle Mode Switch
- E=Economy Mode Switch
- HP=High Power Mode Switch

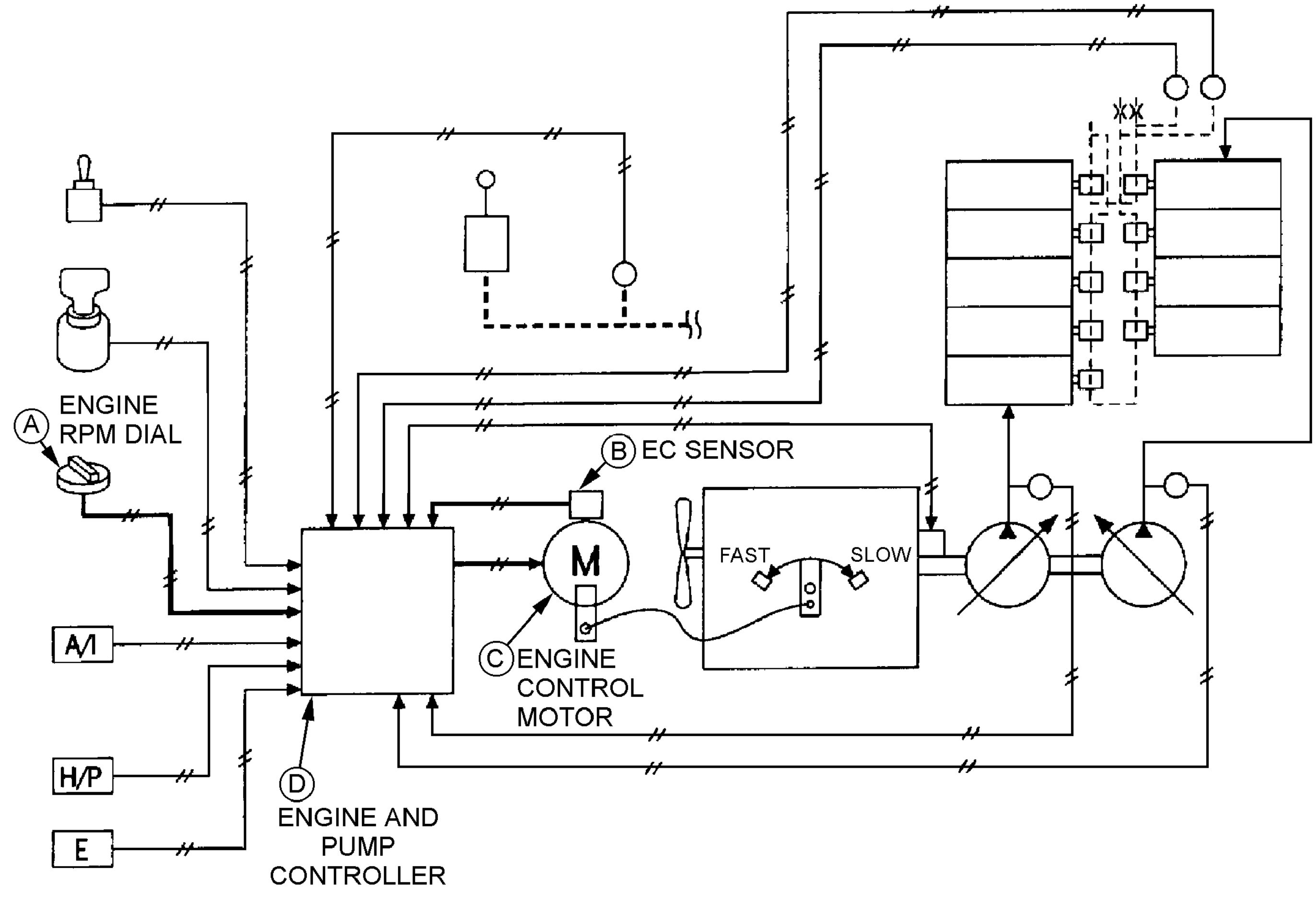
Turning the engine rpm dial or pushing the AI, E, or HP mode switches sends an electrical signal to the engine and pump controller (C). The controller senses the electrical signal and then from the stored data sends an electrical signal to the engine control motor (D). The engine control motor regulates engine speed by a push-pull cable attached to the fuel injection pump lever located in the pump drive housing.

The engine speed sensor (P) (located in the pump drive housing) counts the pump drive gear teeth as the gears rotate. This senses actual engine speed. The sensing signal is sent to the engine and pump controller (C) which calculates engine speed.



T115409

ENGINE RPM DIAL SPEED CONTROL CIRCUIT OPERATION



T115580 Ⓔ ENGINE RPM DIAL SPEED CONTROL CIRCUIT

T115580 –19–27MAY98

The function of the engine rpm dial speed control circuit (E) is to control engine speed from slow to fast idle in standard mode in response to the position of engine rpm dial (A).

As the engine rpm dial is turned to increase or decrease engine speed, the electrical signal sent from the dial to the engine and pump controller (D) changes. Then, from data stored in the controller, the controller sends an electrical signal to actuate the engine control motor (C). The control motor moves the injection pump lever by a push-pull cable to change engine speed in response to the position of the engine rpm dial. The EC (engine control) sensor (B) sends an electrical feedback signal to the controller indicating the motor's position.

The engine speed for slow idle is limited by the slow idle stop bracket. The data for slow idle position is stored in the engine and pump controller and is used to calculate the positions for auto-idle, E (economy), and HP (high power) modes. (See Engine Learning Control Circuit Operation in this group. For adjustment, see Injection Pump Fast and Slow Idle Stops Adjustment in Group 9010-20.)

The engine speed for fast idle in standard mode is controlled by data stored in the engine and pump controller. The parameter for fast idle in standard mode can be change from the factory setting within a specified range. (See Excavator Diagnostic Software Special Function—Engine Speed in Group 9025-25.)

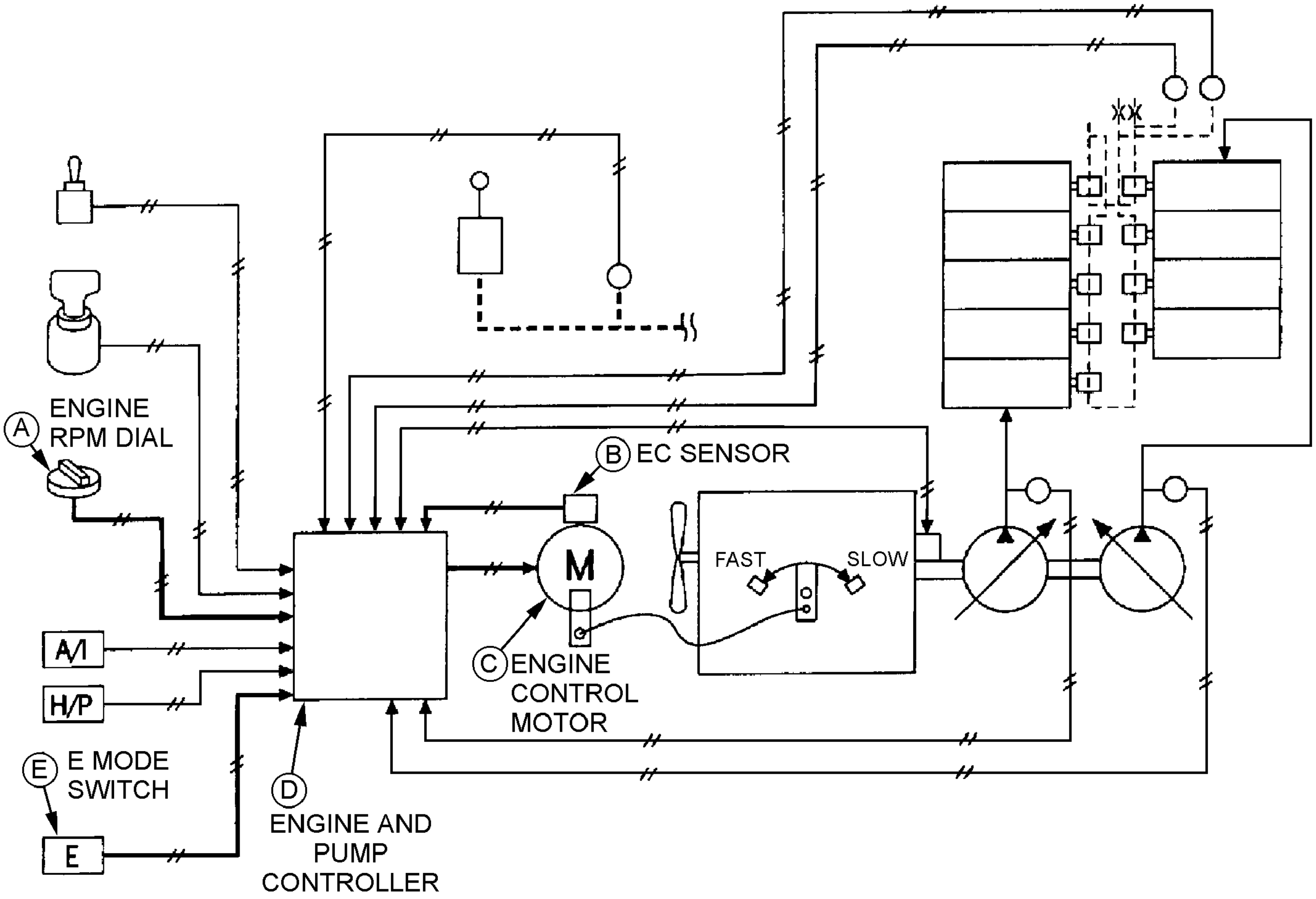
Continued on next page

Theory of Operation

The fast idle stop bracket on the injection pump limits the maximum engine speed for HP mode. (For adjustment, see Injection Pump Fast and Slow Idle Stops Adjustment in Group 9010-20.).

CED,OUOE003,1053 –19–11AUG98–2/2

E (ECONOMY) MODE SPEED CONTROL CIRCUIT OPERATION



T115581

Ⓕ E (ECONOMY) MODE SPEED CONTROL CIRCUIT

T115581 –19–27MAY98

The function of E (economy) mode speed control circuit (F) is to operate the engine at a lower speed range when full engine power is not needed. The engine power is somewhat less but digging power is the same as in standard mode. Operating in E mode also improves fuel efficiency and reduces the noise level. The E mode function is available when dig mode is selected as the work mode. The E mode indicator is ON when the E mode switch (E) is push down to show that E mode is actuated.

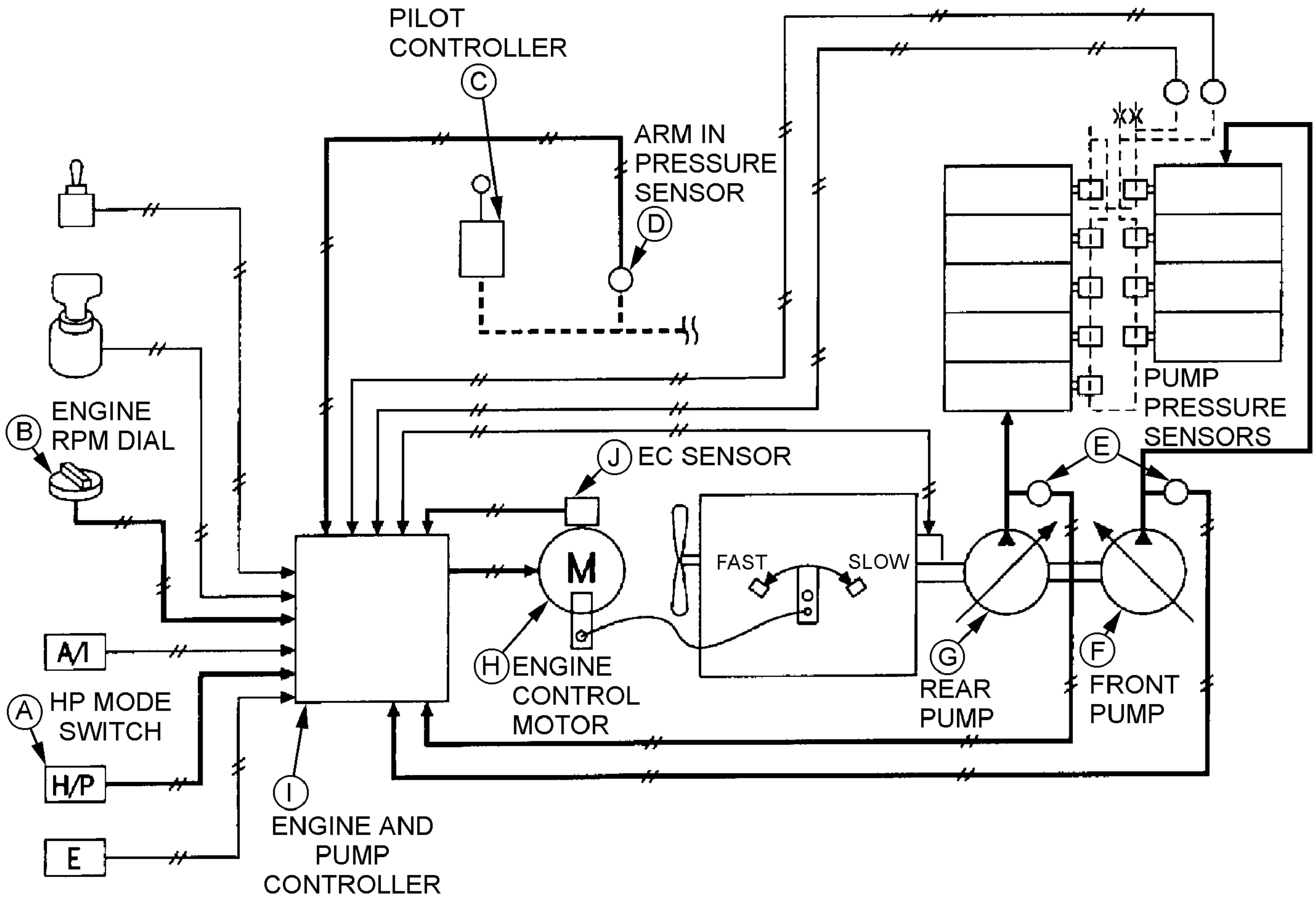
NOTE: Standard mode is when the E mode and HP mode switches are OFF.

When E mode is actuated, the engine and pump controller (D) sends electrical signals to the engine control motor (C) to run the engine in a speed range lower than standard mode. The adjustable range for engine speed is from the specified speed for E mode down to slow idle and is in proportion to the engine rpm dial position. The electrical signals to the motor are calculated from data stored in the engine and pump controller (D). The EC (engine control) sensor (B) sends an electrical feedback signal to the controller indicating the motor's position.

The parameter for engine speed in E (economy) mode can be change from the factory setting within a specified range. (See Excavator Diagnostic Software Special Function—Engine Speed Adjustment in Group 9025-25.)

CED,OUOE003,1054 –19–11AUG98–1/1

HP (HIGH POWER) MODE SPEED CONTROL CIRCUIT OPERATION



T115582

Ⓚ HP (HIGH POWER) MODE SPEED CONTROL CIRCUIT

The function of the HP (high power) mode speed control circuit (K) is to increase engine speed when a little more hydraulic power is needed for arm in operation. The HP mode is available when in the dig work mode. HP mode is used in the standard and E (economy) modes.

The HP mode is actuated with the following conditions:

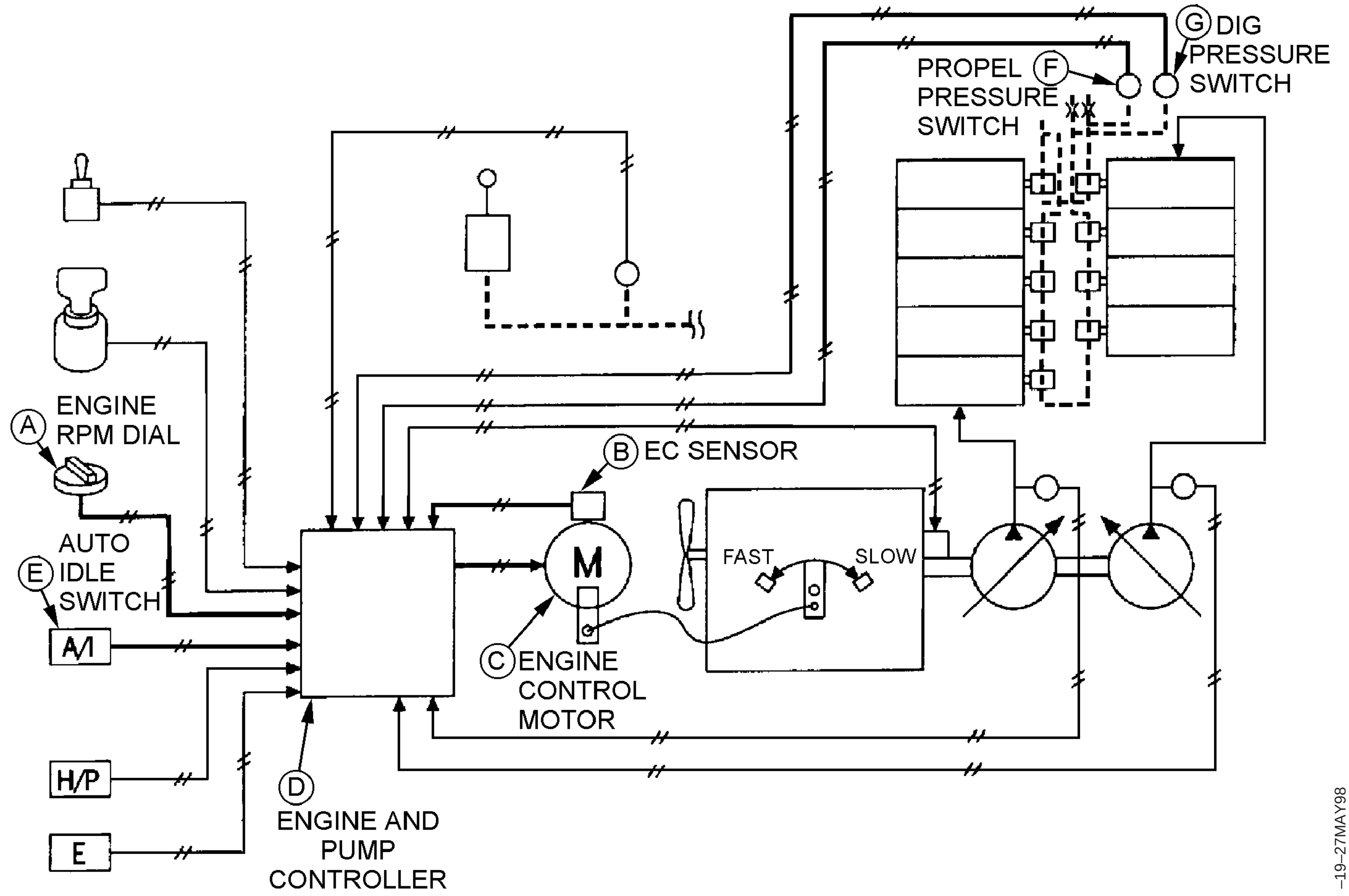
- HP mode switch (A) is pushed down. The HP indicator is ON.
- Engine speed is approximately 1600 rpm or faster. The electrical signal from the engine rpm dial (B) to the engine and pump controller (I) indicates the engine speed.
- Arm in function is actuated. The arm in pressure sensor (D) sends an electrical signal to the engine and pump controller (I).
- The pump delivery pressure is approximately 23 440 kPa (234 bar) (3400 psi) or higher. The pump pressure sensors (E) send an electrical signal to the engine and pump controller.

Continued on next page

Theory of Operation

When all conditions are meet, the engine and pump controller sends an electrical signal to the engine control motor to increase the engine speed. The amount of engine speed increase is somewhat controlled by the pump regulators adjustment and the load on the engine. The maximum engine speed for HP mode is limited by the fast idle stop bracket on the injection pump. (For adjustment, see Injection Pump Fast and Slow Idle Stops Adjustment in Group 9010-20.).

AUTO-IDLE MODE SPEED CONTROL CIRCUIT OPERATION



T115583

Ⓗ AUTO-IDLE MODE SPEED CONTROL CIRCUIT

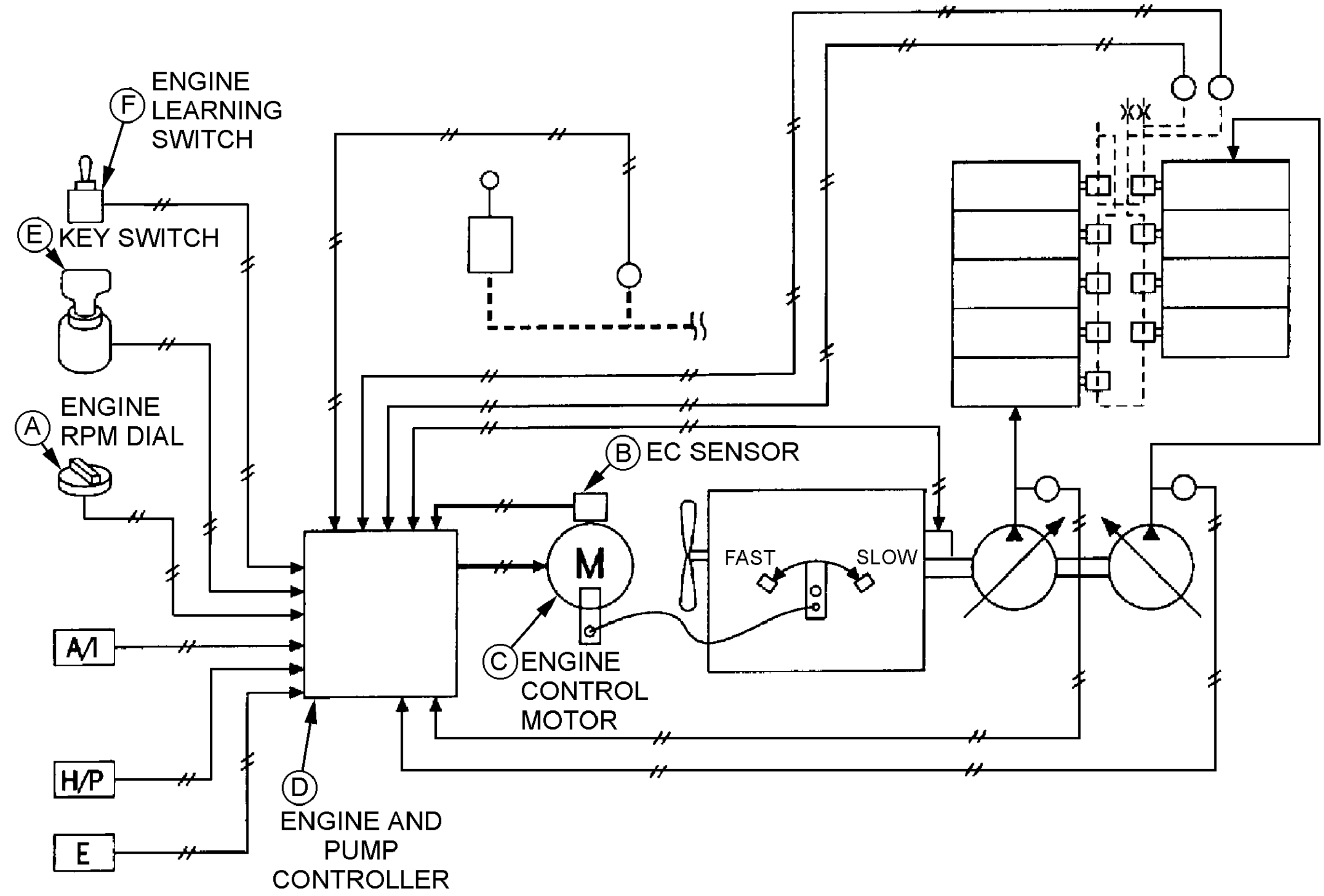
The function of the auto-idle mode speed control circuit (H) is to automatically reduce engine speed when all dig and propel function are in neutral to reduce fuel consumption and the noise level. The AI indicator is ON when the auto-idle switch (E) is pushed to show that the auto-idle function is actuated. Pushing the switch again turns the auto-idle function off.

When auto-idle function is actuated and no electrical signal is received from the propel or dig pressure switches (F and G) for more than four seconds, the engine and pump controller (D) sends an electrical signal to the engine control motor (C). The control motor reduces the engine speed to the specified auto-idle speed. The electrical signal sent to the motor is calculated from data stored in the engine and pump controller. The EC (engine control) sensor (B) sends an electrical feedback signal to the controller indicating the motor's position.

Actuating the propel or a dig function causes an electrical signal to be sent from the propel or dig pressure switch to the controller. The controller then sends an electrical signal to the engine control motor to increase engine speed back to the setting of engine rpm dial.

The parameter for auto-idle engine speed can be change from the factory setting within a specified range. (See Excavator Diagnostic Software Special Function—Engine Speed in Group 9025-25.)

ENGINE SPEED LEARNING CONTROL CIRCUIT OPERATION



T115584 Ⓖ ENGINE SPEED LEARNING CONTROL CIRCUIT

The function of the engine speed learning control circuit (G) is to learn the slow idle position as determined by the slow idle stop bracket on the injection pump and to store that data in the engine and pump controller (D).

When the engine learning switch (F) is pushed up to the learning position and the key switch (E) is turned on, the engine control motor (C) is driven by an electrical signal from the engine and pump controller (D). The control motor moves the injection pump lever to the slow idle position (the end of slot in slow idle stop bracket). An electrical feedback signal corresponding to the slow idle position is sent back to the engine and pump controller by the EC (engine control) sensor (B). The slow idle position data is stored in the engine and pump controller.

The position of the engine control motor for auto-idle mode, E (economy) mode, and fast idle in standard mode is based on the slow idle position data stored in the engine and pump controller.

When the following components are repaired or replaced, or when engine speeds deviate from specification, the engine control motor adjustment and engine learning control procedure must be performed.

- Engine.
- Engine speed control cable.

Continued on next page

- Slow idle bracket at injection pump.
- Fast idle bracket at injection pump.
- Engine control motor and sensor.
- Engine and pump controller.

(See Engine Control Motor and Sensor Adjustment and Engine Speed Learning Procedure in Group 9010-20.)

The procedure is not necessary after the replacement of batteries.

CED,OUOE003,1057 –19–11AUG98–2/2

Group 10
System Operational Checks

ENGINE OPERATIONAL CHECKS

This procedure is designed so the mechanic can make a quick check of the engine using a minimum amount of diagnostic equipment. If you need additional information, read Theory of Operation, Group 9010-05.

A location will be required which is level and has adequate space to complete the driving checks.

The engine and all other major components must be at operating temperature for some checks. A tachometer is required.

Locate system check in the left column and read completely, following this sequence from left to right. Read each check completely before performing.

At the end of each check, if no problem is found, that check is complete or an additional check is needed. If problem is indicated, you will be given repair required and group location. If verification is needed, you will be given next best source of information:

Group 10 (System Operational Checks)

Group 15 (Diagnostic Information)

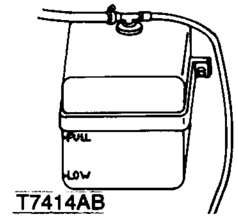
Group 20 (Adjustments)

Group 25 (Tests)

TX,9010,SB110 –19–25MAY98–1/1

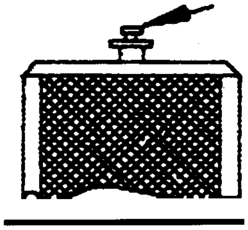
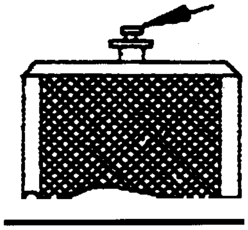
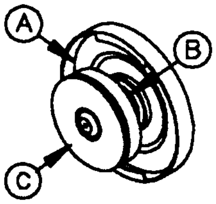
❶ COOLING SYSTEM CHECKS

– – –1/1

COOLANT LEVEL AND CONDITION IN RECOVERY TANK CHECK	 T7414AB –19–13DEC90	Engine stopped, radiator cool. Inspect coolant level and condition in overflow tank. Is coolant level between FULL and LOW marks on overflow tank? Is coolant free of oil, foam, or rust?	**YES:** Go to next check. **NO:** Add coolant if low. Drain and flush overflow tank and radiator, replace coolant if dirty or rusty. If coolant is oily, check for hydraulic or engine oil leaks into cooling system. Go to Group 0510 or Group 9000-04.

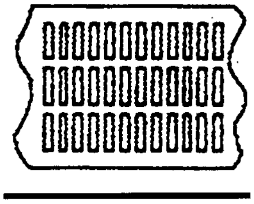
– – –1/1

System Operational Checks

COOLANT LEVEL AND CONDITION IN RADIATOR CHECKS	 T6488FY –UN–19OCT88 ⚠ **CAUTION: Prevent personal injury, DO NOT remove radiator cap unless engine is cool. When engine is hot and cap is removed, hot coolant or steam will spray out causing serious burns.** Engine OFF. Engine cold. Remove radiator cap. With engine cold, is coolant level just below filler neck in radiator? Is coolant free of oil, foam or rust?	**YES:** Go to next check. **NO:** Add coolant if low. Flush radiator and engine if coolant is dirty or rusty. Add clean coolant. Go to Group 9000-04. If coolant is oily, check for hydraulic or engine oil leaks into cooling system. Go to Engine Repair chapter. – – –1/1
RADIATOR CAP CHECK	 T6488FY –UN–19OCT88  T7690AB –UN–23JAN92 **A—Gasket** **B—Spring** **C—Seal** ⚠ **CAUTION: Prevent personal injury, DO NOT remove radiator cap unless engine is cool. When engine is hot and cap is removed, hot coolant or steam will spray out causing serious burns.** Engine stopped and cool. Remove radiator cap. If coolant is warmer than surrounding air temperature, is a "whoosh" sound heard when cap is loosened? Does cap have a stop position that requires it to be pushed down to remove? Does cap have a good seal (C) and gasket (A)? Is spring (B) in good condition?	**YES:** Go to next check. **NO:** Replace radiator cap. – – –1/1

System Operational Checks

RADIATOR INTERNAL CORE CHECK



T6488FZ –UN–19OCT88

CAUTION: Prevent personal injury, DO NOT remove radiator cap unless engine is cool. When engine is hot and cap is removed, hot coolant or steam will spray out causing serious burns.

Raise engine access door.

Remove radiator cap.

Drain coolant into a clean container until core tubes are visible.

Is radiator core free of rust, lime, or corrosion? Are passages in core clean, not plugged?

YES: Go to next check.

NO: Remove and clean or replace radiator. Fill cooling system with clean coolant. Go to Group 9000-04.

– – –1/1

RADIATOR OUTSIDE AIR FLOW CHECK

Open engine access door.

Open left rear access door.

Inspect radiator screen for mud and debris.

Are radiator fins free of mud, leaves, grass, and other debris?

Is radiator damaged?

YES: Clean outside of radiator and straighten fins if bent. Replace radiator if severely damaged.

NO: Go to next check.

– – –1/1

COOLANT HOSES AND CLAMPS CHECK

Are radiator and heater hoses free of twists, kinks, cracks, leaks or wear from rubbing on adjacent parts?

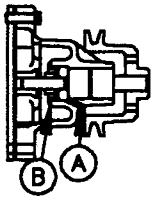
Are hose clamps tight and installed correctly?

YES: Go to next check.

NO: Replace or untwist hoses as required. Tighten or reinstall hose clamps.

– – –1/1

WATER PUMP CHECK



T7690AC –UN–27JAN92

A—Weep Hole
B—Seal

Engine stopped.

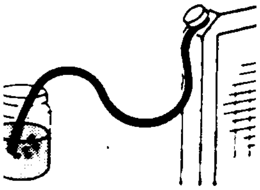
Is coolant leaking from weep hole (A)?

YES: Seal (B) has failed. Replace seal or water pump. Go to Engine Repair chapter and Cooling System.

NO: Go to next check.

– – –1/1

ENGINE HEAD GASKET SEAL CHECK



T6171AR –UN–25MAY89

Engine at normal temperature.

Radiator full.

Install radiator cap and tighten.

Place end of radiator overflow hose into a container of clear water.

Operate engine at fast idle. Load engine by holding a hydraulic function over relief.

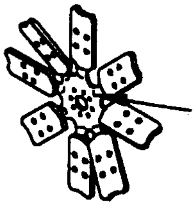
Look for bubbles coming from overflow tube. Do bubbles flow from tube intermittently?

YES: Head gasket is OK. Go to next Check.

NO: If there is a constant flow of bubbles from tube, loose or damaged cylinder head or a leaking head gasket may be indicated. Go to Engine Repair chapter.

– – –1/1

FAN BLADES CHECK



T7694AH –UN–03FEB92

Are fan blades bent or twisted?

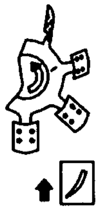
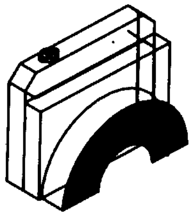
Are fan blades cracked or nicked?

YES: Replace fan.

NO: Go to next check.

– – –1/1

System Operational Checks

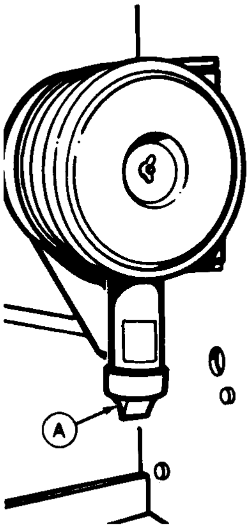
FAN DIRECTION CHECK	 T6488GB –UN–23AUG93	Is fan installed correctly with cupped portion side (Arrow) of fan away from radiator? *NOTE: If fan is installed backwards, about 50% of its capacity is lost.*	**YES:** Go to next check. **NO:** Install fan correctly. – – –1/1
FAN SHROUD AND FAN GUARD CHECK	 T6488GC –UN–23AUG93	Check clearance between fan and fan shroud. Is fan centered in shroud? Is guard free of damage? Are all mounting brackets and hardware tight?	**YES:** Go to next check. **NO:** Adjust fan shroud if fan is not centered. Repair or replace guard. Tighten loose hardware. Replace fan shroud if needed. – – –1/1
FAN BELT CHECK		Is fan belt free of oil or grease? Is inside surface of belt free of cracks or frayed edges? Is belt aligned with pulleys? *NOTE: Fan belt is self-adjusting.* Is fan belt tightener operating to keep belt tight?	**YES:** Go to next check. **NO:** Replace fan belt if oily, greasy, cracked or otherwise damaged. Repair or replace tightener if belt is loose. – – –1/1

AIR INTAKE SYSTEM CHECKS

– – –1/1

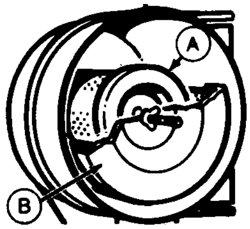
AIR FILTER RESTRICTION INDICATOR AND SWITCH CHECK	Run engine at slow idle. Slowly cover air intake tube. Does air filter restriction indicator light in cab come ON?	**YES:** Go to next check. **NO:** Check monitor circuit fuse, air filter restriction indicator light and switch. Go to Group 9015-15.

– – –1/1

AIR CLEANER UNLOADER VALVE CHECK	 T7531BF –UN–07JUN91 **A—Air Cleaner Unloader Valve** Open left front access door. Inspect unloader valve (A). Is unloader valve slightly open when the engine is not running? Is rubber flexible and showing no sign of becoming hard or brittle? Engine running. Turn auto-idle switch off and turn engine RPM control fully clockwise. Does unloader valve close?	**YES:** Go to next check. **NO:** Replace unloader valve.

– – –1/1

AIR CLEANER ELEMENT CHECK



T7531BG –UN–07JUN91

A—Secondary Element
B—Primary Element

Remove air cleaner cover.

Inspect primary element (B).

Is element clean and in good condition?

Remove wing nut to remove primary element.

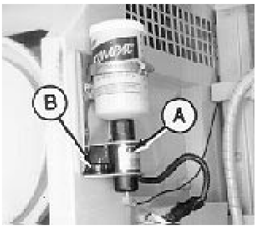
Inspect secondary element (A). Is element clean and in good condition?

YES: Go to next check.

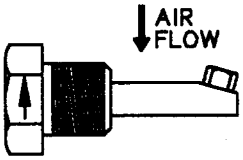
NO: Clean or replace primary element. Replace secondary element if primary element is damaged. Do not clean secondary element. Replace if dirty.

– – –1/1

COLD WEATHER STARTING AID CHECKS



T103516 –UN–04SEP96



T7699AL –UN–03FEB92

A—Starting Aid Solenoid
B—Dust Cover

Raise engine access door.

Open left rear service door.

Check starting fluid can holder (A).

If starting fluid can is NOT in holder, make sure dust cover (B) is installed.

Is starting fluid line from starting aid to air intake manifold straight—NOT kinked or broken?

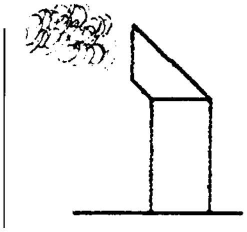
Is arrow on starting aid nozzle pointing AGAINST air flow of air intake manifold?

NOTE: It may be necessary to scrape paint from nozzle to see arrow.

YES: Check complete.

NO: Reposition starting fluid can holder, replace plastic line and tighten nozzle until arrow is in correct position—pointing AGAINST incoming air flow.

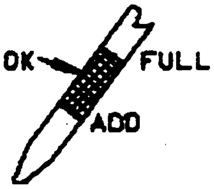
– – –1/1

EXHAUST SMOKE CHECK	 T6488GF –UN–19OCT88 Operate engine until coolant temperature gauge needle is in the "GREEN" zone before doing this check. Run engine at fast idle. Counter rotate tracks to put load to engine. Observe exhaust smoke. Is exhaust smoke dark black or blue smoke? Is exhaust smoke gray or white? *NOTE: Dark black smoke can be caused by dirty air filter or poor fuel delivery. Blue smoke can be caused by worn or damaged piston rings or cylinder liners. Gray or white smoke can be caused by a cold engine, dirty injection nozzles, or both.*	**YES:** Go to Diagnose Engine Malfunctions, Group 9010-15. **NO:** Go to next check. – – –1/1

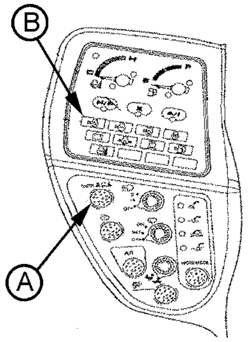
❸ LUBRICATION SYSTEM CHECKS

– – –1/1

OIL LEVEL CHECK



T6488GH –19–23FEB89



T103525 –UN–10SEP96

A—Level Check Switch
B—Engine Oil Level Indicator

Engine OFF.

Remove dipstick and check oil level.

Is oil above “full” mark or below “add” mark on dipstick.

If oil level is high, check for fuel or anti-freeze. Drain a small amount of engine oil into a clear container. Watch oil in container to see if anti-freeze or water accumulates at the bottom.

If oil level is low, check for oil leaks or oil seal problems in engine.

Adjust oil level to between "add" and "full" marks on dipstick.

Key switch ON.

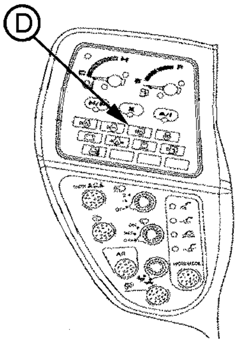
Push pre-operation level check switch (A).

Is green light for engine oil level indicator (B) ON?

YES: Add oil if low. Change oil and filter if too high. Go to Group 9000-04. Check oil level after a few hours operation to determine if a problem exists. Go to Diagnose Engine Malfunctions Group 9010-15.

NO: If oil level indicator light does not come ON, go to Monitor Diagnostic Information in Group 9015-15. If oil level is OK, go to next check.

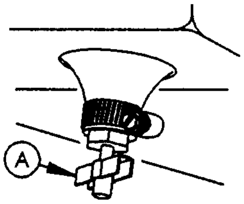
– – –1/1

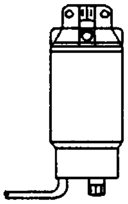
ENGINE OIL CONDITION CHECK	Remove dipstick and check oil condition. Is oil milky or grainy? If oil is milky, moisture or anti-freeze may be present. If oil is grainy, carbon may be present. Carbon in oil may result when engine runs at slow idle too long.	**YES:** Change oil and filter. Check condition of oil after a few hours operation to determine if a problem exists. Go to Group 9000-04 or Diagnose Engine Malfunctions Group 9010-15. **NO:** Go to next check. – – –1/1
ENGINE OIL PRESSURE SWITCH AND INDICATOR CHECK	 T103526 –UN–09SEP96 **D—Engine Oil Pressure Indicator** Turn key switch from OFF to ON and observe engine oil pressure indicator. Does indicator (D) come ON and stay ON? Start engine and observe engine oil pressure indicator. Does indicator go OFF a few seconds after engine starts?	**YES:** Go to next check. **NO:** Stop engine if engine oil pressure indicator remains ON after engine starts. Go to Group 9010-15 Diagnose Engine Malfunctions or Engine Repair chapter. If engine oil pressure indicator does not come ON, go to Group 9015-10 Monitor Circuit Diagnostic Procedures. – – –1/1

④ FUEL SYSTEM CHECKS

– – –1/1

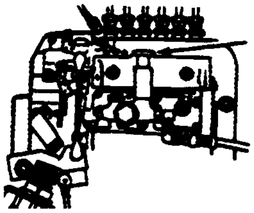
FUEL TANK INTERIOR CHECK	**IMPORTANT: Be careful not to damage fuel gauge sender float or low fuel level sending unit.** Remove fuel cap. Use a flashlight to inspect bottom of fuel tank by shining light through the fuel. Is dirt, debris, or contamination seen in tank?	**YES:** Drain fuel, dispose of contaminated fuel properly. Remove debris, clean bottom of tank. Replace fuel filters. Check water separator. **NO:** Go to next check. – – –1/1

FUEL TANK SUMP CHECK	 T7700AA –UN–18FEB92	**A—Drain Valve** Hold a clean container under fuel tank drain valve (A). Remove recessed hex plug. Open drain valve for a few seconds and catch fuel in container. Check condition of fuel in container. Is water present or is fuel cloudy?	**YES:** Drain until clear fuel flows or drain all fuel from tank, dispose of contaminated fuel properly. Replace fuel filters, check water separator. **NO:** Go to next check. – – –1/1

PRIMARY FUEL FILTER (WATER SEPARATOR) CHECK	 T7700AB –UN–25FEB92	Inspect fuel in primary fuel filter (water separator). Is water or other contamination present?	**YES:** Replace primary fuel filter element. **NO:** Go to next check. – – –1/1

FUEL TRANSFER PUMP CHECK

T103528 –UN–04SEP96



T6493AA –UN–19OCT88

A—Bleed Screw

Open bleed screw (A) on fuel filter and operate hand primer on fuel transfer pump.

Does fuel come out of bleed screw when hand primer is operated?

Tighten bleed screw and again operate hand primer.

Is resistance felt when hand primer is initially pumped and increase as system pressure increases?

YES: Go to next check.

NO: Be certain fuel filter is clean. If not, replace filter and recheck fuel supply pump.

– – –1/1

FUEL SYSTEM CHECK

Engine OFF.

Disconnect fuel return hose from leak-off line.

Connect a hose to leak-off line to route excess fuel into a container.

Start engine and run at fast idle.

Put engine under load by operating a hydraulic function over relief.

Observe fuel flow from leak-off line.

Does fuel flow from leak-off line with engine at full load?

NOTE: Fuel that flows from leak-off line is excess fuel not required by the engine and flows back to the fuel tank.

YES: Go to next check.

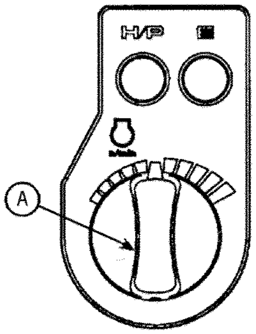
NO: Fuel supply is restricted, check for plugged fuel filters, plugged fuel tank cap vent, restricted lines, stuck injection pump overflow valve, or a malfunctioning fuel transfer pump. Repair or replace as necessary.

– – –1/1

❺ ENGINE SPEED AND PERFORMANCE CHECKS

– – –1/1

ENGINE RPM DIAL CHECK



T102100 –UN–26JUL96

A—Engine RPM Dial

Start the engine.

Turn engine rpm dial (A) to the right to fast idle position.

Did engine speed increase to fast idle in standard mode?

Turn engine rpm dial to the left to slow idle position.

Did engine speed decrease to slow idle?

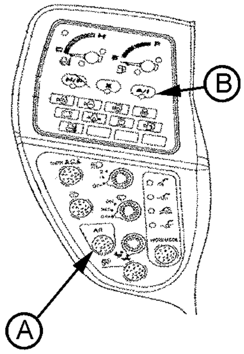
NOTE: To check and verify engine speeds, see procedure in Group 9010-20.

YES: Go to next check.

NO: Check engine rpm dial and harness. Go to Group 9015-15.

– – –1/1

AUTO-IDLE SPEED CHECK



T103536 –UN–09SEP96

A—Auto-Idle Switch
B—Auto-Idle Indicator

Start engine.

Run engine at half speed.

Push auto-idle switch (A) on.

Does the auto-idle indicator (B) come on?

Does the engine speed decrease to auto-idle speed after about 4 seconds?

Actuate the bucket function momentarily. Does the engine speed increase immediately to the engine rpm dial setting?

Does the engine speed return to auto-idle after 4 seconds?

Push auto-Idle switch (A) again to turn it off.

Does the engine speed increase immediately to the engine rpm dial setting and the indicator go out?

YES: Go to next check.

NO: See Auto-Idle Circuit Diagnostic Procedures in Group 9015-15.

– – –1/1

9010
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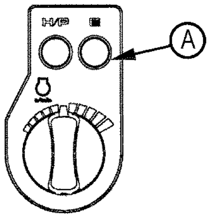
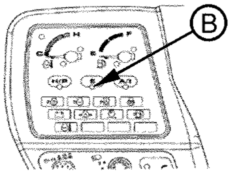
14

E (ECONOMY) MODE



T103545 –UN–09SEP96



T103546 –UN–09SEP96

A—E (Economy) Mode Switch
B—E (Economy) Mode Indicator

Start engine.

Turn engine rpm dial clockwise to fast idle.

Push E mode switch (A) on.

Did you hear a decrease in engine speed?

Did the indicator light (B) come on?

Push the E mode switch again to turn it off.

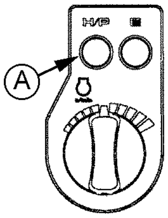
Did indicator light go out and engine speed increase to fast idle?

YES: Go to next check.

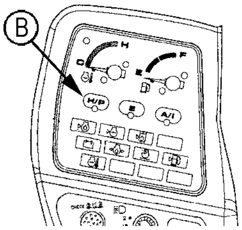
NO: See engine speed controls in Group 9015-15.

– – –1/1

HP (HIGH POWER) MODE CHECK



T111983 –UN–27OCT97



T112183 –UN–13NOV97

A—HP (High Power) Mode Switch
B—HP (High Power) Mode Indicator

Start engine.

Run engine at fast idle.

Push HP (high power) mode switch (A) on.

Did HP (high power) mode indicator (B) come on?

Operate the arm in function over relief (arm cylinder fully extended).

Does the engine speed increase?

Push HP mode switch again to turn it off.

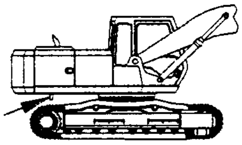
Does HP mode indicator go out?

YES: Go to next check.

NO: Check switch, indicator, and harness. Go to Group 9015-15.

– – –1/1

System Operational Checks

ENGINE BLOW-BY CHECK	 T7700AC –UN–10FEB92 Run engine at fast idle and check blow-by tube. Are fumes barely visible at the blow-by tube at fast idle, with no load? *NOTE: Excessive blow-by indicates that piston rings and cylinder liners do not seal off the combustion chamber. This is a comparative check that requires some experience to determine excessive blow-by.*	**YES:** Go to next check. **NO:** If blow-by is excessive, go to Compression Pressure Test in Group 9010-25. – – –1/1

LOOSE OR WORN ENGINE PARTS	Run engine at slow idle. Move hydraulic control lever to operate a hydraulic function over relief to put engine under load. Does engine run smooth, no knocking or rattling noise?	**YES:** Operational Checkout complete. **NO:** Go to Abnormal Engine Noise, in Group 9010-15. – – –1/1

Group 15
Diagnostic Information

DIAGNOSE ENGINE MALFUNCTIONS

NOTE: Diagnostic charts are arranged from most probable and simplest to verify, to least likely and more difficult to verify.

Symptom	Problem	Solution
Engine Cranks But Will Not Start Or Hard To Start	No fuel	Add fuel. Bleed air.
	Wrong fuel	Use correct fuel.
	Water in fuel or water frozen in fuel line	Drain water from fuel tank trap. Inspect fuel filter for water. Change filter.
	Fuel filter plugged	Replace fuel filter. Bleed air clean fuel tank strainer.
	Debris in fuel	Drain fuel tank. Clean tank strainer. Add clean fuel.
	Air in fuel system	Check for bubbles in fuel filter and tighten connections. Bleed air.
	Fuel pump	Check fuel pump pressure. See Engine Repair chapter.
	Low battery power	Charge or install new batteries.
	Slow cranking speed (poor electrical connection)	Clean and tighten battery and starter connections. Incorrect engine oil (Cold weather).
	Wrong engine oil	Use correct oil.
	Air filter plugged	Check air filter restriction indicator and air filter elements. Clean or replace elements.
	Standby fuse or relay	Replace fuse, relay or wiring. See Group 9015-10.

Continued on next page

Diagnostic Information

Symptom	Problem	Solution
Engine Will Not Stop When Key Switch Is Turned OFF	Starter circuit isolating diode (V2) shorted	Pull power on fuse (F5) to stop engine. Replace start circuit isolation diode. See Group 9015-10.
Engine Will Not Crank When Key Switch Is Turned To Start Position	Start circuit isolation diode (V2) open	Replace start circuit isolation diode. See Group 9015-10.
	Injection pump metering valve sticking	Lightly tap injection pump housing. If engine now starts, repair metering valve. See Local Fuel Injection Pump Service Center.
	Electric shut-off	Check shut-off solenoid. See Group 9015-10. Inspect solenoid wiring and linkage. See your Local Fuel Injection Pump Service Center.
	Injection pump	Remove and test pump. See your Local Fuel Injection Pump Service Center.
	Injection nozzle(s)	Remove and test nozzles. See Engine Repair chapter.
	Starter	Replace starter.
	Worn compression rings or low compression	Check compression. Repair. See Engine Repair chapter.
	Starting ether used excessively	Remove nozzles and add small amount of oil to each cylinder. See Engine Repair chapter.
	Blown head gasket	Route tube between radiator and overflow tank into container of fluid and check for bubbles. Bubbles indicate head gasket leakage. See Engine Repair chapter.
Engine Knocks, Runs Irregularly or Stops	Air in fuel	Inspect filter for evidence of air in fuel. Tighten connections and bleed fuel system.

Continued on next page

Symptom	**Problem**	**Solution**
	Debris in fuel	Drain fuel tank. Clean tank strainer. Add clean fuel.
	Wrong fuel	Use correct fuel.
	Water in fuel	Drain tank water trap, inspect filter element for water. Replace filters.
	Fuel filter plugged	Replace filter.
	Fuel injection pump out of time	Time injection pump. See Engine Repair chapter.
	Idle speeds adjustment too low	Adjust slow idle speed. See Group 9010-20.
	Engine overheating	Test cooling system. See Group 9010-25.
	Fuel transfer pump	Test pump pressure. See Engine Repair chapter.
	Fuel injection pump	Remove and test fuel injection pump. See your Local Fuel Injection Pump Service Center.
	Injection nozzle(s)	Remove and test nozzle(s). See Engine Repair chapter.
	Improper valve clearance	Check and adjust valve clearance. See Engine Repair chapter.
	Valve sticking or burned	Do compression pressure test. See Engine Repair chapter.
	Bent push rods	Inspect. Replace. See Engine Repair chapter.

Continued on next page

Diagnostic Information

Symptom	Problem	Solution
	Worn or broken compression rings or cylinder head gasket leaking	Route tube between radiator and overflow tank into a container of fluid and check for bubbles. Bubbles indicate head gasket leakage. See Engine Repair chapter. Do compression pressure test. See Engine Repair chapter.
Engine Not Developing Full Power	Fuel filter plugged	Change filter. Bleed air.
	Air filter plugged	Clean or replace air cleaner elements.
	Debris in fuel	Drain fuel tank. Clean Tank strainer.
	Wrong fuel	Use correct fuel.
	Fuel tank outlet fitting plugged	Clean.
	Fast idle speed incorrect	Do Fast Idle Speed Adjustment. See Group 9010-20.
	Hydraulic system leakage	Do Hydraulic System Checks. See Group 9025-25.
	Fuel line to pump or pump return to tank restricted	Check, repair.
	Fuel pump	Do Fuel Pump Pressure Test. See Engine Repair chapter.
	Timing incorrect	Check injection pump timing. See Engine Repair chapter.
	Injection nozzles	Remove and test injection nozzles. See Engine Repair chapter.
	Low compression	Do Compression Pressure Test. See Engine Repair chapter.
	Injection pump delivery or governor	Repair pump. See your Local Fuel Injection Pump Service Center.

Continued on next page

Diagnostic Information

Symptom	Problem	Solution
	Turbocharger	Do turbocharger inspection. See Engine Repair chapter.
	Valves burned, warped	Repair valves. See Engine Repair chapter.
	Cam shaft worn	Do Valve Lift Test. See Engine Repair chapter.
Engine Overheats	Coolant level low	Fill cooling system and check for leaks.
	Thermostat stuck closed or missing	Test and/or reinstall. See Group 0400 and Engine Repair chapter.
	Radiator screen plugged	Remove and clean screen.
	Radiator, oil cooler cores plugged with dirt or fins bent	Check air flow (see Group 9010-25). Clean radiator. Straighten fins.
	Air filter plugged	Clean or replace elements.
	Gauge or sender	Check gauge and sender. See Group 9015-10.
	Fan belt soaked with oil or pulleys worn excessively	Inspect, replace. See Operator’s Manual or Repair Manual.
	Shroud or baffles (foam rubber) missing	Inspect. Repair or replace.
	Fan blade on backward	Reinstall. See Engine Repair chapter.
	Fan belt tension adjuster	Replace.
	Radiator cap or water in radiator	Test, replace cap.
	Hydraulic system overheating	Verify, repair. See Group 9025-25.
	Cooling system passages dirty	Flush cooling system.
	Water pump	Repair. See Engine Repair chapter.

Continued on next page

Diagnostic Information

Symptom	Problem	Solution
	Fuel injection pump timing	Check injection pump static timing. See Engine Repair chapter.
	Fuel delivery excessive	Remove and adjust fuel injection pump. See your Local Fuel Injection Pump Service Center.
Engine Stalls Easily Under Load	Engine speed sensor	Check engine speed sensor. See Group 9015-15.
	Engine and pump controller	Check engine and pump controller. See Group 9015-15.
	Wiring harness	Check wiring harness. See Group 9015-15.
	Fuel water separator filter plugged	Change water separator filter.
Engine Speed Does Not Change When Engine RPM Dial Is Rotated	Engine control motor	Check engine speed control motor. See Group 9015-15.
	Engine speed sensor	Check engine speed sensor. See Group 9015-15.
	Engine and pump controller	Check engine and pump controller. See Group 9015-15.
	Wiring harness	Check wiring harness. See Group 9015-15.
Engine Idle Speed Is Too Fast Or Slow	Linkage not adjusted	Adjust Linkage. See Group 9010-20.
	Engine and pump controller	Check engine and pump controller. See Group 9015-15.
	Engine control motor	Check engine speed control actuator solenoid. See Group 9015-15.
	Fuel injection pump	Remove and test fuel injection pump. See your Local Fuel Injection Pump Service Center.

Continued on next page

Symptom	Problem	Solution
	Wiring harness	Check wiring harness. See Group 9015-15.
Auto-Idle Does Not Work	Pilot oil pressure switches (swing, Auto-Idle, and travel)	Check pilot oil pressure switches. See Group 9015-15.
	Engine control motor.	Check engine control motor. See Group 9015-15.
	Engine and pump controller	Check controller. See Group 9015-15.
	Wiring harness	Check wiring harness. See Group 9015-15.
Coolant Temperature Too Low	Thermostat stuck open	Replace thermostat. See Engine Repair chapter.
	Temperature gauge	Install new gauge or sending unit.
Oil In Coolant Or Coolant In Crankcase	Oil cooler leaking	Test, repair. See Engine Repair chapter.
	Head gasket leaking	Inspect, and replace. See Engine Repair chapter.
	Cylinder head cracked	Check, replace. See Engine Repair chapter.
	Liner packing leaking and/or cracked cylinder block	Remove pan, inspect bottom end, repair, verify and replace if necessary. See Engine Repair chapter.
Low Engine Oil Pressure	Oil level low	Fill to proper level.
	Oil filter plugged	Install new oil filter and oil.
	Oil pump intake screen plugged or loose	Clean. See Engine Repair chapter.
	Wrong grade of oil or fuel dilution	Use correct grade of oil. See Engine Repair chapter.

Continued on next page

Diagnostic Information

Symptom	Problem	Solution
	Engine Oil pressure regulating valve	Repair valve. See Engine Repair chapter.
	Internal oil passages leak and/or spray cooling jet missing	Check, repair. See Engine Repair chapter.
	Pressure pipe from oil pump leaking	Check. See Engine Repair chapter.
	Oil pump drive gear loose	Check, repair drive gear. See Engine Repair chapter.
	Oil pump gear and/or housing worn	Repair. See Engine Repair chapter.
	Excessive main or connecting rod bearing clearance	Replace main bearings or connecting rod bearings. See Engine Repair chapter.
High Engine Oil Pressure	Oil viscosity wrong (too thick)	Drain and refill with correct oil. See Section 9000, Group 04.
	Pressure regulating valve stuck or misadjusted	Verify, repair. See Engine Repair chapter.
	Piston cooling spray orifices plugged	Verify, clean. See Engine Repair chapter.
	Engine oil has anti-freeze	Verify, repair, change oil.
Engine Uses Too Much Oil	Wrong oil	Use correct oil. See Section 9000, Group 04.
	Oil level too high	Correct. Check to see if some other fluid is leaking into oil.
	Oil leaks	Check engine oil drain plug.
	Air cleaner plugged	Clean air cleaner elements or install new elements
	Crankcase breather restricted	Remove, clean. See Engine Repair chapter.

Continued on next page

Symptom	Problem	Solution
	Engine operating too hot or oil cooler water passage plugged	Test cooling system. See Group 9010-25. Test thermostat. See Engine Repair chapter.
	Main or connecting rod bearing clearance excessive	Replace main bearings or connecting rod bearings. See Engine Repair chapter.
	Pistons or liners scored	Check, repair pistons or liners. See Engine Repair chapter.
	Piston rings worn, broken or stuck	Do Compression Pressure Test. See Engine Repair chapter.
	Oil return slots in piston clogged	Clean. See Engine Repair chapter.
	Crankshaft thrust bearing worn (misaligned piston and rod)	Check piston and rod assembly. See Engine Repair chapter.
	Valve guides or valve stems worn	Check, repair. See Engine Repair chapter.
Engine Uses Too Much Fuel	Fuel system leakage	Tighten connections. See Engine Repair chapter.
	Plugged or dirty air intake	Clean air intake system.
	Wrong fuel	Use correct fuel.
	Injection pump static timing	Check, injection pump static timing. See Engine Repair chapter.
	Injection nozzles	Test, repair nozzles. See Engine Repair chapter.
Excessive Black Smoke	Wrong fuel	Use correct fuel.
	Plugged or dirty air intake or exhaust system.	Clean air intake and exhaust system.
	Injection pump static timing	Check injection pump timing. See Engine Repair chapter.

Continued on next page

Diagnostic Information

Symptom	Problem	Solution
	Over-fueling	Remove and adjust fuel injection pump. See your Local Fuel Injection Pump Service Center.
	Injection nozzle orifice plugged	Check and repair. See Engine Repair chapter.
Excessive Blue or White Smoke	Cranking speed too slow	Check batteries and connections. See Group 9015-10
	Injection pump static timing	Check injection pump timing. See Engine Repair chapter.
	Engine running too “cold”	Check thermostat. See Group 0400 and Engine Repair chapter.
	Wrong fuel	Use correct fuel.
	Liners have wear and/or piston ring stuck	Do Compression Pressure Test in Engine Repair chapter.
Detonation	Fuel injection pump static timing incorrect and/or injection pump advance faulty	Check injection pump static timing. See Engine Repair chapter.
	Ether starting aid solenoid stuck	Check and repair.
Abnormal Noise	Oil level low	Check and add oil.
	Wrong engine oil	Use correct oil.
	Engine oil diluted with fuel	Inspect engine oil. Inspect fuel pump spindle, seal and housing.
	Valve clearance excessive	Check, adjust valve. See Engine Repair chapter.
	Engine static timing incorrect	Check, adjust. See Engine Repair chapter.
	Push rods bent	Inspect, replace push rods. See Engine Repair chapter.

Continued on next page

Symptom	Problem	Solution
	Main and/or connecting rod bearing caps loose or worn	Inspect main bearing cap screws and connecting rod cap screws. See Engine Repair chapter.
	Piston scored	Replace piston. See Engine Repair chapter.
	Piston pin bushings worn	Replace pins and bushings. See Engine Repair chapter.
	Rocker arm shafts worn	Check. See Engine Repair chapter.
	Crankshaft end play excessive	Check, repair. See Engine Repair chapter.
	Balancer shafts out of time	Retime. See Engine Repair chapter.
Turbocharger Excessively Noisy or Vibrates	Bearings not lubricated	Insufficient oil pressure. Check for restricted turbocharger oil line.
	Worn bearings	Replace. See Engine Repair chapter.
	Air leak in engine, intake or exhaust manifold	Inspect and repair. See Engine Repair chapter.
	Improper clearance between turbine wheel and turbine housing	Remove exhaust elbow and air inlet hose. Inspect and repair. See Engine Repair chapter.
	Broken blades on turbine	Remove exhaust elbow and air inlet hose. Inspect and repair. See Engine Repair chapter.
Oil Dripping From Turbocharger Adapter	Damaged or worn bearings and/or worn seals	Inspect compressor and turbine wheel for damaged blades. Check for proper engine service intervals or dirt entering engine. See Engine Repair chapter.
	Excessive crankcase pressure	Check for plugged oil drain line. Clean.

Continued on next page

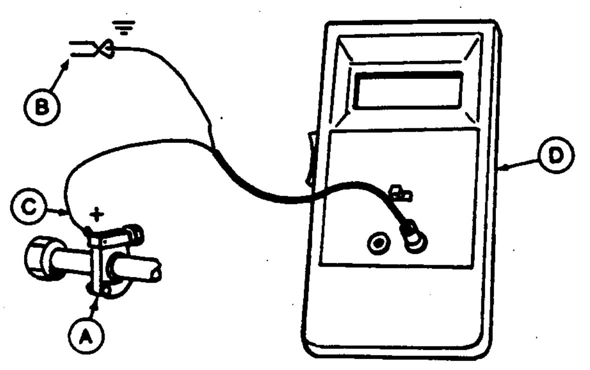
Diagnostic Information

Symptom	Problem	Solution
	Turbocharger oil return line carbon buildup where line passes exhaust manifold.	Remove line. Inspect and clean.
Excessive Drag In Turbocharger Rotating Members	Carbon build-up behind turbine wheel caused by combustion deposits	Inspect and clean. See Engine Repair chapter.
	Dirt build-up behind compressor wheel caused by air intake leaks	Inspect and repair. See Engine Repair chapter.
	Bearing seizure or dirty or worn bearings caused by excessive temperature, unbalanced wheel, dirty oil, oil starvation, or insufficient lubrication.	Check for plugged air filters. See Engine Repair chapter.

TX,9010,SB112 –19–29MAY98–12/12

JT05801 CLAMP-ON ELECTRONIC TACHOMETER INSTALLATION

SERVICE EQUIPMENT AND TOOLS
JT05801 Clamp-On Electronic Tachometer



A—Clamp-On Transducer
B—Black Clip (-)
C—Red Clip (+)
D—Digital Readout Unit

1. Before installing clamp-on electronic tachometer, remove the paint from a straight section of injection line within 100 mm (4 in.) of No. 1 injection nozzle. Use emery cloth to remove the paint.
2. Install the clamp-on transducer (A). Tighten finger tight only—DO NOT overtighten.
3. Connect the red clip (+) (C) to the clamp-on transducer.
4. Connect the black clip (-) (B) to a ground connection such as the head of a cap screw or other metal part on engine.
5. Start the engine. Check for a reading on the digital readout unit (D).

CED,TX08227,2879 –19–22APR98–1/1

CHECK AND ADJUST FUEL SHUT-OFF SOLENOID LINKAGE

SPECIFICATIONS	
Overtravel Needed Distance	3—6 mm (1/8—1/4 in.)
Ball Joint Hole-to-shut-Off Lever Hole Length	3 turns short
Fuel Shut-Off Solenoid Plunger-to-Ball Joint Torque	8 N•m (70 lb-in.)
Fuel Shut-Off Lever-to-Run Position Stop Clearance	Less than 0.025 mm (0.001 in.) with key switch ON and solenoid plunger bottomed.
Shut-Off Lever Clearance	Within 3 mm (0.125 in.) Of Stop Position Stop

SERVICE EQUIPMENT AND TOOLS
Feeler Gauge

Continued on next page

TX,05,GG2305 –19–22APR98–1/3

1. Disconnect ball joint (C) from fuel shut-off lever (D).

2. Turn key switch to ON. It is not necessary to start engine for this procedure.

3. Push plunger (F) into solenoid housing until the plunger bottoms. With key switch ON, solenoid hold coil is energized and will hold plunger in the run position

4. Manually pull fuel shut-off lever (D) up against the run position stop (upper stop) (H).

5. Check that hole in ball joint (C) is 3—6 mm (1/8—1/4 in.) short of aligning with hole in fuel shut-off lever.

   The 3—6 mm (1/8—1/4 in.) is the amount of overtravel needed to compress the spring in the plunger to hold the shut-off lever against the run position stop when plunger is bottomed in the solenoid housing.

Overtravel Needed—Specification

Distance.. 3—6 mm (1/8—1/4 in.)

6. Adjust ball joint as necessary.

   Manually pull fuel shut-off lever up against the run position stop (upper stop).

   Adjust ball joint so hole is aligned with hole in shut-off lever and then turn ball joint to shorten linkage by three turns.

Ball Joint Hole-to-shut-Off Lever Hole—Specification

Length... 3 turns short

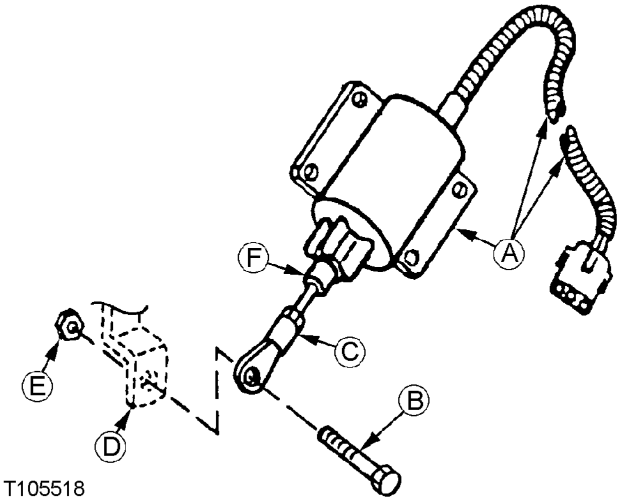
Hold ball joint and tighten nut.

Fuel Shut-Off Solenoid Plunger-to-Ball Joint—Specification

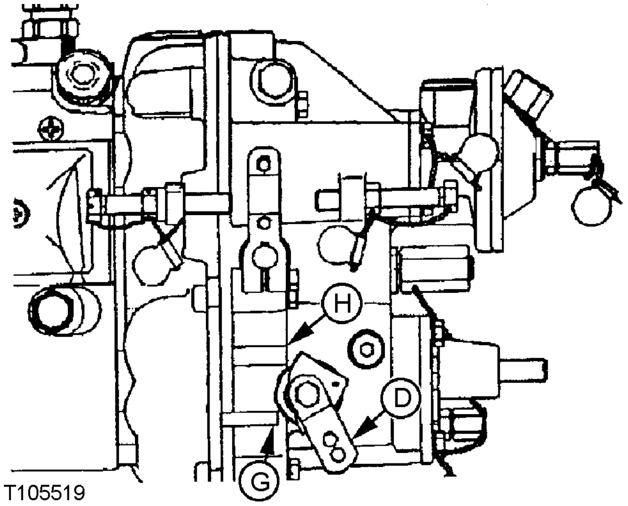
Torque .... 8 N•m (70 lb-in.)

7. Turn key switch to OFF.

8. Connect ball joint to fuel shut-off lever using cap screw (B) and nut (E).



T105518 –UN–04DEC96



T105519 –UN–04DEC96

A—Shut-Off Solenoid
B—Cap Screw
C—Ball Joint
D—Fuel Shut-Off Lever
E—Lock Nut
F—Plunger
G—Stop Position Stop (Lower Stop)
H—Run Position Stop (Upper Stop)

Continued on next page

IMPORTANT: Failure to have the shut-off lever tight against run position stop (upper stop) can result in low engine horsepower.

9. Turn the key switch to ON.

   Push plunger into solenoid housing so hold coil holds the plunger in the run position.

   Check that shut-off lever is tight against run position stop using a 0.025 mm (0.001 in.) feeler gauge. If feeler gauge passes between shut-off lever and stop, shorten the linkage two more turns.

Fuel Shut-Off Lever-to-Run Position Stop—Specification

Clearance .... Less than 0.025 mm (0.001 in.) with key switch ON and solenoid plunger bottomed.

10. Turn key switch to OFF.

    The spring inside the solenoid housing boot will extend the plunger to push the shut-off lever down to the stop position stop (lower stop) (G).

    Check that shut-off lever is within 3 mm (0.125 in.) of stop position stop.

Shut-Off Lever—Specification

Clearance .... Within 3 mm (0.125 in.) Of Stop Position Stop

TX,05,GG2305 –19–22APR98–3/3

ENGINE SPEED CHECK

SPECIFICATIONS	
Engine Fast Idle in Standard Mode Speed	2180 ± 25 rpm
Engine Slow Idle Speed	900 ± 25 rpm

SERVICE EQUIPMENT AND TOOLS
JT05801 Clamp-On Electronic Tachometer

1. Connect the tachometer. (See JT05801 Clamp-On Electronic Tachometer Installation in this group.)

2. Warm engine to normal operating temperature.

3. Turn engine rpm dial to the right to check fast idle in standard mode.

Engine Fast Idle in Standard Mode—Specification

Speed.. 2180 ± 25 rpm

4. Turn engine rpm dial to the left to check slow idle.

Engine Slow Idle—Specification

Speed.. 900 ± 25 rpm

5. If not to specifications, do the Engine Speed Learning Procedure. (See procedure in this group.)

   If engine speeds are still not to specification, do the Injection Pump Fast and Slow Idle Stops Adjustment. (See procedure in this group.)

TX,9010,GG2711 –19–19MAY98–1/1

INJECTION PUMP FAST AND SLOW IDLE STOPS ADJUSTMENT

SPECIFICATIONS	
Engine Speed Slow Idle Stop Screw	900 ± 25 rpm
Engine Speed Fast Idle Stop Screw	2250 ± 25 rpm

SERVICE EQUIPMENT AND TOOLS
JT07294 Laptop Computer

1. Connect a tachometer or the JT07294 Laptop Computer to check engine speeds.

2. Warm engine to its normal operating temperature.

3. Stop the engine.

4. Disconnect speed control cable at the injection pump lever.

5. Start the engine.

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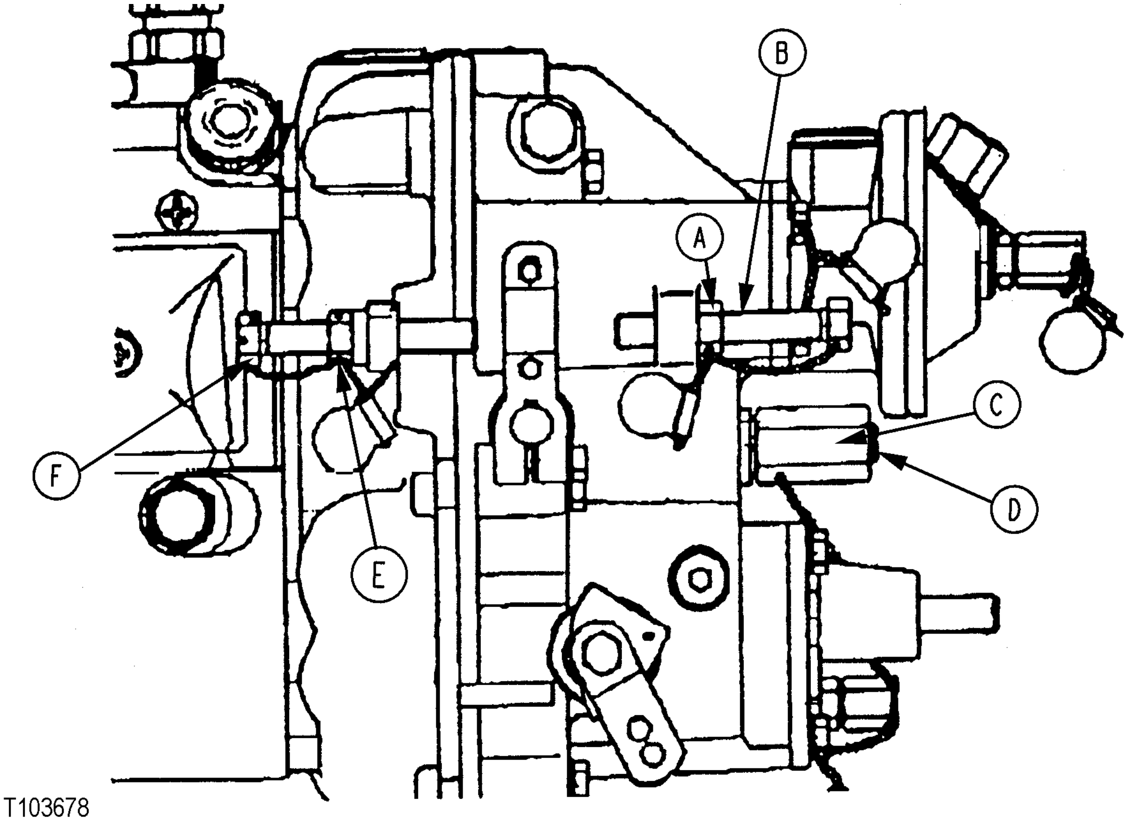


A—Nut
B—Slow Idle Stop Screw
C—Nut
D—Supplementary Idle Screw
E—Nut
F—Fast Idle Stop Screw

6. Push injection pump lever against fast idle stop screw (F). Record the engine speed.

   Push injection pump lever against slow idle stop screw (B). Record the engine speed.

Engine Slow Idle Stop Screw—Specification

Speed.. 900 ± 25 rpm

Engine Fast Idle Stop Screw—Specification

Speed.. 2250 ± 25 rpm

Adjust the fast and slow idle stop screws on injection pump as needed.

7. Loosen nut (C) on the supplementary idle screw (D). Turn the screw out three turns.

8. Loosen nut (A) on the slow idle stop screw (B)

9. Hold injection pump lever against the slow idle stop screw.

   Adjust the slow idle stop screw to obtain an engine speed that is 30—40 rpm less than the slow idle specification.

   Hold screw and tighten nut.

10. Turn the supplementary idle screw in to increase engine speed to the slow idle specification. Hold screw and tighten nut.

Continued on next page

For example, to obtain the 900 rpm slow idle speed, turn the slow idle stop screw (B) out to get approximately 865 rpm. Hold screw and tighten the nut. Then turn the supplementary idle screw (D) in to increase engine speed to 900 rpm. Hold screw and tighten nut.

11. Pull injection pump lever rapidly to fast idle then decelerate to slow idle. Slow idle must be to specification.

NOTE: Increasing slow idle setting a small amount, but no more than the maximum specifications, may help to reduce surging or hunting. If surging or hunting continues, repair injection pump.

12. Loosen nut (E) on fast idle stop screw (F).

    Pull lever against fast idle stop screw. Turn screw in to decrease engine speed; turn screw out to increase engine speed. Hold screw and tighten nut.

NOTE: The fast idle stop screw on the injection pump serves as the stop when the HP (high power) mode is actuated.

13. Stop the engine. Connect the cable to lever.

14. Do Engine Control Motor and Sensor Adjustment and then the Engine Speed Learning Procedure. (See procedures in this group.)

TX,9010,UU3410 –19–19MAY98–3/3

ENGINE CONTROL MOTOR AND SENSOR ADJUSTMENT

SPECIFICATIONS	
Arm-to-Engine Control Motor Shaft Cap Screw Torque	13 N•m (115 lb-in.)

When the following components are repaired or replaced, or when engine speeds deviate from specification, the engine control motor and sensor adjustment and engine learning control procedure must be performed.

- Engine
- Engine speed control cable
- Engine control motor and sensor
- Engine and pump controller
- Fast and slow idle stop screws

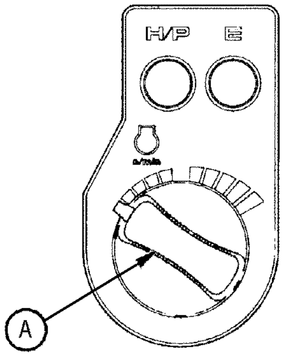
NOTE: The engine control sensor is located inside the engine control motor housing. Sensor is serviced as an assembly with the engine control motor.

1. Check that fast and slow idle stop screws on the injection pump are adjusted to specification. (See Injection Pump Fast and Slow Idle Stops Adjustment in this group.)

2. Turn key switch to ON.

TX,9010,UU3407 –19–19MAY98–1/3

3. Turn the engine rpm dial (A) to slow idle.



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A—Engine RPM Dial

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TX,9010,UU3407 –19–19MAY98–2/3

4. Check that engine speed control cable is connected to the outer hole of engine control motor arm (B).

5. Loosen cap screw (A) in arm (B).

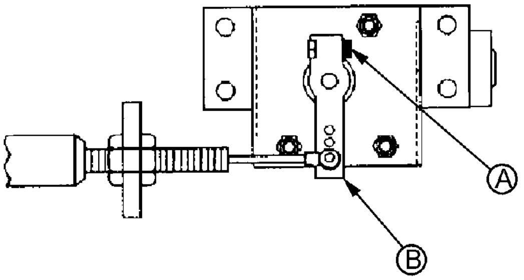
6. Adjust the arm on the shaft so injection pump lever just contacts the slow idle stop screw.

7. Tighten cap screw (A).

Arm-to-Engine Control Motor Shaft Cap Screw—Specification

Torque .... 13 N•m (115 lb-in.)

8. Do the Engine Speed Learning Procedure. (See procedure in this group.)



T109243

T109243 –UN–24APR97

A—Cap Screw
B—Arm

TX,9010,UU3407 –19–19MAY98–3/3

ENGINE SPEED LEARNING PROCEDURE

SPECIFICATIONS	
Engine Slow Idle Speed	900 ± 25 rpm
Engine Auto-Idle Speed	1200 ± 25 rpm
E (Economy) Mode Speed	1980 ± 25 rpm
Fast Idle in Standard Mode Speed	2180 ± 25 rpm

When the following components are repaired or replaced, or when engine speeds deviate from specification, the engine control motor adjustment and engine learning control procedure must be performed.

- Engine
- Engine speed control cable
- Engine control motor and sensor
- Engine and pump controller
- Fast and slow idle stop screws

1. Stop the engine.

2. Disconnect the laptop computer from the test connector.

   Wait for 5 seconds.

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TX,9010,UU3409 –19–11AUG98–1/2

3. Push engine learning switch (C) up to top position. The switch is a three position switch. Make sure it is in the top position.

4. Turn key switch ON. Wait 5 seconds.

5. Turn key switch OFF. Wait 5 seconds.

6. Push engine learning switch to middle position.

7. Check engine speeds.

Engine Slow Idle—Specification

Speed .... 900 ± 25 rpm

Engine Auto-Idle—Specification

Speed .... 1200 ± 25 rpm

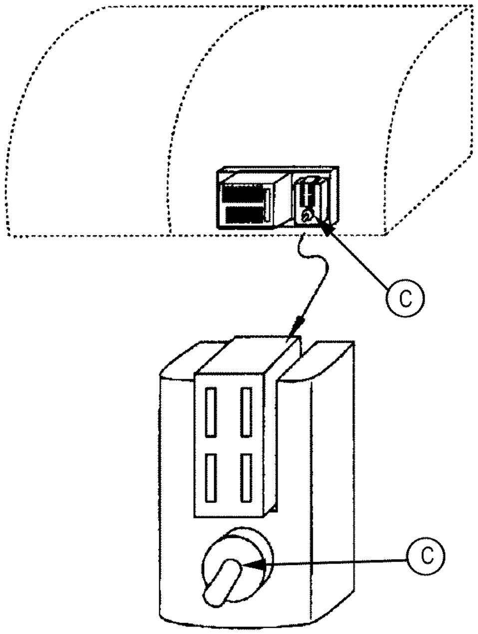
E (Economy) Mode—Specification

Speed .... 1980 ± 25 rpm

Fast Idle in Standard Mode—Specification

Speed .... 2180 ± 25 rpm

NOTE: The laptop computer with the excavator diagnostic software can be used to change the default speeds for slow idle, auto-idle, economy mode, and fast idle in standard mode. See Excavator Diagnostics Program Special Function—Engine Speed Adjustment in Group 9025-25.



T103674

T103674 –UN–11SEP96

C—Engine Learning Switch

TX,9010,UU3409 –19–11AUG98–2/2

COOLING SYSTEM FILL AND DEAERERATION

SPECIFICATIONS	
Cooling System Capacity	22 L (6 gal)

FREEZING TEMPERATURES

IMPORTANT: Use only permanent-type low silicate ethylene glycol base antifreeze in coolant solution. Other types of antifreeze may damage cylinder seals.

Fill cooling system with permanent-type, low silicate, ethylene glycol antifreeze (without stop-leak additive) and clean, soft water.

FILL

1. Fill the radiator to the bottom of the fill neck.

2. Fill the coolant recovery tank to the FULL mark.

Cooling System—Specification

Capacity .... 22 L (6 gal)

DEAERATION

IMPORTANT: The cooling system requires several warm-up and cool down cycles to deaerate. It will NOT deaerate during normal operation. Only during warm-up and cool down cycles will the system deaerate.

1. Start engine. Run engine until coolant reaches a warm temperature.

2. Stop engine. Allow coolant to cool.

3. Check coolant level at recovery tank.

4. If necessary, fill recovery tank to FULL mark.

5. Repeat Steps 1—4 until recovery tank coolant level is repeatedly at the same level (stabilized).

NOTE: The level of the coolant in the cooling system MUST BE repeatedly checked after all drain and refill procedures to ensure that all air is out of the system which allows the coolant level to stabilize. Check coolant level only when the engine is cold.

6. Install recovery tank and radiator caps.

CED,OUOE003,1058 –19–11AUG98–1/1

FUEL LINE LEAKAGE TEST

SPECIFICATIONS	
Fuel Line Leakage Test Pressure	69 kPa (0.7 bar) (10 psi)
To Prevent Fuel System Component Damage Never Exceed Maximum Pressure	103 kPa (1 bar) (15 psi)

Connections may allow air to enter the fuel system without allowing fuel to leak out. Follow this procedure to find air leaks in the system.

Disconnect fuel supply and fuel return lines at fuel tank.

Drain all fuel from system, including fuel transfer pump, fuel injection pump, and fuel filter(s).

Close end of fuel return line using a plug, cap, or a short length of hose, plug, and clamps.

IMPORTANT: Never exceed 103 kPa (1 bar) (15 psi) to prevent damage to fuel system components.

Pressurize the system to 69 kPa (0.7 bar) (10 psi) at the fuel supply line using a regulated pressure air source.

Fuel Line Leakage Test—Specification

Pressure .... 69 kPa (0.7 bar) (10 psi)

To Prevent Fuel System Component Damage Never Exceed Maximum—Specification

Pressure .... 103 kPa (1 bar) (15 psi)

Apply liquid soap and water solution to all joints and connections in the fuel system and inspect for leaks.

Repair any leaks.

Connect supply and return lines and prime system.

Start machine and let run for approximately 10 minutes.

Continued on next page

NOTE: For engines with an in-line fuel injection pump, an internal leak path may allow air to enter the fuel system. If an internal pump leak is suspected, remove the pump and have a pressure test performed by an authorized repair station.

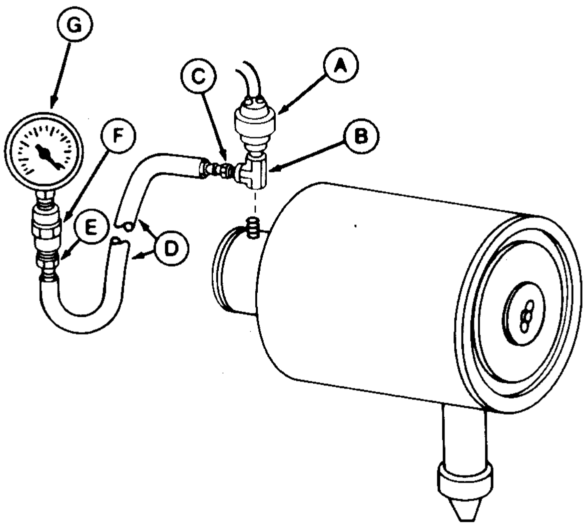
TX,9010,SB119 –19–11AUG98–2/2

AIR FILTER RESTRICTION INDICATOR SWITCH TEST

SPECIFICATIONS	
Air Filter Restriction Indicator Must Come On At Vacuum	6.2 kPa (62 mbar) (25 in. water)

ESSENTIAL TOOLS
JT05652 (1/8 F NPT x 1/8 F NPT x 1/8 M NPT) Tee
JT03246 (1/4 F NPT x 1/4 F NPT) (Parker No. 0202-4-4) Coupler

SERVICE EQUIPMENT AND TOOLS
(1/8 in.) Barbed Fitting
(1/4 in.) Barbed Fitting
0—15 kPa (0—150 mbar) (0—60 in. water) Vacuum Gauge



T7350EP

T7350EP –UN–17DEC90

A—Switch
B—Tee
C—Barbed Fitting
D—Tube
E—Barbed Fitting
F—Coupler
G—Gauge

1. Remove air restriction indicator switch (A).
2. Install parts as shown.
3. Start engine and slowly cover the air cleaner inlet with a piece of paper or cardboard.
4. Air filter restriction indicator (light) must come on.

Air Filter Restriction Indicator Must Come On At—Specification

Vacuum .... 6.2 kPa (62 mbar) (25 in. water)

5. If reading is not within specifications, install a new indicator switch.

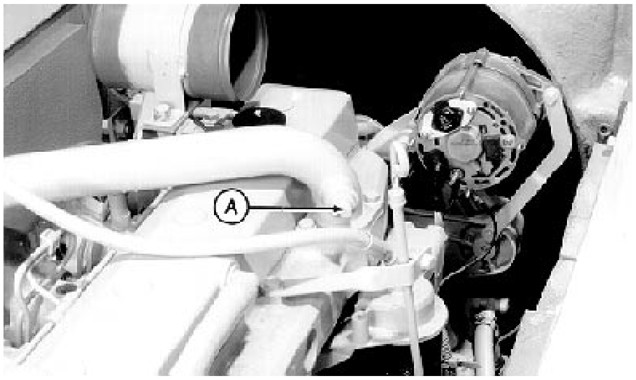
TX,9010,SB120 –19–11AUG98–1/1

AIR INTAKE SYSTEM LEAKAGE TEST

SPECIFICATIONS	
Air Intake System Leakage Test Pressure	14—21 kPa (0.14—0.21 bar) (2—3 psi)

OTHER MATERIAL
T43512 U.S. Thread Lock and Sealer (Medium Strength)
TY9473 Canadian Thread Lock and Sealer (Medium Strength)
242 Thread Lock and Sealer (Medium Strength)

T5906AP –UN–23FEB89



T103680 –UN–12SEP96

A—Plug

1. Remove air cleaner cover and main filter element.

2. Put large plastic bag into and over end of main filter element as shown. Install main filter element and cover.

3. Remove plug (A) from tube between turbocharger and intake manifold.

4. Connect air pressure regulator to manifold using hose and fitting from manifold pressure tester.

5. Pressurize air intake system to 14—21 kPa (0.14—0.21 bar) (2—3 psi). If intake system cannot be pressurized, turn engine slightly to close valves.

Air Intake System Leakage Test—Specification

Pressure .... 14—21 kPa (0.14—0.21 bar) (2—3 psi)

6. Spray soap solution over all connections from the air cleaner to turbocharger or air intake manifold and check for leaks. Correct all leaks.

7. Apply thread lock and sealer (medium strength) to plug. Install plug into intake manifold and tighten.

TX,9010,SB121 –19–17JUN98–1/1

RADIATOR AIR FLOW TEST

SPECIFICATIONS	
Engine Speed	Fast Idle
Air Flow Meter Total Reading Equal to or Greater Than Voltage	5.10 V (typical new)

ESSENTIAL TOOLS
JT05529 Air Flow Meter

SERVICE EQUIPMENT AND TOOLS
JT07306 Analog/Digital Multimeter

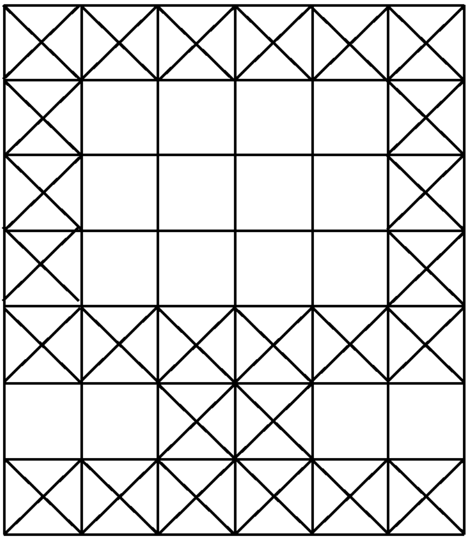
1. Lower all equipment to the ground.
2. Position all levers and pedals in neutral.
3. Stop the engine.
4. Straighten any bent fins in radiator or oil cooler.

CED,OUOE003,1058 –19–12AUG98–1/4

5. Divide the surface of trash screen into 42 equal squares starting at the top.
6. Connect air flow meter to analog/digital multimeter. Set multimeter to AC volts.
7. Start engine and run it at fast idle.

Engine—Specification

Speed .... Fast Idle



T109269 –UN–24APR97

Continued on next page

CED,OUOE003,1058 –19–12AUG98–2/4

8. Put air flow meter against the trash screen so it is centered in a square and air flow is through meter in the direction of air flow arrow.

9. Record voltage reading for each square that is not marked out with an “X”.

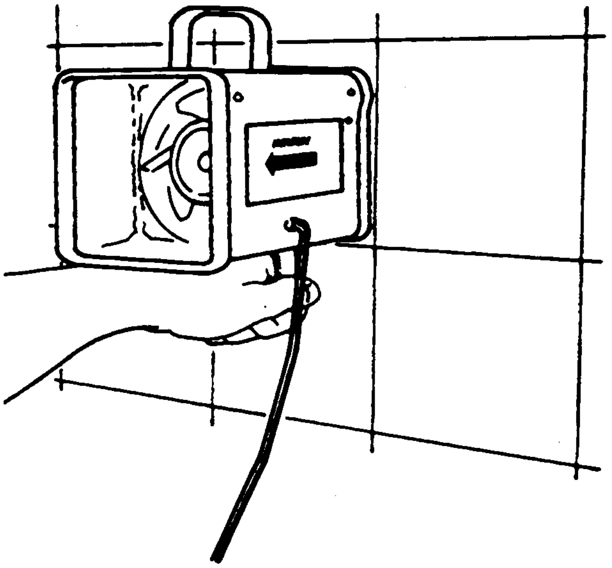
NOTE: Make a copy of the JT05529 Air Flow Meter Test Record shown on the following page. Use to make a record of the voltage readings and machine information.

10. Add the voltage readings. The total of readings must be equal to or greater than the specification.

Air Flow Meter Total Reading Equal to or Greater Than—Specification

Voltage.. 5.10 V (typical new)

11. If readings are less than specification, clean the trash screen and external surfaces of oil cooler and radiator. Repeat test.



T6080AH –UN–01NOV88

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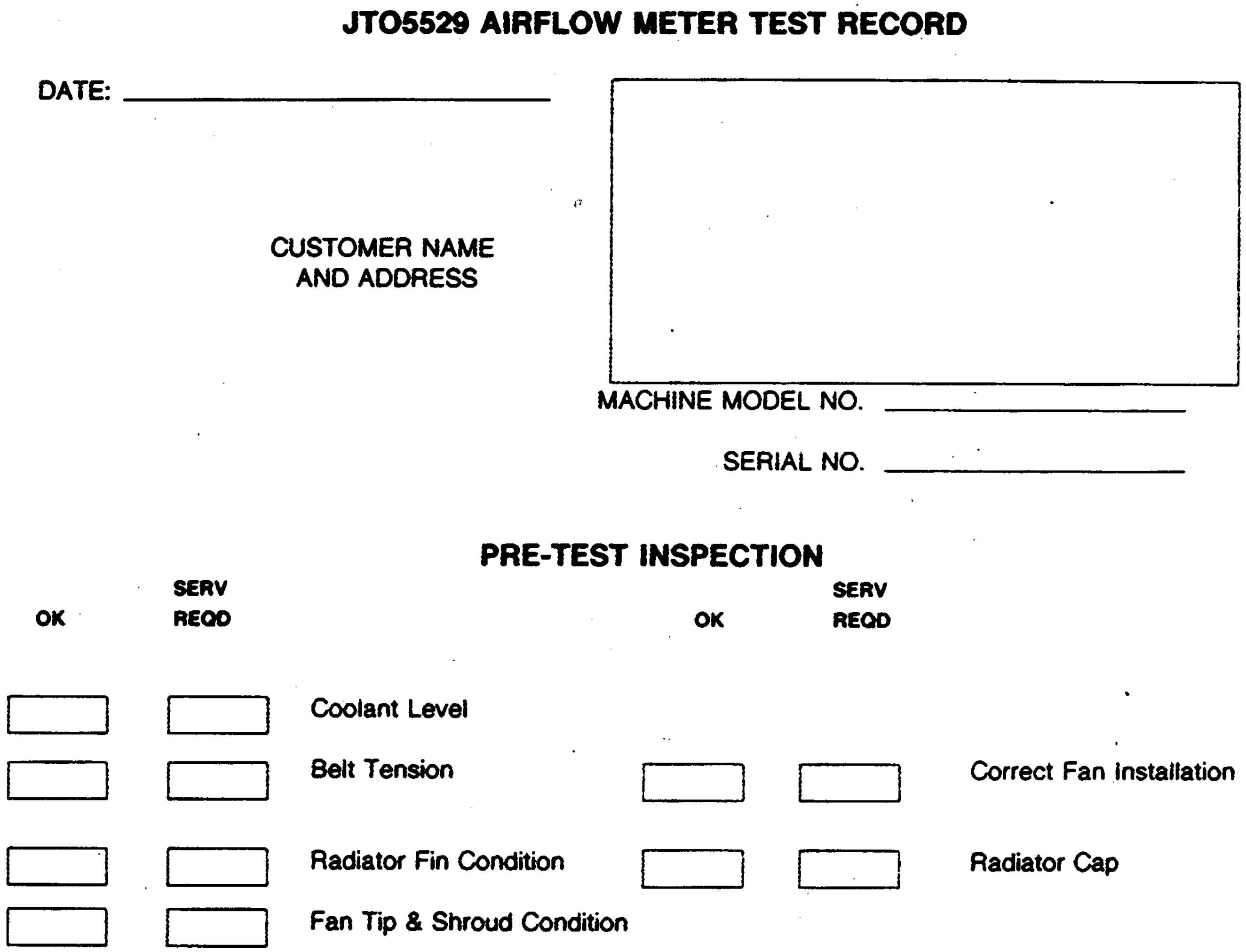


JTO5529 AIRFLOW METER TEST RECORD

DATE: ____________________

CUSTOMER NAME AND ADDRESS

MACHINE MODEL NO. ______________

SERIAL NO. ______________

PRE-TEST INSPECTION

OK	SERV REQD		OK	SERV REQD	
☐	☐	Coolant Level			
☐	☐	Belt Tension	☐	☐	Correct Fan Installation
☐	☐	Radiator Fin Condition	☐	☐	Radiator Cap
☐	☐	Fan Tip & Shroud Condition			

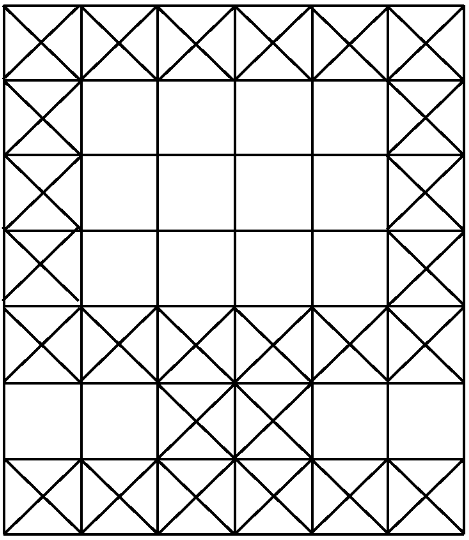
T6500AK –19–21MAR89

1. Divide surface of trash screen into 42 equal squares starting at the top.
2. Start engine and run it at fast idle.

Engine—Specification

Speed .... Fast Idle

3. Put air flow meter against the trash screen so it is centered in a square and air flow is through meter in the direction of air flow arrow.
4. Record voltage reading for each square not marked out with an “X”.
5. The combined total of voltage readings must be equal to or greater than specification.



T109269 –UN–24APR97

ENGINE POWER TEST USING TURBOCHARGER BOOST PRESSURE

SPECIFICATIONS	
Engine Fast Idle Speed	2180 ± 25 rpm in standard mode
Combined Pump Engine Pulldown Speed	100 rpm approximate with arm in over relief
HP Mode Switch Position	On
Rated Engine Speed	2100 rpm
Turbocharger Boost Pressure	79—100 kPa (0.79—1.00 bar) (11.5—14.5 psi) using No. 2 fuel and no muffler
Turbocharger Boost[a] Pressure	74—93 kPa (0.73—0.93 bar) (10.7—13.5 psi) using No. 1 fuel and no muffler

[a] Turbocharger boost pressure is reduced by 7% if using No. 1 fuel.

SERVICE EQUIPMENT AND TOOLS
JT05801 Clamp-On Electronic Tachometer
JT07290 Laptop Computer
JT07274G Excavator Diagnostics Program Disk
JT07273 Cable
JT07248 Turbo Boost Test Kit

OTHER MATERIAL
T43512 U.S. Thread Lock and Sealer (Medium Strength)
TY9473 Canadian Thread Lock and Sealer (Medium Strength)
242 LOCTITE® Thread Lock and Sealer (Medium Strength)

This procedure must only be used as a guide to determine engine condition.

1. Connect tachometer or the laptop computer with excavator diagnostics program. (See JT05801 Clamp-On Electronic Tachometer Installation in this group. For laptop computer, see procedure in Group 9025-25. Select “14 Actual engine speed” from Monitor Data Items.)

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Continued on next page

2. Remove plug (A) from tube between turbocharger and intake manifold.

3. Install fitting, hose, and pressure gauge.

4. Warm engine to normal operating temperature.

5. Turn engine rpm dial to fast idle.

Engine Fast Idle—Specification

Speed .... 2180 ± 25 rpm in standard mode

6. Check combined pump engine pulldown using arm in function over relief.

Combined Pump Engine Pulldown—Specification

Speed .... 100 rpm approximate with arm in over relief

If combined pump engine pulldown is not approximately 100 rpm, turn the load adjusting cartridge on the pump regulators in equal amounts to obtain 100 rpm combined pump engine pulldown. (See Hydraulic Pump Regulator Test and Adjustment—Engine Pulldown in Group 9025-25.)Be sure to turn the load adjusting cartridges out to their original setting at the end of test.

7. Push the HP mode switch on. The HP mode indicator on.

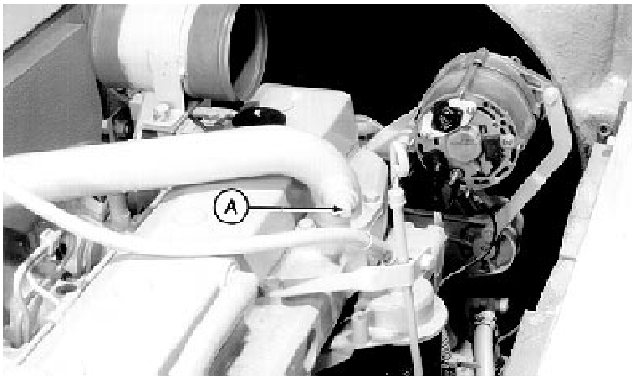
HP Mode Switch—Specification

Position .... On

NOTE: HP mode is actuated so the injection pump lever is pushed against the fast idle stop on the injection pump as the hydraulic pressure increases. With the injection pump lever against the fast idle stop, the maximum amount of fuel is delivered to the engine.

8. Watch the engine speed and pressure.

9. Slowly actuate arm in function over relief to load the engine pulling the speed down below rated engine speed. Repeat this step at least six times.



T103680 –UN–12SEP96

A—Plug

Continued on next page

Rated Engine—Specification

Speed .... 2100 rpm

NOTE: If using the JT07248 Turbo Boost Kit, a check valve at the pressure gauge inlet traps the highest reading for boost pressure and does not decrease as the pressure decreases.

10. Record the highest pressure reading at rated engine speed. The pressure increases as the engine speed is pulled down to rated engine speed and then decreases.

Turbocharger Boost—Specification

Pressure .... 79—100 kPa (0.79—1.00 bar)
(11.5—14.5 psi) using No. 2 fuel
and no muffler

Turbocharged Boost[1]—Specification

Pressure .... 74—93 kPa (0.73—0.93 bar)
(10.7—13.5 psi) using No. 1 fuel
and no muffler

IMPORTANT: Pressure gauge accuracy is very critical for this test. Do not make adjustments to injection pump fuel delivery on the machine to raise or lower boost pressure.

New engine may not develop specified boost pressure. Check after 50 hours of operation.

11. If turbocharger boost pressure is low, check the following:

- Wrong fuel.
- Restricted air filter elements.
- Restricted fuel filter elements.
- Incorrect injection pump timing.

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[1] *Turbocharger boost pressure is reduced by 7% if using No. 1 fuel.*

Continued on next page

- Incorrect fast idle stop adjustment at injection pump for HP mode. (See Injection Pump Fast and Slow Stops Adjustment in this group.)
- Exhaust manifold leaks.
- Intake manifold leaks.
- Faulty fuel pump.
- Low compression pressure.
- Cam lobe wear (valve clearance).
- Faulty fuel injection nozzles.
- Carbon build-up in turbocharger.
- Turbocharger compressor or turbine wheel rubbing housing.

12. Remove gauge and fitting.

13. Apply thread lock and sealer (medium strength) to plug.

    Tighten plug.

14. Turn the load adjusting cartridge on the pump regulators out to their setting. (See Hydraulic Pump Regulator Test and Adjustment—Engine Pulldown in this group.)

CED,TX08227,3197 –19–12AUG98–4/4

INSPECT TORSIONAL DAMPENER

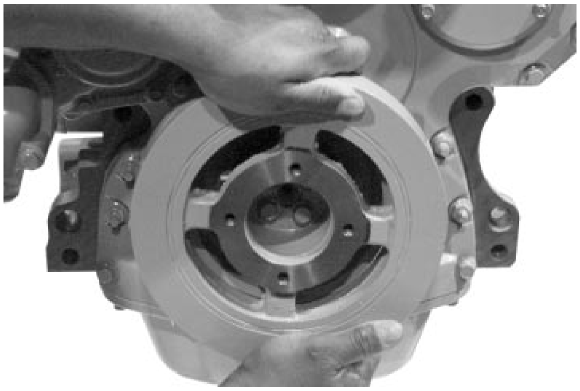
SPECIFICATIONS	
Torsional Dampener Radial Runout	1.50 mm (0.060 in.) maximum
Torsional Dampener Axial Runout (Wobble)	1.50 mm (0.060 in.) maximum

ESSENTIAL TOOLS
JDG820 Flywheel Turning Tool

SERVICE EQUIPMENT AND TOOLS
D17526CI Dial Indicator

IMPORTANT: Do not immerse the torsional dampener in cleaning solvent or any petroleum product. Rubber portion of dampener may be damaged. Never apply thrust on outer ring. Dampener is sensitive to impact damage, such as being dropped or struck with a hammer. The dampener is not repairable. Replace dampener whenever crankshaft is replaced or after major engine overhaul.

1. Grasp outer ring of torsional dampener and attempt to turn it in both directions. If rotation is felt, replace dampener. Also, if rubber is separated, partially missing, or displaced, replace dampener.



RG7507 –UN–23NOV97

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CED,OUOE003,1059 –19–12AUG98–1/3

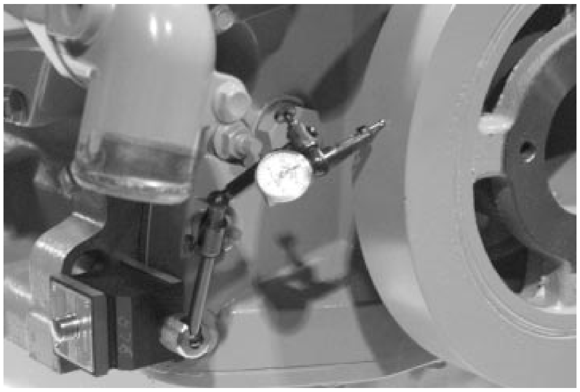
2. Check radial runout by positioning a dial indicator so probe contacts dampener OD.

3. With engine at operating temperature, rotate crankshaft using flywheel turning tool.

4. Note dial indicator reading. If radial runout exceeds specification, replace torsional dampener.

Torsional Dampener—Specification

Radial Runout.. 1.50 mm (0.060 in.) maximum



RG7508 –UN–23NOV97

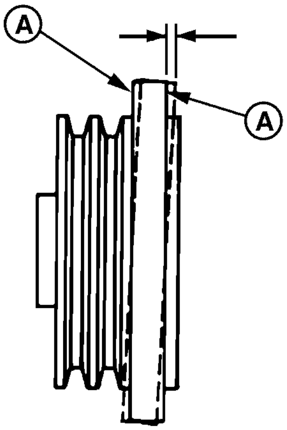
CED,OUOE003,1059 –19–12AUG98–2/3

5. Check axial runout (wobble) using a dial indicator. Measure axial runout at the outer edge of dampener face (A).

6. Rotate crankshaft one complete revolution using flywheel turning tool. Note total dial indicator reading. If axial runout exceeds specification, replace torsional dampener.

Torsional Dampener—Specification

Axial Runout (Wobble) .... 1.50 mm (0.060 in.) maximum



RG5679 –UN–31OCT97

A—Torsional Dampener Face

CED,OUOE003,1059 –19–12AUG98–3/3

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CHAPTER 4

SECTION 9015

ELECTRICAL SYSTEM

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Group 05
System Information

VISUALLY INSPECT ELECTRICAL SYSTEM

Make the following visual electrical inspection prior to starting the tractor after receiving customer complaint:

1. Look for bare wires that could ground a component or short across to another component.

2. Look for missing or worn conduit. This could indicate a wire problem.

3. Look for loose or broken connectors and wires.

4. Inspect batteries for:

    - Corroded terminals
    - Loose terminals or battery posts
    - Dirty condition
    - Damp condition
    - Cracked case
    - Proper electrolyte level

5. Check alternator belt tension.

6. After machine has been shut down for five minutes inspect for overheated parts. They will often smell like burned insulation. Put your hand on the alternator. Heat in these parts when the unit has not been operated for some time is a sure clue to charging circuit problems.

7. If your visual inspection does not indicate the possible malfunction, but your inspection does indicate that the machine can be run, turn the key switch to the IGN position. Try out the accessory circuits, indicator lights, gauge lights. How does each of these components work? Look for sparks or smoke which might indicate shorts.

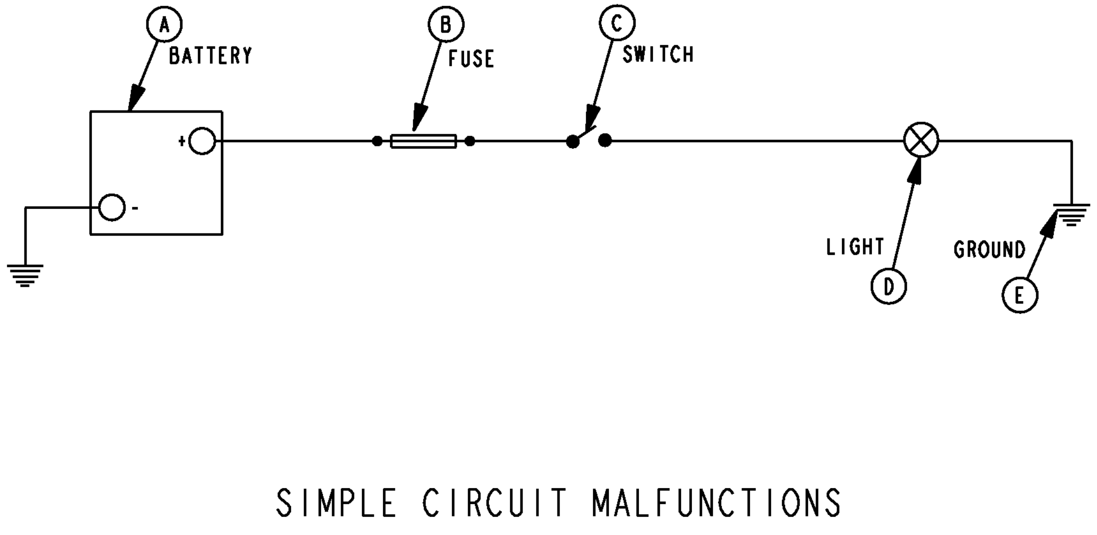
8. Start machine. Check all gauges for good operation and check to see if system is charging or discharging.

9. In general, look for anything unusual.

    Many electrical failures cannot be detected even if the machine is started. Therefore, a systematic and complete inspection of the electrical system is necessary.

TX,9015,MM2910A –19–01MAY95–1/1

CIRCUIT MALFUNCTIONS



T112479

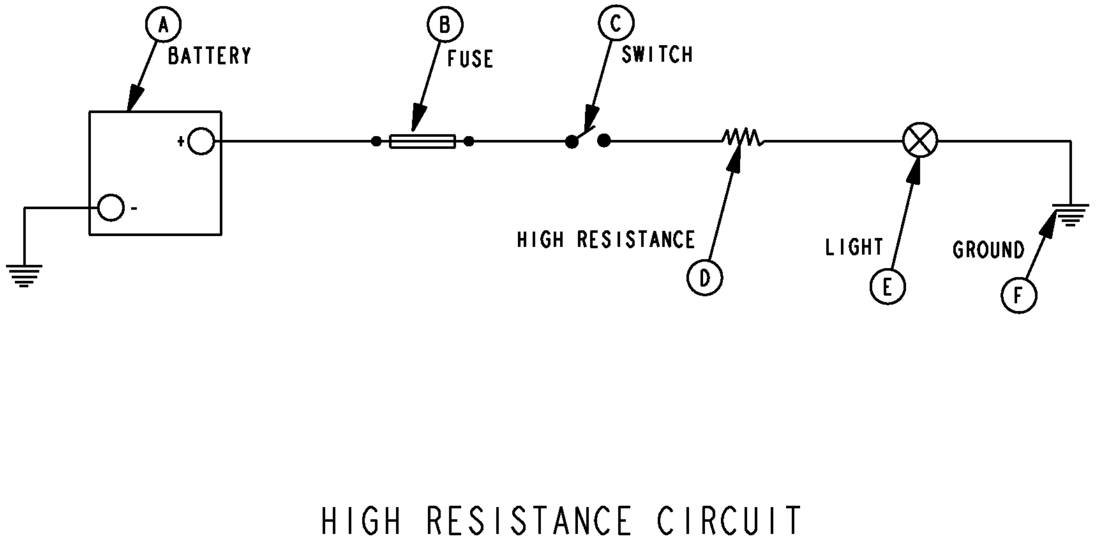
A—Battery
B—Fuse
C—Switch
D—Light
E—Ground

There are four common circuit malfunctions:

1. High-Resistance Circuit.
2. Open Circuit.
3. Grounded Circuit.
4. Shorted Circuit.

CED,TX13067,2 –19–17DEC97–1/1

DEFINITION OF CIRCUIT MALFUNCTIONS



T112473

T112473 –19–17DEC97

A—Battery
B—Fuse
C—Switch
D—High Resistance
E—Light
F—Ground

A High Resistance Circuit has unwanted resistance, like a loose or corroded connection (D) that causes a voltage drop and reduces current flow.

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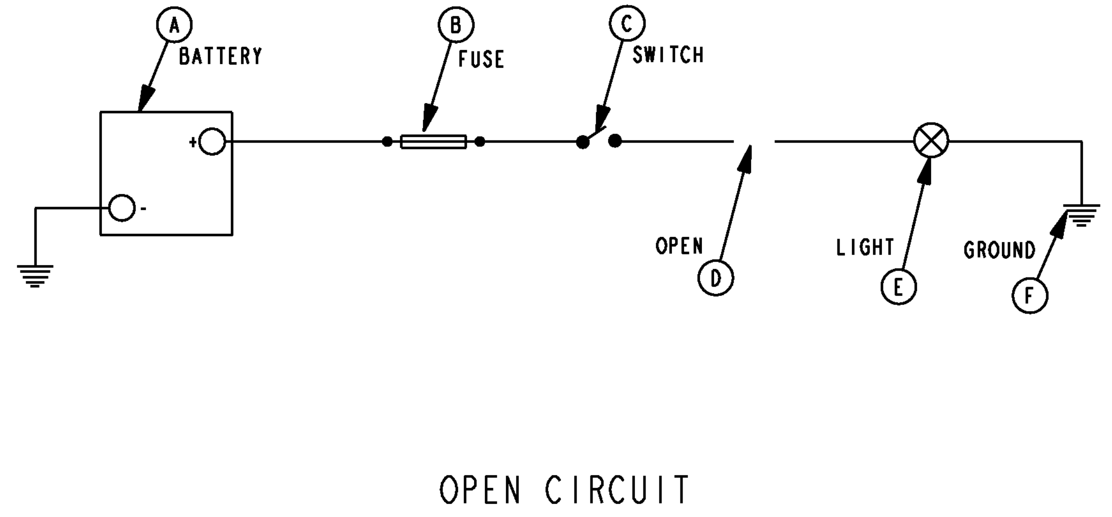

T112476

T112476 –19–17DEC97

A—Battery	**C—Switch**	**E—Light**
B—Fuse	**D—Open**	**F—Ground**

An Open Circuit has a broken wire (D) that prevents current from flowing in the circuit.

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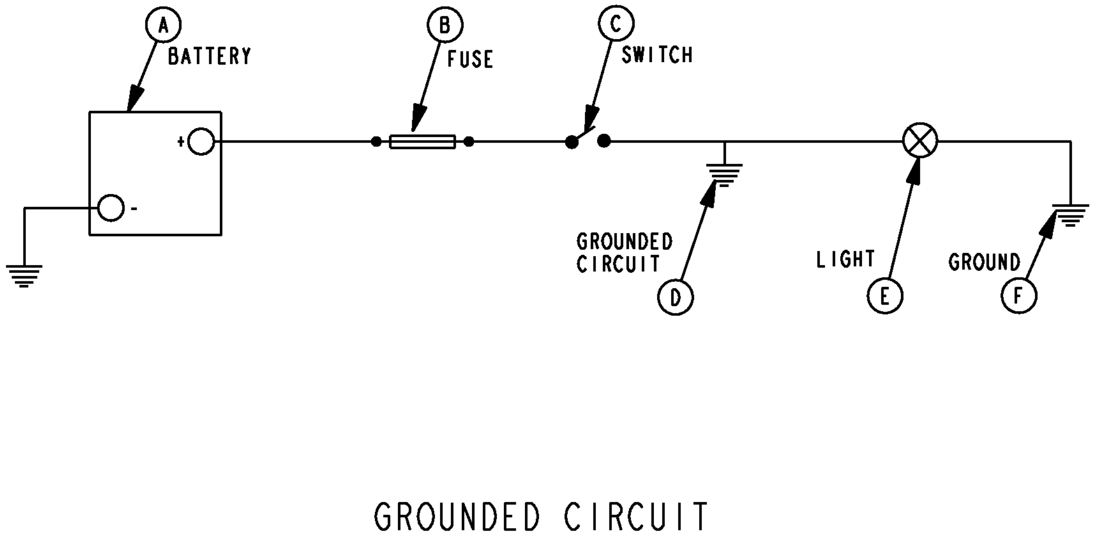

T112477

T112477 –19–17DEC97

A—Battery
B—Fuse
C—Switch
D—Grounded Circuit
E—Light
F—Ground

A Grounded Circuit (shorted circuit) has a power wire with its insulation rubbed through contacting the machine frame (D) providing continuity to the battery ground terminal (shorted to ground).

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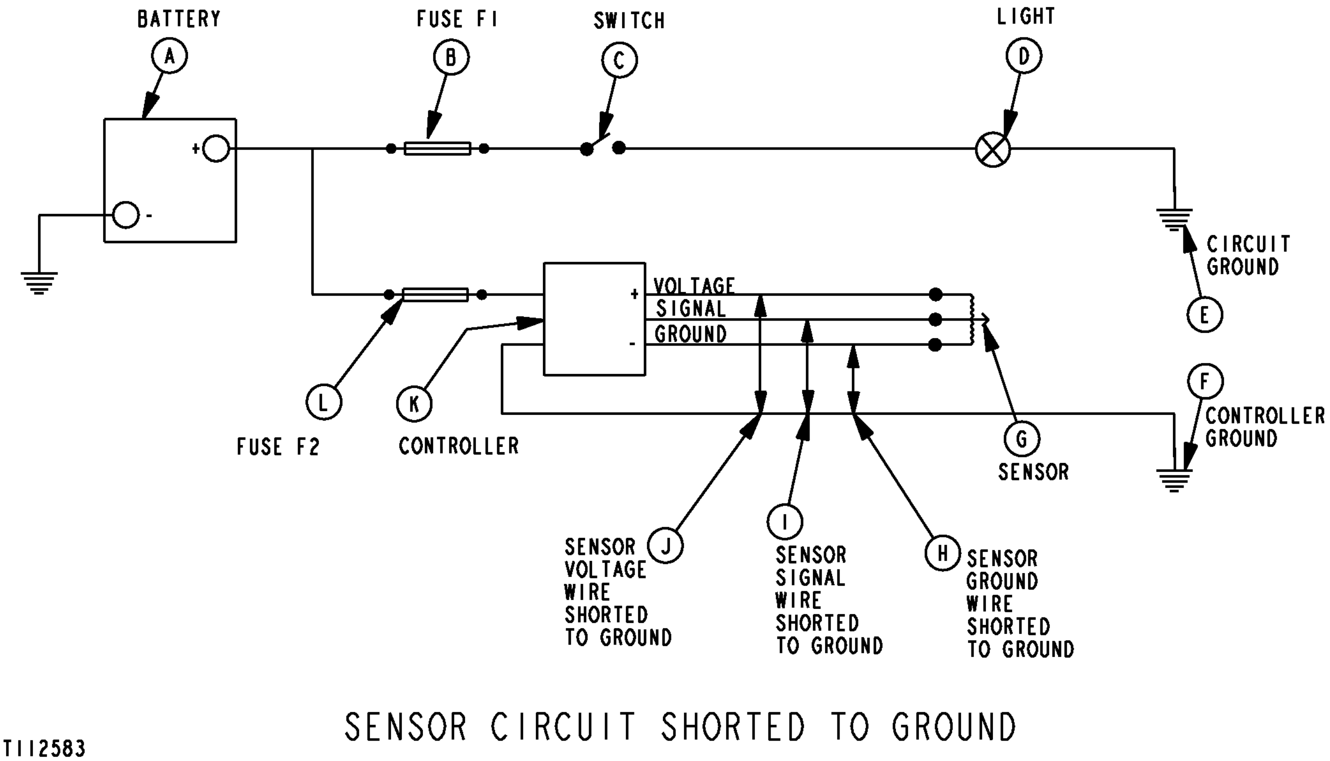
CED,TX13067,4 –19–17DEC97–3/5



T112583 –19–22DEC97

A—Battery
B—Fuse F1
C—Switch
D—Light
E—Circuit Ground
F—Controller Ground

A sensor circuit shorted to ground has one or more sensor wires, voltage wire (J), signal wire (I) or ground wire (H) shorted to machine ground or a grounded wire.

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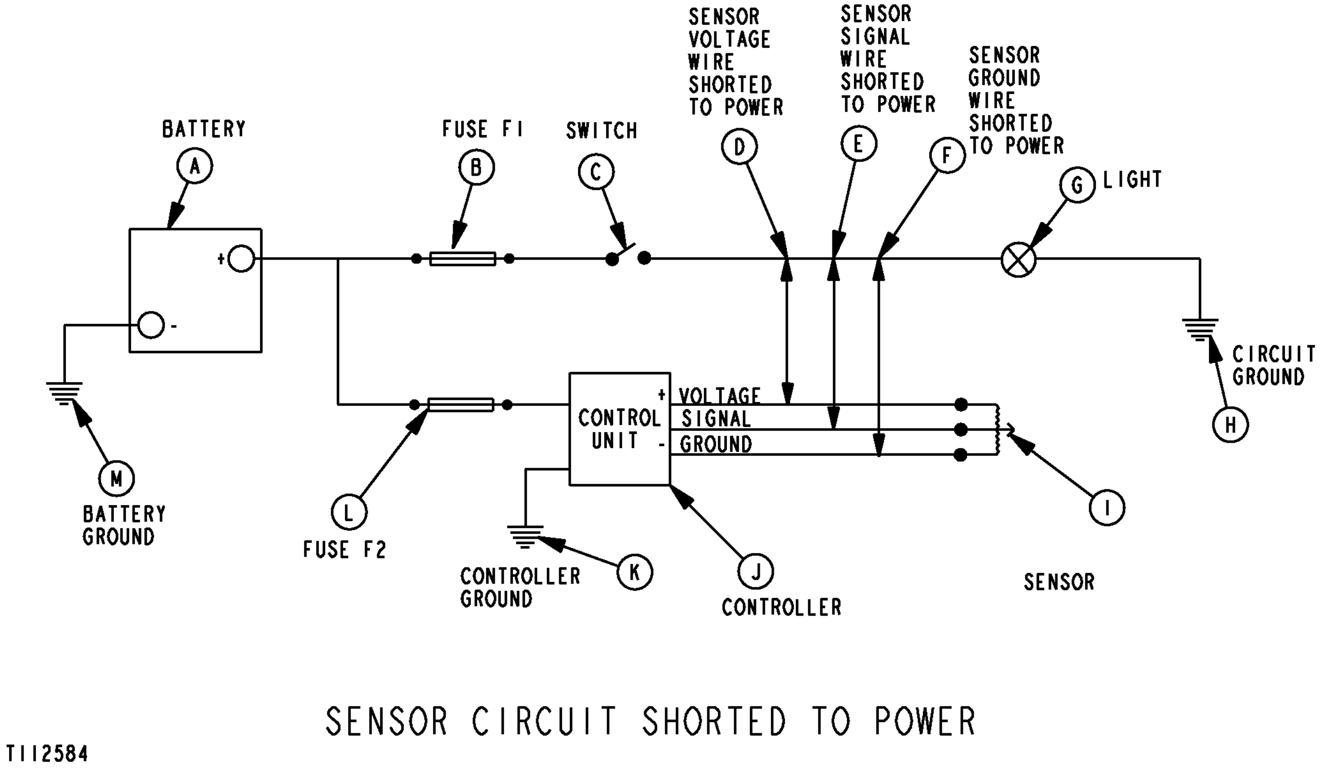
CED,TX13067,4 –19–17DEC97–4/5

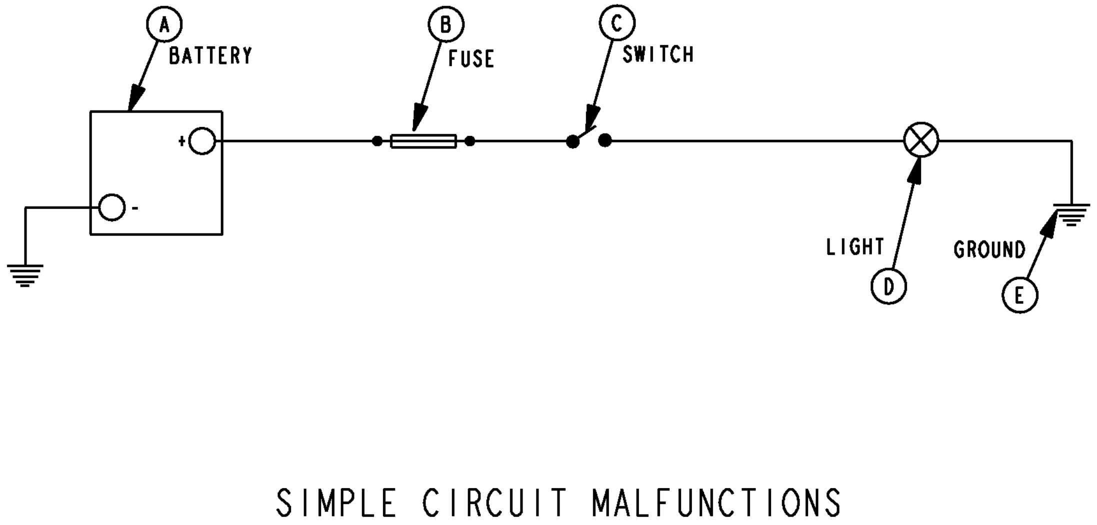


A—Battery	**E—Sensor Signal Wire Shorted to Power**	**H—Circuit Ground**	**M—Battery Ground**
B—Fuse F1	**F—Sensor Ground Wire Shorted to Power**	**I—Sensor**	
C—Switch	**G—Power**	**J—Controller**	
D—Sensor Voltage Wire Shorted to Power		**K—Controller Ground**	
		L—Fuse F2	

A Sensor circuit shorted to power has one or more sensor wires, voltage wire (D), signal wire (E) or ground wire (F) shorted to battery voltage.

CED,TX13067,4 –19–17DEC97–5/5

LOCATION OF CIRCUIT MALFUNCTIONS



T112479

T112479 –19–19DEC97

A—Battery
B—Fuse
C—Switch
D—Light
E—Ground

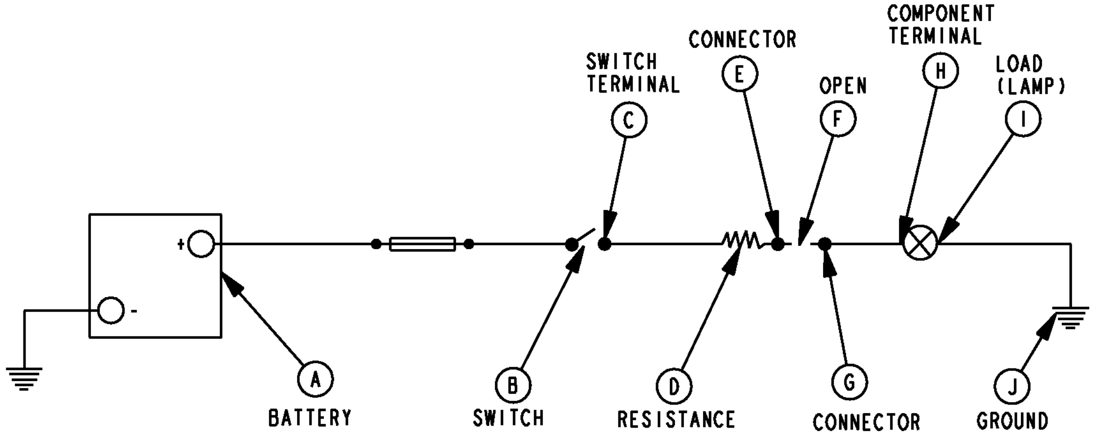
In a simple electrical circuit malfunctions only occur at three locations:

1. Before the controlling switch (C).
2. Between controlling switch (C) and load (D).
3. After the load (D).

Failed components can be diagnosed as circuit malfunctions. Isolate malfunctions to determine the cause of failure.

CED,TX13067,1 –19–18DEC97–1/1

TROUBLESHOOTING CIRCUIT MALFUNCTIONS



FINDING CIRCUIT MALFUNCTIONS

T112480

T112480 –19–17DEC97

High Resistance Circuit:

1. A high resistance circuit results in slow, dim or no component operation. High resistance can be caused by loose, corroded or oily connector terminals.
2. High resistance can be caused by wire that is too small or has broken strands internally.
3. Troubleshoot a high resistance circuit by measuring voltage between the switch and load with the switch ON.
4. If voltage is low, the malfunction is between the point of measurement and the battery. Continue measuring voltage toward battery until normal voltage is found. Malfunction is between last two points of measurement.
5. If voltage is normal, the malfunction is between point of measurement and circuit ground. Continue measuring voltage toward circuit ground until low voltage is found. Malfunction is between last two points of measurement.

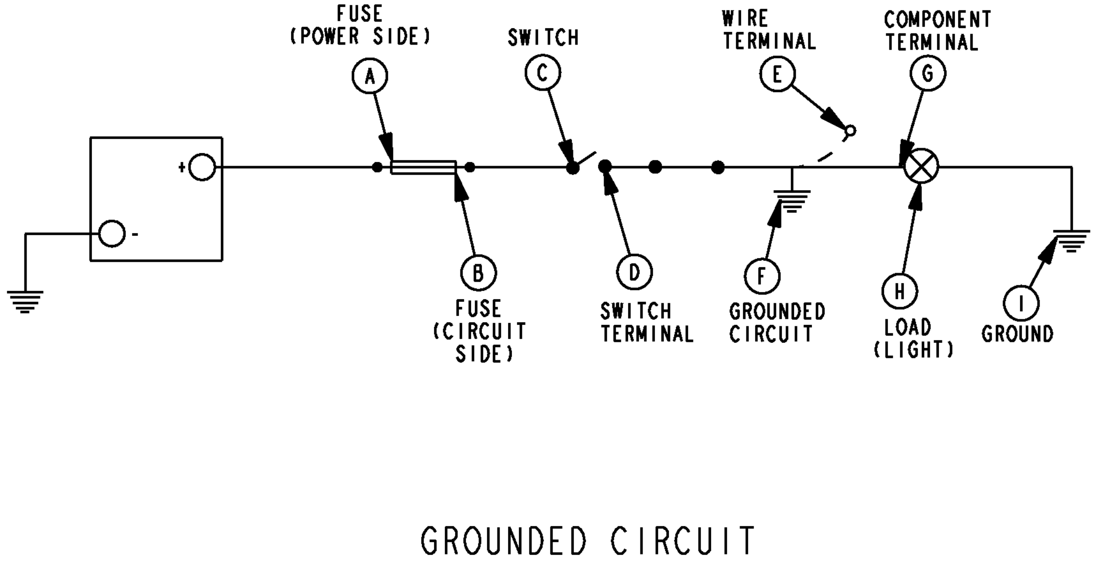
Open Circuit:

1. An open circuit results in no component operation. An open circuit can be caused by broken wires, disconnected connector, blown fuse or tripped circuit breaker.
2. Troubleshoot an open circuit by replacing the fuse or resetting the circuit breaker, then measure voltage between the switch and load with the switch ON.
3. If voltage is zero, the malfunction is between the point of measurement and the battery. Continue measuring voltage toward the battery until normal voltage is found. Malfunction is between last two points of measurement.

Continued on next page

4. If voltage is normal, the malfunction is between point of measurement and circuit ground. Continue measuring voltage toward circuit ground until zero voltage is found. Malfunction is between last two points of measurement.

CED,TX13067,2 –19–18DEC97–2/3



T112481

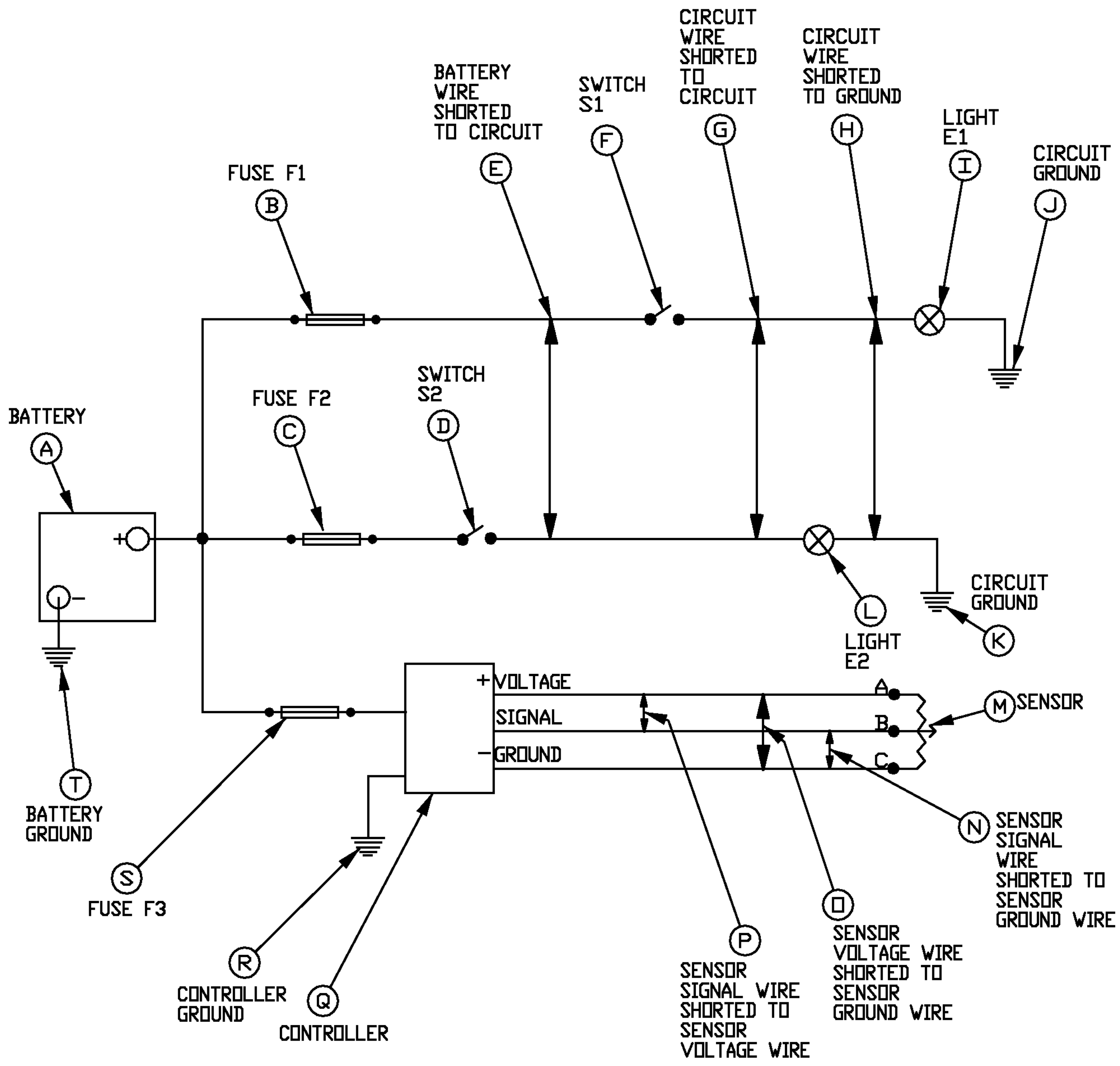
T112481 –19–17DEC97

Grounded Circuit:

1. A grounded circuit results in no component operation and the fuse blown or circuit breaker open.
2. Troubleshoot a grounded circuit by turning the switch OFF, and checking continuity to frame ground between the fuse circuit side (B) and switch (C).
3. If continuity is measured, the malfunction is between fuse and switch. Inspect wire harness for burned areas or insulation rubbed off a wire.
4. If continuity is not measured, measure continuity to frame ground, between switch terminal (D) and component terminal (G).
5. If continuity is measured, the malfunction is between switch and component. Inspect wire harness for burned areas or insulation rubbed off a wire.

CED,TX13067,2 –19–18DEC97–3/3

CIRCUIT SHORTED TO POWER AND CIRCUIT SHORTED TO ITSELF



CIRCUIT SHORTED TO POWER
AND
SENSOR CIRCUIT SHORTED TO ITSELF

T118682

T118682 –19–25NOV98

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Circuit Shorted to Power:

1. Complex circuits can fail in numerous ways. Circuits can short to other circuits causing components to operate when unrelated switches are turned ON. In the example if switch S1 is ON and wires are shorted at (G) light E1 and E2 will be ON.
2. Components can operate even when all switches are OFF. In the example if wires are shorted at (E), light E2 will be ON all the time.
3. Components can operate strangely. In the example if wires are shorted at (H), fuse F1 will blow when switch S1 is turned ON. If switch S2 is turned ON, light E2 will operate normally and light E1 may be very dim, or light E1 and E2 may be dim, even if fuse F1 is blown.

Sensor Circuit Shorted to Itself:

1. Sensors are part of a controller circuit. Controllers are used to operate components like engines, transmissions or hydraulic systems. Sensors send information such as speed, pressure or temperature from the component to the controller to monitor operation of the component. If a malfunction occurs in the component, or the sensor circuit the controller no longer receives a “normal” signal. “Abnormal” signals received by a controller mean part of the circuit has a malfunction.
2. Sensor circuits can fail in numerous ways. Service Codes will be generated when sensor circuits fail. Controllers may allow the component to operate normally, may allow operation in a reduced capacity such as a “limp home mode”, or the controller may prevent any component operation.
3. If a sensor circuit signal wire (N) shorts to a ground wire, a “Short to Ground” Service Code may be generated
4. If a sensor circuit voltage wire (O) shorts to ground, a Service Code may or may not be generated, but other sensors connected to the controller will cease to work, because their supply voltage will also be shorted to ground. Erratic operation of the monitor may result.
5. If a sensor circuit voltage wire (P) shorts to the sensor signal wire a Service Code may or may not be generated. The controller may receive a signal indicating the sensor is reading its maximum upper or lower limit.

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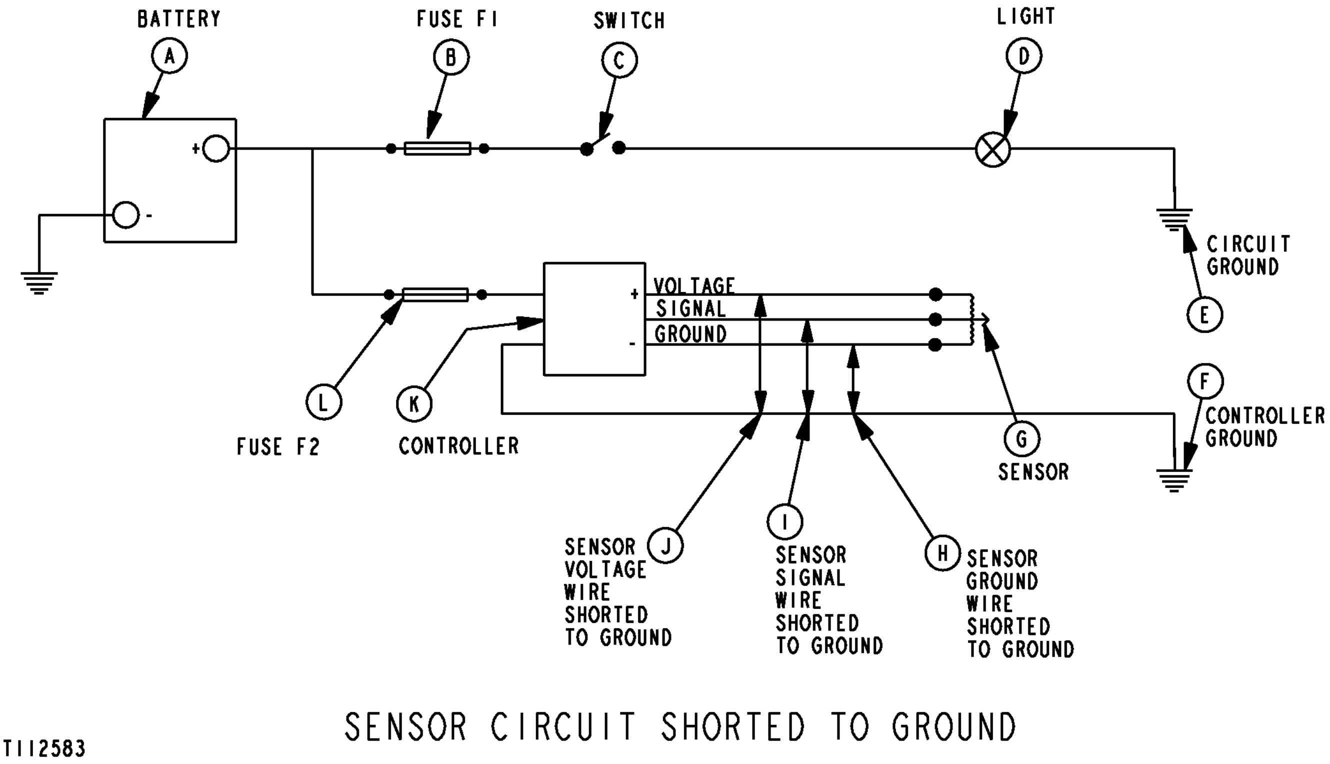


T112583 –19–22DEC97

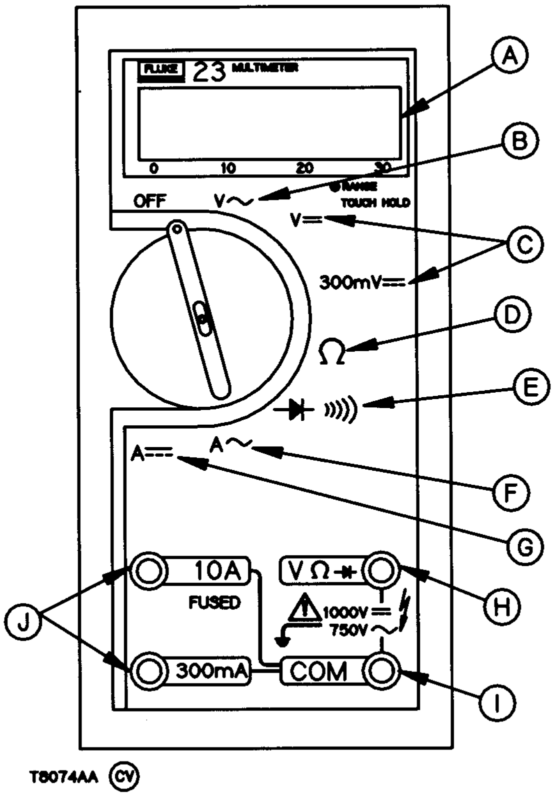
Sensor Circuit Shorted to Ground:

1. If a sensor circuit ground wire shorts to a machine ground wire (H), a service code probably won't be generated. Sensor operation may be normal.
2. If a sensor signal wire shorts to a machine ground wire (I), a Short to Ground service code may be generated.
3. If a sensor voltage wire shorts to a machine ground wire (J), a Service Code may be generated. The monitor indicator for the sensor may illuminate.

CED,TX13067,200 –19–05FEB98–3/3

MULTIMETER

The multimeter is an auto-ranging digital display that allows very accurate readings to be taken.

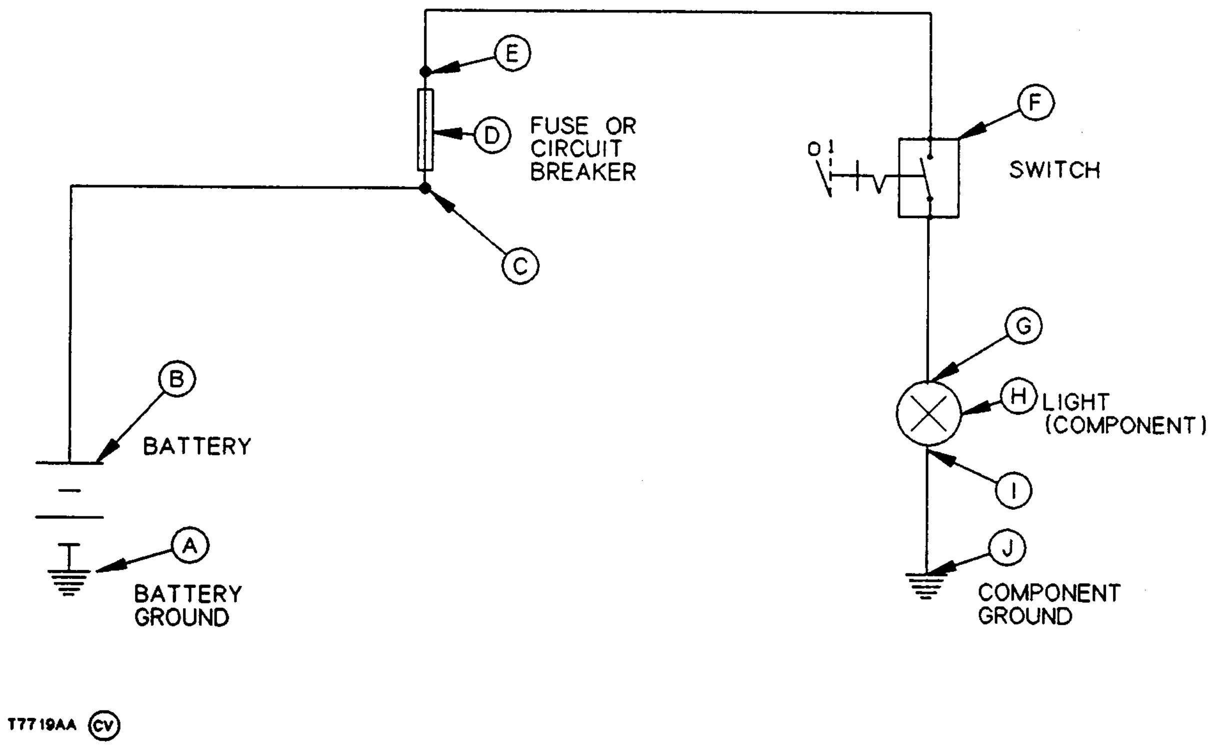


T8074AA –19–03SEP93

A—Display
B—Voltage AC (Alternating Current)
C—Voltage DC (Direct Current)
D—Resistance
E—Diode Test/Continuity
F—Current AC (Alternating Current)
G—Current DC (Direct Current)
H—Voltage, Resistance, Diode/Continuity (Red Lead Input)
I—Ground (Black Lead Input)
J—Current/Amps (Red Lead Input)

TX,9015,MM2916A –19–20MAR96–1/1

SEVEN STEP ELECTRICAL TEST PROCEDURE



T7719AA –19–05MAR92

A—Battery Ground	**D—Fuse Or Circuit Breaker**	**G—Battery Side Of Component Terminal**	**I—Ground Side Of Component Terminal**
B—Battery	**E—Component Side Of Fuse Or Circuit Breaker**	**H—Light (Component)**	**J—Component Ground**
C—Battery Side Of Fuse Or Circuit Breaker	**F—Switch**		

Step 1—Switch ON	
Check battery side of circuit breaker (C) for battery voltage	Battery voltage normal. Go to Step 2.
	Low voltage, repair high resistance.
	Open circuit from battery.
Step 2—Switch OFF	
Check component side of circuit breaker for battery voltage	Battery voltage normal. Go to Step 4.
	Low voltage, repair high resistance.
	No voltage. Go to Step 3.

Continued on next page

Step 3—Switch OFF	
Check component side of circuit breaker for continuity to ground	Continuity to ground. Repair grounded circuit at or before switch.
	No continuity to ground, replace circuit breaker.
Step 4—Switch ON	
Check component side of circuit breaker for battery voltage	Battery voltage normal. Go to Step 6.
	Low voltage, repair high resistance.
	No voltage. Go to Step 5.
Step 5	
Disconnect wire at battery side of component (G). Switch ON. Check wire at (G) for battery voltage	Battery voltage, repair component.
	No voltage, repair grounded or open circuit at or after switch.
Step 6—Switch ON	
Check lead to component at (G) for battery voltage	Battery voltage normal. Go to Step 7.
	Low voltage, repair high resistance in circuit between fuse and component.
	No voltage, repair high resistance or open circuit between fuse and component.
Step 7—Switch ON	
Check ground wire of component at (I) for voltage	No voltage, good continuity to ground.
	Repair component.
	Voltage, poor continuity to ground. Repair high resistance or open ground circuit.

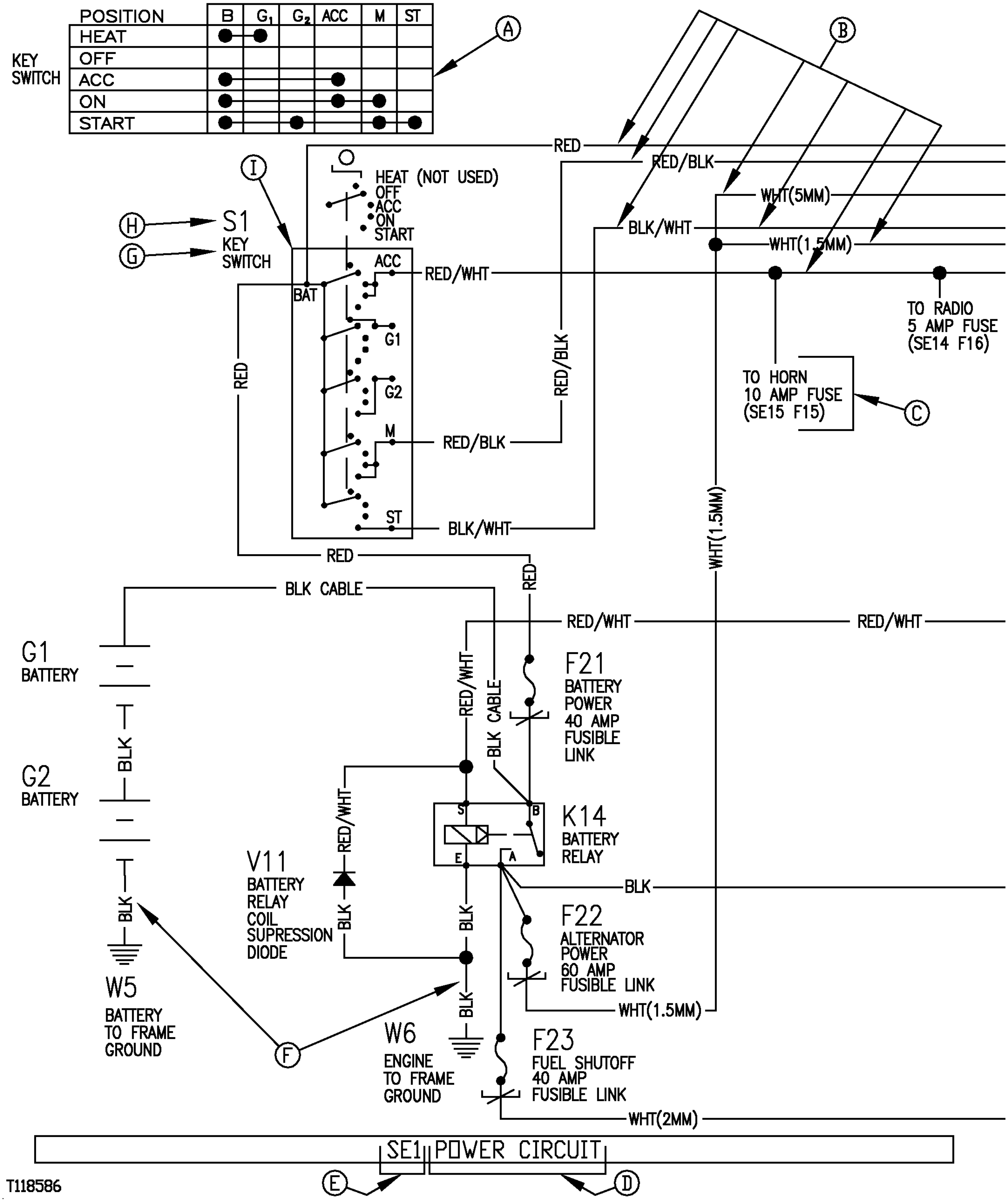
SYSTEM FUNCTIONAL SCHEMATIC INFORMATION

SYSTEM FUNCTIONAL SCHEMATIC DIAGRAM

The System Functional Schematic is a schematic diagram of the complete machine. All harnesses are identified by letter/number designation and description—Engine and Frame Harness (W1), Cab Harness (W2) etc. Each wire is identified by color (Blk, Red/Wht, Blk/Wht etc.) All components are identified by letter/number designation, description and are represented by a schematic symbol. Component letter/number designation, (S1 Key Switch, F21 Battery Power 40 Amp Fusible Link, etc.) will indicate that component throughout the manual. The System Functional Schematic is divided into Sections. Each section contains one or more electrical circuits. Each section is indicated by a number and circuit (SE1 Power Circuit, SE2 Starting Circuit, etc.)

NOTE: All System Functional Schematic Diagrams are shown with key switch in the off position.

READING A SYSTEM FUNCTIONAL SCHEMATIC DIAGRAM



KEY SWITCH

POSITION	B	G1	G2	ACC	M	ST
HEAT	●	●				
OFF						
ACC	●			●		
ON	●			●	●	
START	●		●		●	●

T118586 –19–23NOV98

Continued on next page

A—Continuity Chart	**D—Circuit Name**	**H—Component Identification Code**
B—Power Wires	**E—Section Number**	**I—Component Schematic Symbol**
C—Other Routing Location Information	**F—Ground Wires**	
	G—Component Name	

The System Functional Schematic Diagram is made up of sections which contain one or more Subsystem Functional Schematics laid out side by side in a logical sequence of related functions. Each Subsystem is a major group of components like starting components or charging components. Each Section of the System Functional Schematic is assigned a number (E) and a name (D) that reflects that group of components. The System Functional Schematic is formatted with power supply wires (B) shown across the top of the drawing and ground wires (F) across the bottom. The schematic contains no harness or connector information.

Each electrical component is shown by a schematic symbol (I), the component name (G), and a component identification code (H). A continuity chart (A) is included for the key switch.

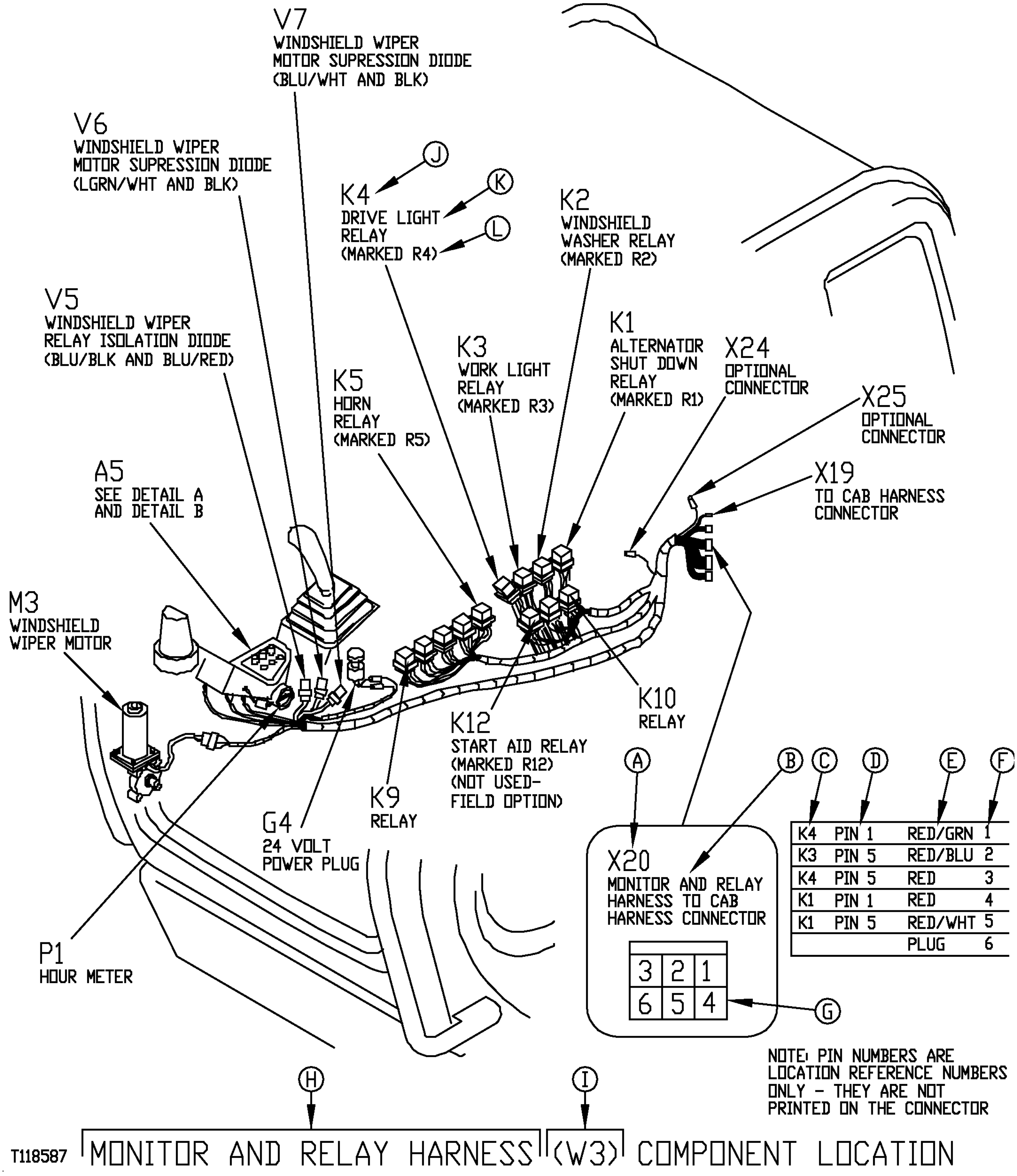
Other routing location information (C) is included for reference. In the example shown the Red/Wht wire also is connected to the Horn 10 Amp Fuse which is located on Section 15 of the System Functional Schematic; and the fuse identification number is F10.

The same names and identification codes are used on all machine drawings, the System Functional Schematic, the Harness Component Location Drawing and the Harness Connectors, Wires and Pin Location drawings. Components and connectors can easily be cross-referenced from one drawing to another. See Group 9015-10 for Functional Schematic and Component Location Legend.

CED,OUTX782,7 –19–19NOV98–2/2

READING A HARNESS COMPONENT LOCATION DIAGRAM

T118587 –19–18MAR99



K4	PIN 1	RED/GRN	1
K3	PIN 5	RED/BLU	2
K4	PIN 5	RED	3
K1	PIN 1	RED	4
K1	PIN 5	RED/WHT	5
		PLUG	6

TX,9015,MM2920B –19–19NOV98–1/4

A—Mating Harness Connector Identification Number
B—Mating Harness Connector Identification Name
C—Routing Destination of Wire (Shown as Component Identification Number)
D—Pin Number of Harness Connector to Which Wire is Routed
E—Wire Color
F—Pin Number of Harness Connector
G—Front View of Harness Connector
H—Name of Harness
I—Harness Identification Number

NOTE: The same names and identification numbers are used on all machine schematic and harness electrical drawings throughout the Operation and Test Technical Manual so components can easily be cross-referenced from one drawing to another.

The component location by harness drawing is a pictorial representation that shows harness routing, component location and mating harness connector information.

The location of each component that is connected to the harness is shown and identified by its alpha-numeric identification number (J) and component name (K). In the example shown, the component is also identified by an R number (L) that is actually marked on the part.

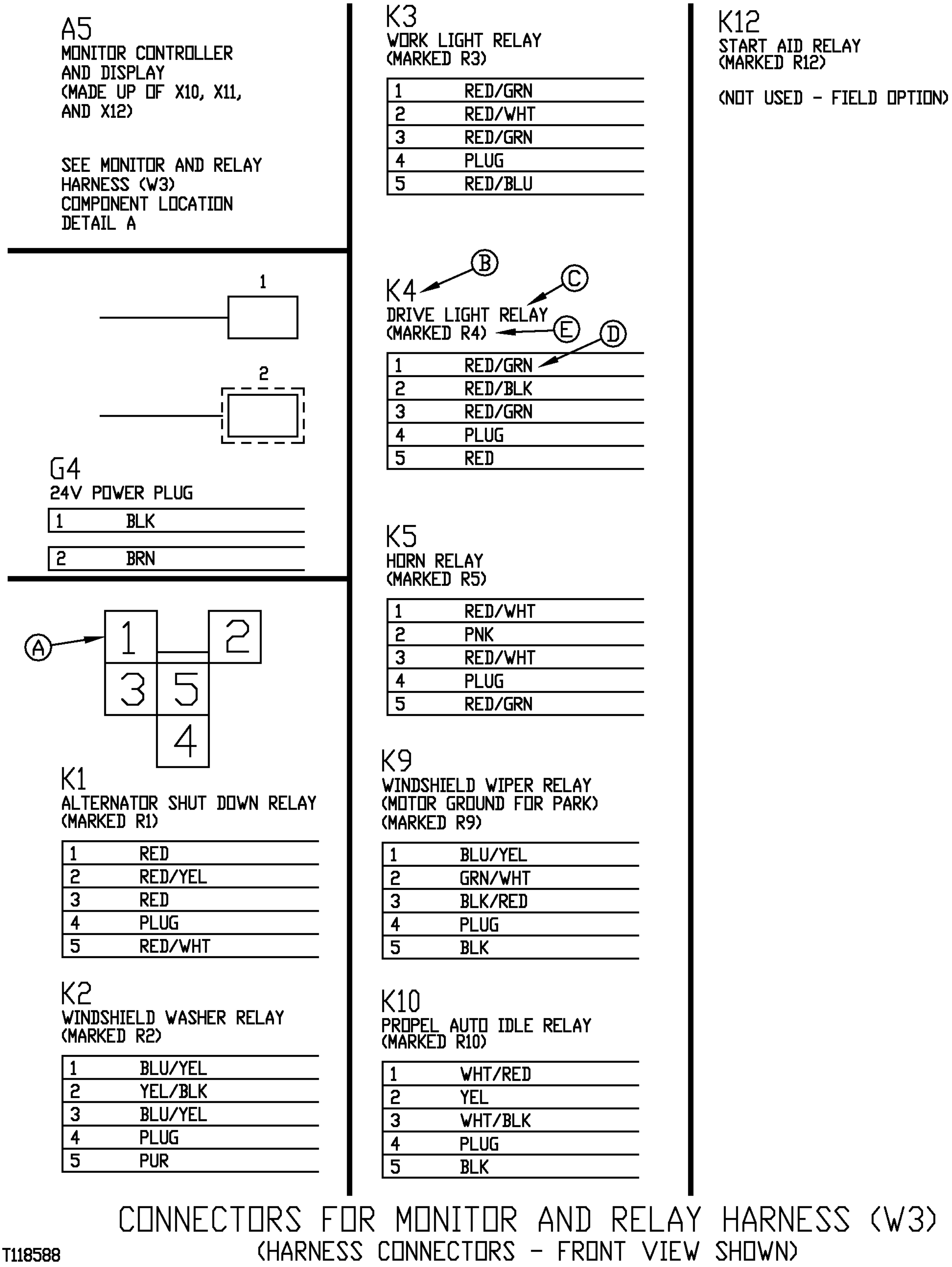
Each connector that joins one harness to another is identified by an “X” component identification number (A) and a name (B). An end (front) view (G) of the connector is shown. Also, a diagram view of the connector shows connector terminal number (F), wire color (E) and destination of each wire (C and D).

In the example shown, X20 Connector connects the Monitor and Relay Harness to the Cab Harness. Pin 1 (F) of the connector contains a Red/Grn wire (E), which is routed to Pin 1 (D) of the connector for K4 (C) Drive Light Relay.

NOTE: Pin numbers are location reference numbers only—they are not printed on the connector.

Each wiring harness component location is followed by individual component connector drawings. These drawings show an end (front) view and a diagram view of each connector in the harness that connects to a component.

Continued on next page



A5
MONITOR CONTROLLER AND DISPLAY
(MADE UP OF X10, X11, AND X12)

SEE MONITOR AND RELAY HARNESS (W3) COMPONENT LOCATION DETAIL A

G4
24V POWER PLUG

1	BLK
2	BRN

K1
ALTERNATOR SHUT DOWN RELAY
(MARKED R1)

1	RED
2	RED/YEL
3	RED
4	PLUG
5	RED/WHT

K2
WINDSHIELD WASHER RELAY
(MARKED R2)

1	BLU/YEL
2	YEL/BLK
3	BLU/YEL
4	PLUG
5	PUR

K3
WORK LIGHT RELAY
(MARKED R3)

1	RED/GRN
2	RED/WHT
3	RED/GRN
4	PLUG
5	RED/BLU

K4
DRIVE LIGHT RELAY
(MARKED R4)

1	RED/GRN
2	RED/BLK
3	RED/GRN
4	PLUG
5	RED

K5
HORN RELAY
(MARKED R5)

1	RED/WHT
2	PNK
3	RED/WHT
4	PLUG
5	RED/GRN

K9
WINDSHIELD WIPER RELAY
(MOTOR GROUND FOR PARK)
(MARKED R9)

1	BLU/YEL
2	GRN/WHT
3	BLK/RED
4	PLUG
5	BLK

K10
PROPEL AUTO IDLE RELAY
(MARKED R10)

1	WHT/RED
2	YEL
3	WHT/BLK
4	PLUG
5	BLK

K12
START AID RELAY
(MARKED R12)

(NOT USED - FIELD OPTION)

CONNECTORS FOR MONITOR AND RELAY HARNESS (W3)
(HARNESS CONNECTORS - FRONT VIEW SHOWN)

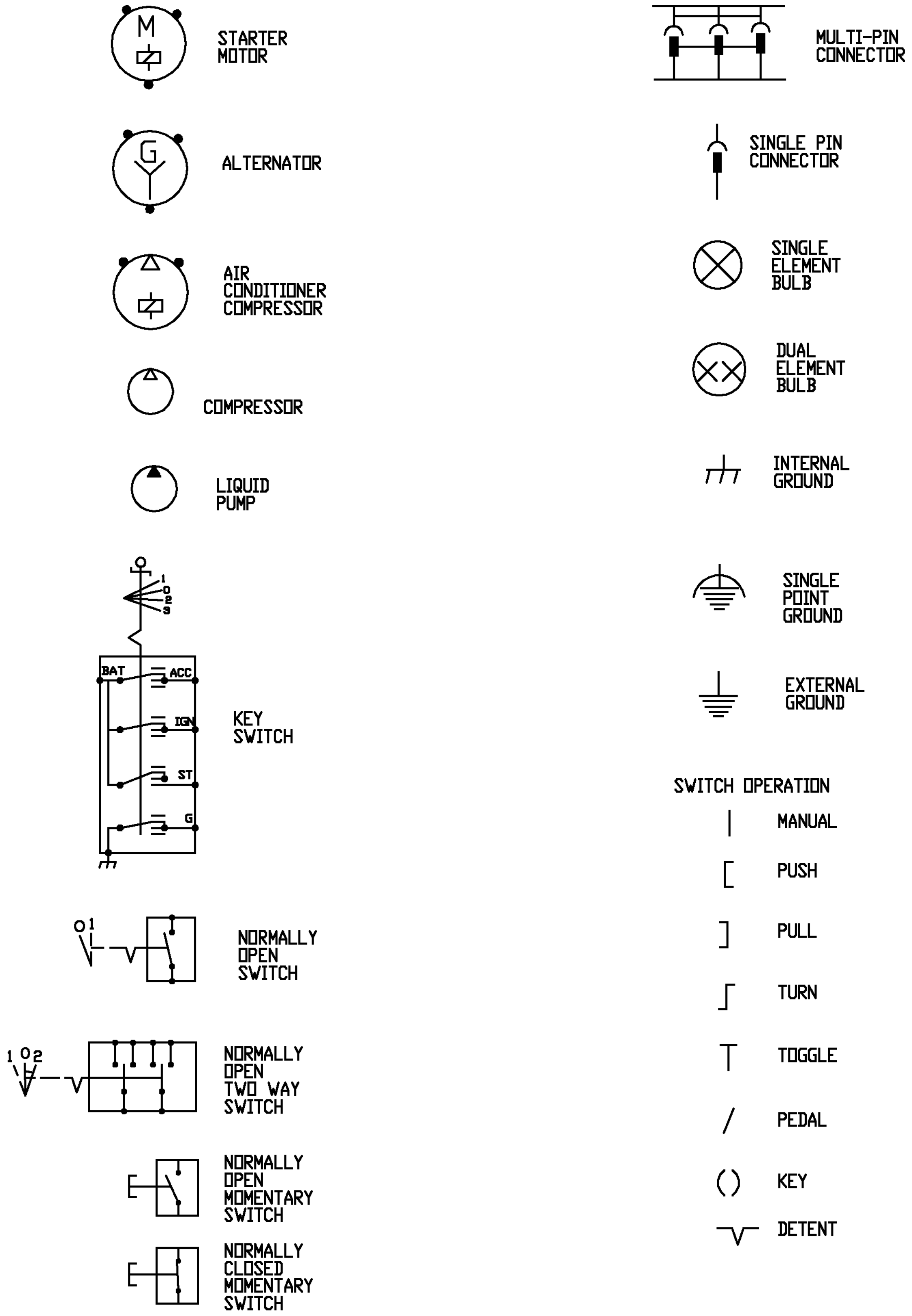
Continued on next page

TX,9015,MM2920B –19–19NOV98–3/4

In the preceding example, to see the location of the Red/Grn wire in the harness connector for the K4 Drive Light Relay, refer to the Connector Diagram. This drawing shows the end (front) view of the connector (A), the Component Identification Number (B), the Component Name (C), the Component Marked Number (if any) (E) and the wire color (D).

TX,9015,MM2920B –19–19NOV98–4/4

ELECTRICAL SCHEMATIC SYMBOLS



T117534

T117534 –19–07OCT98

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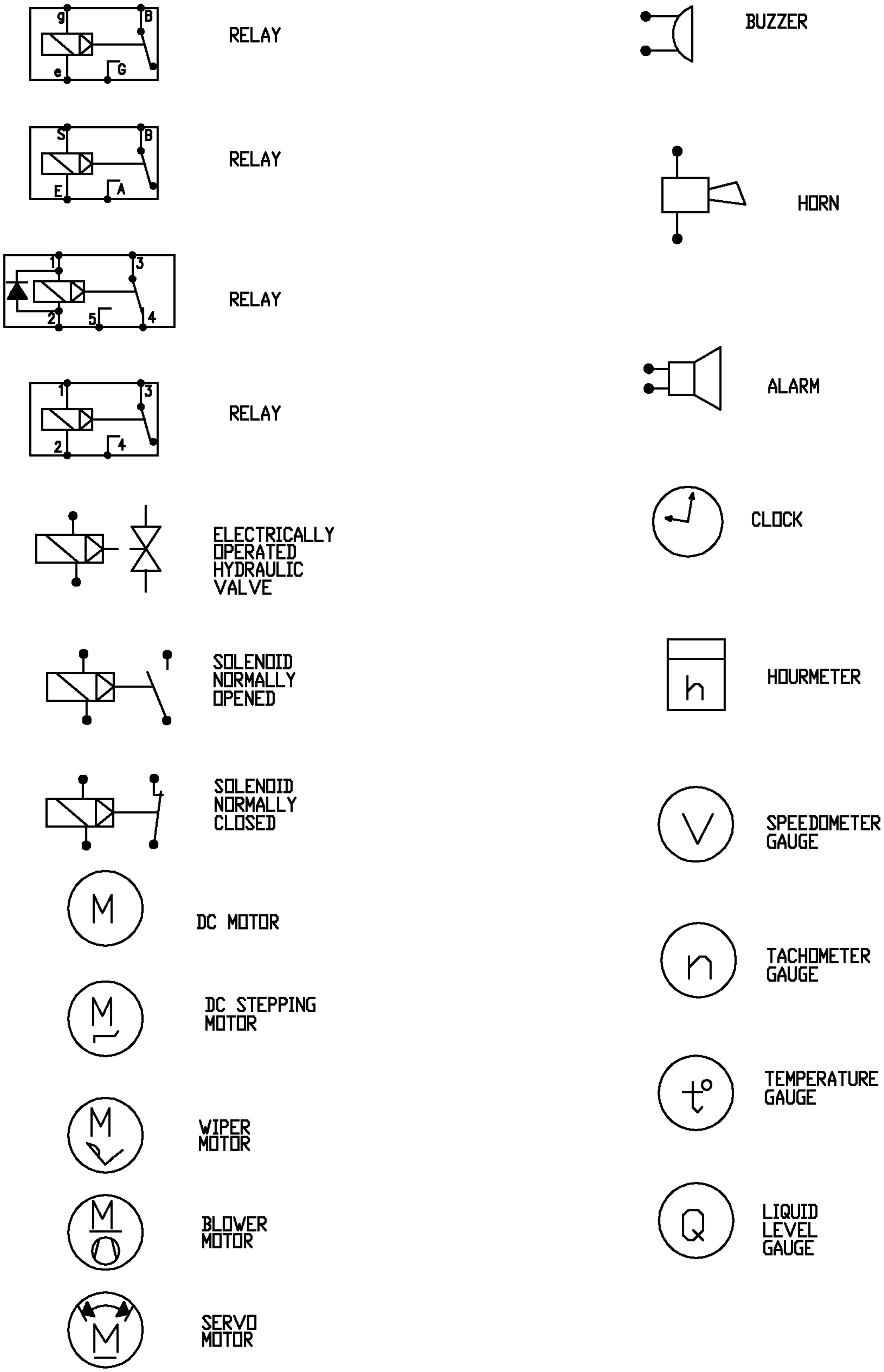

T117637

T117637 –19–07OCT98

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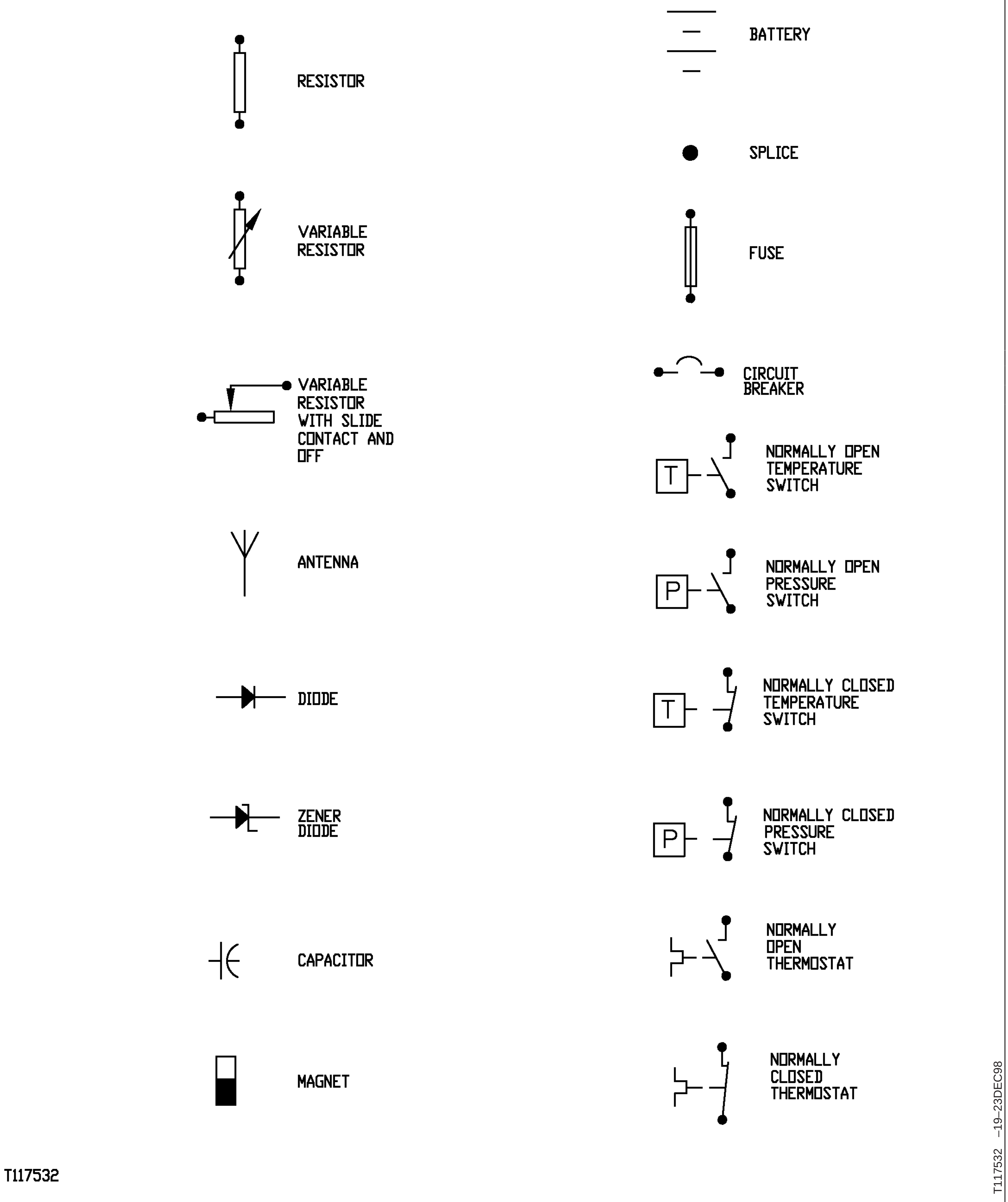
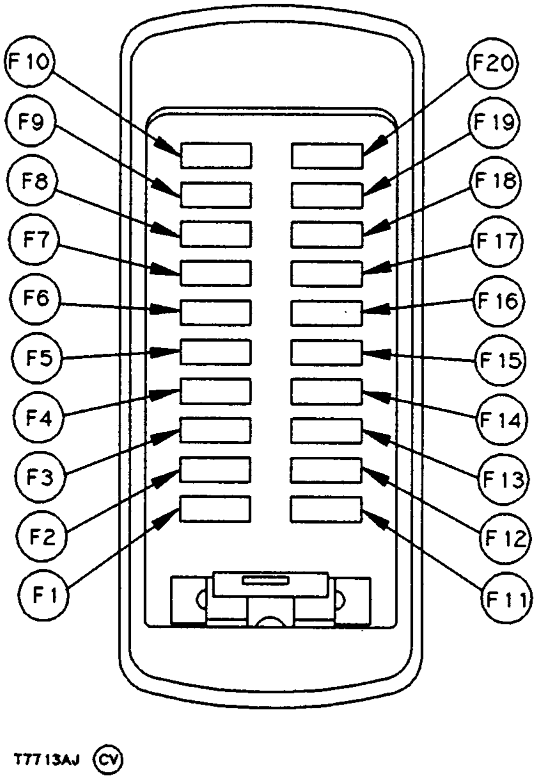

RESISTOR
BATTERY
SPLICE
VARIABLE RESISTOR
FUSE
VARIABLE RESISTOR WITH SLIDE CONTACT AND OFF
CIRCUIT BREAKER
NORMALLY OPEN TEMPERATURE SWITCH
T
ANTENNA
NORMALLY OPEN PRESSURE SWITCH
P
DIODE
NORMALLY CLOSED TEMPERATURE SWITCH
T
ZENER DIODE
NORMALLY CLOSED PRESSURE SWITCH
P
CAPACITOR
NORMALLY OPEN THERMOSTAT
MAGNET
NORMALLY CLOSED THERMOSTAT
T117532
T117532 –19–23DEC98

FUSE SPECIFICATIONS

IMPORTANT: Install fuse with correct amperage rating to prevent electrical system damage from overload.

NOTE: The "marked" name in parenthesis is the fuse name shown on the fuseblock cover.

Fuse block is located behind the operators seat under a fuse block cover.



T7713AJ –UN–06MAR92

F1—Radio and Monitor Controller Backup 5-Amp Fuse (marked Back Up)
F2—Engine and Pump Controller 10-Amp Fuse (marked Controller)
F3—Engine Control (EC) Motor 10-Amp Fuse (marked EC Motor)
F4—Solenoid 5-Amp Fuse (marked Solenoid)
F5—Power On 10-Amp Fuse (marked Pow. On)
F6—Monitor Controller and Display 5-Amp Fuse (marked Sw. Box)
F7—Switched Power 5-Amp Fuse (marked Option 1)
F8—Switched Power 10-Amp Fuse (marked Option 2)
F9—Battery Power 5-Amp Fuse (marked Option 3)
F10—Travel Alarm 5-Amp Fuse (marked Travel)
F11—Work and Drive Lights 20-Amp Fuse (marked Lamp)
F12—Windshield Wiper 10-Amp Fuse (marked Wiper)
F13—Blower Motor 20-Amp Fuse (marked Heater)
F14—Air Conditioner Controller and Relays 5-Amp Fuse (marked Air Con)
F15—Horn 10-Amp Fuse (marked Horn)
F16—Radio 5-Amp Fuse (marked Radio)
F17—Lighter 10-Amp Fuse (marked Lighter)
F18—Dome Light 5-Amp Fuse (marked Room Lamp)
F19—Auxiliary 10-Amp Fuse (marked Auxiliary)
F20—Start Aid 20-Amp Fuse (marked Start Aid) (Not used)

CED,TX02661,227 –19–19OCT98–1/1

FUSE (BLADE-TYPE) COLOR CODES

Amperage Rating	Color
1	Black
3	Violet
4	Pink
5	Tan
7-1/2	Brown
10	Red
15	Light Blue
20	Yellow
25	Natural (White)
30	Light Green

CED,TX14795,4106 –19–22NOV97–1/1

COMPONENT IDENTIFICATION TABLE

Each component (electrical device) and main connector will have and identification letter assigned to it. A number is added to the letter to separate and indicate the total components within that letter group.

Continued on next page

TX,10,111507 –19–22AUG96–1/2

Identification Letter	Type	Examples
A	System, subassembly, parts group	Control units, trigger boxes, two-way radios, logic module, FNR logic module
B	Transducer for conversion of non-electrical variables to electrical and vice versa	Speed sensors, pressure sensors, pressure switches horns, sensors, pickups, limit-value sensors, pulse generators, loudspeakers, inductive pickups, probes, air-flow sensors, oil-pressure switches, temperature sensors, ignition-voltage pickups
C	Condenser, capacitor	Condensers and capacitors, general
D	Binary device, memory	Digital devices, integrated circuits, pulse counters, magnetic tape recorders
E	Various devices and equipment	Heating devices, air conditioners, light, headlights, spark plugs, ignition distributors
F	Protection device	Release mechanisms, polarity protection devices, fuses, current protection circuits
G	Power supply, generator	Batteries, generators, alternators, charging units
H	Monitor, alarm, signalling device	Audible alarms, indicator lights, turn-signal lights, brake lights, alarms, warning lights, buzzers
K	Relay	Battery relays, turn-signal relays, solenoid switches, starting relays, warning flashers
L	Inductor	Choke coils, coils, windings
M	Motor	Blower motors, fan motors, starter motors
N	Regulator, amplifier	Regulators (electronic or electromechanical), voltage stabilizers
P	Measuring instrument	Ammeter, diagnostic connectors, tachometers, fuel gauge, pressure gauges, measuring points, test points, speedometers
R	Resistor	Flame glow plugs, sheathed-element flame glow plugs, glow plugs, heating resistors, NTC resistors, PTC resistors, potentiometers, regulating resistors
S	Switch	Switches and pushbuttons, general key switch, light switch, horn switch, flasher switch
T	Transformer	Ignition coil, ignition transformer
U	Modulator, converter	DC transformers
V	Semiconductor, electron tubes	Transistors, diodes, electron tubes, rectifiers, semiconductors, thyristors, zener diodes
W	Transmission path, conductor, antenna	Antennas, shielding components, shielded conductors, cable harnesses, conductors, ground conductors
X	Terminal, plug, plug and socket connection	Terminal studs, electrical connections, connectors electrical line couplers, line connectors, sockets, plugs, terminals, plug-and-socket connections
Y	Electrically actuated mechanical device	Permanent magnets, (solenoid-operated) injection valves, electromagnetic clutches and brakes, air valves, fuel pumps, solenoids, switching valves, start valves, locking systems
Z	Electrical filter	Interference suppression filters

TX,10,111507 –19–22AUG96–2/2

FUNCTIONAL SCHEMATIC AND COMPONENT LOCATION LEGEND

NOTE: A2—Engine and Pump Controller (SE8, W2)

A2 indicates component identification number.

Engine and Pump Controller indicates component name.

SE8 indicates section numbers of SYSTEM FUNCTIONAL SCHEMATIC where component is located.

W2 is the identification number of the COMPONENT LOCATION and HARNESS CONNECTOR (WITH WIRE AND PIN LOCATION) drawings for the component. This would indicate that the Engine and Pump Controller is connected to W2 Cab Harness.

- A1—Radio (SE14, W2)
- A2—Engine and Pump Controller (SE8, W2)
- A3—Air Conditioner Controller (SE17, W9)
- A4—Engine Mode and RPM Control Unit (SE4, W2)
- A5—Monitor Controller and Display (SE5, W3)
- A6—Quick Hitch Control Box (SE19, W2)

- B1—Air Filter Restriction Switch (SE6, W1)
- B2—Fuel Level Switch (SE6, W1)
- B3—Engine Coolant Temperature Switch (SE6, W1)
- B4—Engine Oil Pressure Switch (SE6, W1)
- B5—Hydraulic Oil Level Switch (SE6, W1)
- B6—Engine Coolant Level Switch (SE6, W1)
- B7—Engine Oil Level Switch (SE6, W1)
- B8—Fuel Level Sensor (SE6, W1)
- B9—Engine Coolant Temperature Sensor (SE4, W1)
- B10—Not Used
- B11—Not Used
- B12—Charge Air Temperature Switch (SE6, W1)
- B13—Boom Up Pressure Switch (SE7, W1)
- B14—Dig Pressure Switch (SE7, W1)
- B15—Propel Pressure Switch (SE7, W1)
- B16—Engine Speed (N) Sensor (SE8, W1)
- B17—Engine Control (EC) Sensor (Located Inside Engine Control Motor Housing) (SE7, W1)
- B18—Rear Pump Pressure Sensor (SE7, W1)
- B19—Front Pump Pressure Sensor (SE7, W1)
- B20—Arm In Pressure Sensor (SE7, W1)
- B21—Rear Pump Control Pressure Sensor (SE7, W1)
- B22—Front Pump Control Pressure Sensor (SE7, W1)
- B23—Right Speaker (SE14, W2)
- B24—Left Speaker (SE14, W2)
- B25—High Note Horn (SE15, W1)
- B26—Low Note Horn (SE15, W1)
- B27—Air Conditioner High and Low Pressure Switch (SE17, W9)
- B28—Not Used
- B29—Air Conditioner and Heater Thermistor (SE17, W9)
- B30—Hydraulic Oil Filter Restriction Switch (Model 230LCRD) (SE6, W1)
- B31—Not Used
- B32—Overload Alarm Proximity Switch (SE19, W1)
- B33—Overload Alarm Pressure Switch (SE19, W1)
- B34—Auxiliary Hydraulic Control Switch (SE18, W2)

- E1—Left Work Light (SE13, W1)
- E2—Not Used
- E3—Cab Dome Light (SE15, W2)
- E4—Monitor Controller and Display Backlight (SE5, W3)
- E5—Engine RPM Dial Backlight (SE4, W2)
- E6—Right Work Light (SE13, W1)
- E7—Left Cab Drive Light (SE13, W1)
- E8—Right Cab Drive Light (SE13, W1)
- E9—Left Rear Light (SE13, W1)
- E10—Right Rear Light (SE13, W1)

- F1—Radio and Monitor Controller Backup 5 Amp Fuse (marked Back Up) (SE6, W2)
- F2—Engine and Pump Controller 10 Amp Fuse (marked Controller) (SE9, W2)
- F3—Engine Control (EC) Motor 10 Amp Fuse (marked EC Motor) (SE9, W2)
- F4—Solenoid 5 Amp Fuse (marked Solenoid) (SE9, W2)

Continued on next page

- F5— Power On 10 Amp Fuse (marked Pow. On) (SE3, W2)
- F6—Monitor Controller and Display 5 Amp Fuse (marked Sw. Box) (SE4, W2)
- F7—Switched Power 5 Amp Fuse (marked Option 1) (SE18, W2)
- F8—Switched Power 10 Amp Fuse (marked Option 2) (SE18, W2)
- F9—Battery Power 5 Amp Fuse (marked Option 3) (SE18, W2)
- F10—Travel Alarm 5 Amp Fuse (marked Option 1) (SE18, W2)
- F11—Work and Drive Lights 20 Amp Fuse (marked Lamp) (SE13, W2)
- F12—Windshield Wiper 10 Amp Fuse (marked Wiper) (SE12, W2)
- F13—Blower Motor 20 Amp Fuse (marked Heater) (SE16, W2)
- F14—Air Conditioner Controller and Relays 5 Amp Fuse (marked Heater) (SE17, W2)
- F15—Horn 10 Amp Fuse (marked Horn) (SE15, W2)
- F16—Radio 5 Amp Fuse (marked Radio) (SE14, W2)
- F17—Lighter 10 Amp Fuse (marked Lighter) (SE15, W2)
- F18—Dome Light 5 Amp Fuse (marked Room Lamp) (SE15, W2)
- F19—Auxiliary 10 Amp Fuse (marked Auxiliary) (SE18, W2)
- F20—Start Aid 20 Amp Fuse (marked Start Aid) (SE2, W2)
- F21—Battery Power 40 Amp Fusible Link (SE1, W1)
- F22—Alternator Power 60 Amp Fusible Link (SE1, W1)
- F23—Fuel Shutoff 40 Amp Fusible Link (SE1, W1)
- F24—Quick Hitch 5 Amp Fuse (SE19, W2)

- G1—Battery (SE1, W1)
- G2—Battery (SE1, W1)
- G3—Alternator (SE3, W1)
- G4—24 Volt Power Plug (SE15, W3)
- G5—24 Volt Slave Receptacle (SE1, W1)

- H1—Dig Mode Indicator Light (SE5, W3)
- H2—Grading Mode Indicator Light (SE5, W3)
- H3—Precision Mode Indicator Light (SE5, W3)
- H4—Attachment Mode Indicator Light (SE5, W3)
- H5—High Power Mode Indicator Light (SE4, W3)
- H6—Economy Mode Indicator Light (SE4, W3)
- H7—Auto Idle Mode Indicator Light (SE4, W3)
- H8—Monitor Controller and Display Alarm (SE5, W3)
- H9—Overload Alarm (SE19, W2)
- H10—Travel Alarm (SE10, W1)
- H11—Spare Indicator Light (SE4, W3)
- H12—Hydraulic Oil Level Indicator Light (SE4, W3)
- H13—Fuel Level Indicator Light (SE4, W3)
- H14—Air Filter Restriction Indicator Light (SE4, W3)
- H15—Charge Air Temperature Indicator Light (SE4, W3)
- H16—Engine Coolant Temperature Indicator Light (SE4, W3)
- H17—Engine Oil Pressure Indicator Light (SE4, W3)
- H18—Alternator Voltage Indicator Light (SE4, W3)
- H19—Engine Oil Level Indicator Light (SE4, W3)
- H20—Engine Coolant Level Indicator Light (SE4, W3)
- H21—Hydraulic Oil Filter Restriction Indicator Light (SE5, W3)
- H22—Quick Hitch Alarm (SE19, W2)
- H23—Quick Hitch Indicator Light (SE19, W2)

- K1—Alternator Shut Down Relay (Marked R1) (SE3, W3)
- K2—Windshield Washer Relay (Marked R2) (SE11, W3)
- K3—Work Light Relay (Marked R3) (SE13, W3)
- K4—Drive Light Relay (Marked R4) (SE13, W3)
- K5—Horn Relay (Marked R5) (SE15, W3)
- K6—Windshield Wiper Relay (Motor Ground and Intermittent) (Marked R6) (SE11, W3)
- K7—Windshield Wiper Relay (Wiper Run) (Marked R7) (SE12, W3)
- K8—Windshield Wiper Relay (Hold for Park) (Marked R8) (SE12, W3)
- K9—Windshield Wiper Relay (Motor Ground for Park) (Marked R9) (SE2, W3)
- K10—Propel Auto Idle Relay (Marked R10) (SE7, W3)

Continued on next page

- K11—Starter Protection Relay (Marked R11) (SE2, W3)
- K12—Start Aid Relay (Marked R12) (SE2, W3)
- K13—Starter Relay (SE2, W1)
- K14—Battery Relay (SE1, W1)
- K15—Fuel Shutoff Relay (SE3, W1)
- K16—Overload Alarm Relay (SE19, W1)
- K17—Not Used
- K18—Not Used
- K19—Not Used
- K20—Not Used
- K21—Not Used
- K22—Not Used
- K23—Not Used
- K24—Air Conditioner Blower Motor and Main Power (Low Speed) Relay (SE17, W9)
- K25—Air Conditioner Compressor Clutch Relay (SE17, W9)
- K26—Air Conditioner Blower Motor (Low Medium Speed) Relay (SE17, W9)
- K27—Air Conditioner Blower Motor (Medium Speed) Relay (SE17, W9)
- K28—Air Conditioner Blower Motor (High Speed) Relay (SE17, W9)

- M1—Starter (SE2, W1)
- M2—Engine Control (EC) Motor (SE8, W1)
- M3—Windshield Wiper Motor (SE11, W3)
- M4—Windshield Washer Motor (SE11, W1)
- M5—Heater Blower Motor (Without Air Conditioner) (SE16, W2)
- M6—Air Conditioner and Heater Blower Motor (SE17, W9)
- M7—Not Used
- M8—Not Used
- M9—Air Conditioner Internal and External Cab Air Servomotor (SE17, W9)
- M10—Air Conditioner Blower Port Change Servomotor (SE17, W9)
- M11—Air Conditioner Air Mixer Servomotor (SE17, W9)

- P1—Hour Meter (SE5, W3)
- P2—Engine Coolant Temperature Gauge (SE4, W3)
- P3—Fuel Gauge (SE4, W3)

- R1—Not Used
- R2—Heater Blower Motor Dropping Resistor Block (Without Air Conditioner) (SE16, W2)
- R3—Not Used
- R4—Engine Coolant Temperature Gauge Resistor (150 ohms) (SE5, W3)
- R5—Fuel Gauge Resistor (220 ohms) (SE5, W3)
- R6—Alternator Excitation Resistor (SE3, W2)
- R7—Not Used
- R8—Not Used
- R9—Not Used
- R10—Engine RPM Dial (SE4, W2)
- R11—Air Conditioner and Heater Blower Motor Dropping Resistor Block (SE17, W9)

- S1—Key Switch (SE1, W2)
- S2—Horn Switch (SE15, W2)
- S3—Dome Light Switch (SE15, W2)
- S4—Heater Blower Motor Switch (Without Air Conditioner) (SE16, W2)
- S5—Fluid Level Check Switch (SE5, W3)
- S6—Buzzer Stop Switch (SE5, W3)
- S7—Work Mode Selection Switch (SE5, W3)
- S8—Propel Speed Change Switch (SE5, W3)
- S9—Wiper Speed Switch (SE5, W3)
- S10—Drive and Work Light Switch (SE5, W3)
- S11—Economy (E) Mode Switch (SE4, W2)
- S12—High Power (HP) Mode Switch (SE4, W2)
- S13—Auto Idle Switch (SE5, W3)
- S14—Windshield Wiper Enable Switch (SE4, W2)
- S15—Windshield Washer Switch (SE5, W3)
- S16—Learning Switch (SE9, W2)
- S17—Travel Alarm Cancel Switch (SE10, W2)
- S18—Start Aid Switch (SE2, W2)
- S19—Power Boost Switch (SE9, W2)
- S20—Rear Lights Switch (SE13, W2)
- S21—Quick Hitch Switch (SE19, W2)
- S22—Low Idle Sense Switch
- S23—Hand Held Tool Switch

- V1—Start Aid Diode (SE2, W1)
- V2—Alternator Shut Down Relay Isolation Diode (SE3, W2) (Red/Wht and Red/Blk)

Continued on next page

- V3—Switched Power Fuse (F8) Suppression Diode (SE18, W2) (Blk and Red)
- V4—Propel Auto Idle Relay (marked R10) Isolation Diode (SE7, W2) (Wht/Blk and Yel)
- V5—Windshield Wiper Relay (marked R8) Isolation Diode (SE12, W3) (Blu/Blk and Blu/Red)
- V6—Windshield Wiper Motor Suppression Diode (SE11, W3) (Blk and LGrn/Wht)
- V7—Windshield Wiper Motor Suppression Diode (SE11, W3) (Blk and Blu/Wht)
- V8—Fuel Shutoff Solenoid Hold-In Coil Suppression Diode (SE3, W2) (Brn/Blk and Blk)
- V9—Start Relay Coil Suppression Diode (SE2, W2) (Yel/Grn and Blk/Wht)
- V10—Fuel Shutoff Solenoid Pull-In Coil Suppression Diode (SE3, W2) (Red/Blk and Blk)
- V11—Battery Relay Coil Suppression Diode (SE1, W1) (Blk and Red/Wht)

- W1—Engine and Frame Harness
- W2—Cab Harness
- W3—Monitor and Relay Harness
- W4—Radio Antenna (SE14, W2)
- W5—Battery to Frame Ground (W1)
- W6—Engine to Frame Ground (W1)
- W7—Cab to Frame Ground (W2)
- W8—Starter to Frame Ground (SE2, W1)
- W9—Air Conditioner Harness
- W10—Air Compressor and Rock Drill Harness (Model 230LCRD)

- X1—Diagnostic Connector (SE9, W2)
- X2—Learning Switch Connector (SE9, W2)
- X3—Attachment Pressure Switch Connector (SE9, W2)
- X4—Accel Connector (SE8, W2)
- X5—Optional Connector (SE18, W2)
- X6—Auxiliary Connector (SE18, W2)
- X7—Optional Right Speaker Connector (SE14, W2)
- X8—Engine and Frame Harness to Cab Harness Connector (W1, W2)
- X9—Engine and Frame Harness to Cab Harness Connector (W1, W2)
- X10—Monitor Controller and Display Connector (20-Pin) (W3)
- X11—Monitor Controller and Display Connector (16-Pin) (W3)
- X12—Monitor Controller and Display Connector (12-Pin) (W3)
- X13—Engine and Pump Controller Connector (26-Pin) (W2)
- X14—Engine and Pump Controller Connector (16-Pin) (W2)
- X15—Engine and Pump Controller Connector (22-Pin) (W2)
- X16—Air Conditioner Harness to Cab Harness Connector (SE17, W2, W9)
- X17—Air Conditioner Controller Connector (16-Pin) (SE17, W9)
- X18—Air Conditioner Controller Connector (12-Pin) (SE17, W9)
- X19—Monitor and Relay Harness to Cab Harness Connector (2-Pin) (W2, W3)
- X20—Monitor and Relay Harness to Cab Harness Connector (6-Pin) (W2, W3)
- X21—Monitor and Relay Harness to Cab Harness Connector (12-Pin) (W2, W3)
- X22—Monitor and Relay Harness to Cab Harness Connector (16-Pin) (W2, W3)
- X23—Monitor and Relay Harness to Cab Harness Connector (8-Pin) (W2, W3)
- X24—Optional Connector (W3)
- X25—Optional Connector (W3)
- X26—Engine and Frame Harness to Cab Harness Connector (W1, W2)
- X27—Auxiliary Power Terminal Strip (SE8, W1, W2)
- X28—Rear Light Switch Harness to Rear Light Harness Connector (SE13, W1)

- Y1—Air Conditioner Compressor Clutch (SE17, W1 and W9)
- Y2—Quick Hitch Solenoid (SE19, W1)
- Y3—Not Used
- Y4—Start Aid Solenoid (SE2, W1)
- Y5—Power Boost Proportional Solenoid (SE7, W1)
- Y6—Propel Speed Change Proportional Solenoid (SE8, W1)
- Y7—Fuel Shutoff Solenoid (SE3, W1)
- Y8—Speed Sense Proportional Solenoid (SE7, W1)

Continued on next page

- Y9—Arm Regenerative Proportional Solenoid (SE7, W1)
- Y10—Not Used
- Y11—Hand Held Tools Solenoid

CED,OUOE012,123 –19–15MAR99–5/5

SYSTEM FUNCTIONAL SCHEMATIC SECTION LEGEND

NOTE: SE1—Power Circuit

SE1 indicates section number of System Functional Schematic where circuit is located.

Power Circuit indicates circuit name.

- SE1—Power Circuit
- SE2—Starting Circuit
- SE3—Charging and Fuel Shut-Off Circuit
- SE4—Monitor Controller and Display Circuit
- SE5—Monitor Controller and Display Circuit
- SE6—Monitor Controller and Display Circuit
- SE7—Engine and Pump Controller Circuit
- SE8—Engine and Pump Controller Circuit
- SE9—Engine and Pump Controller Circuit
- SE10—Travel Alarm Circuit
- SE11—Windshield Wiper and Washer Circuit
- SE12—Windshield Wiper and Washer Circuit
- SE13—Work and Drive Light Circuit
- SE14—Radio Circuit
- SE15—Accessory Circuit
- SE16—Heater Circuit (Machines Without Air Conditioner)
- SE17—Heater and Air Conditioner Circuit
- SE18—Optional Connector Circuit
- SE19—Overload Alarm And Quick Hitch Circuit

CED,OUOE012,144 –19–19MAR99–1/1

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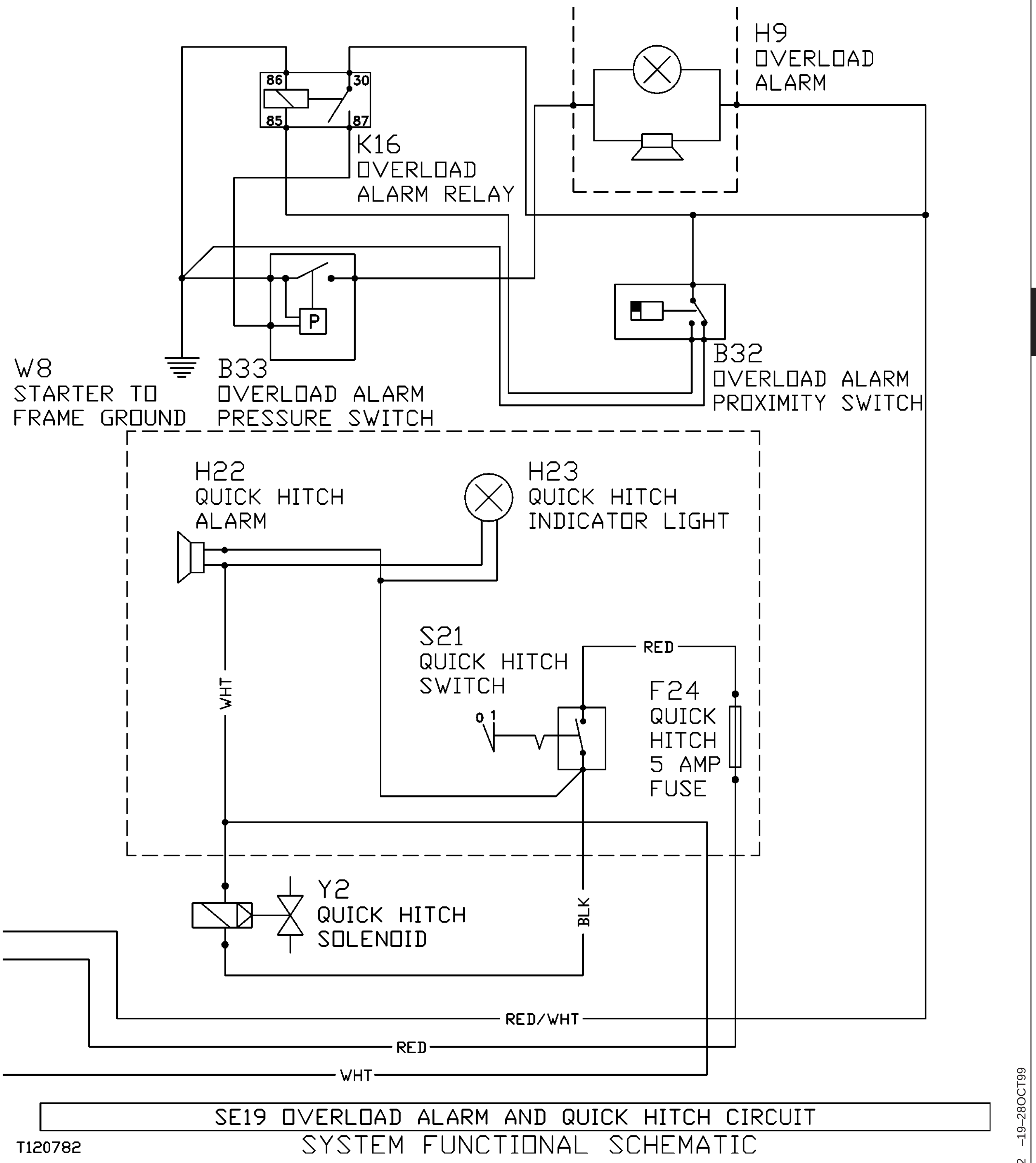
SYSTEM FUNCTIONAL SCHEMATIC (SE19)



T120782 –19–28OCT99

CED,OUOE012,167 –19–19MAR99–1/1

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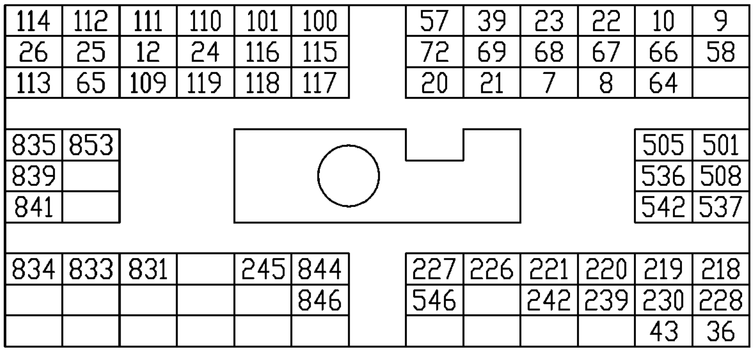
X8
ENGINE AND FRAME
HARNESS TO CAB
HARNESS CONNECTOR
(FRONT VIEW SHOWN)



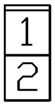
114	112	111	110	101	100	57	39	23	22	10	9
26	25	12	24	116	115	72	69	68	67	66	58
113	65	109	119	118	117	20	21	7	8	64	
835	853									505	501
839										536	508
841										542	537
834	833	831		245	844	227	226	221	220	219	218
					846	546		242	239	230	228
										43	36

Y5	PIN 1	BLU/RED	7
Y8	PIN 1	RED/WHT	8
Y6	PIN 1	LGRN/BLK	9
Y9	PIN 1	BLU/ORG	10
M2	PIN 3	ORG	12
Y5	PIN 2	BLU/BLK	20
Y8	PIN 2	RED/YEL	21
Y6	PIN 2	LGRN/RED	22
Y9	PIN 2	BLU/WHT	23
M2	PIN 1	BRN/RED	24
M2	PIN 2	RED	25
M2	PIN 4	YEL	26
B16	PIN 1	BLK	36
B21	PIN 1	BLK/YEL	39
B16	PIN 1	WHT	43
B13	PIN 2	BLK/RED	57
B14	PIN 1	BLK/WHT	58
B22	PIN 3	BLU	64
B17	PIN 2	YEL/BLK	65
B19	PIN 2	RED/GRN	66
B18	PIN 2	GRN/BLK	67
B20	PIN 2	RED/BLK	68
B21	PIN 3	BLK/BLU	69

B21	PIN 2	BLK/PNK	72
B14	PIN 2	ORG/BLK	100
B13	PIN 1	ORG/BLU	101
B17	PIN 1	YEL/BLU	109
B19	PIN 1	WHT	110
B18	PIN 1	WHT/RED	111
B20	PIN 3	YEL/RED	112
B17	PIN 3	BRN/BLU	113
B19	PIN 3	RED/YEL	114
B18	PIN 3	RED/BLU	115
B20	PIN 1	BRN/WHT	116
B22	PIN 1	YEL/BLK	117
B22	PIN 2	BRN/BLU	118
B15	PIN 2	ORG	119
B4	PIN 1	WHT/RED	218
B5	PIN 2	GRN	219
B6	PIN 1	BLU	220
B7		WHT/BLK	221
B1	PIN 1	GRN/BLU	226
B2		WHT/YEL	227
B3	PIN 1	RED/BLU	228
G3	(D+)	BLU/YEL	230
B8	PIN 2	BRN	239

B9		RED/GRN	242
B12	PIN 1	BRN/YEL	245
G3	(GND)	BLK	501
K13	(e)	BLK/WHT	505
K14	(S)	RED/WHT	508
E1		RED/BLU	536
E2	(+)	RED	537
B26		RED/GRN	542
M4	PIN L	PUR	546
H10	PIN B	WHT/RED	831
H10	PIN D	WHT/BLK	833
B15	PIN 1	BLK/GRN	834
K13	(g)	YEL/GRN	835
NOT USED		BLK/RED	839
K15	(G)	RED/BLK	841
Y7	PIN 2	BRN/BLK	844
H10	PIN A	WHT	846
Y1		BLK/YEL	853

X9
ENGINE AND FRAME
HARNESS TO CAB
HARNESS POWER
CONNECTOR



K13	PIN B	WHT	1
F21		RED	2

CONNECTORS -
FRONT VIEW SHOWN

NOTE: PIN NUMBERS ARE
LOCATION REFERENCE NUMBERS
ONLY - THEY ARE NOT
PRINTED ON THE CONNECTOR

ENGINE AND FRAME HARNESS (W1) COMPONENT LOCATION

T121285

T121285 –19–28OCT99

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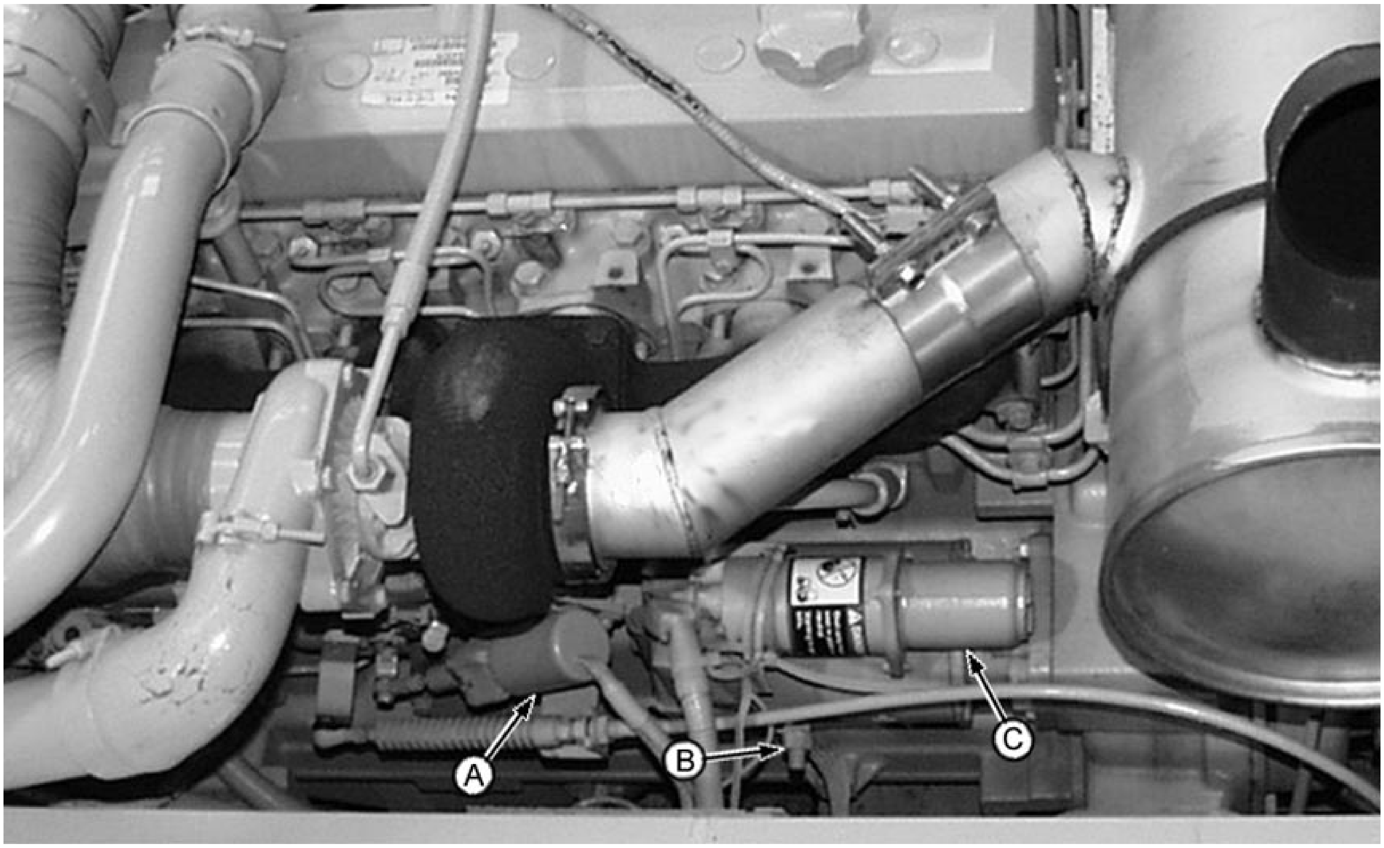


Engine and Frame Harness Component Location—Detail A

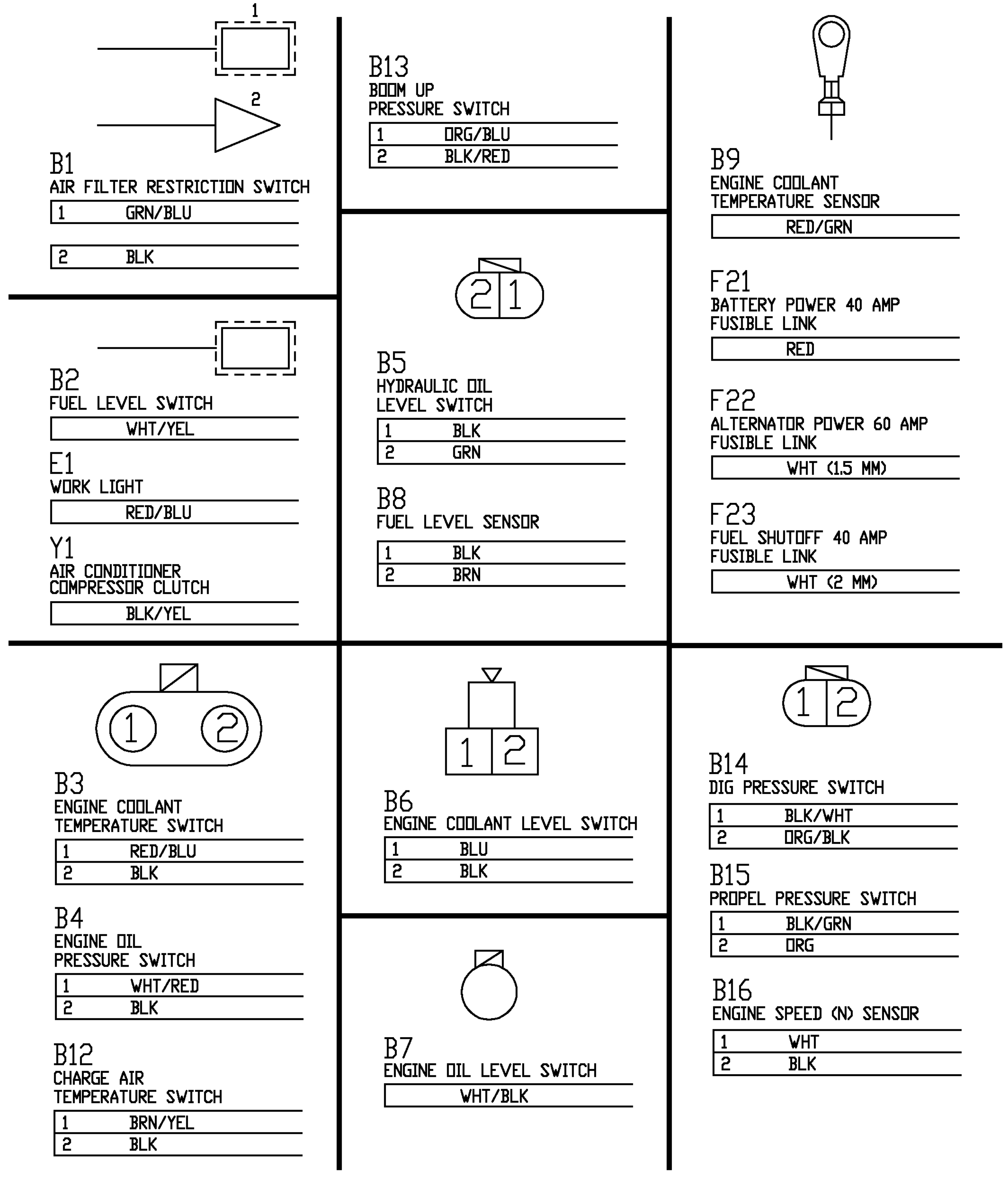
A—Y7 Fuel Shutoff Solenoid

B—W8 Starter to Frame Ground

C—M1 Starter

9015
10
20

ENGINE AND FRAME HARNESS (W1) CONNECTORS, WIRE AND PIN LOCATION



B1
AIR FILTER RESTRICTION SWITCH

1	GRN/BLU
2	BLK

B2
FUEL LEVEL SWITCH

WHT/YEL

E1
WORK LIGHT

RED/BLU

Y1
AIR CONDITIONER COMPRESSOR CLUTCH

BLK/YEL

B3
ENGINE COOLANT TEMPERATURE SWITCH

1	RED/BLU
2	BLK

B4
ENGINE OIL PRESSURE SWITCH

1	WHT/RED
2	BLK

B12
CHARGE AIR TEMPERATURE SWITCH

1	BRN/YEL
2	BLK

B13
BOOM UP PRESSURE SWITCH

1	ORG/BLU
2	BLK/RED

B5
HYDRAULIC OIL LEVEL SWITCH

1	BLK
2	GRN

B8
FUEL LEVEL SENSOR

1	BLK
2	BRN

B6
ENGINE COOLANT LEVEL SWITCH

1	BLU
2	BLK

B7
ENGINE OIL LEVEL SWITCH

WHT/BLK

B9
ENGINE COOLANT TEMPERATURE SENSOR

RED/GRN

F21
BATTERY POWER 40 AMP FUSIBLE LINK

RED

F22
ALTERNATOR POWER 60 AMP FUSIBLE LINK

WHT (1.5 MM)

F23
FUEL SHUTOFF 40 AMP FUSIBLE LINK

WHT (2 MM)

B14
DIG PRESSURE SWITCH

1	BLK/WHT
2	ORG/BLK

B15
PROPEL PRESSURE SWITCH

1	BLK/GRN
2	ORG

B16
ENGINE SPEED (N) SENSOR

1	WHT
2	BLK

CONNECTORS FOR ENGINE AND FRAME HARNESS (W1)
(HARNESS CONNECTORS – FRONT VIEW SHOWN)

T118102

T118102 –19–24NOV98

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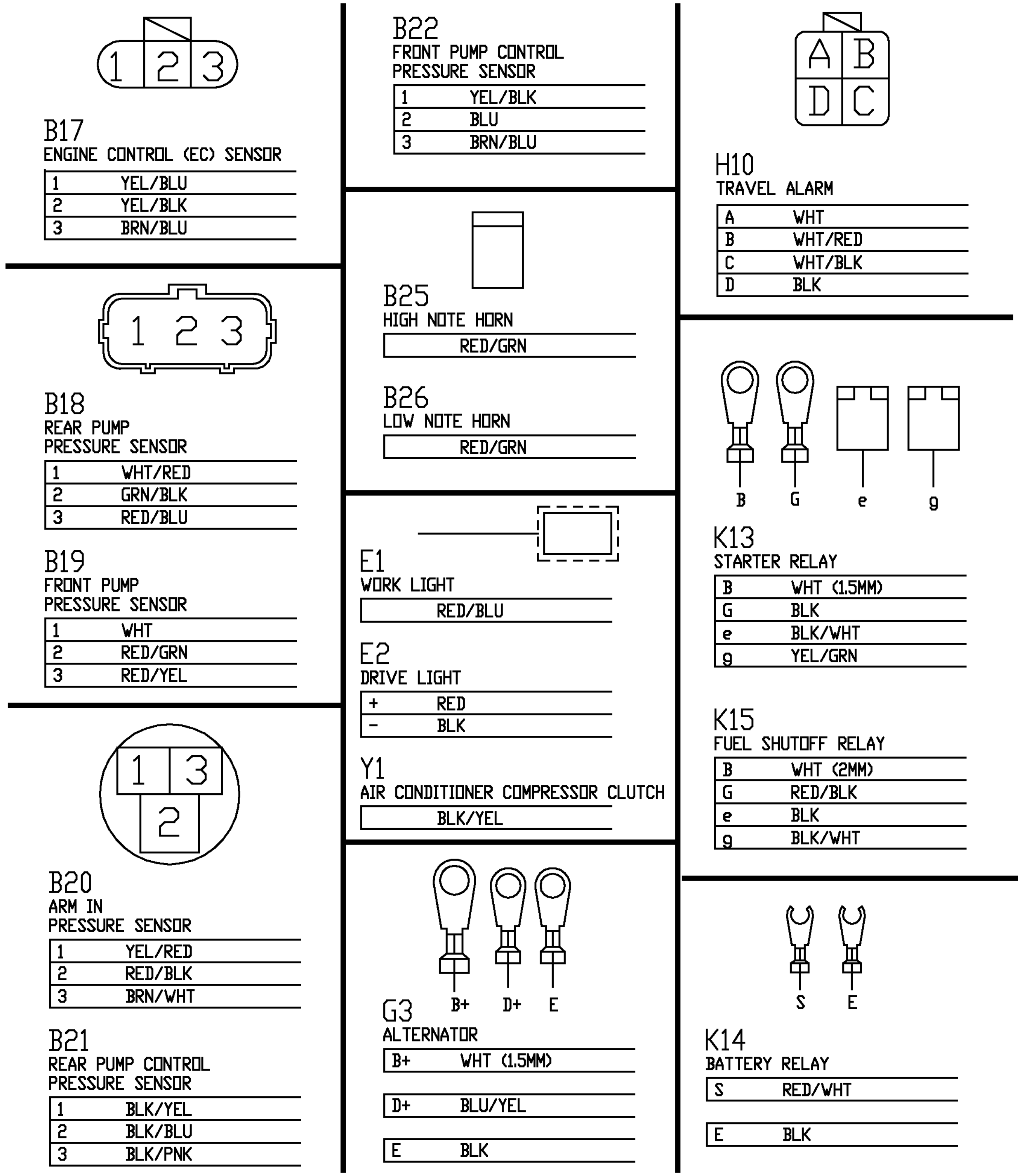

B17
ENGINE CONTROL (EC) SENSOR

1	YEL/BLU
2	YEL/BLK
3	BRN/BLU

B18
REAR PUMP
PRESSURE SENSOR

1	WHT/RED
2	GRN/BLK
3	RED/BLU

B19
FRONT PUMP
PRESSURE SENSOR

1	WHT
2	RED/GRN
3	RED/YEL

B20
ARM IN
PRESSURE SENSOR

1	YEL/RED
2	RED/BLK
3	BRN/WHT

B21
REAR PUMP CONTROL
PRESSURE SENSOR

1	BLK/YEL
2	BLK/BLU
3	BLK/PNK

B22
FRONT PUMP CONTROL
PRESSURE SENSOR

1	YEL/BLK
2	BLU
3	BRN/BLU

B25
HIGH NOTE HORN

RED/GRN

B26
LOW NOTE HORN

RED/GRN

E1
WORK LIGHT

RED/BLU

E2
DRIVE LIGHT

+	RED
-	BLK

Y1
AIR CONDITIONER COMPRESSOR CLUTCH

BLK/YEL

G3
ALTERNATOR

B+	WHT (1.5MM)
D+	BLU/YEL
E	BLK

H10
TRAVEL ALARM

A	WHT
B	WHT/RED
C	WHT/BLK
D	BLK

K13
STARTER RELAY

B	WHT (1.5MM)
G	BLK
e	BLK/WHT
g	YEL/GRN

K15
FUEL SHUTOFF RELAY

B	WHT (2MM)
G	RED/BLK
e	BLK
g	BLK/WHT

K14
BATTERY RELAY

S	RED/WHT
E	BLK

CONNECTORS FOR ENGINE AND FRAME HARNESS (W1)
(HARNESS CONNECTORS - FRONT VIEW SHOWN)

T118103

T118103 –19–17NOV98

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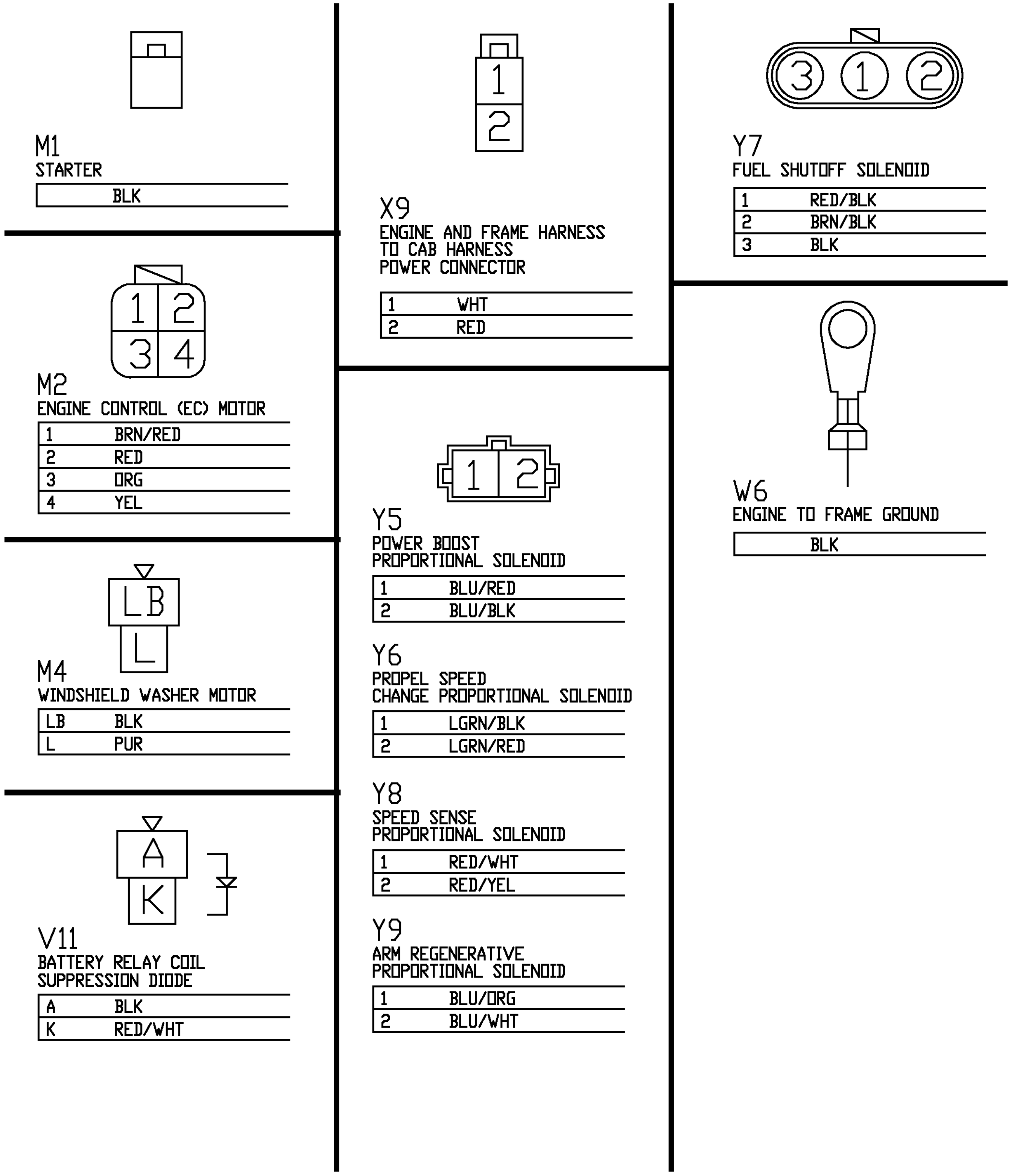

M1
STARTER

BLK

X9
ENGINE AND FRAME HARNESS TO CAB HARNESS POWER CONNECTOR

1	WHT
2	RED

Y7
FUEL SHUTOFF SOLENOID

1	RED/BLK
2	BRN/BLK
3	BLK

M2
ENGINE CONTROL (EC) MOTOR

1	BRN/RED
2	RED
3	ORG
4	YEL

W6
ENGINE TO FRAME GROUND

BLK

Y5
POWER BOOST PROPORTIONAL SOLENOID

1	BLU/RED
2	BLU/BLK

M4
WINDSHIELD WASHER MOTOR

LB	BLK
L	PUR

Y6
PROPEL SPEED CHANGE PROPORTIONAL SOLENOID

1	LGRN/BLK
2	LGRN/RED

Y8
SPEED SENSE PROPORTIONAL SOLENOID

1	RED/WHT
2	RED/YEL

V11
BATTERY RELAY COIL SUPPRESSION DIODE

A	BLK
K	RED/WHT

Y9
ARM REGENERATIVE PROPORTIONAL SOLENOID

1	BLU/ORG
2	BLU/WHT

CONNECTORS FOR ENGINE AND FRAME HARNESS (W1)
(HARNESS CONNECTORS - FRONT VIEW SHOWN)

T118104

T118104 –19–17NOV98

9015
10
22

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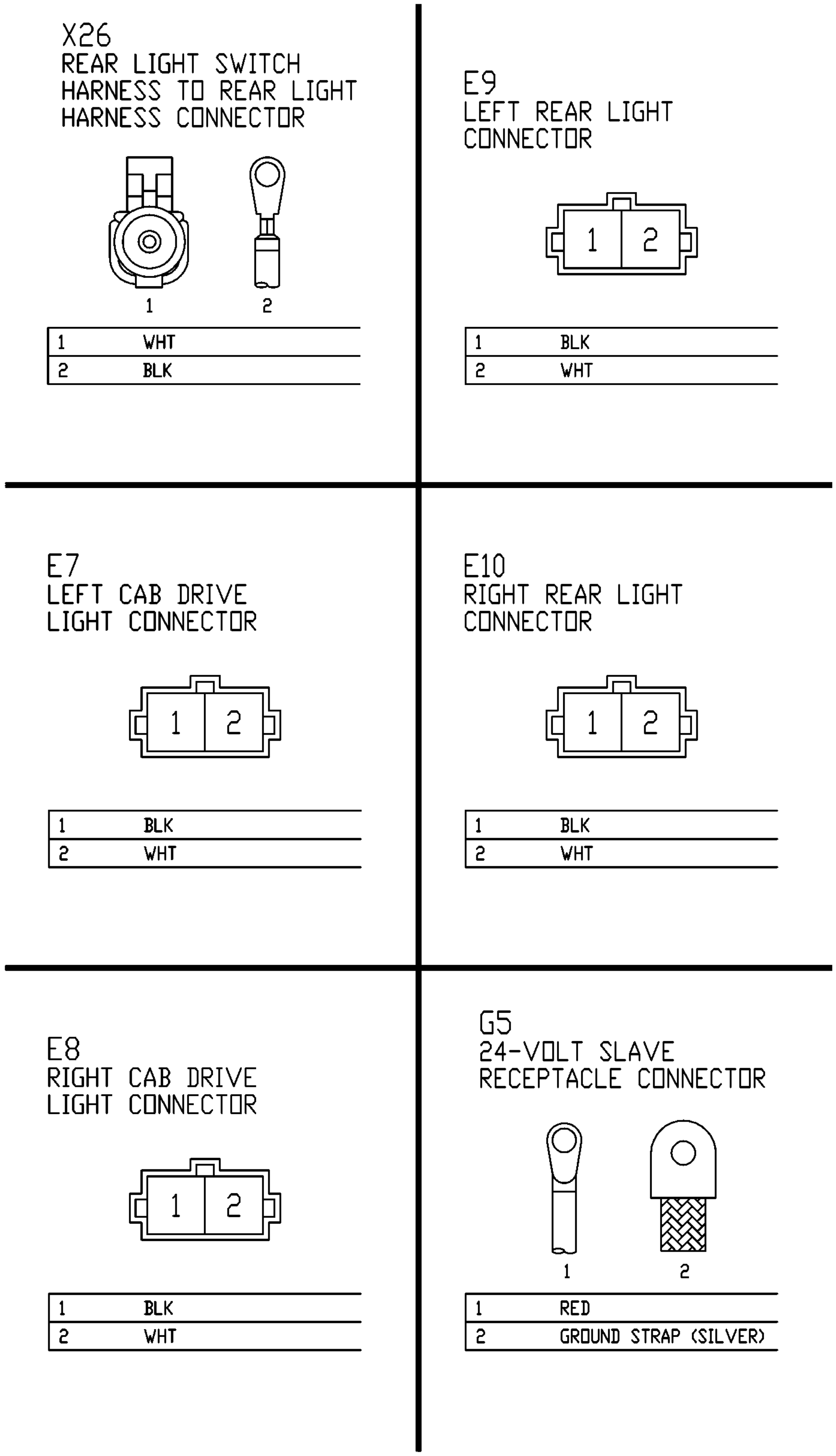

CONNECTORS FOR ENGINE AND FRAME HARNESS (W1)
(HARNESS CONNECTORS – FRONT VIEW SHOWN)

T120784

T120784 –19–28OCT99

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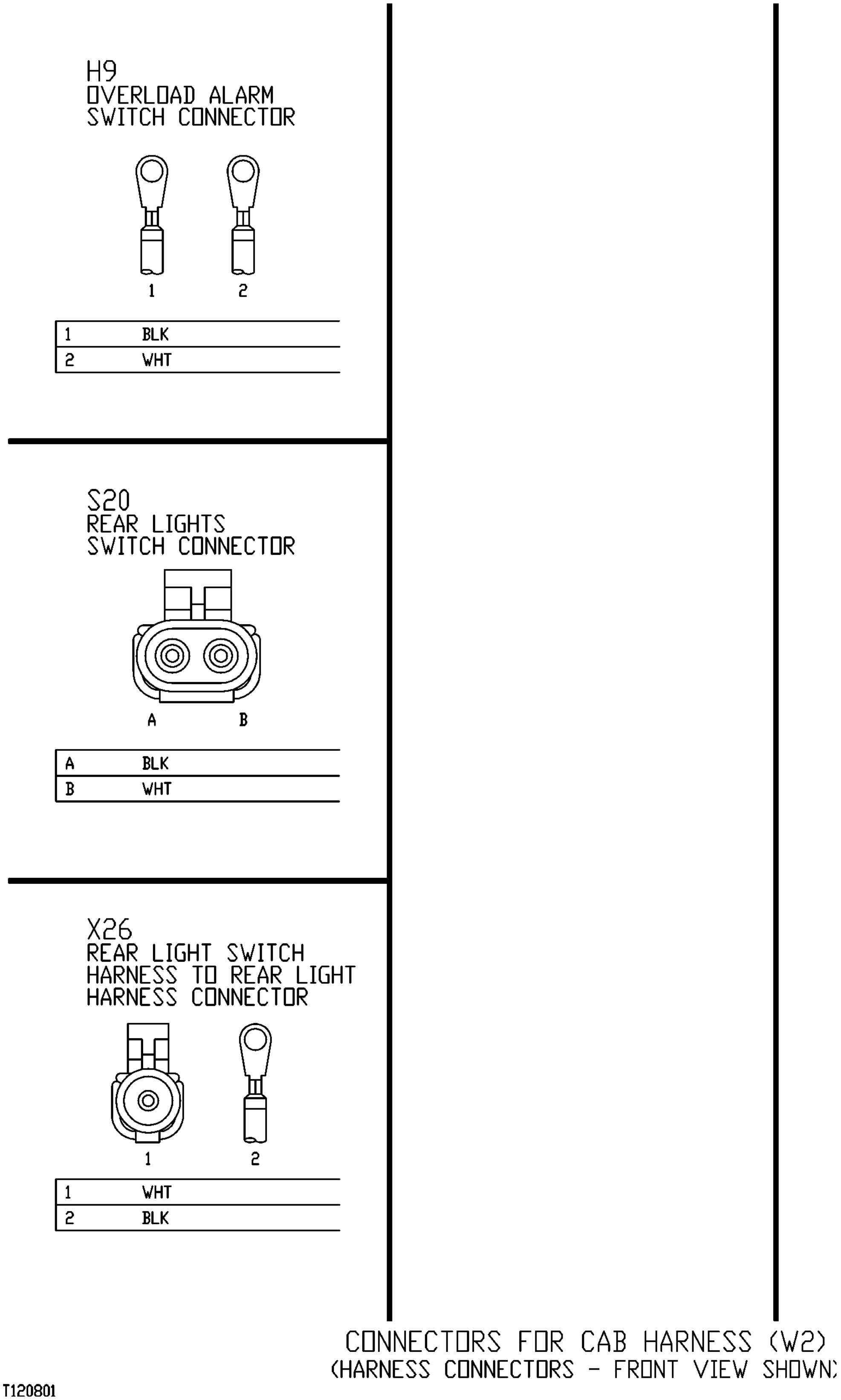
T120801 –19–28OCT99



H9
OVERLOAD ALARM
SWITCH CONNECTOR

1	BLK
2	WHT

S20
REAR LIGHTS
SWITCH CONNECTOR

A	BLK
B	WHT

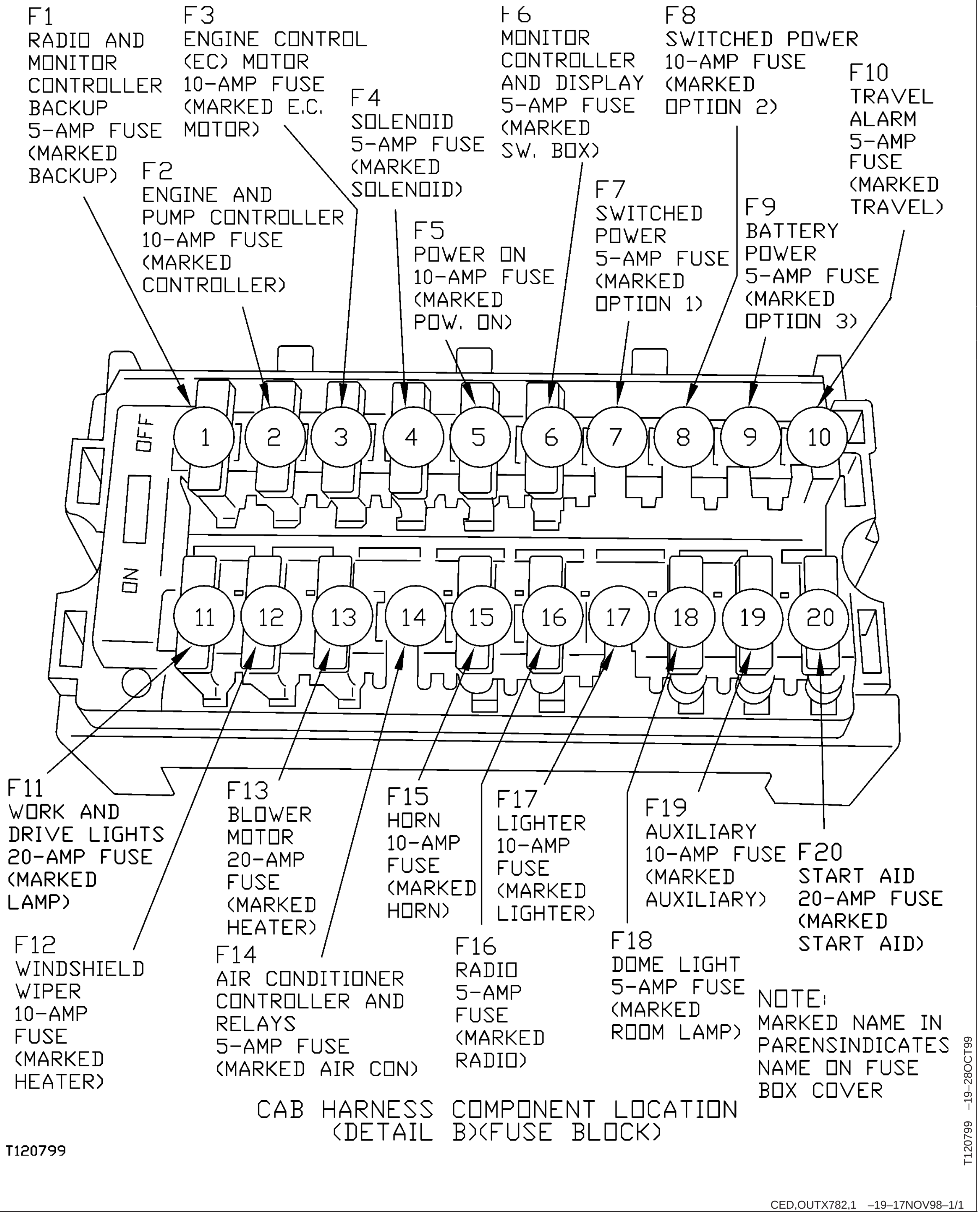
X26
REAR LIGHT SWITCH
HARNESS TO REAR LIGHT
HARNESS CONNECTOR

1	WHT
2	BLK

CONNECTORS FOR CAB HARNESS (W2)
(HARNESS CONNECTORS – FRONT VIEW SHOWN)

T120801

CAB HARNESS (W2) COMPONENT LOCATION—DETAIL B (FUSE BLOCK)

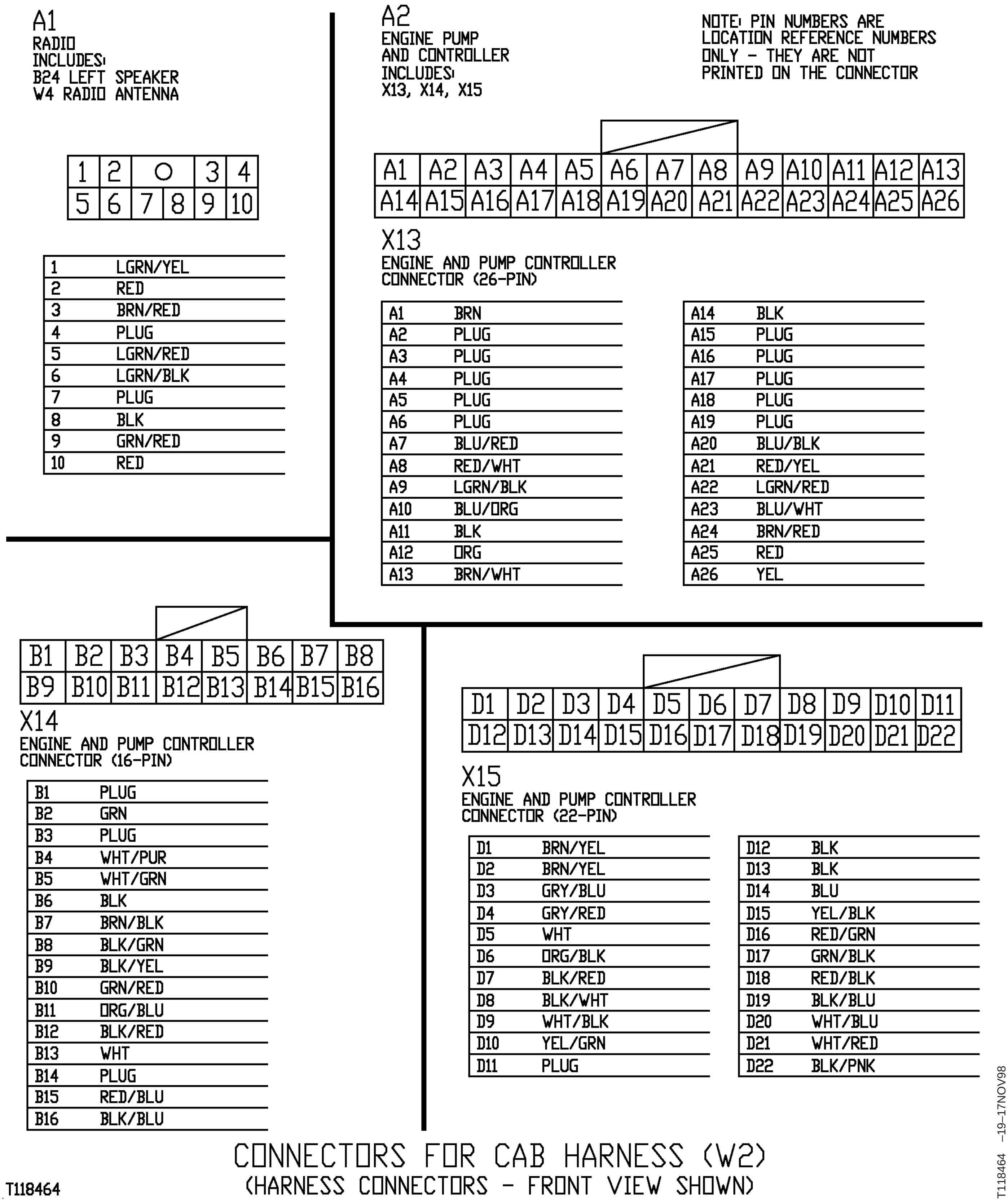


CAB HARNESS COMPONENT LOCATION (DETAIL B)(FUSE BLOCK)

T120799

CED,OUTX782,1 –19–17NOV98–1/1

CAB HARNESS (W2) CONNECTORS, WIRE AND PIN LOCATION



NOTE: PIN NUMBERS ARE LOCATION REFERENCE NUMBERS ONLY - THEY ARE NOT PRINTED ON THE CONNECTOR

1	LGRN/YEL
2	RED
3	BRN/RED
4	PLUG
5	LGRN/RED
6	LGRN/BLK
7	PLUG
8	BLK
9	GRN/RED
10	RED

X13
ENGINE AND PUMP CONTROLLER CONNECTOR (26-PIN)

A1	BRN	A14	BLK
A2	PLUG	A15	PLUG
A3	PLUG	A16	PLUG
A4	PLUG	A17	PLUG
A5	PLUG	A18	PLUG
A6	PLUG	A19	PLUG
A7	BLU/RED	A20	BLU/BLK
A8	RED/WHT	A21	RED/YEL
A9	LGRN/BLK	A22	LGRN/RED
A10	BLU/ORG	A23	BLU/WHT
A11	BLK	A24	BRN/RED
A12	ORG	A25	RED
A13	BRN/WHT	A26	YEL

X14
ENGINE AND PUMP CONTROLLER CONNECTOR (16-PIN)

B1	PLUG
B2	GRN
B3	PLUG
B4	WHT/PUR
B5	WHT/GRN
B6	BLK
B7	BRN/BLK
B8	BLK/GRN
B9	BLK/YEL
B10	GRN/RED
B11	ORG/BLU
B12	BLK/RED
B13	WHT
B14	PLUG
B15	RED/BLU
B16	BLK/BLU

X15
ENGINE AND PUMP CONTROLLER CONNECTOR (22-PIN)

D1	BRN/YEL	D12	BLK
D2	BRN/YEL	D13	BLK
D3	GRY/BLU	D14	BLU
D4	GRY/RED	D15	YEL/BLK
D5	WHT	D16	RED/GRN
D6	ORG/BLK	D17	GRN/BLK
D7	BLK/RED	D18	RED/BLK
D8	BLK/WHT	D19	BLK/BLU
D9	WHT/BLK	D20	WHT/BLU
D10	YEL/GRN	D21	WHT/RED
D11	PLUG	D22	BLK/PNK

CONNECTORS FOR CAB HARNESS (W2)
(HARNESS CONNECTORS - FRONT VIEW SHOWN)

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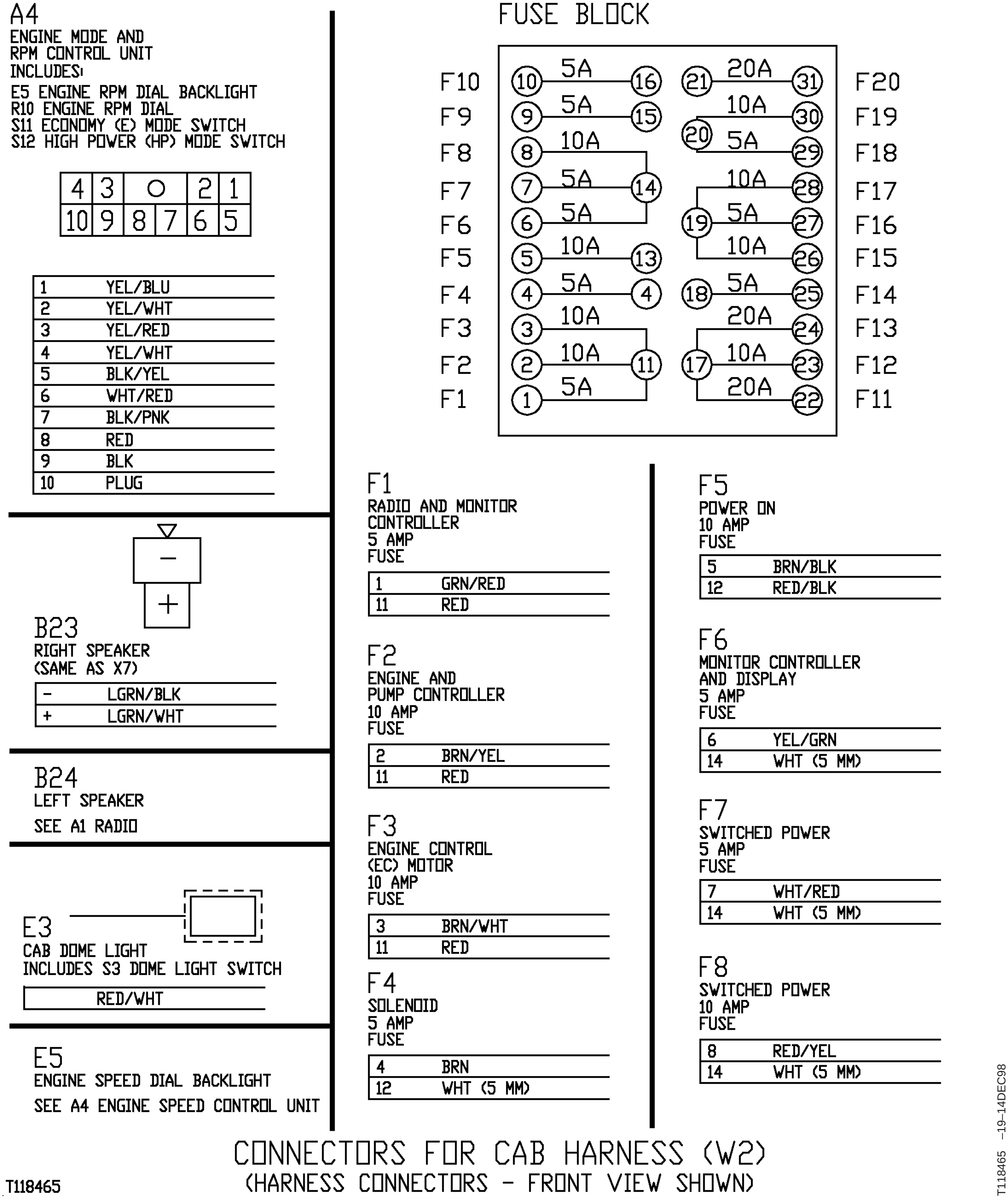

A4
ENGINE MODE AND
RPM CONTROL UNIT
INCLUDES:
E5 ENGINE RPM DIAL BACKLIGHT
R10 ENGINE RPM DIAL
S11 ECONOMY (E) MODE SWITCH
S12 HIGH POWER (HP) MODE SWITCH

1	YEL/BLU
2	YEL/WHT
3	YEL/RED
4	YEL/WHT
5	BLK/YEL
6	WHT/RED
7	BLK/PNK
8	RED
9	BLK
10	PLUG

B23
RIGHT SPEAKER
(SAME AS X7)

−	LGRN/BLK
+	LGRN/WHT

B24
LEFT SPEAKER

SEE A1 RADIO

E3
CAB DOME LIGHT
INCLUDES S3 DOME LIGHT SWITCH

RED/WHT

E5
ENGINE SPEED DIAL BACKLIGHT

SEE A4 ENGINE SPEED CONTROL UNIT

F1
RADIO AND MONITOR
CONTROLLER
5 AMP
FUSE

1	GRN/RED
11	RED

F2
ENGINE AND
PUMP CONTROLLER
10 AMP
FUSE

2	BRN/YEL
11	RED

F3
ENGINE CONTROL
(EC) MOTOR
10 AMP
FUSE

3	BRN/WHT
11	RED

F4
SOLENOID
5 AMP
FUSE

4	BRN
12	WHT (5 MM)

F5
POWER ON
10 AMP
FUSE

5	BRN/BLK
12	RED/BLK

F6
MONITOR CONTROLLER
AND DISPLAY
5 AMP
FUSE

6	YEL/GRN
14	WHT (5 MM)

F7
SWITCHED POWER
5 AMP
FUSE

7	WHT/RED
14	WHT (5 MM)

F8
SWITCHED POWER
10 AMP
FUSE

8	RED/YEL
14	WHT (5 MM)

CONNECTORS FOR CAB HARNESS (W2)
(HARNESS CONNECTORS - FRONT VIEW SHOWN)

T118465

T118465 –19–14DEC98

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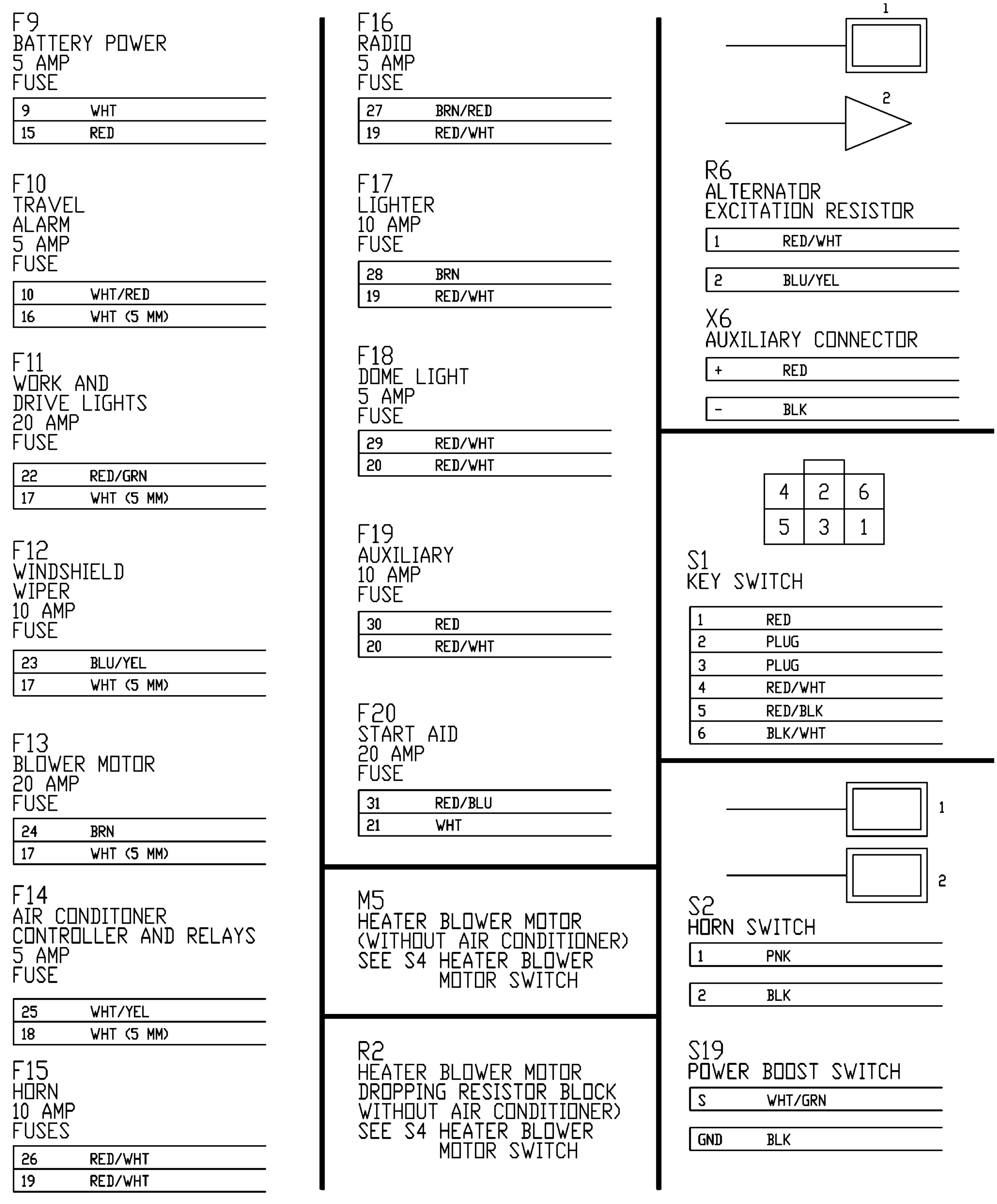


F9
BATTERY POWER
5 AMP
FUSE

9	WHT
15	RED

F10
TRAVEL
ALARM
5 AMP
FUSE

10	WHT/RED
16	WHT (5 MM)

F11
WORK AND
DRIVE LIGHTS
20 AMP
FUSE

22	RED/GRN
17	WHT (5 MM)

F12
WINDSHIELD
WIPER
10 AMP
FUSE

23	BLU/YEL
17	WHT (5 MM)

F13
BLOWER MOTOR
20 AMP
FUSE

24	BRN
17	WHT (5 MM)

F14
AIR CONDITONER
CONTROLLER AND RELAYS
5 AMP
FUSE

25	WHT/YEL
18	WHT (5 MM)

F15
HORN
10 AMP
FUSES

26	RED/WHT
19	RED/WHT

F16
RADIO
5 AMP
FUSE

27	BRN/RED
19	RED/WHT

F17
LIGHTER
10 AMP
FUSE

28	BRN
19	RED/WHT

F18
DOME LIGHT
5 AMP
FUSE

29	RED/WHT
20	RED/WHT

F19
AUXILIARY
10 AMP
FUSE

30	RED
20	RED/WHT

F20
START AID
20 AMP
FUSE

31	RED/BLU
21	WHT

M5
HEATER BLOWER MOTOR
(WITHOUT AIR CONDITIONER)
SEE S4 HEATER BLOWER
MOTOR SWITCH

R2
HEATER BLOWER MOTOR
DROPPING RESISTOR BLOCK
WITHOUT AIR CONDITIONER)
SEE S4 HEATER BLOWER
MOTOR SWITCH

R6
ALTERNATOR
EXCITATION RESISTOR

1	RED/WHT
2	BLU/YEL

X6
AUXILIARY CONNECTOR

+	RED
-	BLK

4	2	6
5	3	1

S1
KEY SWITCH

1	RED
2	PLUG
3	PLUG
4	RED/WHT
5	RED/BLK
6	BLK/WHT

S2
HORN SWITCH

1	PNK
2	BLK

S19
POWER BOOST SWITCH

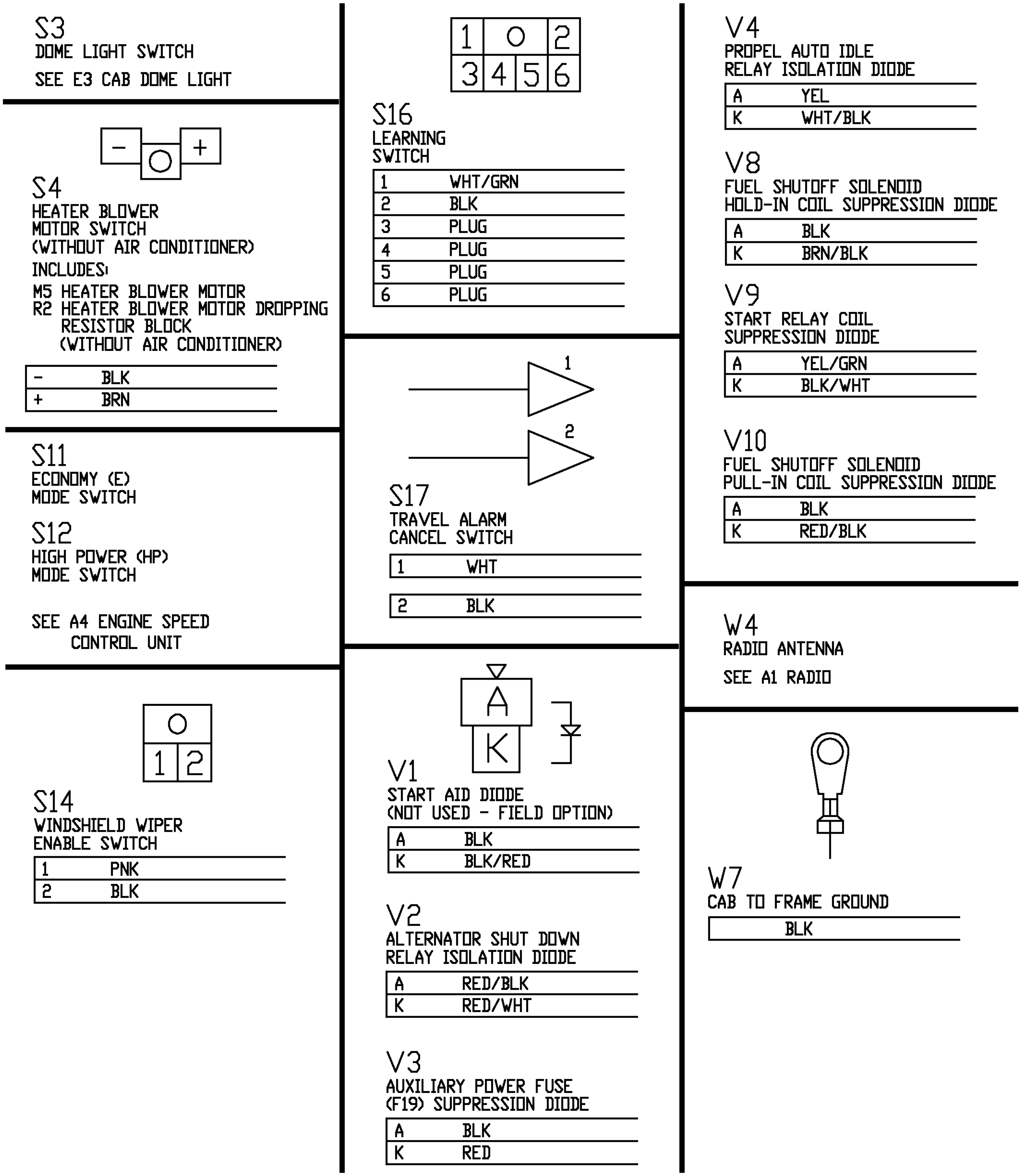
S	WHT/GRN
GND	BLK

T120787

CONNECTORS FOR CAB HARNESS (W2)
(HARNESS CONNECTORS - FRONT VIEW SHOWN)

T120787 –19–28OCT99

Continued on next page



S3
DOME LIGHT SWITCH

SEE E3 CAB DOME LIGHT

S4
HEATER BLOWER
MOTOR SWITCH
(WITHOUT AIR CONDITIONER)

INCLUDES:
M5 HEATER BLOWER MOTOR
R2 HEATER BLOWER MOTOR DROPPING
RESISTOR BLOCK
(WITHOUT AIR CONDITIONER)

-	BLK
+	BRN

S11
ECONOMY (E)
MODE SWITCH

S12
HIGH POWER (HP)
MODE SWITCH

SEE A4 ENGINE SPEED
CONTROL UNIT

S14
WINDSHIELD WIPER
ENABLE SWITCH

1	PNK
2	BLK

S16
LEARNING
SWITCH

1	WHT/GRN
2	BLK
3	PLUG
4	PLUG
5	PLUG
6	PLUG

S17
TRAVEL ALARM
CANCEL SWITCH

1	WHT
2	BLK

V1
START AID DIODE
(NOT USED - FIELD OPTION)

A	BLK
K	BLK/RED

V2
ALTERNATOR SHUT DOWN
RELAY ISOLATION DIODE

A	RED/BLK
K	RED/WHT

V3
AUXILIARY POWER FUSE
(F19) SUPPRESSION DIODE

A	BLK
K	RED

V4
PROPEL AUTO IDLE
RELAY ISOLATION DIODE

A	YEL
K	WHT/BLK

V8
FUEL SHUTOFF SOLENOID
HOLD-IN COIL SUPPRESSION DIODE

A	BLK
K	BRN/BLK

V9
START RELAY COIL
SUPPRESSION DIODE

A	YEL/GRN
K	BLK/WHT

V10
FUEL SHUTOFF SOLENOID
PULL-IN COIL SUPPRESSION DIODE

A	BLK
K	RED/BLK

W4
RADIO ANTENNA

SEE A1 RADIO

W7
CAB TO FRAME GROUND

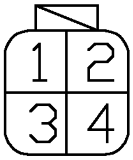
BLK

CONNECTORS FOR CAB HARNESS (W2)
(HARNESS CONNECTORS - FRONT VIEW SHOWN)

T118493

T118493 –19–05JAN99

Continued on next page

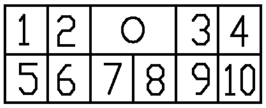


X1
DIAGNOSTIC CONNECTOR

1	BLK/BLU
2	BLK
3	BLK/GRN
4	RED/BLU

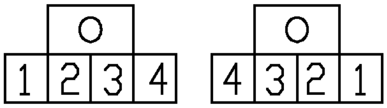
X2
LEARNING SWITCH CONNECTOR

SEE S16 LEARNING SWITCH



X3
ATTACHMENT PRESSURE SWITCH CONNECTOR

1	GRN
2	GRN/RED
3	YEL/GRN
4	PLUG
5	PLUG
6	PLUG
7	PLUG
8	PLUG
9	PLUG
10	BLK

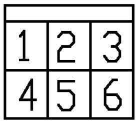


X4
ACCEL CONNECTOR

1	BLK/PNK
2	WHT/BLU
3	YEL/GRN
4	PLUG

X4
ACCEL CONNECTOR
(OTHER HALF)

1	BLK/PNK
2	BLK/PNK
3	PLUG
4	PLUG



X5
OPTIONAL CONNECTOR

1	WHT/RED
2	RED/YEL
3	WHT
4	RED
5	RED/BLU
6	BLK

X7
OPTIONAL RIGHT SPEAKER CONNECTOR

SEE B23 RIGHT SPEAKER CONNECTOR

X13
ENGINE AND PUMP CONTROLLER CONNECTOR
(26-PIN)

X14
ENGINE AND PUMP CONTROLLER CONNECTOR
(16-PIN)

X15
ENGINE AND PUMP CONTROLLER CONNECTOR
(22-PIN)

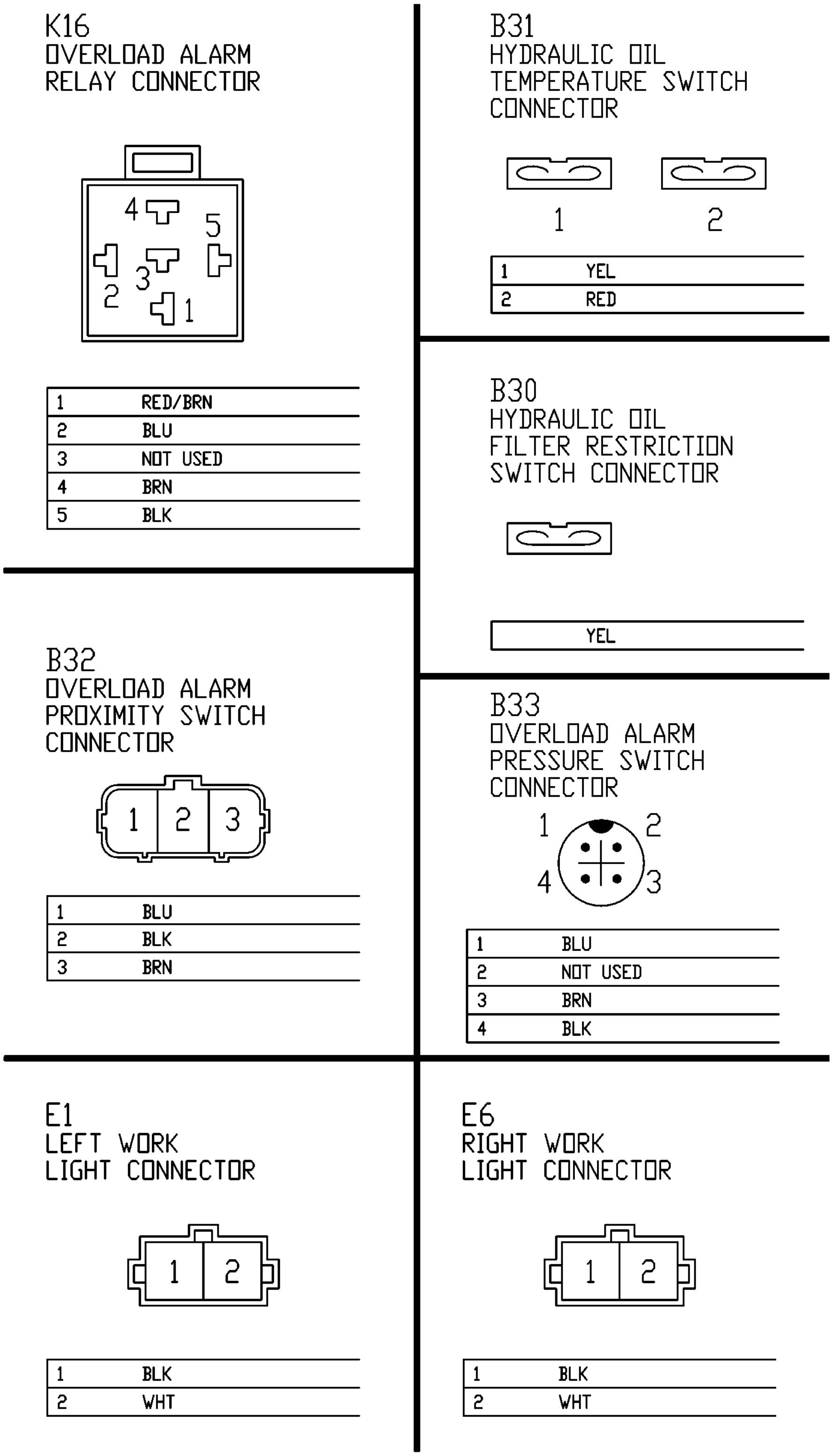
SEE A2 ENGINE AND PUMP CONTROLLER

CONNECTORS FOR CAB HARNESS (W2)
(HARNESS CONNECTORS - FRONT VIEW SHOWN)

T118494

T118494 –19–17NOV98

Continued on next page



K16
OVERLOAD ALARM
RELAY CONNECTOR

1	RED/BRN
2	BLU
3	NOT USED
4	BRN
5	BLK

B31
HYDRAULIC OIL
TEMPERATURE SWITCH
CONNECTOR

1	YEL
2	RED

B30
HYDRAULIC OIL
FILTER RESTRICTION
SWITCH CONNECTOR

YEL

B32
OVERLOAD ALARM
PROXIMITY SWITCH
CONNECTOR

1	BLU
2	BLK
3	BRN

B33
OVERLOAD ALARM
PRESSURE SWITCH
CONNECTOR

1	BLU
2	NOT USED
3	BRN
4	BLK

E1
LEFT WORK
LIGHT CONNECTOR

1	BLK
2	WHT

E6
RIGHT WORK
LIGHT CONNECTOR

1	BLK
2	WHT

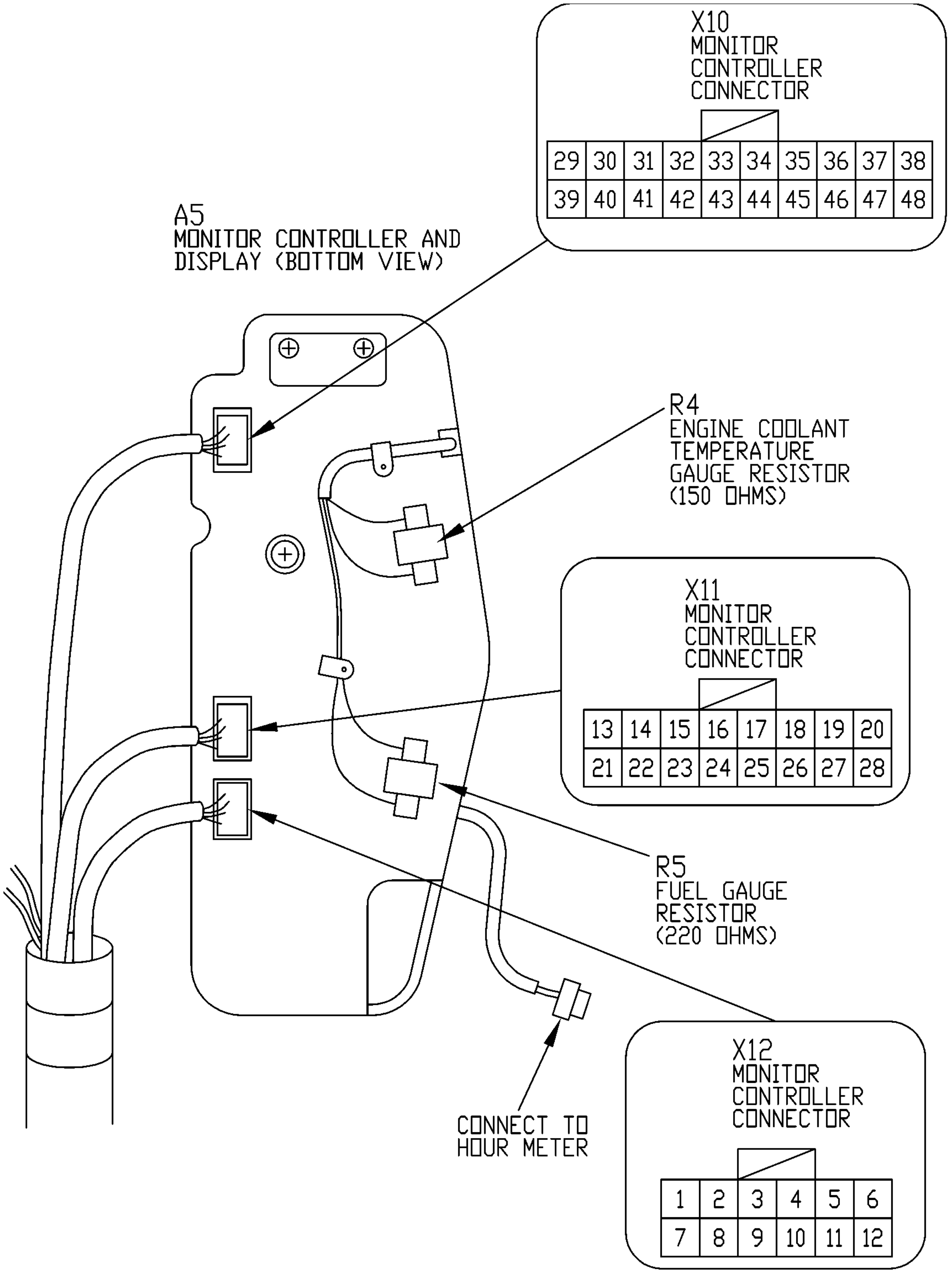
CONNECTORS FOR ENGINE AND FRAME HARNESS (W1)
(HARNESS CONNECTORS – FRONT VIEW SHOWN)

T120783

T120783 –19–28OCT99

FOLDOUT PAGE 4-60 IS AT REAR OF MANUAL

MONITOR AND RELAY HARNESS (W3) COMPONENT LOCATION—DETAIL A (MONITOR CONTROLLER CONNECTORS)



YEL/GRN	29
YEL/GRN	30
PLUG	31
PLUG	32
PLUG	33
YEL/BLU	34
YEL/RED	35
PLUG	36
BLK	37
YEL/WHT	38
GRN/RED	39
YEL/GRN	40
RED	41
BLU/YEL	42
YEL/GRY	43
BRN/YEL	44
–	45
BRN	46
RED/GRN	47
GRN/BLK	48

ORG/BLK	13
PLUG	14
WHT	15
PLUG	16
BLK/RED	17
RED/YEL	18
RED/BLK	19
RED/WHT	20
GRY/BLU	21
GRY/RED	22
ORG/BLU	23
GRN/WHT	24
YEL/BLK	25
BLU/GRN	26
BRN/WHT	27
BLU/GRN	28

RED/BLU	1
WHT/YEL	2
GRN/BLU	3
PLUG	4
PLUG	5
PNK	6
WHT/BLK	7
BLU	8
GRN	9
WHT/RED	10
WHT/BLK	11
GRY	12

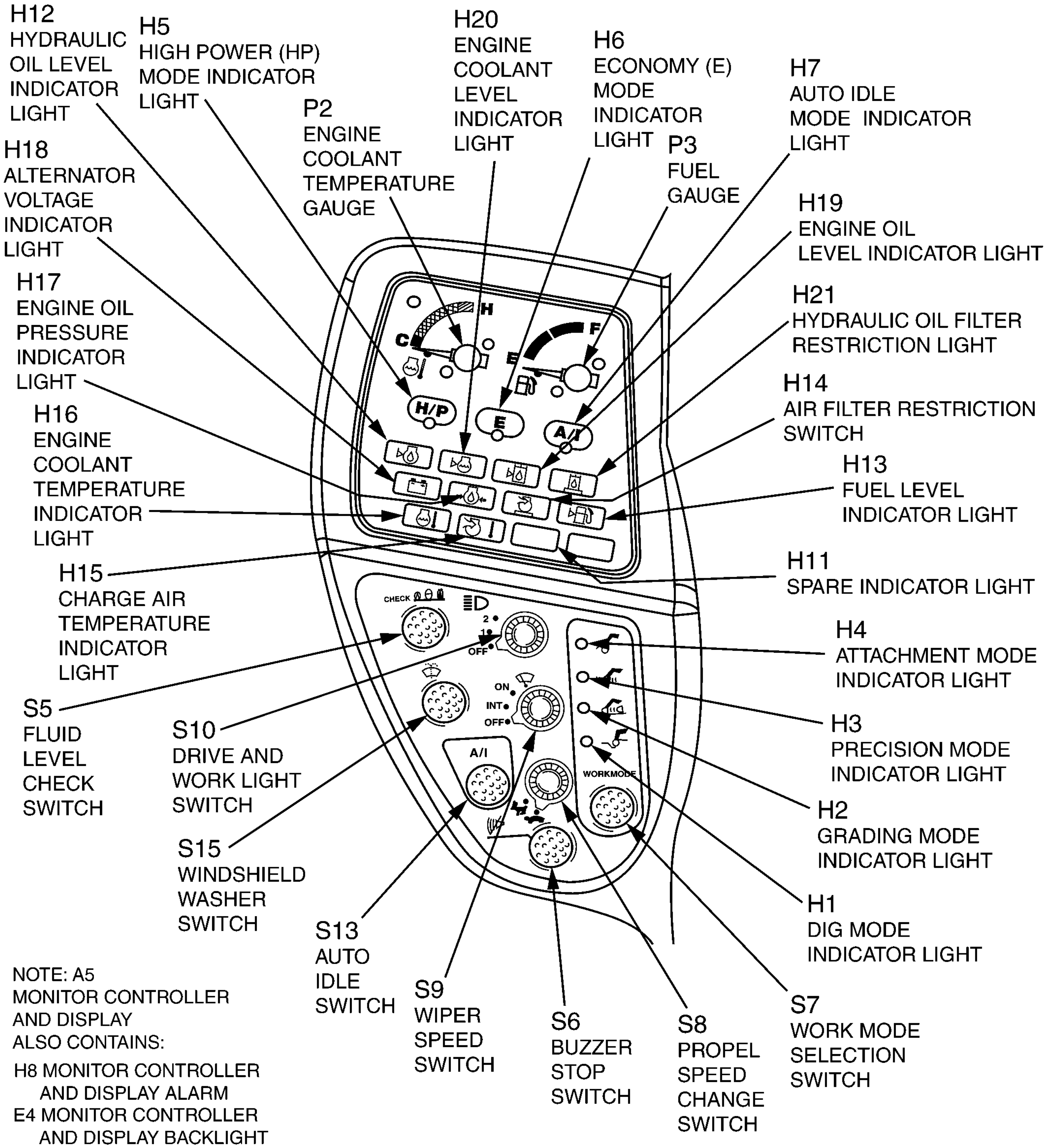
MONITOR AND RELAY HARNESS (W3) COMPONENT LOCATION
(DETAIL A - MONITOR CONTROLLER CONNECTORS)

T120786

T120786 –19–28OCT99

CED,TX02661,246 –19–04NOV98–1/1

MONITOR AND RELAY HARNESS (W3) COMPONENT LOCATION—DETAIL B (MONITOR CONTROLLER INDICATORS)



NOTE: A5
MONITOR CONTROLLER
AND DISPLAY
ALSO CONTAINS:
H8 MONITOR CONTROLLER
AND DISPLAY ALARM
E4 MONITOR CONTROLLER
AND DISPLAY BACKLIGHT

MONITOR AND RELAY HARNESS (W3) COMPONENT LOCATION
(DETAIL B - MONITOR CONTROLLER INDICATORS)

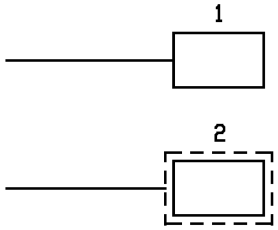
T120576

CED,OUOE012,152 –19–19MAR99–1/1

MONITOR AND RELAY HARNESS (W3) CONNECTORS, WIRE AND PIN LOCATION

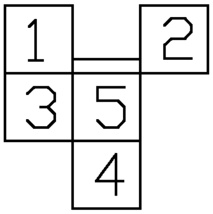
A5
MONITOR CONTROLLER
AND DISPLAY
(MADE UP OF X10, X11,
AND X12)

SEE MONITOR AND RELAY
HARNESS (W3)
COMPONENT LOCATION
DETAIL A



G4
24V POWER PLUG

1	BLK
2	BRN



K1
ALTERNATOR SHUT DOWN RELAY
(MARKED R1)

1	RED
2	RED/YEL
3	RED
4	PLUG
5	RED/WHT

K2
WINDSHIELD WASHER RELAY
(MARKED R2)

1	BLU/YEL
2	YEL/BLK
3	BLU/YEL
4	PLUG
5	PUR

K3
WORK LIGHT RELAY
(MARKED R3)

1	RED/GRN
2	RED/WHT
3	RED/GRN
4	PLUG
5	RED/BLU

K4
DRIVE LIGHT RELAY
(MARKED R4)

1	RED/GRN
2	RED/BLK
3	RED/GRN
4	PLUG
5	RED

K5
HORN RELAY
(MARKED R5)

1	RED/WHT
2	PNK
3	RED/WHT
4	PLUG
5	RED/GRN

K6
WINDSHIELD WIPER RELAY
(MOTOR GROUND AND INTERMITTENT)
(MARKED R6)

1	BLU/YEL
2	BLU/GRN
3	LGRN/WHT
4	BLU/BLK
5	BLK

K7
WINDSHIELD WIPER RELAY
(WIPER RUN)
(MARKED R7)

1	BLU/YEL
2	BRN/WHT
3	BLU/WHT
4	BLK/RED
5	BLU/YEL

K8
WINDSHIELD WIPER RELAY
(HOLD FOR PARK)
(MARKED R8)

1	BLU/YEL
2	BRN/WHT
3	BLU/RED
4	PLUG
5	BRN/WHT

K9
WINDSHIELD WIPER RELAY
(MOTOR GROUND FOR PARK)
(MARKED R9)

1	BLU/YEL
2	GRN/WHT
3	BLK/RED
4	PLUG
5	BLK

K10
PROPEL AUTO IDLE RELAY
(MARKED R10)

1	WHT/RED
2	YEL
3	WHT/BLK
4	PLUG
5	BLK

K11
STARTER PROTECTION RELAY
(MARKED R11)

1	RED
2	RED/YEL
3	YEL/GRN
4	BLK
5	PLUG

K12
START AID RELAY
(MARKED R12)

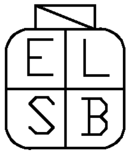
(NOT USED – FIELD OPTION)

CONNECTORS FOR MONITOR AND RELAY HARNESS (W3)
(HARNESS CONNECTORS – FRONT VIEW SHOWN)

T118352

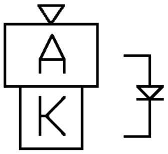
T118352 –19–17NOV98

Continued on next page



M3
WINDSHIELD WIPER MOTOR

E	LGRN/WHT
L	BLU/WHT
S	BLU/BLK
B	BLU/YEL



V5
WINDSHIELD WIPER RELAY ISOLATION DIODE

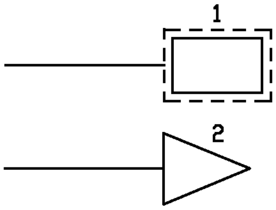
A	BLU/RED
K	BLU/BLK

V6
WINDSHIELD WIPER MOTOR SUPPRESSION DIODE

A	BLK
K	LGRN/WHT

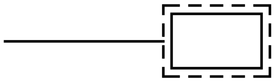
V7
WINDSHIELD WIPER MOTOR SUPPRESSION DIODE

A	BLK
K	BLU/WHT



X24
OPTIONAL CONNECTOR

1	GRN/BLK
2	GRY



X25
OPTIONAL CONNECTOR

WHT/BLK

CONNECTORS FOR MONITOR AND RELAY HARNESS (W3)
(HARNESS CONNECTORS – FRONT VIEW SHOWN)

T118497

T118497 –19–17NOV98

AIR CONDITIONER HARNESS (W9) COMPONENT LOCATION—SEE GROUP 9031-15

CED,TX02661,249 –19–04NOV98–1/1

AIR CONDITIONER HARNESS (W9) CONNECTORS, WIRE AND PIN LOCATION—SEE GROUP 9031-15

CED,TX02661,250 –19–04NOV98–1/1

Group 15
Sub-System Diagnostics

POWER CIRCUIT OPERATIONAL INFORMATION

The following conditions must be met for the circuits to function:

With key switch S1 OFF, voltage must be present at the following:

- Battery positive terminals
- Key switch S1 terminal BAT
- Battery relay K14 terminal B
- Radio and monitor controller backup 5-amp fuse F1
- Engine and pump controller 10-amp fuse F2
- Engine control (EC) motor 10-amp fuse F3
- Battery power 5-amp fuse F9
- Battery power 40-amp fusible link F21
- Alternator shut down relay K1 terminals 1 and 3
- Starter protection relay K11 terminal 1

With key switch S1 in ACC position, voltage must be present at the following:

- Key switch S1 terminal ACC
- Horn 10-amp fuse F15
- Radio 5-amp fuse F16
- Lighter 10-amp fuse F17
- Dome light 5-amp fuse F18
- Auxiliary 10-amp fuse F19

With key switch S1 ON, voltage must be present at the following:

- Alternator excitation resistor R6
- Key switch S1 terminal M
- Battery relay K14 terminal S and A
- Alternator power 60-amp fusible link F22
- Starter motor terminal C
- Solenoid 5-amp fuse F4
- Power On 10-amp fuse F5
- Monitor controller and display 5-amp fuse F6
- Switched power 5-amp fuse F7
- Switched power 10-amp fuse F8
- Travel alarm 5-amp fuse F10
- Work and drive lights 20-amp fuse F11
- Windshield wiper 10-amp fuse F12
- Blower motor 20-amp fuse F13
- Air conditioner controller and relays 5-amp fuse F14
- Start Aid 20-amp fuse F20
- Fuel shutoff 40-amp fusible link F23

CED,OUOE012,130 –19–15MAR99–1/1

POWER CIRCUIT THEORY OF OPERATION

The power circuit includes batteries, key switch, battery relay, battery relay fuse, battery relay diode and all other fuses.

With key switch OFF, battery power is available at terminal BAT of key switch S1, terminals 1 and 3 of alternator shut down relay K1, terminal 1 of starter protection relay K11, and through battery power 40-amp fusible link F21 to terminal B of battery relay K14. Battery power is also applied to radio and monitor controller backup 5-amp fuse F1, engine and pump controller 10-amp fuse F2, and engine control (EC) motor 10-amp fuse F3 and battery power 5 amp fuse F9.

With key switch turned to ACC, battery power is available at horn 10-amp fuse F15, lighter 10-amp fuse F17, dome light 5-amp fuse F18, auxiliary 10-amp fuse F19 and radio 5-amp fuse F16.

With key switch turned to ON, battery relay K14 is energized by power from key switch S1 terminal M to battery relay terminal S. Operating power from terminal A of the battery relay is applied to starter motor M1 terminal B, fuel shutoff 40-amp fusible link F23, and through alternator power 60-amp fusible link F22 to fuses F4, F6, F7, F8, F10, F11, F12, F13, F14 and F20. Operating power is also applied from key switch S1 terminal M to alternator excitation resistor R6 and power on 10-amp fuse F5.

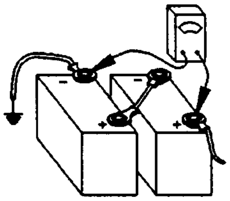
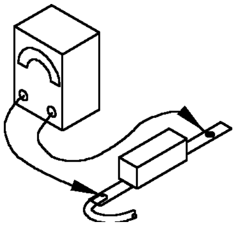
Connection to an external battery source is provided by 24-volt slave receptacle G5.

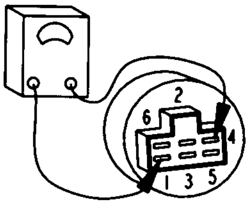
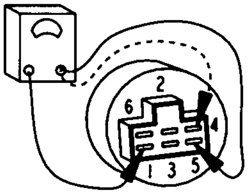
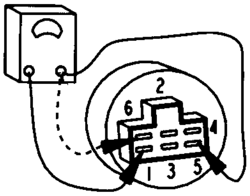
FOLDOUT PAGE 4-68 IS AT REAR OF MANUAL

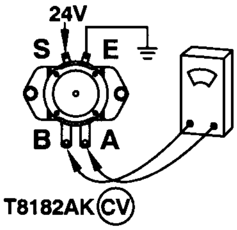
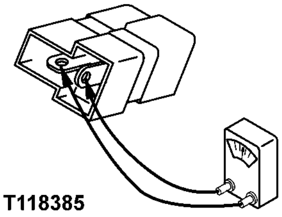
❶ POWER CIRCUIT DIAGNOSTIC PROCEDURES

IMPORTANT: Do not disconnect electrical connectors while the engine is running. Damage to Engine and Pump Controller or other components may result. Disconnect connectors only when instructed during a test or check.

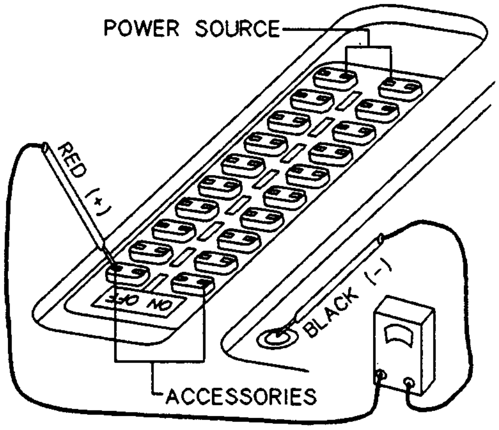
– – –1/1

BATTERY (G1, G2) VOLTAGE CHECK	 T7487AF –UN–20MAR91	Measure battery voltage by connecting a voltmeter to (-) negative battery terminal grounded to frame and (+) positive battery terminal connected to machine harness. Is 24 to 28 volts measured?	**YES:** Batteries are OK. Go to next check. **NO:** Batteries are undercharged. Charge batteries. – – –1/1
BATTERY POWER 40 AMP FUSIBLE LINK (F21) CHECK	 T109319 –UN–28APR97	Disconnect fusible link from battery relay. Connect ohmmeter to both ends of fusible link. Is continuity measured?	**YES:** Fusible link is OK. Check wiring harness. **NO:** Fusible link has failed. Replace fusible link. – – –1/1

KEY SWITCH (S1) CHECK	 T8357AK –UN–09NOV94	**1—B Terminal** **2—G1 Terminal** **3—G2 Terminal** **4—ACC Terminal** **5—M Terminal** **6—ST Terminal** Remove harness from key switch. Turn key switch to ACC. Is continuity measured between key switch terminals 1 and 4?	**YES:** Go to next step. **NO:** Key switch has failed if continuity is not measured or continuity is measured between other terminals. Replace.
	 T8357AL –UN–09NOV94	**1—B Terminal** **2—G1 Terminal** **3—G2 Terminal** **4—ACC Terminal** **5—M Terminal** **6—ST Terminal** Remove harness from key switch. Turn key switch ON. Is continuity measured between key switch terminals 1 and 4, and terminals 1 and 5?	**YES:** Go to next step. **NO:** Key switch has failed if continuity is not measured or continuity is measured between other terminals. Replace.
	 T8357AM –UN–02DEC98	**1—B Terminal** **2—G1 Terminal** **3—G2 Terminal** **4—ACC Terminal** **5—M Terminal** **6—ST Terminal** Remove harness from key switch. Turn key switch to START. Is continuity measured between key switch terminals 1 and 5, and terminals 1 and 6?	**YES:** Key switch is OK. **NO:** Key switch has failed if continuity is not measured or continuity is measured between other terminals. Replace. – – –1/1

BATTERY RELAY (K14) CHECK	 T8182AK –UN–03MAR94 Disconnect harness from relay. Connect 24 volts to small terminal S and ground small terminal E. Does relay click? Connect ohmmeter to large terminals A and B. Is continuity measured?	**YES:** Relay is OK. Check wiring harness. **NO:** Relay has failed. Replace relay. – – –1/1
BATTERY RELAY COIL SUPPRESSION DIODE (V11) CHECK	*NOTE: A diode can fail in two modes, either shorted or open. Continuity will be measured in one direction only in a serviceable diode. Use “diode checking mode” on meter when checking continuity.*  T118385 –UN–21NOV98 Remove diode from connector. Connect an ohmmeter to diode terminals. Is continuity measured? Reverse ohmmeter probes. Is continuity measured?	**YES:** If continuity is measured in both checks, diode has failed in a shorted mode. Replace. **NO:** If continuity is NOT measured in either check, diode has failed in an open mode. Replace. **NO:** If continuity is measured in one check and not the other, diode is OK. – – –1/1

FUSE CHECK



T7468AF –UN–14MAR91

Remove cover from fuse block.

Turn key switch ON.

Connect black (-) probe of multimeter to screw head (ground) in console.

Set multimeter to measure 24 volts.

Connect multimeter red (+) probe to the outside slot in each fuse.

Is 24 volts measured on each fuse?

YES: Fuse is OK

NO: Replace fuse.

– – –1/1

CHARGING CIRCUIT OPERATIONAL INFORMATION

The following conditions must be met for the circuit to function:

- Key switch ON
- Voltage present at alternator G3 terminals B+ and D+
- Engine running

CED,OUOE012,12 –19–26OCT98–1/1

CHARGING CIRCUIT THEORY OF OPERATION

The charging circuit includes batteries, key switch, alternator shut down relay, alternator excitation resistor, alternator shutdown relay and isolation diode, monitor controller and display.

With key switch S1 ON, battery power is applied through alternator power 60-amp fusible link F22 to terminal B+ of alternator G3. Alternator excitation power is applied from key switch S3 terminal M through alternator shut down relay isolation diode V2 and alternator excitation resistor R6 to alternator terminal D+. The excitation voltage is monitored by controller and display monitor A5 at terminal 42.

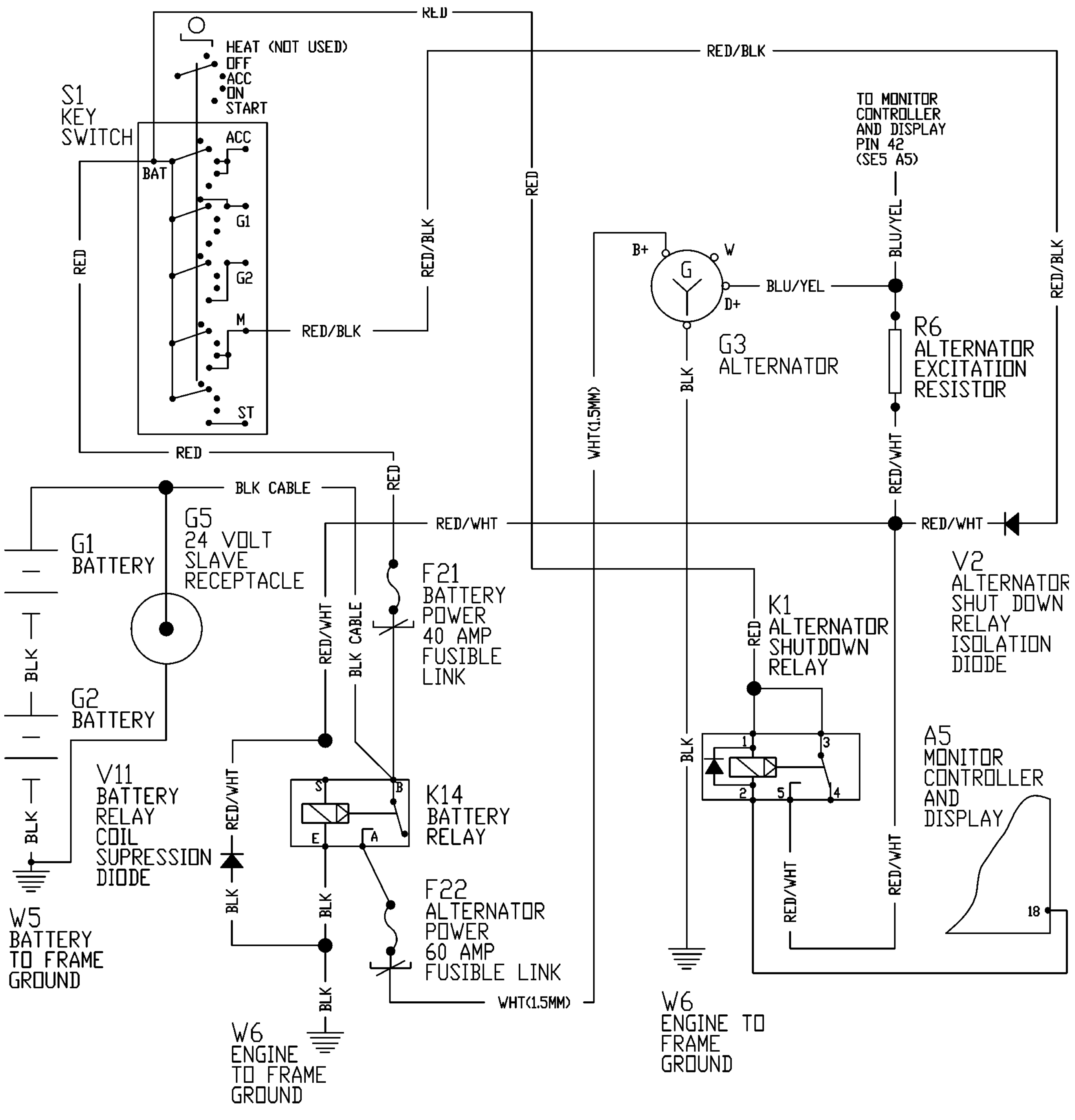
With the engine running and the charging circuit functioning properly, the voltage at alternator terminal D+ is greater than 10 volts, therefore, alternator voltage indicator light H18 and monitor controller and display alarm H8 are off. Output current from alternator terminal B charges the batteries as needed and provides power to the machine circuits. If the voltage at alternator terminal D+ drops below 6 volts, as a result of a charging circuit failure or the engine not running, the monitor controller will turn on the alternator voltage indicator light and sound the display alarm.

Once the monitor controller senses that the engine is running (voltage at alternator terminal D+ is greater than 10 volts), monitor controller and display terminal 18 is grounded. This provides a ground path for alternator shutdown relay K1, energizing the relay. With relay K1 energized, battery power is applied through contacts 3 and 5 to alternator excitation resistor R6. This ensures that power to the alternator excitation circuit (and the alternator voltage output) is maintained as long as the engine is running, even if the key switch is turned to OFF or ACC momentarily.

Isolation diode V2 isolates the battery power at terminal 5 of relay K1 from the key switch ON power circuits.

CED,OUOE012,28 –19–02NOV98–1/1

CHARGING CIRCUIT SCHEMATIC

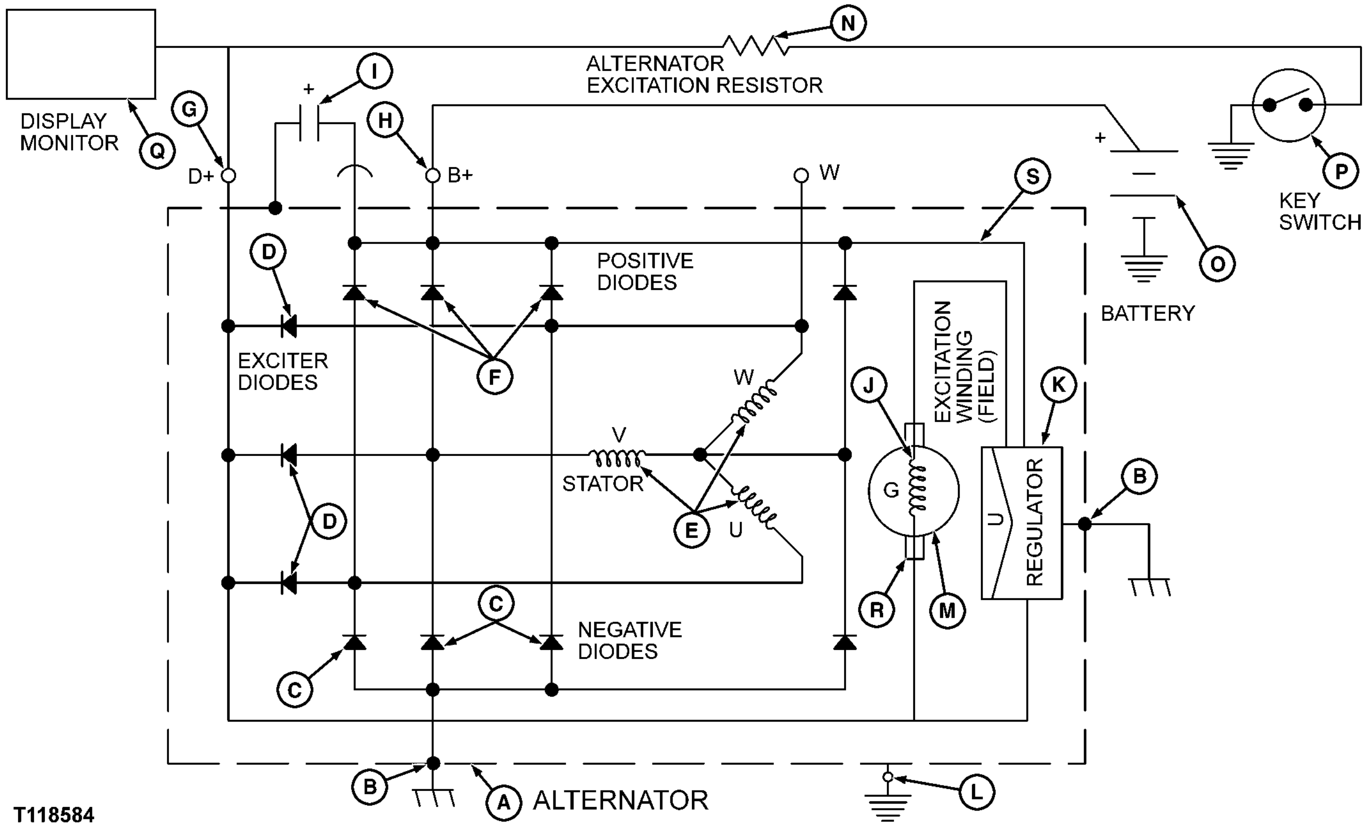


T120579

CHARGING CIRCUIT

T120579 –19–28OCT99

ALTERNATOR THEORY OF OPERATION



A—Alternator
B—Internal Ground
C—Negative Diodes
D—Exciter Diodes
E—Stator Windings
F—Positive Diodes
G—D+ Terminal
H—B+ Terminal
I—Noise Filter
J—Excitation Winding
K—Regulator
L—External Ground Terminal
M—Rotor
N—Alternator Excitation Resistor
O—Battery
P—Key Switch
Q—Display Monitor
R—Brushes
S—Sense Circuit

The alternator has three basic stages for proper operation. The operating principles are as follows.

PRE-EXCITATION STAGE

When key switch (P) is turned to ON, battery power flows through the alternator excitation resistor (N) to terminal D+ (G) on alternator, excitation winding (J), through regulator (K) and to internal ground (B).

EXCITATION STAGE

During alternator start (as the engine speeds up from 0 to idle) current supplied by the alternator excitation resistor to the field coil of the rotor produces a magnetic field which induces current in the three-phase winding of the stator (E). The alternator reaches cut-in RPM when the induced current is large enough to produce voltage equal to the battery voltage plus 1.0 volt. At this time, some current from the stator is rectified by the exciter diodes (D) (producing battery voltage at the B+ terminal (G) and is supplied to the carbon brushes and slip rings of the excitation winding, strengthening the magnetic field in the excitation winding. This in turn will increase the stator voltage. This will occur continuously until the alternator (A) is fully excited and the alternator regulated voltage is reached.

Continued on next page

NORMAL OPERATION

The alternating current induced in the stator winding (E) is rectified by the positive and negative diodes (F and C) and delivered to the battery and current consuming accessories. The currents in the stator winding (E) are constantly changing magnitude and direction. However, current flowing to the battery and accessories always maintains the same direction. This is because no matter what position the rotor (M) is in, all the diodes are simultaneously involved in the process of rectification. The regulator (K) measures the B+ voltage (H) and compares it to an internal reference. When the B+ voltage (H) starts to rise above the reference voltage, the regulator (K) switches off the field current. When the B voltage (H) starts to fall below the reference voltage the regulator (K) switches on the field current. The regulator (K) switches the field on and off several thousand times a second in response to the current load placed on the alternator output and the engine RPM.

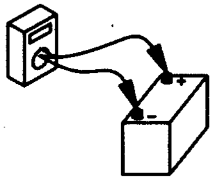
CED,OUOE012,13 –19–27OCT98–2/2

❶ CHARGING CIRCUIT DIAGNOSTIC PROCEDURES

IMPORTANT: Do not disconnect electrical connectors while the engine is running. Damage to Engine and Pump Controller or other components may result. Disconnect connectors only when instructed during a test or check.

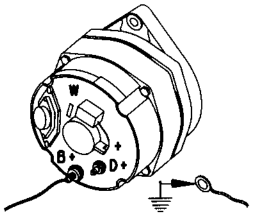
NOTE: For a problem that cannot be identified using the diagnostic procedures, check the wiring harnesses and diodes in the circuits for shorts and opens.

– – –1/1

ALTERNATOR (G3) OUTPUT CHECK	 T6569AZ –UN–23AUG93	Key switch OFF. With voltmeter connected from battery (+) terminal to vehicle ground, measure and record battery voltage. 24 - 25.5 volts is normal. Start and run engine at 1500 rpm, and check battery voltage. Does battery voltage increase to 27.4 - 28.4 volts?	**YES:** Alternator is OK. **NO:** Repair alternator.

– – –1/1

ALTERNATOR VOLTAGE INDICATOR LIGHT (H18) CHECK



T8322AC –UN–10OCT94

B+—Alternator Output
D+—Alternator Excitation

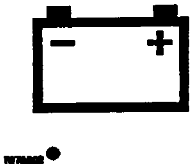
Turn key switch ON.

Engine OFF.

Is alternator voltage indicator light on?

YES: Go to next step.

NO: Go to next check.



T6768CR –UN–18OCT88

Start engine.

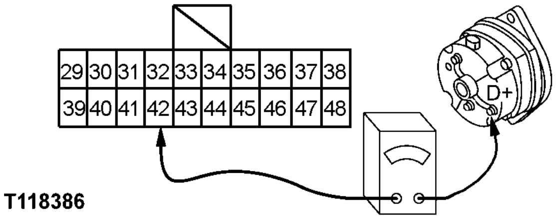
Does alternator voltage indicator light go off.

YES: Alternator voltage indicator light and harness are OK.

NO: Check alternator harness for short circuit between alternator and monitor controller. Also check alternator output.

– – –1/1

ALTERNATOR VOLTAGE INDICATOR LIGHT HARNESS CHECK



T118386 –UN–21NOV98

Key switch OFF.

Disconnect 20-pin harness connector from monitor controller and display.

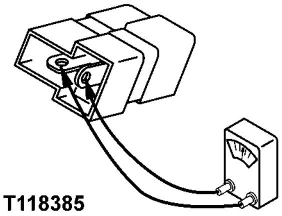
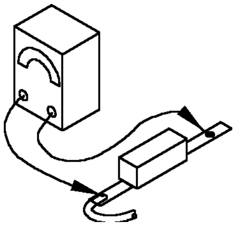
Measure continuity from alternator terminal D+ to pin 42 in harness side of 20-pin monitor controller and display connector.

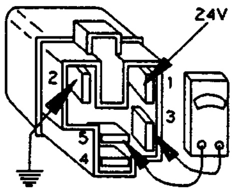
Is continuity measured?

YES: Check indicator lamp.

NO: Harness has failed. Repair.

– – –1/1

ALTERNATOR SHUT DOWN RELAY ISOLATION DIODE (V2) CHECK	*NOTE: A diode can fail in two modes, either shorted or open. Continuity will be measured in one direction only in a serviceable diode. Use “diode checking mode” on meter when checking continuity.*  T118385 T118385 –UN–21NOV98 Remove diode from connector. Connect an ohmmeter to diode terminals. Is continuity measured? Reverse ohmmeter probes. Is continuity measured?	**YES:** If continuity is measured in both checks, diode has failed in a shorted mode. Replace. **NO:** If continuity is NOT measured in either check diode has failed in an open mode. Replace. **NO:** If continuity is measured in one check and not the other, diode is OK. – – –1/1
ALTERNATOR POWER 60 AMP FUSIBLE LINK (F22) CHECK	 T109319 –UN–28APR97 Disconnect fusible link from battery relay. Connect ohmmeter to both ends of fusible link. Is continuity measured?	**YES:** Fusible link is OK. Check wiring harness. **NO:** Fusible link has failed. Replace fusible link. – – –1/1

ALTERNATOR SHUT DOWN RELAY (K1) CHECK	 T7447BG –19–14JAN91 **1—24 Volt Terminal** **2—Ground Terminal** **3—Relay Common** **4—Relay Normally Closed** **5—Relay Normal Open** Disconnect harness from relay. Connect 24 volts to relay terminal 1 and ground terminal 2. Does relay click? Connect ohmmeter to terminals 3 and 5. Does ohmmeter read continuity?	**YES:** Relay is OK. **NO:** Relay has failed. Replace. – – –1/1

STARTING AND FUEL SHUTOFF CIRCUIT OPERATIONAL INFORMATION

The following conditions must be met for the circuit to function:

Key switch in START and voltage present at the following:

- Starter relay K13 terminal B
- Fuel shutoff relay K15 terminal B
- Starter M1 terminal C
- Fuel shutoff solenoid Y7 hold-in coil terminal

STARTING AND FUEL SHUTOFF CIRCUIT THEORY OF OPERATION

When key switch S1 is moved to START, power is applied from key switch terminal ST to terminal e of starter relay K13 and terminal g of fuel shutoff relay K15, energizing both relays. (The ground path for the starter relay coil is provided through terminals 3 and 4 of de-energized starter protection relay K11). Battery power from alternator power fusible link F22 is applied from terminals B and G of energized starter relay K13 to starter M1 solenoid terminal C, energizing the solenoid. This applies battery voltage at starter terminal B (from battery relay K14) to the motor winding, and the starter motor starts cranking the engine.

At the same time, power from fuel shutoff fusible link F23 is applied through terminals B and G of the energized fuel shutoff relay to the pull-in coil of fuel shutoff solenoid Y7, opening the fuel valve. Power from power on 10-amp fuse F5 at the hold-in coil of the fuel shutoff solenoid keeps the fuel valve open after the key switch is returned to ON.

When the engine is running and the alternator is producing output voltage, starter protection relay K11 is energized by ground applied to terminal 2 of the relay from pin 18 of monitor controller and display A5. This prevents the starter motor from being activated if the key switch is moved to START while the engine is running, by removing the ground path for starter relay K13.

When star aid switch S18 is pressed, start aid relay K12 is energized by ground applied to terminal 2. With relay K12 energized, power from start aid fuse F20 is applied to start aid solenoid Y4 through the energized relay contacts, energizing the start aid solenoid. Start aid solenoid diode V1 limits the voltage spikes generated by the solenoid coil when it is de-energized.

Start relay coil suppression diode V9 limits the voltage spikes generated by the starter relay coil when the relay de-energizes.

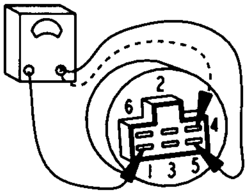
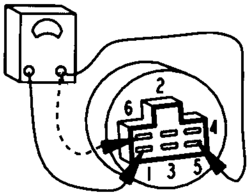
Fuel shutoff solenoid pull-in and hold-in coil suppression diodes V10 and V8 limit the voltage spikes generated by the solenoid coils when they are de-energized.

FOLDOUT PAGE 4-81 IS AT REAR OF MANUAL

❶ STARTING CIRCUIT DIAGNOSTIC PROCEDURES

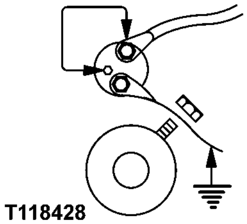
IMPORTANT: Do not disconnect electrical connectors while the engine is running. Damage to Engine and Pump Controller or other components may result. Disconnect connectors only when instructed during a test or check.

– – –1/1

KEY SWITCH (S1) CHECK	 T8357AL –UN–09NOV94 **1—B Terminal** **2—G1 Terminal** **3—G2 Terminal** **4—ACC Terminal** **5—M Terminal** **6—ST Terminal** Remove harness from key switch. Turn key switch to ON. Is continuity measured between terminals 1 and 4, and 1 and 5?	**YES:** Go to next step. **NO:** Key switch has failed. Replace.
	 T8357AM –UN–02DEC98 **1—B Terminal** **2—G1 Terminal** **3—G2 Terminal** **4—ACC Terminal** **5—M Terminal** **6—ST Terminal** Remove harness from key switch. Turn key switch to START. Is continuity measured between terminals 1 and 5, and 1 and 6?	**YES:** Key switch is OK. **NO:** Key switch has failed. Replace.

– – –1/1

STARTER (M1) SOLENOID CHECK



T118428 –UN–21NOV98

CAUTION: Starter will crank engine if metal strap is NOT disconnected from motor.

Disconnect metal strap from starter motor large terminal.

Connect battery voltage to solenoid small terminal.

Ground metal strap from solenoid with heavy gauge wire.

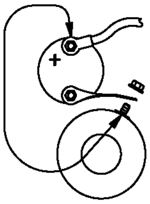
Does solenoid click?

YES: Solenoid is OK. Check wiring harness.

NO: Repair or replace starter solenoid.

– – –1/1

STARTER (M1) MOTOR CHECK



T6534BJ –UN–07JAN97

Disconnect metal strap from starter motor large terminal.

Connect a heavy gauge wire from battery positive cable to starter motor terminal.

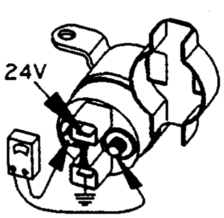
Does starter motor turn, but NOT crank engine.

YES: Starter motor is OK. Check wiring harness.

NO: Repair or replace starter.

– – –1/1

STARTER RELAY (K13) CHECK



T7466AD –UN–14MAR91

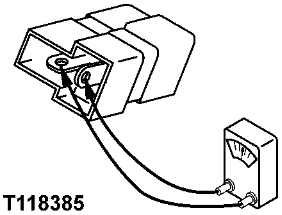
Disconnect harness from relay. Connect 24 volts to small terminal e and ground small terminal g. Measure continuity between large terminals B and G.

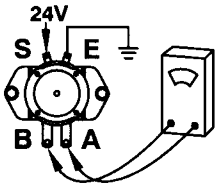
Is continuity measured?

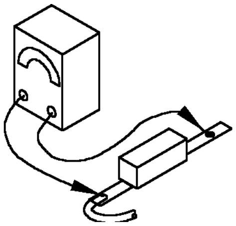
YES: Relay is OK. Check wiring harness.

NO: Relay has failed. Replace relay.

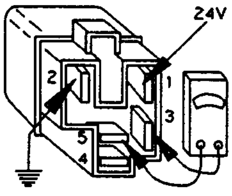
– – –1/1

START RELAY COIL SUPPRESSION DIODE (V9) CHECK	*NOTE: A diode can fail in two modes, either shorted or open. Continuity will be measured in one direction only in a serviceable diode. Use "diode checking mode" on meter when checking continuity.*  T118385 T118385 –UN–21NOV98 Remove diode from connector. Connect an ohmmeter to diode terminals. Is continuity measured? Reverse ohmmeter probes. Is continuity measured?	**YES:** If continuity is measured in both checks, diode has failed in a shorted mode. Replace. **NO:** If continuity is NOT measured in either check, diode has failed in an open mode. Replace. **NO:** If continuity is measured in one check and not the other, diode is OK. – – –1/1

BATTERY RELAY (K14) CHECK	 T8182AK CV T8182AK –UN–03MAR94 **S—Relay Coil +24 Volt Terminal** **E—Relay Coil Ground Terminal** **B—Relay Battery Input Terminal** **A—Relay Battery Output Terminal** Disconnect harness from relay. Connect 24 volts to small terminal S and ground small terminal E. Measure continuity between large terminals A and B. Is continuity measured?	**YES:** Relay is OK. Check wiring harness. **NO:** Relay has failed. Replace relay. – – –1/1

ALTERNATOR POWER 60 AMP FUSIBLE LINK (F22) CHECK	 T109319 –UN–28APR97 Disconnect fusible link from battery relay. Connect ohmmeter to both ends of fusible link. Measure continuity between terminals. Is continuity measured?	**YES:** Fusible link is OK. Check wiring harness. **NO:** Fusible link has failed. Replace fusible link. – – –1/1

STARTER PROTECTION RELAY (K11) CHECK



T7447BG –19–14JAN91

1—24 Volt Terminal
2—Ground Terminal
3—Relay Common
4—Relay Normally Closed
5—Relay Normally Open

Disconnect harness from starter protection relay.

Connect ohmmeter to terminals 3 and 4.

Does ohmmeter read continuity?

Connect 24 volts to relay terminal 1 and ground terminal 2.

Does relay “click”?

Connect ohmmeter to terminals 3 and 5.

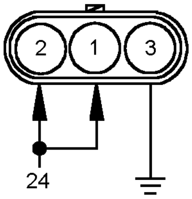
Does ohmmeter read continuity?

YES: Relay is OK.

NO: Relay has failed. Replace.

– – –1/1

FUEL SHUTOFF SOLENOID (Y7) CHECK



T118387

T118387 –UN–21NOV98

Disconnect harness from fuel shutoff solenoid.

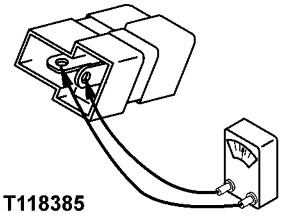
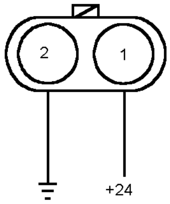
Connect 24 volts to solenoid terminals 1 and 2, and ground terminal 3, then remove power from terminal 2.

Does solenoid “click” and pull injection pump shutoff lever back, and remain in the energized position after power is removed from terminal 2?

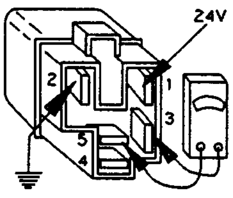
YES: Solenoid is OK.

NO: Solenoid has failed. Replace.

– – –1/1

FUEL SHUT-OFF SOLENOID HOLD-IN COIL SUPPRESSION DIODE (V8) AND FUEL SHUT-OFF SOLENOID PULL-IN COIL SUPPRESSION DIODE (V10) CHECK	*NOTE: A diode can fail in two modes, either shorted or open. Continuity will be measured in one direction only in a serviceable diode. Use “diode checking mode” on meter when checking continuity.*  T118385 –UN–21NOV98 Remove diode from connector. Connect an ohmmeter to diode terminals. Is continuity measured? Reverse ohmmeter probes. Is continuity measured? – – –1/1	**YES:** If continuity is measured in both checks, diode has failed in a shorted mode. Replace. **NO:** If continuity is NOT measured in either check, diode has failed in an open mode. Replace. **NO:** If continuity is measured in one check and not the other, diode is OK.
START-AID SOLENOID (Y4) CHECK	 T111034 T111034 –UN–21AUG97 **IMPORTANT: DO NOT start engine with start aid can removed from solenoid. Dust can enter the engine, seriously damaging the engine.** Disconnect harness from start-aid solenoid. Remove ether can from start-aid Connect 24 volts to solenoid terminal No. 1 and ground terminal No. 2. Does solenoid click? Reconnect harness. Replace ether can. – – –1/1	**YES:** Solenoid is OK. Go to next check. **NO:** Solenoid has failed. Replace.

START AID RELAY (K12) CHECK



T7447BG –19–14JAN91

1—24 Volt Terminal
2—Ground Terminal
3—Relay Common
4—Relay Normally Closed
5—Relay Normally Open

Disconnect harness from start aid relay.

Connect ohmmeter to terminals 3 and 5.

Does ohmmeter read open?

Connect 24 volts to relay terminal 1 and ground terminal 2.

Does relay “click”?

Connect ohmmeter to terminals 3 and 5.

Does ohmmeter read continuity?

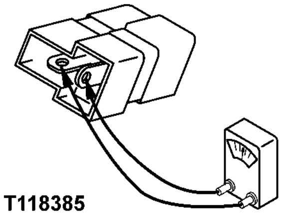
YES: Relay is OK. Check switch and harness.

NO: Relay has failed. Replace.

– – –1/1

START AID COIL SUPPRESSION DIODE (V1) CHECK

NOTE: A diode can fail in two modes, either shorted or open. Continuity will be measured in one direction only in a serviceable diode. Use “diode checking mode” on meter when checking continuity.



T118385 –UN–21NOV98

Remove diode from connector.

Connect an ohmmeter to diode terminals.

Is continuity measured?

Reverse ohmmeter probes.

Is continuity measured?

YES: If continuity is measured in both checks, diode has failed in a shorted mode. Replace.

NO: If continuity is NOT measured in either check, diode has failed in an open mode. Replace.

NO: If continuity is measured in one check and not the other, diode is OK.

– – –1/1

WINDSHIELD WIPER AND WASHER CIRCUIT OPERATIONAL INFORMATION

The following conditions must be met for the circuit to function:

- Upper windshield in closed position with latch fully engaged.
- Key switch ON.

CED,OUOE012,8 –19–21OCT98–1/1

WINDSHIELD WIPER AND WASHER CIRCUIT THEORY OF OPERATION

The windshield wiper and washer circuit has four modes of operation: windshield wiper ON (continuous), windshield wiper INT (intermittent), windshield wiper OFF (park), and windshield wash. The operation of the windshield wiper and washer circuit is controlled by signals from the monitor controller and the state of the wiper motor internal position status switch.

WINDSHIELD WIPER CONTINUOUS OPERATION

When wiper speed switch S9 is placed in the ON position, windshield wiper relays K6 (motor ground and intermittent), K7 (wiper run), and K8 (hold for park) are energized by grounds at terminals 26 and 27 of monitor controller and display A5. Windshield wiper relay K9 (motor ground for park) is de-energized by an open at terminal 24 of the monitor controller and display.

Power for windshield wiper motor M3 is supplied from windshield wiper 10-amp fuse F12 through contacts 3 and 5 of energized wiper run relay K7 to terminal L of the wiper motor. Terminal E of the wiper motor is connected to frame ground through contacts 3 and 5 of relay K6, and the wiper motor runs. The wiper motor drives a Pittman arm assembly which moves the wiper blade back and forth across the windshield.

Windshield wiper motor suppression diodes V6 and V7 protect the circuit components from voltage transients generated by the wiper motor.

WINDSHIELD WIPER INTERMITTENT OPERATION

When wiper speed switch S9 is placed in the INT position, monitor controller and display A5 grounds terminals 27 and 28, and windshield wiper motor M3 is started in the same manner as described for continuous operation. After 1 to 2 seconds, the ground at terminal 28 of the monitor controller and display is removed by the controller, causing motor ground and intermittent relay K6 to de-energize. However, ground to wiper motor terminal E is now provided from wiper motor terminal S through contacts 3 and 4 of de-energized relay K6, and the wiper motor continues to run.

When the wiper motor reaches the intermittent stop position (wiper blade at right side of window), terminal S (which is applied to wiper motor terminal E through contacts 3 and 4 of de-energized relay K6) is switched from ground to +24 volts (from motor terminal B) by the wiper motor internal switch. With +24 volts now at both wiper motor terminals, E and L, the motor stops running. After a few seconds, the cycle is repeated by another 1 to 2 second ground pulse from terminal 28 of the monitor controller and display.

WINDSHIELD WIPER PARK OPERATION

When wiper speed switch S9 is turned to the OFF position, monitor controller and display A5 grounds terminal 24, energizing motor ground for park relay K9, and opens terminals 26, 27, and 28. If the wiper motor is running (not in the intermittent stop position), ground from terminal S of the wiper motor (applied through relay K8 contacts 3 and 5) keeps windshield wiper relays K7 (wiper run) and K8 (hold for park) energized. The ground from terminal S is also supplied through the de-energized contacts of motor ground and intermittent relay K6 to wiper motor terminal E, and the wiper motor continues running.

Continued on next page

When windshield wiper motor M3 reaches the intermittent stop position, wiper motor terminal S is switched from ground to +24 volts by the wiper motor internal switch. The +24 volts is applied to wiper motor terminal E, and also reverse biases windshield wiper relay isolation diode V5, causing windshield wiper relays K7 (wiper run) and K8 (hold for park) to be de-energized. Ground is now applied through contacts 5 and 3 of energized relay K9 and contacts 3 and 4 of de-energized relay K7 to wiper motor terminal L. With +24 volts on wiper motor terminal E and ground on wiper motor terminal L, the motor runs backwards until a cam in the Pittman arm assembly causes the wiper to be driven off the right side of the windshield into the park position on the windshield frame . When the wiper motor reaches the park position, motor terminal S is grounded by the motor internal switch, and the motor stops.

WINDSHIELD WASHER OPERATION

When windshield washer switch S15 is pressed, windshield washer relay K2 is energized by a ground at terminal 24 of monitor controller and display A5. Power is applied to windshield washer motor M4 from windshield wiper 10–amp fuse F12 through contacts 3 and 5 of energized relay K2. The motor drives the windshield washer pump, to spray fluid from the windshield washer fluid reservoir onto the windshield. When the switch is released, ground is removed from terminal 24 of monitor controller and display A5, and the washer motor stops.

FOLDOUT PAGE 4-91 IS AT REAR OF MANUAL

❶ WINDSHIELD WIPER AND WASHER CIRCUIT DIAGNOSTIC PROCEDURES

IMPORTANT: Do not disconnect electrical connectors while the engine is running. Damage to Monitor Controller or other components may result. Disconnect connectors only when instructed during a test or check.

NOTE: If windshield wiper does not operate, first check the latch on the upper right corner of the windshield. The windshield must be all the way down and the right latch must be secured to contact the windshield wiper enable switch, which allows the wiper to operate.

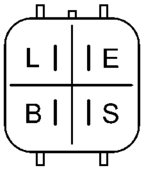
Before troubleshooting the circuits, clean all terminals in the monitor controller and harness connectors using a non-conductive lubricating contact cleaner, then try the circuit operation again before proceeding. TY16324 Contact Cleaner can be used.

– – –1/1

WINDSHIELD WIPER 10 AMP FUSE (F12) CHECK	Remove fuse block cover. Remove fuse from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. **NO:** Replace Fuse. If fuse blows again, check for short.

– – –1/1

WINDSHIELD WIPER MOTOR (M3) RUN AND INTERMITTENT STOP CHECK



T118388

T118388 –UN–21NOV98

Disconnect harness from windshield wiper motor.

Connect wiper motor connector terminal E to connector terminal S.

Connect +24 volts to wiper motor connector terminal L.

If the windshield wiper was in the park position, did it operate for one sweep, then stop in the intermittent stop position?

Connect wiper motor connector terminal E to ground (while still connected to S).

Does windshield wiper operate?

Remove ground from terminal E.

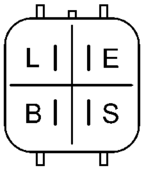
Does windshield wiper continue operating until wiper blade reaches intermittent park position, then stop?

YES: Check harness, wiper relays and monitor controller.

NO: Replace windshield wiper motor.

– – –1/1

WINDSHIELD WIPER MOTOR (M3) PARK CIRCUIT CHECK



T118388

T118388 –UN–21NOV98

With key switch ON, move windshield wiper switch to INT.

When wiper stops in intermittent stop position, turn key switch OFF, then turn windshield wiper switch OFF.

Disconnect harness from windshield wiper motor.

Connect wiper motor connector terminal L to connector terminal B.

Connect +24 volts to wiper motor connector terminal E.

Ground wiper motor connector terminal S.

Does wiper motor operate until wiper blade reaches park position?

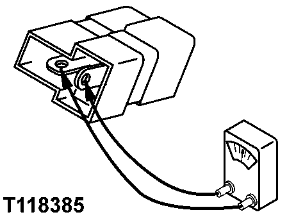
YES: Check harness, wiper relays and monitor controller.

NO: Replace windshield wiper motor.

– – –1/1

WINDSHIELD WIPER MOTOR SUPPRESSION DIODE (V6, V7) CHECK

NOTE: A diode can fail in two modes, either shorted or open. Continuity will be measured in one direction only in a serviceable diode.



T118385

T118385 –UN–21NOV98

The windshield wiper diodes are located inside right console lower cover.

Remove diodes from connectors.

Connect an ohmmeter to diode terminals.

Is continuity measured?

Reverse ohmmeter probes.

Is continuity measured?

Install diodes in connectors.

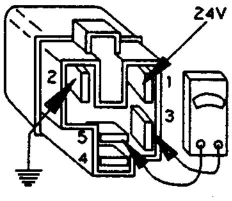
YES: If continuity is measured in both checks, diode has failed in a shorted mode. Replace.

NO: If continuity is NOT measured in either check, diode has failed in an open mode. Replace.

NO: If continuity is measured in one check and not the other, diode is OK. Check wiring harness and monitor controller

– – –1/1

WINDSHIELD WIPER RELAY (MOTOR GROUND AND INTERMITTENT) (K6), WINDSHIELD WIPER RELAY (WIPER RUN) (K7), WINDSHIELD WIPER RELAY (HOLD FOR PARK) (K8) AND WINDSHIELD WIPER RELAY (MOTOR GROUND FOR PARK) (K9) CHECK



T7447BG –19–14JAN91

1—24-Volt Terminal
2—Ground Terminal
3—Relay Common
4—Relay Normal Closed
5—Relay Normal Open

Disconnect relay from harness.

Connect ohmmeter to relay terminals 3 and 4.

Does ohmmeter read continuity?

Connect 24 volts to relay terminal 1 and ground terminal 2.

Does relay “click”?

With 24 volts still connected to terminal 1, connect ohmmeter to terminals 3 and 5.

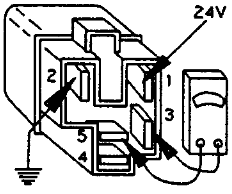
Does ohmmeter read continuity?

YES: Relay is OK.

NO: Relay has failed. Replace.

– – –1/1

WINDSHIELD WASHER RELAY (K2) CHECK



T7447BG –19–14JAN91

1—24-Volt Terminal
2—Ground Terminal
3—Relay Common
4—Relay Normal Closed
5—Relay Normal Open

Disconnect relay from harness.

Connect ohmmeter to relay terminals 3 and 4.

Does ohmmeter read continuity?

Connect 24 volts to relay terminal 1 and ground terminal 2.

Does relay “click”?

With 24 volts still connected to terminal 1 connect ohmmeter to terminals 3 and 5.

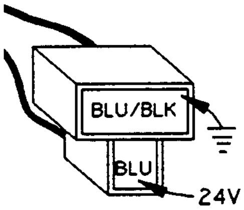
Does ohmmeter read continuity?

YES: Relay is OK.

NO: Relay has failed. Replace.

– – –1/1

WINDSHIELD WASHER MOTOR (M4) CHECK



T7395EG –UN–15OCT90

Disconnect harness from windshield washer motor.

Connect 24 volts to BLUE wire terminal in washer motor connector.

Ground BLUE/BLACK wire terminal in washer motor connector.

Does windshield washer motor operate?

YES: Check wiring harness and monitor controller.

NO: Replace windshield washer motor.

– – –1/1

WINDSHIELD WIPER ENABLE SWITCH (S14) CHECK

Slide upper windshield up.

Remove windshield wiper enable switch retaining plate located in upper right hand corner of cab.

Connect ohmmeter across pins 1 and 2 of the switch and actuate the switch.

Is continuity measured when switch is actuated and no continuity when switch is not actuated?

YES: Windshield wiper enable switch is OK.

NO: Check wiring harness and monitor controller.

– – –1/1

WINDSHIELD WIPER ENABLE SWITCH (S14) HARNESS CHECK	Slide upper windshield up. Remove windshield wiper enable switch retaining plate located in upper right hand corner of cab. Using an ohmmeter, measure resistance of harness wire from enable switch pin 1 to pin 6 of monitor controller 12-pin connector, and from enable switch pin 2 to ground. Is continuity measured in both checks?	**YES:** Windshield wiper enable switch harness is OK. **NO:** Check monitor controller. – – –1/1

WORK AND DRIVE LIGHT CIRCUIT OPERATIONAL INFORMATION

In order for the work and drive light circuits to function, the key switch must be in the ACC or ON position.

CED,OUOE012,134 –19–16MAR99–1/1

WORK AND DRIVE LIGHT CIRCUIT THEORY OF OPERATION

When the key switch is in the ON or ACC position, power is applied from work and drive light 10-amp fuse F11 to terminals 1 and 3 of work and drive light relays K3 and K4.

When drive and work light switch S10 is moved to position 1, drive light relay K4 is energized by ground applied to relay terminal 2 from terminal 19 of monitor and controller display A5. With the drive light relay energized, power is applied through relay terminals 3 and 5 to drive light E2, and cab lights E7 and E8.

Power from the drive light relay is also applied to terminal 41 of monitor controller and display A5, terminal 8 of engine mode and speed control unit A4, and the ILLUM terminal of radio A1 for panel illumination.

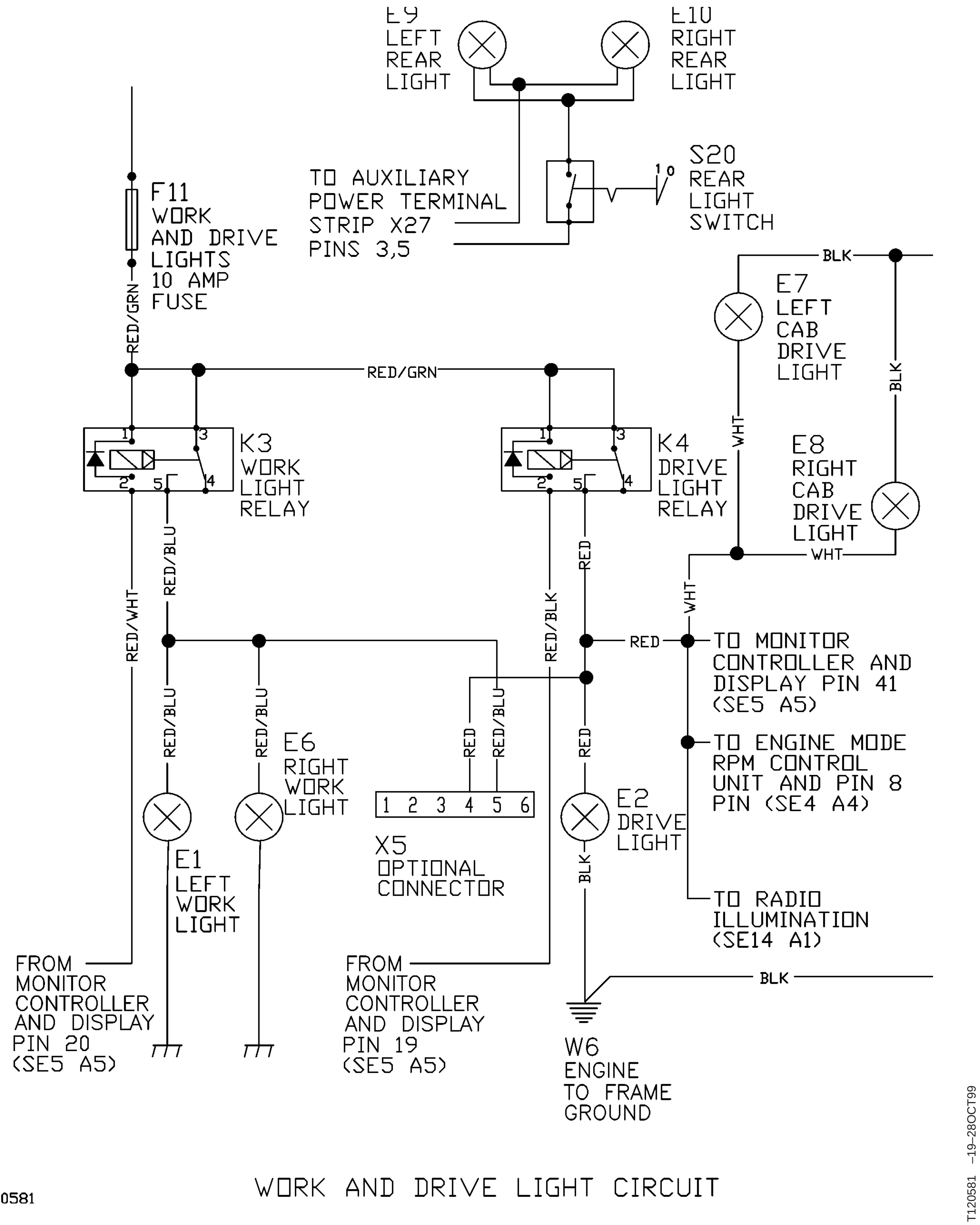
When the light switch is moved to position 2, terminal 20 of the monitor controller and display is also grounded (terminal 19 remains grounded), energizing work light relay K3 as well. With the work light relay energized, power is applied through relay terminals 3 and 5 to work lights E1 and E6.

Relays K3 and K4 also apply power to pins 5 (work light) and 4 (drive light) of optional connector X5 to provide for connection of additional lights.

When the key switch is in the ON or ACC position, power is also applied from auxiliary power fuse F19 through terminal 3 of terminal strip X27, to rear light switch S20. When switch S20 is On, power is applied to left and right rear lights E9 and E10. The ground path for the rear lights is provided through X27 terminal 5 to cab ground.

CED,OUOE012,135 –19–16MAR99–1/1

WORK AND DRIVE LIGHT CIRCUIT SCHEMATIC



Work and Drive Light Circuit

CED,OUOE012,189 –19–27MAY99–1/1

❶ WORK AND DRIVE LIGHT CIRCUIT DIAGNOSTIC PROCEDURES

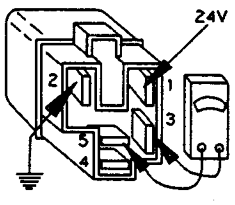
IMPORTANT: Do not disconnect electrical connectors while the engine is running. Damage to Engine and Pump Controller or other components may result. Disconnect connectors only when instructed during a test or check.

NOTE: Before troubleshooting the circuits, clean all terminals in the monitor controller and harness connectors using a non-conductive lubricating contact cleaner, then try the circuit operation again before proceeding. TY16324 Contact Cleaner can be used.

– – –1/1

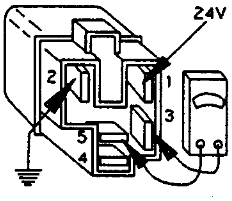
WORK AND DRIVE LIGHTS 20 AMP FUSE (F11) CHECK	Remove fuse block cover. Remove fuse from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. **NO:** Replace Fuse. If fuse blows again, check for short.

– – –1/1

DRIVE LIGHT RELAY (K4) CHECK	 T7447BG –19–14JAN91 **1—24 Volt Terminal** **2—Ground Terminal** **3—Relay Common** **4—Relay Normally Closed** **5—Relay Normally Open** Disconnect harness from relay. Connect ohmmeter to terminals 3 and 5. Does ohmmeter read open? Connect 24 volts to relay terminal 1 and ground terminal 2. Does relay “click”? With 24 volts still connected to terminal 1, connect ohmmeter to terminals 3 and 5. Does ohmmeter read continuity?	**YES:** Relay is OK. **NO:** Relay has failed. Replace.

– – –1/1

WORK LIGHT RELAY (K3) CHECK



T7447BG –19–14JAN91

1—24-Volt Terminal
2—Ground Terminal
3—Relay Common
4—Relay Normally Closed
5—Relay Normally Open

Disconnect harness from relay.

Connect ohmmeter to terminals 3 and 5.

Does ohmmeter read open?

Connect 24 volts to relay terminal 1 and ground terminal 2.

Does relay 'click'?

With 24 volts still connected to terminal 1, connect ohmmeter to terminals 3 and 5.

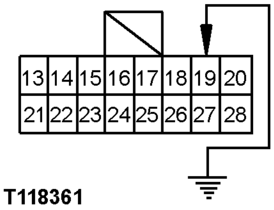
Does ohmmeter read continuity?

YES: Relay is OK.

NO: Relay has failed. Replace.

– – –1/1

DRIVE LIGHTS (E2, E7, E8) CIRCUIT CHECK



T118361 –UN–21NOV98

Disconnect 16-pin harness connector from monitor controller and display panel.

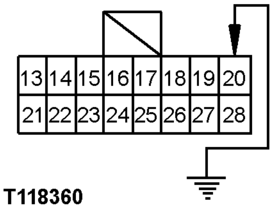
Ground harness connector pin 19.

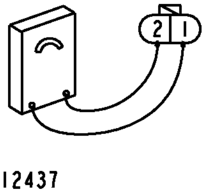
Do drive light E2 and left and right cab lights E7 and E8 operate with key switch in ACC position?

YES: Light switch on monitor controller and display panel has failed. Replace.

NO: Check light bulbs, wire harness and drive light relay.

– – –1/1

WORK LIGHTS (E1) CIRCUIT CHECK	 T118360 –UN–21NOV98 Disconnect 16-pin harness connector from monitor controller and display panel. Ground harness connector pin 20. Do work lights E1 and E6 operate with key switch in ACC position?	**YES:** Light switch on monitor controller and display panel has failed. Replace. **NO:** Check light bulbs, wire harness, and work light relay. – – –1/1

REAR LIGHTS (E9, E10) CIRCUIT CHECK	Remove fuse block cover. Remove fuse F19 from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. Go to next step. **NO:** Replace Fuse. If fuse blows again, check circuit for short.
	 T112437 –UN–05DEC97 Disconnect harness connector from rear lights switch S20. Connect ohmmeter across switch connector pins. Does ohmmeter read open with switch Off, and continuity with switch On?	**YES:** Light switch is OK. Check light bulbs and wire harness **NO:** Switch has failed. Replace. – – –1/1

ACCESSORY CIRCUITS OPERATIONAL INFORMATION

In order for the circuits to function, the key switch must be in the ACC or ON position.

CED,OUOE012,21 –19–31OCT98–1/1

ACCESSORY CIRCUITS THEORY OF OPERATION

The accessory circuits include the horns (B25, B26), the cab dome light (E3), and the 24-volt power plug (G4).

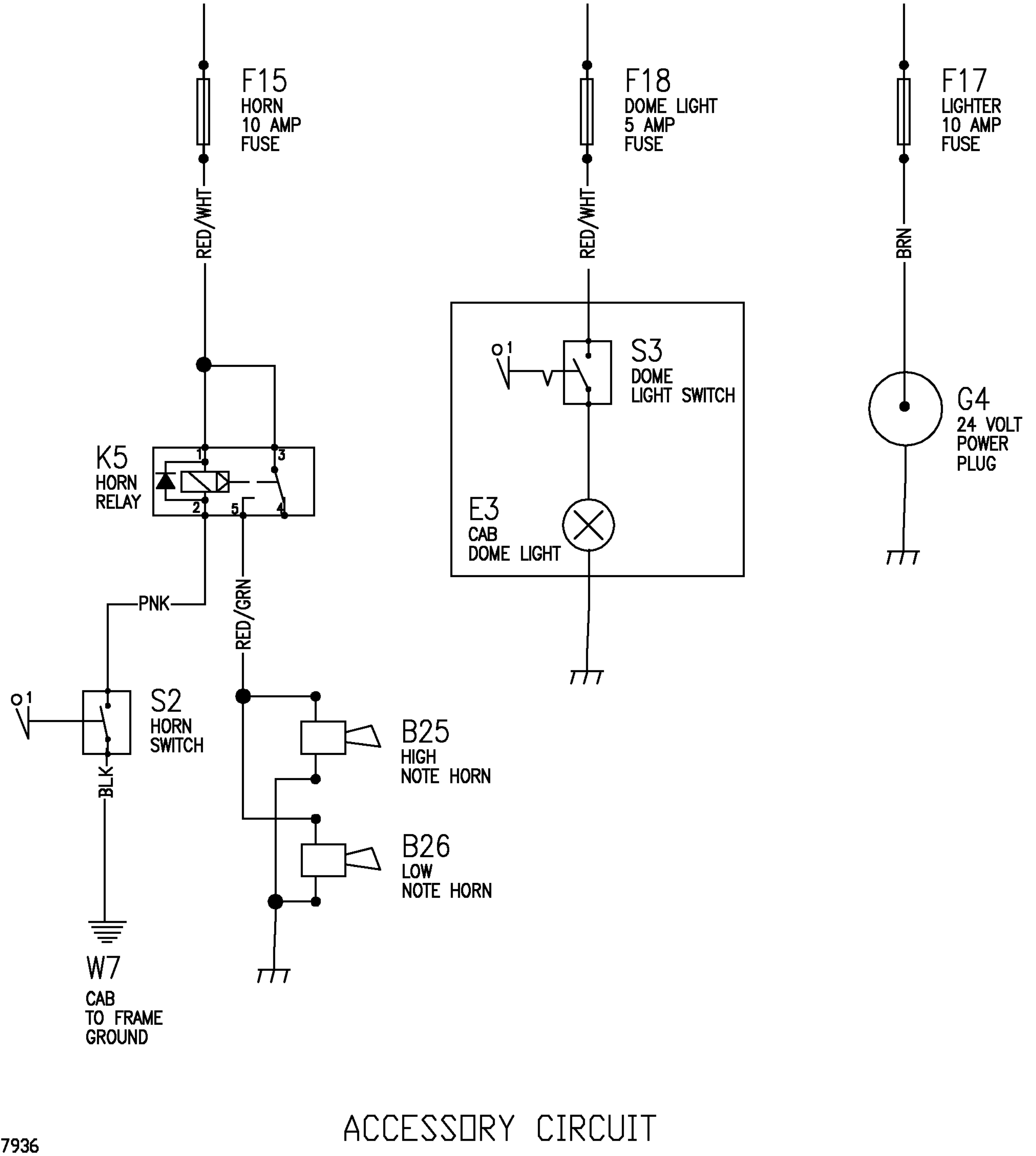
Power from horn 10-amp fuse F15 is applied to terminal 1 and 3 of horn relay K5. When horn switch S2 is pressed, the closed contacts of the switch apply ground to terminal 2 of the horn relay, and the relay is energized. With the relay is energized, power is applied from relay terminal 5 to high and low note horns B25 and B26, sounding the horns.

Power from dome light 5-amp fuse F18 is applied to dome light switch S3. When the switch is turned ON, power is applied to cab dome light E3, turning the light on.

Power from lighter 10-amp fuse F17 is applied to 24-volt power plug G4.

CED,OUOE012,22 –19–31OCT98–1/1

ACCESSORY CIRCUITS SCHEMATIC



T117936 –19–18NOV98

CED,OUOE012,23 –19–31OCT98–1/1

➊ ACCESSORY CIRCUITS DIAGNOSTIC PROCEDURES

IMPORTANT: Do not disconnect electrical connectors while the engine is running. Damage to Engine and Pump Controller or other components may result. Disconnect connectors only when instructed during a test or check.

– – –1/1

HORN 10 AMP FUSE (F15) CHECK	Remove fuse block cover. Remove fuse from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. **NO:** Replace Fuse. If fuse blows again, check for short.

– – –1/1

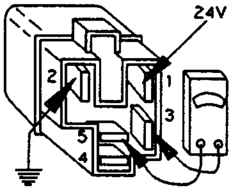
DOME LIGHT 5 AMP FUSE (F18) CHECK	Remove fuse block cover. Remove fuse from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. **NO:** Replace Fuse. If fuse blows again, check for short.

– – –1/1

LIGHTER 10 AMP FUSE (F17) CHECK	Remove fuse block cover. Remove fuse from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. **NO:** Replace Fuse. If fuse blows again, check for short.

– – –1/1

HORN RELAY (K5) CHECK



T7447BG –19–14JAN91

1—24-Volt Terminal
2—Ground Terminal
3—Relay Common
4—Relay Normally Closed
5—Relay Normally Open

Disconnect harness from relay.

Connect ohmmeter to terminals 3 and 4.

Does ohmmeter read continuity?

Connect 24 volts to relay terminal 1 and ground terminal 2.

Does relay “click”?

With 24 volts still connected to terminal 1, connect ohmmeter to terminals 3 and 5.

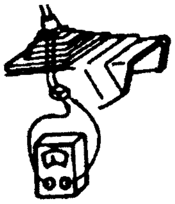
Does ohmmeter read continuity?

YES: Relay is OK.

NO: Relay has failed. Replace.

– – –1/1

HORN SWITCH (S2) CHECK



T108586 –UN–31MAR97

Remove bottom cover from left arm rest.

Disconnect wire harness from horn switch.

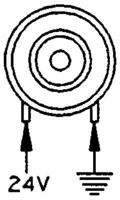
Connect ohmmeter to both wires (pink and black) and push horn button.

Does ohmmeter read continuity?

YES: Horn switch OK. Check wiring harness and horns.

NO: Replace switch.

– – –1/1

HIGH NOTE HORN (B25) AND LOW NOTE HORN (B26) CHECK	 T7469AF –UN–11MAR91	Disconnect wire harness from horns. Connect 24 volts to one terminal of either horn and connect other horn terminal to ground. Does horn sound? Repeat check on other horn.	**YES:** Check wire harness. **NO:** Replace horn.

– – –1/1

QUICK HITCH CIRCUIT OPERATIONAL INFORMATION

In order for the circuit to function, the key switch must be in the ACC or ON position.

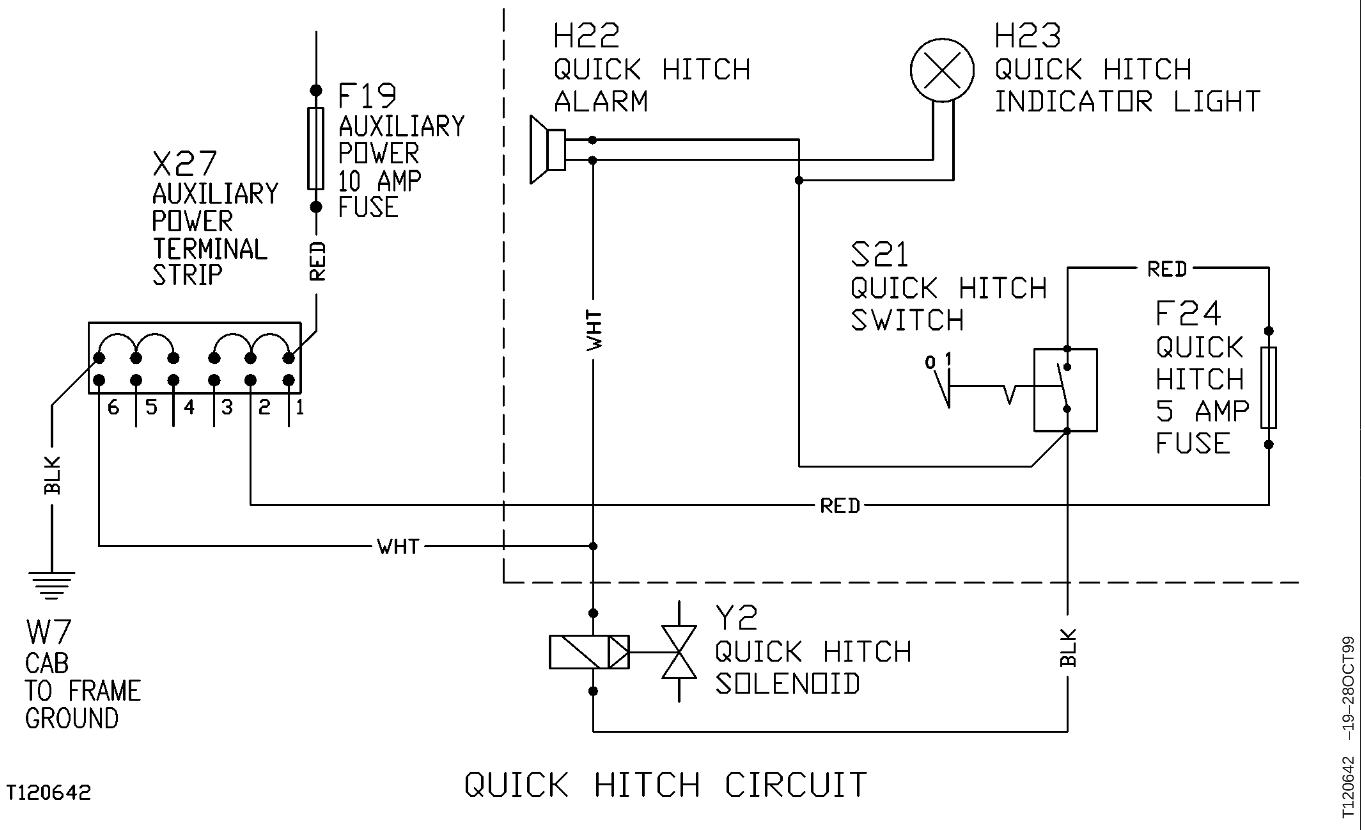
CED,OUOE012,131 –19–15MAR99–1/1

QUICK HITCH CIRCUIT THEORY OF OPERATION

With the key switch in the ON or ACC position, power is applied from auxiliary fuse F19 to quick hitch fuse F24 via terminal 2 of auxiliary terminal strip X27. When quick hitch switch S21 is moved to the UNLATCH (closed) position, power from fuse F24 is applied through the switch to solenoid Y2, energizing the solenoid. With the switch in the UNLATCH position, power is also applied from to warning light H23 and audible alarm H22.

CED,OUOE012,132 –19–15MAR99–1/1

QUICK HITCH CIRCUIT SCHEMATIC



Quick Hitch Circuit

CED,OUOE012,133 –19–15MAR99–1/1

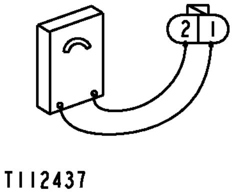
❶ QUICK HITCH CIRCUIT DIAGNOSTIC PROCEDURES

– – –1/1

1a AUXILIARY 10 AMP FUSE (F19) CHECK	Remove fuse block cover. Remove fuse from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. **NO:** Replace Fuse. If fuse blows again, check for short.

– – –1/1

1b QUICK HITCH CONTROL BOX (A6) CHECK



T112437 –UN–05DEC97

Position boom so implement is resting on ground.

Turn key Switch OFF

Remove harness connector from hitch solenoid.

connect voltmeter to pins 1 and 2 of harness connector.

Turn key switch ON.

⚠ **CAUTION: Do not move control box switch to UNLATCH position unless implement or quick hitch is resting on ground.**

Move control box switch to UNLATCH position.

Does voltmeter read 24 volts?

Does hitch indicator light come on?

Does hitch warning alarm sound?

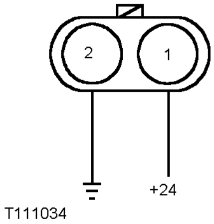
Move control box switch to LATCH position

YES: Control box is OK. Go to next check.

NO: Repair or replace control box.

– – –1/1

1c HITCH SOLENOID (Y2) CHECK



T111034 –UN–21AUG97

Disconnect harness from hitch solenoid.

Connect 24 volts to solenoid terminal No. 1 and ground terminal No. 2.

Does solenoid click?

Reconnect harness.

YES: Solenoid is OK.

NO: Solenoid has failed. Replace.

– – –1/1

HEATER CIRCUIT (MACHINES WITHOUT AIR CONDITIONER)

See Group 9031.

CED,OUOE012,43 –19–10NOV98–1/1

HEATER CIRCUIT (MACHINES WITH AIR CONDITIONER)

See Group 9031.

CED,OUOE012,44 –19–10NOV98–1/1

MONITOR CONTROLLER AND DISPLAY CIRCUIT SPECIFICATIONS

Fuel Sending Unit—Specification

Resistance .... 10 +0 -4 Ohms With Fuel Gauge Reading Full

Fuel Sending Unit—Specification

Resistance .... 38 ± 5 Ohms With Fuel Gauge Reading Half

Fuel Sending Unit—Specification

Resistance .... 90 +10 -0 Ohms With Fuel Gage Reading Empty

Fuel Level Switch Closes At—Specification

Level .... 112 mm (4.4 in.) Fuel In Tank Or Less (30.3—37.9 L) (8—10 Gal)

Engine Oil Pressure Switch Opens At—Specification

Level .... Above 172 kPa (1.72 bar) (24.9 psi)

Engine Oil Pressure Switch Closes At—Specification

Level .... Below 103 kPa (1.03 bar) (14.9 psi)

Engine Coolant Temperature Switch Closes On—Specification

Increasing Temperature.......................... 110°C ± 3°C (230°F ± 37°F)
Maximum

Engine Coolant Temperature Switch Opens On—Specification

Decreasing Temperature... 95°C (203°F)
Minimum

Alternator Charge Light Illuminates At Alternator Excitation Field Output—Specification

Voltage.. 10 ± 1.5 Volts Or Less

Alternator Charge Light Goes Out At Alternator Excitation Field Output—Specification

Voltage... 13 ± 1.5 Volts Or More

Air Filter Restriction Switch Closes At—Specification

Vacuum.. 6.23 kPa ± 1.25 kPa
Vacuum.. 1.84 ± 0.36 in Hg
Vacuum... 25 ± 2.3 in. water

Coolant Temperature Gauge Needle Position At—Specification

Temperature .... 60°C (140°F) Beginning Of Green Area (Cold)
Temperature .... 104°C (219°F) End Of Green Area (Cold)
Temperature .... 110°C (230°F) Beginning Of Red Area (Hot)
Temperature .... 135°C (275°F) End Of Red Area (Hot)

Engine Coolant Temperature Sensor—Specification

Resistance .... 63 Ohms At 60°C (140°F)
Resistance .... 14 Ohms At 104°C (219°F)
Resistance .... 15 Ohms At 110°C (230°F)
Resistance .... 3 Ohms At 135°C (275°F)

Charge Air Temperature Switch Closes At—Specification

Temperature .... 100°C (212°F)

Continued on next page

Hydraulic Filter Restriction Switch Closes At—Specification

Vacuum	6.23 kPa ± 1.25 kPa
Vacuum	1.84 ± 0.36 in Hg
Vacuum	25 ± 2.3 in. water

CED,OUOE012,25 –19–09MAR99–2/2

MONITOR CONTROLLER AND DISPLAY CIRCUIT OPERATIONAL INFORMATION

The key switch must ON for the circuit to function.

CED,OUOE012,26 –19–31OCT98–1/1

MONITOR CONTROLLER AND DISPLAY CIRCUIT THEORY OF OPERATION

The monitor controller and display (A5) contains gauges and indicators, sensor inputs, and switches. The gauges and indicators display the status of machine systems and control switches. The sensor inputs are used by the monitor controller to monitor the status of the machine systems, and the switches are used to control or select machine functions by providing control signal outputs to other machine systems. The illumination of the indicators and the status of control signal outputs are controlled by logic circuits and drivers in the monitor controller in response to the sensor inputs and control switch settings.

Operating power to controller and display is applied from monitor controller and display fuse F5 to terminals 39 and 40. Cab frame ground is applied to terminal 37. Backup power for the controller logic circuits is applied from radio and monitor controller fuse F1 to monitor controller terminal 39.

HOURMETER AND GAUGES

Operating power for the hourmeter is applied from fuse F5 to controller terminal 29, and the controller monitors the alternator excitation field at terminal 42. When the engine is running and the alternator excitation field voltage is greater than 11.5 volts, the hourmeter operates.

The engine coolant temperature and fuel level gauges (P2 and P3) are controlled by coolant temperature and fuel level senders B9 and B8, which provide a variable resistance to ground for the gauges.

Temperature sender B9 is applied to controller terminal 47, and fuel level sender B8 is applied to terminal 46.

STATUS INDICATORS

When the key switch is turned to ON, the monitor controller and display performs a lamp check by illuminating all the status indicators. After 2 - 3 seconds the lamp check mode ends, and indicator lamp illumination is controlled by the sensor inputs.

AIR FILTER RESTRICTION INDICATOR LIGHT (H14)

The air filter restriction switch (B1) is a normally open switch that closes to machine ground when a restriction is sensed with the engine running. The machine ground is applied to controller terminal 3, causing the indicator to illuminate.

FUEL LEVEL INDICATOR LIGHT (H13)

The fuel level switch (B2) is normally open when fuel is in the tank, and closes to machine ground when the fuel level is below 112 mm (4.4 in.). The machine ground is applied to controller terminal 2, causing the indicator to illuminate.

ENGINE COOLANT TEMPERATURE INDICATOR LIGHT (H16)

The engine coolant temperature switch (B3) is a normally open switch that closes to machine ground when the coolant temperature exceeds 105 ± 5°C (221 ± 35°F). The machine ground is applied to controller terminal 1, causing the indicator to illuminate.

ENGINE OIL PRESSURE INDICATOR (H17)

The engine oil pressure switch (B4) is normally closed and opens with the engine running. When the oil pressure falls below 39 kPa (.039 bar) (5.7 psi) the switch closes to machine ground. The machine ground is applied to controller terminal 10, causing the indicator to illuminate.

Continued on next page

HYDRAULIC OIL LEVEL INDICATOR (H12)

Hydraulic oil level switch (B5) is a normally open switch, held closed when the oil level is adequate. The machine ground is applied to controller terminal 9. The monitor controller only checks the status of terminal 9 when the fluid level switch (S5) is pressed. If ground is present when the switch is pressed, the indicator illuminates.

ENGINE COOLANT LEVEL INDICATOR (H20)

Engine coolant level switch (B6) is a normally open switch, held closed when the coolant level is adequate. The machine ground is applied to controller terminal 8. The monitor controller only checks the status of terminal 8 when the fluid level switch (S5) is pressed. If ground is present when the switch is pressed, the indicator illuminates.

ENGINE OIL LEVEL INDICATOR (H19)

Engine oil level switch (B7) is a normally open switch, held closed with adequate oil level. The machine ground is applied to controller terminal 7. The monitor controller only checks the status of terminal 7 when the fluid level switch (S5) is pressed. If ground is present when the switch is pressed, the indicator illuminates.

ALTERNATOR VOLTAGE INDICATOR (H18)

The alternator voltage indicator is controlled by the alternator excitation field voltage monitored by the controller at terminal 42. When the alternator excitation field voltage drops below 10 ± 1.5 volts the indicator illuminates. When the alternator excitation field voltage goes above 13 ± 1.5 volts the indicator goes out.

CHARGE AIR TEMPERATURE INDICATOR (H15)

Charge air temperature switch (B12) is a normally open switch that closes to machine ground when the charge air temperature exceeds 100°C (212°F) . The machine ground is applied to controller terminal 44, causing the indicator to illuminate.

HYDRAULIC OIL FILTER RESTRICTION INDICATOR (H21)

The hydraulic oil filter restriction switch (B30) is a normally open switch that closes to machine ground when the differential pressure in the hydraulic oil filter exceeds 15 psi. The machine ground is applied through switch B31 to controller pin 43, causing the indicator to illuminate.

MONITOR CONTROLLER AND DISPLAY ALARM (H8)

The monitor controller and display alarm sounds when the engine oil pressure is low, or the engine coolant overheats. When the buzzer stop switch (S6) is pressed and released, the buzzer stops sounding and the buzzer function is automatically reset for the engine coolant overheat function. The buzzer cannot be turned off when the oil pressure is low.

The buzzer is reset by turning the key switch to OFF. The buzzer will not sound more than once for the same problem unless it has been reset.

CONTROL SWITCHES AND INDICATORS

WIPER SPEED SWITCH (S9)

The wiper speed switch is used to select intermittent or continuous windshield wiper operation. The monitor controller provides ground switched outputs to the windshield wiper circuit from controller terminals 24, 26 27, and 28 based on the setting of the wiper speed switch. If the windshield is open, a ground from windshield wiper enable switch S14 is allied to monitor controller terminal 6, disabling the wiper speed switch.

WINDSHIELD WASHER SWITCH (S15)

When the windshield washer switch is pressed, the monitor controller provides a ground switched output to the windshield washer circuit from controller terminal 25.

Continued on next page

DRIVE AND WORK LIGHT SWITCH (10)

The drive and work light switch provides ground switched outputs to the light circuits. When the switch is moved to position 1, controller terminal 19 (drive light) is grounded. When the switch is moved to position 2, controller terminals 19 and 20 (work light) are grounded.

WORK MODE SELECTION SWITCH (S7)

The work mode selection switch selects the machine operating modes (dig, grading, precision, or attachment). Each time the switch is pressed the mode selection is stepped to the next mode and the corresponding mode indicator (H1, H2, H3 or H4) is illuminated. The monitor controller provides different combinations of ground switched outputs to the engine and pump controller depending on the mode selected. The outputs are applied to mode 1 and mode 2 monitor controller terminals 21 and 22.

PROPEL SPEED CHANGE SWITCH (S8)

The propel speed change switch selects slow or fast operating speed. When the switch is moved to fast speed, the monitor controller speed selection output to the engine controller at terminal 17 is grounded.

AUTO IDLE (A/I) SWITCH (S13)

When the auto idle (A/I) switch is pressed, the A/I indicator illuminates and the monitor controller provides a ground output to the engine motor and pump controller from terminal 13.

ENGINE MODE AND RPM CONTROL UNIT (A4)

ECONOMY (E) MODE SWITCH (S11)

When the economy (E) mode switch is pressed, a ground is applied from engine mode and RPM control unit terminal 2 to monitor controller terminal 35, causing the economy mode to be selected. With the economy mode selected, the monitor controller illuminates the economy mode indicator light (H6), and provides an output signal to the engine and pump controller from terminal 15. Ground for the mode switch is applied to engine mode and RPM control unit terminal 1.

HIGH POWER (HP) MODE SWITCH (S12)

When the high power (HP) mode switch is pressed, a ground is applied from engine mode and RPM control unit terminal 4 to monitor controller terminal 34, causing the high power mode to be selected. With the high power mode selected, the monitor controller illuminates the high power mode indicator light (H5), and provides an output signal to the engine and pump controller from terminal 23. Ground for the mode switch is applied to engine mode and RPM control unit terminal 3

ENGINE RPM DIAL (R10)

The engine RPM dial provides a variable voltage to engine and pump controller terminal D21 from engine mode and RPM control unit terminal 6 based on the setting of the RPM dial. Power for the RPM dial is applied across engine mode and RPM control unit terminals 5 and 7.

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FOLDOUT PAGE 4-115 IS AT REAR OF MANUAL

MONITOR CONTROLLER AND DISPLAY CIRCUIT DIAGNOSTIC PROCEDURES

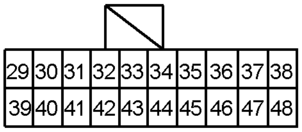
IMPORTANT: Do not disconnect electrical connectors while the engine is running. Damage to Engine and Pump Controller or other components may result. Disconnect connectors only when instructed during a test or check.

NOTE: Before troubleshooting the circuits, clean all terminals in the monitor controller and harness connectors using a non-conductive lubricating contact cleaner, then try the circuit operation again before proceeding. TY16324 Contact Cleaner can be used.

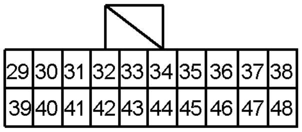
– – –1/1

MONITOR CONTROLLER AND DISPLAY 5 AMP FUSE (F6) CHECK	Remove fuse block cover. Remove fuse from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. **NO:** Replace Fuse. If fuse blows again, check for short.

– – –1/1

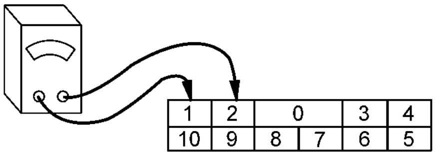
MONITOR CONTROLLER AND DISPLAY (A5) HARNESS POWER CHECK	 **T118378** T118378 –UN–21NOV98 Turn key switch OFF. Disconnect 20-pin harness connector from monitor controller and display. Measure voltage on pins 30, 39 and 40 of harness connector. Is 24 volts measured?	**YES:** Go to next check. **NO:** Repair harness.

– – –1/1

MONITOR CONTROLLER AND DISPLAY (A5) HARNESS GROUND CHECK	 **T118378** T118378 –UN–21NOV98 Turn key switch OFF. Disconnect 20-pin harness connector from monitor controller and display. Measure continuity from pin 37 of harness connector to cab frame. Is continuity measured?	**YES:** Monitor controller has failed. Replace. **NO:** Repair wiring harness. – – –1/1

ECONOMY MODE INDICATOR LIGHT (H6) CHECK	With key switch ON and economy mode OFF, push economy (E) mode switch. Does switch stay down and economy mode indicator light come ON? Push economy (E) mode switch again. Does switch return to original position and indicator go OFF?	**YES:** Indicator and switch are OK. **NO:** Go to next check. – – –1/1

ECONOMY (E) MODE SWITCH (S11) CHECK



T118513

T118513 –UN–21NOV98

Turn key switch OFF.

Disconnect engine rpm dial board connector.

Connect ohmmeter between pins 1 and 2 of dial board connector

Measure continuity with economy (E) mode switch in OFF and ON positions.

Does ohmmeter read open with switch in OFF position, and continuity with switch in ON position?

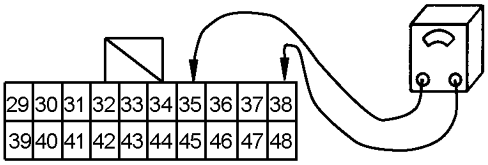
Reconnect engine rpm dial board connector.

YES: Switch is OK. Go to next check.

NO: Switch has failed. Replace.

– – –1/1

ECONOMY (E) MODE SWITCH (S11) HARNESS CHECK



T118512

T118512 –UN–21NOV98

Turn key switch OFF.

Disconnect 20-pin harness connector from monitor controller and display.

Connect ohmmeter between pins 35 and 38 of harness connector

Measure continuity with economy (E) mode switch in OFF and ON positions.

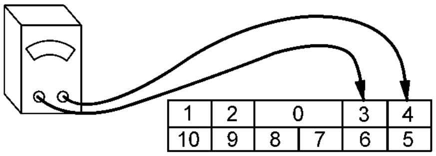
Does ohmmeter read open with switch in OFF position, and continuity with switch in ON position?

YES: Indicator lamp or controller has failed. Replace.

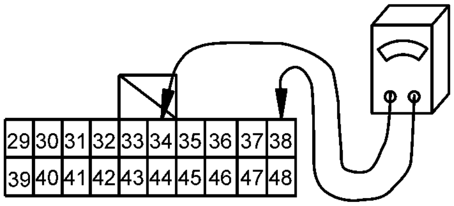
NO: Harness has failed. Repair.

– – –1/1

HIGH POWER MODE INDICATOR LIGHT (H5) CHECK	With key switch ON and high power mode OFF, push high power (HP) mode switch. Does switch stay down and high power mode indicator light come ON? Push high power (HP) mode switch again. Does switch return to original position and indicator go OFF?	**YES:** Indicator and switch are OK. **NO:** Go to next check. – – –1/1

HIGH POWER (HP) MODE SWITCH (S12) CHECK	 **T118515** T118515 –UN–21NOV98 Turn key switch OFF. Disconnect engine rpm dial board connector. Connect ohmmeter between pins 3 and 4 of dial board connector Measure continuity with high power (HP) mode switch in OFF and ON positions. Does ohmmeter read open with switch in OFF position, and continuity with switch in ON position? Reconnect engine rpm dial board connector.	**YES:** Switch is OK. Go to next check. **NO:** Switch has failed. Replace. – – –1/1

HIGH POWER (HP) MODE SWITCH (S12) HARNESS CHECK



T118514

T118514 –UN–21NOV98

Turn key switch OFF.

Disconnect 20-pin harness connector from monitor controller and display.

Connect ohmmeter between pins 34 and 38 of harness connector

Measure continuity with high power (HP) mode switch in OFF and ON positions.

Does ohmmeter read open with switch in OFF position, and continuity with switch in ON position?

YES: Indicator lamp or controller has failed. Replace.

NO: Harness has failed. Repair.

– – –1/1

WORK MODE SELECTION SWITCH (S7), DIG MODE INDICATOR LIGHT (H1), GRADING MODE INDICATOR LIGHT (H2), PRECISION MODE INDICATOR LIGHT (H3) AND ATTACHMENT MODE INDICATOR LIGHT (H4) CHECK

Turn key switch ON.

Push WORKMODE switch several times to cycle through all work mode selections (dig, grading precision, attachments).

Does mode selection change when switch is pressed?

Does each mode indicator come ON as mode is selected?

YES: Switch and indicators are OK.

NO: If modes do not change, switch or monitor controller has failed. Repair or replace.

Replace indicator lamp that does not come ON.

– – –1/1

AUTO IDLE SWITCH (S13) AND AUTO IDLE MODE INDICATOR LIGHT (H7) CHECK

Turn key switch ON.

Push auto idle (A/I) switch.

Does auto idle (A/I) indicator come ON?

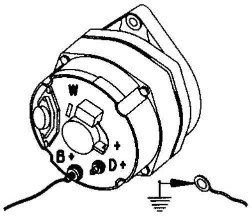
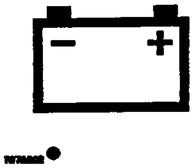
Push auto idle (A/I) again.

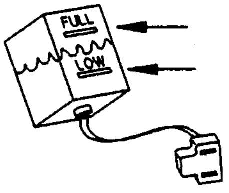
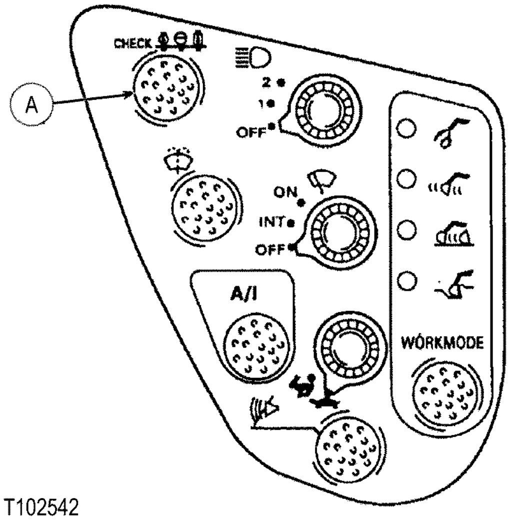
Does auto idle (A/I) indicator go OFF?

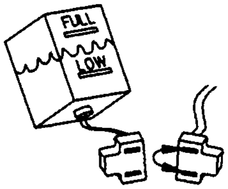
YES: Switch and indicator are OK

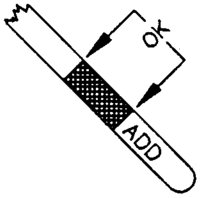
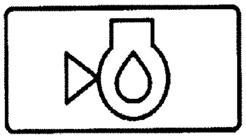
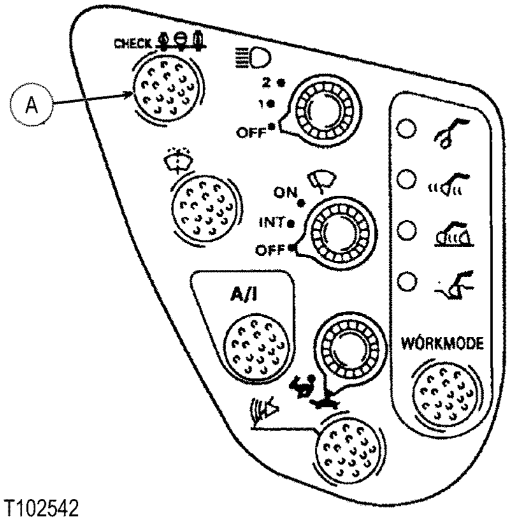
NO: Check indicator lamp. If lamp is OK, switch or controller has failed. Replace.

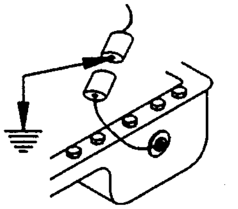
– – –1/1

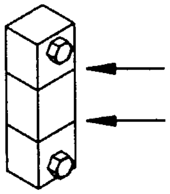
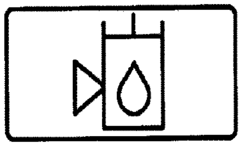
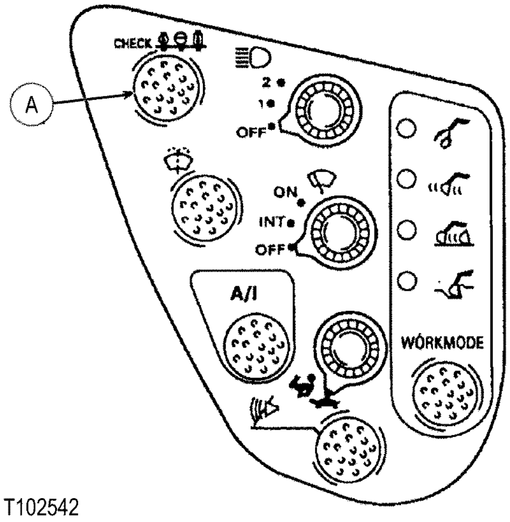
ALTERNATOR VOLTAGE INDICATOR LIGHT (H18) CHECK	 T8322AC –UN–10OCT94  T6768CR –UN–18OCT88 **B+—Battery Terminal** **D+—Excitation Terminal** **IMPORTANT: DO NOT start engine with jumper attached to alternator.** Key switch ON. Engine OFF. Disconnect wire from alternator terminal D+. Connect wire to ground. Is alternator voltage indicator light ON?	**YES:** Go to next check. **NO:** Check wiring harness.
	Remove ground from alternator wire and reconnect to alternator terminal D+. Start engine. Does alternator voltage indicator light go OFF?	**YES:** Indicator light is OK. **NO:** Check wiring harness. – – –1/1

ENGINE COOLANT LEVEL INDICATOR LIGHT (H20) CHECK	 T7469AK –UN–14MAR91 Check coolant level in overflow recovery tank. Be sure level is between FULL and LOW marks. Turn key switch ON. Observe coolant level indicator. Does indicator come ON, then go OFF 2—3 seconds later?	**YES:** Indicator is OK. Go to next step. **NO:** Check indicator lamp.
	 T102542 –UN–29AUG96 **A—Fluid Level Check Switch** Push fluid level check switch. Does coolant level indicator come ON?	**YES:** Engine coolant level switch is OK. **NO:** Go to next check. – – –1/1

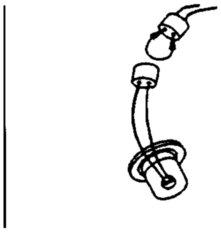
ENGINE COOLANT LEVEL SWITCH (B6) CHECK	 T7469AL –UN–14MAR91 Disconnect harness from engine coolant level switch. Connect a jumper wire between harness connector pins. Turn key switch ON. Push fluid level check switch. Does coolant indicator come ON?	**YES:** Engine coolant level switch has failed. Replace. **NO:** Check wiring harness. – – –1/1

ENGINE OIL LEVEL INDICATOR LIGHT (H19) CHECK	 T7469AM –UN–11MAR91  T101681 –UN–29AUG96 Check oil level in engine pan, be sure level is between FULL and ADD marks on dip stick. Turn key switch ON. Observe engine oil level indicator. Does indicator come ON then go OFF 2—3 seconds later?	**YES:** Indicator is OK. Go to next step. **NO:** Check indicator lamp.
	 T102542 –UN–29AUG96 **A—Fluid Level Check Switch** Push fluid level check switch. Does engine oil level indicator come ON?	**YES:** Engine oil level switch is OK. **NO:** Go to next check. – – –1/1

ENGINE OIL LEVEL SWITCH (B7) CHECK	 T7470AH –UN–11MAR91	Disconnect harness from engine oil level switch. Connect a jumper wire to ground. Turn key switch ON. Push fluid level check switch. Does engine oil level indicator come ON?	**YES:** Engine oil level switch has failed. Replace. **NO:** Check wiring harness. – – –1/1

HYDRAULIC OIL LEVEL INDICATOR LIGHT (H12) CHECK	 T7470AI –UN–11MAR91  T101683 –UN–29AUG96 Check oil level in hydraulic reservoir. Be sure level is between red lines on sight gauge. Turn key switch ON. Observe hydraulic oil level indicator. Does indicator come ON then go OFF 2—3 seconds later?	**YES:** Indicator is OK. Go to next step. **NO:** Check indicator lamp.
	 T102542 –UN–29AUG96 **A—Fluid Level Check Switch** Push fluid level check switch. Does hydraulic oil level indicator come ON	**YES:** Hydraulic oil level switch is OK. **NO:** Go to next check. – – –1/1

HYDRAULIC OIL LEVEL SWITCH (B5) CHECK



T7470AJ –UN–05MAR91

Disconnect harness from hydraulic oil level switch.

Connect a jumper wire between harness connector pins.

Turn key switch ON.

Push fluid level check switch.

Does hydraulic oil level indicator come ON?

YES: Hydraulic oil level switch has failed. Replace.

NO: Check wiring harness.

– – –1/1

HYDRAULIC OIL FILTER RESTRICTION INDICATOR LIGHT (H21) CHECK

Turn key switch ON.

Observe hydraulic oil filter restriction indicator.

Does indicator come ON when key switch is turned ON, then go OFF 2—3 seconds later?

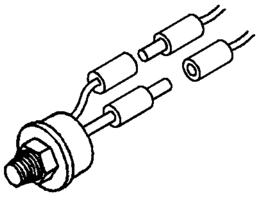
YES: Indicator is OK. Go to next check.

NO: If indicator does not come ON, check indicator lamp.

If indicator does not go OFF, go to next check.

– – –1/1

HYDRAULIC OIL FILTER RESTRICTION SWITCH (B30) CHECK



T118382

T118382 –UN–21NOV98

Disconnect two harness leads from hydraulic oil filter restriction switch.

If indicator was ON, did it go OFF with leads disconnected and key switch ON?

If indicator was OFF, connect two harness leads together.

Does indicator come ON?

YES: Hydraulic oil filter restriction switch has failed. Replace.

NO: Check harness.

– – –1/1

ENGINE COOLANT TEMPERATURE INDICATOR LIGHT (H16) CHECK

T101686 –UN–29AUG96

With engine cool, turn key switch ON.

Observe engine temperature indicator.

Does indicator come ON when key switch is turned ON, then go OFF 2—3 seconds later?

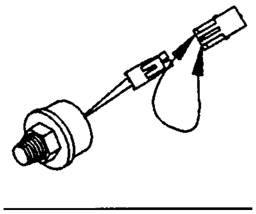
YES: Indicator is OK. Go to next check.

NO: If indicator does not come ON, check indicator lamp.

If indicator does not go OFF, go to next check.

– – –1/1

ENGINE COOLANT TEMPERATURE SWITCH (B3) CHECK



T7470AM –UN–05MAR91

Disconnect harness from engine coolant temperature switch.

If engine coolant temperature indicator was ON, did it go OFF with harness disconnected and key switch ON?

If indicator was OFF, connect a jumper wire between harness connector pins.

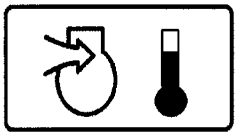
Does indicator come ON when key switch is ON?

YES: Engine coolant temperature switch has failed. Replace.

NO: Check harness.

– – –1/1

CHARGE AIR TEMPERATURE INDICATOR LIGHT (H15) CHECK



T107672
T113692 –UN–24FEB98

Turn key switch ON.

Observe charge air temperature indicator.

Does indicator come ON when key switch is turned ON, then go OFF 2—3 seconds later?

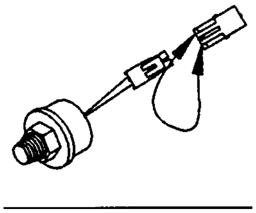
YES: Indicator is OK. Go to next check.

NO: If indicator does not come ON, check indicator lamp.

If indicator does not go OFF, go to next check.

– – –1/1

CHARGE AIR TEMPERATURE SWITCH (B12) CHECK



T7470AM –UN–05MAR91

Disconnect harness from charge air temperature switch.

If indicator was ON, did it go OFF with harness disconnected and key switch ON?

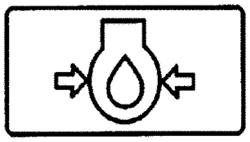
If indicator was OFF, connect a jumper wire between harness connector pins.

Does indicator come ON when key switch is ON?

YES: Charge air temperature switch has failed. Replace.

NO: Check harness.

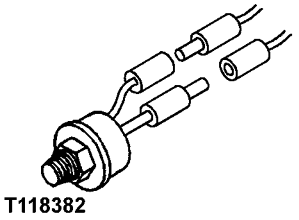
– – –1/1

ENGINE OIL PRESSURE INDICATOR LIGHT (H17) CHECK	 T101684 –UN–29AUG96 Disconnect harness from engine oil pressure switch. Turn key switch ON and observe engine oil pressure indicator. Does indicator come ON when key switch is turned ON, then go OFF 2—3 seconds later?	**YES:** Indicator is OK. Go to next check. **NO:** If indicator does not come ON, check indicator lamp. If indicator does not go OFF, check harness for short. – – –1/1

ENGINE OIL PRESSURE SWITCH (B4) CHECK	Connect harness to engine oil pressure switch. Does indicator come ON with key switch ON?	**YES:** Go to next step. **NO:** Check harness for open. If harness is OK, replace switch.
	Start engine. Observe engine oil pressure indicator. Does indicator go OFF?	**YES:** Engine oil pressure switch is OK. **NO:** Engine oil pressure switch has failed. Replace. – – –1/1

AIR FILTER RESTRICTION INDICATOR LIGHT (H14) CHECK	Turn key switch ON. Observe air filter restriction indicator. Does indicator come ON when key switch is turned ON, then go OFF 2—3 seconds later?	**YES:** Indicator is OK. Go to next check. **NO:** If indicator does not come ON, check indicator lamp. If indicator does not go OFF, go to next check. – – –1/1

AIR FILTER RESTRICTION SWITCH (B1) CHECK



T118382 –UN–21NOV98

Disconnect two harness leads from air filter restriction switch.

If indicator was ON, did it go OFF with leads disconnected and key switch ON?

If indicator was OFF, connect two harness leads together.

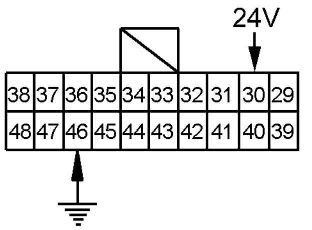
Does indicator come ON when key switch is ON?

YES: Air filter restriction switch has failed. Replace.

NO: Check harness.

– – –1/1

FUEL GAUGE (P3) CHECK



T118389 –UN–30NOV98

Disconnect 20-pin harness connector from monitor display and controller connector.

Connect 24 volts to 20-pin monitor display and controller terminal 30.

Then ground terminal 46.

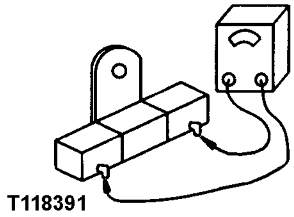
Does gauge needle point to “E” with 24 volts applied to terminal 30, and “F” with terminal 46 grounded?

YES: Gauge and gauge resistor are OK. Go to fuel level sender (B8) check.

NO: Go to next check.

– – –1/1

FUEL GAUGE RESISTOR (220 OHMS) (R5) CHECK



T118391 –UN–21NOV98

NOTE: Check fuel gauge before checking resistor. Resistor is located on bottom of monitor controller panel. Access resistor by removing bottom cover from monitor controller panel.

Connect ohmmeter to resistor terminals.

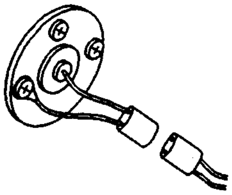
Does ohmmeter read about 220 ohms?

YES: Gauge has failed. Replace.

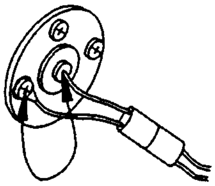
NO: Resistor has failed. Replace.

– – –1/1

FUEL LEVEL SENSOR (B8) CHECK



T7472AE –UN–11MAR91



T7472AD –UN–11MAR91

NOTE: Check fuel gauge before checking sender.

Disconnect harness from fuel level sender.

Observe fuel gauge.

Does gauge needle go to “E”?

Connect jumper wire between harness connector pins.

Does gauge needle go to “F”?

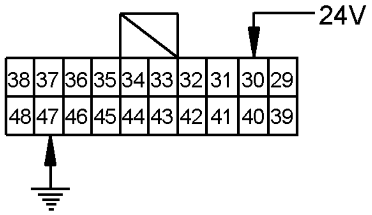
YES: Sender has failed. Replace.

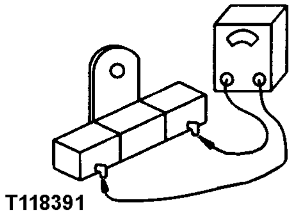
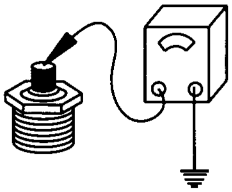
NO: Check harness.

– – –1/1

FUEL LEVEL INDICATOR LIGHT (H13) CHECK	With adequate fuel in tank, turn key switch ON. Observe fuel level indicator. Does indicator come ON when key switch is turned ON, then go OFF 2—3 seconds later?	**YES:** Indicator is OK. Go to next check. **NO:** If indicator does not come ON, check indicator lamp. If indicator does not go OFF, go to next check. – – –1/1

FUEL LEVEL SWITCH (B2) CHECK	Disconnect harness from fuel level switch. If indicator was ON, did it go OFF with harness disconnected and key switch ON? If indicator was OFF, connect a jumper wire between harness connector pins. Does indicator come ON when key switch is ON?	**YES:** Fuel level switch has failed. Replace. **NO:** Check harness. – – –1/1

ENGINE COOLANT TEMPERATURE GAUGE (P2) CHECK	 **T118390** T118390 –UN–21NOV98 Disconnect 20-pin harness connector from monitor display and controller connector. Connect 24 volts to 20-pin monitor display and controller terminal 30. Then ground terminal 47. Does gauge needle point to “C” with 24 volts applied to terminal 30, and “H” with terminal 47 grounded?	**YES:** Gauge and gauge resistor are OK. Go to engine coolant temperature sender (B9) check. **YES:** Go to next check. – – –1/1

ENGINE COOLANT TEMPERATURE GAUGE RESISTOR (150 OHMS) (R4) CHECK	 T118391 –UN–21NOV98 *NOTE: Check engine coolant temperature gauge before checking resistor. Resistor is located on bottom of the monitor controller panel. Access resistor by removing bottom cover from monitor controller panel.* Connect ohmmeter to resistor terminals. Does ohmmeter read about 220 ohms?	**YES:** Gauge has failed. Replace. **NO:** Gauge resistor has failed. Replace. – – –1/1
ENGINE COOLANT TEMPERATURE SENSOR (B9) CHECK	 T8359AJ –UN–10NOV94 *NOTE: Check engine coolant temperature gauge before checking resistor.* Disconnect harness from temperature sender. Connect ohmmeter to sender and ground. Start engine and observe ohmmeter. Does ohmmeter reading decrease as engine becomes warmer?	**YES:** Sender is OK. Check harness. **NO:** Sender has failed. Replace. – – –1/1

ENGINE AND PUMP CONTROLLER CIRCUIT OPERATIONAL INFORMATION

The following conditions must be met for the circuit to function:

Key switch ON and voltage present at the following:

- Engine and pump controller connector terminals B7, D1, D2, A1, and A13
- Relay K10 terminal 1

ENGINE AND PUMP CONTROLLER CIRCUIT THEORY OF OPERATION

The engine and pump controller (EPC) A2 monitors and controls engine speed and all digging functions, propel functions, hydraulic pump functions, and pilot functions.

The EPC applies service codes from EPC terminals B8, B15, and B16 to diagnostic connector X1 for analysis of hydraulic and electrical systems by the diagnostic computer.

ENGINE CONTROL CIRCUITS

ENGINE SPEED CONTROL

The engine speed control circuits monitor and adjust the engine speed to match the operating modes selected. The engine and pump controller (EPC) monitors the engine speed via signals from the engine speed sensor (B16) applied to EPC terminals B6 and B13. The EPC controls the engine speed by sending rotation control signals to the engine control (EC) motor (M2) from terminals A12, A24, A25, and A26. The EC motor is mechanically linked to the engine throttle linkage. As the motor rotates, the engine throttle linkage is moved, changing the engine speed. The engine control (EC) sensor (B17) provides a signal to EPC at terminal D15 indicating the amount of EC motor rotation.

When the engine is started, the dig hydraulic work mode is selected by logic circuit in the monitor controller. Each time work mode select switch is pushed a different work mode is selected (Dig, Grading, Precision, and Attachment).

Operating mode selection signals from the monitor controller and display are applied to EPC terminals B11, D3, D4, D5, and D6. The combination of signals instructs the EPC which mode has been selected.

When an operating mode is changed, the EPC causes the EC motor to rotate, changing the engine speed. When the engine speed matches the requirement for the mode selected, the EC motor stops rotating and the engine speed remains constant. If another mode is selected, the process is repeated until the engine speed has changed to match the new mode speed requirement.

AUTO A/I IDLE MODE

An RPM dial is provided to vary engine speed to any speed between slow idle and fast idle if E or HP modes do not provide a speed adequate to the job. Each time the engine is started, the EPC automatically activates the idle mode to run the engine at the engine rpm dial setting.

When the auto idle mode is activated by the auto idle switch, a signal from the monitor controller is applied to EPC terminal D6 informing the EPC that auto idle is selected. With auto idle selected, mode switches E and HP control engine speed during machine operation. However, if a hydraulic function is not used for more than 4 seconds, the EPC automatically reduces the engine speed to auto idle.

LEARNING SWITCH (S16)

If the engine and pump controller or EC sensor is changed, the EPC learning sequence must be activated the next time engine is started. The learning switch activates the EPC learning sequence by applying a ground to EPC terminal B5. When the switch is activated, the slow idle engine speed is registered in the EPC memory. After maximum power engine speed is stored in EPC memory, the EPC calculates the economy mode (E) speed as a percentage of the slow idle speed.

Continued on next page

HYDRAULIC CONTROL CIRCUITS

The hydraulic control circuits consist of pressure sensors and switches, proportional control solenoids, and power boost switch. The EPC utilizes input signals from the pressure sensors and switches to monitor the machine hydraulic functions. It then controls the propel speed, relief valve pressure, pump swash, and arm regenerative functions by sending control signals to the propel speed, power boost, speed sense, and arm regenerative proportional solenoids.

These circuits control the hydraulic functions of the machine at the same time the EPC is controlling engine speed to provide maximum machine quickness and productivity for the load conditions and operating mode selected.

CED,OUOE012,33 –19–05NOV98–2/2

FOLDOUT PAGE 4-136 IS AT REAR OF MANUAL

➊ ENGINE AND PUMP CONTROLLER CIRCUIT DIAGNOSTIC PROCEDURES

IMPORTANT: Do not disconnect electrical connectors while the engine is running. Damage to Engine and Pump Controller or other components may result. Disconnect connectors only when instructed during a test or check.

NOTE: Before troubleshooting the circuits, clean all terminals in the engine and pump controller, and harness connectors using a non-conductive lubricating contact cleaner, then try the circuit operation again before proceeding. TY16324 Contact Cleaner can be used.

– – –1/1

ENGINE AND PUMP CONTROLLER 10 AMP FUSE (F2) CHECK	Turn key switch OFF. Remove fuse block cover. Remove fuse from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. Check wiring harness **NO:** Replace Fuse. If fuse blows again, check for short.

– – –1/1

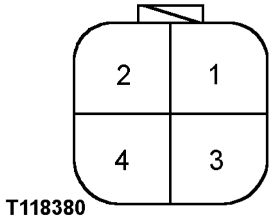
POWER ON FUSE 10 AMP (F5) CHECK	Turn key switch OFF. Remove fuse block cover. Remove fuse from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. Check wiring harness **NO:** Replace Fuse. If fuse blows again, check for short.

– – –1/1

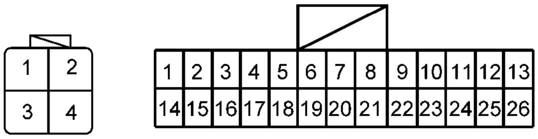
ENGINE CONTROL (EC) MOTOR 10 AMP FUSE (F3) CHECK	Turn key switch OFF. Remove fuse block cover. Remove fuse from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. Check wire from fuse to monitor controller connector D, pins 1 and 2. If OK, go to next check. **NO:** Replace Fuse. If fuse blows again, check for short.

– – –1/1

SOLENOID 5 AMP FUSE (F4) CHECK	Remove fuse block cover. Remove fuse from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. Check wiring harness **NO:** Replace Fuse. If fuse blows again, check for short. – – –1/1

ENGINE CONTROL (EC) MOTOR (M2) CHECK	 T118380 –UN–21NOV98 Disconnect harness from EC motor. Measure resistance between pin 1 and pin 3, and between pin 2 and pin 4. Does ohmmeter read approximately the same resistance for both measurements?	**YES:** EC motor is OK. Go to next check. **NO:** Motor has failed. Replace. – – –1/1

ENGINE CONTROL (EC) MOTOR (M2) HARNESS CHECK



T118393 –UN–30NOV98

Disconnect harness from EC motor.

Disconnect 26-pin connector A from engine and pump controller.

Measure continuity from pin 1 in EC motor connector to pin 24 in connector A.

Measure continuity from pin 2 in EC motor connector to pin 25 in connector A.

Measure continuity from pin 3 in EC motor connector to pin 12 in connector A.

Measure continuity from pin 4 in EC motor connector to pin 26 in connector A.

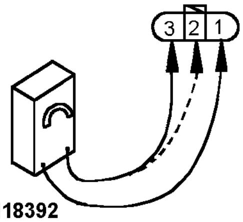
Does ohmmeter read approximately the same resistance in all 4 measurements?

YES: EC motor harness is OK. Go to next check.

NO: Repair open wire.

– – –1/1

ENGINE CONTROL (EC) SENSOR (B17) CHECK



T118392

T118392 –UN–21NOV98

1—Positive Terminal
2—Sense Terminal
3—Negative Terminal

Disconnect harness from EC sensor.

Measure resistance of sensor from connector pin 1 to pin 3, and pin 1 to Pin 2.

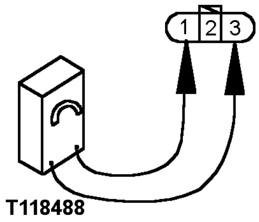
Does ohmmeter read 2000 ± 400 ohms from pin 1 to pin 3 and something less than that from pin 1 to pin 2?

YES: EC Sensor is OK. Go to next check.

NO: Sensor has failed. Replace.

– – –1/1

ENGINE CONTROL (EC) SENSOR (B17) HARNESS CHECK



T118488 –UN–21NOV98

1—Positive Terminal
2—Sense Terminal
3—Negative Terminal

Turn key switch OFF.

Disconnect harness from EC sensor.

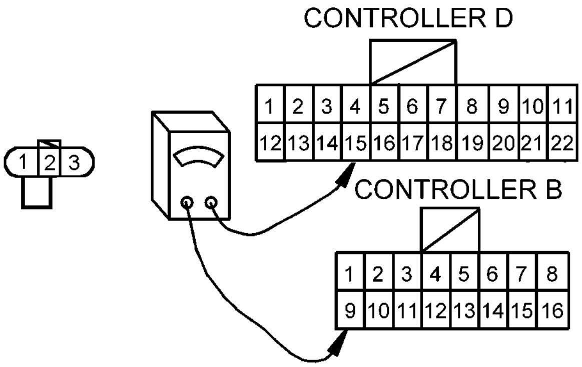
Turn key switch ON.

Measure voltage between pin 1 and pin 3 of EC sensor harness connector.

Is 5 volts measured?

YES: Go to next step.

NO: Harness has failed. Repair.



T118379 –19–30NOV98

1—Positive Terminal
2—Sense Terminal
3—Negative Terminal

Turn key switch OFF.

Disconnect harness from EC sensor.

Connect jumper wire between sensor harness connector pins 1 and 2.

Disconnect 22-pin connector D and 16-pin connector B from engine and pump controller.

Measure continuity between pin 9 of connector B and pin 15 of connector D.

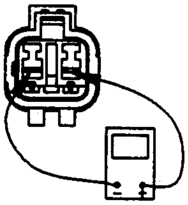
Is continuity measured?

YES: Harness is OK.

NO: Harness has failed. Repair.

– – –1/1

ENGINE SPEED (N) SENSOR (B16) CHECK



T7502BM –UN–01APR91

Turn key switch OFF.

Disconnect harness from engine speed sensor.

Measure resistance across speed sensor connector pins 1 and 2.

Does ohmmeter read 810 ± 240 ohms?

Start engine.

Measure AC voltage at speed sensor terminals. Increase engine speed.

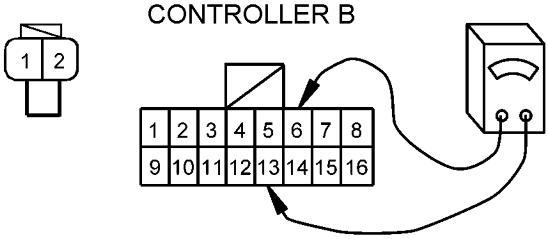
Does AC voltage increase as engine speed increases?

YES: Sensor is OK. Go to next check.

NO: Sensor has failed. Replace.

– – –1/1

ENGINE SPEED (N) SENSOR (B16) HARNESS CHECK



T118373

T118373 –19–30NOV98

Turn key switch OFF.

Disconnect harness from engine speed sensor.

Disconnect 16-pin connector B from engine and pump controller.

Measure continuity between pins 6 and 13 of connector B.

Does ohmmeter read open?

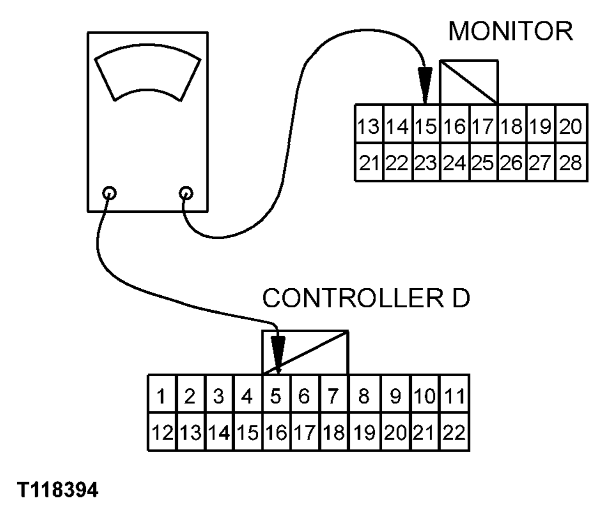
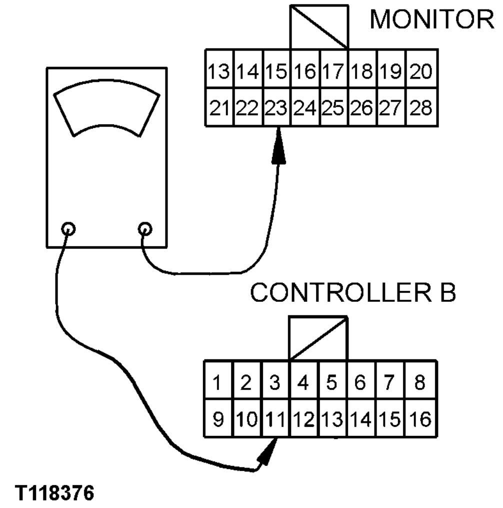
Connect jumper wire between sensor harness connector pins 1 and 2.

Is continuity measured?

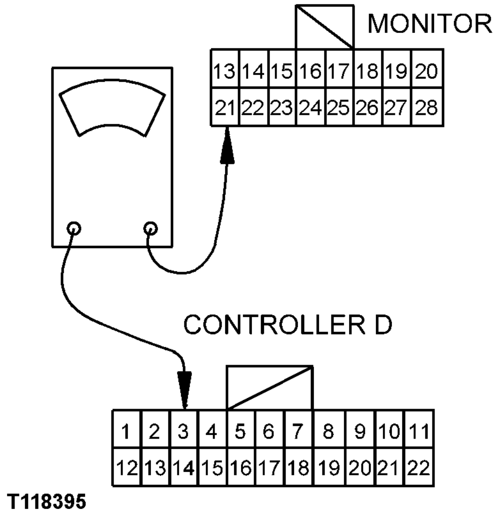
YES: Harness is OK.

NO: Harness has failed. Repair.

– – –1/1

ECONOMY (E) MODE OUTPUT TO ENGINE AND PUMP CONTROLLER HARNESS CHECK	 T118394 –19–30NOV98 Disconnect 16-pin harness connector from monitor controller and display, and 22-pin harness connector D from engine and pump controller. Measure continuity between pin 15 of monitor controller harness connector and pin 5 of engine and pump controller harness connector D. Is continuity measured?	**YES:** Harness wire is OK. **NO:** Harness wire is open. Repair. – – –1/1
HIGH POWER (HP) MODE OUTPUT TO ENGINE AND PUMP CONTROLLER HARNESS CHECK	 T118376 –19–30NOV98 Disconnect 16-pin harness connector from monitor controller and display, and 16-pin harness connector B from engine and pump controller. Measure continuity between pin 23 of monitor controller harness connector and pin 11 of engine and pump controller harness connector B. Is continuity measured?	**YES:** Harness wire is OK. **NO:** Harness wire is open. Repair. – – –1/1

MODE 1 OUTPUT TO ENGINE AND PUMP CONTROLLER HARNESS CHECK



T118395 –19–30NOV98

Disconnect 16-pin harness connector from monitor controller and display, and 22-pin harness connector D from engine and pump controller.

Measure continuity between pin 21 of monitor controller harness connector and pin 3 of engine and pump controller harness connector D.

Is continuity measured?

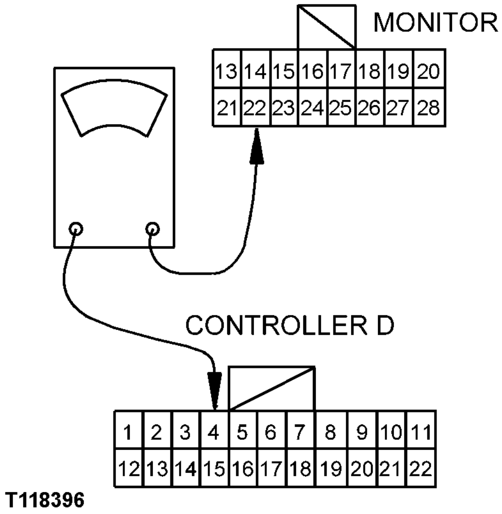
YES: Harness wire is OK. Go to next check.

NO: Harness wire is open. Repair.

– – –1/1

9015
15
78

MODE 2 OUTPUT TO ENGINE AND PUMP CONTROLLER HARNESS CHECK



T118396 –19–30NOV98

Disconnect 16-pin harness connector from monitor controller and display, and 22-pin harness connector D from engine and pump controller.

Measure continuity between pin 22 of monitor controller harness connector and pin 4 of engine and pump controller harness connector D.

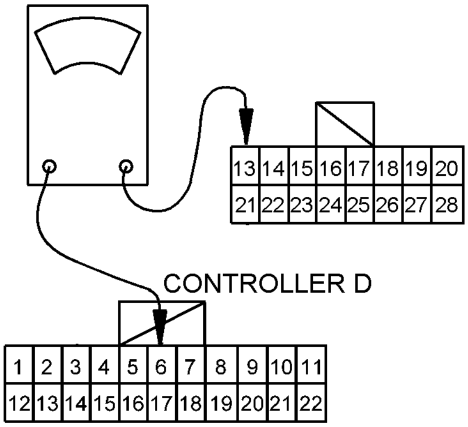
Is continuity measured?

YES: Harness wire is OK.

NO: Harness wire is open. Repair.

– – –1/1

AUTO IDLE TO SYSTEM CONTROLLER HARNESS CHECK



T118381

T118381 –19–21NOV98

Disconnect 16-pin harness connector from monitor controller, and 22-pin harness connector D from engine and pump controller.

Measure continuity between pin 13 of monitor controller harness connector and pin 6 of engine and pump controller harness connector D.

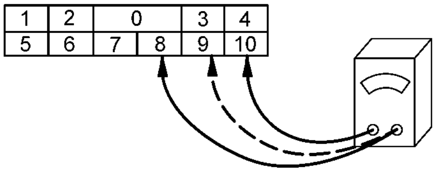
Is continuity measured?

YES: Harness wire is OK.

NO: Harness wire is open. Repair.

– – –1/1

ENGINE RPM DIAL (R10) CHECK



T118383

T118383 –UN–17MAR99

Disconnect harness connector from engine mode and rpm control unit.

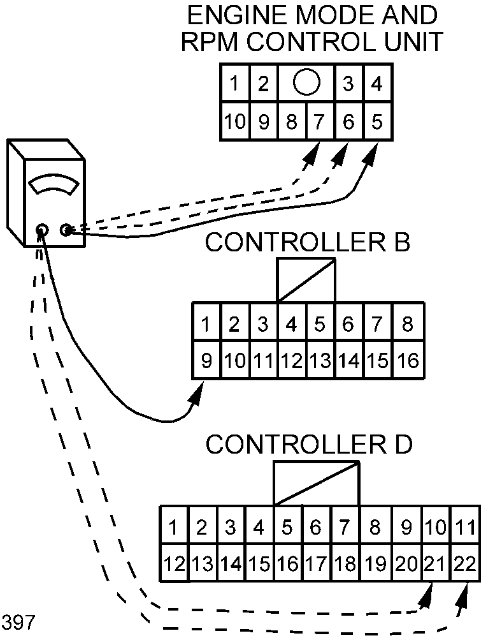
Measure resistance from engine mode and RPM control unit terminal 5 to terminal 7, and from terminal 5 to terminal 6.

Is 5000 ± 500 ohms measured from terminal 5 to terminal 7, and less than that from terminal 5 to terminal 6?

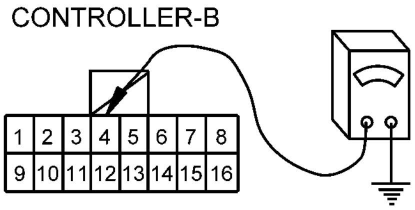
YES: Engine RPM dial is OK. Go to next check.

NO: Engine RPM dial has failed. Replace.

– – –1/1

ENGINE RPM DIAL (R10) HARNESS CHECK	 T118397 –19–30NOV98 Disconnect 16-pin harness connector B and 22-pin harness connector D from engine and pump controller. Disconnect harness connector from engine mode and RPM control unit A4. Measure continuity from pin 5 of engine mode and RPM control unit harness connector to pin 9 of engine and pump controller harness connector B. Measure continuity from pin 7 of engine mode and RPM control unit harness connector to pin 22 of engine and pump controller harness connector D. Measure continuity from pin 6 of engine mode and RPM control unit harness connector to pin 21 of engine and pump controller harness connector D. Is continuity measured?	**YES:** Engine rpm dial harness is OK. **NO:** Harness had failed. Repair. – – –1/1

POWER BOOST SWITCH (S19) CHECK



T118538

T118538 –19–21NOV98

Turn key switch OFF.

Disconnect 16-pin harness connector B from engine and pump controller.

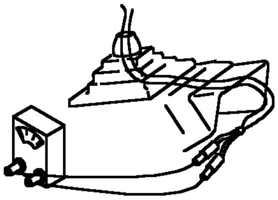
Connect ohmmeter from pin 4 of harness connector B to ground.

Press power boost switch.

Does ohmmeter read continuity when switch is pressed?

YES: Switch and harness are OK.

NO: Go to next step.



T118486

T118486 –UN–21NOV98

Remove right console bottom cover.

NOTE: Do not disconnect wires other than power boost wires.

Disconnect two leads from power boost switch.

Connect ohmmeter to both leads from switch.

Press switch button.

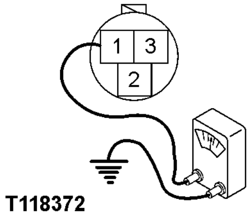
Does ohmmeter read continuity?

YES: Switch is OK. Check harness wiring.

NO: Switch has failed. Replace.

– – –1/1

ARM IN PRESSURE SENSOR (B20) HARNESS CHECK



T118372 –UN–21NOV98

1—Positive Terminal
2—Sense Terminal
3—Negative Terminal

Turn key switch OFF.

Disconnect harness from arm in pressure sensor.

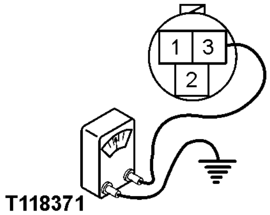
Connect voltmeter to sensor harness connector pin 1 and ground.

Turn key switch ON.

Does voltmeter read 5 volts?

YES: Harness wire is OK. Go to next step.

NO: Wire or engine and pump controller has failed. Repair.



T118371 –UN–21NOV98

1—Positive Terminal
2—Sense Terminal
3—Negative Terminal

Turn key switch OFF.

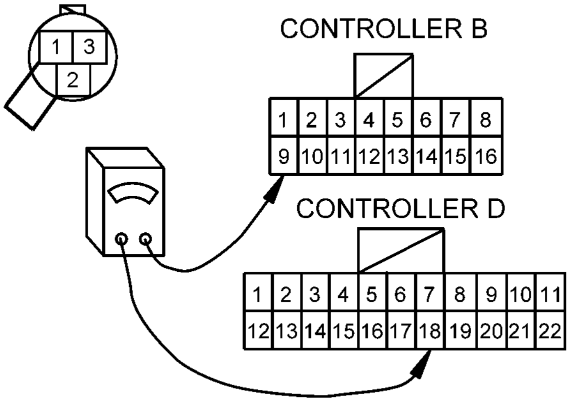
Connect ohmmeter to sensor harness connector pin 3 and ground.

Does ohmmeter read continuity?

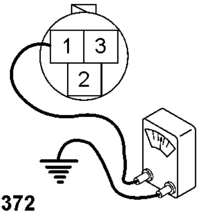
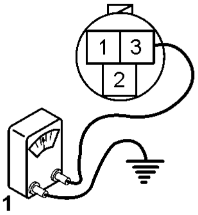
YES: Harness wire is OK. Go to next step.

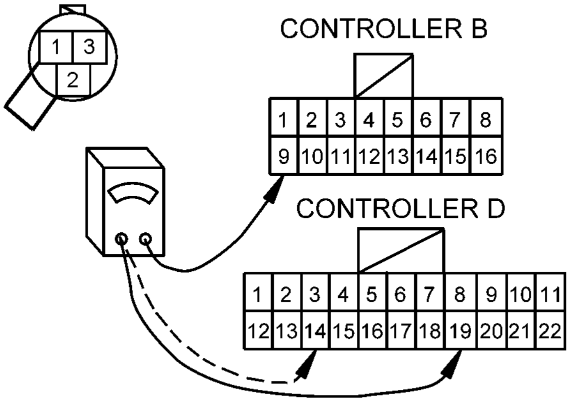
NO: Wire has failed. Repair.

– – –1/2

	 **T118358** T118358 –19–21NOV98 Install jumper between sensor harness connector pins 1 and 2. Disconnect 22-pin connector D and 16-pin connector B from engine and pump controller. Measure continuity between pin 9 of harness connector B and pin 18 of harness connector D. Is continuity measured?	**YES:** Wire harness is OK. Go to next check. **NO:** Wire from pin 18 of connector D to pin 2 of sensor harness connector has failed. Repair. – – –2/2

ARM IN PRESSURE SENSOR (B20) CHECK	Install pump control test harness JT07353 in series with wiring harness and sensor. Connect voltmeter to test harness jacks. With engine running, pilot control lever forward, and hydraulic functions in neutral, observe voltage. Is voltage between 0.5 and 0.7 volts? Actuate arm in to achieve hydraulic function over relief. Does voltage increase to between 3.3 and 3.5 volts with hydraulic function over relief?	**YES:** Sensor is OK. Engine and pump controller may have failed. **NO:** Sensor has failed. Replace. – – –1/1

REAR PUMP CONTROL PRESSURE SENSOR (B21) AND FRONT CONTROL PRESSURE SENSOR (B22) HARNESS CHECK	 **T118372** T118372 –UN–21NOV98 **1—Positive Terminal** **2—Sense Terminal** **3—Negative Terminal** Turn key switch OFF. Disconnect wiring harness connector from front (B22) or rear (B21) pump control pressure sensor. Connect voltmeter to sensor harness connector pin 1 and ground. Turn key switch ON. Does voltmeter read 5 volts?	**YES:** Harness wire is OK. Go to next step. **NO:** Wire or engine and pump controller has failed. Repair.
	 **T118371** T118371 –UN–21NOV98 **1—Positive Terminal** **2—Sense Terminal** **3—Negative Terminal** Turn key switch OFF. Connect ohmmeter to sensor harness connector pin 3 and ground. Does ohmmeter read continuity?	**YES:** Harness wire is OK. Go to next step. **NO:** Wire has failed. Repair.
		– – –1/2



T118359

T118359 –19–21NOV98

Install jumper between sensor harness connector pins 1 and 2.

Disconnect 22-pin connector D and 16-pin connector B from engine and pump controller.

Measure continuity between pin 9 of harness connector B and pin 19 of harness connector D (for front pressure sensor), or pin 14 of harness connector D (for rear pressure sensor) .

Is continuity measured?

YES: Wire harness is OK. Go to next check.

NO: Wire from connector D to sensor harness connector pin 2 has failed. Repair.

– – –2/2

REAR PUMP CONTROL PRESSURE SENSOR (B21) AND FRONT CONTROL PRESSURE SENSOR (B22) CHECK

Install pump control test harness JT07353 in series with wiring harness and sensor.

Connect voltmeter to test harness jacks.

With engine running, pilot control lever forward, and hydraulic functions in neutral, observe voltmeter.

Is voltage 0.5 - 0.7 volts?

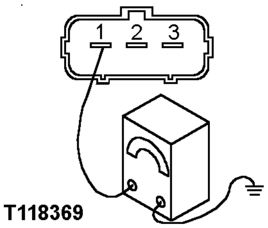
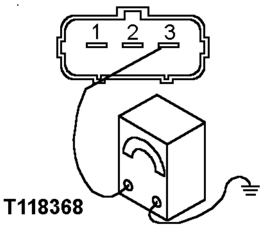
Slowly actuate boom up (for front pressure sensor B22) or left track (for rear pressure sensor B21) until motion just begins.

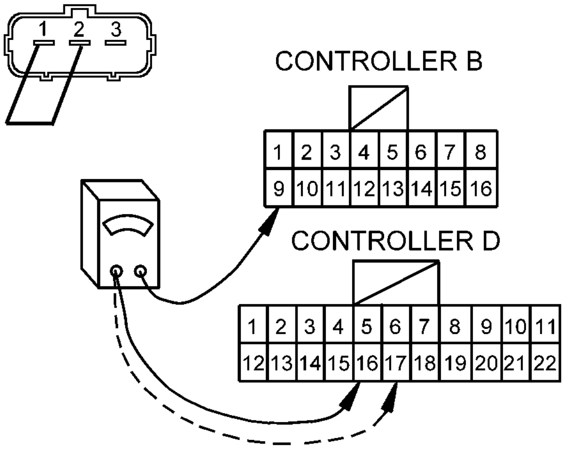
Does voltage increase to 3.3 - 3.5 volts when pilot controller reaches full activation?

YES: Sensor is OK. Engine and pump controller may have failed.

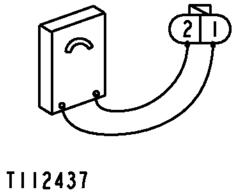
NO: Sensor has failed. Replace.

– – –1/1

REAR PUMP PRESSURE SENSOR (B18) AND FRONT PUMP PRESSURE SENSOR (B19) SENSOR HARNESS CHECK	 T118369 –UN–21NOV98 **1—Positive Terminal** **2—Sense Terminal** **3—Negative Terminal** Turn key switch OFF. Disconnect wiring harness connector from front (B19) or rear (B18) pump pressure sensor. Connect voltmeter to sensor harness connector pin 1 and ground. Turn key switch ON. Does voltmeter read 5 volts?	**YES:** Harness wire is OK. Go to next step. **NO:** Wire or engine and pump controller has failed. Repair.
	 T118368 –UN–21NOV98 **1—Positive Terminal** **2—Sense Terminal** **3—Negative Terminal** Turn key switch OFF. Connect ohmmeter to sensor harness connector pin 3 and ground. Does ohmmeter read continuity?	**YES:** Harness wire is OK. Go to next step. **NO:** Wire has failed. Repair.
		– – –1/2

	 **T118370** T118370 –19–21NOV98 **1—Positive Terminal** **2—Sense Terminal** **3—Negative Terminal** Install jumper between sensor harness connector pins 1 and 2. Disconnect 22-pin connector D and 16-pin connector B from engine and pump controller. Measure continuity between pin 9 of harness connector B and pin 16 of harness connector D (for front pressure sensor), or pin 17 of harness connector D (for rear pressure sensor) . Is continuity measured?	**YES:** Wire harness is OK. Go to next check. **NO:** Wire from connector D to sensor harness connector pin 2 has failed. Repair. – – –2/2
REAR PUMP PRESSURE SENSOR (B18) AND FRONT PUMP PRESSURE SENSOR (B19) CHECK	Install pump pressure sensor test harness JT07354 in series with wiring harness and sensor. Connect voltmeter to test harness jacks. With engine running, pilot control lever forward, and hydraulic functions in neutral, observe voltmeter. Is voltage 0.5 - 0.7 volts? Actuate arm in to achieve hydraulic function over relief. Does voltage increase to 3.3 - 3.5 volts with hydraulic function over relief?	**YES:** Sensor is OK. Engine and pump controller may have failed. **NO:** Sensor has failed. Replace. – – –1/1

BOOM UP PRESSURE SWITCH (B13) CHECK



T112437 –UN–05DEC97

Turn key switch OFF.

Disconnect wiring harness at boom up pressure switch.

Connect ohmmeter to pins 1 and 2 of pressure switch connector.

With engine running and pilot control lever forward, actuate boom up lever.

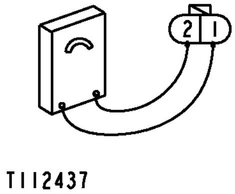
Is continuity measured when boom up lever is actuated?

YES: Pressure switch is OK. Check switch harness. If harness is OK, engine and pump controller may have failed.

NO: Boom up pressure switch has failed. Replace.

– – –1/1

DIG PRESSURE SWITCH (B14) CHECK



T112437 –UN–05DEC97

Turn key switch OFF.

Disconnect wiring harness at dig pressure switch.

Connect ohmmeter to pins 1 and 2 of pressure switch connector.

With engine running and pilot control lever forward, slowly actuate arm in lever while observing ohmmeter.

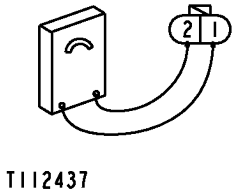
Is continuity measured as arm in lever is actuated?

YES: Pressure switch is OK. Check switch harness. If harness is OK, engine and pump controller may have failed.

NO: Dig pressure switch has failed. Replace.

– – –1/1

PROPEL PRESSURE SWITCH (B15) CHECK



T112437 –UN–05DEC97

Turn key switch OFF.

Disconnect wiring harness at propel pressure switch.

Connect ohmmeter to pins 1 and 2 of pressure switch connector.

With engine running and pilot control lever forward, slowly actuate propel lever while observing ohmmeter.

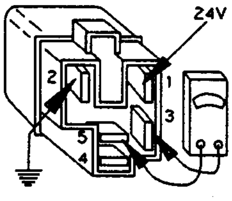
Is continuity measured as propel lever is actuated and track begins to move?

YES: Pressure switch is OK. Check for continuity from harness connector pin 1 to ground. If OK, go to next check.

NO: Propel pressure switch has failed. Replace.

– – –1/1

PROPEL AUTO IDLE RELAY (K10) CHECK



T7447BG –19–14JAN91

1—24-Volt Terminal
2—Ground Terminal
3—Relay Common
4—Relay Normally Closed
5—Relay Normally Open

Disconnect relay from harness.

Connect ohmmeter to relay terminals 3 and 4.

Does ohmmeter read continuity?

Connect 24 volts to relay terminal 1, and ground terminal 2.

Does relay “click”?

With 24 volts still connected to terminal 1, connect ohmmeter to terminals 3 and 5.

Does ohmmeter read continuity?

YES: Relay is OK.

NO: Relay has failed. Replace.

– – –1/1

TRAVEL ALARM 5 AMP FUSE (F10) CHECK

Remove fuse block cover.

Remove fuse from fuse block.

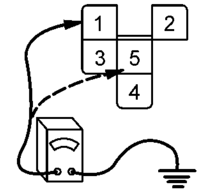
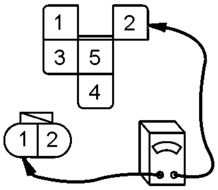
Using ohmmeter, check fuse for continuity.

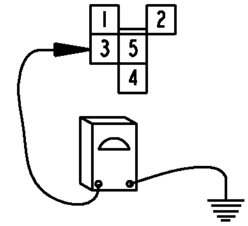
Is continuity measured?

YES: Fuse is OK. Go to next check.

NO: Replace Fuse. If fuse blows again, check for short.

– – –1/1

PROPEL AUTO IDLE RELAY (K10) HARNESS CHECK	 **T118561** T118561 –UN–21NOV98 Turn key switch OFF. Remove harness connector from relay With ohmmeter measure continuity from relay harness connector pin 5 to ground. Is continuity measured? Connect voltmeter from relay harness connector pin 1 to ground. Turn key switch to ON and measure voltage at pin 1. Is 24 volts measured?	**YES:** Wire are OK. Go to next step. **NO:** Wire has failed. Repair.
	 **T118362** T118362 –UN–21NOV98 **1—24-Volt Terminal** **2—Ground Terminal** **3—Relay Common** **4—Relay Normally Closed** **5—Relay Normally Open** Turn key switch OFF. Disconnect wiring harness at propel pressure switch. *NOTE: Use “diode checking mode” on meter when checking this reading.* Connect an ohmmeter to relay harness connector pin 2 and pressure switch connector pin 1. Measure resistance, then reverse ohmmeter probes and measure resistance again. Does resistance read approximately 500 ohms in one direction, and open in the other direction?	**YES:** Wire and isolation diode V4 are OK. Go to next step. **NO:** Check wire for open. If OK, go to diode V4 check.
		– – –1/2



T102860 –UN–12AUG96

1—24-Volt Terminal
2—Ground Terminal
3—Relay Common 5 Volts To D9
4—Relay Normally Closed
5—Relay Normally Open To Ground

Connect voltmeter to relay harness connector pin 3 and ground.

Turn key switch ON.

Does voltmeter read 5 volts.

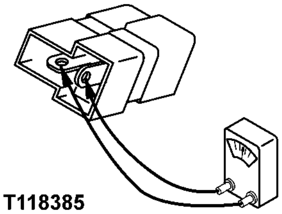
YES: Harness is OK.

NO: Harness or engine and pump controller has failed. Repair or replace.

– – –2/2

PROPEL AUTO IDLE RELAY ISOLATION DIODE (V4) CHECK

NOTE: A diode can fail in two modes, either shorted or open. Continuity will be measured in one direction only in a serviceable diode. Use “diode checking mode” on meter when checking continuity.



T118385

T118385 –UN–21NOV98

Remove diode from connector.

Connect an ohmmeter to diode terminals.

Is continuity measured?

Reverse ohmmeter probes.

Is continuity measured?

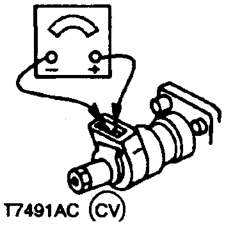
YES: If continuity is measured in both checks, diode has failed in a shorted mode. Replace.

NO: If continuity is NOT measured in either check, diode has failed in an open mode. Replace.

NO: If continuity is measured in one check and not the other, diode is OK.

– – –1/1

PROPEL SPEED CHANGE PROPORTIONAL SOLENOID (Y6) CHECK



T7491AC –UN–08APR91

Turn key switch OFF.

Remove wire clip from bottom of solenoid harness connector.

Disconnect harness from solenoid.

Connect ohmmeter to solenoid terminals.

Does ohmmeter read approximately 24 ohms?

YES: Solenoid is OK. Go to next check.

NO: Solenoid has failed. Replace.

– – –1/1

PROPEL SPEED CHANGE PROPORTIONAL SOLENOID (Y6) HARNESS CHECK

Turn key switch OFF.

Install proportional solenoid test harness JT07352 in series with wiring harness and sense solenoid.

Connect voltmeter to test harness jacks.

Start engine and while observing voltmeter, drive machine at full propel speed until fast speed kicks in.

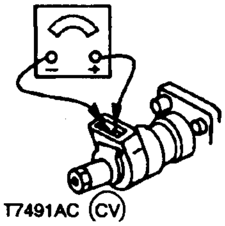
Does voltmeter read approximately 6 volts in slow speed, and 12 volts in fast speed?

YES: Harness and engine and pump controller are OK.

NO: Harness or engine and pump controller has failed. Repair or replace.

– – –1/1

ARM REGENERATIVE PROPORTIONAL SOLENOID (Y9) CHECK



T7491AC –UN–08APR91

Turn key switch OFF.

Remove wire clip from bottom of solenoid harness connector.

Disconnect harness from solenoid.

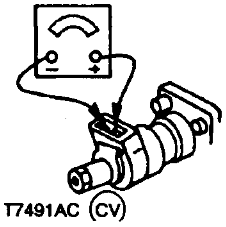
Connect ohmmeter to solenoid terminals.

Does ohmmeter read approximately 24 ohms?

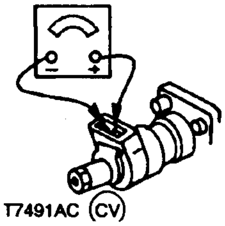
YES: Solenoid is OK. Go to next check.

NO: Solenoid has failed. Replace.

– – –1/1

ARM REGENERATIVE PROPORTIONAL SOLENOID (Y9) HARNESS CHECK	Turn key switch OFF. Install proportional solenoid test harness JT07352 in series with wiring harness and sense solenoid. Connect voltmeter to test harness jacks. Start engine and move arm all the way out and boom down. Adjust idle to slow (voltmeter reading approximately 7 volts). Move boom up and arm in at the same time. Does voltmeter read higher voltage (approximately 9 volts) while boom and arm are moving?	**YES:** Harness and engine and pump controller are OK. **NO:** Harness or engine and pump controller has failed. Repair or replace. – – –1/1
POWER BOOST PROPORTIONAL SOLENOID (Y5) CHECK	 T7491AC –UN–08APR91 Turn key switch OFF. Remove wire clip from bottom of solenoid harness connector. Disconnect harness from solenoid. Connect ohmmeter to solenoid terminals. Does ohmmeter read approximately 24 ohms?	**YES:** Solenoid is OK. Go to next check. **NO:** Solenoid has failed. Replace. – – –1/1
POWER BOOST PROPORTIONAL SOLENOID (Y5) HARNESS CHECK	Turn key switch OFF. Install proportional solenoid test harness JT07352 in series with wiring harness and sense solenoid. Connect voltmeter to test harness jacks. Start engine and observe voltmeter while pressing power boost switch. Does voltmeter read approximately 5 volts when switch is not pressed, and approximately 9 volts when switch is pressed? Hold power boost switch pressed. Does the voltage drop to 5 volts after approximately 8 seconds?	**YES:** Harness and engine and pump controller are OK. **NO:** Harness or engine and pump controller has failed. Repair or replace. – – –1/1

SPEED SENSE PROPORTIONAL SOLENOID (Y8) CHECK



T7491AC –UN–08APR91

Turn key switch OFF.

Remove wire clip from bottom of solenoid harness connector.

Disconnect harness from solenoid.

Connect ohmmeter to solenoid terminals.

Does ohmmeter read approximately 24 ohms?

YES: Solenoid is OK. Go to next check.

NO: Solenoid has failed. Replace.

– – –1/1

SPEED SENSE PROPORTIONAL SOLENOID (Y8) HARNESS CHECK

Turn key switch OFF.

Install proportional solenoid test harness JT07352 in series with wiring harness and sense solenoid.

Connect voltmeter to test harness jacks.

Start engine, set auto idle mode to OFF, and set engine idle to medium speed so that voltmeter reads approximately 5.5 volts (RPM dial set at first bar after mid range).

Bottom arm in to load engine.

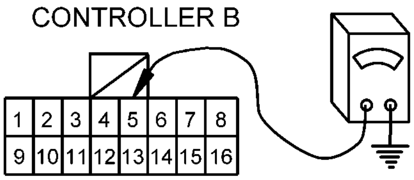
Does voltmeter read approximately 7 volts with arm bottomed in?

YES: Harness and engine and pump controller are OK.

NO: Harness or engine and pump controller has failed. Repair or replace.

– – –1/1

LEARNING SWITCH (S16) CHECK



T118558

T118558 –19–21NOV98

Turn key switch OFF.

Disconnect 16-pin connector B from engine and pump controller.

Turn switch to ON.

Measure continuity from pins 5 of connector B to ground.

Is continuity measured?

YES: Switch and harness are OK.

NO: Switch or harness has failed. Check and repair or replace.

– – –1/1

TRAVEL ALARM CIRCUIT OPERATIONAL INFORMATION

The following conditions must be met for the circuit to function:

- Key switch ON
- Voltage present at travel alarm 5-amp fuse F10

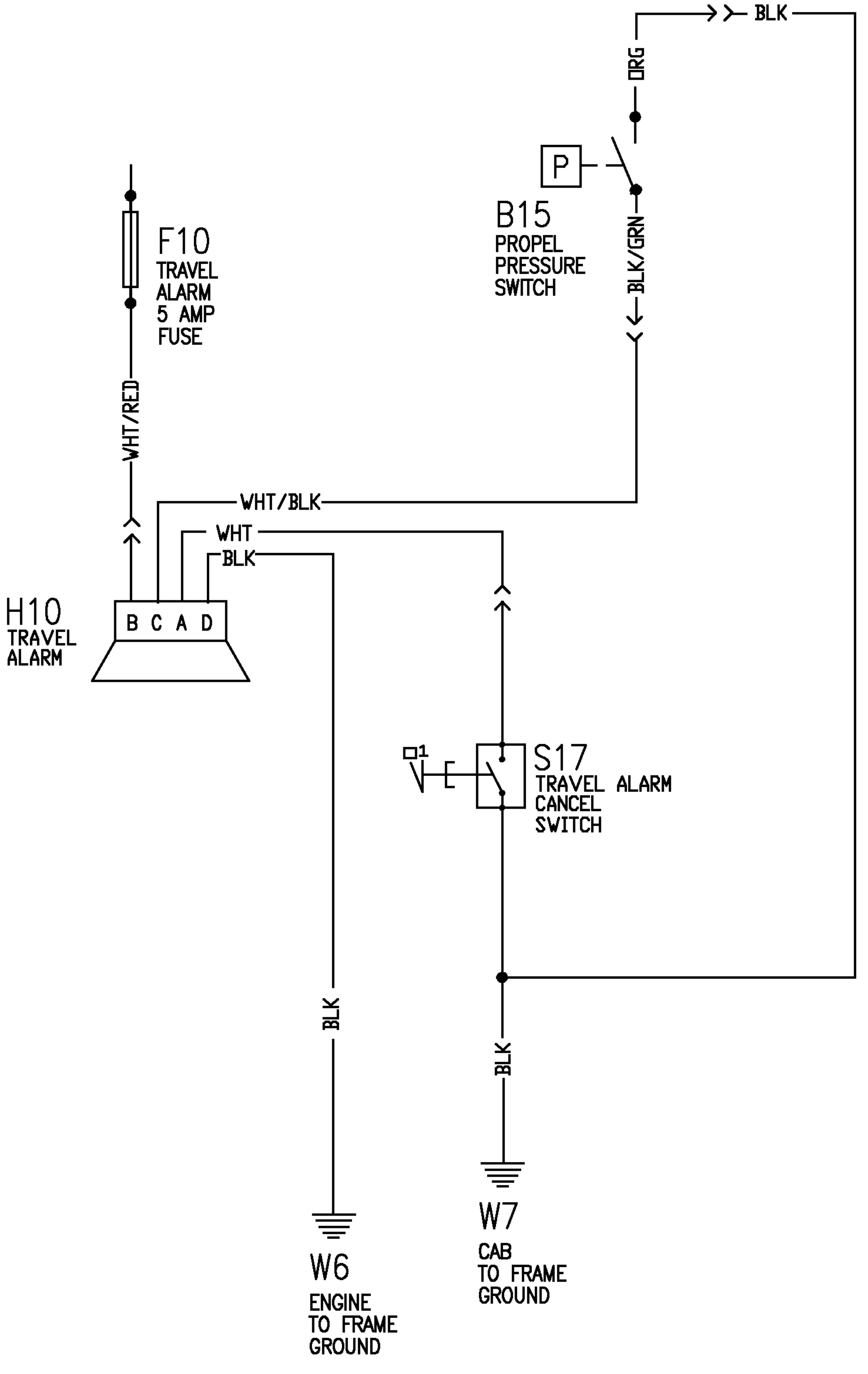
CED,OUOE012,137 –19–16MAR99–1/1

TRAVEL ALARM CIRCUIT THEORY OF OPERATION

The travel alarm circuit contains: travel alarm fuse F10, travel alarm H10, travel alarm cancel switch S17, and propel pilot pressure switch B15. Operating voltage for the travel alarm is applied from fuse F10 to travel alarm terminal B. When the propel levers are moved to forward or reverse positions, propel pressure switch B15 senses pilot pressure and closes. With the switch closed ground is applied to terminal C of the travel alarm, activating the alarm. After the travel alarm has sounded for 10 seconds, the travel alarm cancel switch may be pushed to turn the alarm off by grounding alarm terminal A.

CED,OUOE012,37 –19–05NOV98–1/1

TRAVEL ALARM CIRCUIT SCHEMATIC



T117932

TRAVEL ALARM CIRCUIT

T117932 –19–30NOV98

➊ TRAVEL ALARM CIRCUIT DIAGNOSTIC PROCEDURES

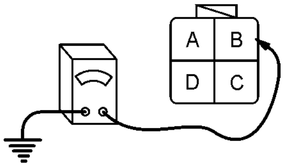
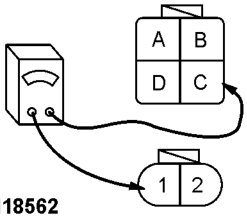
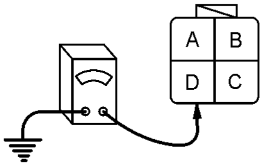
IMPORTANT: Do not disconnect electrical connectors while the engine is running. Damage to Engine and Pump Controller or other components may result. Disconnect connectors only when instructed during a test or check.

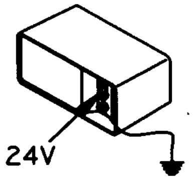
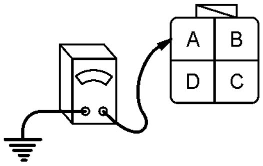
NOTE: Before troubleshooting the circuits, clean all terminals in the engine and pump controller and harness connectors using a non-conductive lubricating contact cleaner, then try circuit operation again before proceeding. TY16324 John Deere Contact Cleaner can be used.

– – –1/1

TRAVEL ALARM 5 AMP FUSE (F10) CHECK	Remove fuse block cover. Remove fuse from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. Go to next check. **NO:** Replace Fuse. If fuse blows again, check for short.

– – –1/1

TRAVEL ALARM (H10) HARNESS CHECK	 **T118563** T118563 –UN–21NOV98 Turn key switch OFF. Disconnect harness connector from travel alarm. Connect voltmeter to harness connector pin B and ground. Turn key switch ON. Is 24 volts measured?	**YES:** Go to next step. **NO:** Harness has failed. Repair.
	 **T118562** T118562 –UN–21NOV98 Turn key switch OFF. Disconnect harness connector from propel pressure switch. Connect ohmmeter from travel alarm harness connector pin C to propel pressure switch harness connector pin 1. Is continuity measured?	**YES:** Go to next step. **NO:** Harness has failed. Repair.
	 **T118564** T118564 –UN–21NOV98 Connect ohmmeter from travel alarm harness connector pin D to ground. Is continuity measured?	**YES:** Harness is OK. Go to next check. **NO:** Harness has failed. Repair. – – –1/1

TRAVEL ALARM (H10) CHECK	 T8037BB –UN–30JUN93 With harness connector disconnected, connect 24 volts to travel alarm terminal B, and ground terminal C. Does alarm sound?	**YES:** Alarm is OK. **NO:** Alarm has failed. Replace. – – –1/1
TRAVEL ALARM CANCEL SWITCH (S17) CHECK	 **T118559** T118559 –UN–21NOV98 Turn key switch OFF. Disconnect harness connector from travel alarm. Connect ohmmeter from travel alarm harness connector pin A to ground. Push travel alarm cancel switch. Is continuity measured when switch is pressed?	**YES:** Switch and harness are OK. **NO:** Switch or harness has failed. Repair or replace. – – –1/1

OVERLOAD ALARM CIRCUIT OPERATIONAL INFORMATION

The following conditions must be met for the circuit to function:

- Key switch ON
- Voltage present at auxiliary power 10-amp fuse F19

CED,OUOE012,136 –19–16MAR99–1/1

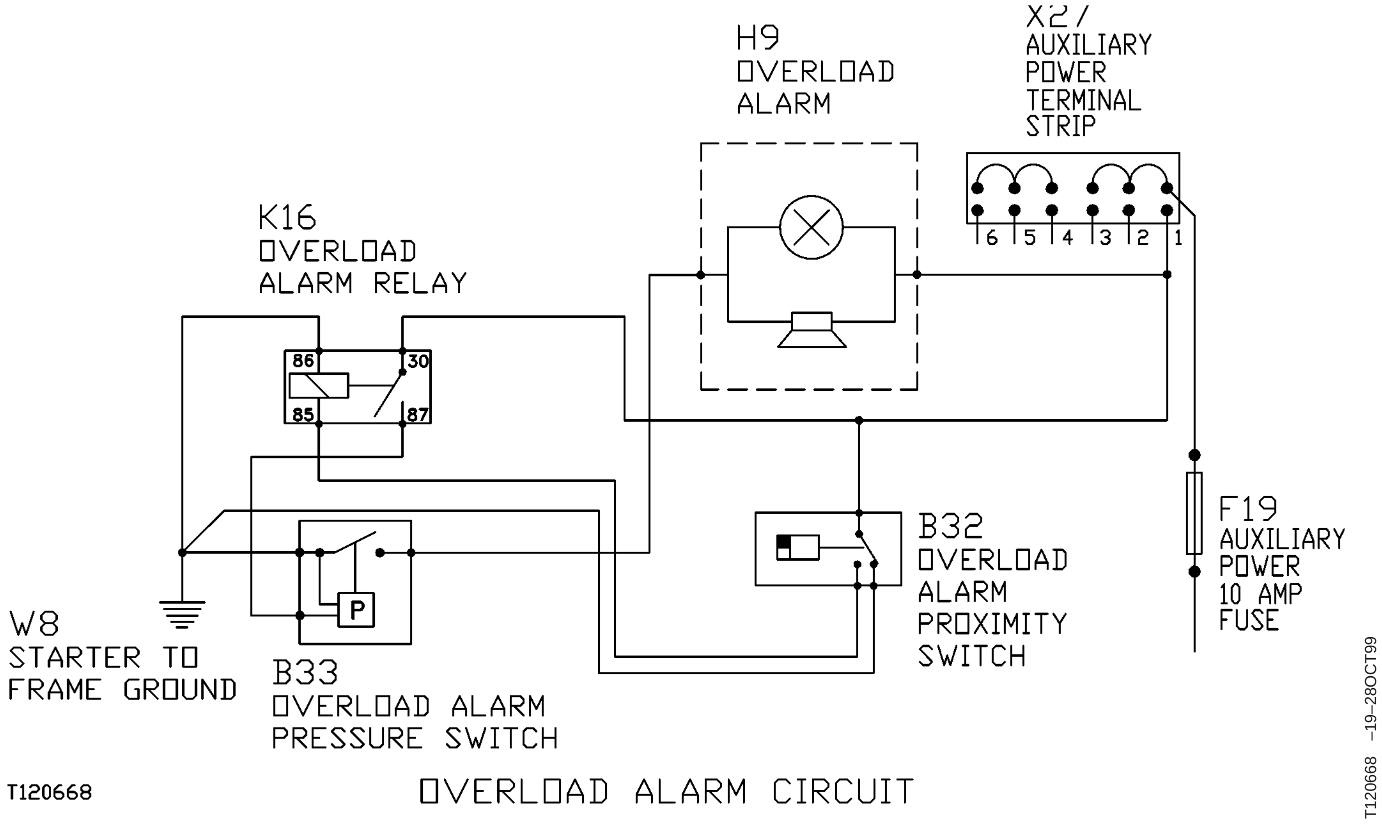
OVERLOAD ALARM CIRCUIT THEORY OF OPERATION

The overload alarm circuit contains: proximity switch B32, pressure switch B33, relay K16, and alarm H9.

Operating voltage for the overload alarm circuit is applied from fuse F19, through terminal strip X27, terminal 1 to the overload alarm power terminal, terminal 30 of relay K16, and terminal 1 of the proximity switch. When the boom is positioned on either side of the machine, proximity switch B32 closes and energizes relay K16 by applying +24 volts to relay terminal 85. With relay K16 energized, +24 volts is applied from terminal 87 to pressure switch B33, enabling the pressure switch. If the boom cylinder hydraulic pressure exceeds 3780 psi, (230LCR) or 2400 psi (230LCRD) switch B33 closes, activating the alarm, by applying ground to the overload alarm ground terminal.

CED,OUOE012,138 –19–16MAR99–1/1

OVERLOAD ALARM CIRCUIT SCHEMATIC



Overload Alarm Circuit Schematic

CED,OUOE012,140 –19–17MAR99–1/1

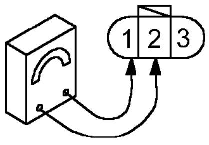
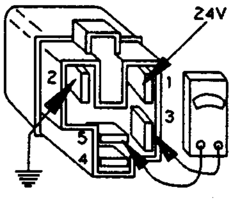
➊ OVERLOAD ALARM CIRCUIT DIAGNOSTIC PROCEDURES

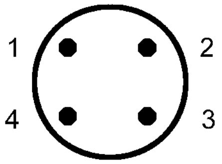
– – –1/1

AUXILIARY 10 AMP FUSE (F19) CHECK	Remove fuse block cover. Remove fuse from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. **NO:** Replace Fuse. If fuse blows again, check for short.

– – –1/1

Sub-System Diagnostics

OVERLOAD ALARM (H9) CHECK	Turn key switch OFF. Jumper alarm ground terminal (BLK wire) to cab ground. Turn key switch ON. Does alarm sound? Turn key switch OFF.	**YES:** Alarm is OK. Go to next check. **NO:** Replace alarm. – – –1/1
OVERLOAD ALARM PROXIMITY SWITCH (B32) CHECK	 **T120671** T120671 –UN–25MAR99 Operate excavator to position boom to either side of excavator. Turn key switch OFF. Remove harness connector from proximity switch. Connect ohmmeter to terminals 1 and 2 of switch connector. Does ohmmeter read continuity?	**YES:** Switch is OK. Go to next check. **NO:** Switch has failed. Replace. – – –1/1
OVERLOAD ALARM RELAY (K16) CHECK	 T7447BG –19–14JAN91 Disconnect harness from overload alarm relay. Connect ohmmeter to relay terminals 30 and 87. Does ohmmeter read open? Connect 24 volts to relay terminal 85 and ground terminal 86. Does relay “click”? Connect ohmmeter to terminals 30 and 87. Does ohmmeter read continuity?	**YES:** Relay is OK. Go to next check. **NO:** Relay has failed. Replace. – – –1/1

OVERLOAD ALARM HARNESS CHECK	 **T120685** T120685 –UN–25MAR99 Disconnect harness from overload alarm pressure switch With boom positioned at either side of excavator, turn key switch ON. With voltmeter, measure voltage at pressure switch harness connector pin 3. Is 24 volts measured?	**YES:** Go to next step. **NO:** Check wire harness.
	Turn key switch OFF. Connect jumper wire across pressure switch harness connector pins 1 and 4. Turn key switch ON. Does overload alarm sound?	**YES:** Pressure switch has failed. Replace. **NO:** Harness has failed. Replace. – – –1/1

Group 20
References

BATTERY OPERATION

SPECIFICATIONS	
Percent Charged For Stabilized Open Circuit Voltage 12.6 Volts or More	100%
Percent Charged For Stabilized Open Circuit Voltage 12.4 Volts	75%
Percent Charged For Stabilized Open Circuit Voltage 12.2 Volts	50%
Percent Charged For Stabilized Open Circuit Voltage 12.0	25%
Percent Charged For Stabilized Open Circuit Voltage 11.7 or Less	0%

A battery is a device for converting chemical energy to electrical energy. It is not a storage tank for electricity, but stores electrical energy in chemical form.

Because of the constant chemical to electrical change (self-discharge, discharge, or charge), the battery has a limited life. Proper care (cleaning, adding water, charging) will extend the life of the battery.

The battery is made up of positive plates, negative plates, separators, plate straps, and chemical solution (electrolyte). The electrolyte is a solution of sulfuric acid and water. Sulfuric acid is not lost during overcharging; therefore, if the liquid solution is low, only water should be added.

In a fully charged battery, the positive plate is lead peroxide (PBQ2), the negative plate is ’spongy’ lead (Pb), and the electrolyte solution is about 1.270 times heavier than water. The amount that the solution is heavier than water is called specific gravity.

All batteries will self discharge at a rate of .001 specific gravity point per 24 hour period at a constant 85 °F. The discharge rate increases as temperature increases and decreases as temperature decreases. If the machine is not used for a period of time, the batteries must be maintained or stored in a cool place.

Wipe batteries with a damp cloth. If terminals are corroded, use a stiff brush and wash with an ammonia solution. After washing, flush battery and compartment with clear water. Keep caps in place when cleaning and charging.

Batteries should be maintained at an open circuit voltage of 12.40 volts or greater. To determine open circuit voltage use the following chart.

CHECK OPEN CIRCUIT VOLTAGE FOR STATE OF CHARGE

NOTE: Stabilize voltage by turning on high beams 15 Amp load for 15 seconds.

Percent Charged For Stabilized Open Circuit Voltage—Specification

12.6 Volts or More	100%
12.4 Volts	75%
12.2 Volts	50%
12.0	25%
11.7 or Less	0%

CED,TX14795,4147 –19–05AUG97–1/1

BATTERY SPECIFICATIONS

Battery Voltage—Specification

Volts.. 12 Volts

Cold Cranking Power—Specification

Amps... 1100 amps at —18°C (0°F)

Reserve Capacity—Specification

Minutes .... 400 minutes at 25 amps

Fully Charged Electrolyte Specific Gravity—Specification

Specific Gravity.. 1.265—1.280

CED,TX14795,4148 –19–13AUG98–1/1

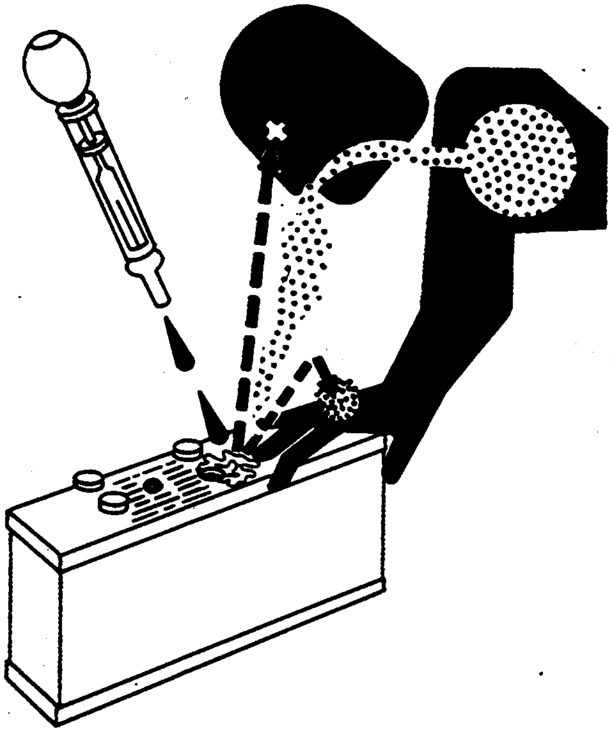
References

DIAGNOSE BATTERY MALFUNCTIONS

Symptom	Problem	Solution
Battery Using Too Much Water	Shorted battery cell	Check battery state of charge. (See Procedure for Testing Batteries.)
	High ambient temperature	Add distilled water.
	Cracked battery case	Check battery hold down clamps. Replace battery.
	Regulator	Do Alternator Output Check. (See Charging Circuit Operational Checks.)
Cracked Battery Case	Battery hold down clamp too tight, too loose or missing	Install new battery. Install hold down clamps correctly.
	Frozen battery	Keep electrolyte at correct level and battery fully charged during cold weather.
Low Battery Output	Low water level	See Battery Using Too Much Water and Cracked Battery Case symptoms.
	Dirty or wet battery top, causing discharge	Clean battery top. Recharge battery.
	Corroded or loose battery cable ends	Clean and tighten cable end clamps. Recharge battery.
	Broken or loose battery posts	Wiggle posts by hand. If posts are loose or will turn, replace battery.
	Loose fan/alternator belt or worn pulleys	Inspect belt or pulley. Adjust or replace as necessary.

CED,TX14795,4149 –19–05AUG97–1/1

CHECK BATTERY ELECTROLYTE LEVEL AND TERMINALS



TS203 –UN–23AUG88

CAUTION: Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.

Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.

Always remove grounded (-) battery clamp first and replace it last.

Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

1. **Filling batteries in a well-ventilated area.**
2. **Wearing eye protection and rubber gloves.**
3. **Avoiding breathing fumes when electrolyte is added.**
4. **Avoiding spilling or dripping electrolyte.**
5. **Use proper jump start procedure.**

If you spill acid on yourself:

1. **Flush your skin with water.**
2. **Apply baking soda or lime to help neutralize the acid.**
3. **Flush your eyes with water for 10—15 minutes. Get medical attention immediately.**

If acid is swallowed:

1. **Drink large amounts of water or milk.**
2. **Then drink milk of magnesia, beaten eggs, or vegetable oil.**
3. **Get medical attention immediately.**

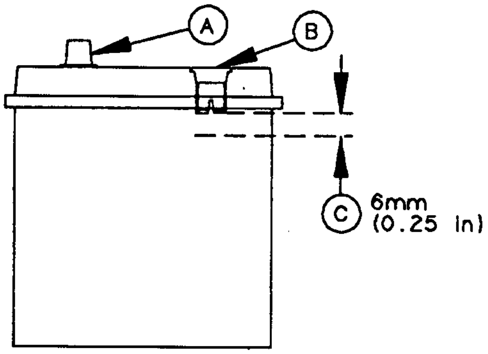
1. Remove hold-down clamps.

2. Remove battery covers.

Continued on next page

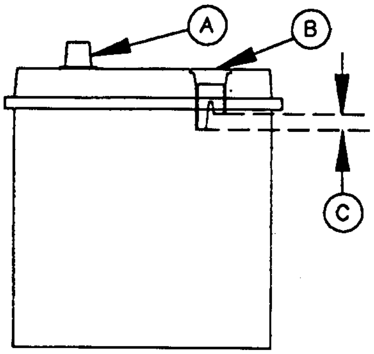
IMPORTANT: During freezing weather, batteries must be charged after water is added to prevent battery freezing. Charge battery using a battery charger or by running the engine.

3. Fill each cell to within specified range with distilled water. DO NOT overfill.



T6996DB –UN–10FEB89

Single Level Fill Tube Application



T6996DA –UN–10FEB89

Dual Level Fill Tube Application

A—Battery Post
B—Fill Tube
C—Electrolyte Level Range

TX,16,UU3540 –19–01SEP95–2/2

References

PROCEDURE FOR TESTING BATTERIES

1. VISUAL CHECK

   a. Check for damage such as cracked or broken case and electrolyte leakage.

      If damage is seen, replace battery.

   b. Check electrolyte level. (See procedure in this group.)

      If low, add distilled water to specified level and charge battery.

   c. Check terminals for corrosion.

      If corroded, clean using a wire brush or battery post cleaner such as JT05838 Battery Post/Clamp Cleaner.

   d. Check posts for looseness.

      If posts are loose, replace battery.

2. HYDROMETER TEST

   a. Check specific gravity with a hydrometer or battery tester such as JT05460 Coolant/Battery Tester.

   b. Record specific gravity reading for each cell.

   c. If high and low readings vary LESS than 0.050 and average specific gravity is between 1.225 and 1.280, battery is fully charged, go to LOAD TEST.

   d. If high and low readings vary LESS than 0.050 and average specific gravity is LESS than 1.225, charge battery and repeat test. If average specific gravity is still LESS than 1.225, replace both batteries.

   e. If high and low readings vary MORE than 0.050, charge battery and repeat test. If high and low readings still vary MORE than 0.050, replace both batteries.

3. LOAD TEST

   a. Check battery capacity with a load tester such as JT05832 Battery Load Tester. Follow tester manufacturer's instructions for proper load test procedures.

   b. If one battery fails load test, replace both batteries.

TX,16,UU3538 –19–01SEP95–1/1

USING BOOSTER BATTERIES—24 VOLT SYSTEM

Before boost starting, machine must be properly shut down and secured to prevent unexpected machine movement when engine starts.

CAUTION: An explosive gas is produced while batteries are in use or being charged. Keep flames or sparks away from the battery area. Make sure the batteries are charged in a well ventilated area.

IMPORTANT: The machine electrical system is a 24-volt negative (-) ground. Connect two 12-volt booster batteries together in series as shown for 24 volts.

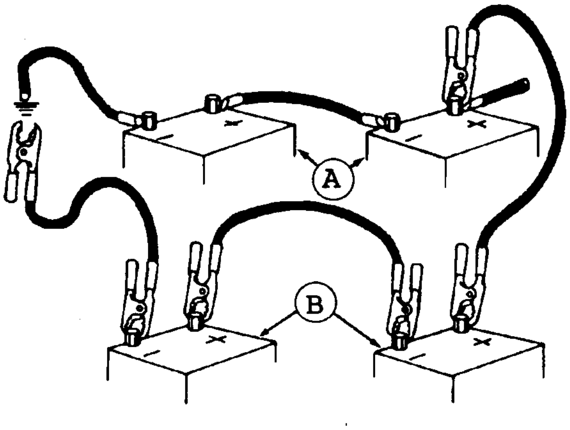
1. Connect one end of the positive cable to the positive terminal of machine batteries (A) and the other end to the positive terminal of booster batteries (B).

2. Connect one end of the negative cable to the negative terminal of booster batteries. Then connect the other end of negative cable to the machine frame as far away from the machine batteries as possible.

3. Start the engine.

4. Immediately after starting the engine, disconnect the end of negative cable from the machine frame first. Then disconnect the other end of negative cable from the negative terminal of booster batteries.

5. Disconnect the positive cable from the booster batteries and machine batteries.



T6713AH1 CV

T6713AH1 –UN–24OCT91

Two Battery Application

A—Machine Batteries
B—Booster Batteries

CED,TX14795,4152 –19–14MAY98–1/1

REPLACING BATTERIES

SPECIFICATIONS	
Cold Cranking Amps at -18°C (0°F) amps	1100 Amps
Minutes Reserve Capacity at 25 amps Reserve Capacity	400 Minutes

Your machine is equipped with a negative (-) ground electrical system. It uses two 12-volt batteries. If one of the two batteries fails, both batteries must be replaced. Use only batteries meeting following specifications.

Cold Cranking Amps at -18°C (0°F)—Specification

Amps.. 1100 amps

Minutes Reserve Capacity at 25 amps—Specification

Reserve Capacity .... 400 Minutes

CED,TX14795,4153 –19–25JUN96–1/1

ADDING 12 OR 24 VOLT ACCESSORIES

IMPORTANT: This machine has a 24-volt electrical system. Installing 12-volt accessories without addition of 24-volt to 12-volt converter may cause battery failure.

When possible, use 24-volt accessories. If 12-volt accessories are added, use a 24-volt to 12-volt converter. Converters are available from your authorized dealer. (See the Industrial Equipment Attachment Guide.)

Converter capacity requirements depend on the load of the accessories installed. Follow electronic dealer and manufacturer's recommendations to determine the capacity of the converter required and its installation requirements.

The following precautions must be followed when adding electrical and/or electronic devices:

1. DO NOT mount 24 volt-to-12 volt converters in the cab. Converters should be mounted as close to the battery as possible. Converters supplied through Deere parts system provide installation instructions outlining proper installation procedures and location.

2. DO NOT mount electrical devices directly in front of system controller (between controller and seat). Mounting above the controller on shelf behind seat is acceptable.

3. DO NOT mount electrical devices within 6 inches of existing harnesses.

4. Isolate the case of the electrical device from the vehicle or cab frame. The ground for the device should be through a separate ground wire to the converter (if equipped) or starter ground stud.

5. Twist the power and the ground wires from the device together and run as close to the vehicle frame as possible. Twisting the wires helps to cancel any radio frequency fields that form around the wire.

6. Use of shielded wire reduces radio frequency fields even more. Twist power and ground wire together as above. Ground shield to frame at power source end and metal case of device at the opposite end. If device does not have a metal case, ground shield on device end to frame.

7. DO NOT run the device from the electronic device in parallel with the existing harnesses. DO NOT band wires to vehicle harnesses.

8. Install noise filters on positive end of all electronic devices. Noise filter should be located as close to the device as possible. Filters can be purchased at local electronic stores.

9. Mount antennas as far away from the engine and pump controller as possible. It is best not to mount antennas on the cab at all. Best locations are at the back of the unit on the counterweight or sheet metal above the batteries.

IMPORTANT: DO NOT connect an accessory to one battery. Connecting a 12-volt accessory to one battery will cause one battery to overcharge, and the other battery to undercharge, causing battery failure.

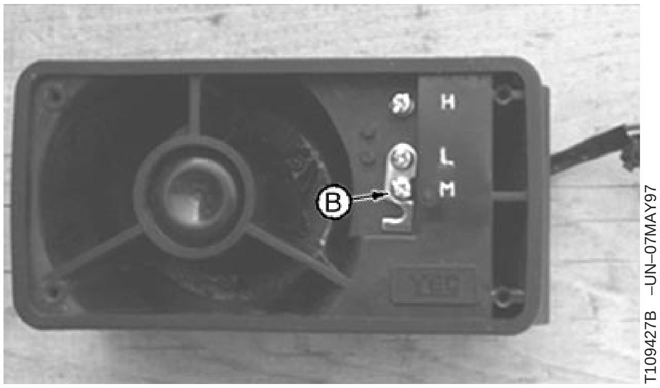
CED,TX14795,4154 –19–13AUG98–1/1

CHANGING TRAVEL ALARM VOLUME

IMPORTANT: It may be necessary to adjust travel alarm volume to meet local regulations.

NOTE: Alarm removed from machine for clarity of photograph.

Move switch (B) to adjust volume of travel alarm. The alarm can be set at HIGH, MED (medium), or LOW volume.



B—Switch
H—High Level
L—Low Level
M—Medium Level

CED,TX14795,4155 –19–25JUN96–1/1

PROPORTIONAL SOLENOID TEST HARNESS

Test harness JT07352 is used to check proportional solenoid Y5, Y6, Y8, and Y9 circuits.

CED,OUOE012,45 –19–23NOV98–1/1

PUMP CONTROL TEST HARNESS

Test harness JT07353 is used to check arm in and pump control pressure sensors B20, B21, and B22.

CED,OUOE012,46 –19–23NOV98–1/1

PUMP PRESSURE SENSOR TEST HARNESS

Test harness JT07354 is used to check front and rear pump pressure sensors B18 and B19.

CED,OUOE012,47 –19–24NOV98–1/1

BLANK

CHAPTER 5

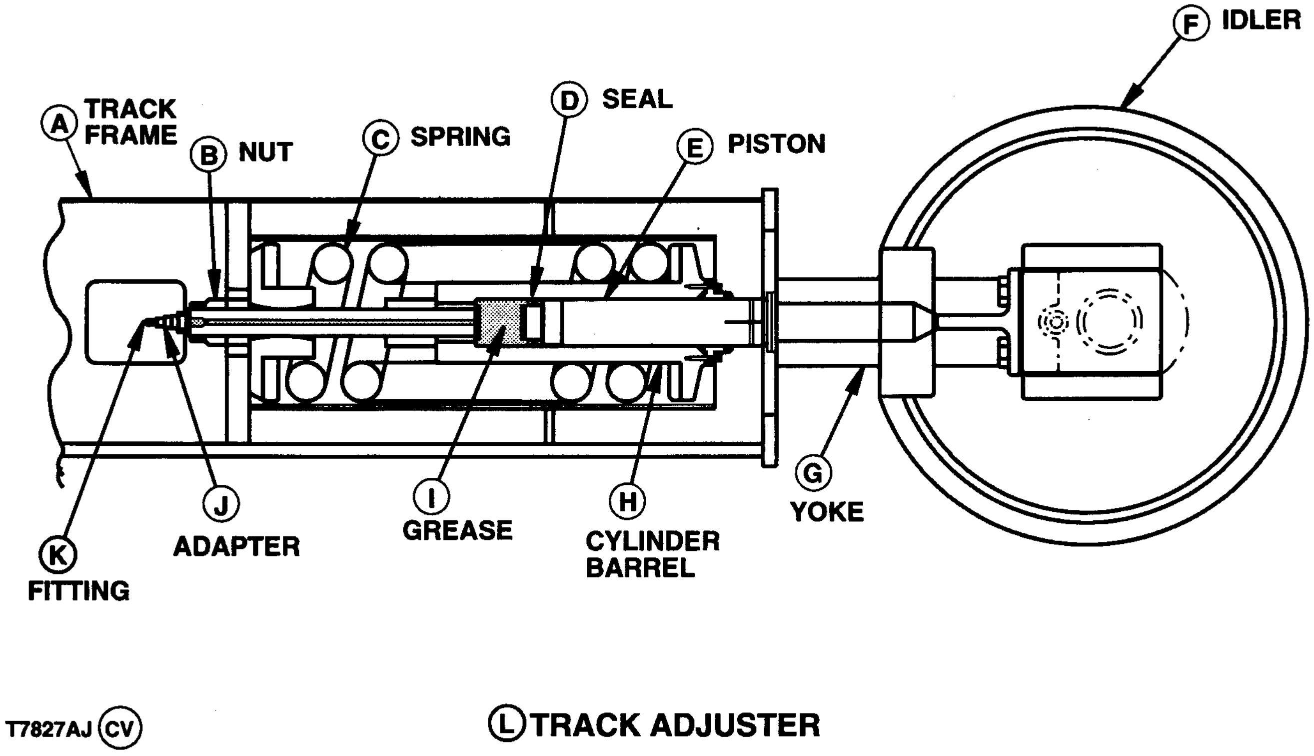
SECTION 9020

POWER TRAIN

BLANK

Group 05
Theory of Operation

TRACK ADJUSTER OPERATION



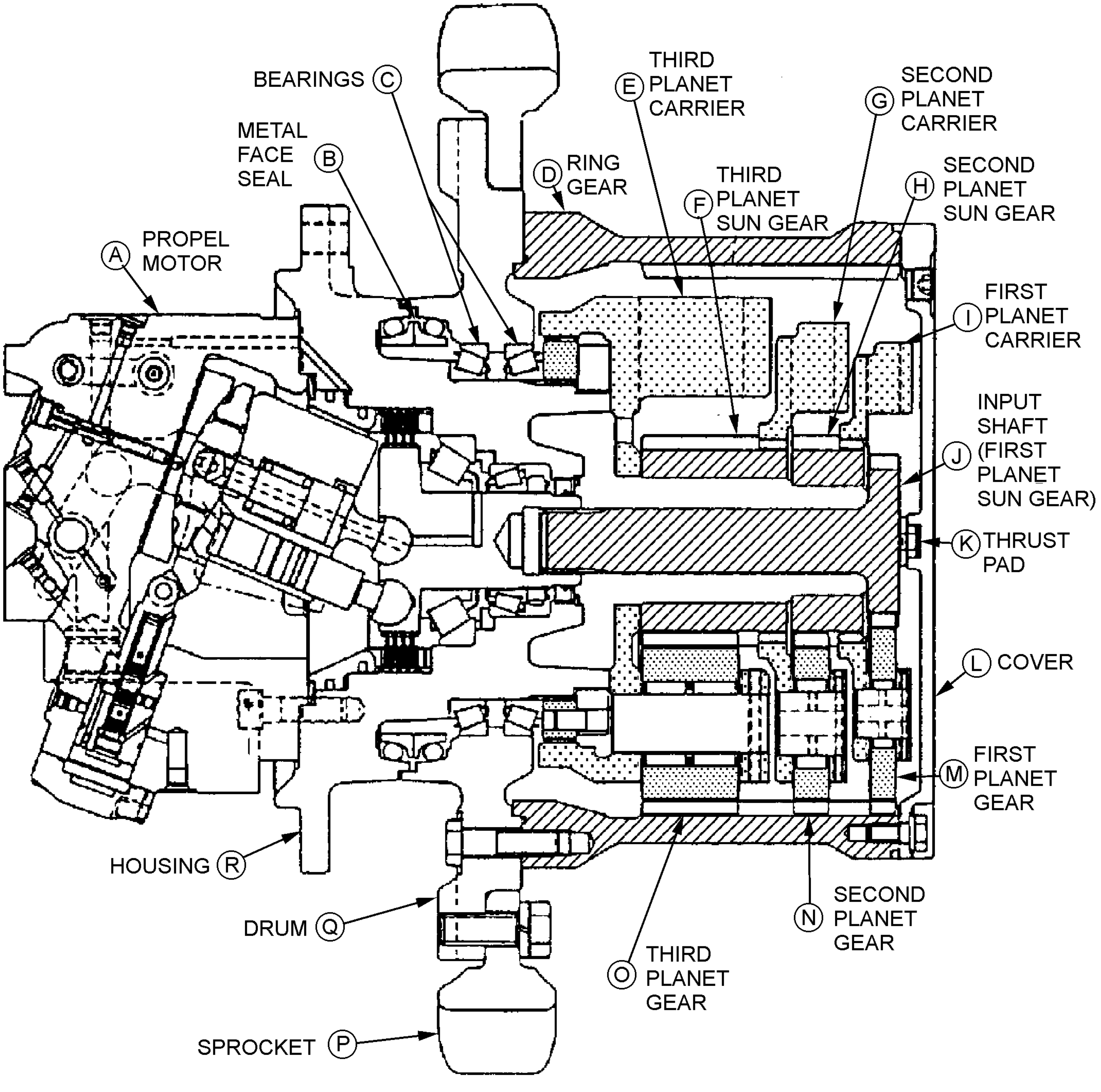
T7827AJ –19–28OCT92

The track adjuster (L) is supported by the track frame (A). Shock loads on the track and front idler (F) are absorbed by the track recoil spring (C).

To tighten the track, pump grease (I) into fitting (K) to force the piston (E) out. As it presses against the yoke (G), the track becomes tighter. Loosen adapter (J), NOT the fitting (K) to release grease to loosen track. Grease will escape through a small passage that is concealed by nut (B).

TX,05,GG2177 –19–19MAY98–1/1

PROPEL GEARBOX OPERATION



Ⓢ PROPEL GEARBOX

The propel gearbox (S) is a triple reduction planetary drive. The gearbox is interchangeable from the right to the left side of machine. The propel motor (A) is connected to and turns the input shaft (first planet sun gear) (J).

Continued on next page

Theory of Operation

Rotary motion is transferred from the input shaft to the sprocket (P) by the three planetary gear sets that mesh with the ring gear (D). As the input shaft is rotated it turns the first planet gears (M). The gears rotate against the ring gear causing the first planet carrier (I) to rotate. The first planet carrier is connected to the second planet sun gear (H) which is in mesh with and rotates the second planet gears (N). As the second planet gears rotate against the ring gear they turn the second planet carrier (G). The second planet carrier is connected to the third planet sun gear (F). The third planet sun gear rotate the third planet gears (O). The third planet carrier (E) is fixed to the housing (R) and does not rotate so the rotation of the third planet gears is transferred to the ring gear. Because the ring gear and sprocket (P) are fasten to the drum (Q) they all rotate together driving the track chain to move the machine.

A replaceable thrust pad (K) is used in the cover (L) to hold the input shaft in position.

TX,9025,GG2611 –19–19MAY98–2/2

Group 15
Diagnostic Information

DIAGNOSE UNDERCARRIAGE COMPONENTS MALFUNCTIONS

NOTE: Diagnose malfunction charts are arranged from most probable and simplest to verify, to least likely and most difficult to verify.

Symptom	Problem	Solution
Noisy or Loose Track Chain	Incorrect track tension adjustment	Adjust track sag. (See Group 9020-20.)
	Loose shoes	Remove loose shoes to clean material from between shoe and link. Install shoes and tighten cap screws to specified torque. (See Group 0130.)
	Grease leaking from track adjuster seals or relief valve	Inspect between second and third roller, at base of relief valve, and at hole in side of relief valve for leakage. Replace seals or relief valve. (See Group 0130.)
Tight Track Chain	Material packing in sprocket	Adjust track sag with material packed in sprocket. (See Group 9020-20.)
	Track sag less than specification	Adjust track sag. (See Group 9020-20.)
Frequent Track Chain Sag Adjustment Required	Grease leaking from track adjuster seals or relief valve	Inspect between second and third roller, at base of relief valve, and at hole in side of relief valve for leakage. Replace seals or relief valve. (See Group 0130.)
Excessive Oil Leakage From Idlers and Rollers	Loose plug, worn or damaged O-ring, or metal faced seal	Repair roller or idler. (See Group 0130.)
Bent Track Shoes	Excessive grouser wear	Measure grouser height. (See procedure in this group.) Rebuild grousers or replace shoes.

Continued on next page

TX,9020,GG2642 –19–25APR97–1/2

Diagnostic Information

Symptom	Problem	Solution
	Loose track shoes	Remove loose shoes to clean material from between shoe and link. Install shoes and tighten cap screws to specified torque. (See Group 0130.)
	Excessive high speed operation on rough and rocky terrain	Slow propel speed on rough and rocky terrain.
"Popping" of Track	High propel loads in reverse	High propel loads in reverse can cause the recoil spring to retract allowing sprocket to slip in chain.
	Material packed in sprocket	Material filling sprocket teeth can cause sprocket tooth to bushing impact.
Cracked Track Link	Excessive high speed operation on rough and rocky terrain	Slow propel speed on rough and rocky terrain.
	Track shoes too wide for ground conditions	Use the narrowest shoes possible for required flotation.
Chipped Link Rails	Repeated high impacts with roller tread on flanges caused by a loose or snaky track, or using shoes that are too wide	Adjust track chain sag. (See Group 9020-20.)
		Check track chain pitch. (See procedure in this group.)
		Use the narrowest shoes possible for required flotation.
Individual Undercarriage Component Wear	See Undercarriage Appraisal Manual SP326	Rebuild components using weld. Repair or replace components.

TX,9020,GG2642 –19–25APR97–2/2

MEASURE TRACK CHAIN BUSHING WEAR

SPECIFICATIONS	
Track Chain Bushing OD	59.0 mm (2.32 in.) new
Track Chain Bushing OD	54.0 mm (2.13 in.) minimum used

SERVICE EQUIPMENT AND TOOLS
D17524C1[a] 100 mm Caliper
[a]Tools are available in a kit such as the JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.

T82865 –UN–08NOV88

Minimum used is the maximum allowable wear for turning pins and bushings.

Measure bushing outer diameter at the two worn places using a caliper such as the D17524C1 100 mm Caliper from JT05518A Undercarriage Inspection Service Tool Kit.

Track Chain Bushing—Specification

OD .... 59.0 mm (2.32 in.) new
OD .... 54.0 mm (2.13 in.) minimum used

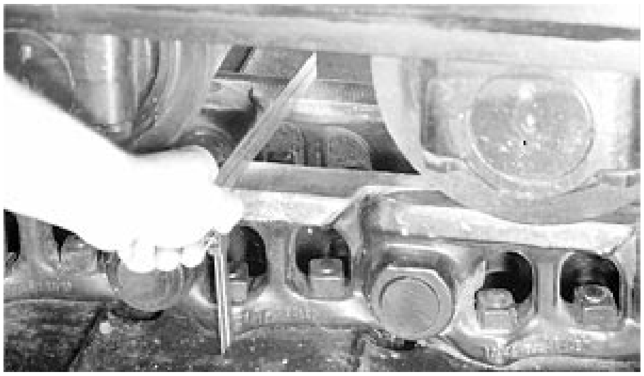
NOTE: See Undercarriage Appraisal Manual SP326 for additional information.

CED,OUOE003,615 –19–29MAY98–1/1

MEASURE TRACK CHAIN LINK WEAR

SPECIFICATIONS	
Track Chain Link Height	105.0 mm (4.13 in.) new
Track Chain Link Height	98.0 mm (3.86 in.) minimum used

SERVICE EQUIPMENT AND TOOLS
JT05521[a] Depth Gauge (200 mm Ruler)
JT05534[a] Right Angle Attachment
D05231ST[a] 300 mm Ruler
[a]Tools are available in a kit such as the JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.



T82864 –UN–08NOV88

Minimum used is the maximum allowable wear for rebuilding links.

Measure height of several links to find an average using a depth gauge such as the JT05521 200 mm Ruler, JT05534 Right Angle Attachment, and D05231ST 300 mm Ruler from JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.

9020
15
4

Track Chain Link—Specification

Height .... 105.0 mm (4.13 in.) new
Height .... 98.0 mm (3.86 in.) minimum used

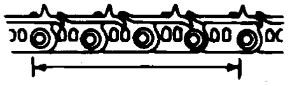
NOTE: See Undercarriage Appraisal Manual SP326 for additional information.

CED,OUOE003,616 –19–29MAY98–1/1

MEASURE TRACK CHAIN PITCH

SPECIFICATIONS	
Track Chain Pitch	762.0 mm (30.00 in.) new
Track Chain Pitch	780.0 mm (30.71 in.) maximum used

SERVICE EQUIPMENT AND TOOLS
JT05520[a] Metric Tape Measure
[a]Tools are available in a kit such as the JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.



T6813AL –UN–29JAN98

Maximum used is the maximum allowable wear for turning pins and bushings.

1. Remove slack by putting a wooden block between sprocket and chain; then slowly move machine in reverse to tighten chain.

2. Measure pitch across several four-link sections as shown, except section on either side of master pin, to find average chain wear. Use a tape measure such as the JT05520 Metric Tape from JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.

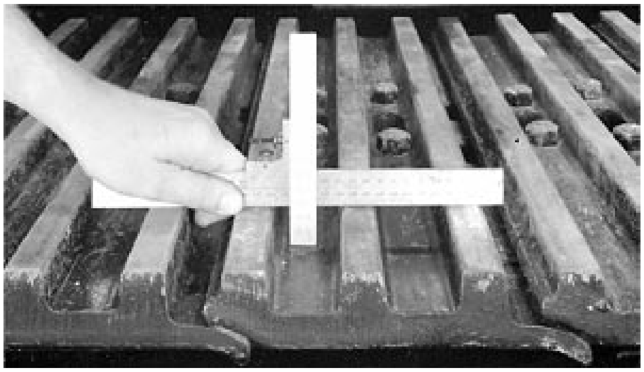
Track Chain—Specification

Pitch.. 762.0 mm (30.00 in.) new
Pitch.. 780.0 mm (30.71 in.) maximum used

NOTE: See Undercarriage Appraisal Manual SP326 for additional information.

CED,OUOE003,617 –19–29MAY98–1/1

MEASURE TRACK SHOE GROUSER WEAR (SERIAL NO. —599999)


T82859 –UN–08NOV88

SPECIFICATIONS	
Track Shoe Grouser Height	26.0 mm (1.02 in.) new
Track Shoe Grouser Height	15.0 mm (0.59 in.) minimum used

SERVICE EQUIPMENT AND TOOLS
JT05521 Depth Gauge (200 mm Ruler)
JT05534 Right Angle Attachment
D05231ST Ruler (300 mm)
JT05518A Undercarriage Inspection Service Tool Kit
JT05523 Undercarriage Inspection Service Tool Kit

Minimum used is the maximum allowable wear for rebuilding grouser bars with weld.

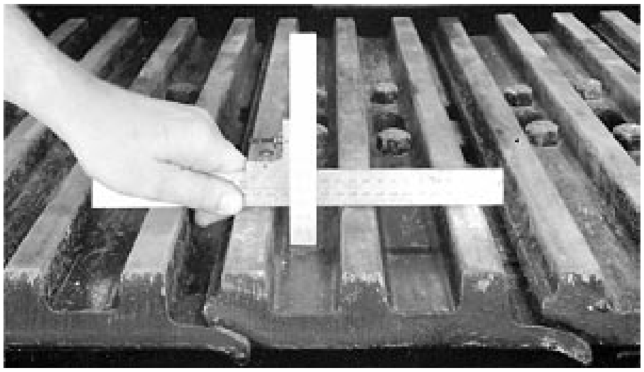
Measure grouser height of several track shoes to find an average using a depth gauge such as the JT05521 200 mm Ruler, JT05534 Right Angle Attachment, and D05231ST 300 mm Ruler from JT05518A or JT0552 Undercarriage Inspection Service Tool Kit.

Track Shoe Grouser—Specification

Height	26.0 mm (1.02 in.) new
Height	15.0 mm (0.59 in.) minimum used

TX,9020,GG2683 –19–14AUG98–1/1

MEASURE TRACK SHOE GROUSER WEAR (SERIAL NO. 600000—)


T82859 –UN–08NOV88

SPECIFICATIONS	
Track Shoe Grouser Height	25.5 mm (1.00 in.) new
Track Shoe Grouser Height	15.0 mm (0.59 in.) minimum used

SERVICE EQUIPMENT AND TOOLS
JT05521 Depth Gauge (200 mm Ruler)
JT05534 Right Angle Attachment
D05231ST Ruler (300 mm)
JT05518A Undercarriage Inspection Service Tool Kit
JT05523 Undercarriage Inspection Service Tool Kit

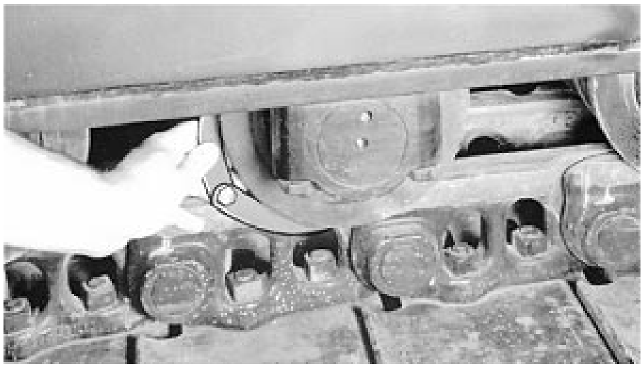
Minimum used is the maximum allowable wear for rebuilding grouser bars with weld.

Measure grouser height of several track shoes to find an average using a depth gauge such as the JT05521 200 mm Ruler, JT05534 Right Angle Attachment, and D05231ST 300 mm Ruler from JT05518A or JT0552 Undercarriage Inspection Service Tool Kit.

Track Shoe Grouser—Specification

Height .... 25.5 mm (1.00 in.) new
Height .... 15.0 mm (0.59 in.) minimum used

MEASURE TRACK ROLLER WEAR


T87973 –UN–08NOV88

SPECIFICATIONS	
Track Roller Tread OD	155.0 mm (6.10 in.) new
Track Roller Tread OD	149.0 mm (5.87 in.) minimum used

SERVICE EQUIPMENT AND TOOLS
JT05519[a] Special Roller Caliper
[a]Tools are available in a kit such as the JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.

Minimum used is the maximum allowable wear for rebuilding roller tread.

Under some conditions roller wear can be uneven. If wear is uneven, rollers may be interchanged to even out the wear.

Measure roller tread diameter using a caliper such as the JT05519 Special Roller Caliper from JT05518A or JT05523 Undercarriage Inspection Service Tool KitUndercarriage Inspection Service Tool Kit.

Track Roller Tread—Specification

OD	155.0 mm (6.10 in.) new
OD	149.0 mm (5.87 in.) minimum used

NOTE: See Undercarriage Appraisal Manual SP326 for additional information.

MEASURE TRACK CARRIER ROLLER WEAR

SPECIFICATIONS	
Track Carrier Roller Tread OD	120.0 mm (4.72 in.) new
Track Carrier Roller Tread OD	110.0 mm (4.33 in.) minimum used

SERVICE EQUIPMENT AND TOOLS
JT05519[a] Special Roller Caliper
[a]Tools are available in a kit such as the JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.

T6813AQ –UN–29JAN98

Used minimum tread diameter is the maximum allowable wear for rebuilding wear surface.

Measure roller tread diameter using a caliper such as the JT05519 Special Roller Caliper from JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.

Track Carrier Roller Tread—Specification

OD	120.0 mm (4.72 in.) new
OD	110.0 mm (4.33 in.) minimum used

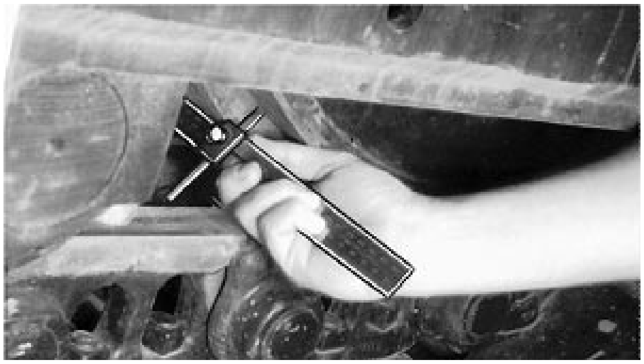
NOTE: See Undercarriage Appraisal Manual SP326 for additional information.

TX,9020,GG2686 –19–29MAY98–1/1

MEASURE FRONT IDLER WEAR

SPECIFICATIONS	
Front Idler Flange Height	19.0 mm (0.75 in.) new
Front Idler Flange Height	23.0 mm (0.91 in.) maximum used

SERVICE EQUIPMENT AND TOOLS
JT05521[a] Depth Gauge (200 mm Ruler)
JT05534[a] Right Angle Attachment
D05231ST[a] 300 mm Ruler
[a]Tools are available in a kit such as the JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.



T87972 –UN–08NOV88

Maximum used flange height is the maximum allowable height of flange for rebuilding wear surface.

Measure height of flange using a depth gauge such as the JT05521 200 mm Ruler, JT05534 Right Angle Attachment, and D05231ST 300 mm Ruler from JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.

9020
15
10

Front Idler Flange—Specification

Height	19.0 mm (0.75 in.) new
Height	23.0 mm (0.91 in.) maximum used

NOTE: See Undercarriage Appraisal Manual SP326 for additional information.

TX,9020,GG2685 –19–29MAY98–1/1

MEASURE SWING BEARING WEAR

SPECIFICATIONS	
Swing Bearing Play	1.3 mm (0.051 in.) or less new
Swing Bearing Play	4.3 mm (0.169 in.) maximum

SERVICE EQUIPMENT AND TOOLS
D17526CI Dial Indicator
D17525CI Magnetic Base with Adjustable Arm

CAUTION: Stay clear of moving parts. Position dial indicator so it can be seen while operator can see you.

NOTE: *Two people are needed to do the measurement. One to operate the machine and one to take the readings.*

1. Check that swing bearing to main frame cap screws are tight. (See Group 4350.)

   Check that bearing is lubricated with the specified grease. (See Track Adjuster, Working Tool Pivot, Swing Bearing, and Swing Bearing Gear Grease in General Information Section.)

   Check that bearing rotation is smooth and without noise.

2. Install the dial indicator with needle point contacting bottom face of swing bearing outer race.

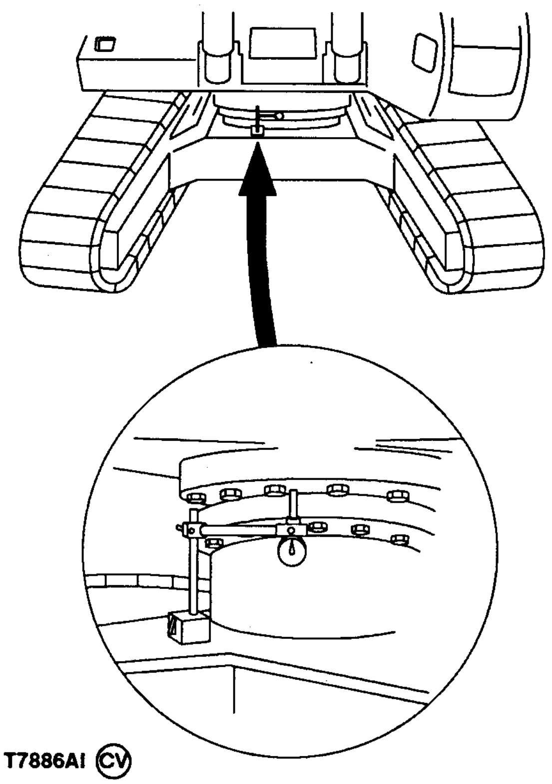
3. Move boom and arm to position shown with bucket off the ground.

4. Turn dial indicator to zero.

5. Lower boom to raise front idlers off the ground approximately 500 mm (20 in.)

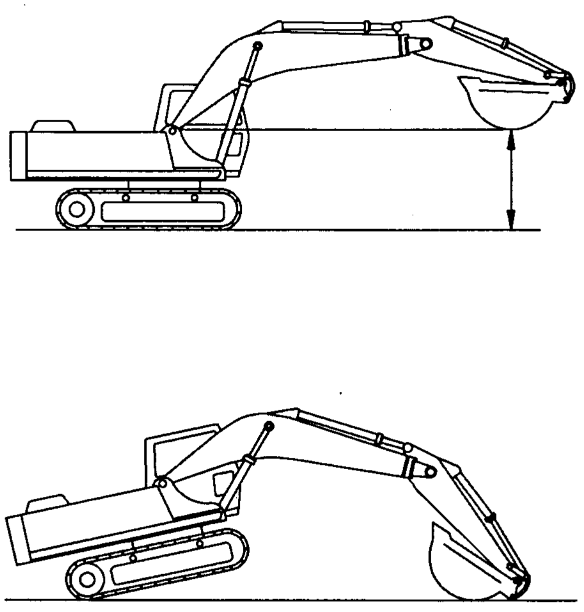
6. Record dial indicator reading.

   If reading is more than maximum allowable, check for steel ball and spacer wear. Repair or replace swing bearing as needed. (See Group 4350.)



T7886AI CV

T7886AI –UN–23NOV92



T7886AJ CV

T7886AJ –UN–23NOV92

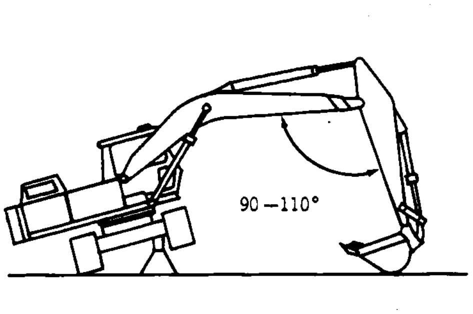
Continued on next page

Swing Bearing—Specification

Play .... 1.3 mm (0.051 in.) or less new
Play... 4.3 mm (0.169 in.) maximum

TX,9020,GG2639 –19–13AUG98–2/2

ADJUST TRACK SAG



T6876FG —UN—06DEC88

SPECIFICATIONS	
Machine Weight	23 773 kg (52 410 lb) approximate
Track Sag	300—335 mm (11-13/16—13-3/16 in.)
Nut and Valve Assembly Torque	147 N•m (108 lb-ft)

ESSENTIAL TOOLS
Grease Gun

OTHER MATERIAL
TY2098 U.S. Multi-Purpose Grease

1. Swing upperstructure to side. Lower boom to raise track off the ground.

   Keep the angle between boom and arm at 90—110° with the round side of bucket on the ground.

CAUTION: Prevent possible injury from unexpected machine movement. Put blocks or shop stands under machine frame to support machine while measuring track sag.

The approximate weight of machine is 23 773 kg (52 410 lb).

Machine—Specification

Weight... 23 773 kg (52 410 lb) approximate

2. Put blocks or shop stands under the machine to support machine.

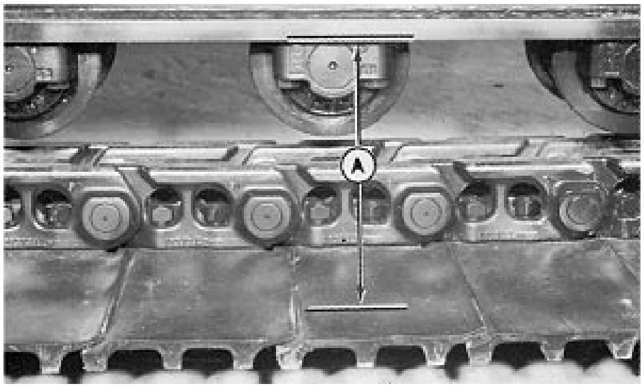
3. Slowly turn the track forward for two revolutions and then in reverse for two revolutions. Stop the track while moving in reverse direction so all track sag is at the bottom.

Continued on next page

4. Measure track sag (A) at middle track roller from the bottom of tack frame to the top surface of track shoe.

Track—Specification

Sag .... 300—335 mm
(11-13/16—13-3/16 in.)



A—Track Sag

Continued on next page

CAUTION: High pressure grease in track adjuster cylinder. Do not remove grease fitting or nut and valve assembly to release grease.

IMPORTANT: Prevent possible damage to track components. Do not use the grease fitting on track adjuster cylinder for lubrication. Use this grease fitting only for track sag adjustment.

5. To decrease track sag, add multi-purpose grease to track adjuster cylinder through grease fitting (A) located in access hole (D) in track frame. Use a grease gun with a maximum capacity of 68 950 kPa (690 bar) (10 000 psi).

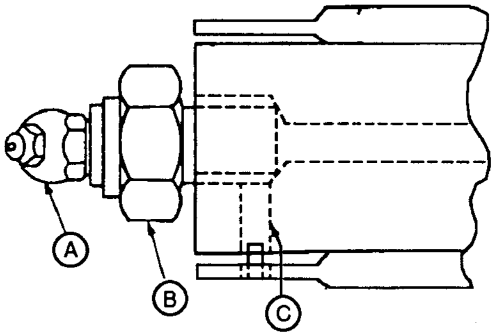
   To increase track sag, loosen nut and valve assembly (B) one turn to release grease from track adjuster cylinder through bleed hole (C) in rod.

   Tighten nut and valve assembly when track sag is correct.

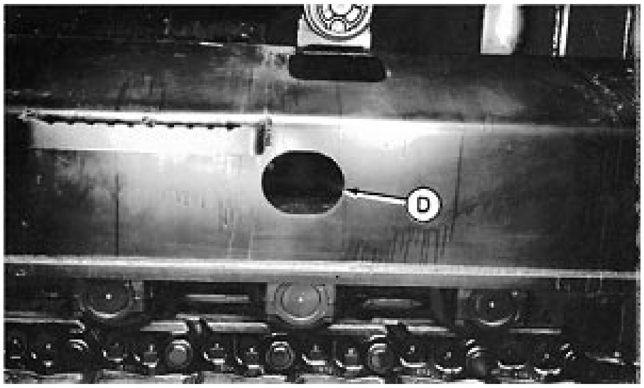
Nut and Valve Assembly—Specification

Torque .... 147 N•m (108 lb-ft)

NOTE: If piston in track adjuster cylinder does not move, remove the cylinder to make repairs. (See Remove and Install Track Adjuster in Group 0130.)



T7396DZ –UN–28NOV90



T7869AQ –UN–22OCT92

A—Grease Fitting
B—Nut and Valve Assembly
C—Bleed Hole
D—Access Hole

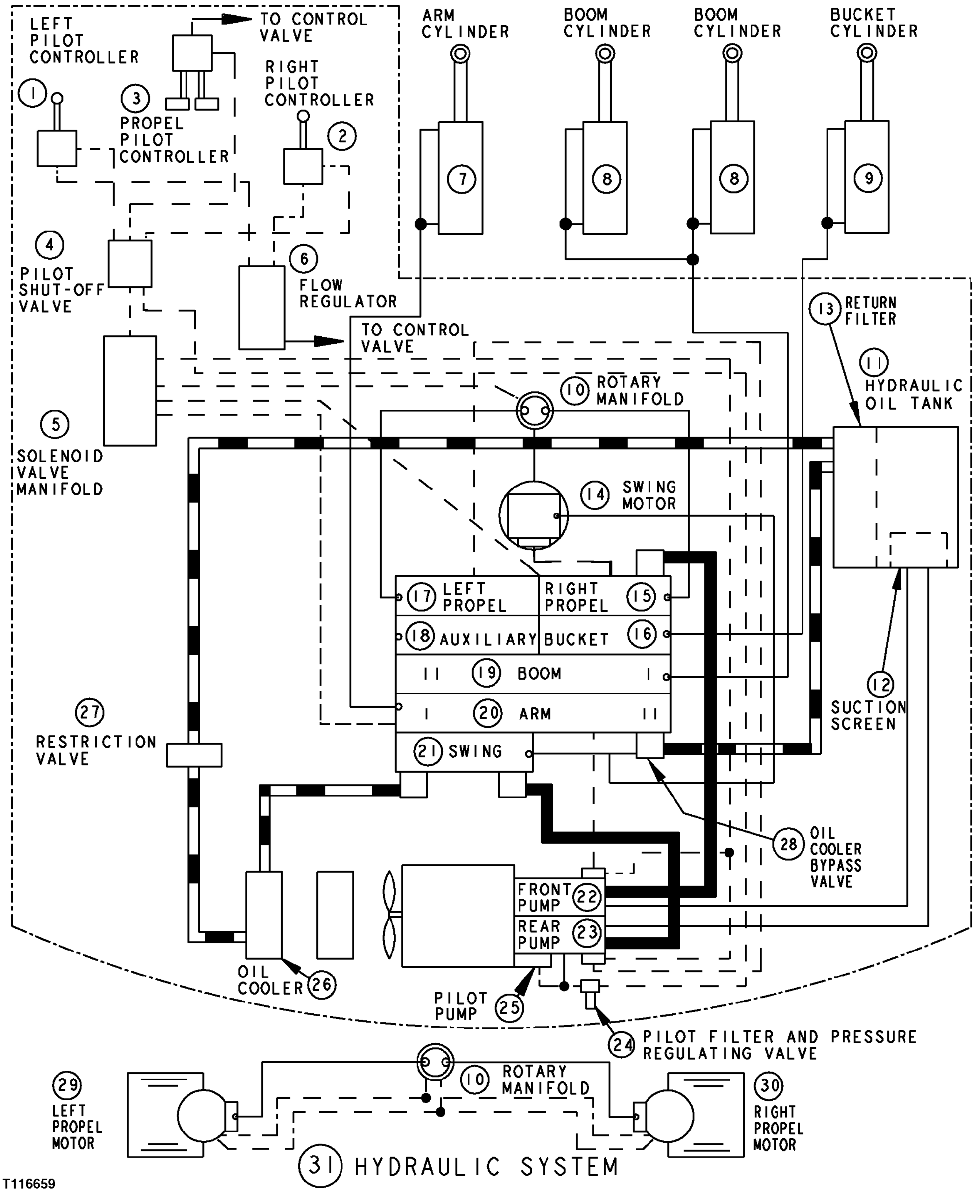
CHAPTER 6

SECTION 9025

HYDRAULIC SYSTEM

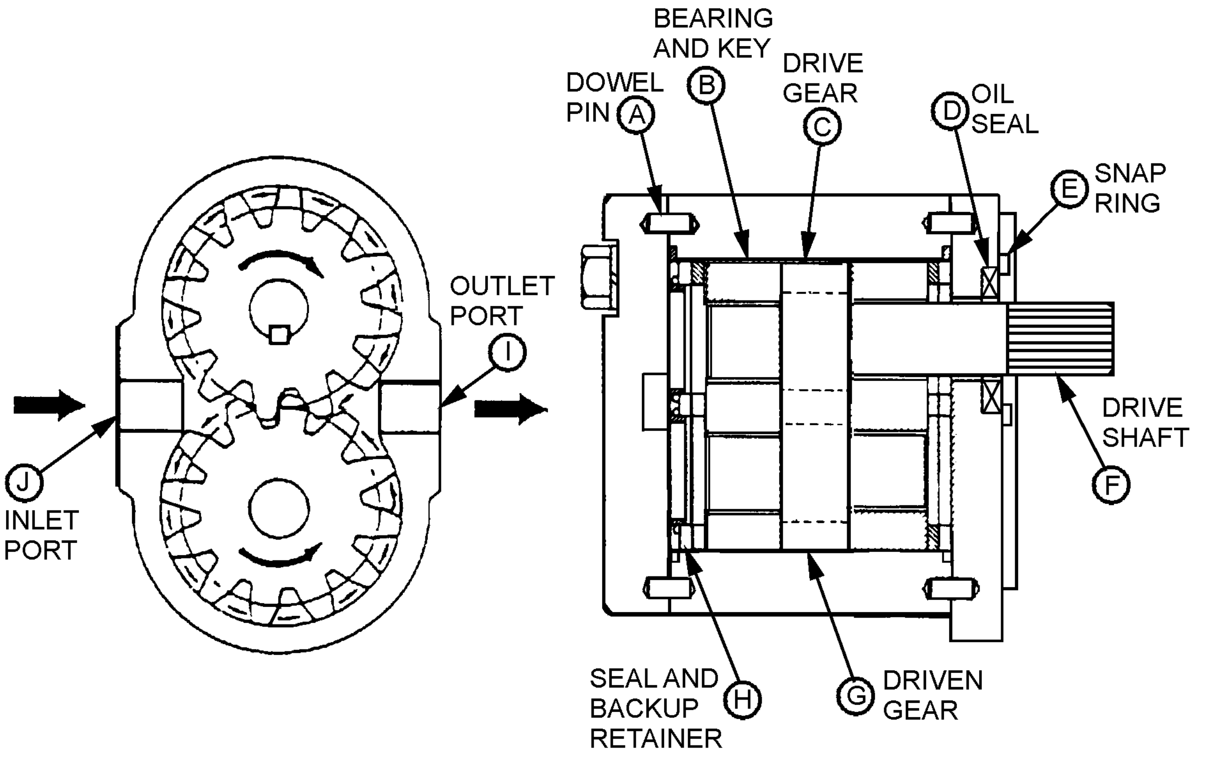
BLANK

HYDRAULIC SYSTEM DIAGRAM



T116659

PILOT PUMP OPERATION



(K) PILOT PUMP

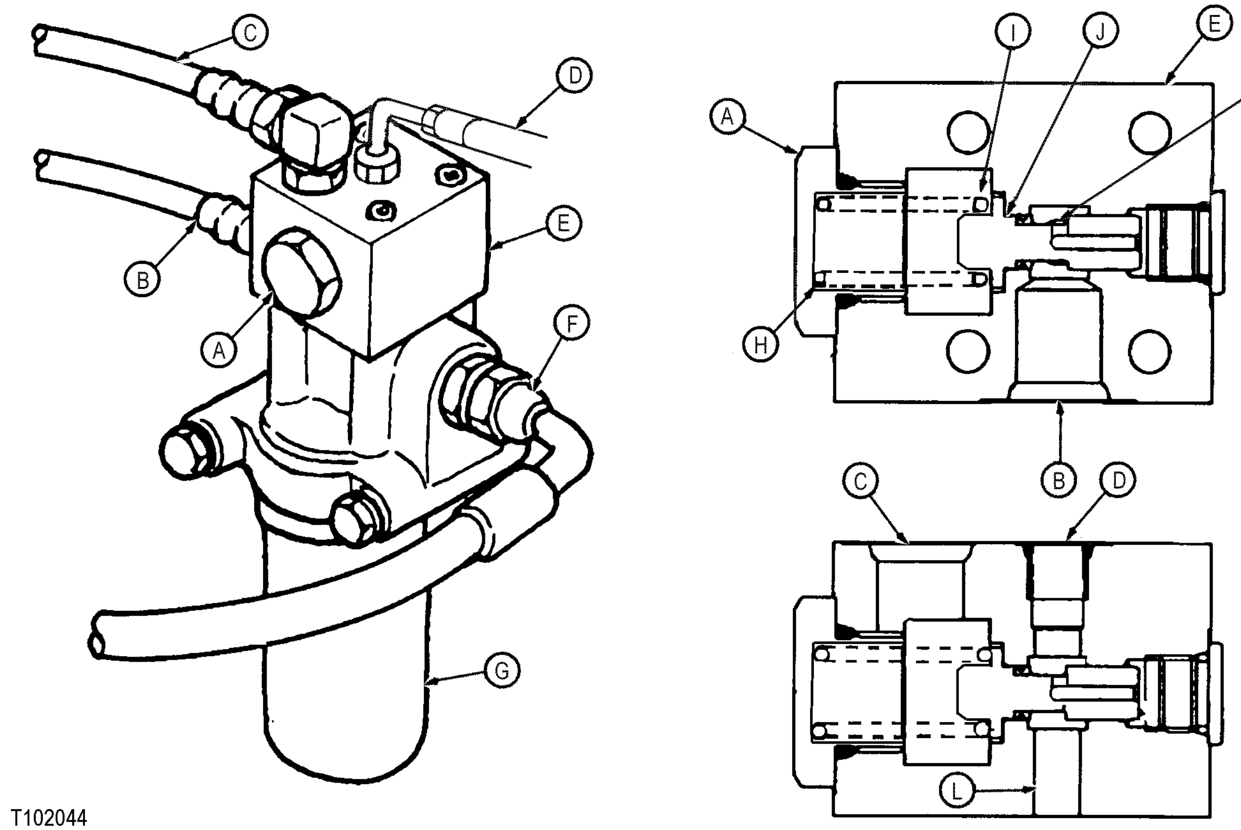
T112516 –19–17DEC97

The pilot pump (K) is a fixed-displacement, external gear pump. The pilot pump is attached to the pump drive gearbox just to the rear of the rear pump. The pump is driven through a gear train by the rear pump.

The inlet port (J) is connected by a suction line to the suction line for the front and rear pumps. The outlet port (I) is connected to the pilot pressure regulating valve and pilot filter. The outlet is also connected by a tube and passages in pump housing to the small end of the front and rear pump servo piston and the pump regulators.

TX,9025,GG2283 –19–22APR98–1/1

PILOT PRESSURE REGULATING VALVE AND FILTER OPERATION



T102044

T102044 –UN–01AUG96

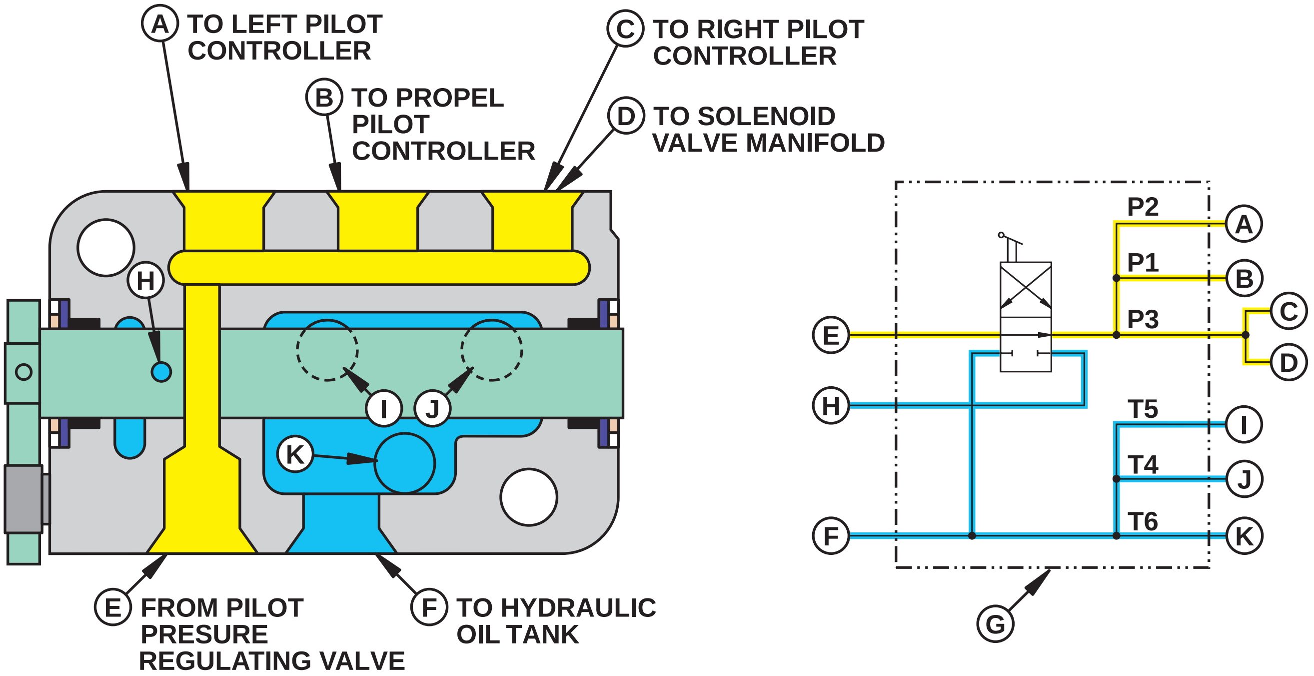
A—Plug
B—Regulated Pilot Oil To Pilot Shutoff Valve
C—Return Oil to Hydraulic Oil Tank
D—Regulated Pilot Oil to Control Valve
E—Pilot Pressure Regulating Valve
F—Pilot Oil From Pilot Pump
G—Pilot Filter and Bypass Valve
H—Shim
I—Spring
J—Pilot Pressure Regulating Valve Spool
K—Orifice
L—Pilot Oil From Pilot Filter

The pilot filter and pilot pressure regulating valve are incorporated into one assembly.

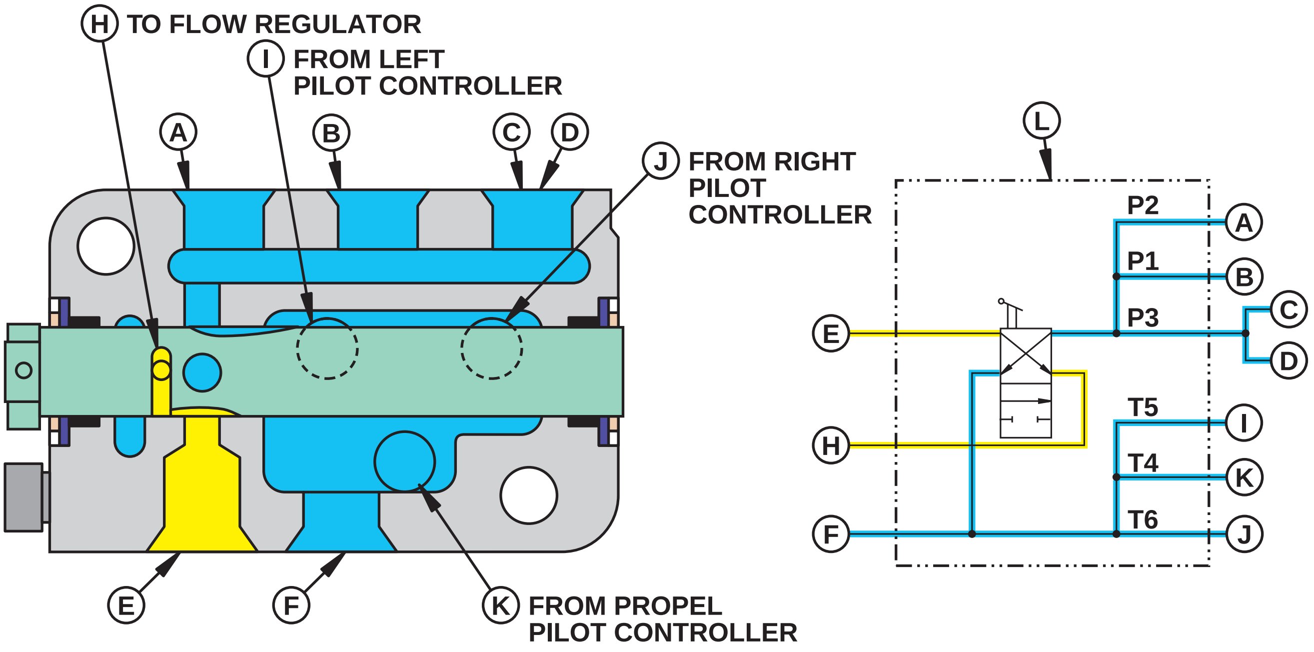
The pilot filter (G) consists of a filter element and a bypass valve. The bypass valve senses the differential pressure between the inlet side and outlet side of the filter element. During normal operation, the bypass valve is held closed by a spring and pilot oil flows through the filter element and out to the pilot pressure regulating valve. If the filter element becomes plugged, pressure on the inlet side increases forcing the bypass valve open. Pilot oil now bypasses the filter element and unfiltered oil flows to the pilot pressure regulating valve.

The pilot pressure regulating valve (E) is a bypass flow regulating valve and is used to regulate the pilot oil pressure in the pilot oil circuit. Pilot oil flows through the orifice (K) to the end of the pilot pressure regulating valve spool (J). When the pressure in the pilot circuit increases to the pressure setting of the spring (I), the spool is pushed right against the spring. Regulated pilot oil flows to the pilot shutoff valve (B) and the control valve (D). Oil not needed to maintain the pressure in the pilot circuit flows to the hydraulic oil tank as return oil (C).

PILOT SHUT-OFF VALVE OPERATION



Ⓖ PILOT SHUT-OFF VALVE ON



Ⓛ PILOT SHUT-OFF VALVE OFF

🟨 Ⓜ PILOT OIL

🟦 Ⓝ RETURN OIL

T101854

T101854 –19–06MAY98

Continued on next page

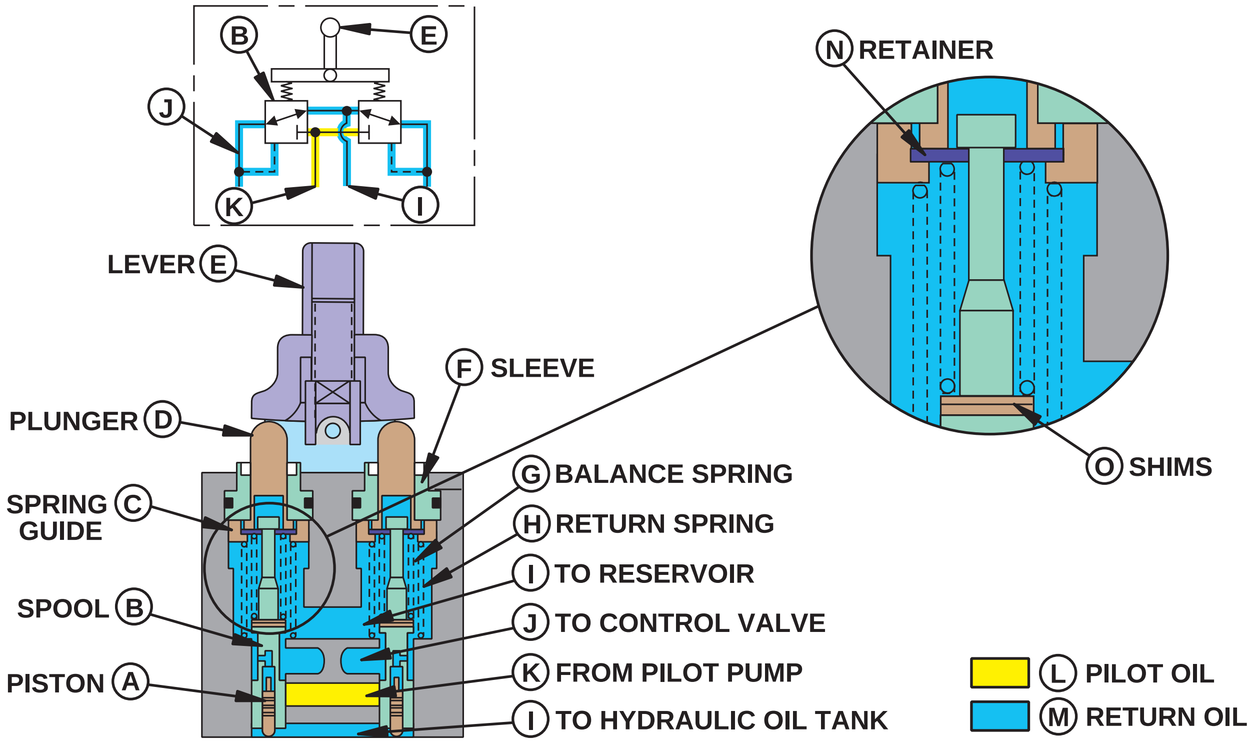
The pilot shut-off valve is a manual-operated, two-position, three-way rotary valve. The shut-off valve is rotated by pushing or pulling the pilot shut-off lever. The valve is located under the cab.

In the on (G) position, shut-off lever is pushed forward to the unlocked position, pilot oil flows to inlet ports of the pilot controllers, propel pilot controller, and solenoid valve manifold. Return oil from the controllers flows to the shut-off valve and then through the solenoid valve manifold and back to the hydraulic oil tank.

In the off (L) position, shut-off lever is pulled rearward to the locked position, pilot oil to the controllers and solenoid valve manifold is blocked and the pilot oil now flows to the flow regulator valve (H). Pilot oil that flows to the flow regulator when shut-off valve is locked is part of the warm-up circuit. The inlet ports for the controllers are open to hydraulic oil tank through the shut-off valve and solenoid valve manifold.

TX.9025,GG2284 –19–19MAY98–2/2

PILOT CONTROLLER OPERATION—NEUTRAL



T111390

Ⓟ PILOT CONTROLLER - NEUTRAL

T111390 –19–06MAY98

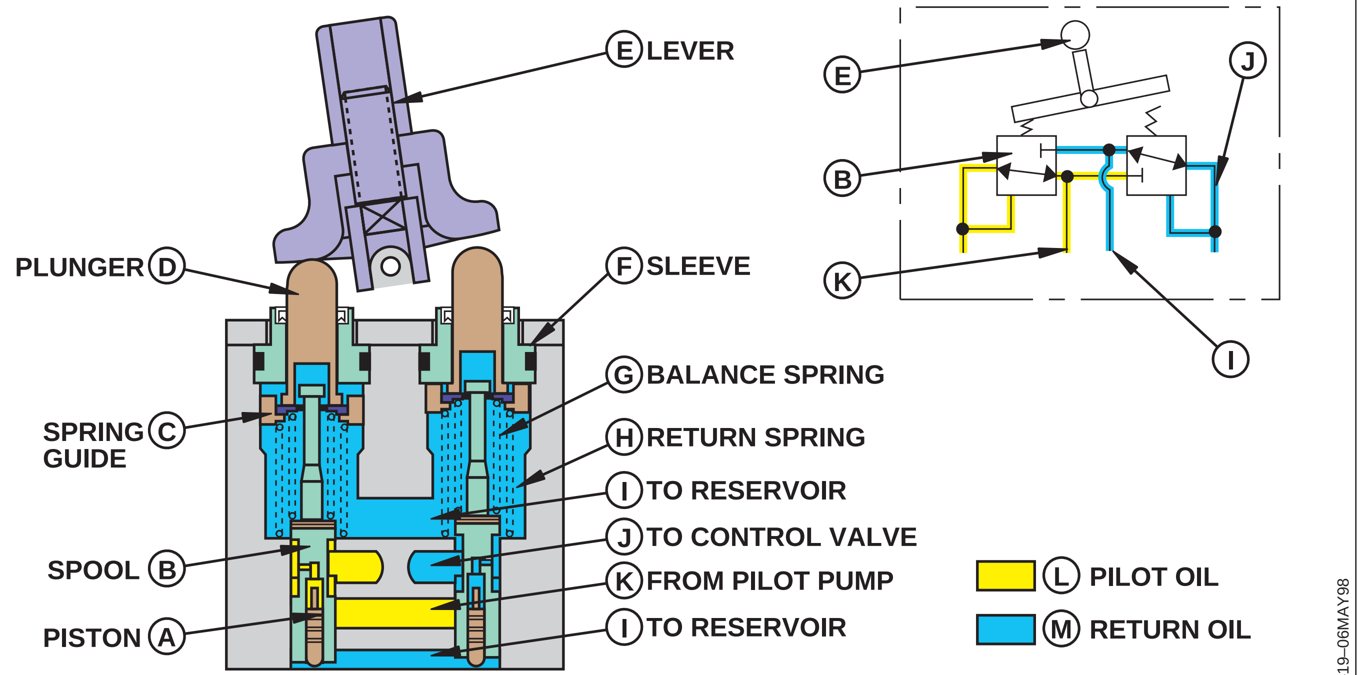
Two hand-operated pilot controllers (right and left) are used to control the dig functions. Each controller assembly contains four valve assemblies, one for each direction of each function.

The pilot controller consists of the plunger (D), sleeve (F), spring guide (C), retainer (N), spool (B), piston (A), balance spring (G), shims (O), and return spring (H). The spools are select fitted to the bores in the housing. The quantity of shims for each balance spring and spool assembly has been determined at the factory for correct operation of the controller. The balance and return springs used in ports 1 and 3 are different than the balance and return springs used in ports 2 and 4. The port numbers are stamped on the housing.

In neutral (P), the spool is pushed up by the return spring to block oil from the pilot pump (K) to control valve (J) pilot cap. With the spool up, the passage to the control valve pilot cap is connected to the hydraulic oil tank (I).

TX,9025,GG2285 –19–22APR98–1/1

PILOT CONTROLLER OPERATION—METERING AND FULL STROKE



T7350CK

Ⓝ PILOT CONTROLLER – METERING

T7350CK –19–06MAY98

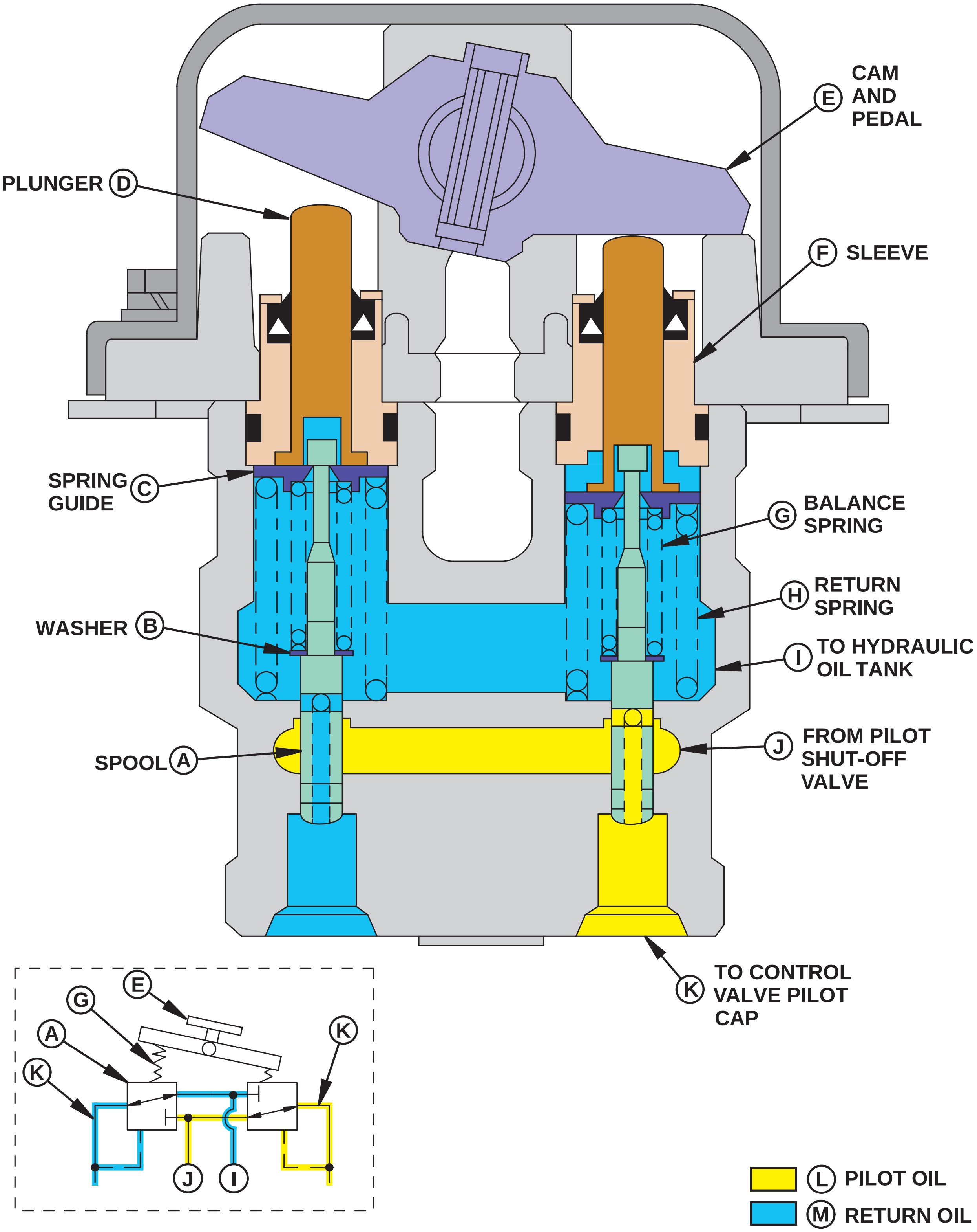
To meter a function, the lever (E) is moved slightly. This moves the plunger (D) and spring guide (C) against the balance spring (G) which moves the spool (B) down. The spool blocks the hydraulic oil tank (reservoir) passage (I) and opens the passage from the pilot pump (K) to control valve (J) pilot cap.

Pilot oil (L) also acts on piston (A) in the spool, moving the spool up against the balance spring which closes the passage to the control valve pilot cap. This maintains pressure in the control valve pilot cap passage according to the force on the balance spring by the plunger. As the lever is moved further, the plunger applies more force to the balance spring and the pressure to control valve pilot cap again increases to balance the spool.

When the lever (E) is moved to full stroke, the plunger (D) movement is transmitted directly to the spool (B). This forces the spool down connecting the passage from pilot pump (K) with the passage to the control valve (J) pilot cap. Oil pressure to the control valve pilot cap now equals pilot circuit pressure.

TX,9025,GG2286 –19–17NOV97–1/1

PROPEL PILOT CONTROLLER OPERATION



T108942

Ⓝ PROPEL PILOT CONTROLLER - FULL STROKE

T108942 –19–06MAY98

Continued on next page

One pilot controller is used to control the propel functions. The controller contains four valve assemblies, one for each direction of travel for each track.

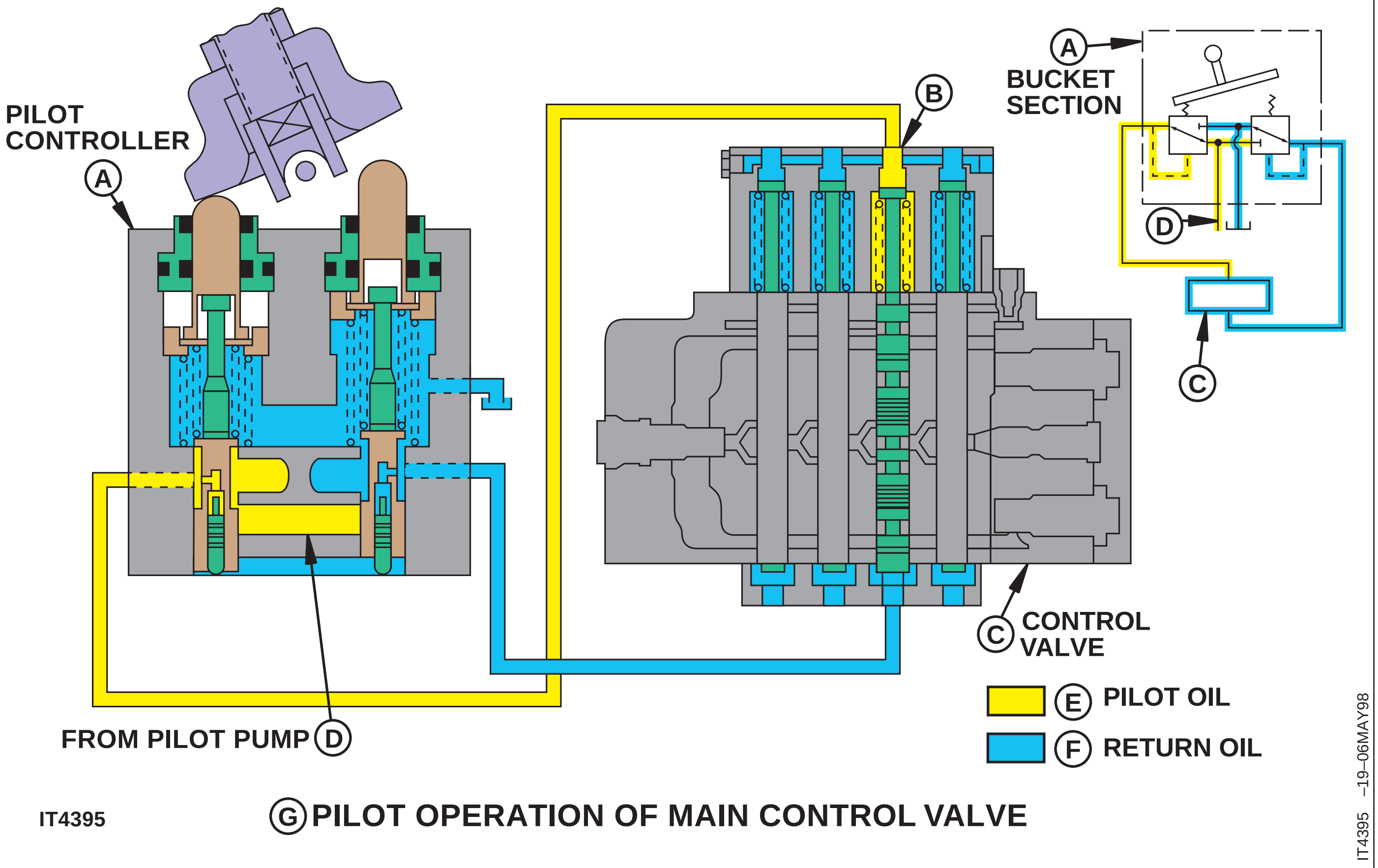
The pilot controller consists of the cam and pedal (E), plunger (D), sleeve (F), spring guide (C), spool (A), balance spring (G), and return spring (H).

In neutral, the spool is pushed up by the return spring to block pilot oil from the pilot shutoff valve (J). With the spool up, the passage to the control valve pilot cap (K) is connected to the hydraulic oil tank (I) by the passage through the spool (A).

When the pedal is pushed to move the machine, the cam (E) pushes the plunger and spring guide down against the return spring and balance spring. The balance spring pushes the spool down. As the spool is pushed down the passage from the control valve pilot cap to the hydraulic oil tank (I) is closed and then is opened to the pilot oil from pilot shutoff valve. When the pilot oil pressure to the control valve pilot cap is equal to the force applied by the balance spring the spool moves up trapping the oil to the pilot cap.

When the pedal and cam is moved to full stroke, the plunger is pushed down further by the balance spring opening the passage through the spool more to the pilot oil. When pressure to the control valve pilot cap is equal to the force applied by the balance spring, the spool moves up until it contacts the plunger. The plunger holds the spool down so the passage through spool remains open to pilot oil. Oil pressure to the control valve pilot cap now equals pilot oil pressure.

PILOT CONTROLLER OPERATION OF CONTROL VALVE

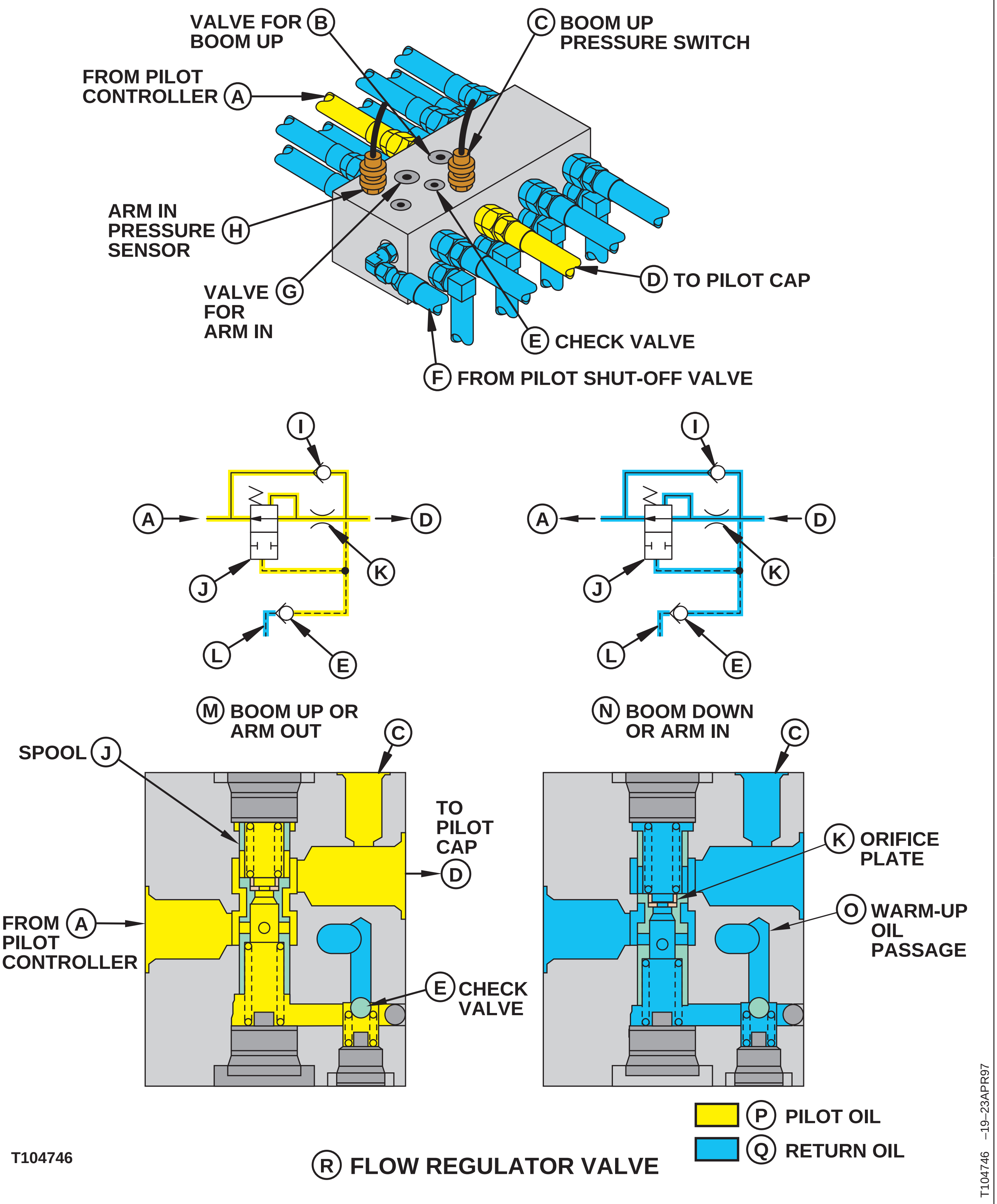


IT4395 Ⓖ PILOT OPERATION OF MAIN CONTROL VALVE

The pilot controllers (A) are connected to the control valve (C) by pilot control hoses through the flow regulator valve. When the pilot controller is actuated, pilot oil (E) from the pilot pump (D) is routed to the control valve pilot cap. In this illustration, the bucket section (B) is actuated. Return oil (F) from the control valve pilot cap is routed through the pilot controller to the hydraulic oil tank.

The pilot hoses for the propel pilot controller are not connected to the flow regulator valve but are connected directly to the control valve pilot caps.

FLOW REGULATOR VALVE OPERATION



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NOTE: The cross section of flow regulator valve shown in the illustration is in the boom up pilot circuit.

The pilot lines for boom, arm, bucket, and swing functions are connected through the flow regulator to the pilot caps on the control valve. The pilot lines for propel function are connected directly to the pilot caps.

The flow regulator valve (R) is a manifold containing similar flow regulator valve spools (J) in the arm out and boom up pilot circuits. Check valves (E) are also included in the warm-up oil passage (O) for arm in, arm out, boom down, and boom up pilot circuits; no check valves are used in the bucket and swing pilot circuits. Each valve spool contains an orifice plate (K) and springs. The size of the orifice is 2.5 mm (0.098 in.).

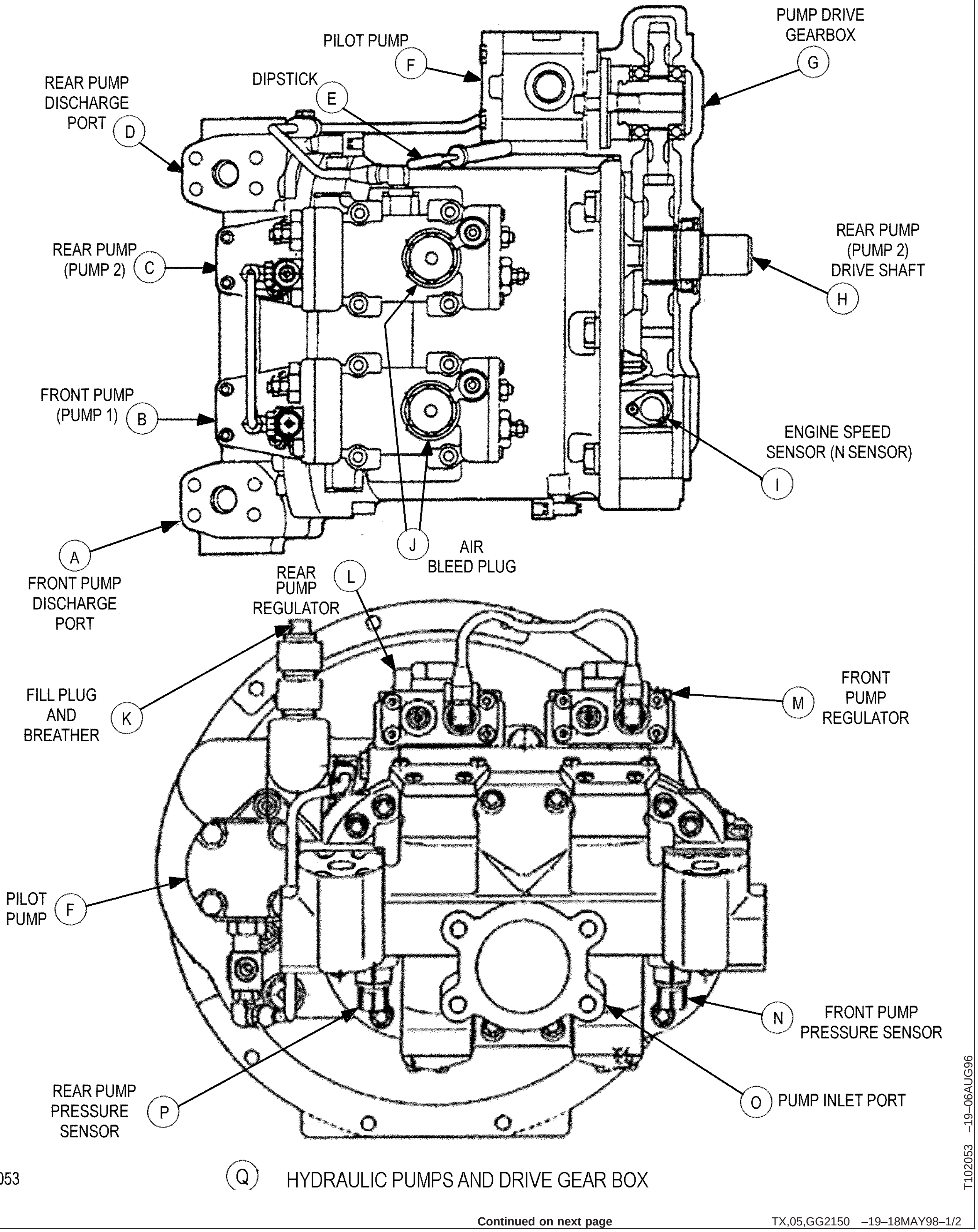
When the boom up or arm out (M) function is actuated, pilot oil from the pilot controller (A) flows through the spool into the bottom spring chamber and through the orifice plate (K) to the pilot cap (D). As the pressure increases the spool pushes upward allowing pilot oil to flow unrestricted to the pilot cap to move the control valve spool. The spool acts as a check valve (I). Return oil from the opposite end of control valve spool flows from the pilot cap and through the manifold to the pilot controller.

When the boom down or arm in (N) function is actuated, the pilot oil to move the control valve spool flows from the pilot controller through the manifold to the pilot cap. Return oil from the opposite end of control valve spool flows from the pilot cap to the manifold and through the orifice plate (K) in the spool (J). As the return pressure increases, the spool is pushed down in proportion to the pressure increase regulating the return oil flow to provide precise movement of a function. From here, oil flows to the pilot controller.

WARM-UP CIRCUIT OPERATION:

When the pilot shut-off valve is in the OFF position and the engine is running, pilot oil flows from the pilot shut-off valve (F) to the flow regulator valve manifold. The oil is heated as it flows through a restriction at the inlet to manifold. The warm-up oil from pilot shut-off valve (L) flows through the warm-up oil passage (O) past the check valves (E) and out to the left and right pilot controllers and top pilot caps to warm the pilot circuit. At the pilot controllers, the warm-up oil flows through the pilot controllers, out the return port, through the pilot shut-off valve to the solenoid valve manifold, and then to the hydraulic oil tank. At the pilot caps, warm-up oil flows through orifices into a return passage in the pilot caps and then to the hydraulic oil tank.

HYDRAULIC PUMP AND DRIVE GEARBOX OPERATION



T102053 Q HYDRAULIC PUMPS AND DRIVE GEAR BOX

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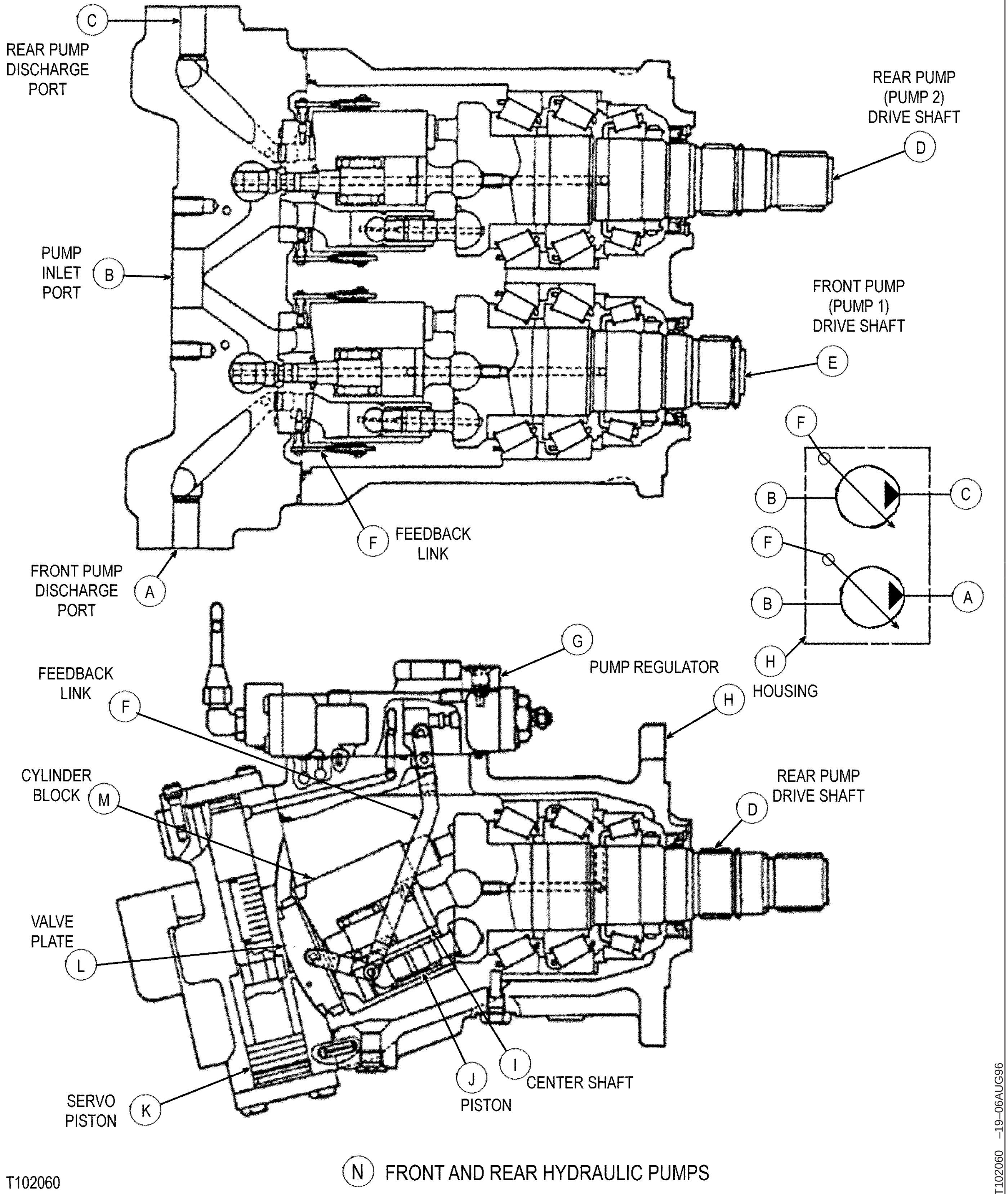
The front pump (B), rear pump (C) and pilot pump (F) are driven by the engine at engine speed through a pump drive gearbox (G). The rear pump drive shaft (H) as well as driving the rear pump also servers as the drive shaft for the pump drive gearbox. The rear pump drive shaft is connected to the engine flywheel through a dampener drive (flex coupling).

TX,05,GG2150 –19–18MAY98–2/2

HYDRAULIC PUMP OPERATION



(N) FRONT AND REAR HYDRAULIC PUMPS

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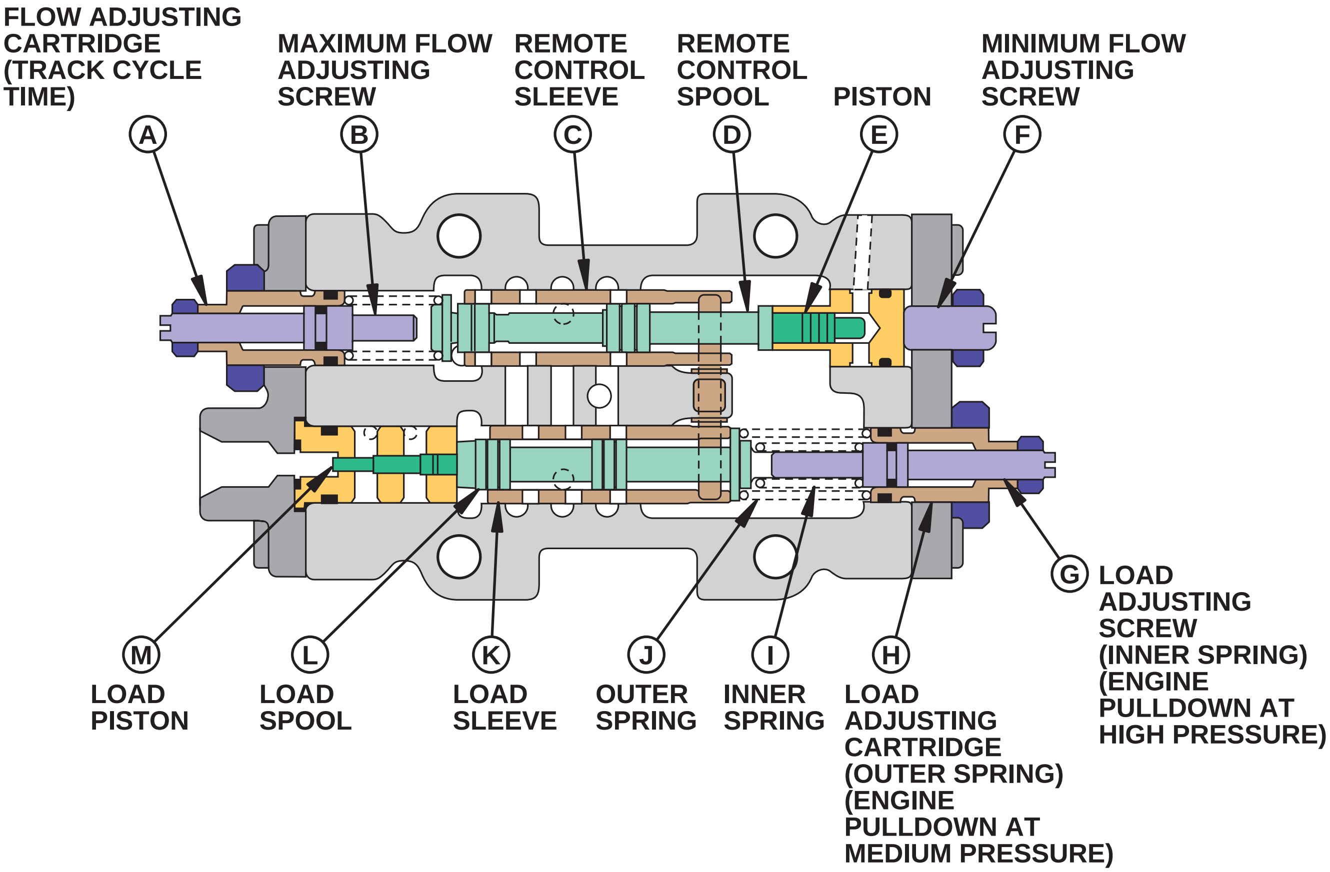
The front and rear hydraulic pumps (N) are variable displacement, bent-axis, piston type pump. Two identical pumps are used to generate oil flow in the hydraulic system. The pump can vary from minimum displacement to maximum displacement depending on hydraulic demand of the system.

A regulator (G) is attached to the top of housing (H) for each pump. A pilot oil signal to the regulator moves a piston which then directs pilot oil to the servo piston (K) which moves the valve plate (L) and cylinder block (M) changing the pump displacement. The feedback link (F), connected to the valve plate, also moves providing a mechanical feedback to the remote control sleeve in the regulator. The remote control sleeve blocks the flow of pilot oil to the servo piston and also traps the oil at both ends of the servo piston stopping its movement.

The front and rear pumps and pilot pump are driven at engine speed through a pump drive gearbox. The rear pump drive shaft (D) as well as driving the rear pump also serves as the drive shaft for the pump drive gearbox. The drive shafts drive the cylinder blocks (M) through the center shafts (I). The cylinder block is positioned at an angle to the drive shaft. As the cylinder block and drive shaft rotate, the pistons (J) move in and out of their bores because of the angle. The pistons which are moving out of their bores draw oil from the hydraulic oil tank through a pump inlet port and ports in the valve plate (L). The pistons which are moving back into their bores push oil through ports in the valve plate out the front and rear discharge ports (A and C) and to the control valve.

The pump displacement, or flow rate, is varied by changing the angle of the cylinder block with respect to the drive shaft. Increasing the angle increases the distance that each piston travels into and out of the bore which increases displacement. Decreasing the angle reduces the distance that each piston travels into and out of the bore which decreases displacement.

HYDRAULIC PUMP REGULATOR COMPONENT OPERATION



9025 05 18

T101949 Ⓝ **PUMP REGULATOR COMPONENTS**

T101949 –19–23APR97

The pump regulators are mounted on the top of the hydraulic pump housing. The major pump regulator components (N) are the flow adjusting cartridge (A), maximum flow (displacement) adjusting screw (B), remote control sleeve (C), remote control spool (D), piston (E), minimum flow (displacement) adjusting screw (F), load adjusting screw (inner spring) (engine pull down at high pressure) (G), load adjusting cartridge (outer spring) (engine pull down at medium pressure) (H), inner spring (I), outer spring (J), load sleeve (K), load spool (L), and load piston (M). Each regulator controls the flow of pilot oil to the large end of its servo piston using the spools and sleeves.

The remote control spool (D) is moved by a reduced pilot oil control signal from front and rear pump control valve. There is a pump control valve located in the left and right control valves. The control signal acts on the end of the piston (E) to control the position of remote control spool against the spring.

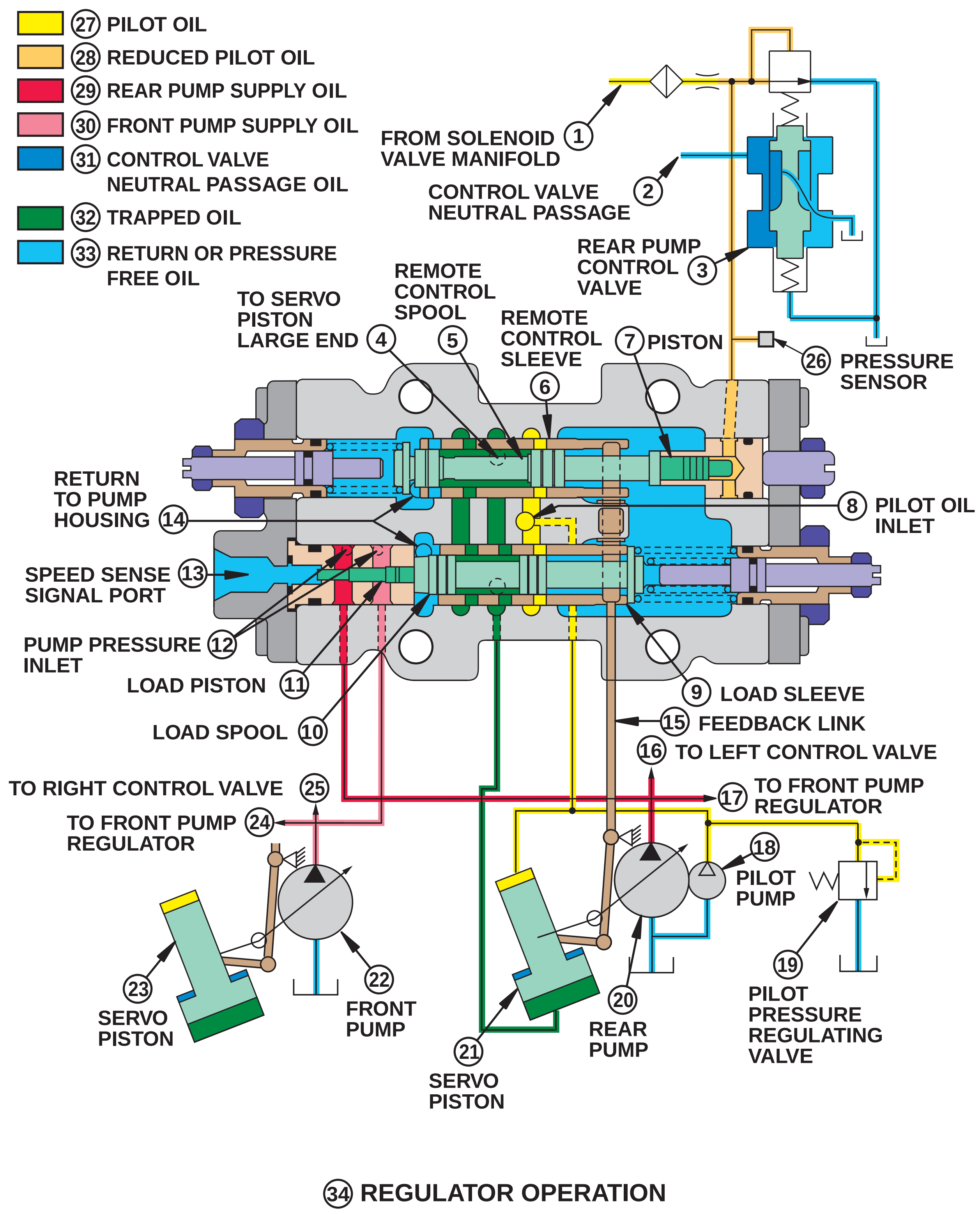
Continued on next page

TX,05,GG2148 –19–19MAY98–1/2

The load spool (L) is moved by the load piston (M) against the springs to decrease pump flow (displacement) and avoid overloading the engine when main system pressure becomes too high. At lower system pressures the spool is moved against only the outer spring (J). At higher pressures, the spool contacts and is moved against the inner spring (I) as well as the outer spring. The pump supply oil pressure is sensed on one shoulder of the load piston and the pump supply oil pressure from the other pump is sensed on the other shoulder. The end of the load piston receives a reduced pilot oil control signal from the speed sensing solenoid valve when the actual engine speed pulls down to the target engine speed.

TX,05,GG2148 –19–19MAY98–2/2

HYDRAULIC PUMP REGULATOR OPERATION



T108968

T108968 –19–29MAY97

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The function of pump regulators is to control the flow of pilot oil to and from the servo piston large end (4) in response to reduced pilot oil control signals from the front and rear pump control valves (3) and supply oil pressure signals from the front and rear pumps (22 and 20). Pump displacement (flow) is changed by sending pilot oil to or releasing pilot oil from the servo piston large end.

Pilot oil from the pilot pump (18) flows through drilled passages in the pump housing to the small end of servo pistons and to the pilot oil inlet (8) at each regulator. Pilot oil pressure is maintained at the small end of servo pistons and at the inlet of both regulators.

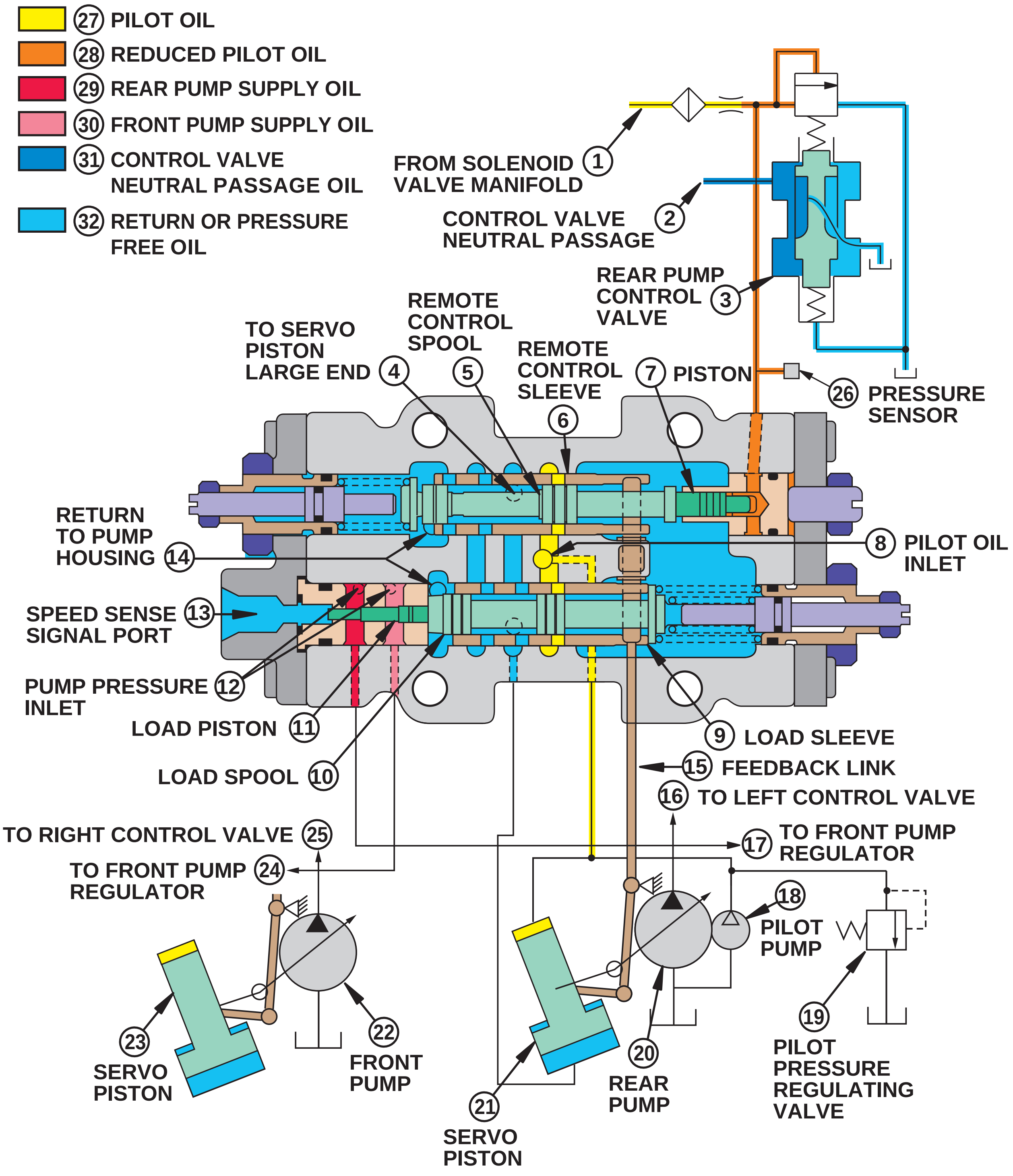
The reduced pilot oil (28) control signal from the front or rear pump control valve is sensed by the piston (7) through hoses from control valve to a port at the top of its respective regulator.

The pump supply oil (29 and 30) from front and rear pumps is sensed through drilled passages in the pump housing to the pump pressure inlets (12) in each regulator.

The control signal from the speed sensing solenoid valve is sensed through a hose to the speed sense signal port (13) at the rear pump regulator and then by a steel line to the front pump regulator.

TX,05,GG2152 –19–20MAY98–2/2

HYDRAULIC PUMP REGULATOR INCREASING, MAXIMUM, AND DECREASING OPERATION



㉝ PUMP FLOW INCREASING

T108969

T108969 –19–24APR97

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INCREASING FLOW (DISPLACEMENT)

When a function is actuated, the reduced pilot oil (28) control signal from the pump control valve (3) to the piston (7) increases. The control signal pushes the piston and remote control spool (5) to the left against the spring until the spring force and control signal pressure are equal. Movement of spool opens a path from the large end of servo piston to return in the pump housing (14). Pilot oil on the small end of servo piston pushes the piston down increasing pump angle which increases the displacement (flow). The servo piston movement is transmitted to the remote control sleeve (6) and load sleeve (9) by the feedback link (15). The sleeves move left until the path to return is closed. The oil at the large end of servo piston is now trapped holding the pump at the displacement (flow rate) that is proportional to the pressure of the pump control valve control signal.

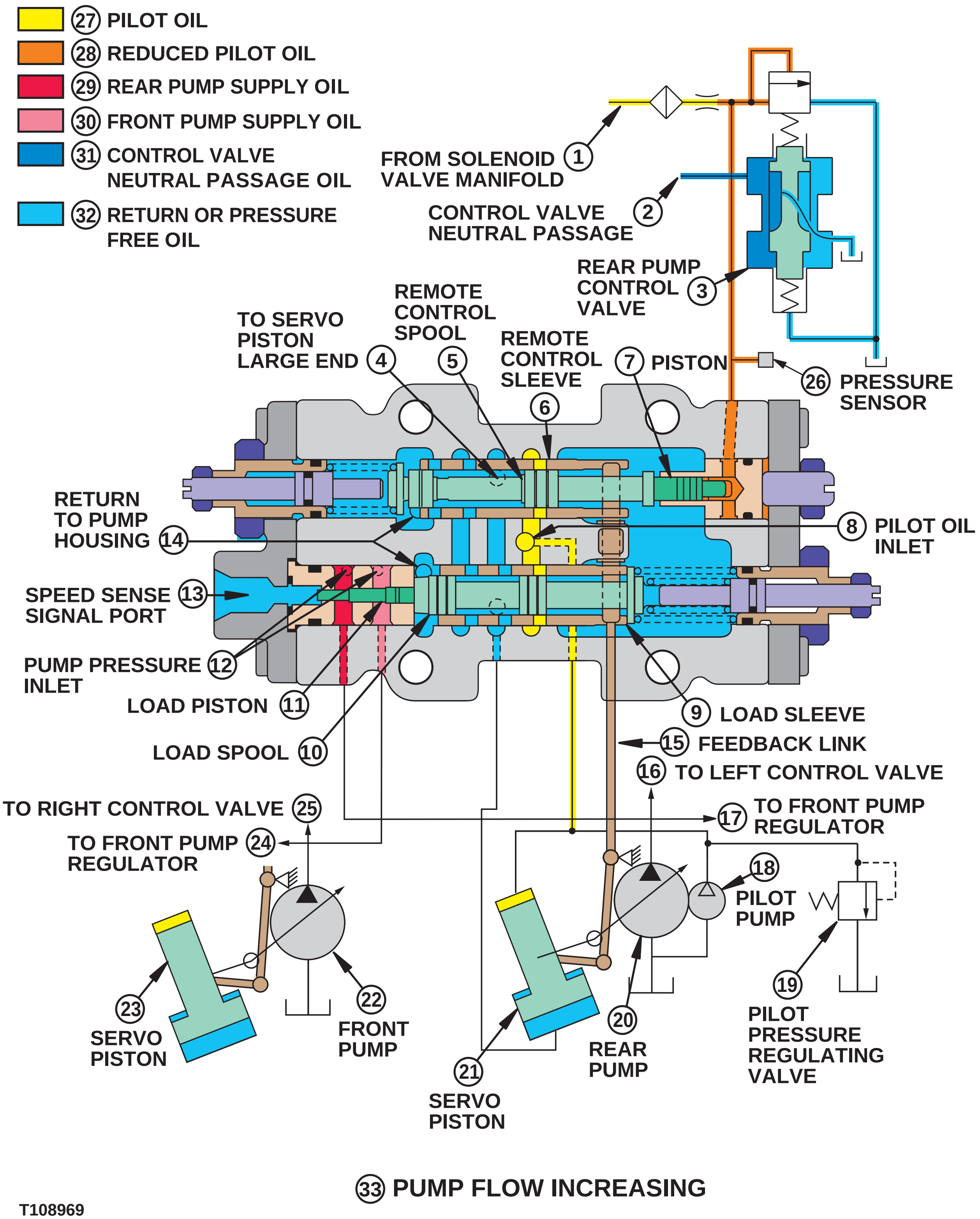
MAXIMUM FLOW (DISPLACEMENT)

When the pilot controller lever is actuated to full stroke, the reduced pilot oil (28) control signal from the pump control valve (3) to the piston (7) increases to its maximum. The control signal pushes the piston and remote control spool to the left until the spool contacts the maximum flow adjusting screw. Movement of spool opens a path from the large end of servo piston to return in pump housing (14). Pilot oil on the small end of servo piston pushes the piston down increasing pump displacement (flow). The servo piston is transmitted to the remote control sleeve (6) and load sleeve (9) by the feedback link (15). The sleeves move left until the path to return is closed. The oil at the large end of servo piston is now trapped holding the pump at maximum displacement (flow rate) that is proportional to the pressure of the pump control valve control signal.

DECREASING FLOW (DISPLACEMENT)

As the function is returned towards neutral, the reduced pilot oil (28) control signal sensed at the piston (7) also decreases. The spring pushes the remote control spool and piston to the right. Movement of the spool opens a path for pilot oil (27) to flow to the servo piston large end (4). The pilot oil pressure applied to the servo piston large end pushes the piston up against the pressure applied to the small end decreasing pump flow. The piston and remote control spool continues to be pushed to the right until spring force again equals the reduced pilot oil control pressure or until the spool contacts the piston (7) cylinder when function is returned to neutral. As the pump displacement decreases, the movement is transmitted to the remote control sleeve (6) and load sleeve (9) by the feedback link (15). The sleeves move right until the path for pilot oil is closed. The oil at the large end of servo piston is now trapped holding the pump at the displacement (flow rate) that is proportional to the pressure of the pump control valve control signal.

HYDRAULIC PUMP REGULATOR SUMMATION AND SPEED SENSING OPERATION



T108969

T108969 –19–24APR97

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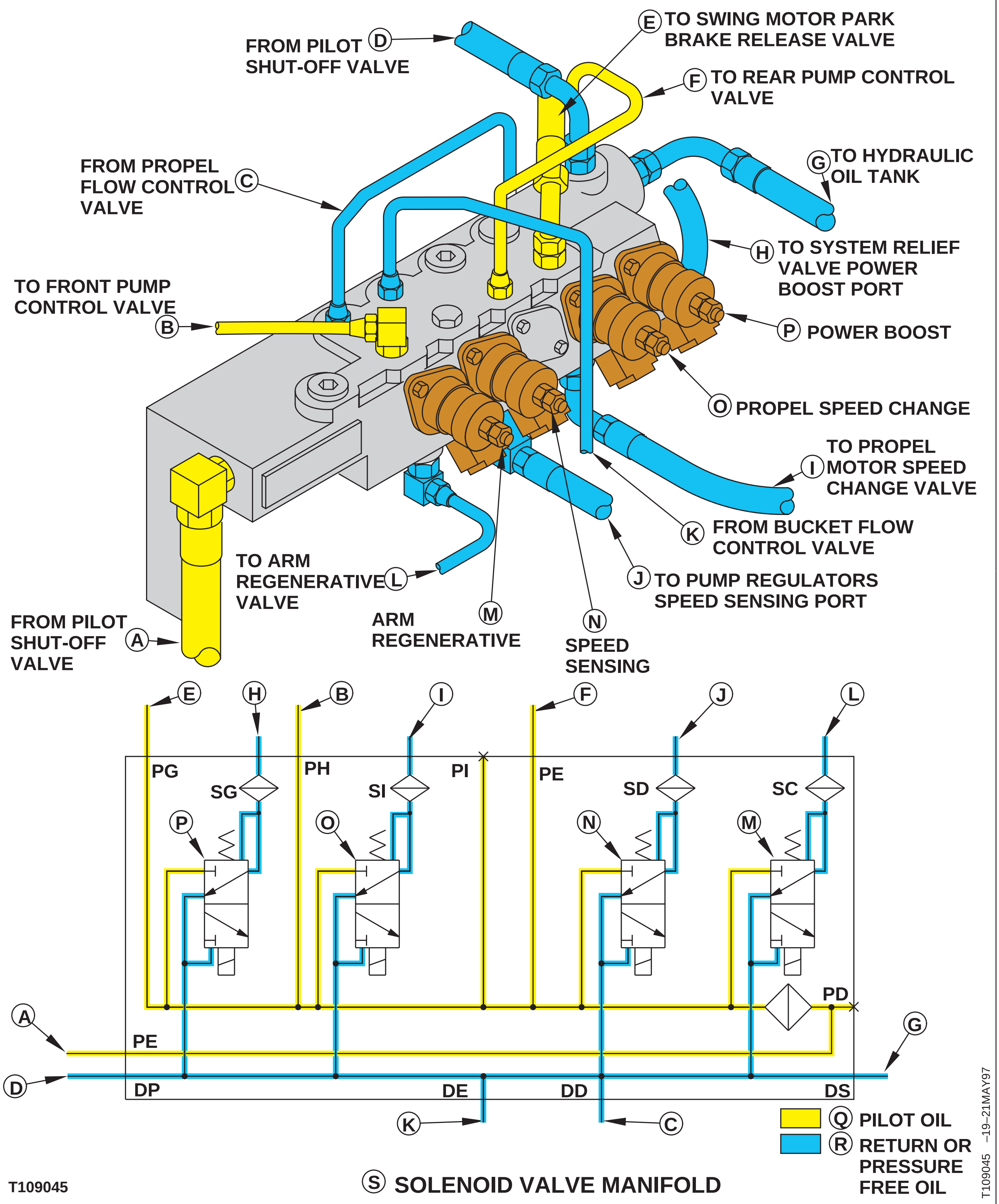
Summation (flow rate control by monitoring both pump pressures)—The pump supply oil pressure (load) for each pump is sensed at the load piston (11) through the pump pressure inlets (12) at its regulator and at the regulator of other pump. The average pressure on the load piston is applied through the load spool (10) to the inner and outer springs. The springs are adjusted against the average pressure so the flow rate of the pumps are approximately equal and each pump uses approximately half the engine output. If the load on either pump increases, the average pressure on the load pistons shift the load spools against the springs opening a path for pilot oil to the servo pistons. The flow rate of both pumps decreases so the load on the pumps does not exceed the engine output. Also engine output is not exceeded even if one pump is loaded relatively high while the other pump stays relatively low.

Speed Sensing—When the actual engine speed, measured by engine speed sensor, is pulled down to the target engine speed, as determined by engine rpm dial position, the speed sensing solenoid valve coil is energized by an electrical signal from the engine and pump controller. The pilot oil control signal is sent to the end of load piston at the speed sense signal port (13) in the front and rear pump regulators. The pilot oil control signal along with the pump supply oil pressure shift the load spools against the springs opening a path for pilot oil to the large end of servo pistons to decrease the pump angle. The flow rate of both pumps decreases so the load on the engine decreases and the actual engine speed can increase. (See Engine Speed Sensing Control Circuit Operation in this group.)

TX,05,GG2205 –19–20MAY98–2/2

PROPORTIONAL SOLENOID VALVE MANIFOLD OPERATION



9025
05
26

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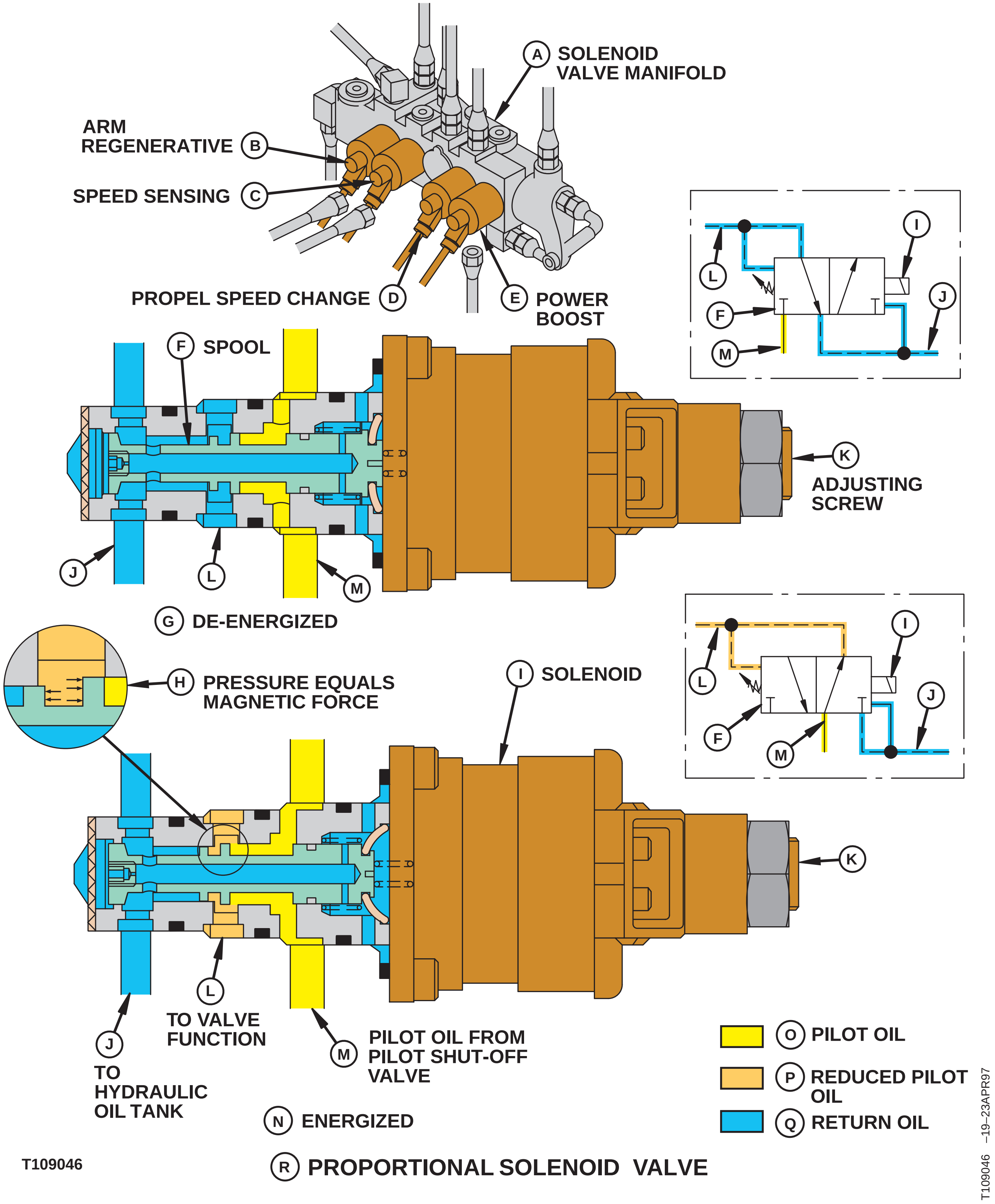
The solenoid valve manifold (S) is mounted on the right control valve. The manifold serves as the central distribution point for pilot oil (Q) to the arm regenerative (M), speed sensing (N), propel speed change (O), and power boost (P) solenoid valves, the front (B) and rear (F) pump control valves, and the swing motor park brake release valve (E). Pilot oil flows to the manifold when the pilot shutoff valve (A) is in unlock position, shutoff lever forward.

Return oil (R) from the pilot shutoff valve (D), propel flow control valve (C), bucket flow control valve (K), and the solenoid valves, when solenoid valves are de-energized, flows through the manifold to the hydraulic oil tank (G).

The identification letters shown on the hydraulic schematic are on the manifold housing next to the ports.

TX,9025,GG2609 –19–20MAY98–2/2

PROPORTIONAL SOLENOID VALVE OPERATION



T109046

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The arm regenerative (SC) (B), speed sense (SD) (C), propel speed change (SI) (D) and power boost (SG) (E) solenoid valve are proportional solenoid valve (R) type. The solenoid valve is activated by an electrical signal from the engine and pump controller (EPC). The electrical signal is a DC voltage that is turned on and off to form a pulse width modulated signal. The solenoid (I) reacts to the “average” voltage to create a magnetic force to shift the spool (F) left against a spring. The reduced pilot oil control signal sent to the valve function (L) depends on how long the electrical signal is on verses on how long it is off. The reduced pilot oil control signal is in proportion to the electrical signal to the solenoid.

When de-energized (G), the spool is pushed to the right by a spring. The valve function port is connected to the hydraulic oil tank (J) port.

When energized (N), the magnetic force shifts the spool left against the spring. Pilot oil (O) flows past the spool flange and out the valve function port as a reduced pilot oil (P) control signal. Because the flange on the right is larger than the flange on the left, the spool is pushed to the right against the magnetic force as the control signal to the valve function increases. When the control signal becomes equal to or greater than the magnetic force, the spool is pushed to the right closing the passage stopping the pressure increase. The reduced pilot oil control signal to the valve function is trapped. The spool is moving constantly to maintain the control signal in response to the electrical signal to the solenoid.

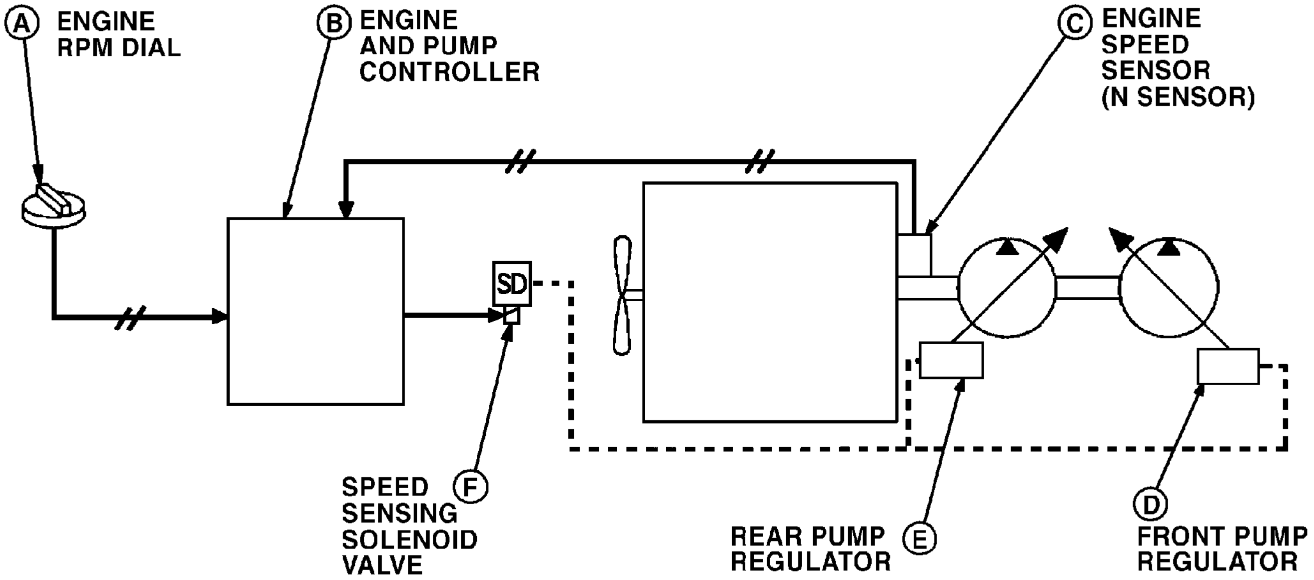
For circuit operation of arm regenerative solenoid valve, see Arm Regenerative Valve Operation in this group.

For circuit operation of speed sense solenoid valve, see Engine Speed Sense Control Circuit Operation in this group.

For circuit operation of propel speed change solenoid valve, see Propel Speed Change Circuit Operation in this group.

For circuit operation of power boost solenoid valve, see Power Boost Control Circuit Operation in this group.

ENGINE SPEED SENSING CONTROL CIRCUIT OPERATION



Ⓖ ENGINE SPEED SENSING CONTROL CIRCUIT

T103218

T103218 –19–07SEP96

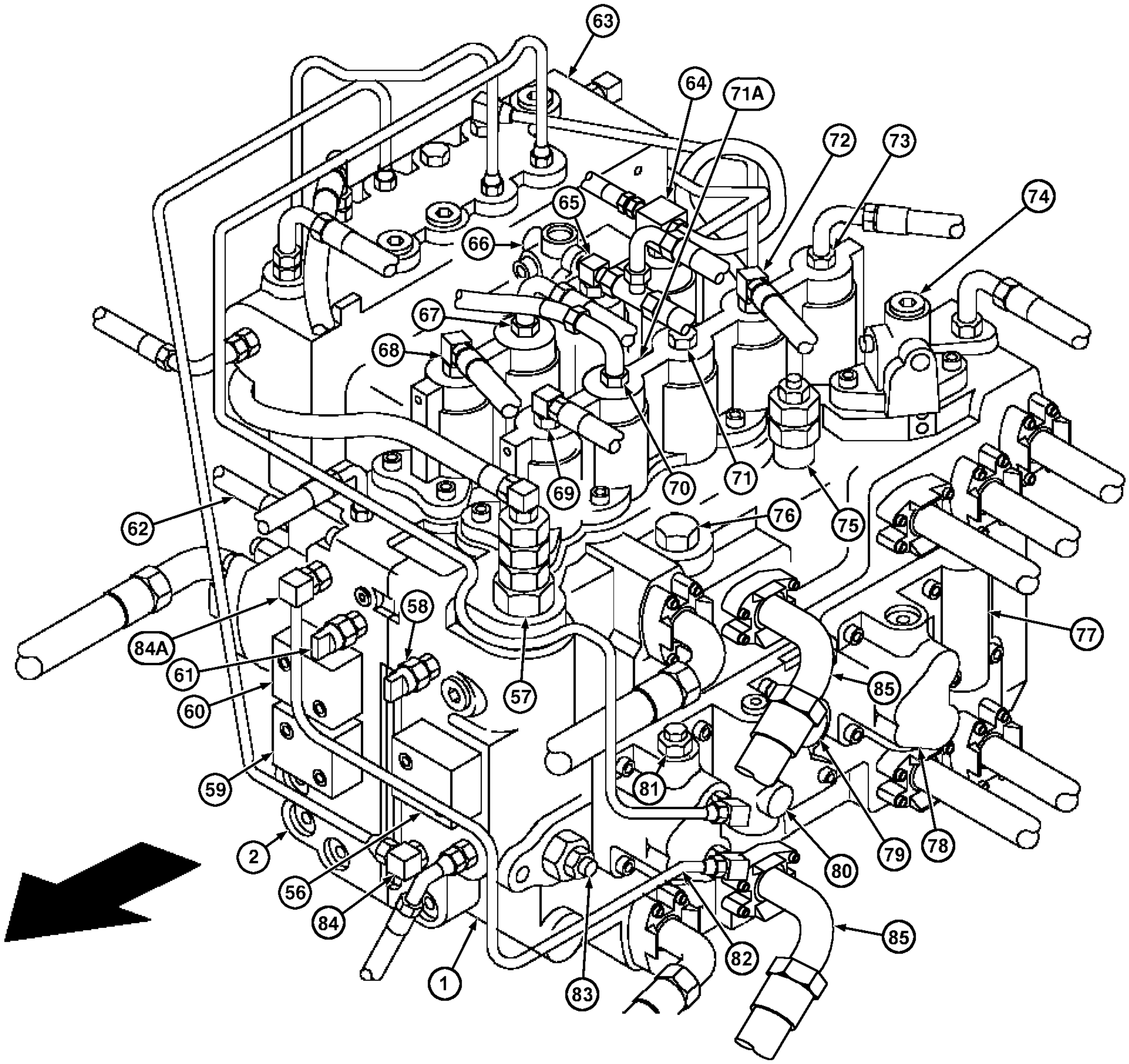
The function of engine speed sensing control circuit (G) is to reduce the hydraulic load on the engine if it exceeds the output torque of the engine.

The speed sensing solenoid valve (F) coil is energized by an electrical signal from the engine and pump controller (B) when the actual engine speed, as sensed by the engine speed sensor (C), is pulled down to the target engine speed. The target engine speed is a function of the engine and pump controller and is selected when the engine rpm dial (A) is turned to the desired actual engine speed.

The pilot oil control signal is sent to the end of the load piston in the front and rear pump regulators (D and E) which then operate to reduce pump flow. (See Hydraulic Pump Regulator Operation in this group.)

TX,05,GG2201 –19–20MAY98–1/1

CONTROL VALVE OPERATION



T120891

T120891 –UN–27MAY99

Left Front

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1—Left Control Valve (5-Spool)
2—Right Control Valve (4-Spool)
56—System Relief Valve Isolation Check Valve
57—System Relief Valve and Power Boost
58—Dig Pressure Switch
59—Flow Combiner Valve Circuit Check Valve
60—System Relief Valve Isolation Check Valve
61—Propel Pressure Switch
62—Filter—Pilot Pressure Inlet
63—Solenoid Valve Manifold
64—Arm II Valve
65—Boom I Valve and Boom Regenerative Valve
66—Boom Reduced Leakage Valve
67—Bucket Valve
68—Right Propel Valve
69—Left Propel Valve
70—Auxiliary Valve
71—Boom II Valve
71A—Propel-Boom Down Selector Valve
72—Arm I Valve
73—Swing Valve
74—Arm Reduced Leakage Valve
75—Arm Out Circuit Relief and Anti-Cavitation Valve
76—Plug
77—Swing Lift Check Valve
78—Arm I Power and Neutral Passage Check Valves (Lift Checks), and Restriction Orifice
79—Boom II Power Passage Check Valve (Lift Check)
80—Auxiliary Power Passage Check Valve (Lift Check)
81—Propel Flow Control Valve
82—Propel Power and Neutral Passage Check Valves (Lift Checks)
83—Rear Pump Control Valve
84—Filter and Orifice for Pilot Pressure to Rear Pump Control Valve
84A—Check Valve and Orifice for Propel Flow Control Valve

The control valve consists of two monoblock valve housings called the left control valve (1) and right control valve (2). The control valves are mounted back-to-back to connect the interconnected oil passages through ports in the mounting faces. The left control valve is a 5-spool section valve consisting of left propel (69), auxiliary (70), boom II (71), arm I (72), and swing (73). The right control valve is a 4-spool section valve consisting of right propel (68), bucket (67), boom I (65), and arm II (64). Each spool is selectively fitted to its bore in the housings. The spools are moved by pilot oil controlled by the pilot controllers located in the cab.

For the location of all valves used in the control valve, see the three illustrations labeled Left Front, Right Rear, and Bottom and the legends. Also see the Control Valve Circuit Schematic for location of components.

All valves are accessible from the outside of control valve by removing a plug, cover, or the pilot caps. For line connections to the control valves, see Control Valve Component and Line Identification in Group 9025-15. The solenoid valve manifold is also located on the right control valve.

The control valve is an open-center valve. Each valve section controls the flow rate and direction for its hydraulic circuit. The rear (83) and front (98) pump control valves, located in neutral passage of the left (1) and right (2) control valves, are used to send a control signal to the front and rear pump regulators when a function is actuated. (See Pump Control Valve Operation in this group.) Two pressure switches (58 and 61) located on the front of the control valve are closed to send an electrical signal to the engine and pump controller when a dig or propel function is actuated.

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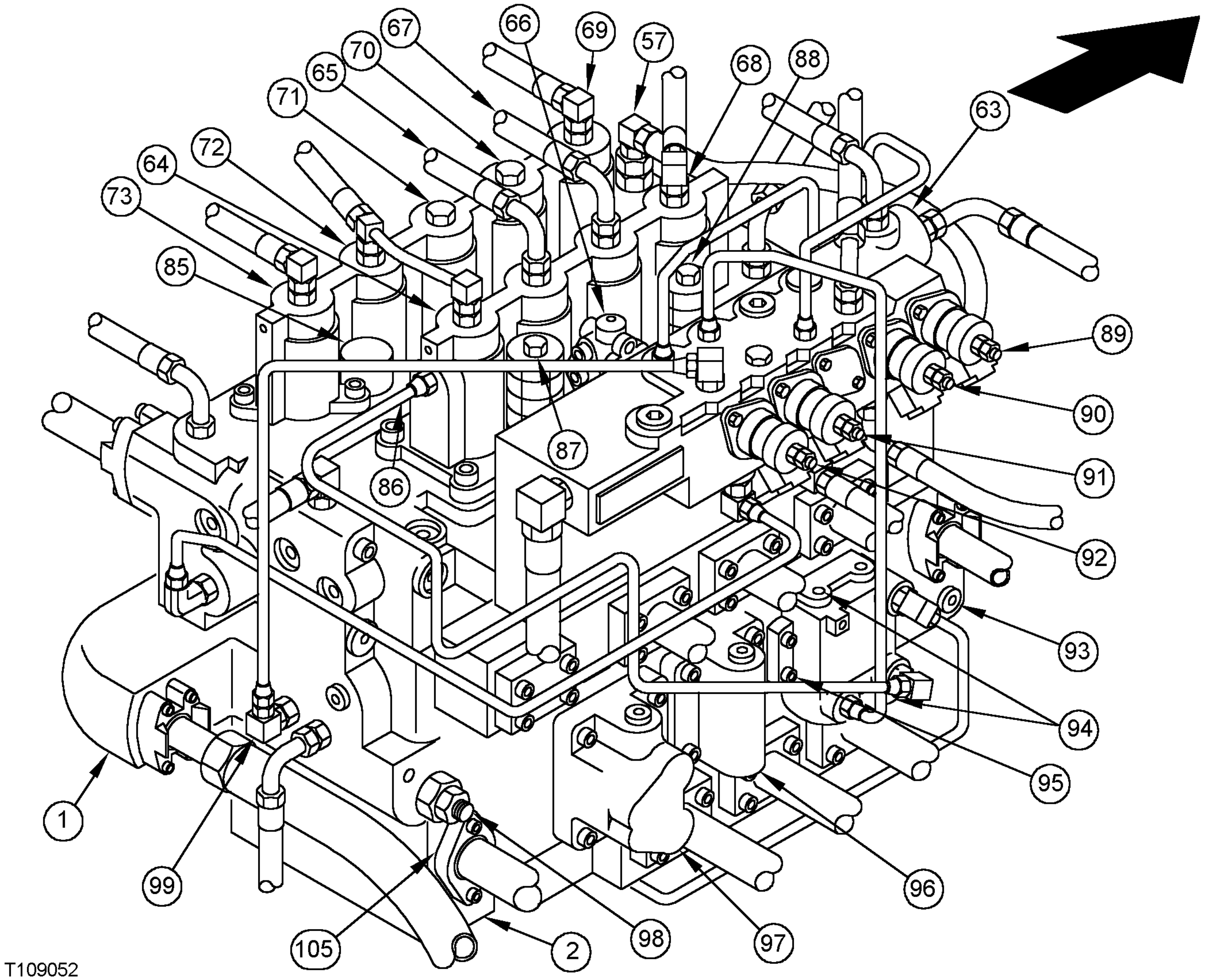

Right Rear

1—Left Control Valve (5-Spool)
2—Right Control Valve (4-Spool)
57—System Relief Valve and Power Boost
63—Solenoid Valve Manifold
64—Arm II Valve
65—Boom I Valve and Boom Regenerative Valve
66—Boom Reduced Leakage Valve
67—Bucket Valve
68—Right Propel Valve
69—Left Propel Valve
70—Auxiliary Valve
71—Boom II Valve
72—Arm I Valve
73—Swing Valve
85—Arm Regenerative Valve
86—Arm II to Arm I Neutral Passage Check Valve
87—Boom Up Circuit Relief Valve
88—Bucket Dump Circuit Relief Valve
89—Power Boost Solenoid Valve
90—Propel Speed Change Solenoid Valve
91—Speed Sensing Solenoid Valve
92—Arm Regenerative Solenoid Valve
93—Flow Combiner Valve
94—Bucket Flow Control Valve Pilot Valve A and B, and Poppet Valve
95—Bucket Check Valve (Lift Check)
96—Boom I Power and Neutral Passage Check Valves (Lift Checks)
97—Right Control Valve to Arm I Power Passage Check Valves and Restriction Orifice
98—Front Pump Control Valve
99—Filter and Orifice for Pilot Pressure to Front Pump Control Valve
105—Oil Cooler Bypass Valve

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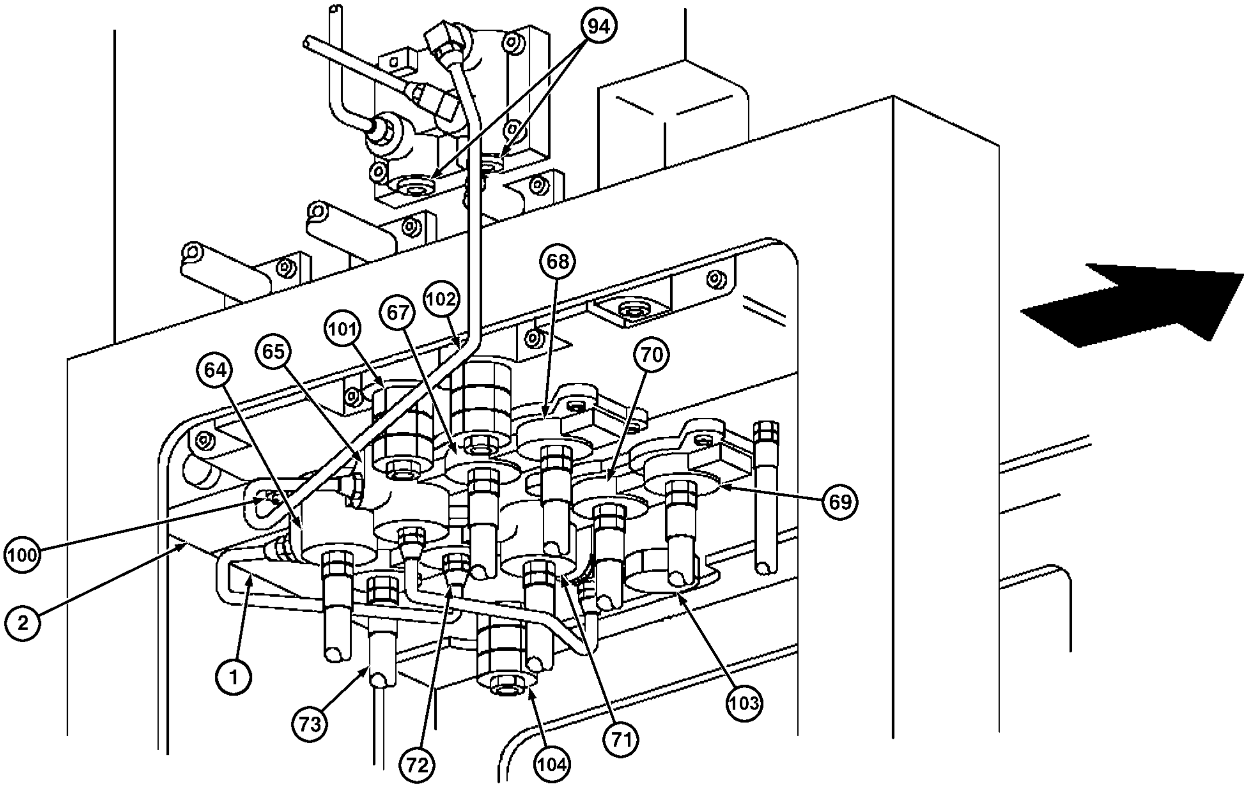
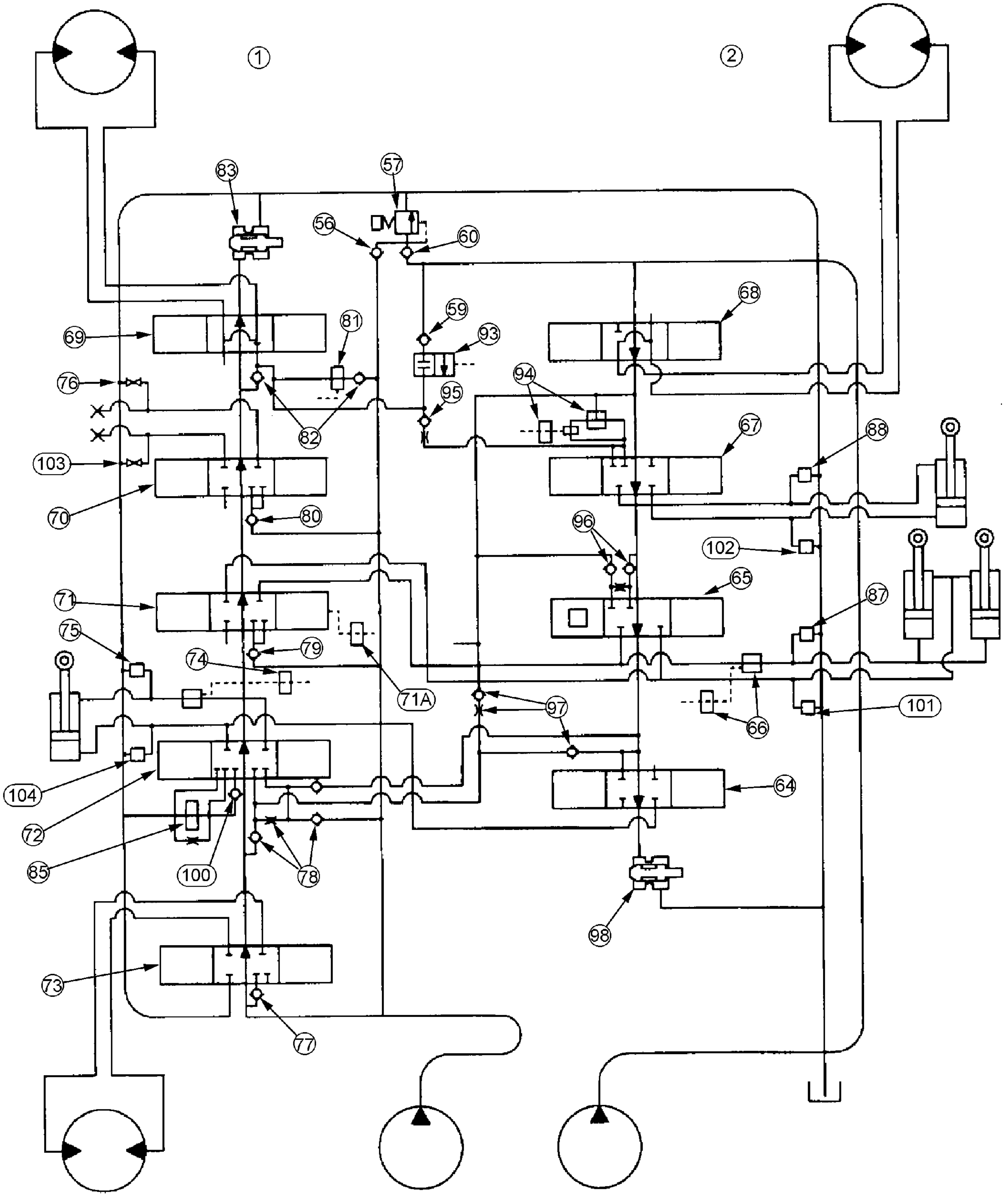


T120890

Bottom

1—Left Control Valve (5-Spool)
2—Right Control Valve (4-Spool)
64—Arm II Valve
65—Boom I Valve
67—Bucket Valve
68—Right Propel Valve
69—Left Propel Valve
70—Auxiliary Valve
71—Boom II Valve
72—Arm I Valve
73—Swing Valve
94—Bucket Flow Control Valve
100—Arm Regenerative Circuit Check Valve
101—Boom Down Circuit Relief and Anti-Cavitation Valve
102—Bucket Curl Circuit Relief and Anti-Cavitation Valve
103—Plug
104—Arm In Circuit Relief and Anti-Cavitation Valve

CONTROL VALVE CIRCUIT SCHEMATIC



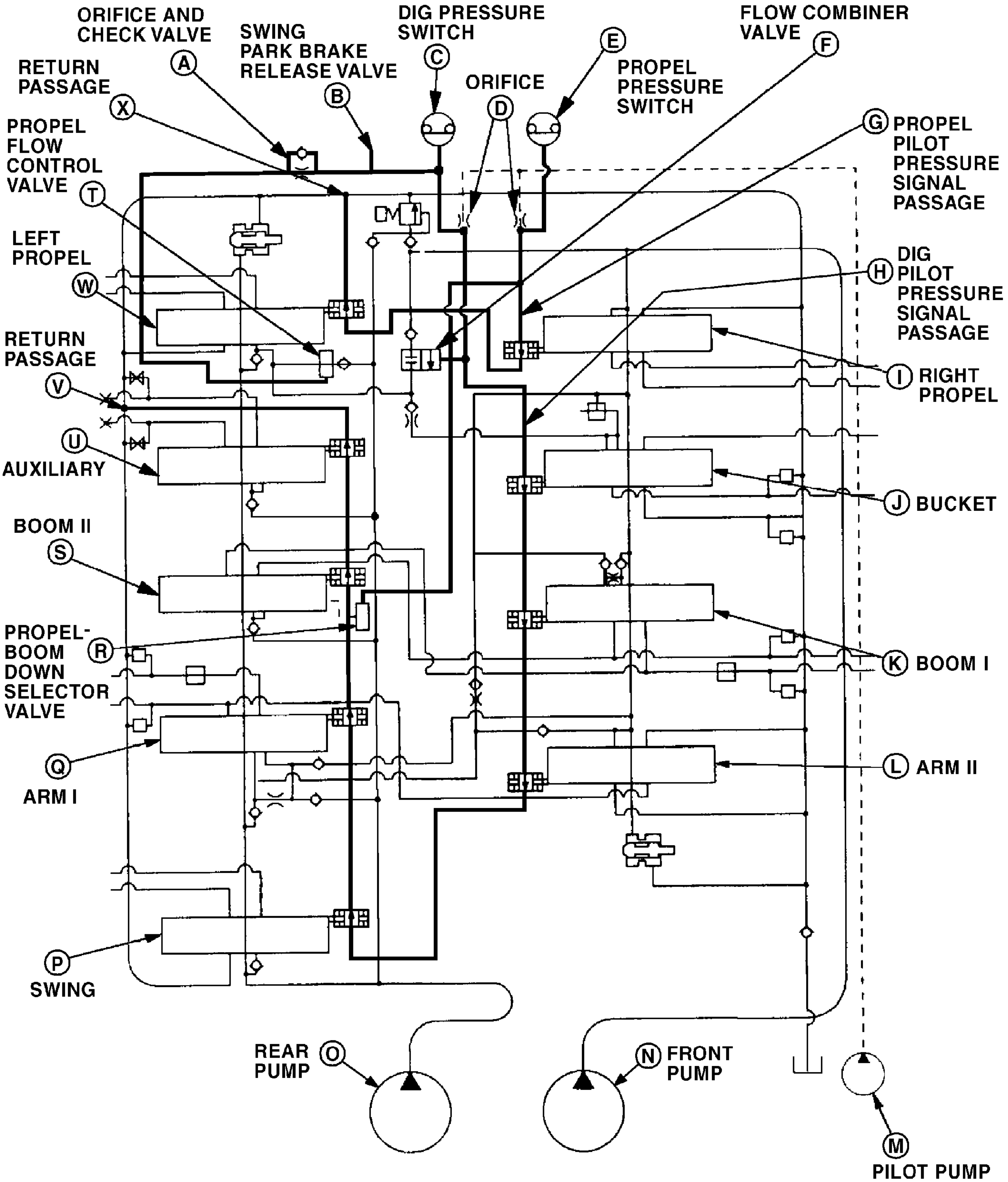
(105) CONTROL VALVE CIRCUITS

T109055

Continued on next page

1—Left Control Valve (5-Spool)
2—Right Control Valve (4-Spool)
56—System Relief Valve Isolation Check Valve
57—System Relief Valve and Power Boost
59—Flow Combiner Valve Circuit Check Valve
60—System Relief Valve Isolation Check Valve
64—Arm II Valve
65—Boom I Valve and Boom Regenerative Valve
66—Boom Reduced Leakage Valve
67—Bucket Valve
68—Right Propel Valve
69—Left Propel Valve
70—Auxiliary Valve
71—Boom II Valve
71A—Propel-Boom Down Selector Valve
72—Arm I Valve
73—Swing Valve
74—Arm Reduced Leakage Valve
75—Arm Out Circuit Relief and Anti-Cavitation Valve
76—Plug
77—Swing Lift Check Valve
78—Arm I Power and Neutral Passage Check Valves (Lift Checks), and Restriction Orifice
79—Boom II Power Passage Check Valve (Lift Check)
80—Auxiliary Power Passage Check Valve (Lift Check)
81—Propel Flow Control Valve
82—Propel Power and Neutral Passage Check Valves (Lift Checks)
83—Rear Pump Control Valve
85—Arm Regenerative Valve
86—Arm II Neutral Passage to Arm I Power Passage Check Valve
87—Boom Up Circuit Relief Valve
88—Bucket Dump Circuit Relief Valve
93—Flow Combiner Valve
94—Bucket Flow Control Valve Pilot Valve A and B, and Poppet Valve
95—Bucket Check Valve (Lift Check)
96—Boom I Power and Neutral Passage Check Valves (Lift Checks)
97—Right Control Valve to Arm I Power Passage Check Valves and Restriction Orifice
98—Front Pump Control Valve
100—Arm Regenerative Circuit Check Valve
101—Boom Down Circuit Relief and Anti-Cavitation Valve
102—Bucket Curl Circuit Relief and Anti-Cavitation Valve
103—Plug
104—Arm In Circuit Relief and Anti-Cavitation Valve
105—Control Valve Circuits

CONTROL VALVE PILOT PRESSURE SIGNAL PASSAGE OPERATION



T103077

Ⓨ DIG AND PROPEL PILOT PRESSURE SIGNAL

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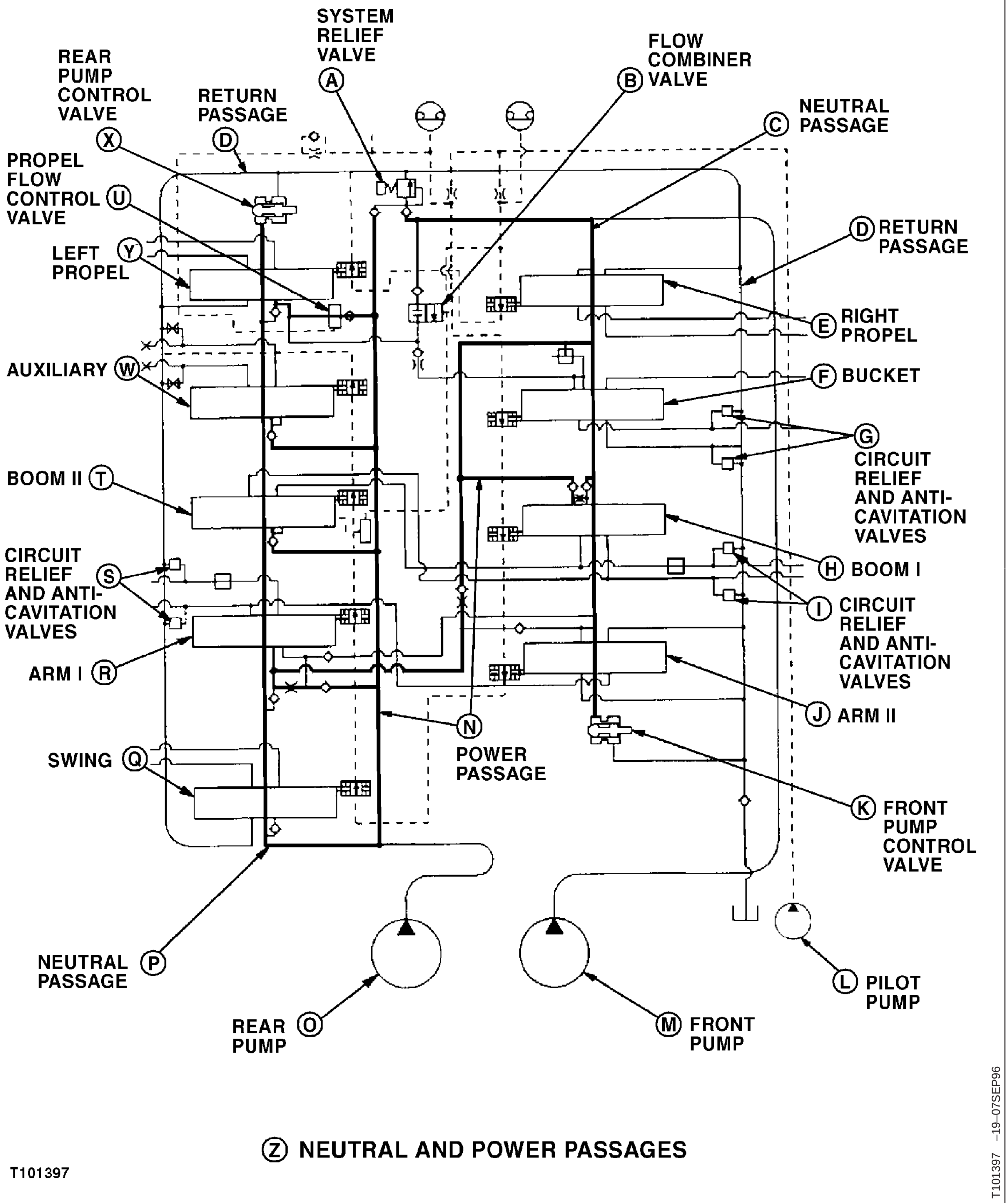
Pilot oil from the pilot pump (M) flows to the control valve and through the orifices (D) into the propel pilot pressure signal passage (G) and dig pilot pressure signal passage (H). The oil in the propel pilot pressure signal passage flows to the propel pressure switch (E), the propel-boom down selector valve (R), past the top end of the right (I) and left (W) propel valve spools, and then to the return passage (X). The oil in the dig pilot pressure signal passage flows to the dig pressure switch (C), the propel flow control valve (T), flow combiner valve (F), past the top end of bucket (J), boom I (K), arm II (L), swing (P), arm I (Q), boom II (S), and auxiliary (U) valve spools, and then to the return passage (V). The flow of oil through the orifices causes a pressure drop; the pressure of oil downstream of each orifice is less than the pressure upstream of the orifices. None of the switches or valves in the signal passages are actuated.

When a function is actuated, the valve spools shift blocking the flow of oil through the signal passage. The oil pressure upstream of the valve spool increases to approximately the pressure setting of pilot pressure regulating valve and actuates the switch and valves in that signal passage.

TX,05,GG2192 –19–20MAY98–2/2

CONTROL VALVE NEUTRAL AND POWER PASSAGES OPERATION



Ⓩ NEUTRAL AND POWER PASSAGES

T101397

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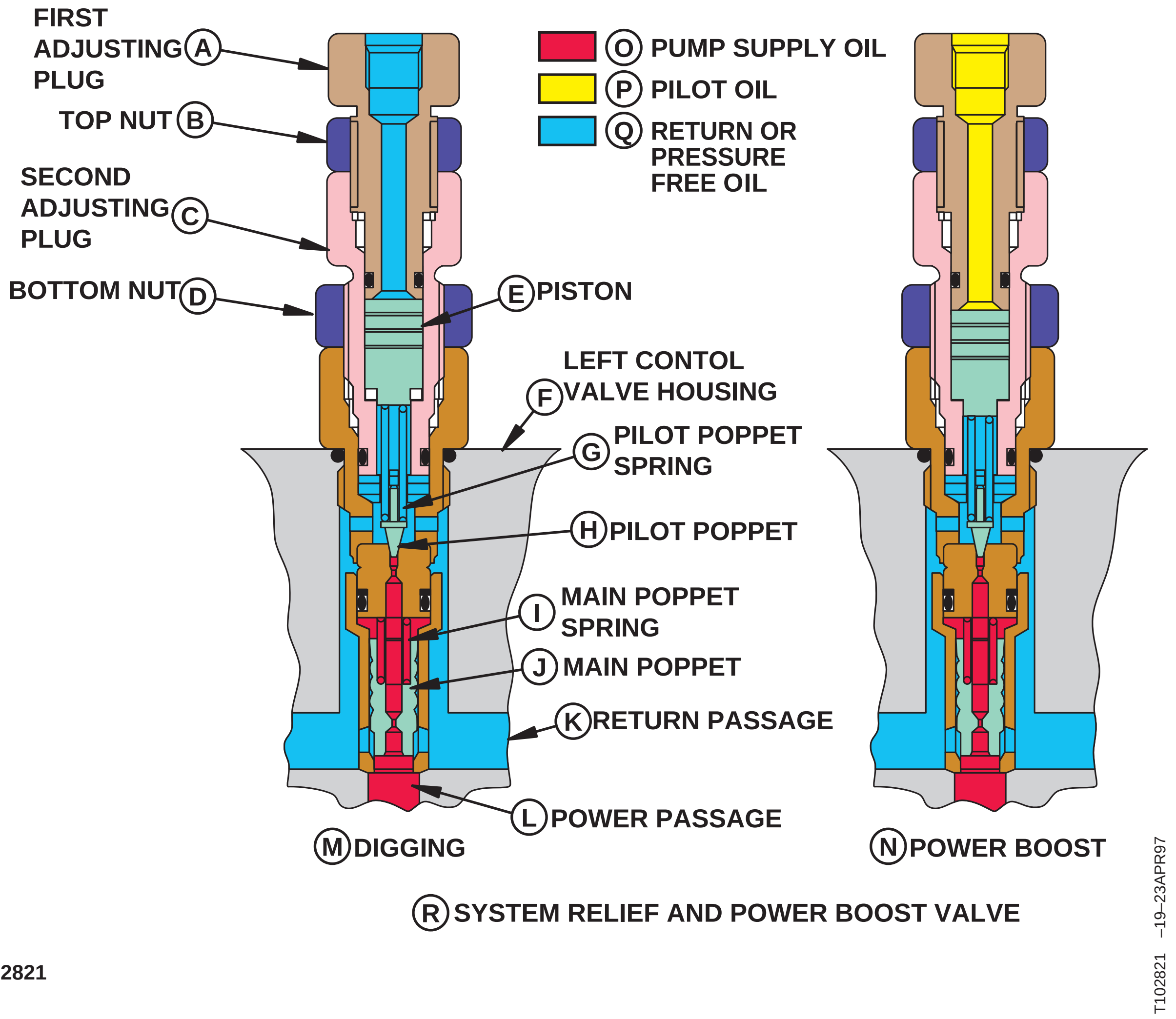
Theory of Operation

Supply oil from the front pump (M) flows to the right control valve. Supply oil from the rear pump (O) flows to the left control valve. When all functions are in neutral supply oil flows through the neutral passages (C and P), through the pump control valves (K and X), and into the return passage (D). Power passages (N) in the left and right control valves are used to route supply oil for the combined operation of functions.

TX,05,GG2191 –19–20MAY98–2/2

SYSTEM RELIEF AND POWER BOOST VALVE OPERATION



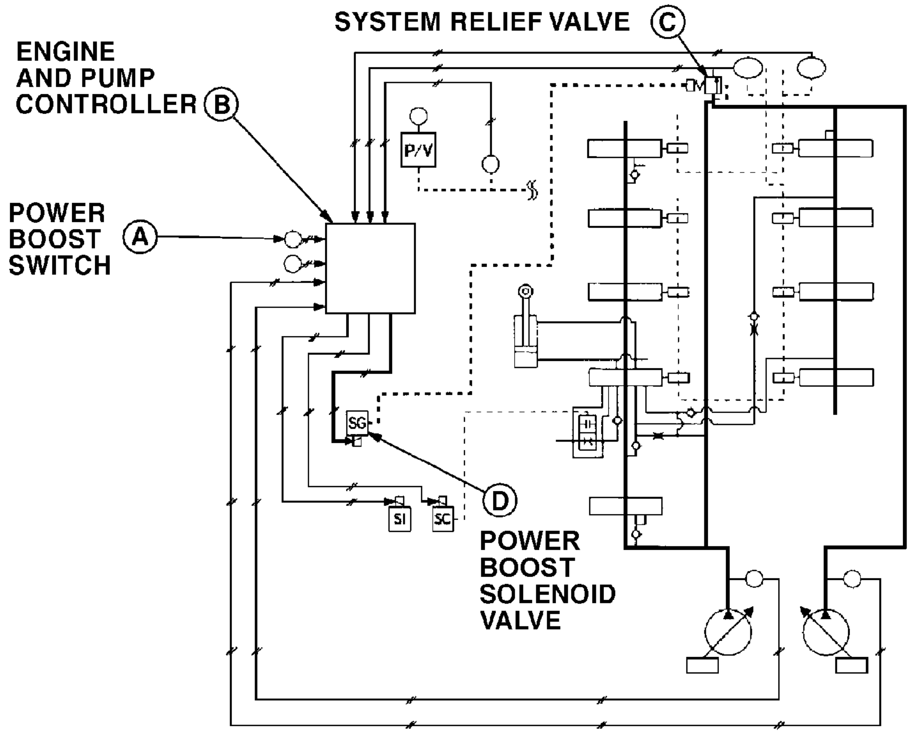
T102821

The function of system relief and power boost valve (R) is to limit the main hydraulic system operating pressure. The system relief and power boost valve is a pilot-operated, poppet-type relief valve with a piston (E).

When the pump supply oil in the power passage (L) pressure exceeds the relief valve setting, pilot poppet (H) is pushed off its seat letting oil behind main poppet (J) flow to the return passage (K). A pressure difference is created across the main poppet because oil flows out faster than oil can flow through the orifice in poppet. The main poppet is pushed open to relieve pressure oil to the return passage.

For power boost operation (N), pilot oil (P) from the power boost solenoid valve pushes the piston (E) down increasing the pressure setting of the pilot poppet spring (G). The main hydraulic system can now operate at a higher operating pressure for approximately 8 seconds.

POWER BOOST CONTROL CIRCUIT OPERATION



Ⓔ POWER BOOST CONTROL CIRCUIT

T109063

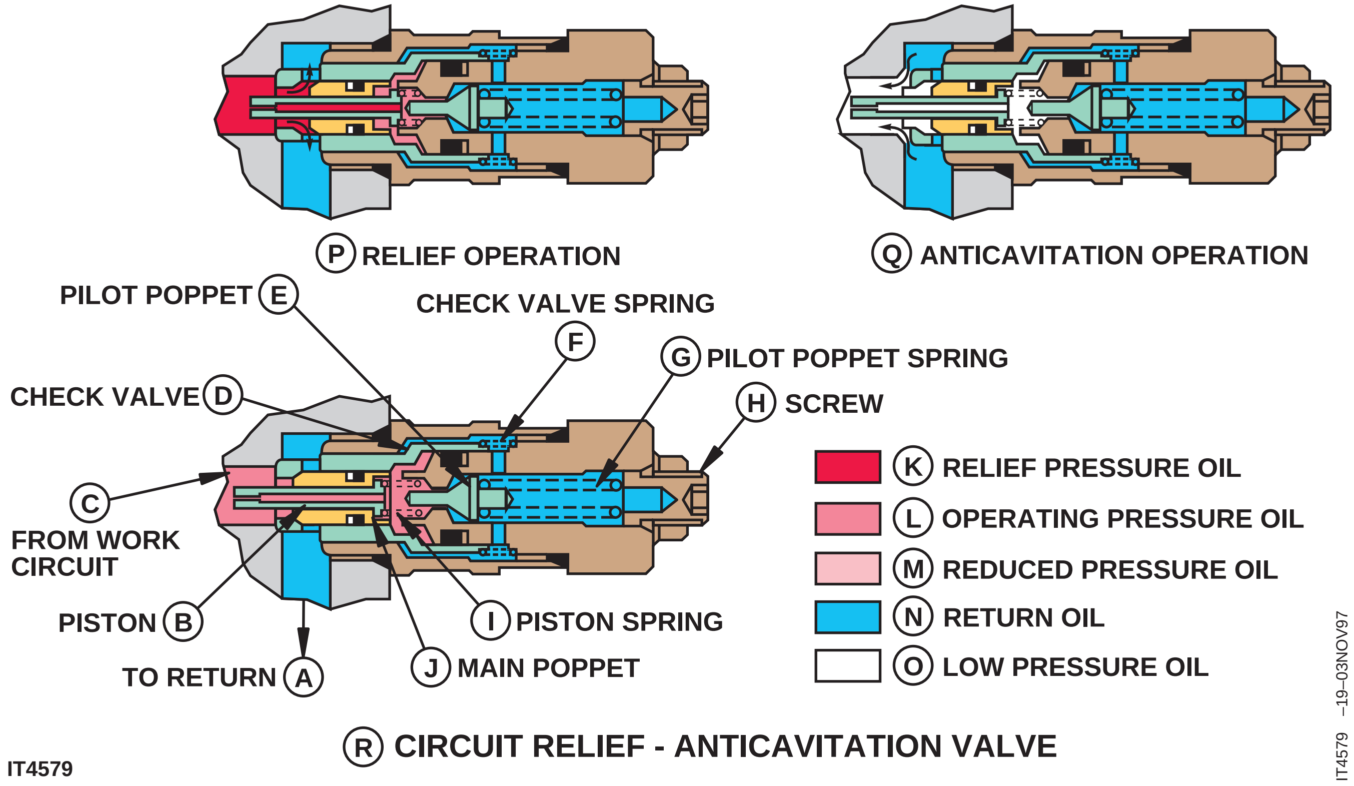
T109063 –19–29APR97

The function of power boost control circuit (E) is to temporarily increase the main hydraulic system operating pressure by increasing the system relief valve pressure.

When the power boost switch (A) is pushed the engine and pump controller (B) sends an electrical signal to energize the power boost solenoid valve (D) coil. The pilot oil pressure signal pushes the piston in the system relief valve (C) down increasing the pressure setting. The main hydraulic system can now operate at a higher operating pressure for approximately 8 seconds.

TX,05,GG2202 –19–29MAY98–1/1

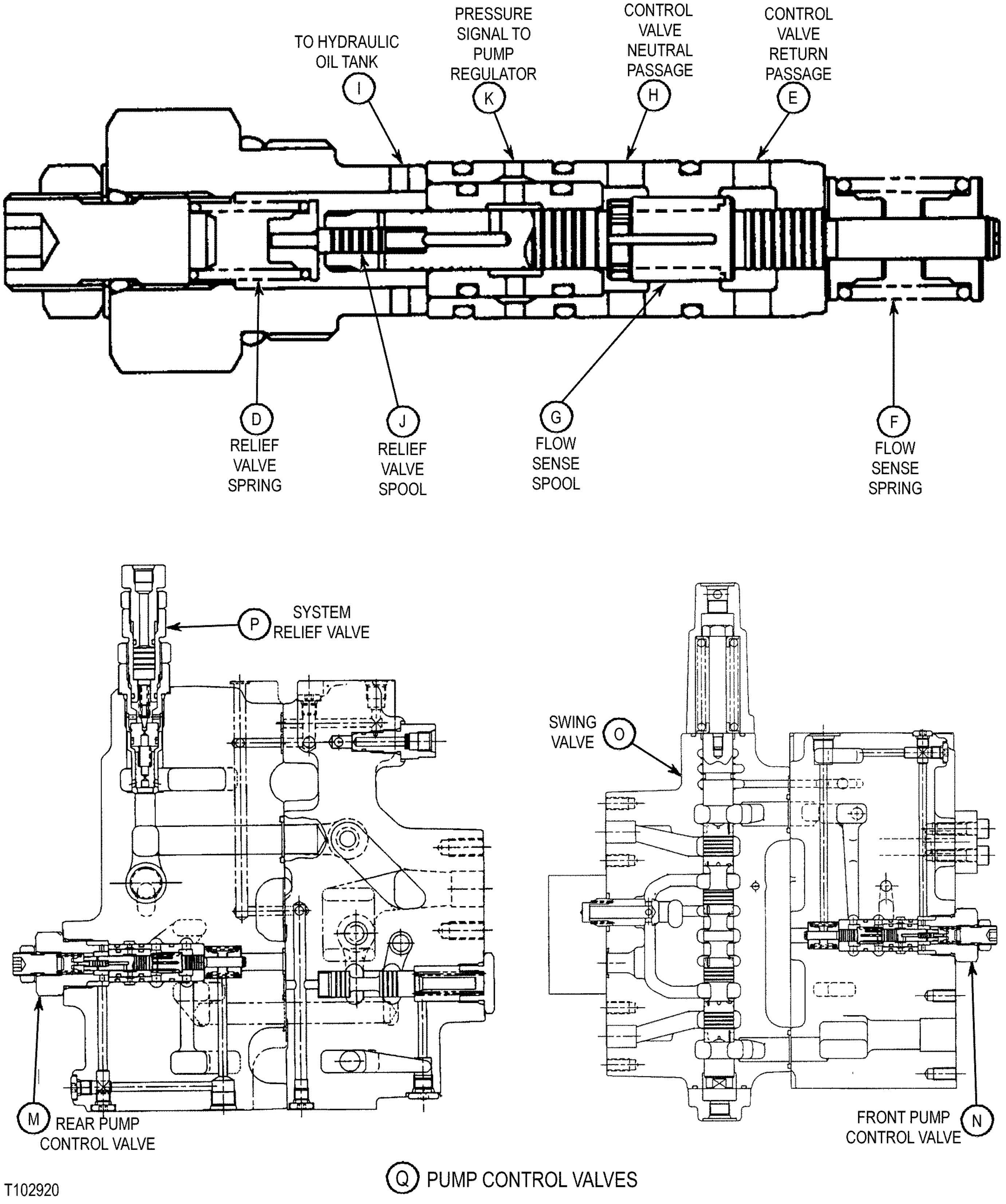
CIRCUIT RELIEF VALVE OPERATION



At pressures below the circuit relief setting the main poppet (J) remains closed. In relief operation (P), the relief valve opens in three steps. In the first step, the pilot poppet (E) is opened. Flow restriction through the hollow piston (B) causes the pressure in the cavity behind the main poppet to decrease. In the second step of relief operation the piston seats against the pilot poppet (E). This further reduces oil flow into the cavity and greatly decreases the pressure against the back side of main poppet. The main poppet opens in the third step of relief operation.

During anti-cavitation operation (Q) the check valve (D) retracts to allow oil to flow from the return passage into the work circuit. During normal operation the operating oil pressure (L) on the inner shoulder holds the check valve against its seat. This pressure decreases as pressure in the work circuit decreases. The return oil pressure (N) on the outer shoulder moves the check valve, main poppet, and piston against the springs to open the valve.

PUMP CONTROL VALVE OPERATION



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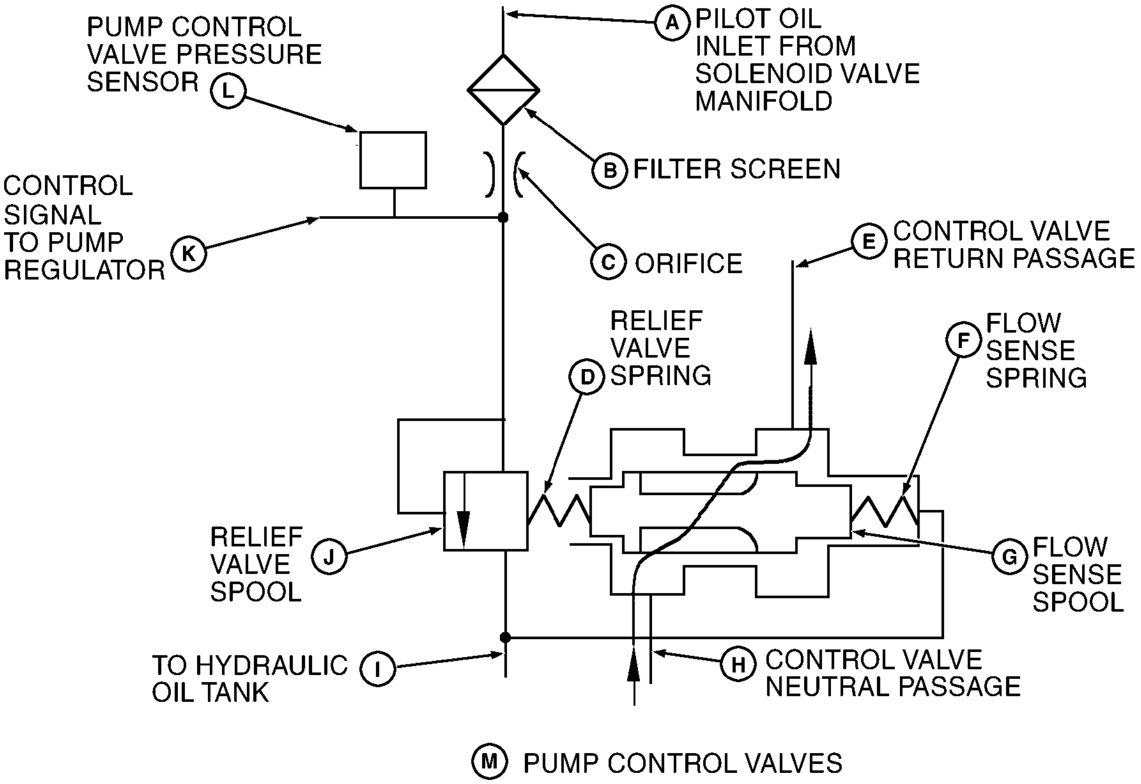


T116656

T116656 –19–24AUG98

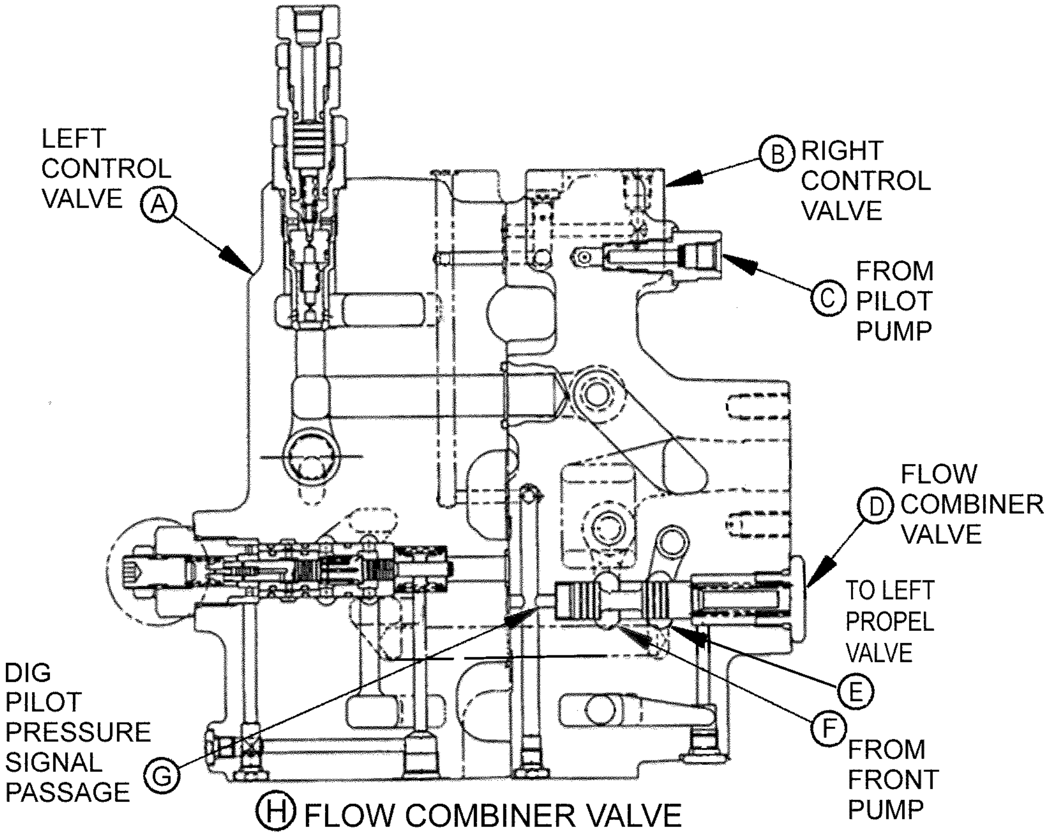
A pump control valve (Q) is located at the downstream end of the control valve neutral passage (H) in the left and right control valves. The function of pump control valve is to send a regulated pilot oil control signal to the front and rear pump regulators to change pump flow in response to the actuation of control valve spools.

Control Valve Spools in Neutral:
When all control valve spools are in neutral the neutral passage through the control valve is not restricted and full flow from the pump flows through the neutral passage and flow sense spool (G) to the control valve return passage (E). Full flow causes the flow sense spool to move to the right against the flow sense spring (F) decreasing the pressure setting of the relief valve spring (D). The relief valve spool is pushed open to direct pilot oil to the hydraulic oil tank (I) decreasing the control signal to the pump regulator (K).

Control Valve Spool Actuated:
When a single or combine functions are actuated the control valve spool shifts decreasing flow through the neutral passage and flow sense spool. As flow through the flow sense spool decreases, the spool is shifted to the left by the flow sense spring increasing the pressure setting on the relief valve spring. The relief valve spool shifts more closed decreasing pilot oil flow to the hydraulic oil tank and increasing the control signal to the pump regulator which causes pump flow to increase. (See Hydraulic Pump Regulator Operation in this group.)

In addition, the control signal to pump regulators is sensed by the pump control pressure sensors (L) sending an electrical signal to the engine and pump controller for the propel speed change function. (See Propel Motor Speed Change Circuit Operation in this group.)

FLOW COMBINER VALVE OPERATION



T109067

Pilot oil from the pilot pump (C) flows through the orifice (L), into the dig pilot pressure signal passage (G), past each dig function valve spool, and then to the return circuit. The flow combiner valve (D), propel flow control valve (M), and the swing motor park brake release valve (K) are connected to the signal passage between the orifice and spools.

When one or more dig functions are actuated, pilot oil flow through the signal passage to return is blocked by a valve spool (arm II valve shown) (O). The pressure in the blocked portion of the signal passage increases shifting the flow combiner, propel flow control, and swing park brake release valve spools.

Supply oil from the front pump (P) now flows through the flow combiner valve to the left propel valve (E) as well as the right propel valve to ensure that the machine does not mistrack during combined propel and dig function operations. The flow combiner check valve (N) prevents back flow past the flow combiner valve. The left propel valve does not receive supply oil from the rear pump (Q) except through the propel flow control valve if the upstream pressure is higher than the pressure in the flow combiner circuit.

The dig and propel pressure switches are actuated to send an electrical signal to engine and pump controller when the propel and dig functions are actuated.

When just the propel function is actuated, the left propel valve is supplied with oil from the rear pump and the right propel valve is supplied with oil from the front pump.

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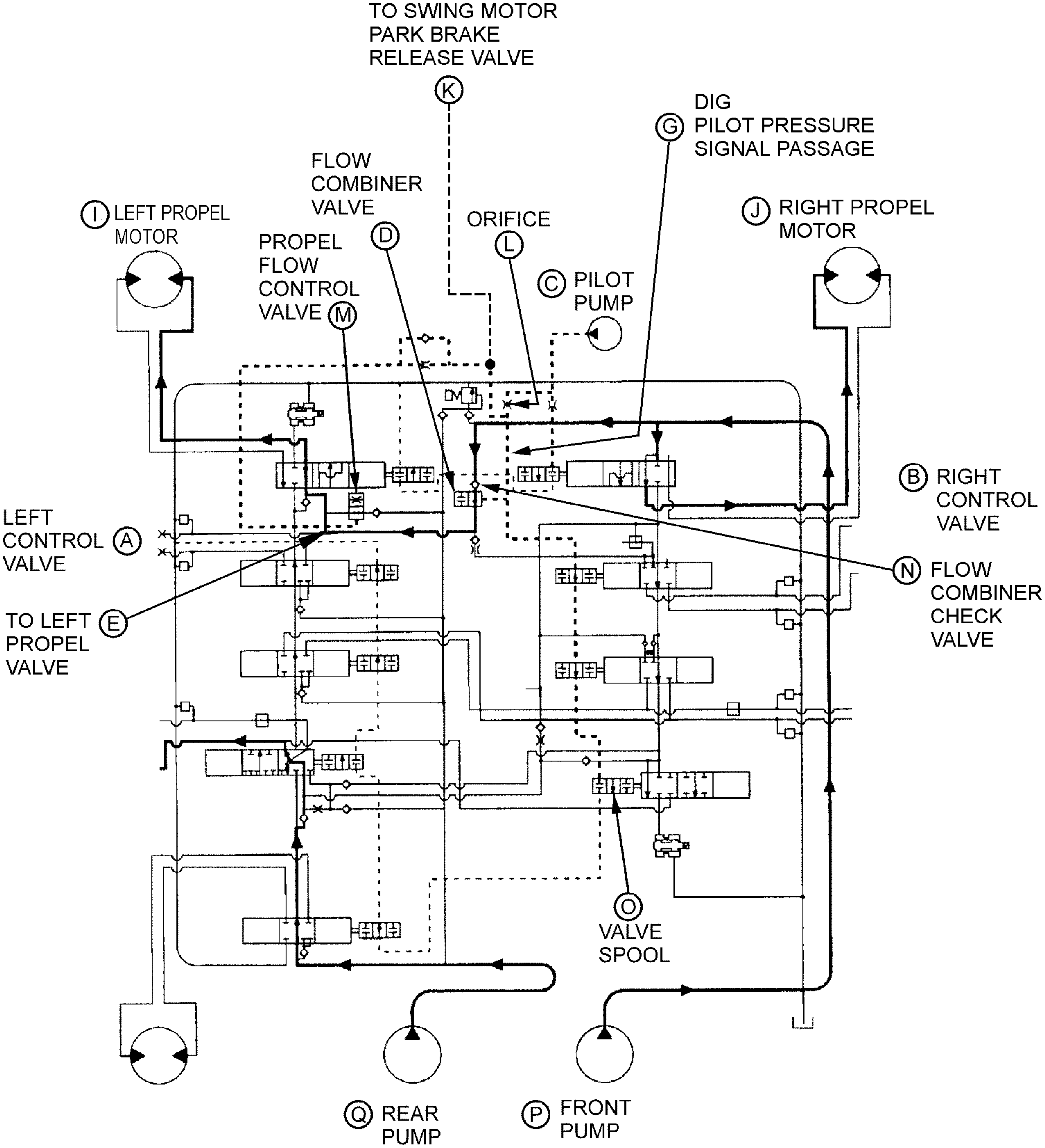
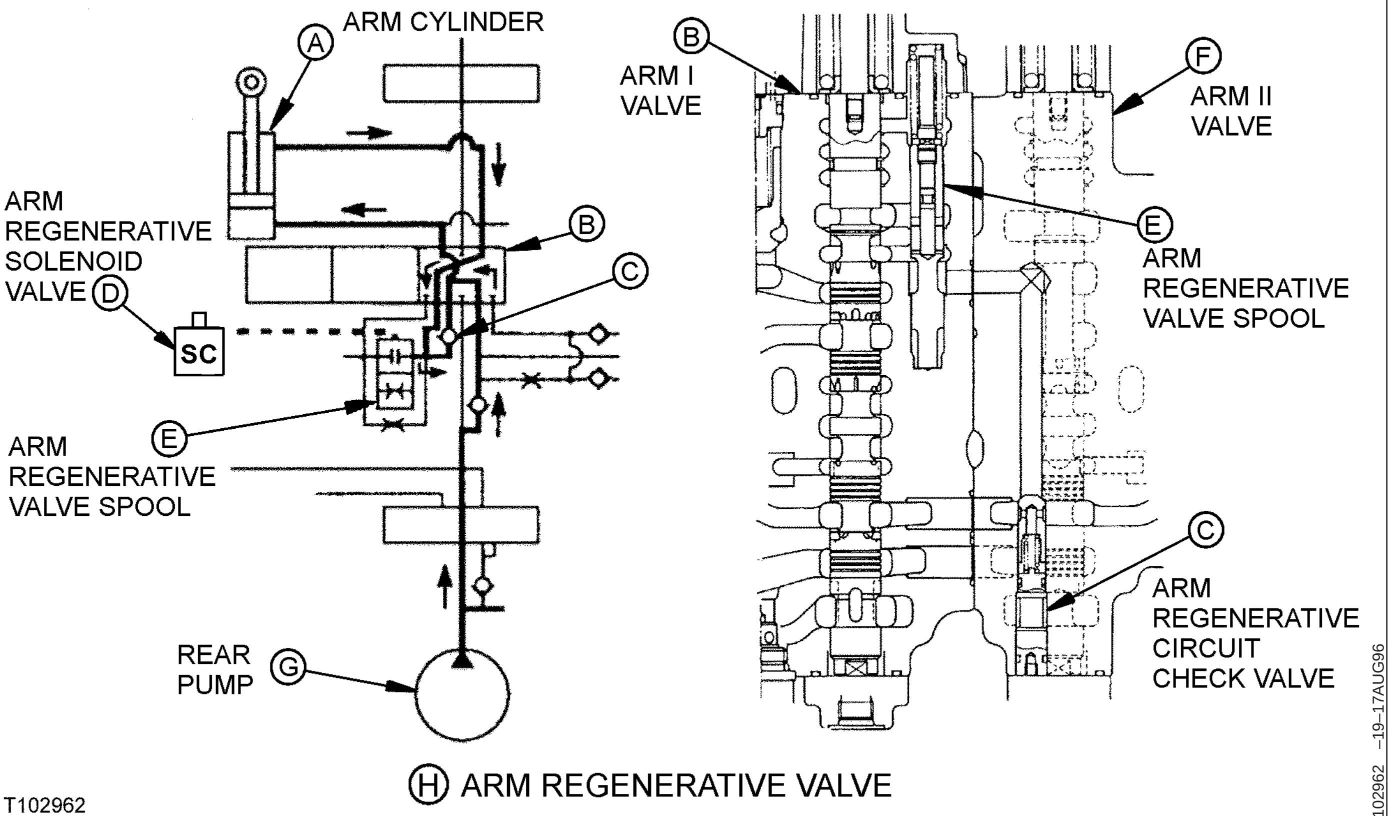


Ⓡ FLOW COMBINER VALVE CIRCUIT

T109074

T109074 –19–23APR97

ARM REGENERATIVE VALVE OPERATION



H ARM REGENERATIVE VALVE

T102962

The arm regenerative valve (H) is used to improve arm controllability and prevent arm cylinder (A) cavitation during arm IN operation by combining the return oil from arm cylinder rod end with the pump supply oil to the arm cylinder head end.

Under the following operating conditions: low rear pump delivery pressure, high pilot pressure to the pilot cap for arm in, and boom up actuated, gravity can pull the arm in faster than the pump can supply oil to the arm cylinder head end. The operating conditions are sensed by the rear pump pressure sensor (I), arm in pressure sensor (K), and boom up pressure switch (L). The pressure switch and sensors send electrical signals to the engine and pump controller (M). The engine and pump controller sends an electrical signal to the arm regenerative solenoid valve (D) to energizes the coil. The solenoid valve then sends a pressure signal to the arm regenerative valve spool (E) to shift it blocking the passage to return. The return oil from the rod end of arm cylinder now flows through the arm regenerative circuit check valve (C) and then to the head end of arm cylinder with the pump supply oil. Return oil not used flows through the orifice (J) to the return passage.

There are five check valves located in the passages to the arm I valve to prevent back flow through the control valve. For arm in function, return and supply oil flows through the arm I valve only.

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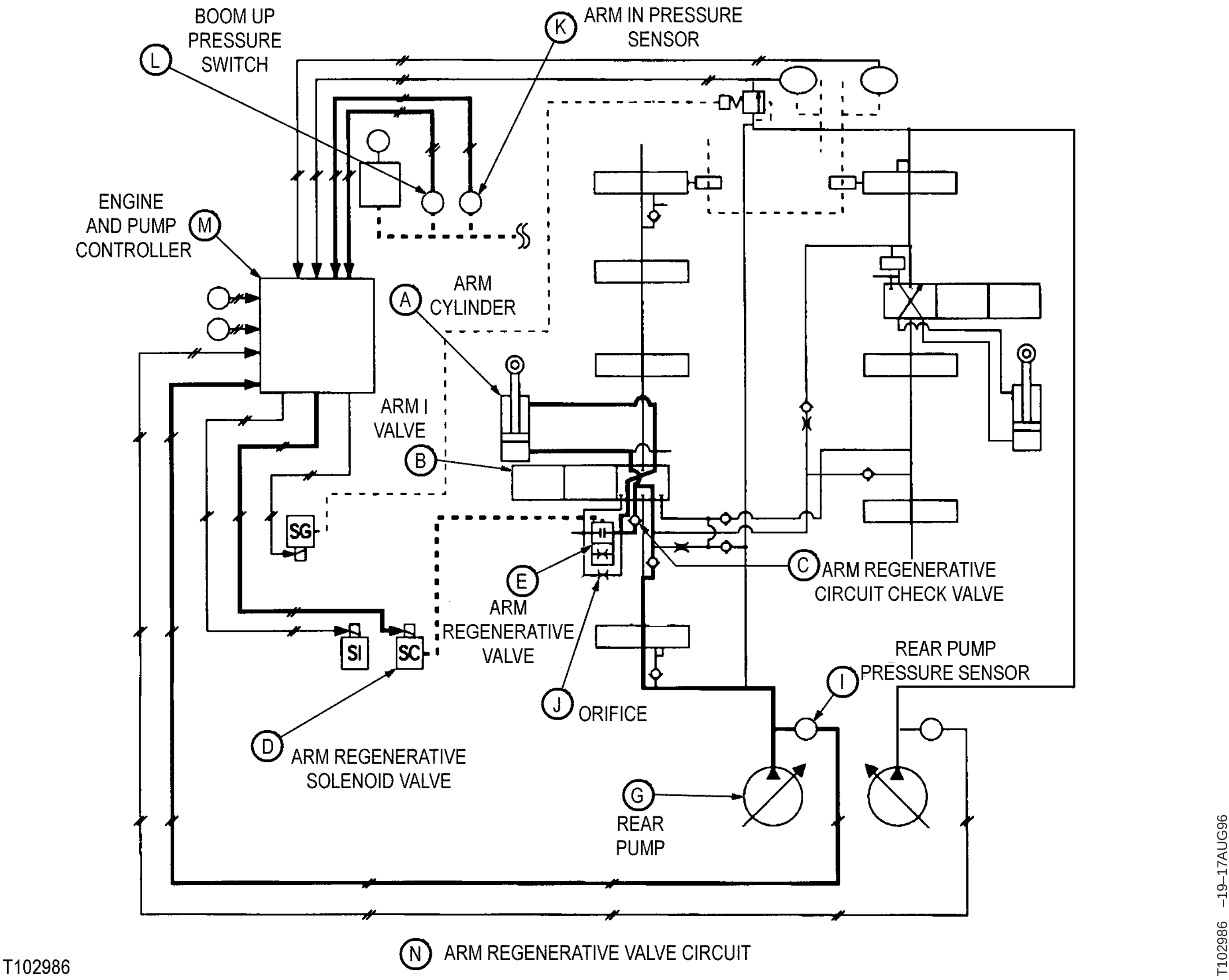
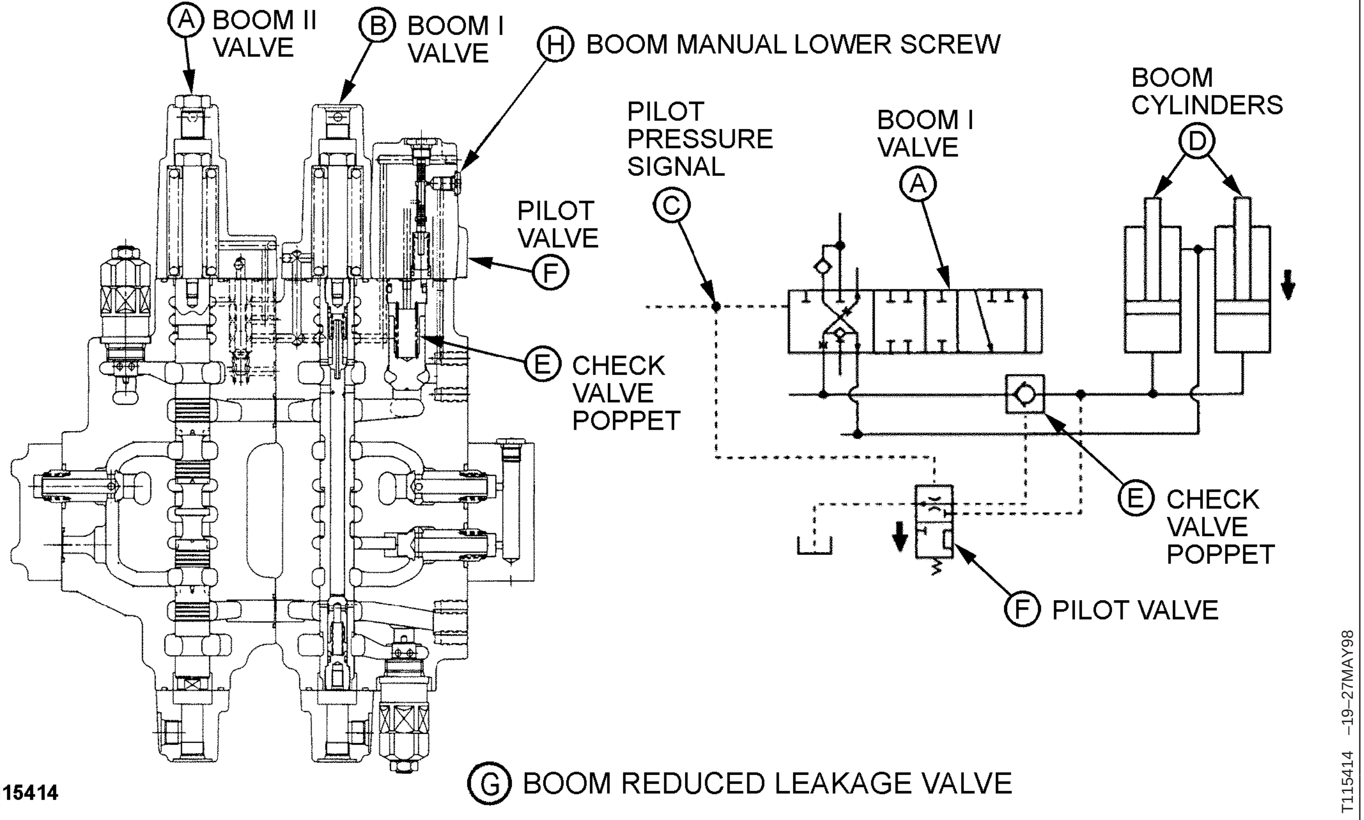


N ARM REGENERATIVE VALVE CIRCUIT

TX,05,GG2185 –19–08JUN98–2/2

BOOM AND ARM REDUCED LEAKAGE VALVES OPERATION



T115414

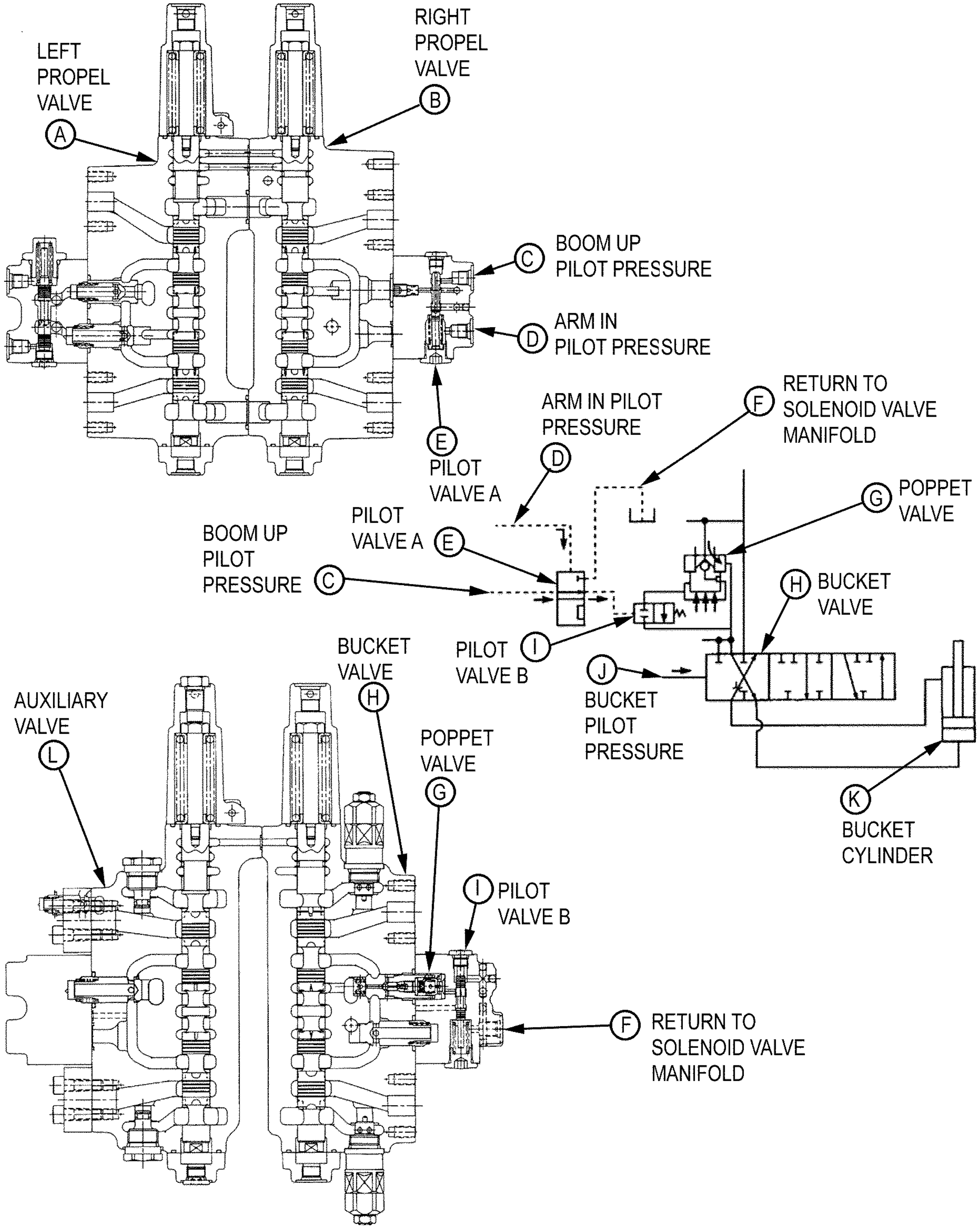
Reduced leakage valves (G) are used in the boom head end circuit and arm rod end circuit. The function of a reduced leakage valve is to reduce cylinder drift by stopping leakage from the cylinder back through the control valve.

When the control valve is in neutral, the oil pressure generated in the boom cylinder head end or arm cylinder rod end by the load on the cylinders is applied to the top (spring end) of check valve poppet (E) through the pilot valve (F). The poppet is held closed against the seat in housing trapping the oil from the cylinder at the work port.

When boom down or arm in function is actuated, the pilot pressure signal (C) from the pilot controller also shifts the pilot valve (F). The oil pressure from the cylinder is blocked by the pilot valve. The oil pressure at the top (spring end) of check valve poppet can now flow through the pilot valve to the warm-up passage in the pilot caps and then to the hydraulic oil tank. The oil pressure from the cylinder pushes the poppet off its seat opening the passage for oil to flow into the control valve return passage. The poppet is pushed off its seat because the OD of upper land at the head end of poppet is slightly larger than the lower land.

The boom manual lower screw (H) is used to lower the boom if the engine should stop with the boom in the raised position. (See Lower Boom With Engine Stopped in Group 9025-25.)

BUCKET FLOW CONTROL VALVE OPERATION



Ⓜ BUCKET FLOW CONTROL VALVE

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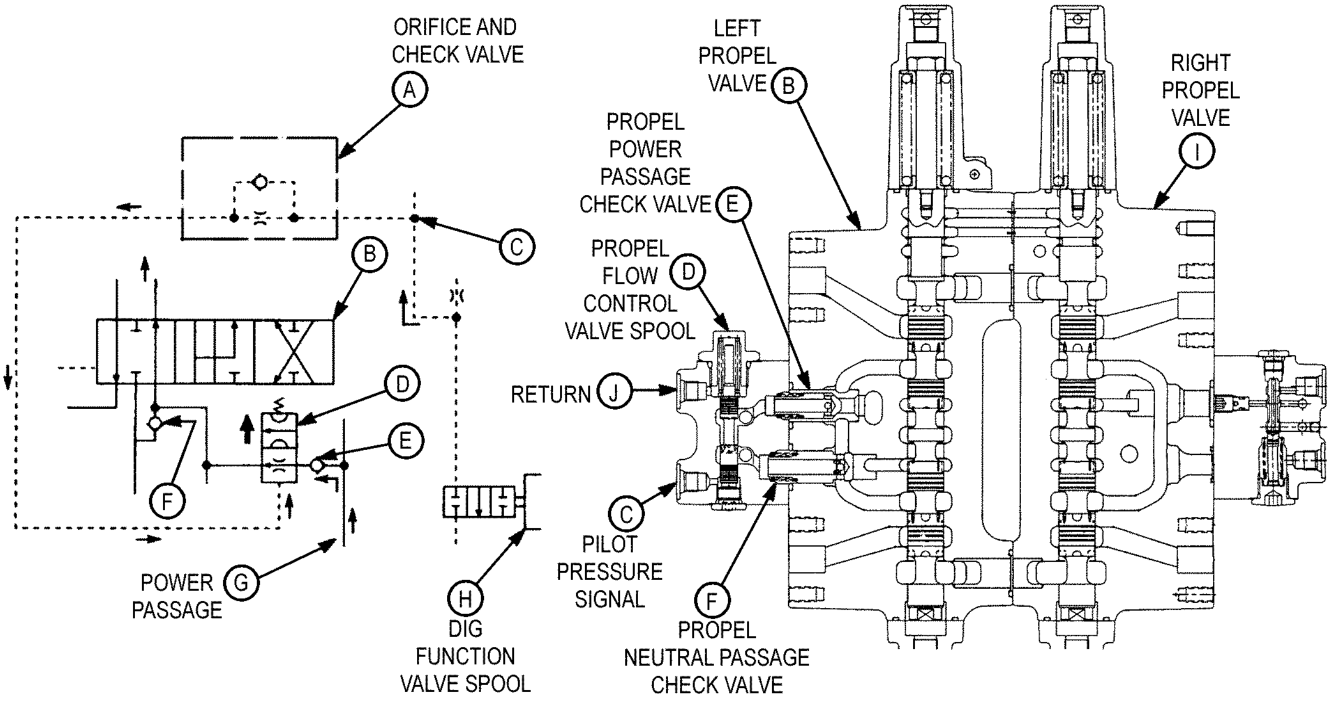
TX,05,GG2187 –19–20MAY98–1/2

The bucket flow control valve (M) restricts oil flow to the bucket cylinder in the combined operations of bucket, arm in, and boom up to ensure supply oil flow goes to the higher-loaded boom function to raise the boom.

When arm in function is actuated the pilot pressure also shifts pilot valve A (E). If boom up function is actuated the pilot pressure also flows through pilot valve A to shift pilot valve B (I) closing the passage from the poppet valve (G). The pressure on the back side of the poppet valve increases closing the poppet valve causing a restriction for supply oil flow through the poppet valve to the bucket valve (H).

TX,05,GG2187 –19–20MAY98–2/2

PROPEL FLOW CONTROL VALVE OPERATION



T103020 –19–16AUG96

T103020

Ⓚ PROPEL FLOW CONTROL VALVE

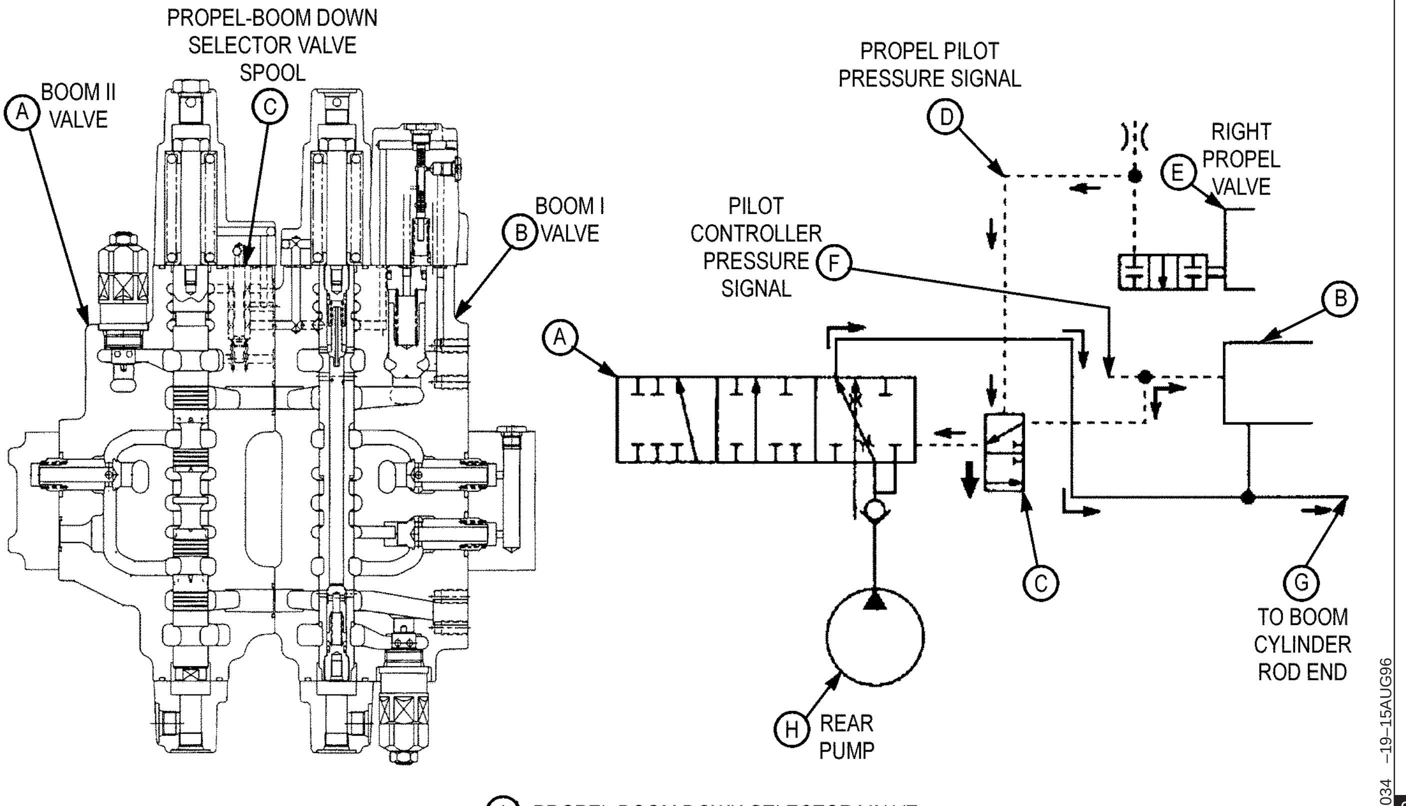
The propel flow control valve (K) is used to reduce shock loads from the power passage (G). The shock loads are caused by the operation of dig functions upstream of the left propel valve (B).

The propel flow control valve is located in the power passage to the left propel control valve.

When a dig function (H) is actuated while propelling, the pilot pressure signal also flows through the orifice in the orifice and check valve (A) assembly to gradually shift the propel flow control valve spool (D). The gradual shift of spool slowly restricts the flow of supply oil to the left propel valve reducing any shock loads.

The pilot pressure signal is released quickly through the check valve when all dig functions are returned to neutral. The propel flow control valve spool is shifted quickly to the open position by the spring.

PROPEL-BOOM DOWN SELECTOR VALVE OPERATION



T103034

Ⓘ PROPEL-BOOM DOWN SELECTOR VALVE

The function of propel-boom down selector valve (I) is to route the pilot controller pressure signal (F) to shift the boom II valve (A) also when the combined propel and boom down functions are actuated.

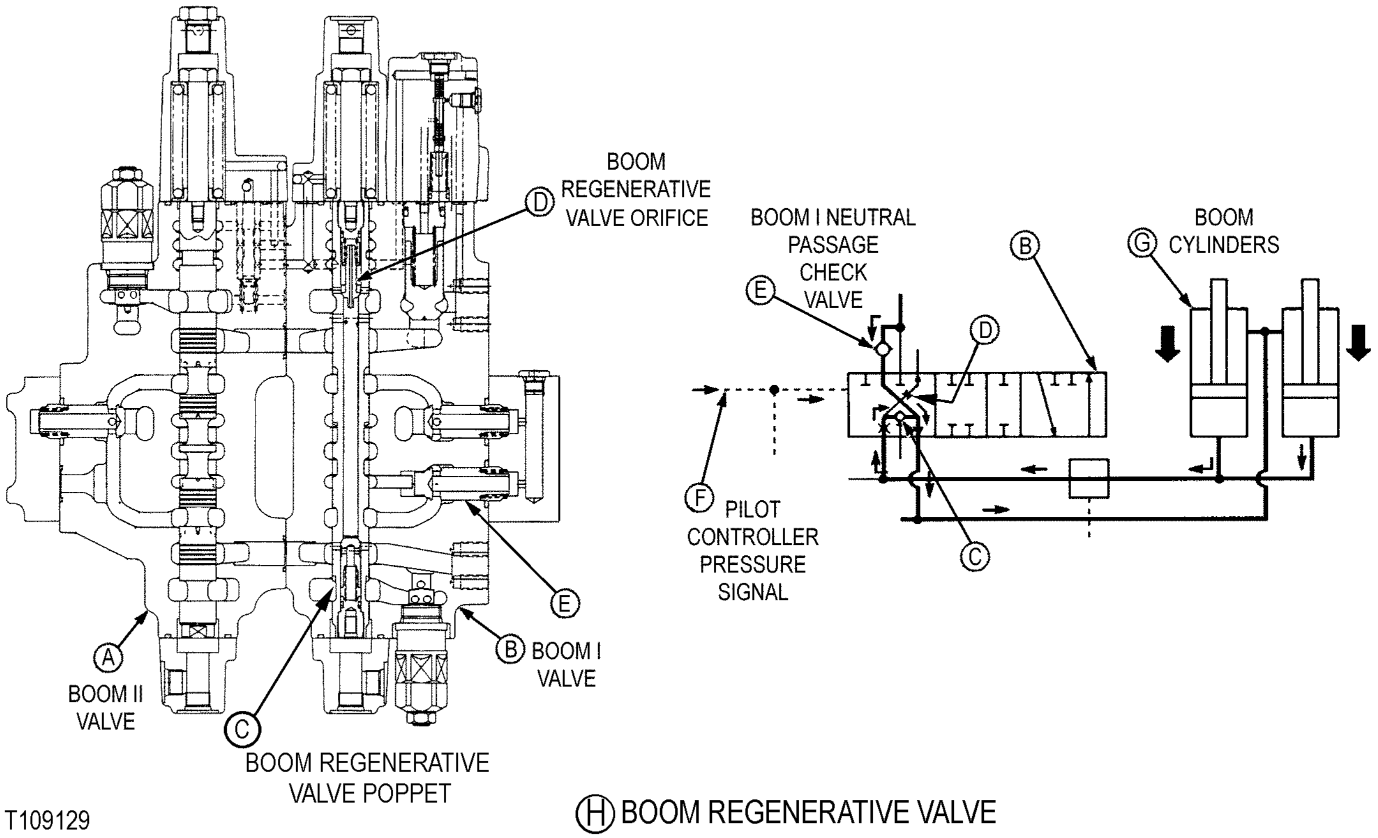
When just the boom down function is actuated, the pilot controller pressure signal (F) flows to the pilot cap to shift the boom I valve only. Pilot oil to the boom II valve is blocked by the propel-boom down selector valve spool (C). Front pump supply oil flows through the right propel valve (E) neutral passage to the boom I valve and out to the rod end of boom cylinders. Return oil from the head end flows through the boom I valve to return.

However, in a propel and boom down combined operations front pump supply oil is blocked by the right propel valve (E) and does not flow to the boom I valve (B). To get supply oil to the rod end of boom cylinders, the boom II valve (A) is shifted to route rear pump (H) supply oil to the cylinders. When the right propel valve (E) is actuated, the propel pilot pressure signal (D) increases shifting the propel-boom down selector valve spool (C). The pilot controller pressure signal can now flow through the selector valve and shift the boom II valve.

The return oil from the head end of boom cylinders still flows through the boom I valve to return.

TX,05,GG2189 –19–08JUN98–1/1

BOOM REGENERATIVE VALVE OPERATION



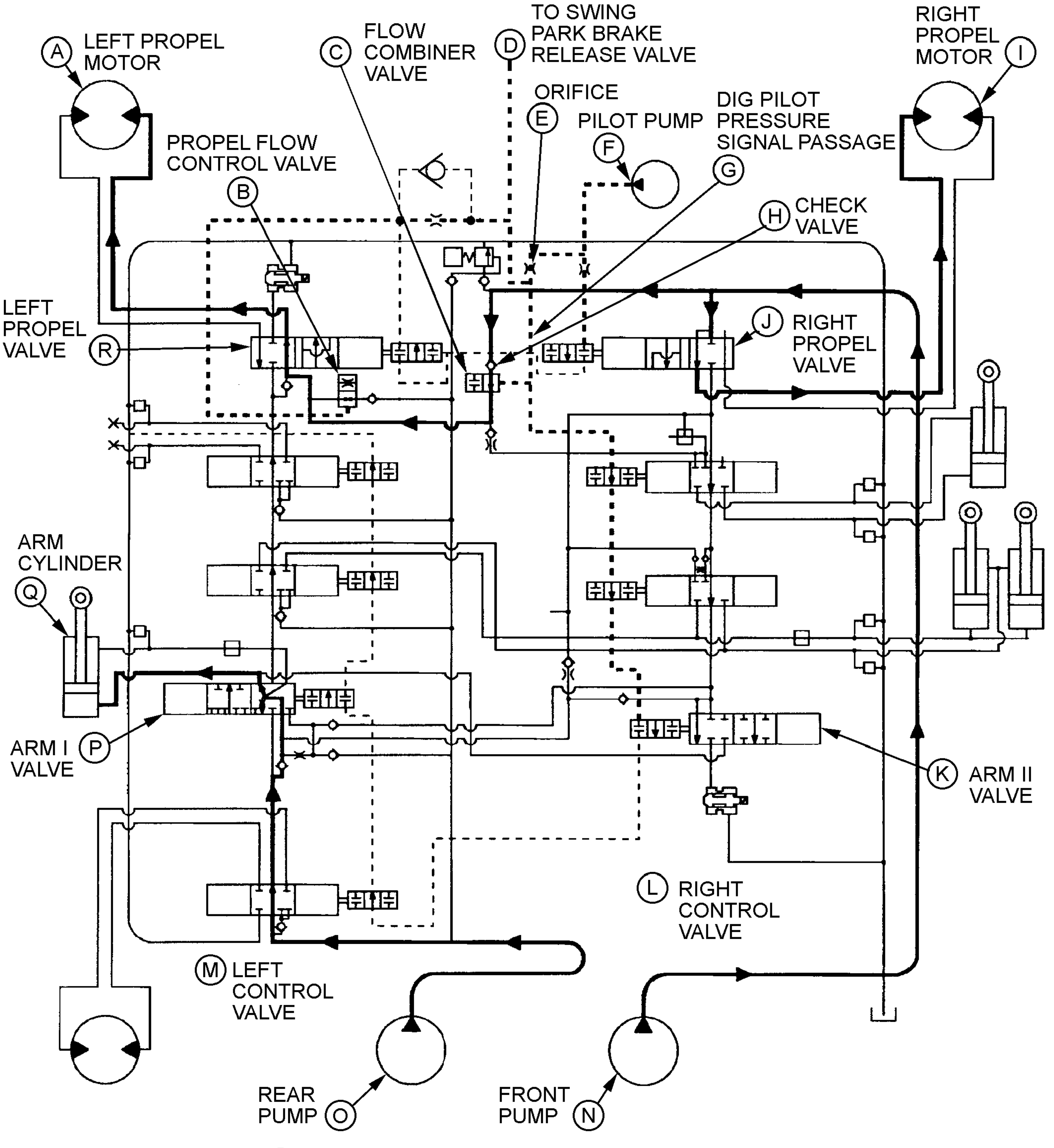
H BOOM REGENERATIVE VALVE

The function of boom regenerative valve (H) during boom down operation is to combine the return oil flow from head end of boom cylinders (G) with the pump supply oil to the rod end to prevent cavitation.

During boom down operation, if pump supply oil pressure is lower than the return oil pressure from the head end the return oil pushes the boom regenerative valve poppet (C) open and flows to the rod end. Return oil not used flows through the boom regenerative valve orifice (D) to the return passage.

The boom I neutral passage check valve (E) prevents back flow through the control valve.

PROPEL AND ARM IN COMBINED OPERATION



Ⓢ PROPEL AND ARM IN COMBINED

T116658

T116658 –19–24AUG98

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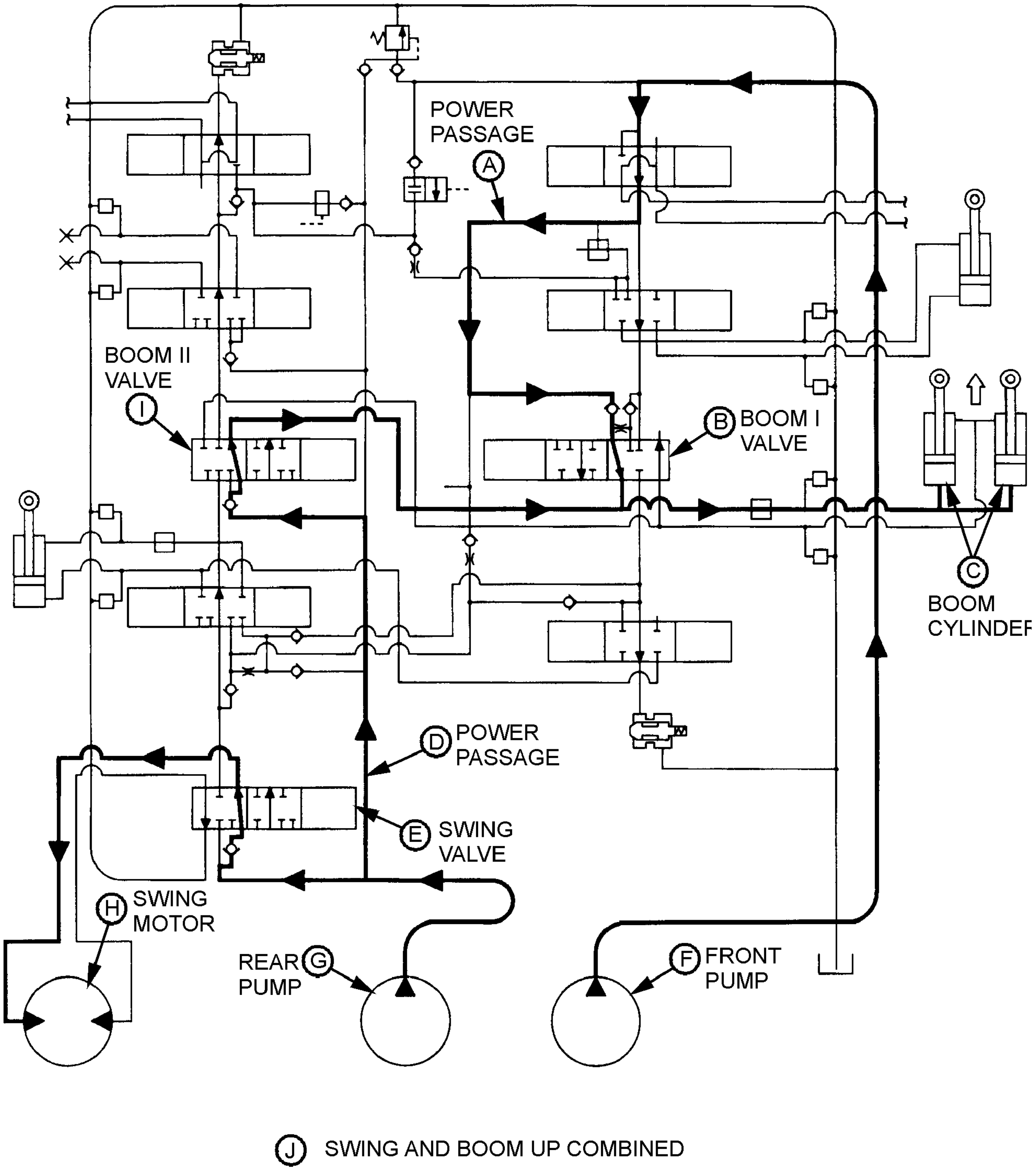
Actuating the propel and arm in functions in combined operation (S) shifts the left (R) and right (J) propel valves and the arm II (K) and arm I (P) valves. With the valves shifted, pilot oil flow through the dig pilot pressure signal passage (G) is blocked by the arm II valve causing the pilot oil pressure in the passage to increase. The increased pressure shifts the flow combiner valve (C), propel flow control valve (B), and swing park brake release valve (D).

Supply oil from the front pump (N) flows through the right propel valve (J) to turn the right propel motor (I) as well as through the flow combiner valve (C) and left propel valve (R) to turn the left propel motor (A). Because one pump is used to supply oil to both propel motors, the machine can propel straight even when the arm in function is actuated in combined operation with the propel function. The check valve (H) prevents back flow through the flow combiner valve.

Supply oil from the rear pump (O) flows through the arm I valve (P) to move the arm cylinder (Q). Supply oil from the rear pump can flow through the check valve and propel flow control valve (B) if upstream pressure is higher than pressure in the flow combiner valve passage.

CED,OUOE035,132 –19–20MAY98–2/2

SWING AND BOOM UP COMBINED OPERATION



T113344

T113344 –19–17FEB98

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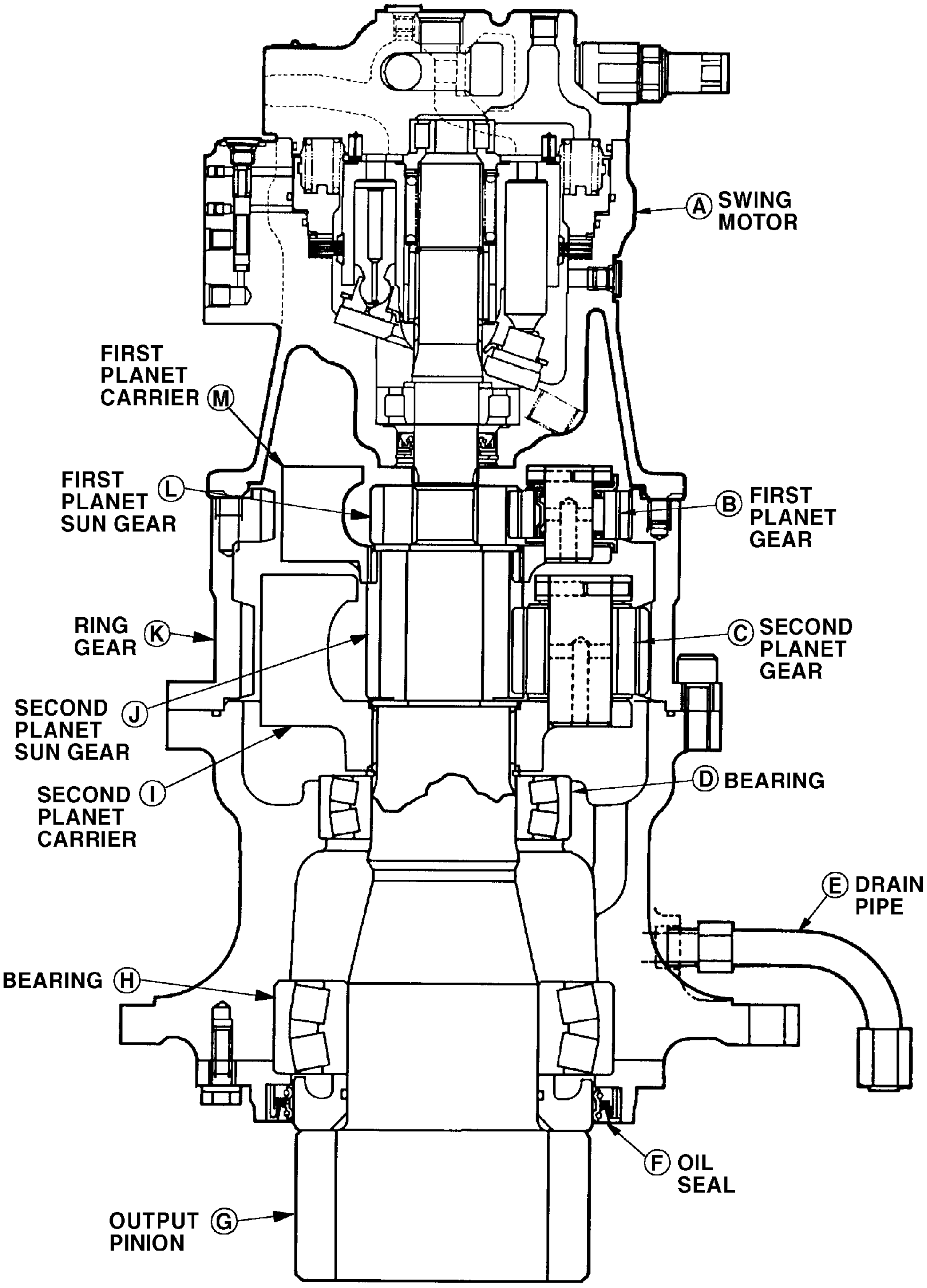
Actuating the swing and boom up in combined operation (J) shifts the swing valve (E), boom I valve (B), and boom II valve (I).

Pressure oil from the front pump (F) flows through the power passage (A) and boom I valve and out to the boom cylinders (C) to raise the boom. At the same time pressure oil from the rear pump (G) flows through the swing valve (E) and out to the swing motor to swing the upperstructure.

Pressure oil not used by the swing function flows through the power passage (D) and boom II valve (I). The pressure oil combines with the pressure oil from the front pump and flows to the boom cylinders. The boom is raised by combined oil flow from the front and rear pumps.

CED,TX08227,2991 –19–09FEB98–2/2

SWING GEARBOX OPERATION



N SWING GEARBOX

T103086 –19–07SEP96

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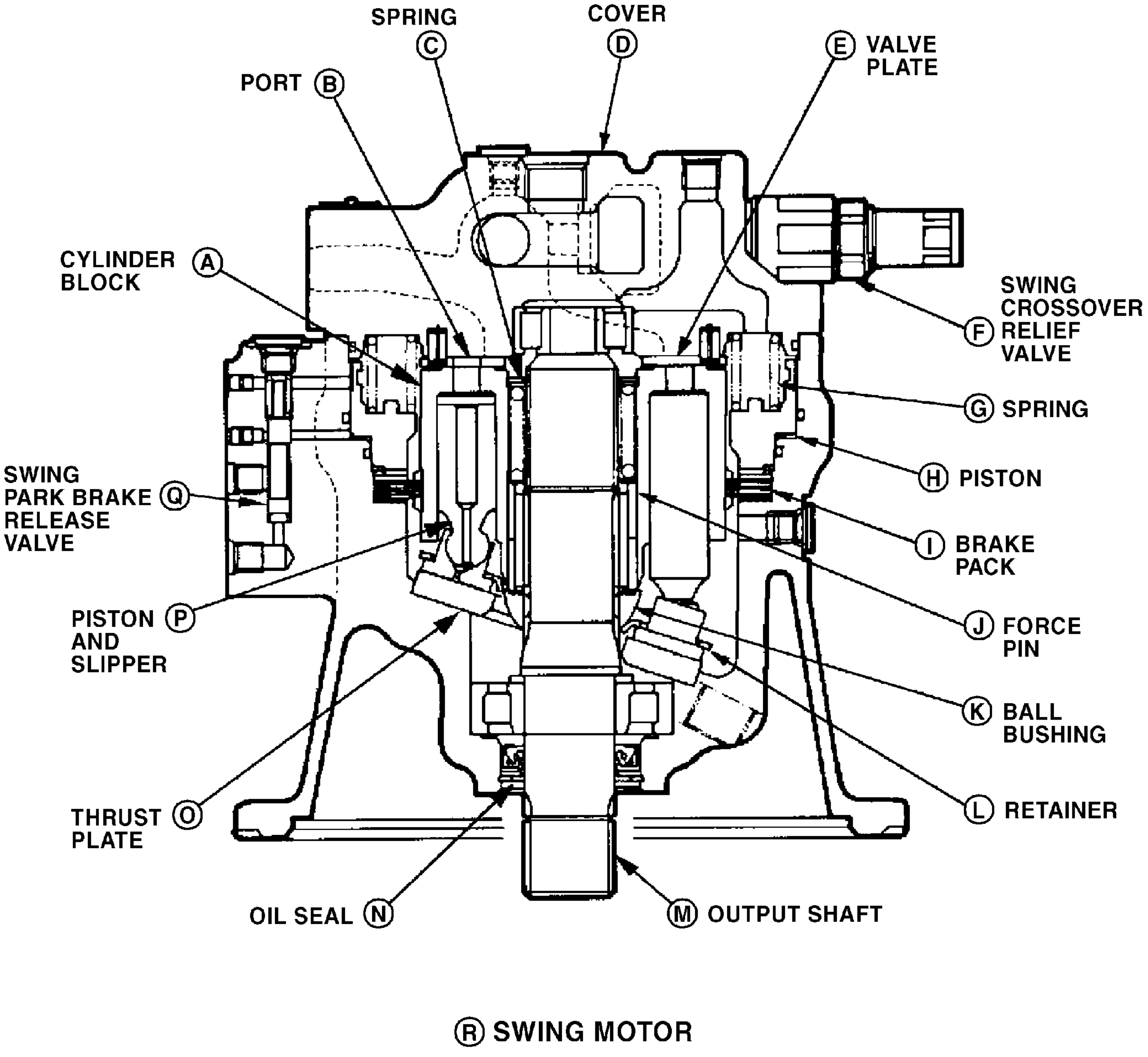
The swing gearbox (N) is a double reduction planetary drive type gearbox. The swing motor (A) is mounted on the swing gearbox and encloses the top side of gearbox. The output pinion (G) is in mesh with swing gear. Swing motor rotational speed is reduced by the double reduction planetary gear set.

The first planet sun gear (L) is connected to motor output shaft and is located between a retaining ring and thrust washer. The first planet gears (B) rotate around roller bearings on shafts in the first planet carrier (M). Rotation of the first planet carrier causes the second planet sun gear (J) to rotate. The second planet sun gear is located between thrust washers. Second planet gears (C) rotate around shafts in the second planet carrier (I). The second planet carrier is connected to the output pinion (G) and this causes the output pinion to rotate.

The pinion rotates in two spherical roller bearings (D and H). Downward movement of pinion is prevented by a retaining ring seated against upper bearing. Upward movement is prevented by second sun pinion. Oil seal (F) prevents oil from leaking out of swing gearbox and keeps grease from coming in.

TX,05,GG2193 –19–20MAY98–2/2

SWING MOTOR OPERATION



T103087

T103087 –19–12SEP96

The swing motor (R) consists of the rotating group, park brake, and cover (D). The cover contains the swing crossover relief valves (F), make-up check valves and inlet and outlet ports. The valve plate (E) is held in position by dowel pins in the cover. The swing motor is a fixed displacement, axial piston, fixed position thrust plate (O) motor. It is bidirectional so the upperstructure can swing in both directions.

Continued on next page

The rotating group consists of a cylinder block (A) with nine pistons and slippers (P). The cylinder block is connected to the output shaft (M). Each piston is connected to a slipper by a ball joint. Slippers slide on the inclined thrust plate (O) forcing the cylinder block to turn. Retainer (L) holds the slippers on the thrust plate and the retainer itself is held against the slippers by force pins (J) and spring (C).

Oil from swing control valve is routed through cover (D), valve plate (E), and port (B) to the pistons.

In operation, high pressure supply oil enters the cylinder bores through ports forcing pistons down against inclined thrust plate. The slippers slide down the inclined thrust plate causing the rotating group to turn. The output shaft is turned by the cylinder block. Swing speed varies depending on the amount of supply oil delivered by the pump through the control valve.

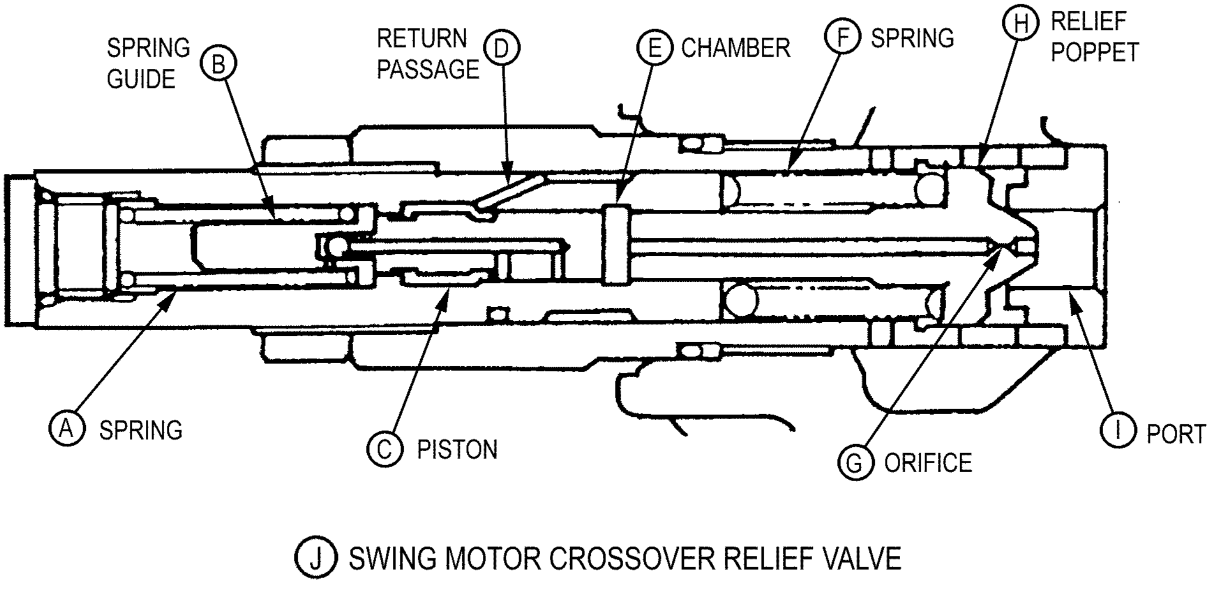
During the second half of motor’s revolution, low pressure oil is discharged as pistons slide back up the inclined thrust plate. To reverse rotation, oil flow is reversed. A small amount of supply oil flows through the center of each piston to ball joint and to face of slipper for lubrication.

The motor is internally lubricated from leakage inside the motor. Lubrication oil is routed up through the cover to the hydraulic oil tank.

The swing motor park brake is spring applied and hydraulically released. The plates in the brake pack (I) are connected to the housing. The disks are connected to and rotate with the cylinder block. When the pilot controllers are in neutral, pilot oil is blocked from the piston (H) by the swing park brake release valve (Q). The brake springs squeeze the plates and disks together to prevent the upperstructure from swinging. The swing park brake is released when the swing, boom, arm, or bucket function is actuated.

TX,05,GG2194 –19–20MAY98–2/2

SWING MOTOR CROSSOVER RELIEF VALVE OPERATION



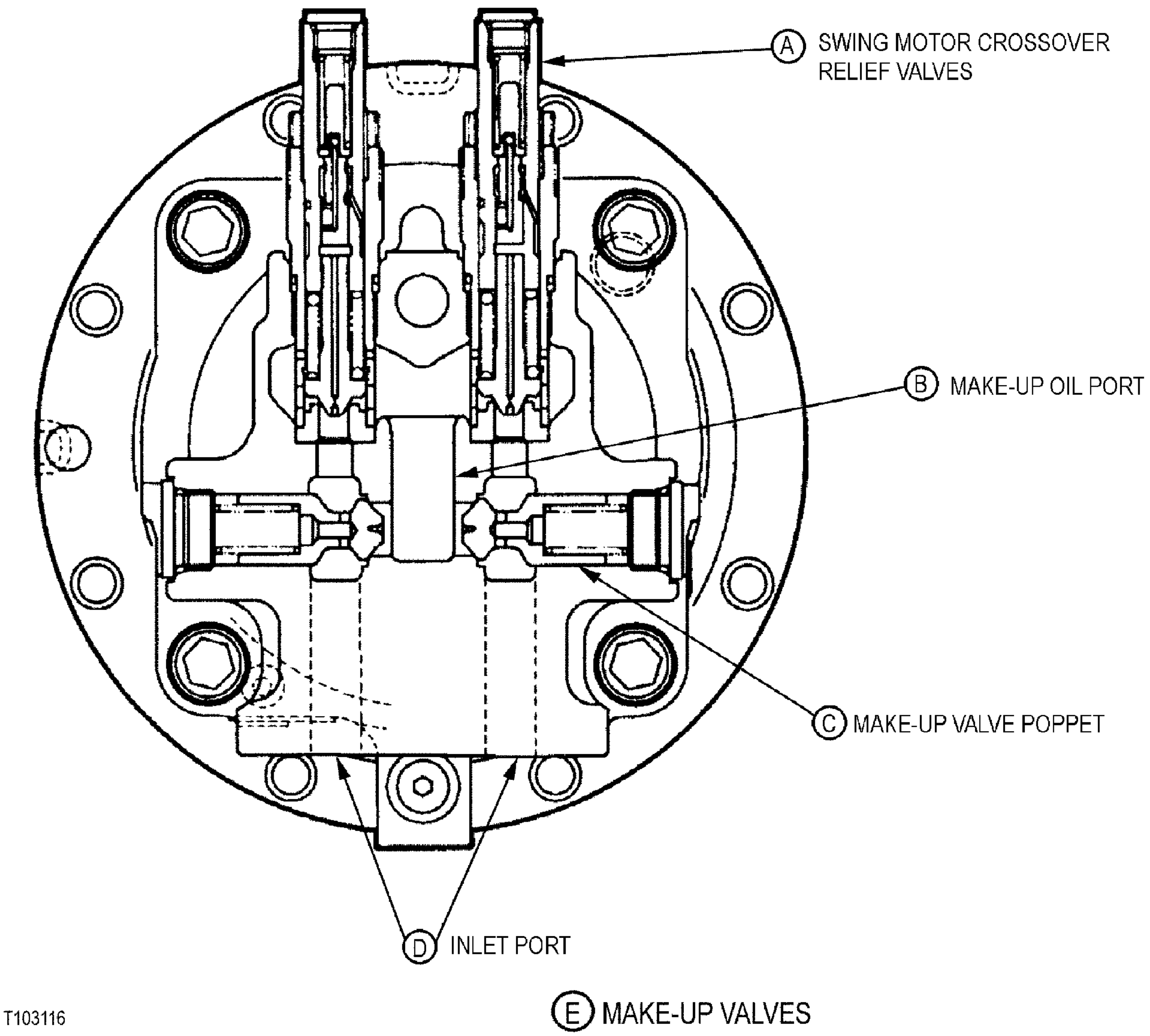
T103106 –19–20AUG96

The function of swing crossover relief valve (J) is to relieve the high pressure generated in the swing circuit when starting or stopping the swing operation. The oil pressure in the swing circuit becomes high because of the inertia of the upperstructure to starting and stopping.

When the oil pressure in port (I) increases to the valve pressure setting, the relief poppet (H) is pushed off its seat to relieve pressure oil to return. The pressure is also sensed in the chamber (E) through the orifice (G). The opening of the relief poppet is further dampened by the action of the piston (C), spring guide (B), and spring (A). Oil from the spring (A) chamber is release through the orifices in the spring guide and piston to the return passage (D). The relief poppet is pushed back to the right by the spring (F) and the pressure in the chamber.

TX,05,GG2195 –19–20MAY98–1/1

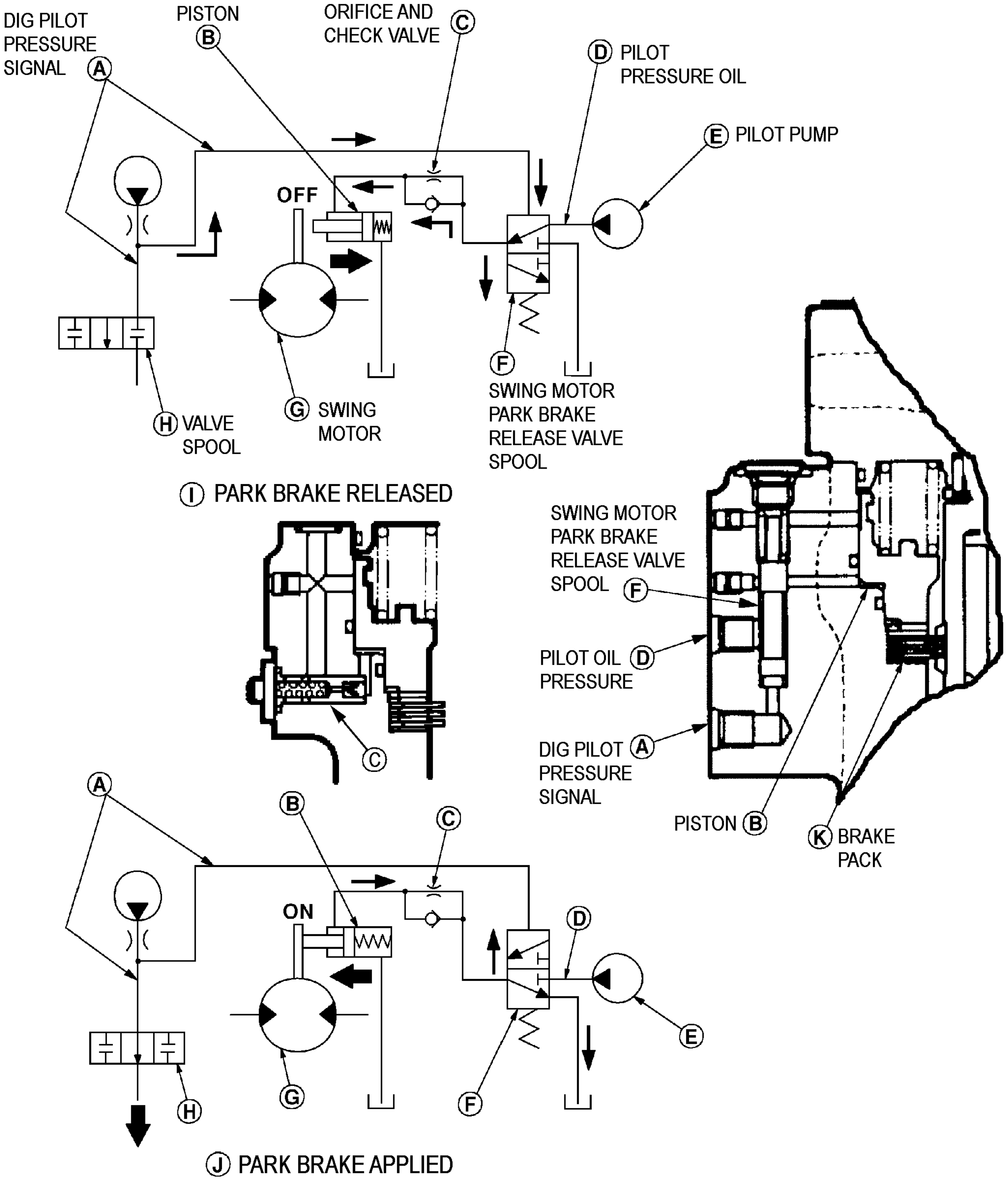
SWING MOTOR MAKE-UP VALVE OPERATION



While stopping the swing function the control valve spools go to neutral and the lines to inlet ports (D) at the swing motor are blocked at the control valve. Because of the inertia of the upperstructure the oil pressure in one side of the swing motor becomes high. For a few seconds the motor acts like a pump. The relief poppet in the crossover relief valve opens to relieve the high pressure oil to the make-up oil port (B).

Because the lines to the motor are blocked the continued rotation of the upperstructure lowers the pressure on the other side of the motor until cavitation starts. When cavitation starts the make-up poppet (C) is pushed open by the return oil in the make-up oil port. The return oil flows in and prevents cavitation. The make-up oil port is connected to the return passage in the control valve. The return oil pressure is maintained by the restriction valve located downstream of the oil cooler.

SWING MOTOR PARK BRAKE RELEASE VALVE OPERATION



Ⓛ SWING MOTOR PARK BRAKE RELEASE VALVE

T109165

T109165 –19–21APR97

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The function of swing motor park brake release valve (L) is to route pilot oil pressure (D) to the piston releasing the brake pack when a dig or swing function is actuated.

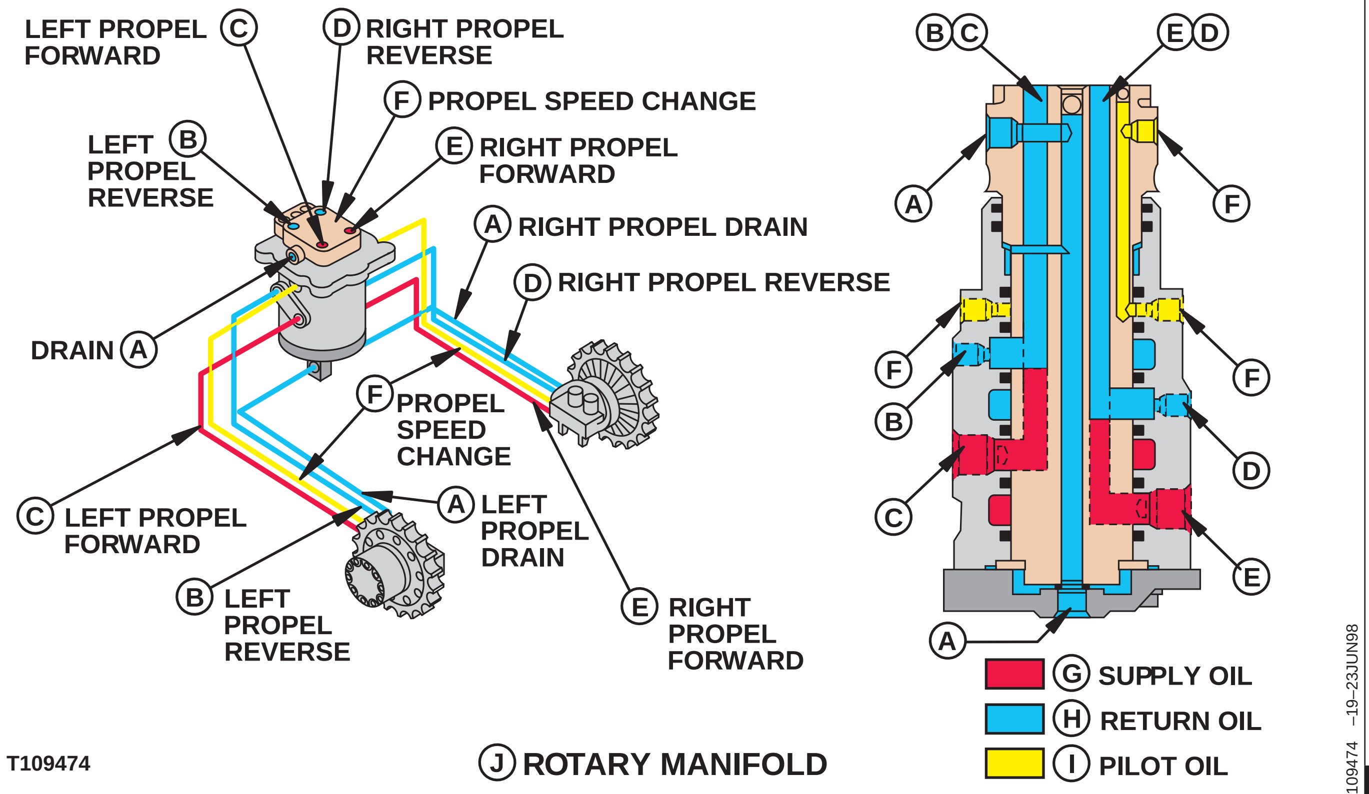
Park Brake Released (I):
When a swing or dig function is actuated, the flow of pilot oil through dig pilot pressure signal passage in the control valve is blocked by a valve spool (H). The dig pilot pressure signal (A) increases and shifts the swing motor park brake release valve spool (F). Pilot pressure oil (D) from the solenoid valve manifold flows through the spool to piston (B) chamber. The pilot pressure oil pushes the piston up against the spring releasing the brake pack (K). The upperstructure is now free to turn.

Park Brake Applied (J):
When the valve spool (H) is returned to neutral, pilot oil flows through the dig pilot pressure signal passage to the return passage causing the pressure signal to decrease. The release valve spool (F) is shifted by the spring blocking the flow of pilot oil pressure to the piston (B) chamber. The oil in the piston chamber flows through the orifice (C) to return as the springs push the piston down applying the park brake. The oil is metered through the orifice to slow engagement to ensure that park brake is only fully applied after the upperstructure has stopped. The orifice and check valve is located in the swing motor housing adjacent to the swing motor park brake release valve.

Pilot oil pressure (D) is maintained at the release valve spool (F) as long as the pilot shutoff valve is ON. The circuit for pilot oil pressure is from the pilot pump (E), through the pilot shutoff valve, solenoid valve manifold, and then to the release valve spool.

TX,05,GG2197 –19–20MAY98–2/2

ROTARY MANIFOLD OPERATION

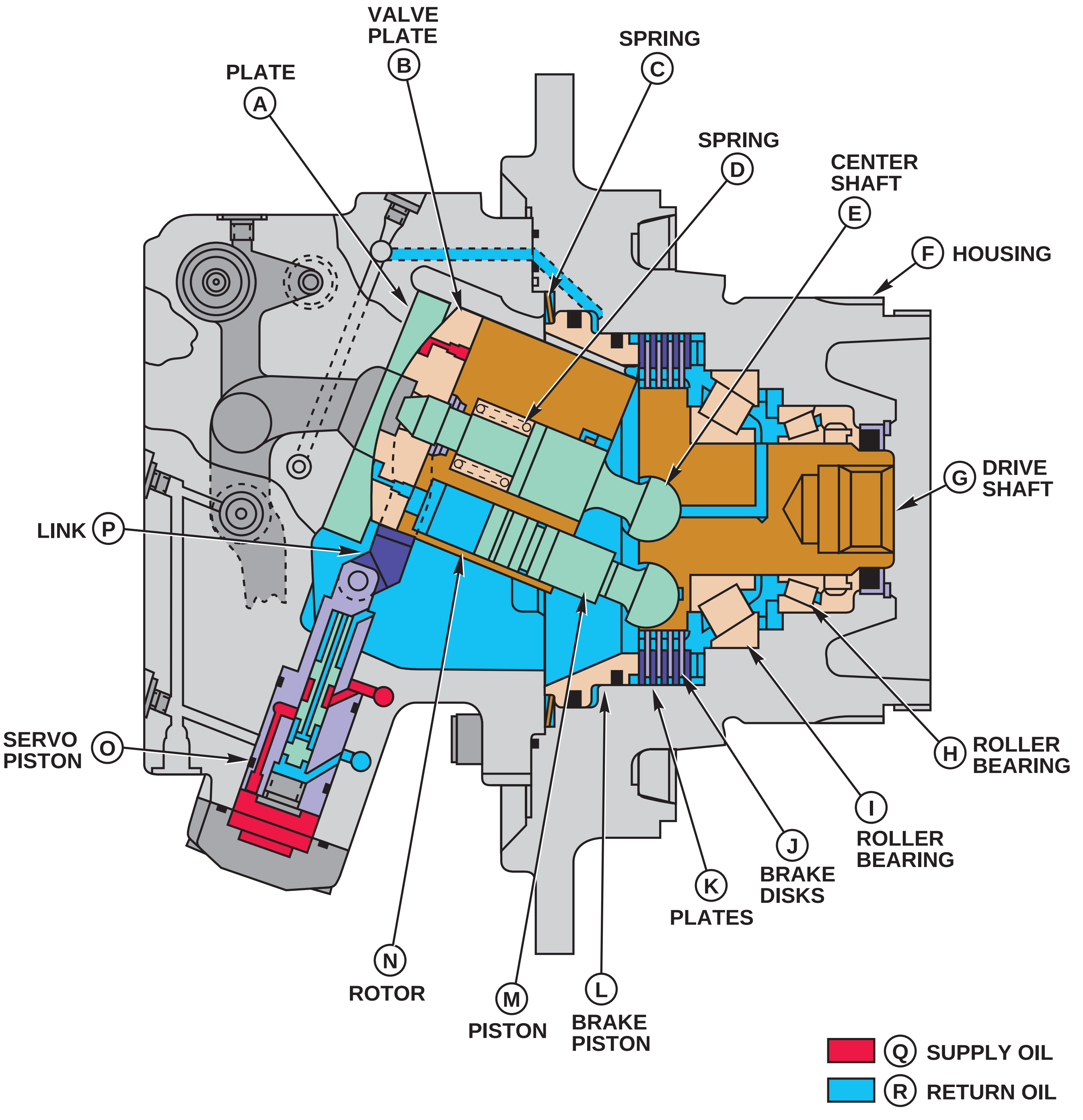


The rotary manifold (J) is a 360° rotary joint. It allows oil to flow to and from the propel motors without twisting hoses when the upperstructure is rotated.

The inner spindle is connected to the upperstructure and the housing is connected to the undercarriage. The housing rotates about the spindle during swing operation.

Oil flows into and through the spindle to passages in the housing, and then out of the housing to the propel motors. Sealing rings stop oil from leaking between the spindle and housing into adjacent passages.

PROPEL MOTOR OPERATION



T7499AA –19–23APR97

TXC7499AA

Ⓢ PROPEL MOTOR

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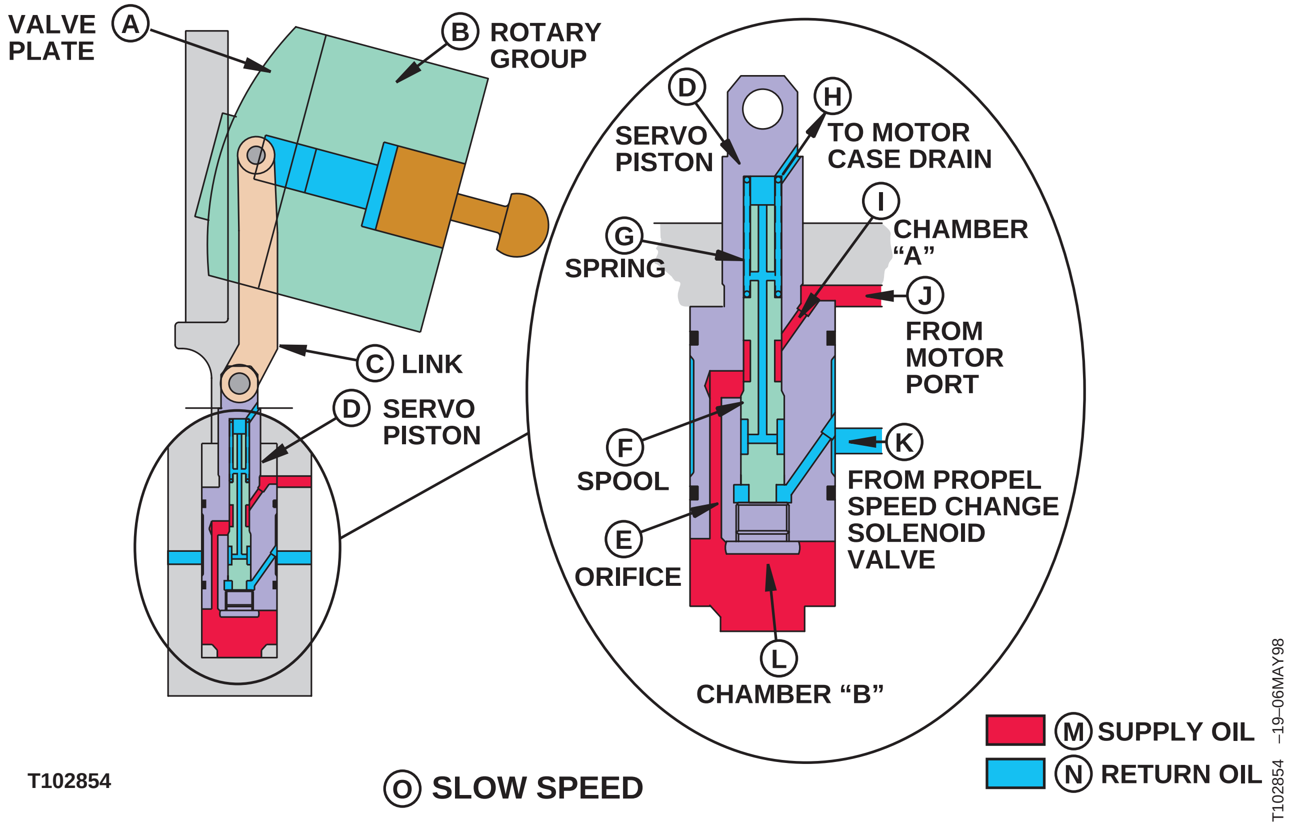
The propel motor (S) is a variable-displacement, bent-axis, axial-piston type motor that includes the brake valve housing and propel park brake. The counterbalance valve, crossover relief valves, park brake release shuttle valve, pressure reducing valve, servo piston shuttle valve, and the servo piston (O) are integral components of the brake valve housing. The speed selector valve spool is located in the servo piston.

The servo piston (O) controls the angle of rotor (N), pistons (M) and center shaft (E) with respect to the drive shaft (G). As the angle is changed the motor displacement changes which changes propel motor speed.

Supply oil flows through the valve plate (B) to half of the pistons (M) in the rotor (N). The oil forces the pistons to slide down the cylinder block bores transferring the force to the drive shaft (G) turning the drive shaft. As the cylinder block and drive shaft rotate, half of the pistons move out of their bores while the remaining pistons in the other half of the cylinder block move back in their bores to discharge oil to return.

TX,05,GG2167 –19–20MAY98–2/2

PROPEL MOTOR SLOW SPEED OPERATION



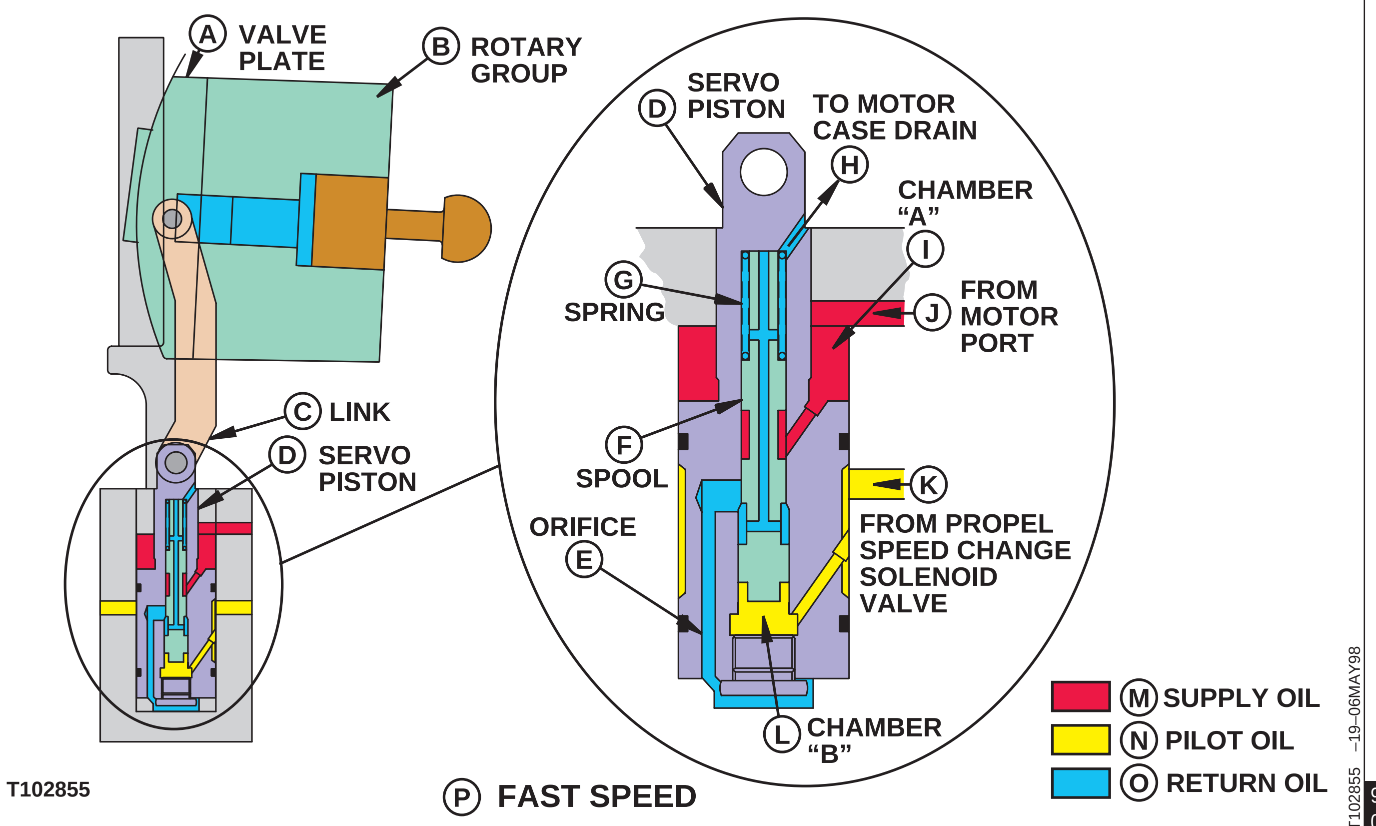
Ⓞ SLOW SPEED

The servo piston (D) is connected by a link (C) to the valve plate (A). When servo piston is extended or retracted by supply oil pressure the angle of the rotary group (B) changes and the propel speed changes accordingly.

When propel speed is set to slow speed the bottom of speed selector valve spool (F) is open to return through the propel speed change solenoid valve. The spool (F) is pushed down by the spring (G). (For operation of propel speed change solenoid valve, see Proportional Solenoid Valve Operation in this group. For circuit operation, see Propel Motor Speed Change Circuit Operation in this group.)

Supply oil from motor port (J) is now applied to both chamber “A” (I) and chamber “B” (L) at the same time. Supply oil pressure in chamber “B” acts on a larger area than the supply oil pressure in chamber “A” causing the servo piston to move upward increasing rotary group swash angle. As the swash angle increases, the stroke of each piston is increased resulting in slower revolution of the propel motor for slower propel speed. (See Propel Motor Fast Speed Operation in this group.)

PROPEL MOTOR FAST SPEED OPERATION



In fast speed the pilot oil (N), from the propel speed change solenoid valve (K), is higher than spring force and spool (F) is pushed up. The oil in chamber "B" is routed to return through motor case drain (H). Supply oil (M) from the motor port (J) is applied to chamber "A", servo piston (D) moves down to reduce rotary group (B) swash angle. With reduced swash angle the piston stroke is reduced which increases rotary group turning speed that increases propel speed.

NOTE: For operation of propel speed change solenoid valve, see Proportional Solenoid Valve Operation in this group. For circuit operation, see Propel Motor Speed Change Circuit Operation in this group.

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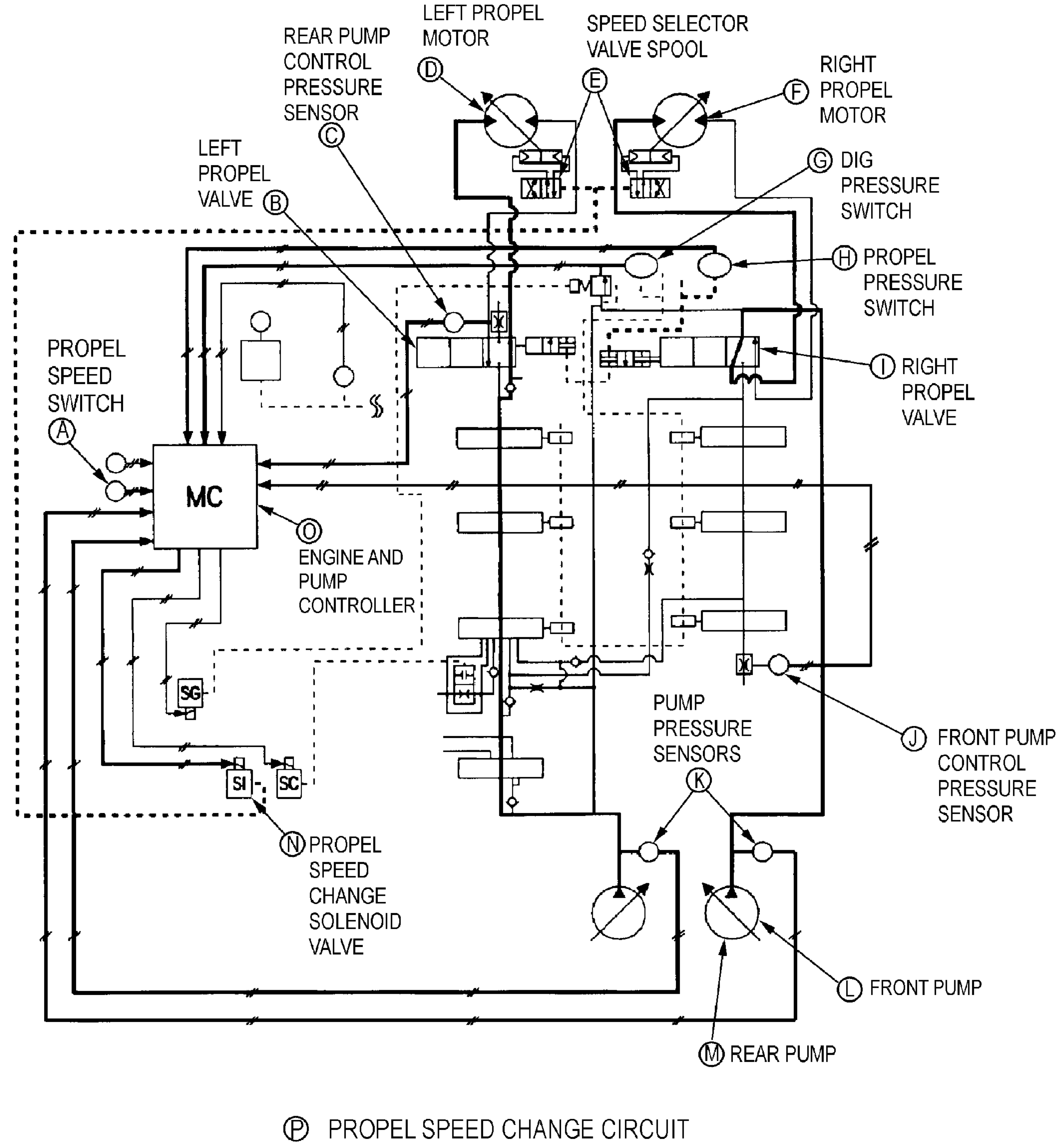
TX,05,GG2169 –19–20MAY98–1/1

PROPEL MOTOR SPEED CHANGE CIRCUIT OPERATION



T109188

T109188 –19–23APR97

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When the propel speed switch (A) is in slow speed, the propel speed change solenoid valve (N) coil is de-energized. The speed selector valve spools (E) are open to return through the solenoid valve. The propel motors (D and F) are at maximum displacement causing the machine to travel at slow speed.

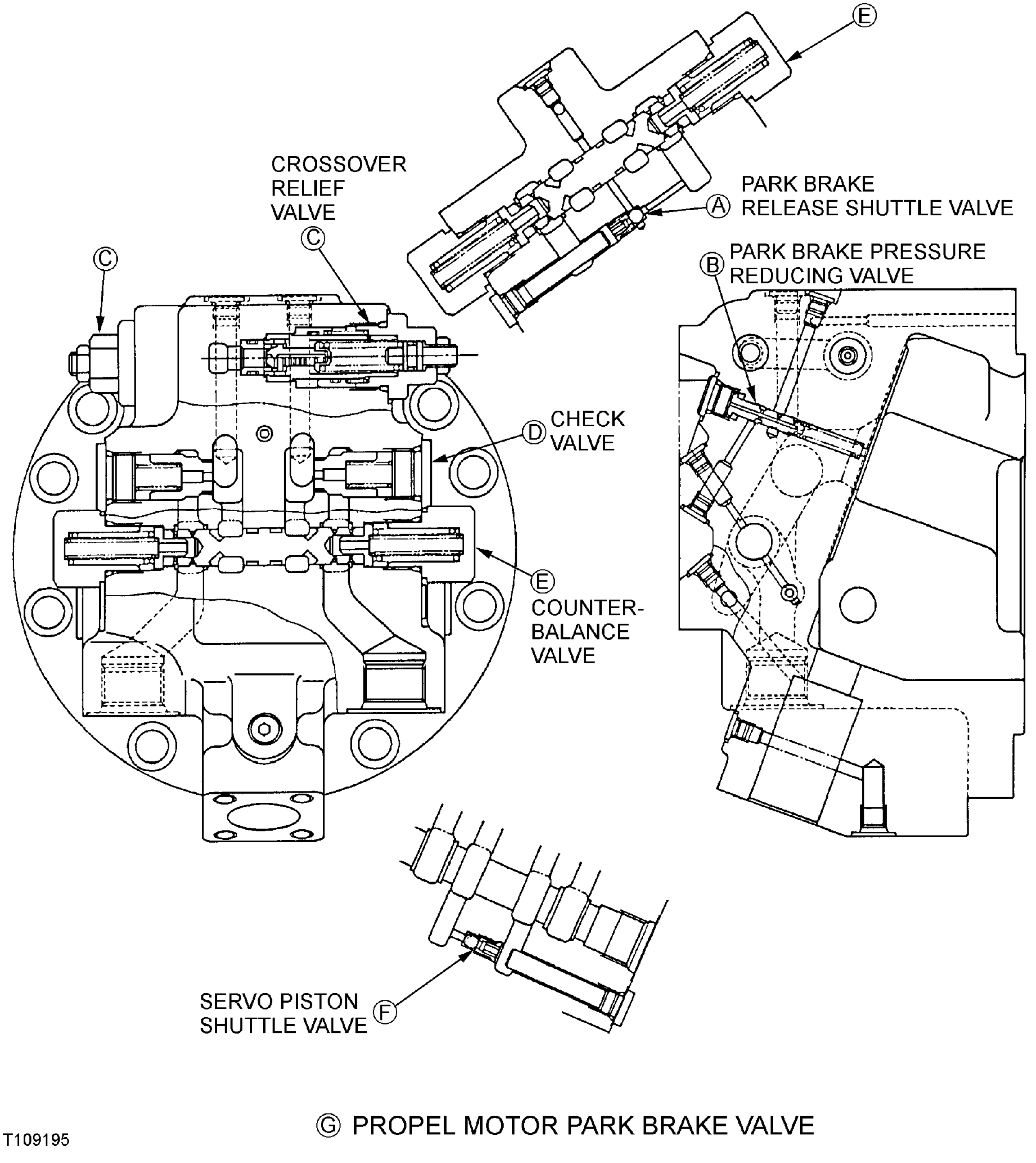
The propel speed goes to fast with the following operating conditions:

- Propel speed switch is at fast speed.
- Propel pressure switch (H) in closed.
- Dig pressure switch (G) is open.
- Electrical signal for front (J) and rear (C) pump control pressure sensors increases because pilot oil control signals from front and rear pump control valves are increasing.
- Rear and front pump pressure sensors (K) are sensing low supply oil delivery pressure.

When the electrical signals are received at the engine and pump controller (O), the controller sends an electrical signal to energize the solenoid valve (N) coil. The pilot oil pressure signal shifts the speed change valve spool (E) causing the motor to go to minimum displacement and the machine to travel at fast speed. (See Propel Motor Fast Speed Operation in this group.)

TX,05,GG2200 –19–20MAY98–2/2

PROPEL MOTOR PARK BRAKE VALVE HOUSING OPERATION



Ⓖ PROPEL MOTOR PARK BRAKE VALVE

The propel motor park brake valve (G) housing contains the park brake release shuttle valve (A), park brake pressure reducing valve (B), crossover relief valve (C), check valves (D), counterbalance valve (E), servo piston shuttle valve (F) and servo piston.

Continued on next page

Park brake release shuttle valve (A) routes supply oil from the pressurized motor port through a groove in the counterbalance valve (E), to the park brake pressure reducing valve (B), and then to the park brake piston to release the park brake.

Park brake pressure reducing valve (B) reduces the supply oil pressure routed to the park brake to prevent sudden brake application.

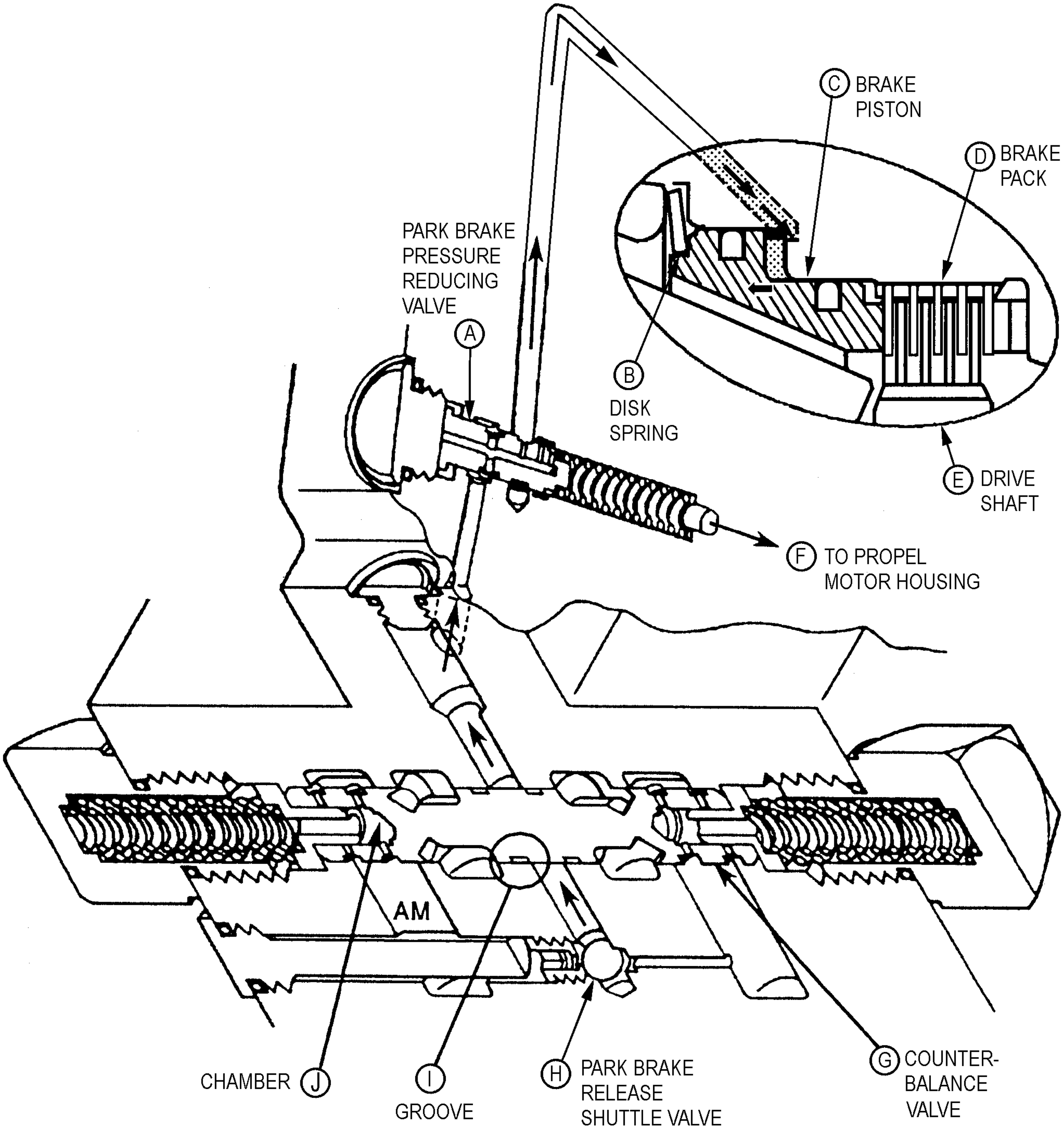
Crossover relief valves (C) protect the motor circuit from pressure spikes.

Check valves (D) ensure smooth starts and stops, and prevent motor cavitation by working together with the counterbalance valve (E).

Counterbalance valve (E) is used for smooth starting and stopping and helps prevent overrunning of the motor when traveling down a slope.

Servo piston shuttle valve (F) routes supply oil from the pressurized motor port to the servo piston. (For operation of servo piston and speed selector valve, see Propel Motor Slow Speed Operation and Propel Motor Fast Speed Operation in this group.)

PROPEL MOTOR PARK BRAKE RELEASE CIRCUIT OPERATION



Ⓚ PROPEL MOTOR PARK BRAKE RELEASE

T109202

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TX,9025,GG2613 –19–20MAY98–1/2

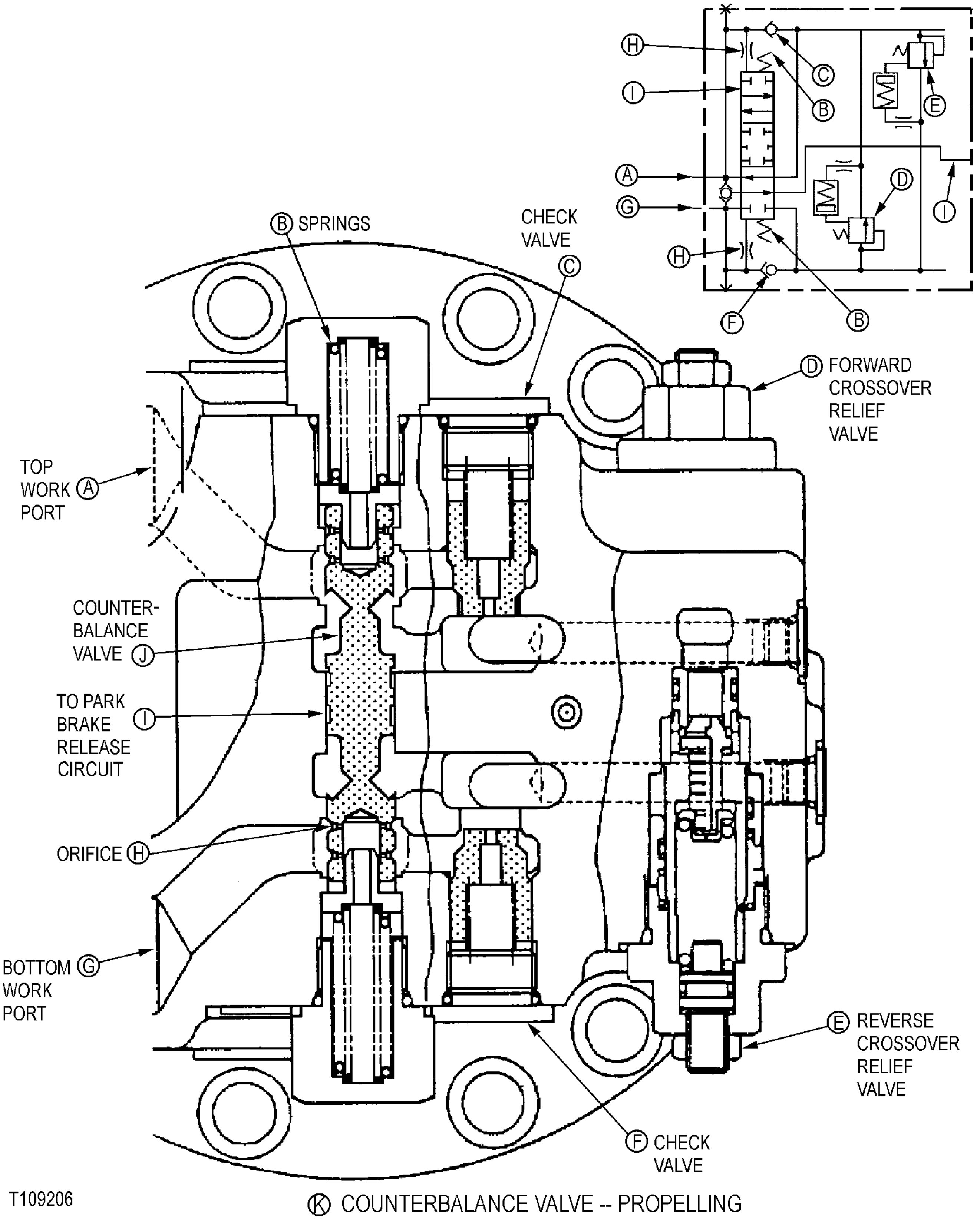
Propel park brake is spring applied and hydraulically released type brake. Brake is applied by a disk spring (B) whenever the propel control valve spools are in neutral. The plates in the brake pack (D) are connected to the motor housing. The disks are connected to and rotate with the drive shaft (E). The disk spring pushes against the piston to squeeze the plates and disks together to keep the machine from moving.

When the propel pilot controllers are actuated the propel valve spools route supply oil to the bottom work port of propel motor for forward travel or the top work port for reverse travel. The supply oil flows into the chamber (J) at the end of counterbalance valve (G). At the same time supply oil moves the park brake release shuttle valve (H) to route supply oil to the park brake pressure reducing valve (A) but is blocked by the counterbalance valve. When supply oil pressure increases enough to shift the counterbalance valve, supply oil flows through the groove (I) to the park brake pressure reducing valve. The pressure reducing valve operates to reduce the supply oil pressure. Reduced pressure oil flows to the brake piston (C) to move it against the disk spring (B) force and releases the park brake. Oil not used to release the park brake flows through the orifice in the reducing valve spool and into the propel motor housing (F).

When propel pilot controllers are returned to neutral, supply oil is blocked by the valve spools and the propel motor work ports are open to the control valve return passage. The counterbalance valve (G) returns to its neutral position causing the machine to slow and then stop (dynamic braking). The pressure reducing valve (A) is shifted by its spring. The disk spring (B) pushing against the brake piston (C) forces the oil to flow through the orifice in the reducing valve and into the propel motor housing (F). The delay caused by the oil flowing through the orifice is enough to slow engagement to ensure that park brake is only fully applied after the machine has stopped.

TX,9025,GG2613 –19–20MAY98–2/2

PROPEL MOTOR COUNTERBALANCE VALVE OPERATION



Ⓚ COUNTERBALANCE VALVE -- PROPELLING

T109206 –19–23APR97

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When the propel valve spools in the main control valve are in neutral position, counterbalance valve (J) is held in the center position by springs (B) on both ends of counterbalance valve. Both propel motor oil lines are connected to the control valve return passage. Oil in each motor is trapped by check valves (C and F) and counterbalance valve (J) holding the motors stationary. The park brake release circuit is also routed to return and the brake spring hold the brake on.

When the propel pilot controller is moved to forward position, supply oil is routed from the propel valves in the control valve to bottom work port (G). If propel pilot controller is moved to reverse position, supply oil would be routed to top work port (A).

In forward direction, supply oil enters bottom work port (G), flows around counterbalance valve to check valve (F). Check valve opens and oil flows into the motor.

Return oil from the motor is blocked by check valve (C) and counterbalance valve (J). This, along with the motor's resistance to turning, causes pressure in bottom work port (G) to increase. The increasing pressure is also sensed at the end of counterbalance valve through orifice (H). As pressure increases, the spool is pushed upward against the spring force. As spool moves up, oil from the motor flows past notches in the counterbalance valve to the top work port (A) and the propel motors start to turn. Supply oil is also routed to the park brake release circuit (I) to release the park brake. (For park brake release circuit operation, see Propel Motor Park Brake Release Circuit Operation in this group.)

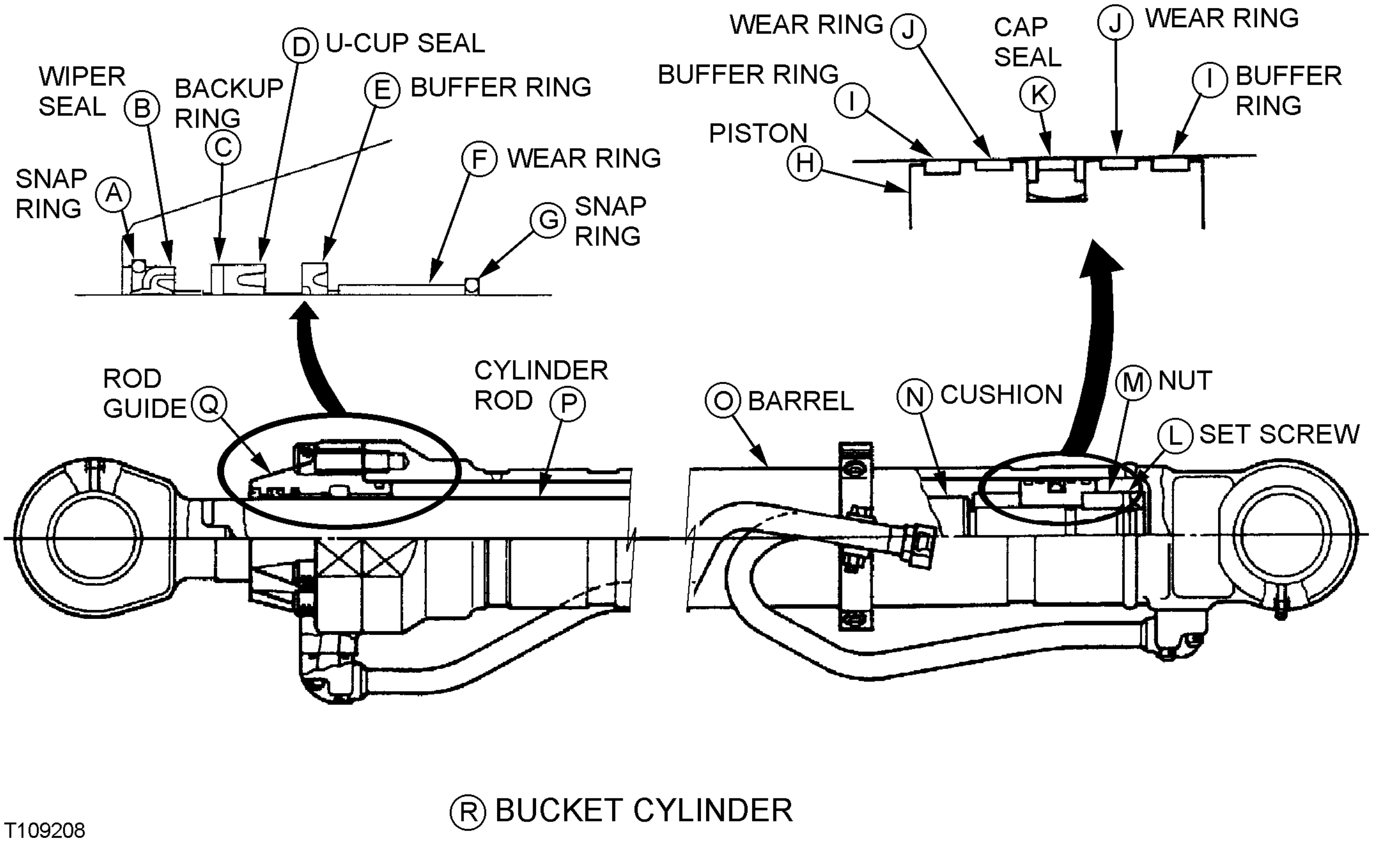
When the propel pilot controller is returned to neutral position, the oil in both work ports (A and G) is routed to control valve return passage. Both check valves will seat and counterbalance valve will center trapping oil in the motor to prevent rotation. Oil will also flow back through the brake passage to the motor housing and the park brake will engage after the propel motor stops rotating. At the same time, the shock pressure caused by the inertia force of the motor stopping is released through the crossover relief valves (D and E). Check valves (C and F) have a make-up function to prevent cavitation in the motor.

When traveling down a hill, the weight of the machine may begin to overrun the propel motors. This would cause faster travel than desired and cause cavitation at the inlet side of motors. As pressure decreases in the inlet passage of the motor, the pressure holding the counterbalance valve also decreases. Spring (B) force moves the counterbalance valve down thus restricting return flow from the motor slowing motor rotation. This is called “dynamic braking”.

During normal operation supply oil from the control valve is routed past the counterbalance valve and check valve to the motor. Supply oil is also routed to the crossover relief valves (D and E). The crossover relief valves are direct acting relief valves with a cushion sleeve. Supply oil is sensed on the end of poppet of one relief valve. Oil also pushes the sleeve up on the other relief valve to help keep its poppet closed.

During relief operation oil pressure overcomes spring force pushing the poppet off its seat. Pressure oil is relieved from the passage that is pressurized to the passage that is at return pressure bypassing the motor.

CYLINDER OPERATION



T109208

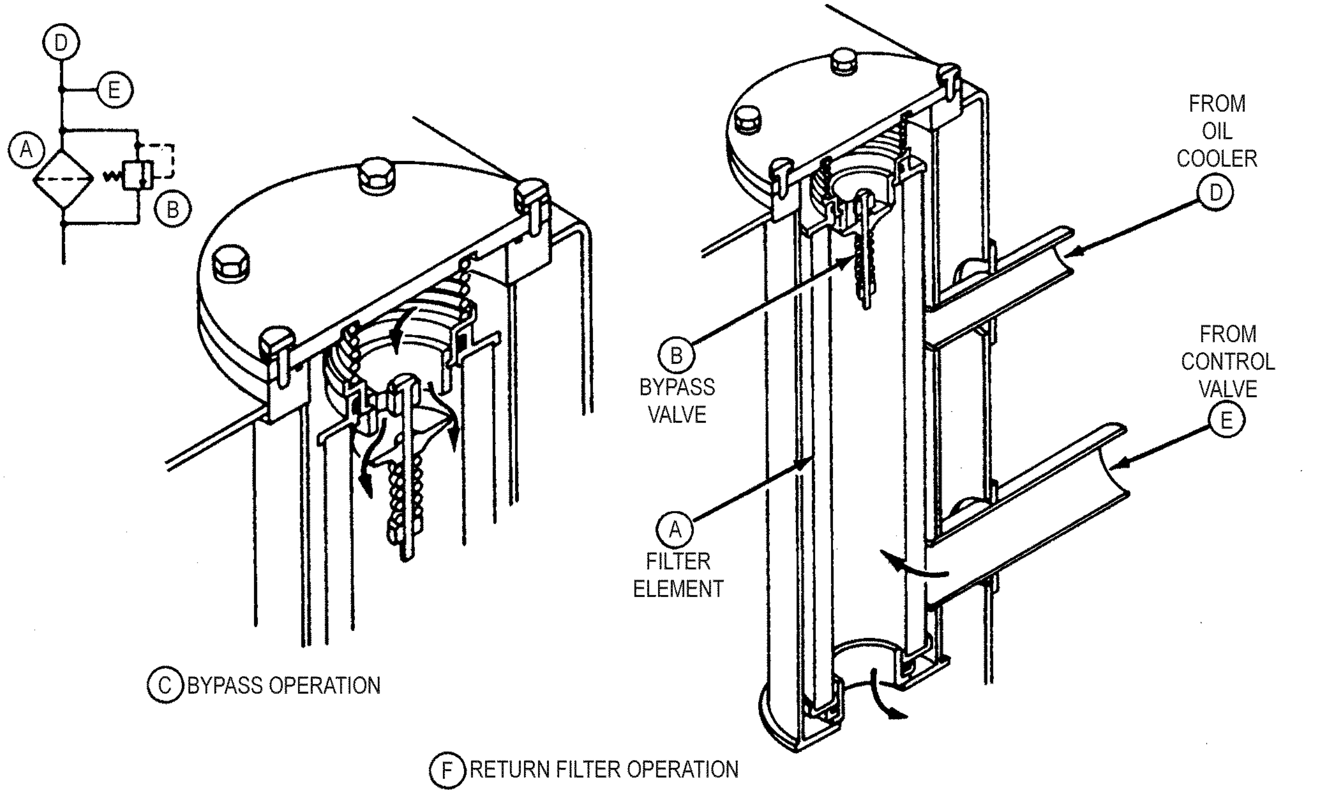
R BUCKET CYLINDER

The boom, arm, and bucket cylinders are similar in design. The bucket cylinder (R) is illustrated. The rod guide (Q) is fastened to the cylinder barrel with cap screws and is fitted with a wear guide (F) held in place by a snap ring (G). A buffer ring (E), U-cup seal (D), backup ring (C), and wiper seal (B) are used in the rod guide. A snap ring (A) is used to help hold wiper seal in place. The U-cup seal (D) is protected against high pressure by the buffer ring (E) and stops the small amount of oil which may pass by the buffer ring.

The piston (H) is a slip fit on the cylinder rod (P) and is retained with a nut (M). A set screw (L) prevents loosening of the nut. The piston is fitted with a cap seal (K), wear rings (J), and buffer rings (I).

Boom, bucket and arm cylinders have a cushion (N) in front of the piston to provide cushioning action in cylinder extension. As the cylinder nears the end of stroke the cushion enters a bore in the rod guide. The remaining return oil ahead of piston must flow through a small clearance between the cushion and rod guide. Only the arm cylinder is cushioned in retraction. The end of the rod enters a bore in the head end of the cylinder. The remaining return oil ahead of the piston and nut must flow through this small clearance as the cylinder bottoms out in this direction.

RETURN FILTER OPERATION



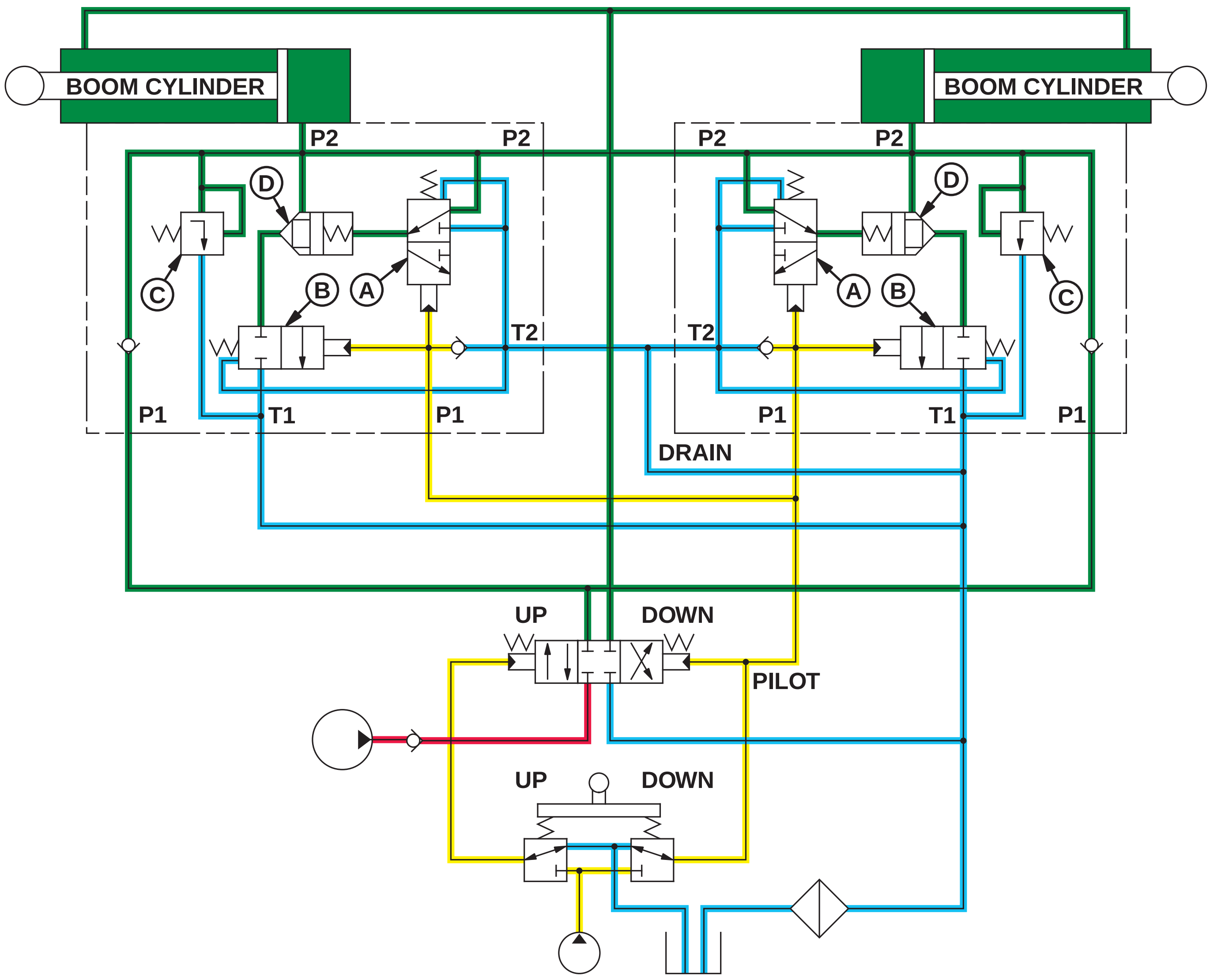
T101917

The filter element (A) is located in a chamber inside the hydraulic oil tank. O-rings are used at each end of the filter element to prevent leakage. A spring holds the filter element on its seat.

Return oil from the oil cooler (D) and the control valve (E) flow through the filter element from the outside to the center. Filtered oil flows out the bottom of filter into the hydraulic oil tank.

A bypass valve (B) is located at the top of the filter. The valve opens to protect the filter element against pressure surges in the return circuit and allows a path for return oil if the filter element becomes plugged. During bypass operation, oil flows into the chamber faster than it can flow through the filter element causing the pressure to increase. The higher pressure forces the bypass valve open allowing oil to flow down the center of the filter element and into the hydraulic oil tank. The bypass valve closes when the pressure decreases below the pressure setting of the bypass valve.

BOOM CYLINDER CONTROLLED LOAD LOWERING VALVE OPERATION



Ⓐ PILOT VALVE
Ⓑ METERING VALVE
Ⓒ CIRCUIT RELIEF VALVE
Ⓓ POPPET VALVE

🟥 Ⓔ SUPPLY OIL
🟩 Ⓕ TRAPPED OIL
🟦 Ⓖ RETURN OIL
🟨 Ⓗ PILOT OIL

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T120994

Ⓘ BOOM CYLINDER CONTROLLED LOAD LOWERING VALVE

Continued on next page

Boom cylinder controlled load lowering valves are used in the boom circuit. The function of the boom cylinder controlled load lowering valve is to prevent the boom from falling by maintaining pressure in the circuit in case of a rupture.

Pressure oil from head end of the boom cylinder flows through pilot valve (1). The oil flows to the spring end of poppet valve (2), closing the passage of oil from the boom cylinder to sump. In the down position, pilot oil moves pilot valve (1) against spring force closing off oil flow from the boom cylinder to spring end of poppet valve (2). Oil flowing from the boom cylinder to the plunger side of poppet valve (2) overcomes the spring force and allows oil to flow through valve (3) and back to sump. Valve (3) is metered open from pilot pressure applied by pilot valve (1).

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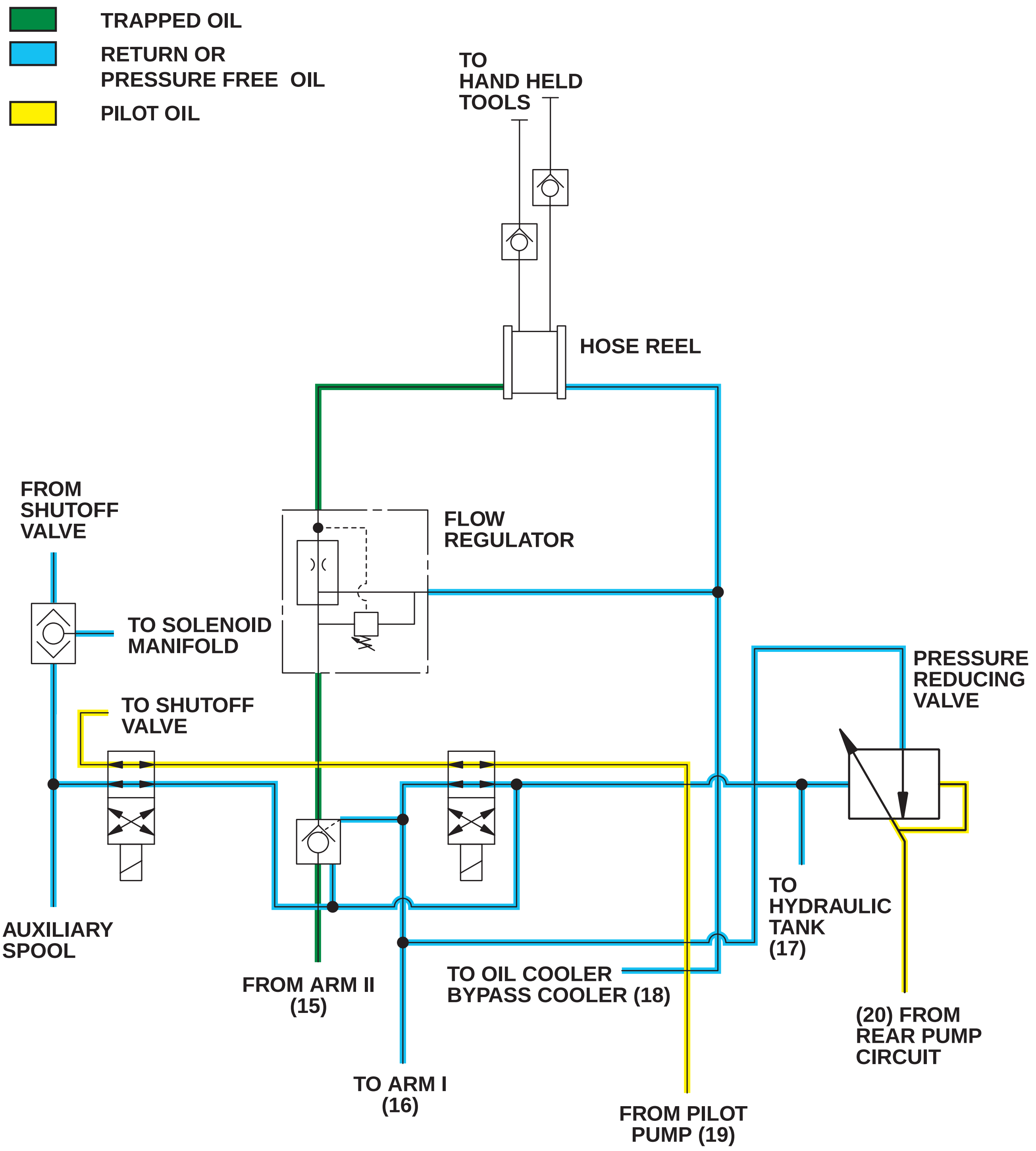
AUXILIARY HYDRAULICS OPERATION



T121560

T121560 –19–11OCT99

Continued on next page

The auxiliary hydraulic circuit is used to power the hydraulic clamp on the model (250LCR), the rock drill attachment on the model (250LCRD and the hose reel on both models. The auxiliary lines use screw-together couplers to attach the attachment hoses. The couplers can be connected under pressure.

The hydraulic clamp requires two-way hydraulic flow. A foot pedal located in the cab is used to control the two-way movement of the hydraulic clamp by varying the foot pedal either up or down. The foot pedal auxiliary pilot controller is connected directly to both ends of the auxiliary spool. The auxiliary spool controls the amount of and direction of pilot oil to the auxiliary spool, which in turn controls the oil flow and the clamp cylinder.

The rock drill (Type II machine) requires flow in only one direction. A switch located on the control panel inside the cab activates a solenoid valve which directs pilot pressure to the top of the main auxiliary spool. This shifts the spool to direct pressure oil to the attachment plumbing. The return circuit is a low pressure only circuit and returns directly to the return line just before it enters the reservoir. The rock drill return oil does not go through the oil cooler circuit.

The hydraulics for the hose reel is activated by a micro switch located behind the cab. Turning the micro switch to the ON position will energize a solenoid and allow pilot oil to flow to the check valve and then to the flow regulator. The flow regulator is located next to the micro switch and contains a lever so that the operator can control the amount of oil sent to the hose reel. At the same time, oil is flowing through the pressure reducing valve to deswash the front pump so it will disable the main valves (Arm, Boom, Proper, and Bucket) by not providing oil flow to them.

The system also controls the flow volume of oil to the rock drill, hydraulic clamp and hose reel by reducing the pump regulation pressure with a pressure reducing valve. This controls the stoke of the pump to provide only the amount of oil needed by the attachments.

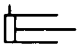
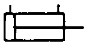
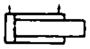
HYDRAULIC SYSTEM CIRCUIT SYMBOLS

These are ISO and ANSI standard hydraulic symbols for use in reading circuit diagrams.

Pumps

HYDRAULIC PUMP FIXED DISPLACEMENT UNIDIRECTIONAL	
VARIABLE DISPLACEMENT UNIDIRECTIONAL	

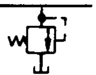
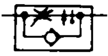
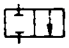
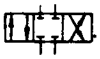
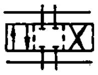
Motors and Cylinders

HYDRAULIC MOTOR FIXED DISPLACEMENT UNIDIRECTIONAL	
VARIABLE DISPLACEMENT UNIDIRECTIONAL	
CYLINDER SINGLE ACTING	
CYLINDER DOUBLE ACTING	
SINGLE END ROD	
DOUBLE END ROD	
ADJUSTABLE CUSHION ADVANCE ONLY	
DIFFERENTIAL PISTON	

Miscellaneous Units

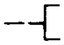
ELECTRIC MOTOR	
ACCUMULATOR, SPRING LOADED	
ACCUMULATOR, GAS CHARGED	
HEATER	
COOLER	
TEMPERATURE CONTROLLER	
FILTER STRAINER	
PRESSURE SWITCH	
PRESSURE INDICATOR	
TEMPERATURE INDICATOR	
DIRECTION OF SHAFT ROTATION ASSUME ARROW ON NEAR SIDE OF SHAFT.	

Valves

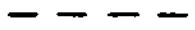
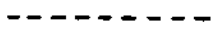
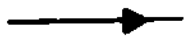
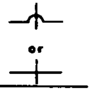
CHECK	
ON-OFF (MANUAL SHUT-OFF)	
PRESSURE RELIEF	
PRESSURE REDUCING	
FLOW CONTROL ADJUSTABLE - NON-COMPENSATED	
FLOW CONTROL ADJUSTABLE (TEMPERATURE AND PRESSURE COMPENSATED)	
TWO POSITION TWO CONNECTION	
TWO POSITION THREE CONNECTION	
TWO POSITION FOUR CONNECTION	
THREE POSITION FOUR CONNECTION	
TWO POSITION IN TRANSITION	
VALVES CAPABLE OF INFINITE POSITIONING (HORIZONTAL BARS INDICATE INFINITE POSITIONS ABILITY)	

Methods of Operation

SPRING	
MANUAL	
PUSH BUTTON	
PUSH-PULL LEVER	
PEDAL OR TREADLE	
MECHANICAL	
DETENT	

PRESSURE COMPENSATED	
SOLENOID, SINGLE WINDING	
REVERSING MOTOR	
PILOT PRESSURE REMOTE SUPPLY	
INTERNAL SUPPLY	

Lines

LINE, WORKING (MAIN)	
LINE, PILOT (FOR CONTROL)	
LINE, LIQUID DRAIN	
FLOW, DIRECTION OF HYDRAULIC	
PNEUMATIC	
LINES CROSSING	
LINES JOINING	
LINE WITH FIXED RESTRICTION	
LINE, FLEXIBLE	
STATION, TESTING, MEASUREMENT OR POWER TAKE-OFF	
TEMPERATURE CAUSE OR EFFECT	
RESERVOIR VENTED	
PRESSURIZED	
LINE, TO RESERVOIR ABOVE FLUID LEVEL	
BELOW FLUID LEVEL	

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FOLDOUT PAGES 6-87 THRU 6-89 ARE AT REAR OF MANUAL

Group 15
Diagnostic Information

DIAGNOSTIC PROCEDURE

Follow the six basic steps below to carry out troubleshooting efficiently.

1. Know the system.

   Study the machine technical manual. Understand the system and circuits. Use schematics, component location drawings, and theory of operation for each circuit and circuit components to better understand how the system, circuits and components work.

2. Ask the operator.

   What type of work was the machine doing when the trouble was noticed?

   Did the trouble start suddenly or has it been getting worse?

   Did the machine have any previous problems? If so, which parts were repaired?

3. Inspect the machine.

   Check all daily maintenance points. (See the operators manual. Check batteries, fuses, fusible link, and electrical connections.

4. Perform Operational Checkout.

   Check all systems and functions on the machine. Use the helpful diagnostic information in the checkout to pinpoint the possible cause of the problem.

5. Preform troubleshooting.

   Connect the laptop computer with excavator diagnostic software, if available. The self-diagnosing function lists any fault codes and gives corrective action information.

   Before starting any troubleshooting first check battery voltage, fusible link, and fuses.

   Go to test groups to check pressures and voltages. Make sure adjustment are correct.

6. Trace a cause.

   Before reaching a conclusion, check the most probable and simplest to verify. Use the flow charts and symptom, problem, solution charts to help identify probable problem components.

   Make a plan for appropriate repair to avoid other malfunctions.

TX,15,GG2234 –19–25APR97–1/1

DIAGNOSE ELECTRONIC AND CONTROL VALVE COMPONENT MALFUNCTIONS

	Engine Control Motor (EC Motor)	**Engine Control Sensor (EC Sensor)**	**Engine rpm Dial**
Operational Function	Move fuel injection pump lever.	Senses position of EC motor	Signal to EC motor to set target engine speed.
Control Problem	Fuel injection pump lever does not move	Loss of EC motor position sensing.	Speed does not change when dial is turned.
Machine Symptoms	Turning engine rpm dial does not increase or decrease engine speed.	Engine speeds slower than speed selected by engine rpm dial and E mode switch. Cannot control speed.	Speed is held at 1600 rpm. (Auto-idle function operates and engine stops by turning key switch off.)
Laptop Computer with Excavator Diagnostic Software Self-Diagnostic Functions	—	01 Fault code is displayed	07 Fault code is displayed.
Laptop Computer with Excavator Diagnostic Software Monitoring Function	—	Monitor No. 2, EC angle. Typical voltage for slow idle is 2.5 volts.	Monitor No. 13, Target Engine Speed.
Harness Check	Install JT07065 Test Harness. Check for control signal.	Install JT07066 Test Harness. Typical voltage for slow idle is 2.5 volts.	—
Note	Engine stopped by fuel shut-off solenoid. If solenoid fails, engine turns over but does not start.	If EC sensor has failed, engine learning control does not work.	—
Description of Operation	See Engine Speed Control System Operation in Group 9010-05.	See Engine Speed Learning Control Circuit Operation in Group 9010-05.	See Engine RPM Dial Speed Control Circuit Operation in Group 9010-05.

Continued on next page

	Pump Control Pressure Sensor	**Pump Pressure Sensor**	**Engine Speed Sensor (N Sensor)**
Operational Function	Senses pump control valve pressure in control valve to control propel motor speed change	Senses front and rear pump delivery pressure.	Senses actual engine speed for the speed sensing system.
Control Problems	No sensor output signal. No control signal to propel speed change solenoid valve.	Loss of propel speed control and HP (high power) mode.	Speed sensing system does not function.
Machine Symptoms	Propel motor operates at slow speed when propel speed switch is turned to fast speed.	Propel speed does not increase when propel speed switch in fast speed (rabbit). HP mode does not work.	Does not affect machine operation except speed sensing.
Laptop Computer with Excavator Diagnostic Software Self-Diagnostic Functions	04 and 05 Fault codes are displayed.	02 and 03 Fault codes are displayed.	—
Laptop Computer with Excavator Diagnostic Software Monitoring Function	Monitor No. 1 and 6, Front and rear pump control pressure.	—	Monitor No. 14, Actual engine speed.
Harness Check	—	—	
Notes	At slow idle with functions in neutral typical pressure is 1725—1930 kPa (17—19 bar) (250—280 psi). A lower pressure may be an open circuit. A higher pressure may be a short circuit.	During combined operation, arm speed is slow if malfunction is at sensor for rear pump.	—
Description of Operation	See Propel Motor Speed Change Circuit Operation in Group 9025-05.	See Propel Motor Speed Change Circuit Operation in Group 9025-05 or HP (High Power) Mode Speed Control Circuit Operation in Group 9010-05.	—

Continued on next page

	Power Boost Solenoid Valve (SG)	**Speed Sensing Solenoid Valve (SD)**	**Arm Regenerative Solenoid Valve (SC)**
Operational Function	Sends a pilot pressure signal to temporary increase system relief valve pressure setting.	Sends a pilot pressure signal to load piston in pump regulators to reduce pump flow.	Sends a pilot pressure signal to shift the arm regenerative valve.
Control Problems	No pressure signal sent to system relief valve. System relief valve pressure setting does not increase.	No pressure signal sent to load piston in pump regulators.	No pressure signal sent to shift arm regenerative valve.
Machine Symptoms	Digging or lifting force does not increase.	Torque required to drive pumps exceed engine output power. Engine speed can decrease below rated speed.	During arm in operation, there is arm cylinder cavitation and controllability becomes less.
Laptop Computer with Excavator Diagnostic Software Self-Diagnostic Functions	—	—	—
Laptop Computer with Excavator Diagnostic Software Monitoring Function	Monitor No. 12, Power boost control pressure.	Monitor No. 11, Speed sense control pressure.	Monitor No. 9, Arm regenerative control pressure.
Harness Check	Install JT07062 Test Harness. Check that indicator light is on.	Install JT07062 Test Harness. Check that indicator light is on.	Install JT07062 Test Harness. Check that indicator light is on.
Notes	If indicator light is off, check wiring harness.	If indicator light is off, check wiring harness.	If indicator light is off, check wiring harness.
Description of Operation	See Power Boost Control Circuit Operation in Group 9025-25.	See Engine Speed Sensing Control Circuit Operation in Group 9025-25.	See Arm Regenerative Valve Operation in Group 9025-05.

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TX,15,GG2238 –19–13AUG98–3/10

	Propel Speed Change Solenoid Valve (SI)	**Propel Pressure Switch**	**Dig Pressure Switch**
Operational Function	Sends a pilot pressure signal to shift speed selector valve spool in propel motors.	Senses when propel function is actuated.	Senses when a dig function is actuated.
Control Problems	No pressure signal sent to shift speed selector valve spool.	No electrical signal sent to engine and pump controller.	No electrical signal sent to engine and pump controller.
Machine Symptoms	Travel speed does not increase when propel speed switch is turned to fast speed (rabbit).	Engine speed does not increase from auto-idle speed when propel function actuated. Propel speed does not increases with propel speed switch in fast speed (rabbit). Travel alarm does not sound.	Engine speed does not increase from auto-idle speed when a dig function actuated.
Laptop Computer with Excavator Diagnostic Software Self-Diagnostic Functions	—	—	—
Laptop Computer with Excavator Diagnostic Software Monitoring Function	Monitor No. 10, Propel motor control pressure.	Monitor No. 20, Pressure switch.	Monitor No. 20, Pressure switch.
Harness Check	Install JT07062 Test Harness. Check that indicator light in on.	—	—
Notes	If indicator light is off, check wiring harness. Also check switches and sensors in propel motor speed change circuit.	Located at the front of right control valve.	Located at the front of left control valve.
Description of Operation	See Propel Motor Speed Change Circuit Operation in Group 9025-05.	See Propel Motor Speed Change Circuit Operation in Group 9025-05 or Auto-Idle Mode Speed Control Circuit Operation in Group 9010-05.	See Auto-Idle Mode Speed Control Circuit Operation in Group 9010-05.

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	Boom Up Pressure Switch	**Arm In Pressure Sensor**	**Learning Switch**
Operational Function	Senses boom up pilot pressure signal.	Senses arm in pilot pressure signal.	To start engine speed learning function.
Control Problems	No electrical signal sent to engine and pump controller.	No electrical signal sent to engine and pump controller.	Engine speed learning function does not operate.
Machine Symptoms	No regenerative function during boom up and arm in.	HP (high power) mode does not function. Arm speed slow when leveling.	For an open circuit, engine speed control system operates normally. Engine speed learning control cannot be actuated. For a short circuit, learning control is actuated when key switch is turned ON.
Laptop Computer with Excavator Diagnostic Software Self-Diagnostic Functions	—	06 Service Code is displayed	—
Laptop Computer with Excavator Diagnostic Software Monitoring Function	Monitor No. 20, Pressure switch.	Monitor No. 5, Arm Roll-In Pilot Pressure.	Monitor No. 28, Engine learning control.
Harness Check	—	—	—
Notes	Switch needed for arm regenerative operation.	Sensor needed for HP mode and arm regenerative operation.	—
Description of Operation	See Arm Regenerative Valve Operation in Group 9025-05.	See Arm Regenerative Valve Operation in Group 9025-05 and HP (High Power) Mode Speed Control Circuit Operation in Group 9010-05.	See Engine Speed Learning Control Circuit Operation in Group 9010-05.

Continued on next page

	Power Boost Switch	**HP (High Power) Mode Switch**	**E (Economy) Mode Switch**
Operational Function	To actuate the power boost function.	To actuate the HP mode function.	To actuate the E mode function
Control Problems	For open circuit, no electrical signal to engine and pump controller. For short circuit, operates for 8 seconds when key switch turned on, but then becomes inoperative.	No electrical signal to engine and pump controller. For short circuit, electrical signal to engine and pump controller at all times.	For open circuit, no electrical signal to engine and pump controller. For short circuit, electrical signal to engine and pump controller at all times.
Machine Symptoms	Digging or lifting force does not increase.	For open circuit, engine speed does not increase when hydraulic pressure increases to specified pressure. For short circuit, engine speed increases even with switch off (up).	For open circuit, engine speed does not decrease from fast idle. For short circuit, engine speed does not increase to fast idle.
Laptop Computer with Excavator Diagnostic Software Self-Diagnostic Functions	—	—	—
Laptop Computer with Excavator Diagnostic Software Monitoring Function	Monitor No. 25, Power boost switch	Monitor No. 24, HP mode switch.	Monitor No. 22, E mode switch.
Harness Check	—	—	—
Notes	Power boost function operates for 8 seconds after switch is pushed.	HP indicator light on when switch is on (down).	E indicator light on when switch is on (down).
Description of Operation	See Power Boost Control Circuit Operation in Group 9025-25.	See HP (High Power) Mode Speed Circuit Operation in Group 9010-05.	See E (Economy) Mode Speed Control Circuit Operation in Group 9010-05.

Continued on next page

Diagnostic Information

	Propel Speed Switch	**Engine and Pump Controller (EPC)**	**Front and Rear Pump Control Valve**
Operational Function	To change propel speed.	To control engine speed, pump and valve operations.	To send a regulated pilot pressure signal to pump regulators in responds to the flow rate through neutral passages in control valve.
Control Problems	No electrical signal sent to engine and pump controller.	Problems may differ depending on the malfunction.	Pressure signal to regulator does not increase when a function is actuated. Pump stays at minimum flow.
Machine Symptoms	For open circuit, propel speed stays at slow speed when switch is turned to fast speed (rabbit).	Problems listed indicate malfunction in EPC. With key switch on, EC motor does not go to start position; engine starts and run at slow idle. Engine speed does not change. Pump stays at minimum, all functions are slow.	For rear pump control valve: left propel cycle time slow, swing also slow; cycle time for bucket, boom or arm almost normal. For front pump control valve: bucket cycle time very slow, boom not raised when leveling, right propel cycle time slow; cycle time for boom, arm, or swing almost normal.
Laptop Computer with Excavator Diagnostic Software Self-Diagnostic Functions	—	—	—
Laptop Computer with Excavator Diagnostic Software Monitoring Function	Monitor No. 26, Propel speed switch.	—	Monitor No. 1, Front pump control pressure and No. 6, Rear pump control pressure.
Harness Check	—	—	—
Notes	Check switches and sensors in propel speed control circuit.	Check fuses before replacing EPC.	—
Description of Operation	See Propel Motor Speed Change Circuit Operation in Group 9025-05.	See Engine and Pump Controller Circuit Theory of Operation in Group 9015-15.	See Pump Control Valve Operation in Group 9025-05.

Continued on next page

	Flow Combiner Valve	**Arm I Power Passage Check Valve and Restriction Orifice**	**Arm I Neutral Passage Check Valve and Restriction Orifice**
Operational Function	To supply oil to left and right propel spools during combined operation of dig and propel functions.	—	—
Control Problems	Sticking or stuck spool. Oil is insufficient or not supplied to left propel spool.	Oil from left control valve power passage insufficient or not supplied to arm I spool.	Oil from right control valve neutral passage insufficient or not supplied to arm I spool.
Machine Symptoms	While traveling straight, machine mistracks when swing is actuated.	Arm speed slow when leveling.	When check valve is stuck closed or orifice clogged, arm speed is slow when leveling
Laptop Computer with Excavator Diagnostic Software Self-Diagnostic Functions	—	—	—
Laptop Computer with Excavator Diagnostic Software Monitoring Function	—	—	—
Harness Check	—	—	—
Notes	—	—	—
Description of Operation	See Flow Combiner Valve Operation in Group 9025-05.	See Control Valve Circuit Schematic in Group 9025-05.	See Control Valve Circuit Schematic in Group 9025-05.

Continued on next page

	Arm Regenerative Valve	**Propel Flow Control Valve**	**Propel-Boom Down Selector Valve**
Operational Function	To route oil from rod end to head end of cylinder during arm in when shifted by arm regenerative solenoid valve.	To reduce shock load created by going from propel operation to combined operation of propel and dig by gradually restricting oil flow from power passage.	To ensure boom down force during combined operation of propel and boom down.
Control Problems	No pressure signal from arm regenerative solenoid valve to shift arm regenerative valve spool. Valve spool is sticking or stuck.	Oil flow not restricted because spool is stuck or no pressure signal to shift propel flow control valve spool.	Boom II spool not shifted during combined operation of propel and boom down. Boom II spool is shifted during just boom down operation.
Machine Symptoms	During arm in, there is arm cylinder cavitation and controllability becomes less.	When stuck closed, shocks felt when changing from propel to combined propel and dig operation. When stuck open, no boom up when combined with propel down a slope or with bucket loading.	When stuck closed: boom down speed is fast, swing speed slow at full stroke during combined swing and boom down operation.
Laptop Computer with Excavator Diagnostic Software Self-Diagnostic Functions	—	—	—
Laptop Computer with Excavator Diagnostic Software Monitoring Function	—	—	—
Harness Check	—	—	—
Notes	—	—	—
Description of Operation	See Arm Regenerative Valve Operation in Group 9025-05.	See Propel Flow Control Valve Operation in Group 9025-05.	See Propel-Boom Down Selector Valve Operation in Group 9025-05.

Continued on next page

	Arm Reduced Leakage Valve	**Boom Reduced Leakage Valve**	**Boom Regenerative Valve**
Operational Function	To prevent arm in drift caused by leakage from the cylinder back through control valve.	To prevent boom down drift caused by leakage from the cylinders back through control valve.	To route return oil from head end to rod end of boom cylinder to prevent cavitation when lowering.
Control Problems	Sticking or stuck check valve or pilot valve. No pilot pressure signal to shift pilot spool.	Sticking or stuck check valve or pilot valve. No pilot pressure signal to shift pilot spool.	Sticking or stuck check valve.
Machine Symptoms	Arm drifts down. Arm in speed is slow or jerky if check valve sticking or does not open.	Boom drifts down. Boom down speed is slow or jerky if check valve sticking or does not open.	Boom lower speed becomes slow with check valve stuck closed. Cannot raise tracks off the ground using boom down with check valve stuck open.
Laptop Computer with Excavator Diagnostic Software Self-Diagnostic Functions	—	—	—
Laptop Computer with Excavator Diagnostic Software Monitoring Function	—	—	—
Harness Check	—	—	—
Notes	—	—	—
Description of Operation	See Boom and Arm Reduced Leakage Valve Operation in Group 9025-05.	See Boom and Arm Reduced Leakage Valve Operation in Group 9025-05.	See Boom Regenerative Valve Operation in Group 9025-05.

	Bucket Flow Control Valve
Operational Function	To restrict oil flow to bucket circuit in combined operation of bucket, arm in, and boom up to ensure oil flows to higher-loaded boom function to raise boom.
Control Problems	Pilot valves and poppet valve sticking or stuck.
Machine Symptoms	Bucket speed is slow if poppet valve is stuck closed. Boom is not raised in combined operation with poppet valve stuck open or pilot valves are stuck open keeping the poppet valve open.
Laptop Computer with Excavator Diagnostic Software Self-Diagnostic Functions	—
Laptop Computer with Excavator Diagnostic Software Monitoring Function	—
Harness Check	—
Notes	—
Description of Operation	See Bucket Flow Control Valve Operation in Group 9025-05.

TX,15,GG2238 –19–13AUG98–10/10

DIAGNOSE HYDRAULIC SYSTEM MALFUNCTIONS

NOTE: Diagnose malfunction charts are arranged from most probable and simplest to verify, to least likely and most difficult to verify.

Symptom	Problem	Solution
All Hydraulic Functions Slow	Low oil level	Check oil level in hydraulic oil tank.
	Cold hydraulic oil	Heat hydraulic oil.
	Oil viscosity too heavy	Use the recommended oil. (See General Information Section.)
	Slow engine speed	Check engine fast and slow idle stop adjustment at injection pump. Do Engine Control Motor and Sensor Adjustment and Engine Speed Learning Procedure. See Group 9010-20.
	Air leak in pump suction line	Check for air bubbles in oil. Tighten clamps, replace O-rings.
	Pilot circuit malfunction	See Diagnose Pilot Circuit Malfunctions. See Group 9025-15.
	Restricted pump suction screen	Clean pump suction screen. See Group 3360.
	Front and rear pump regulators	Adjust pump regulators. See Group 9025-20.
	Worn pumps	Check flow rate using propel cycle times. Do Hydraulic Pump Flow Test. See Group 9025-25.
	System relief valve setting too low or malfunctioning	Check system relief valve setting. See Group 9025-25. Inspect. See Group 3360.
	Circuit relief valve setting too low or malfunctioning	Check circuit relief valve setting. See Group 9025-25. Inspect. See Group 3360.

Continued on next page

Symptom	Problem	Solution
	Low pilot oil pressure	Check pilot pressure regulating valve. See Group 9025-25.
	Front and rear pump control valves	Check pressure. See Group 9025-25. Inspect. See Group 3360.
Hydraulic Oil Overheats	Low oil level	Check oil level in hydraulic oil tank.
	Plugged oil cooler	Test air flow through oil cooler.
	Oil viscosity too light	Use recommended oil. See General Information Section.
	Return filter plugged	Replace filter. See Group 3360.
	System relief valve malfunction	Test system relief valve. See Group 9025-25.
	Oil cooler bypass valve stuck open	Repair or replace. See Group 3360.
	Restriction valve stuck closed	Repair or replace. See Group 3360.
	Fan belt slipping	Check for worn belt. Check tension adjuster. See Remove and Install Fan Belt in Group 0510.
	Pump stuck at maximum displacement	Check flow rate using propel cycle times. Do hydraulic pump flow test. See Group 9025-25.
No Hydraulic Functions	Pilot shutoff lever in LOCK position (rearward)	Push shutoff lever to UNLOCK position (forward).
	No oil	Check oil level in hydraulic oil tank.
	Pump drive failure	Check pump drive coupling. See Group 3360.
	Restricted pump suction screen	Clean pump suction screen. See Group 3360.
Poor Combined Operation	Dig or propel pressure switch	Check pressure switches. Check wiring harness. See Group 9015-15. See harness test in Group 9025-25.

Continued on next page

Diagnostic Information

Symptom	Problem	Solution
	Engine and pump controller	Check engine and pump controller. See Group 9015-15.
	Pilot controller	Check pilot pressure at control valve. See Group 9025-25.
	Pilot pressure regulating valve	Check pilot pressure regulating valve pressure setting. See Group 9025-25.
	Check valves and flow control valves in control valve	Inspect valves. See Group 3360.

TX,15,GG2162 –19–13AUG98–3/3

DIAGNOSE PILOT CIRCUIT MALFUNCTIONS

NOTE: Diagnose malfunction charts are arranged from most probable and simplest to verify, to least likely and most difficult to verify.

Symptom	Problem	Solution
All Functions Cannot Be Operated	Pilot shutoff lever in LOCK position (rearward)	Push shutoff lever to UNLOCK position (forward).
	Pilot pressure regulating valve stuck open	Test pilot pressure regulating valve. See Group 9025-25. Inspect. See Group 3360.
	Pilot pump failure	Remove and inspect pilot pump. See Group 3360.
Function Does Not Stop When Control Lever Released	Control valve spool stuck	Manually move spool to check for sticking. See Group 3360.
	Pilot controller	Check for sticking spool. See Group 3360.
Some Functions Cannot Be Operated, All Others Are Normal	Pilot cap	Inspect for leakage at pilot cap. See Group 3360.
	Pilot controller or hoses to function that cannot be operated	Check pilot controller hoses or pilot controller. See Group 3360.
	Flow regulator valve	Check for stuck spools or check valves. See Group 3360.
	Control valve spool stuck.	Manually move spool to check for sticking. See Group 3360.
All Functions Slow	Pilot filter plugged	Replace pilot filter.
	Low pilot system pressure	Check pilot pressure regulating valve pressure setting. See Group 9025-25.
	Restriction in pilot shut-off valve	Check pilot shut-off lever position. See Group 9025-20.

Continued on next page

Diagnostic Information

Symptom	Problem	Solution
Function Moves In Opposite Direction	Pilot control hoses connected backwards	Check installation of pilot control hoses. See Group 9025-15.

TX,15,GG2163 –19–13AUG98–2/2

DIAGNOSE DIG CIRCUIT MALFUNCTIONS

NOTE: Diagnose malfunction charts are arranged from most probable and simplest to verify, to least likely and most difficult to verify.

Symptom	Problem	Solution
All Dig Functions Slow or No Power	Hydraulic system malfunction	See Diagnose Hydraulic System Malfunctions. See Group 9025-15.
	Pilot circuit malfunction	See Diagnose Pilot Circuit Malfunctions. See Group 9025-15.
	Front or rear pump regulator	Do Hydraulic Pump Regulator Adjustments. See Group 9025-25.
	System relief valve	Test system relief valve. See Group 9025-25.
	Front or rear pump control valve	Check pressure. See Group 9025-25. Inspect. See Group 3360.
	Hydraulic pumps	Check pumps using cycle time. Do Hydraulic Pump Flow Test. See Group 9025-25.
Some Dig Functions Slow (Not All)	Pilot circuit malfunction	See Diagnose Pilot Circuit Malfunctions. See Group 9025-15.
	Control valve leakage	Check dig functions for drift. See Group 9025-25.
	Cylinder leakage	Test cylinder for leakage. See Group 9025-25.
	Circuit relief valve	Test circuit relief valves. See Group 9025-25.
	Valve spool sticking	Manually move spool to check for sticking. See Group 3360.
	Front and rear pump control valves	Check pressure. See Group 9025-25. Inspect. See Group 3360.

Continued on next page

Diagnostic Information

Symptom	Problem	Solution
Load Drifts Down When Control Valve Is In Neutral Position	Cylinder leakage	Test cylinder for leakage. See Group 9025-25.
	Circuit relief valve	Test circuit relief valves. See Group 9025-25.
	Reduced leakage valve for boom down and arm in	Inspect reduced leakage valve. See Group 3360
	Boom manual lower screw loose	Tighten screw to specification. See Group 9025-25
	Control valve leakage	Inspect control valve. See Group 3360.
Load Falls When Control Valve Is Actuated To Raise Load With Engine Running At Slow Idle	Lift check valve leakage	Inspect lift check valve in control valve. See Group 3360.
Function Moves in Opposite Direction	Pilot control hoses connected backwards	Check installation of pilot control hoses. See Group 9025-15.

TX,9025,GG2668 –19–13AUG98–2/2

DIAGNOSE SWING CIRCUIT MALFUNCTIONS

NOTE: Diagnose malfunction charts are arranged from most probable and simplest to verify, to least likely and most difficult to verify.

Symptom	Problem	Solution
Swing Speed Slow In Both Directions	Low pilot system pressure	All other functions are slow. See Diagnose Pilot Circuit Malfunctions. See Group 9025-15.
	Crossover relief valve	Test crossover relief valve pressure. See Group 9025-25.
	Swing valve leakage	Inspect swing valve. See Group 3360.
	Swing motor leakage	Test swing motor for leakage. See Group 9025-25.
	Swing park brake	Check pilot pressure to swing brake release valve. See Group 9025-25.
	Worn rear pump	Check left track cycle time. It will be slow if rear pump is worn. See Group 9025-25.
Swing Speed Slow or Does Not Operate In One Direction	Pilot circuit malfunction	See Diagnose Pilot Circuit Malfunctions. See Group 9025-15.
	Swing make-up valve leakage	Inspect make-up valves. See Group 3360.
	Swing crossover relief valve malfunction	Test swing crossover relief valves. See Group 9025-25.
Upperstructure Drift With Swing Valve In Neutral	Swing park brake	Inspect swing park brake. See Group 3360.
	Swing crossover relief valve leakage	Test swing crossover relief valves. See Group 9025-25.
	Swing make-up check valve leakage	Inspect make-up valves. See Group 3360.

Continued on next page

Diagnostic Information

Symptom	Problem	Solution
	Swing motor leakage	Test swing motor for leakage. See Group 9025-25.
Swing Function Does Not Operate	Pilot circuit malfunction	See Diagnose Pilot Circuit Malfunctions. See Group 9025-15.
	Swing brake release valve malfunction	Inspect swing brake release valve. See Group 3360.
	Swing valve spool stuck	Manually move spool to check for sticking. See Group 3360.
	Mechanical failure of swing motor or gearbox	Disassemble components to determine cause of failure. See Groups 4350 and 4360.

TX,15,GG2165 –19–13AUG98–2/2

DIAGNOSE PROPEL SYSTEM MALFUNCTIONS

Symptom	Problem	Solution
Propel Park Brakes Do Not Apply	Pressure reducing valve stuck, oil not released from piston cavity	Remove valve and clean or replace. See Group 0260.
	Propel park brake	Remove and repair brake. See Group 0260.
Track Will Not Move In One Direction	Pilot Circuit malfunction	See Diagnose Pilot Circuit Malfunctions. See Group 9025-15.
	Propel crossover relief valve	Do Crossover Relief Valve Test and Adjustment. See Group 9020-25.
	Propel control valve spool stuck	Manually move spool to check for sticking. See Group 3360.
	Counterbalance valve spool stuck	Inspect counterbalance valve. See Group 0260.
	Shuttle valve in brake valve assembly not seating	Inspect shuttle valve. See Group 0260.
	Rotary manifold leakage	Inspect rotary manifold. See Group 0260.
Track Will Not Move In Either Direction	Pilot Circuit Malfunction	See Diagnose Pilot Circuit Malfunctions. See Group 9025-15.
	Crossover relief valve	Do Crossover Relief Valve Test and Adjustment. See Group 9025-25.
	Propel pilot controller	Inspect propel pilot controller. See Group 3360.
	Propel valve spool	Manually move spool to check for sticking. See Group 3360.
	Counterbalance valve spools stuck	Inspect counterbalance valve. See Group 0260.
	Mechanical failure of propel motor or gearbox	Disassemble components to determine cause of failure. See Groups 0250 and 0260.

Continued on next page

Diagnostic Information

Symptom	Problem	Solution
	Rotary manifold leakage	Inspect rotary manifold. See Group 0260.
Excavator Mistracks at All Speeds In Both Directions	Track sag adjustment	Adjust track sag. See Group 9020-20.
	Propel pilot controller malfunction	Inspect propel pilot controller. See Group 3360.
	Propel motor crossover relief valve malfunction	Do Crossover Relief Valve Test and Adjustment. See 9020-25.
	Brake valve shuttle valve or servo piston shuttle valve seat leakage.	Inspect check valve and seat. See Group 0260.
	Leakage in motor	Check tracking while descending a hill. If tracking is within specification when descending a hill, but not when on the level or going up hill, motor leakage is indicated. Do Propel Motor Leakage Test. See Group 9020-25.
	Rotary manifold leakage	Inspect rotary manifold. See Group 0260.
	Front and rear pump regulators	Do pump regulators adjustment. See Group 9025-25.
Slow Propel Speed or Low Power	Track sag adjustment	Adjust track sag. See Adjust Track Sag in Group 9020-20.
	Propel motor crossover relief valve	Do Crossover Relief Valve Test and Adjustment. See Group 9020-25.
	Propel brake not releasing	Inspect propel brake. See Group 0260.
	Propel motor	Do Propel Motor Operating Leakage Test. See Group 9020-25.
	Rotary manifold leakage	Inspect rotary manifold. See Group 0260.

Continued on next page

Diagnostic Information

Symptom	Problem	Solution
	Low pump flow	Check propel cycle times. Do Hydraulic Pump Flow Test. See Group 9025-25.
	Engine performance low	Test engine performance. See Group 9010-25.
Combined Propel and Dig Functions Slow or No Power	Flow combiner valve	Check for sticking or stuck valve spool. See Group 3360.
	Propel-boom down selector valve	Check for sticking or stuck valve spool. See Group 3360.
Propel Is “Jerky”	Track sag too tight or too loose	Adjust track sag. See Adjust Track Sag in Group 9020-20.
	No oil or low oil level in rollers	Fill with correct oil. See General Information Section.
	Brake valve shuttle valve or servo piston shuttle valve seat leakage.	Inspect shuttle valve seat. See Group 0260.
	Propel park brake leakage	Inspect propel park brake piston. See Group 0260.
	Mechanical failure in propel motor or gearbox	Inspect motor and gearbox. See Groups 0250 and 0260.
	Deformed track frame	See Undercarriage Appraisal Manual SP326. Repair or replace components.
Excavator Will Not Hold Back and Park Brakes Engage and Disengage When Traveling Down an Incline	Counterbalance valve spool stuck	Inspect counterbalance valve spool. See Group 0260.
Excavator Will Not Turn Smoothly In One Direction or Park Brake Grabs	Counterbalance valve spool stuck	Inspect counterbalance valve spool. See Group 0260.

TX,15,GG2235 –19–13AUG98–3/3

CONTROL LEVER PATTERN CONVERSION

To change your machine pilot control levers from the standard pattern to a John Deere pattern:

1. Lower bucket to the ground.

2. Turn key switch to OFF to stop engine.

CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. The hydraulic oil tank is pressurized. Loosen vent plug to release air pressure.

3. Loosen vent plug (K) to release air pressure from hydraulic oil tank.

4. Open door on storage compartment behind cab.

5. Remove cover above flow regulator valve.

NOTE: Do not use manufacturer's identification tags or markings on line ends to identify lines for this conversion procedure. The conversion must be done on the front (cab side) of flow regulator valve.

6. Switch hoses in an X pattern.

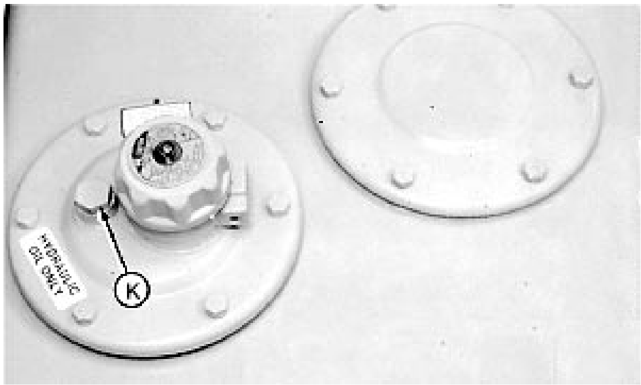
   Switch hose (A) with hose (C).

   Switch hose (B) with hose (D).

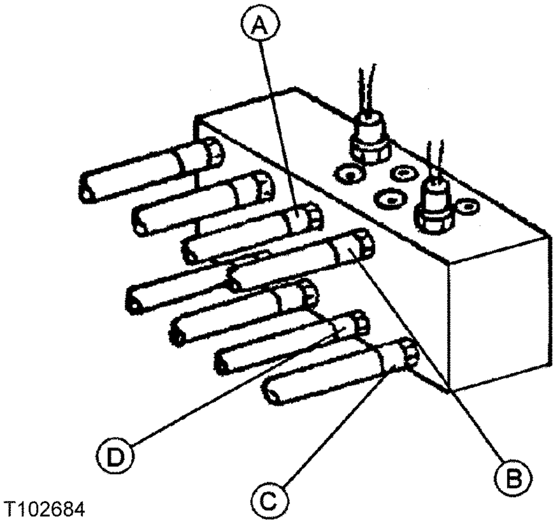
CAUTION: Prevent injury from unexpected control lever function. Install new decals on control consoles.

7. Install new black on yellow decals for John Deere pattern on control consoles near the base of control levers. The decals are enclosed in Operator's Manual package. Additional decals are available through parts.

   When changing back to the standard pattern, install new black on white decals.



T109340 –UN–29APR97



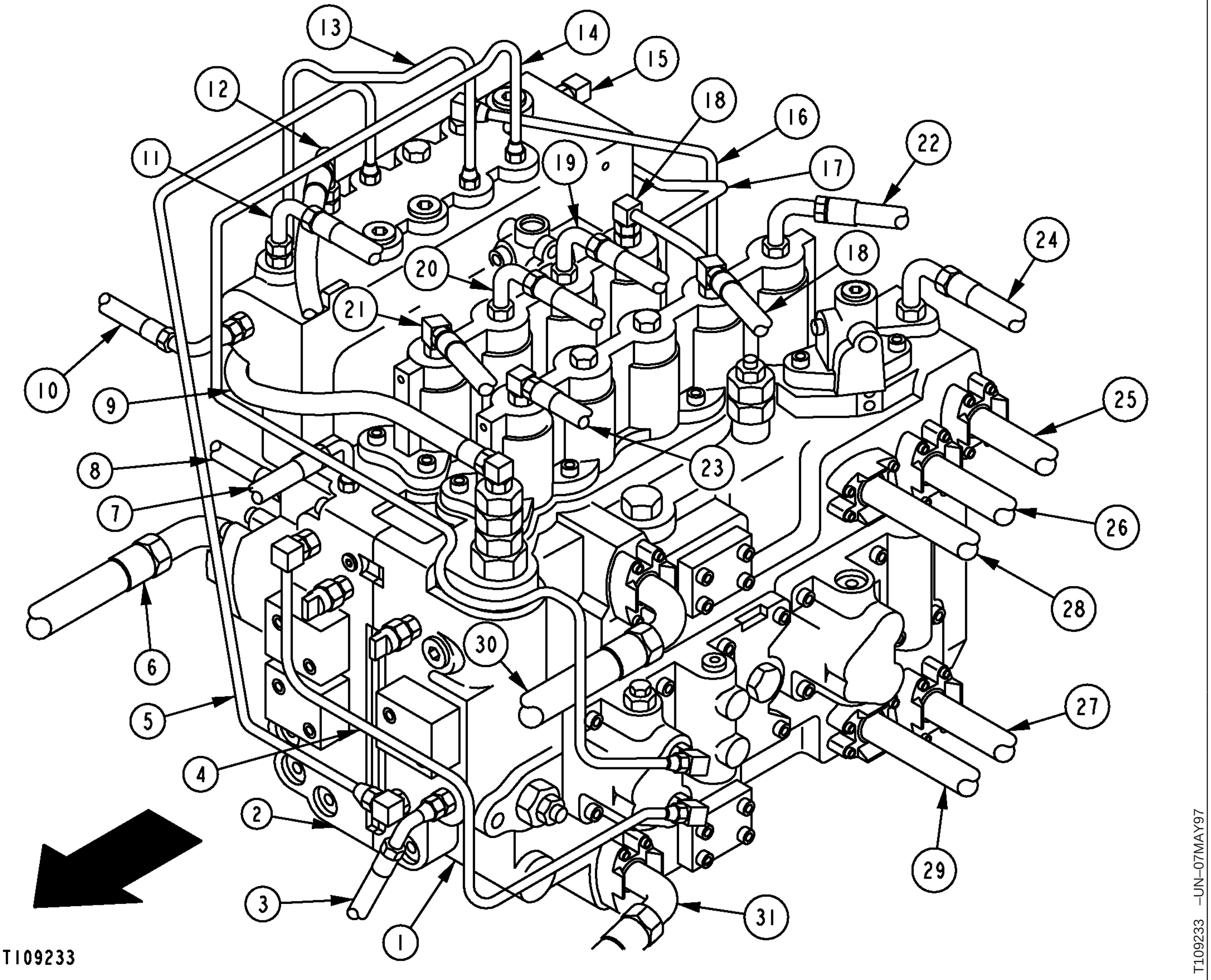
T102684 –UN–07AUG96

A—Hose
B—Hose
C—Hose
D—Hose
K—Vent Plug

9025
15
24

TX,15,GG2237 –19–10MAY97–1/1

CONTROL VALVE LINE IDENTIFICATION—LEFT FRONT



T109233 –UN–07MAY97

Left Front

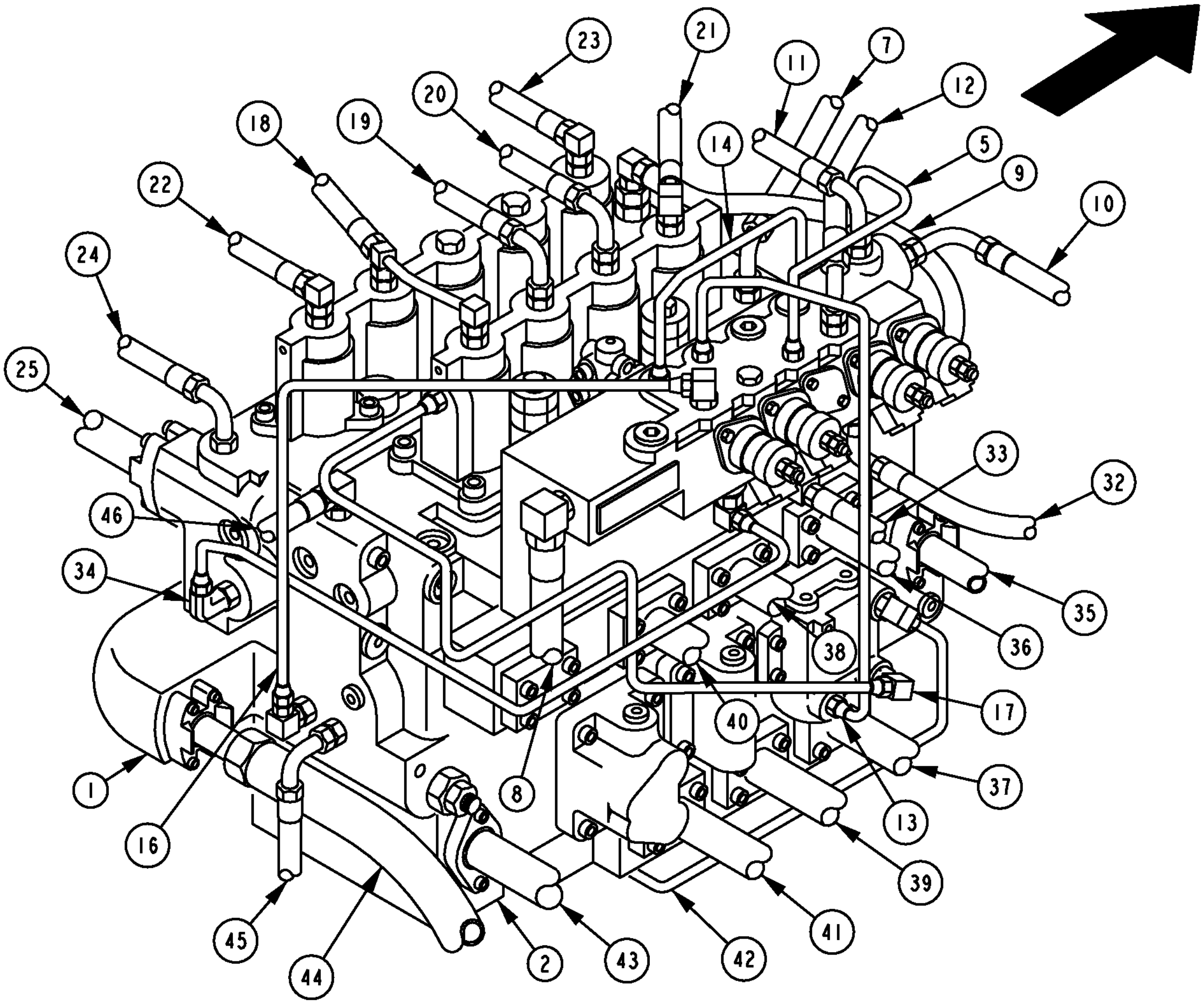
Continued on next page

TX,9025,GG2628 –19–20MAY98–1/2

1—Left Control Valve (5-Spool)
2—Right Control Valve (4-Spool)
3—To Rear Pump Control Valve Pressure Sensor and Rear Pump Regulator
4—Pilot Pressure Signal To Propel Flow Control Valve
5—To Rear Pump Control Valve
6—Inlet Flow From Front Pump
7—Pilot Pressure Signal To Swing Motor Park Brake Release Valve—Bottom Port
8—Pilot Pressure From Pilot Pressure Regulating Valve
9—Power Boost Solenoid Valve to System Relief Valve
10—Return to Hydraulic Tank
11—Return From Pilot Shut-Off Valve
12—Pilot Pressure To Swing Motor Park Brake Release Valve Top Port
13—Return From Bucket Flow Control Valve To Solenoid Valve Manifold
14—Return From Propel Flow Control Valve To Solenoid Valve Manifold
15—Pilot Pressure From Pilot Shut-Off Valve to Solenoid Valve Manifold
16—Pilot Pressure to Front Pump Control Valve
17—Arm In Pilot To Bucket Flow Control Valve—Front Bottom Port
18—Arm In Pilot From Left Pilot Controller—SAE Pattern
19—Boom Down Pilot From Right Pilot Controller—SAE Pattern
20—Bucket Load Pilot From Right Pilot Controller
21—Right Propel Reverse Pilot From Propel Pilot Controller
22—Swing Right Pilot From Left Pilot Controller
23—Left Propel Reverse Pilot From Propel Pilot Controller
24—To Swing Motor Make-Up Oil Port
25—To Hydraulic Oil Cooler
26—To Swing Motor Front Port—Left Swing
27—To Swing Motor Rear Port—Right Swing
28—To Arm Cylinder Rod End—Arm Out
29—To Arm Cylinder Head End—Arm In
30—Left Propel Forward To Rotary Manifold Left Front Port
31—Left Propel Reverse To Rotary Manifold Left Rear Port

TX,9025,GG2628 –19–20MAY98–2/2

CONTROL VALVE LINE IDENTIFICATION—RIGHT REAR



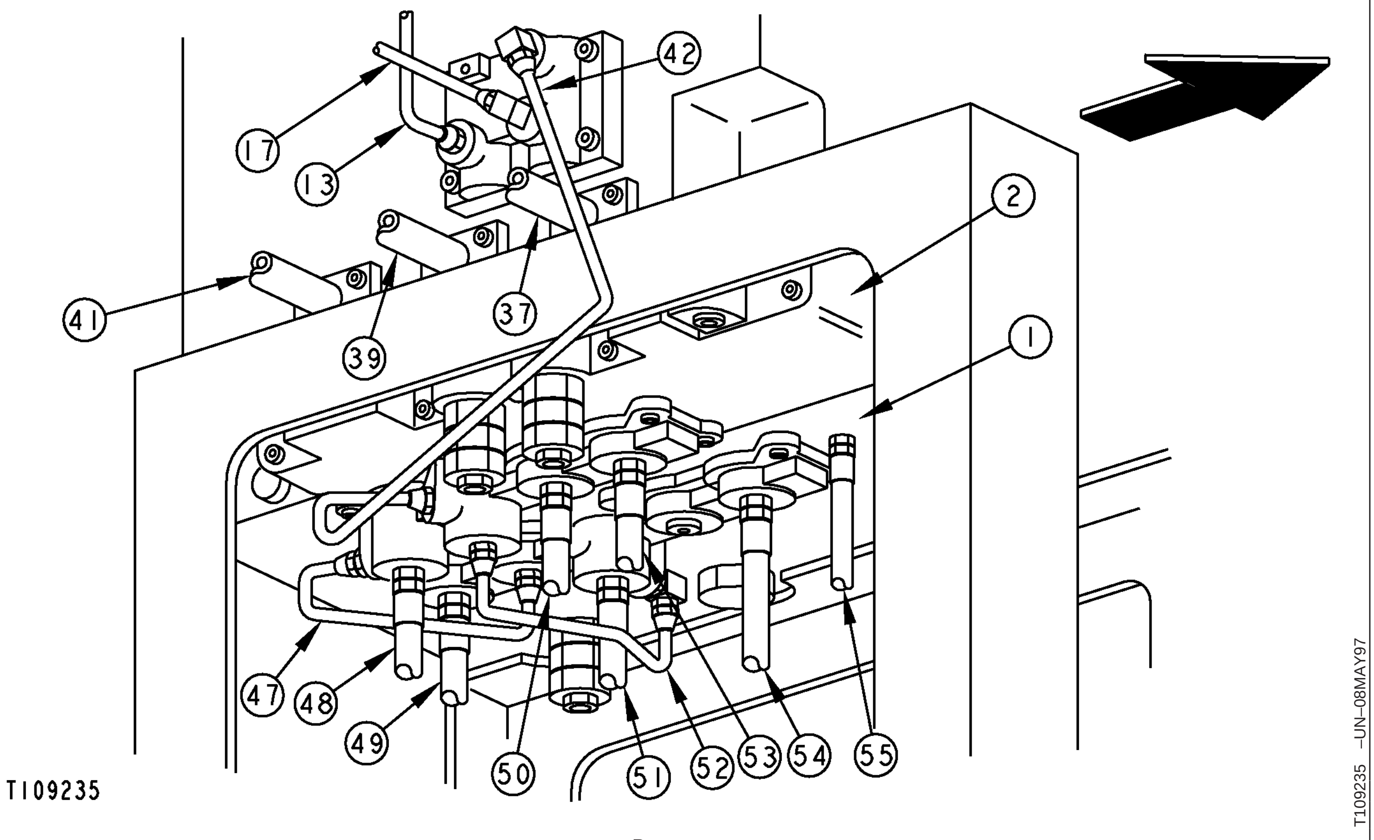
Right Rear

Continued on next page

1—Left Control Valve (5-Spool)
2—Right Control Valve (4-Spool)
5—To Rear Pump Control Valve
7—To Swing Motor Park Brake Release Valve—Bottom Port
9—Power Boost Solenoid Valve to System Relief Valve
10—Return to Hydraulic Tank
11—Return From Pilot Shut-Off Valve
12—Pilot Pressure Signal To Swing Motor Park Brake Release Valve—Top Port
13—Return From Bucket Flow Control Valve To Solenoid Valve Manifold
14—Return From Propel Flow Control Valve To Solenoid Valve Manifold
16—Pilot Pressure to Front Pump Control Valve
17—Arm In Pilot To Bucket Flow Control Valve—Front Bottom Port
18—Arm In Pilot From Left Pilot Controller—SAE Pattern
19—Boom Down Pilot From Right Pilot Controller—SAE Pattern
20—Bucket Curl Pilot From Right Pilot Controller
21—Right Propel Reverse Pilot From Propel Pilot Controller
22—Swing Right Pilot From Left Pilot Controller
23—Left Propel Reverse Pilot From Propel Pilot Controller
24—To Swing Motor Make-Up Oil Port
25—To Hydraulic Oil Cooler
32—To Propel Motor Speed Change Valve
33—Speed Sensing Solenoid Valve To Front and Rear Pump Regulator Speed Sensing Port
34—Arm Regenerative Solenoid Valve To Arm Regenerative Valve
35—Supply Oil From Front Pump
36—Right Propel Forward To Rotary Manifold Right Front Port
37—Right Propel Reverse To Rotary Manifold Right Rear Port
38—To Bucket Cylinder Rod End—Bucket Dump
39—To Bucket Cylinder Head End—Bucket Curl
40—To Boom Cylinder Head End—Boom Up
41—To Boom Cylinder Rod End—Boom Down
42—Pilot Pressure From Boom Up Pilot Cap To Bucket Flow Control Valve
43—Return To Hydraulic Oil Tank
44—Supply Oil From Rear Pump
45—To Front Pump Control Valve Pressure Sensor and Front Pump Regulator
46—Return From Front Pump Control Valve and Warm-Up Circuit To Hydraulic Oil Tank

TX,9025,GG2629 –19–08JUN98–2/2

CONTROL VALVE LINE IDENTIFICATION—BOTTOM

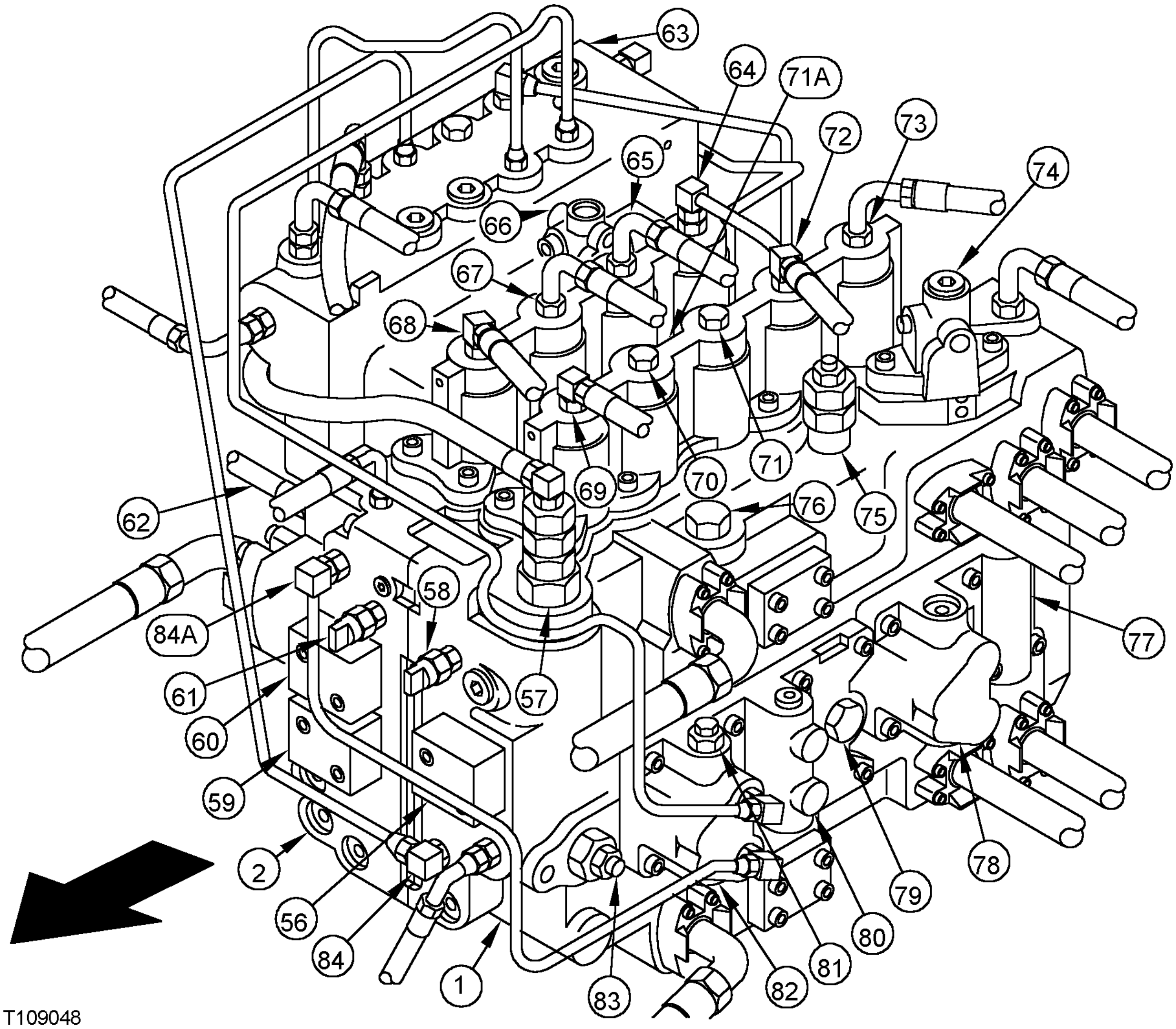


Bottom

13—Return From Bucket Flow Control Valve To Solenoid Valve Manifold
17—Arm In Pilot To Bucket Flow Control Valve—Front Bottom Port
37—Right Propel Reverse To Rotary Manifold Right Rear Port
39—To Bucket Cylinder Head End—Bucket Curl
41—To Boom Cylinder Rod End—Boom Down
42—Bucket Flow Control Valve Front Top Port To Right Side Boom Up Pilot Cap
47—Arm II To Arm I Pilot—Arm Out
48—Arm Out Pilot From Left Pilot Controller—SAE Pattern
49—Swing Left Pilot From Left Pilot Controller
50—Bucket Dump Pilot From Right Pilot Controller
51—Boom Up Pilot From Right Pilot Controller—SAE Pattern
52—Boom II To Boom I Pilot—Boom Up
53—Right Propel Forward Pilot From Propel Pilot Controller
54—Left Propel Forward Pilot From Propel Pilot Controller
55—To Hydraulic Oil Tank—Return From Rear Pump Control Valve

TX,9025,GG2630 –19–21APR97–1/1

CONTROL VALVE COMPONENT IDENTIFICATION—LEFT FRONT



Left Front

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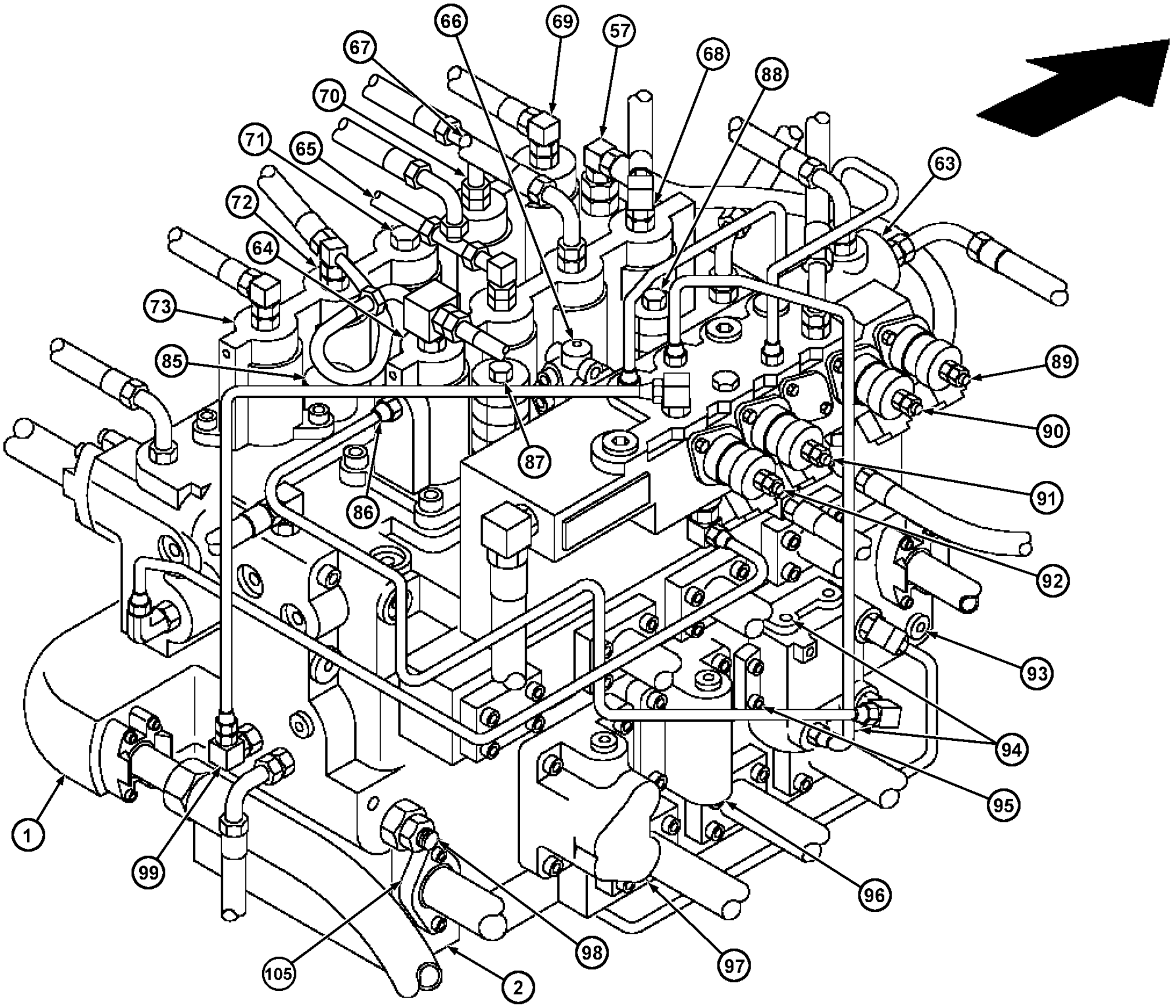
TX,9025,GG2625 –19–20MAY98–1/2

1—Left Control Valve (5-Spool)
2—Right Control Valve (4-Spool)
56—System Relief Valve Isolation Check Valve
57—System Relief Valve and Power Boost
58—Dig Pressure Switch
59—Flow Combiner Valve Circuit Check Valve
60—System Relief Valve Isolation Check Valve
61—Propel Pressure Switch
62—Pilot Pressure Inlet Filter
63—Solenoid Valve Manifold
64—Arm II Valve
65—Boom I Valve and Boom Regenerative Valve
66—Boom Reduced Leakage Valve
67—Bucket Valve
68—Right Propel Valve
69—Left Propel Valve
70—Auxiliary Valve
71—Boom II Valve
71A—Propel-Boom Down Selector Valve
72—Arm I Valve
73—Swing Valve
74—Arm Reduced Leakage Valve
75—Arm Out Circuit Relief and Anti-Cavitation Valve
76—Plug
77—Swing Lift Check Valve
78—Arm I Power and Neutral Passage Check Valves (Lift Checks), and Restriction Orifice
79—Boom II Power Passage Check Valve (Lift Check)
80—Auxiliary Power Passage Check Valve (Lift Check)
81—Propel Flow Control Valve
82—Propel Power and Neutral Passage Check Valves (Lift Checks)
83—Rear Pump Control Valve
84—Filter and Orifice for Pilot Pressure to Rear Pump Control Valve
84A—Check Valve and Orifice for Propel Flow Control Valve

TX,9025,GG2625 –19–20MAY98–2/2

CONTROL VALVE COMPONENT IDENTIFICATION—RIGHT REAR



T120888 –UN–27MAY99

T120888

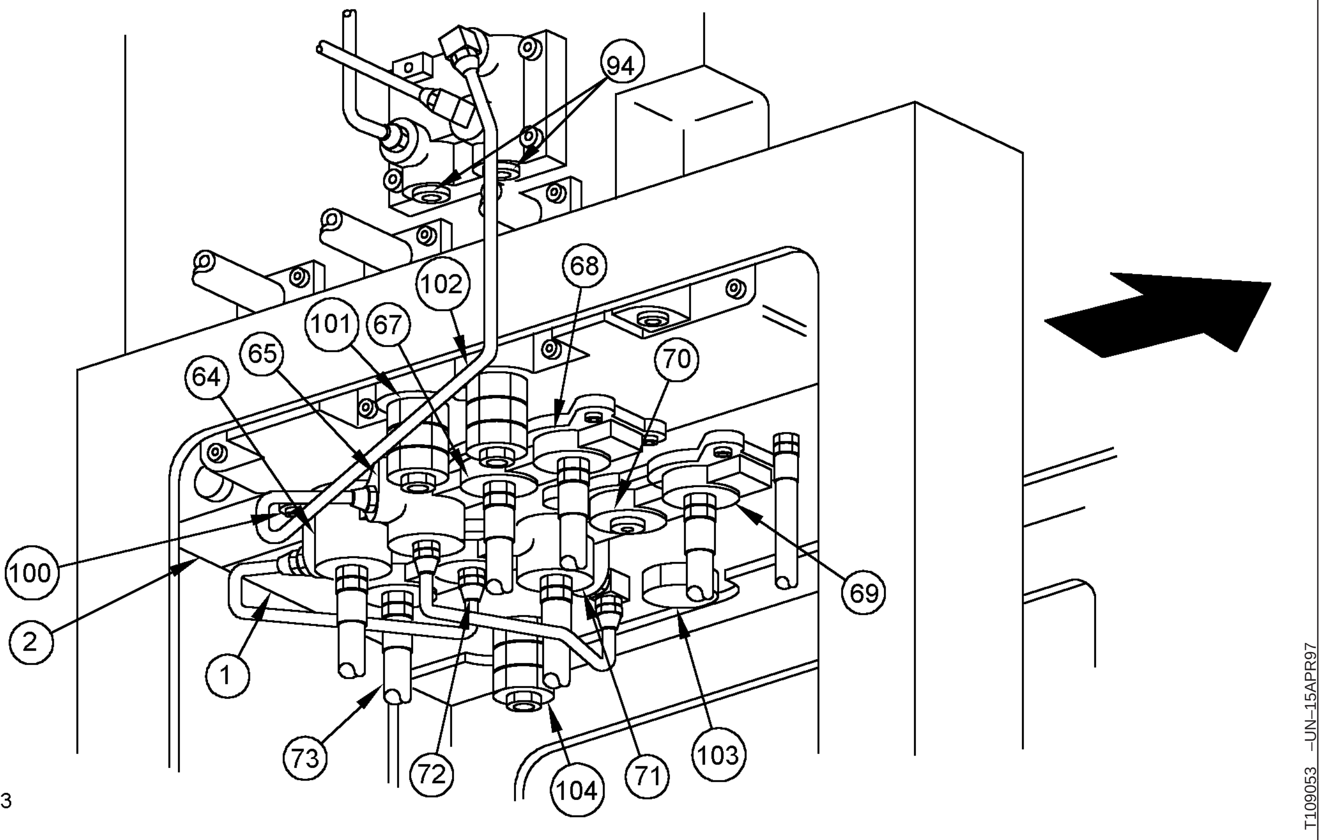
Right Rear

Continued on next page

1—Left Control Valve (5-Spool)
2—Right Control Valve (4-Spool)
57—System Relief Valve and Power Boost
63—Solenoid Valve Manifold
64—Arm II Valve
65—Boom I Valve and Boom Regenerative Valve
66—Boom Reduced Leakage Valve
67—Bucket Valve
68—Right Propel Valve
69—Left Propel Valve
70—Auxiliary Valve
71—Boom II Valve
72—Arm I Valve
73—Swing Valve
85—Arm Regenerative Valve
86—Arm II to Arm I Neutral Passage Check Valve
87—Boom Up Circuit Relief Valve
88—Bucket Dump Circuit Relief Valve
89—Power Boost Solenoid Valve
90—Propel Speed Change Solenoid Valve
91—Speed Sensing Solenoid Valve
92—Arm Regenerative Solenoid Valve
93—Flow Combiner Valve
94—Bucket Flow Control Valve
95—Bucket Check Valve (Lift Check)
96—Boom I Power and Neutral Passage Check Valves (Lift Checks)
97—Arm II Power and Neutral Passage Check Valves and Restriction Orifice
98—Front Pump Control Valve
99—Filter and Orifice for Pilot Pressure to Front Pump Control Valve
105—Oil Cooler Bypass Valve

TX,9025,GG2626 –19–21APR97–2/2

CONTROL VALVE COMPONENT IDENTIFICATION—BOTTOM



Bottom

1—Left Control Valve (5-Spool)
2—Right Control Valve (4-Spool)
64—Arm II Valve
65—Boom I Valve
67—Bucket Valve
68—Right Propel Valve
69—Left Propel Valve
70—Auxiliary Valve
71—Boom II Valve
72—Arm I Valve
73—Swing Valve
94—Bucket Flow Control Valve
100—Arm Regenerative Circuit Check Valve
101—Boom Down Circuit Relief and Anti-Cavitation Valve
102—Bucket Load Circuit Relief and Anti-Cavitation Valve
103—Plug
104—Arm In Circuit Relief and Anti-Cavitation Valve

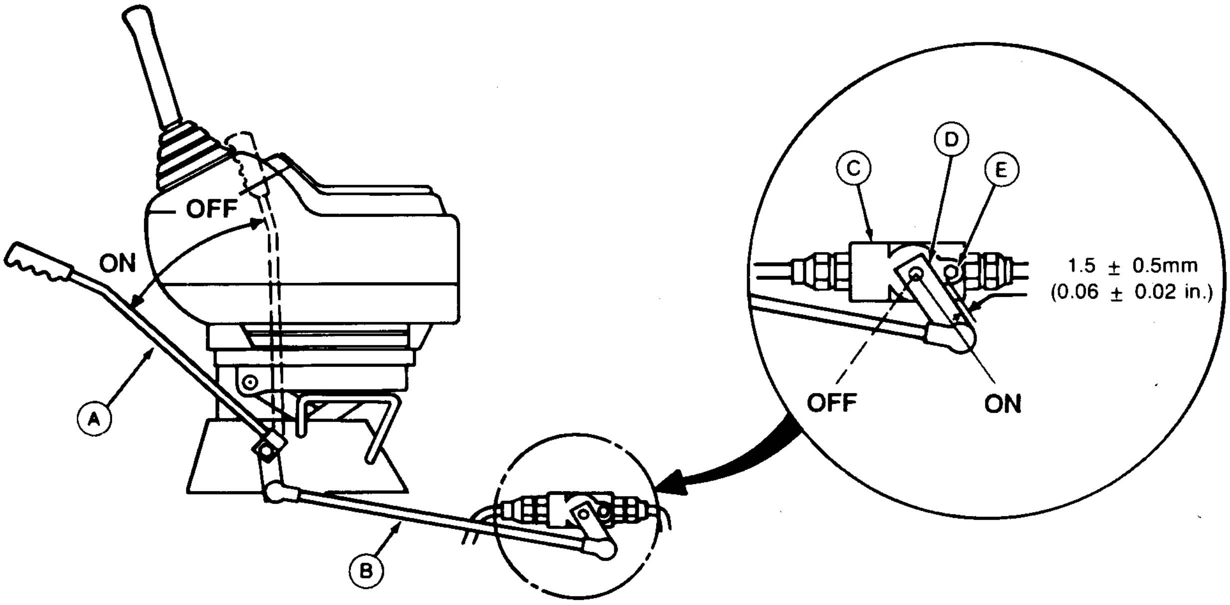
TX,9025,GG2627 –19–20MAY98–1/1

FOLDOUT PAGES 6-124 THRU 6-129 ARE AT REAR OF MANUAL

BLANK

Group 20
Adjustment

PILOT SHUT-OFF VALVE LINKAGE ADJUSTMENT



T7660AL

T7660AL –19–06DEC91

A—Pilot Shut-Off Lever
B—Rod
C—Pilot Shut-Off Valve
D—Lever
E—Cap Screw

SPECIFICATIONS	
Pilot Shut-Off Valve Lever-to-Cap Screw Head Clearance	1.5 ± 0.5 mm (0.06 ± 0.02 in.)

1. Stop engine.

2. Remove cover underneath operator’s station.

3. Push pilot shut-off lever (A) forward to the ON position. Check that lever is against the front stop.

4. Adjust ball joints on rod (B) to get the specified clearance between valve lever (D) and head of cap screw (E).

Pilot Shut-Off Valve Lever-to-Cap Screw Head—Specification

Clearance.. 1.5 ± 0.5 mm (0.06 ± 0.02 in.)

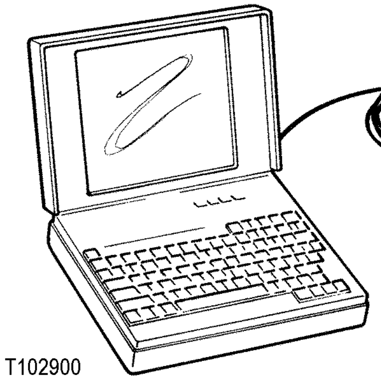
5. Pull pilot shut-off lever to the OFF position. Check that lever is against the rear stop.

⚠ **CAUTION: Machine may move if adjustment is incorrect. Before checking pilot shut-off lever adjustment, make sure the area around machine is clear.**

6. Start the engine. Run engine at slow idle. Actuate the hydraulic functions. Hydraulic functions must not move with the pilot shut-off lever in the OFF position. If hydraulic function move, repeat adjustment procedure.

Group 25
Tests

LAPTOP COMPUTER GENERAL DESCRIPTION



T102900 –19–29AUG96

The JT07274G Excavator Diagnostics Program Disk is designed to run on a laptop computer, such as JT07294 Computer Kit, with the following minimal hardware requirements:

- 486 Processor
- 16 megs of RAM
- WINDOWS® 95 or
- WINDOWS NT™
- Standard RS232 Serial Port

The laptop computer is connected to the John Deere excavator by the JT07273 Cable with a standard RS232 connector fitted with a filter to accommodate the voltage levels of the engine and pump controller.

WINDOWS is a trademark of MICROSOFT CORPORATION.
NT is a trademark of MICROSOFT CORPORATION.

CED,TX08227,2893 –19–22APR98–1/1

EXCAVATOR DIAGNOSTICS PROGRAM—OVERVIEW

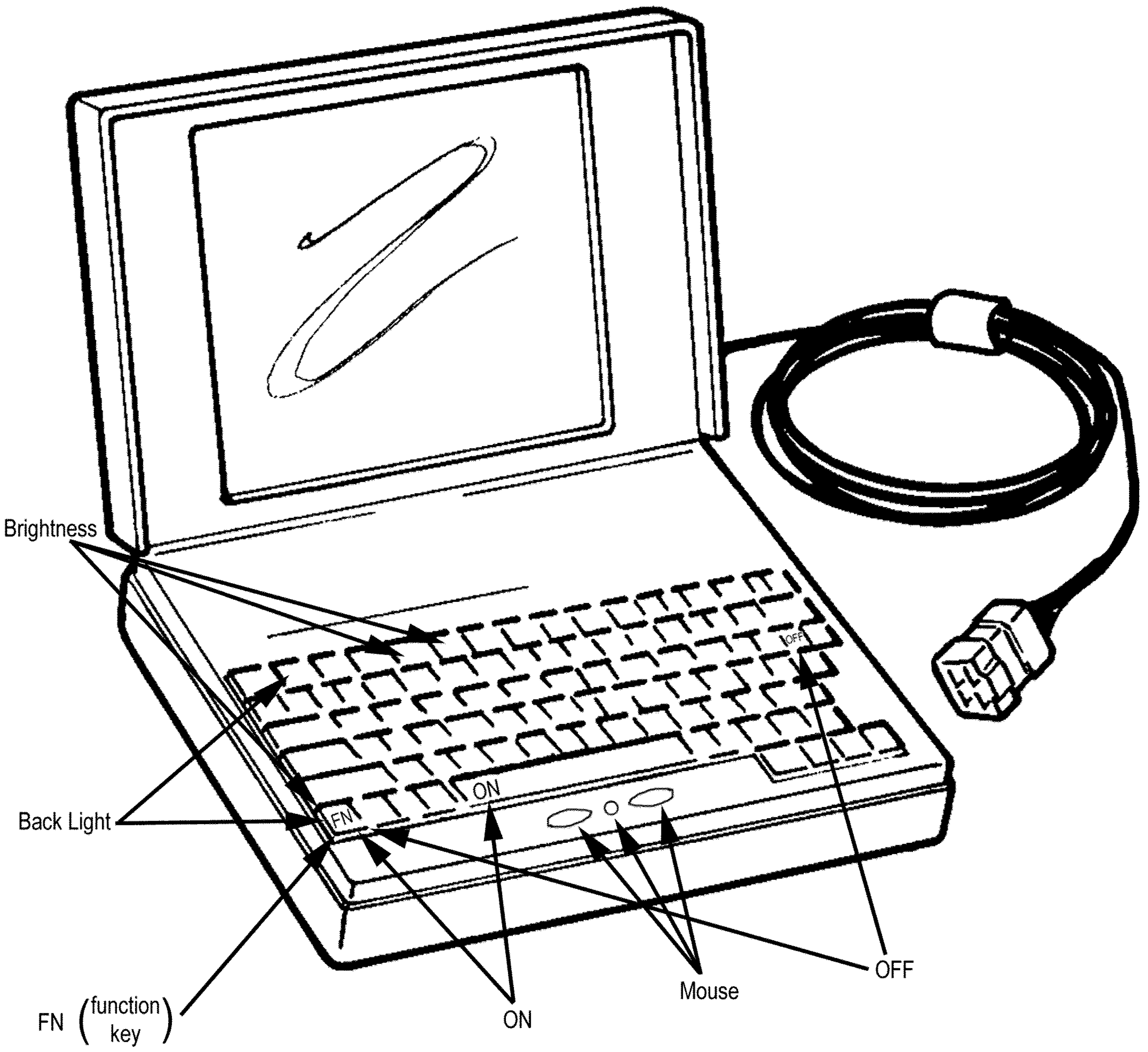
The JT07274G Excavator Diagnostics Program Disk is to be used to monitor information available from the Engine and Pump Controller (EPC) on the John Deere excavator.

In general, the functions provided for John Deere excavators include:

- Identification of Excavator.
- Displaying of Diagnostic Service Codes and Corrective Actions.
- Monitoring Data.
- Adjustment of Parameters.
- On-Line Help.

CED,TX08227,2894 –19–22APR98–1/1

EXCAVATOR DIAGNOSTICS PROGRAM—INSTALL



T102901

Continued on next page

The complete excavator diagnostics program is contained on a single floppy disk. The program requires approximately twelve megabytes upon installation. Installation of the program or software updates is best accomplished using the following procedure:

NOTE: *The latest version of the excavator diagnostics program now contains a list of supported excavator models in the About John Deere window. To check the list of excavator models supported, click on the* **About** *button on the Toolbar or the* **Help** *drop down menu on the Menu Bar and then click on* **About John Deere.**

1. Insert floppy disk in floppy disk drive.

2. Connect floppy disk drive to the computer. As needed, connect an external power source to floppy disk drive.

NOTE: *If floppy disk drive is not connected when the computer is first "booted" (turned on) the floppy disk drive (***e:***) may not be recognized. To "reboot", push* **Ctrl** *and* **Alt** *and* **Delete** *at the same time or push and hold both left and right mouse buttons down for 10 seconds*

3. Turn the computer on. This is done on the recommended computer by pushing function **Fn** and **ON** at the same time.

4. Adjust brightness of screen. Push **Fn** and **F4** or **F5** on computer.

5. Using the mouse, push the **Start** button at the lower left corner of screen.

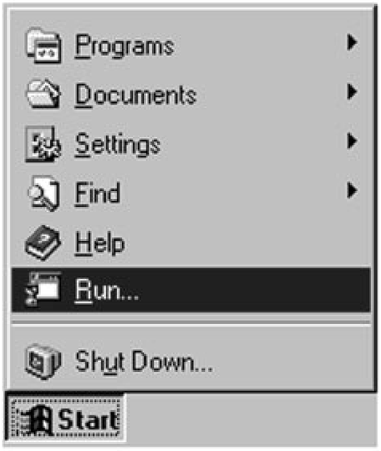
NOTE: *The mouse is a short post located below the space bar. Push the post in direction you want the cursor to move. Click the buttons on the left of the mouse when cursor is in desired location. The tip of the cursor must be on the menu button for menu to open.*

Continued on next page

TX,9025,CR94 –19–22APR98–2/5

6. From the **Start** menu, click on **Run.**

NOTE: To use the Windows 95 Add/Remove Programs feature, click on **Settings** *in the* **Start** *menu, then* **Control Panel, Add/Rem... Programs,** *and then follow the instruction in each window as they are displayed.*



T102902

T102902 –19–29AUG96

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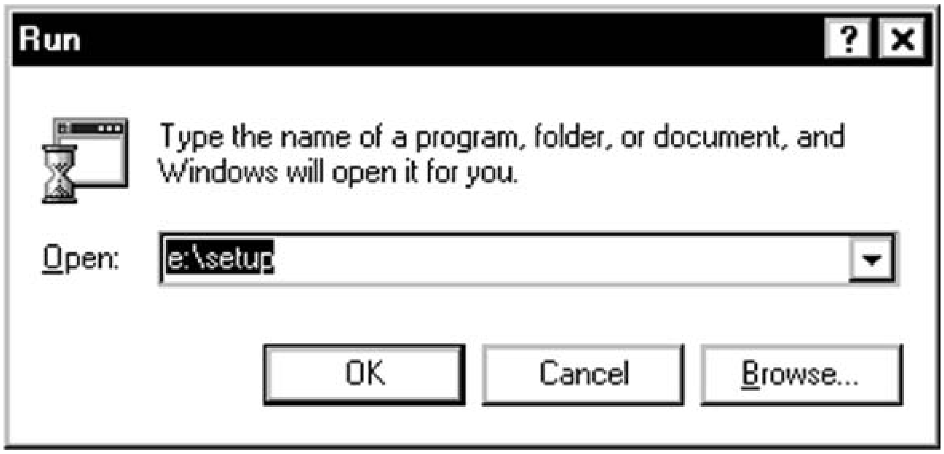


Type the name of a program, folder, or document, and Windows will open it for you.

Open: e:\setup

T102903 –19–19SEP96

7. Type **e:** and then a **** (backslash) in the **Run** dialog window. Then type **setup** (or use the Browse button to find and select “setup” from the floppy disk and then select **Open**). See illustration for an example.

NOTE: Some computers use **a:** *as the floppy disk drive. Repeat previous step with* **a:** *instead of* **e:** *if computer doesn’t recognize the floppy disk drive.*

8. Once the dialog window contains the correct drive and file name, click on the **OK** button.

NOTE: Your computer will remember which drive a disk is loaded on the last time it was done. Therefore pushing the enter key may be all that is required after a disk has been loaded the first time.

9. Setup prompts you with a welcome dialog window that describes the program and lets you continue or exit

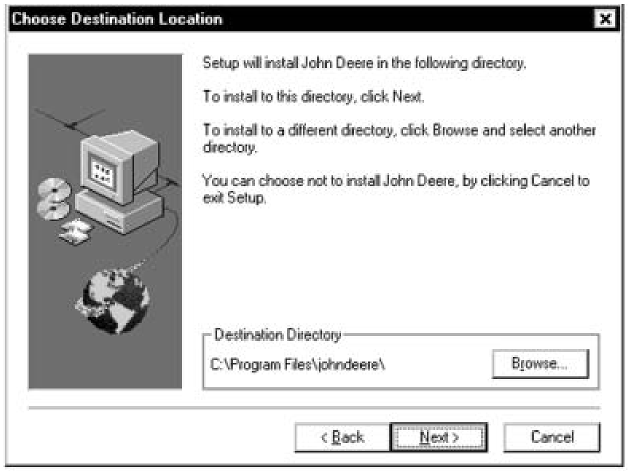
   Click **NEXT**

Continued on next page

TX,9025,CR94 –19–22APR98–4/5

10. Click **Next** to select default location for software placement or click **Browse** to select desired location.

    Congratulations! The program is now installed.



Setup will install John Deere in the following directory.

To install to this directory, click Next.

To install to a different directory, click Browse and select another directory.

You can choose not to install John Deere, by clicking Cancel to exit Setup.

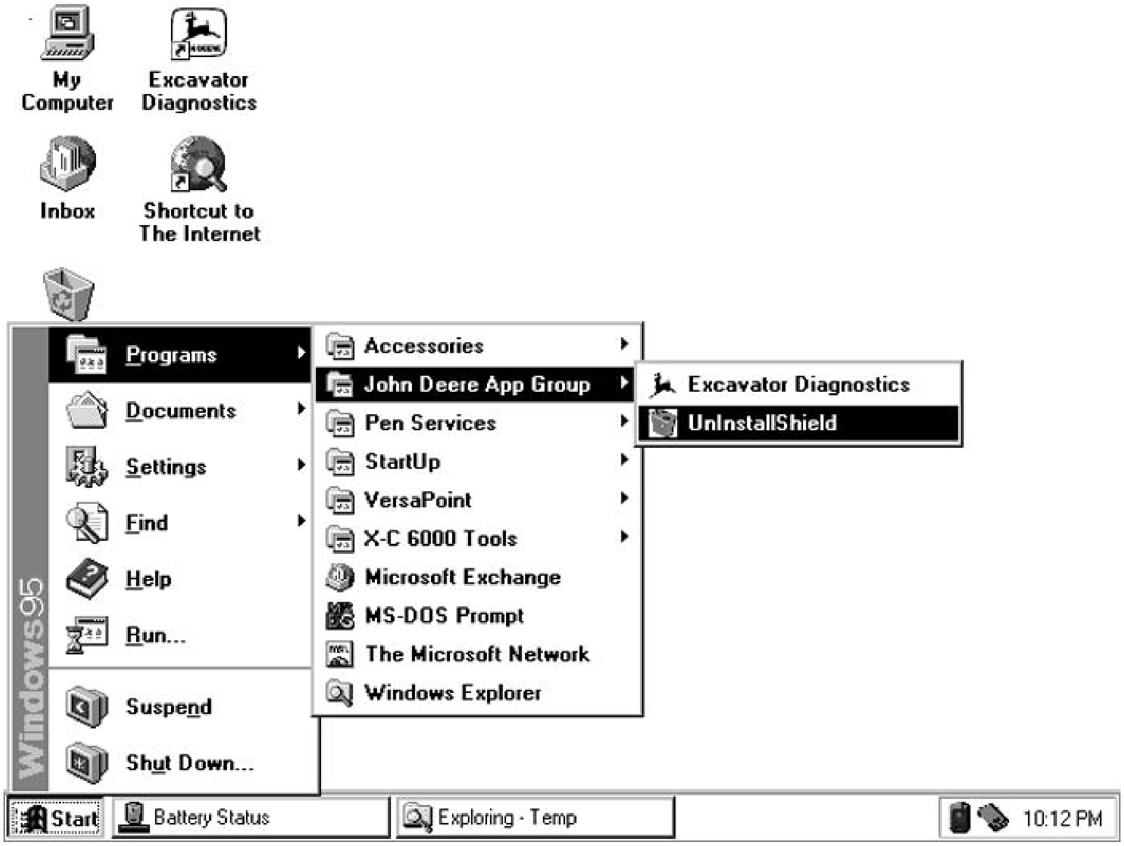
Destination Directory: C:\Program Files\johndeere\

T102904

T102904 –19–29AUG96

TX,9025,CR94 –19–22APR98–5/5

EXCAVATOR DIAGNOSTICS PROGRAM—UNINSTALL



T107199 –19–11FEB97

An Uninstall feature has been created for your convenience to efficiently remove the program from your computer. Click on **Start, Programs, John Deere App Group,** and then **Uninstall Shield** which is below the Excavator Diagnostics menu. Follow on-screen instructions.

NOTE: If John Deere App Group window is open, just click on Uninstall Shield.

EXCAVATOR DIAGNOSTICS PROGRAM—STARTING

The John Deere Excavator Diagnostics Software program is started using the **Excavator Diagnostics** icon on the desktop. Also, can be started from the **John Deere App Group** in the **Programs** menu. The **Excavator Diagnostics** icon is automatically put on the desktop when the program is loaded.

T102905

T102905 –19–06SEP96

Continued on next page

T109483

T109483 –19–13MAY97

NOTE: To install the **Excavator Diagnostics** *icon if not on the desktop, use the following procedure:*

1. *Click on* **Start** *using the right mouse button.*
2. *Click* **Open** *using the left mouse button.*
3. *Double click on* **Programs** *in Start Menu window using the left mouse button.*
4. *Double click on* **John Deere App Group** *icon using the left mouse button.*
5. *Put the mouse pointer on the* **Excavator Diagnostics** *icon.*
6. *Click and hold the right mouse button down and then drag the icon to an empty area on the desktop using the mouse. Release the mouse button when icon in on the desktop.*
7. *Click on* **Create Shortcut(s) Here** *using the left mouse button.*
8. *Using the left mouse button, click on the X in the upper right corner of each open window to close it.*

1. Double click on **Excavator Diagnostics** icon to start program from the desktop (also can click once on the icon and then press the Enter key).

Continued on next page

For starting from the Programs menu:

a. Click on **Start** button in lower left corner of screen.

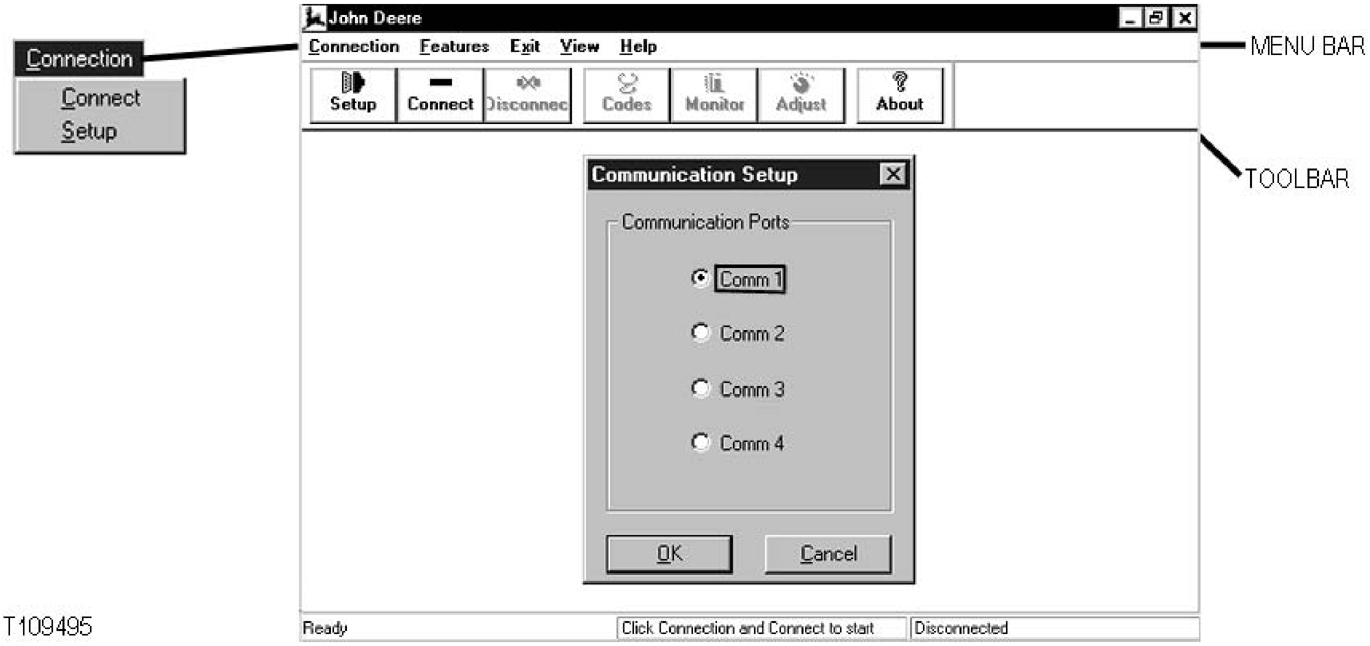
b. Click on **Programs** in Start menu.

c. Click on **John Deere App Group** in the Programs menu.

d. Click on **Excavator Diagnostics.**

2. The John Deere Main Menu screen opens. The menu screen is the gateway to the excavator diagnostic program.

TX,9025,GG2670 –19–22APR98–3/5



● Comm 1

○ Comm 2

○ Comm 3

○ Comm 4

Ready | Click Connection and Connect to start | Disconnected

T109495

T109495 –19–14MAY97

3. The first time the excavator diagnostics program is used on the laptop computer, a communication port must be selected.

   a. Click on the **Setup** button on the Toolbar or on the **Connection** drop down menu on the Menu Bar and then click on **Setup.**

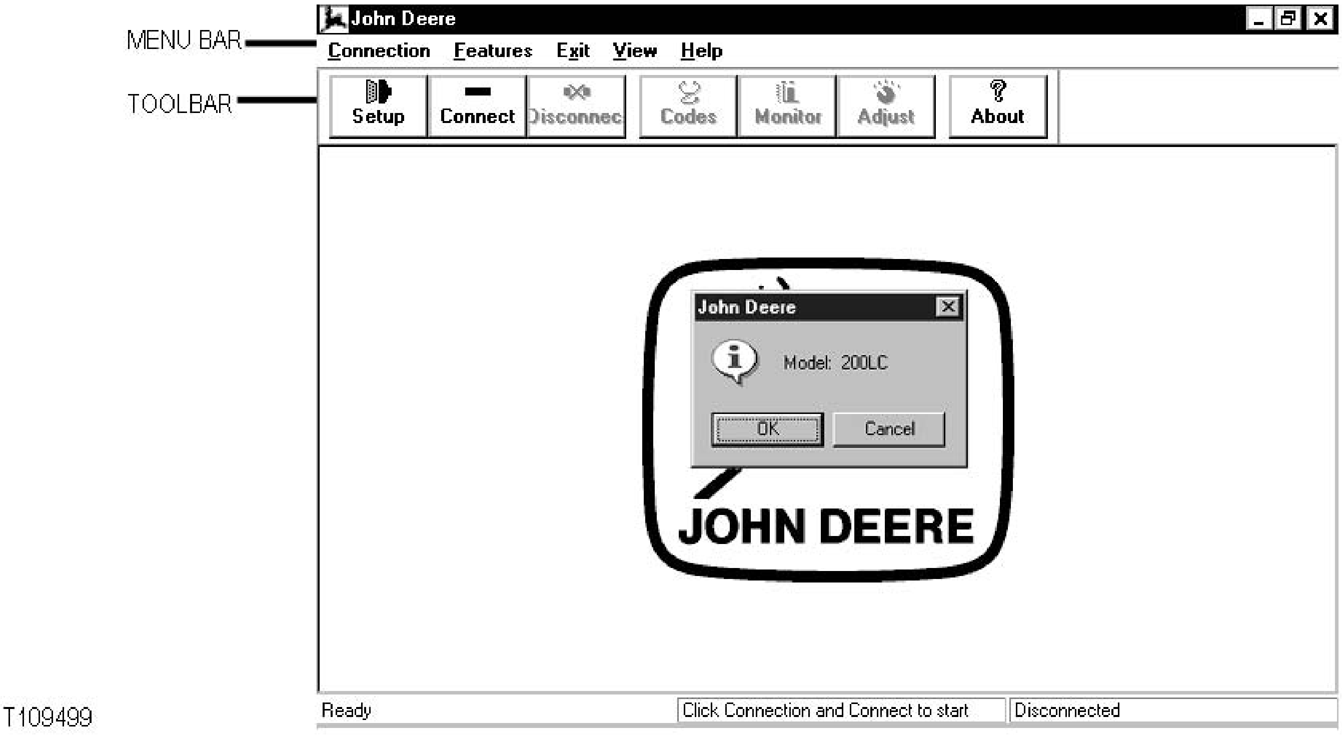
NOTE: *If the Toolbar is not displayed, click on the* **View** *drop menu and then click on* **Toolbar.** *Also click on* **Status Bar** *if not displayed at bottom of window.*

   b. When the **Communication Setup** window opens, click on the communication port your computer needs for communication with the excavator. Most computers use Comm 1.

   c. Using the left mouse button, click on the X in the upper right corner of **Communication Setup** window to close it.

Continued on next page

TX,9025,GG2670 –19–22APR98–4/5



John Deere

Model: 200LC

Ready | Click Connection and Connect to start | Disconnected

T109499 –19–14MAY97

4. Click on the **Connect** button on the Toolbar or on the **Connection** drop down menu on the Menu Bar and then click on **Connect.**

NOTE: *If the Toolbar is not displayed, click on the* **View** *drop menu and then click on Toolbar. Also click on Status Bar if not displayed at bottom of window.*

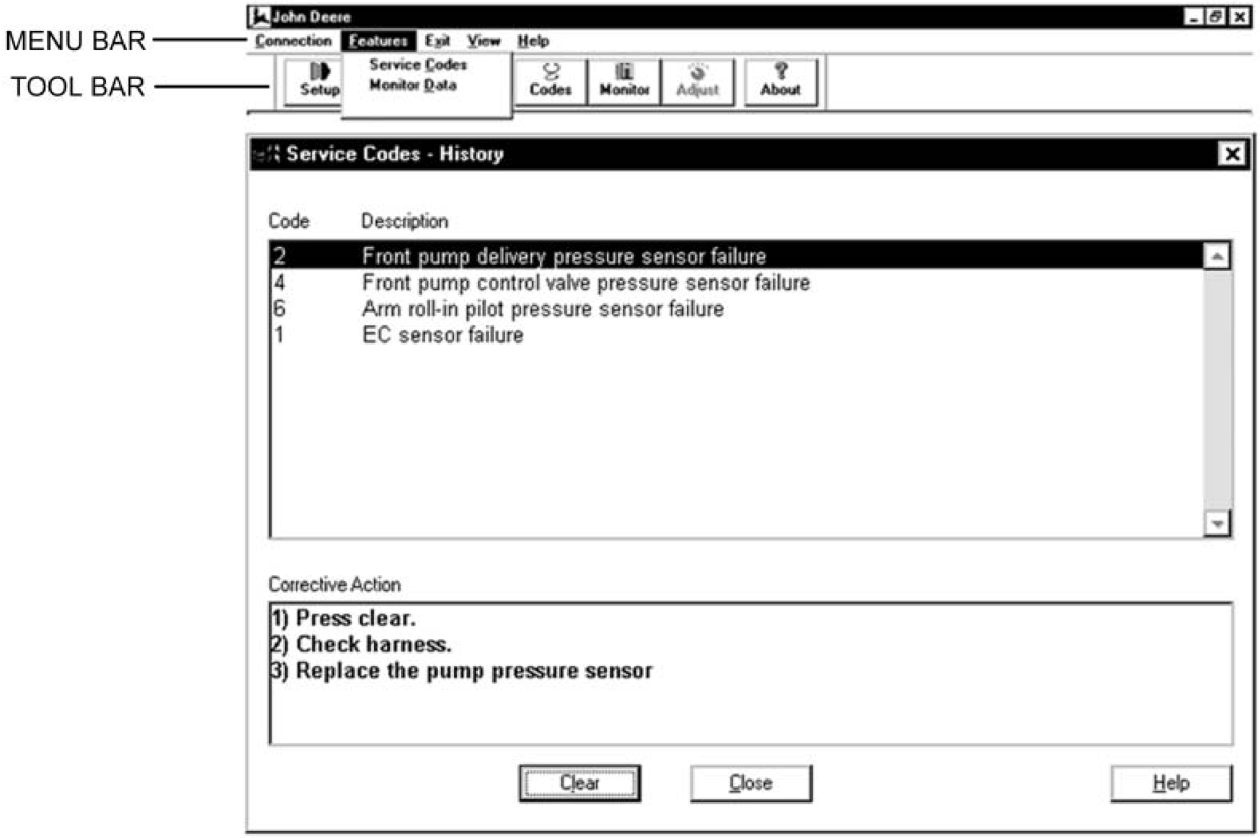
5. The John Deere Model window opens displaying the Model number. Confirm the model number and then click on **OK** or press Enter to continue.

6. When the connection is made, the Toolbar button for **Connect** becomes gray and the **Disconnect, Codes,** and **Monitor** buttons become black.

The current mode for the software is listed in the middle of the Status Bar and the model number to the right. The modes are Main Mode and Service Mode.

The **Disconnect** button on the Toolbar will disconnect the communication with the excavator being diagnosed, no further communication can be performed by the software.

EXCAVATOR DIAGNOSTICS PROGRAM FEATURE—SERVICE CODES



Service Codes - History

Code	Description
2	Front pump delivery pressure sensor failure
4	Front pump control valve pressure sensor failure
6	Arm roll-in pilot pressure sensor failure
1	EC sensor failure

Corrective Action

1) Press clear.
2) Check harness.
3) Replace the pump pressure sensor

T111267 –19–02SEP97

1. Click on the **Codes** button on Toolbar or on the **Features** drop down menu on the Menu Bar and then click on **Service Codes.** (See Excavator Diagnostics Program List of Service Codes in this group.)

   The first group of service codes shown is the **Service Codes-History**. If there are any codes found, the option to clear the Service Codes-History is selectable and not grayed out. Service Codes-History are requested only once from the engine and pump controller.

2. After Service Codes-History have been cleared, the **Service Codes-Current** are displayed and updated periodically—at least 4 samples per minute. Click on a specific service code to get Corrective Action window to display diagnostic advice.

Continued on next page

TX,9025,GG2672 –19–22APR98–1/2

3. If communication is interrupted, such as the key switch being turned off by mistake during service code reading, the **Communication Interruption!** window will display. Click **OK** or press Enter to disconnect. Then turn the key switch back on and click on the **Connect** button or on the **Connection**drop down menu on the Menu Bar and then click on **Connect** to continue.

John Deere

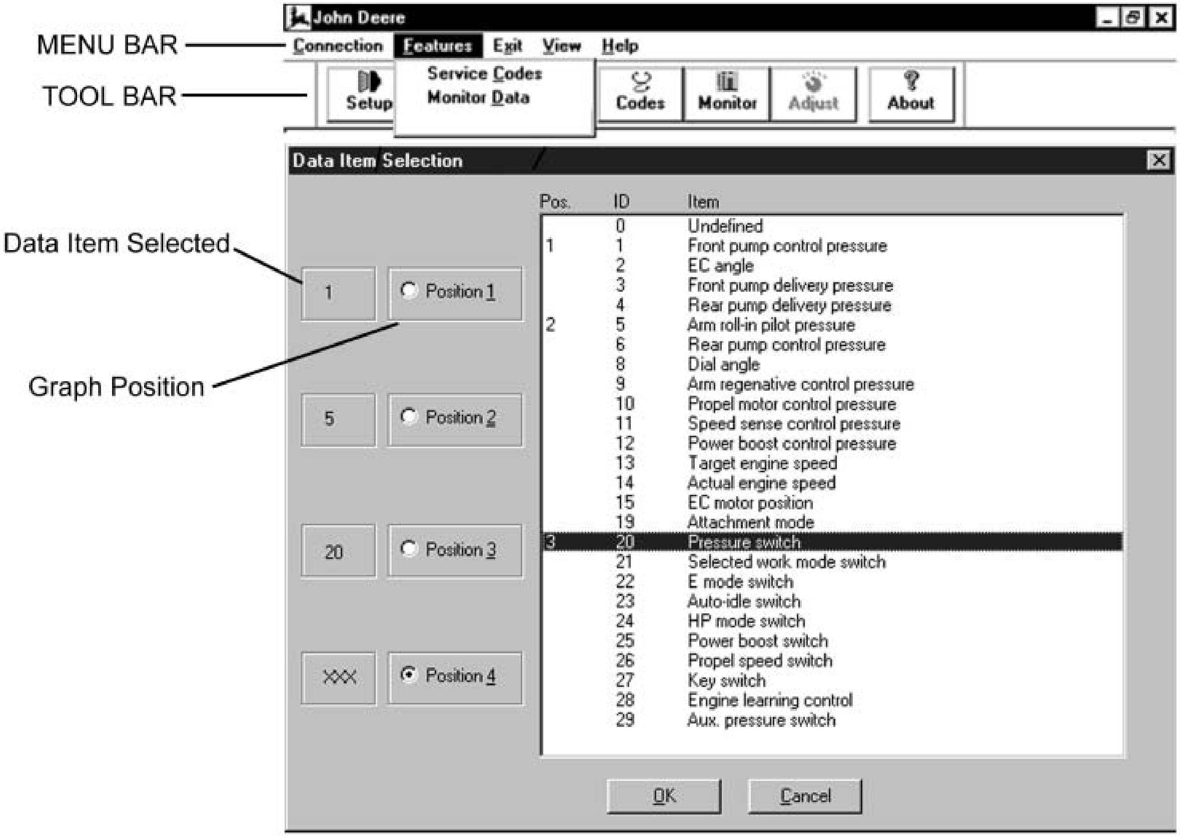
Communication Interruption!

T102910

T102910 –19–29AUG96

TX,9025,GG2672 –19–22APR98–2/2

EXCAVATOR DIAGNOSTICS PROGRAM FEATURE—MONITOR DATA



1	○ Position 1
5	○ Position 2
20	○ Position 3
XXX	● Position 4

Pos.	ID	Item
	0	Undefined
1	1	Front pump control pressure
	2	EC angle
	3	Front pump delivery pressure
	4	Rear pump delivery pressure
2	5	Arm roll-in pilot pressure
	6	Rear pump control pressure
	8	Dial angle
	9	Arm regenative control pressure
	10	Propel motor control pressure
	11	Speed sense control pressure
	12	Power boost control pressure
	13	Target engine speed
	14	Actual engine speed
	15	EC motor position
	19	Attachment mode
3	20	Pressure switch
	21	Selected work mode switch
	22	E mode switch
	23	Auto-idle switch
	24	HP mode switch
	25	Power boost switch
	26	Propel speed switch
	27	Key switch
	28	Engine learning control
	29	Aux. pressure switch

T111272 –19–02SEP97

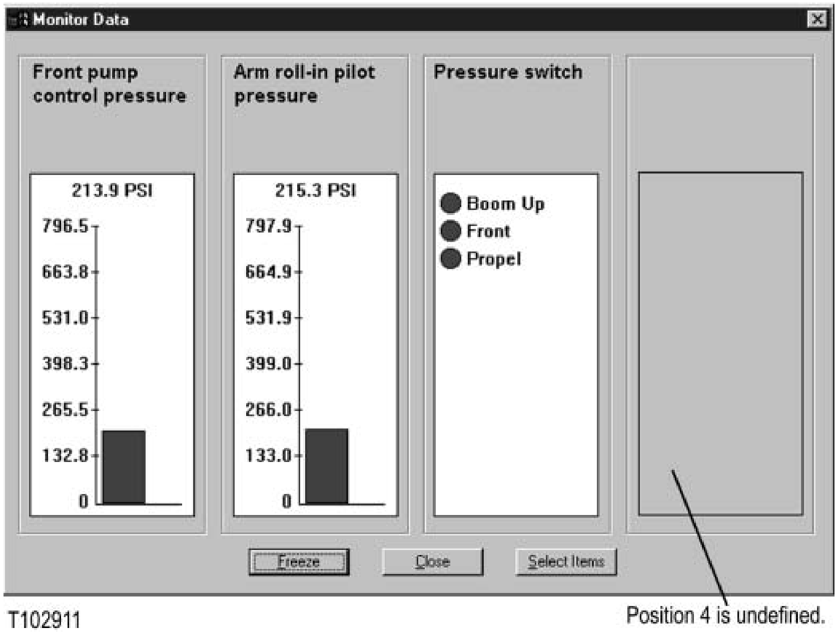
1. Click on the **Monitor** button on Toolbar or on the **Features** drop down menu on the Menu Bar and then click on **Monitor Data** to open the **Data Item Selection** window. (See Excavator Diagnostic Software Monitor Data Items in this group.)

2. Double click (or click once and press the Enter key) on a data item and its ID number appears in the Data Item Selected box at the Graph Position that is highlighted on the left of the screen. The up and down cursor keys and the Enter key also works for selecting data items.

   After your first choice has been made, the next Graph Position is highlighted and allows you to make your second choice. You may choose a data item for each of the four Graph Positions.

3. After choices have been made, click **OK** to view data in graph form in the **Monitor Data** window.

Continued on next page



T102911

Position 4 is undefined.

T102911 –19–29AUG96

4. To change a data item in the **Monitor Data** window, click **Select Items** to toggle back to **Data Item Selection** window.

   Then highlight the Graph Position by clicking on it or use the tab key and then select a data item as before.

5. The data items are polled at about 4 samples per second. You can “freeze” the data by clicking on **Freeze** button. When you click **Unfreeze**, data reading will resume. When highlighted, you can also press the Enter key to toggle between **Freeze** and **Unfreeze**. To highlight a button, press the tab key to highlight the button desired.

TX,9025,GG2673 –19–22APR98–2/3

6. If communication is interrupted, such as the key switch being turned off by mistake while reading data, the **Communication Interruption!** window will display. Turn the key switch back on and then click **Retry** or press Enter to continue. When communication is again established, the Monitor Data window opens to its last settings.

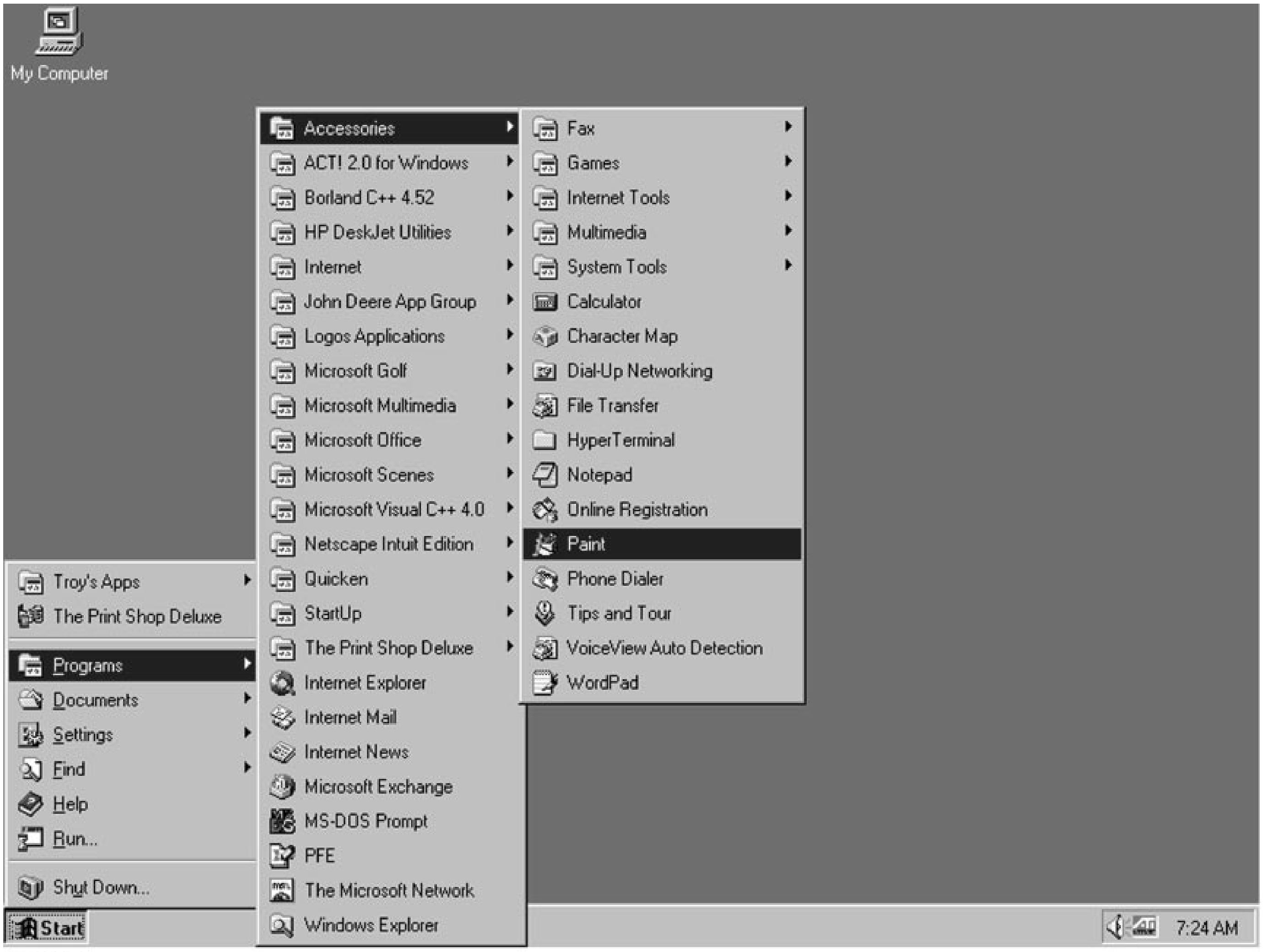
Communication Interruption!

T103375

T103375 –19–29AUG96

TX,9025,GG2673 –19–22APR98–3/3

EXCAVATOR DIAGNOSTICS PROGRAM FEATURE—SAVING MONITOR DATA



T109321

T109321 –19–28APR97

1. You can save a copy of “frozen” data to a disk following these steps:
   a. Click on the application to make it the active window.
   b. Press **Alt** and the **PrtScn** keys.
   c. Click on **Start, Programs, Accessories,** and then **Paint.**
   d. When **Paint** opens, paste “frozen” data by pressing **Control** and the **V** keys.
   e. Click on **Edit** and then on **Copy To.**
   f. Type in a File name, select a drive to Save in and then click on **Save.**
2. The saved file may be opened and printed in either a paint or page layout program.

EXCAVATOR DIAGNOSTICS PROGRAM SPECIAL FUNCTION—ENGINE SPEED ADJUSTMENT

Special Function allows you to adjust the following engine speed factory settings parameters: (For factory settings, see Excavator Diagnostics Program Special Function—Engine Speed Factory Settings Parameters in this group.)

- Slow idle (RPM)
- Economy (RPM)
- Fast idle (RPM)
- Auto idle (RPM)
- Attachment (RPM)

Attachment (RPM) is used to adjust the engine speed for an attachment connected to the machine's hydraulic system that requires a specified pump flow rate. When in Attachment Mode and the proper pressure switch and wiring harness are installed, the engine speed changes to the adjusted speed when the attachment is actuated.

See the Engine Speed to Pump Flow Rate Chart in this group for the engine speed to get the specified pump flow rate.

To change a parameter, the excavator must be in Service Mode. Follow the steps below for placing the excavator in service mode and adjusting parameters.

NOTE: *If computer is currently connected, click on the* **Disconnect** *button on the Toolbar or on the* **Connection** *drop down menu on the Menu Bar and then click on* **Disconnect**.

1. Turn the key switch off.

2. Connect the laptop computer cable to the diagnostic test port.

Continued on next page

3. Push the learning switch (C) up to the top position and wait for 10 seconds.

4. Turn the key switch on.

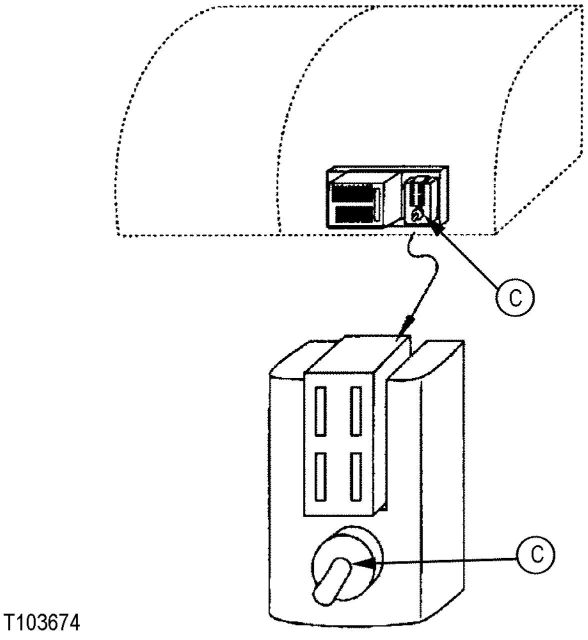
5. Click on the **Connect** button on the Toolbar or on the **Connection** drop down menu on the Menu Bar and then click on **Connect**.

   The John Deere Model window opens displaying the Model number. Confirm the model number and then click on **OK** or press Enter to continue.

6. The **Warning Service Mode** window opens warning that excavator is in Service Mode. Click **OK.**

NOTE: Service Mode and machine model number is displayed in the Status Bar at bottom of window.

In Service mode, the Service Codes and Monitor Data cannot be accessed.



T103674 –UN–11SEP96

C—Learning Switch

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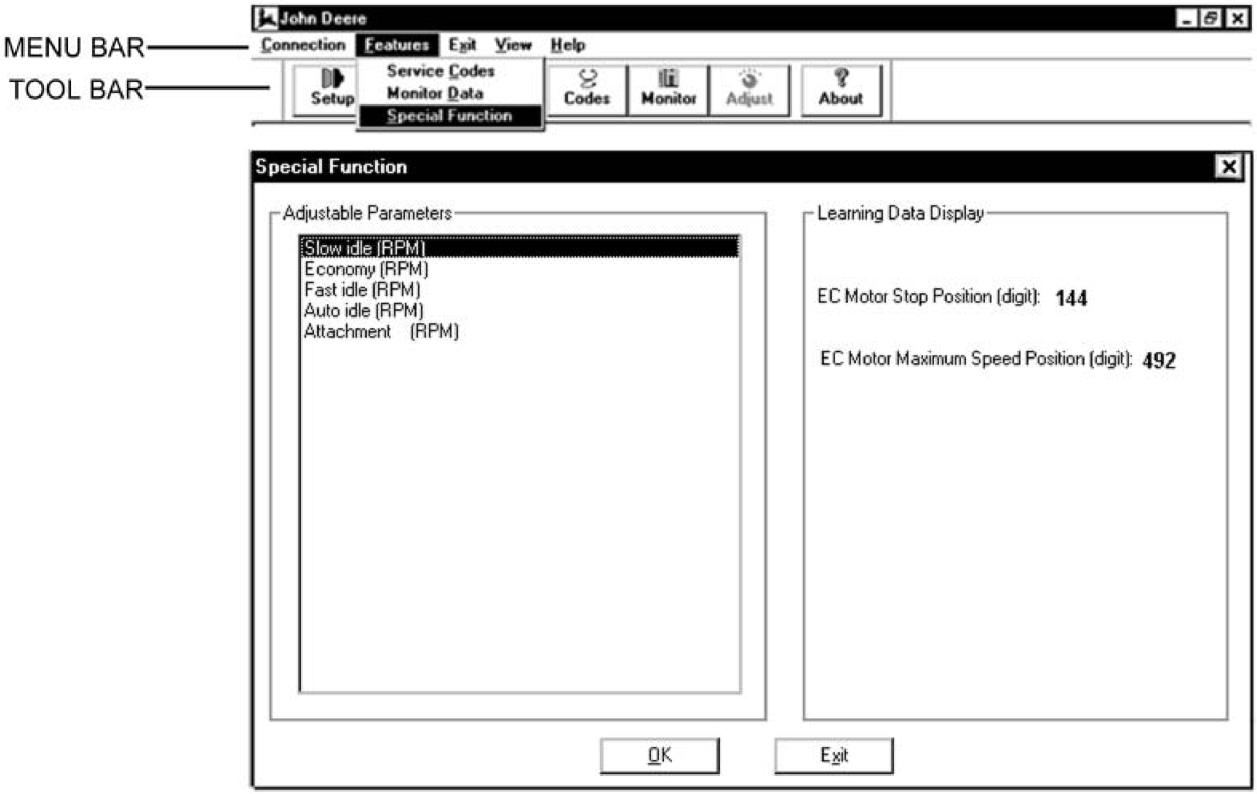

Slow idle (RPM)
Economy (RPM)
Fast idle (RPM)
Auto idle (RPM)
Attachment (RPM)

EC Motor Stop Position (digit): 144

EC Motor Maximum Speed Position (digit): 492

T111739 –19–14OCT97

7. Click on the **Adjust** button on the Toolbar or on the **Features** drop down menu on the Menu Bar and then click on **Special Function** to open the **Special Function** window.

   The Special Function window allows the user to select the Adjustable Parameters for adjustment and view the values under Learning Data Display.

8. Use the cursor keys to move the highlight to the parameter you wish to change then press **Enter** to bring up the Parameter Change screen.

The Parameter Change window contains:

- Parameter (to be changed)
- Adjustable Range
- Initial (deviation from factory set rpm)
- Minimum Adjusting Deviation
- Current (deviation from factory setting)
- Adjustment (were change is made)

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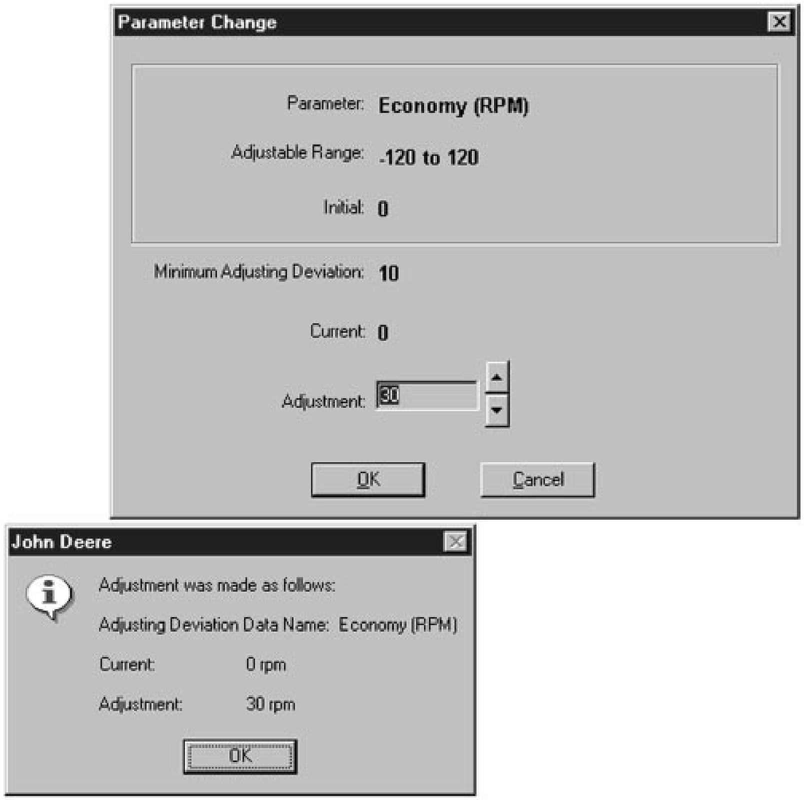

Parameter: Economy (RPM)

Adjustable Range: -120 to 120

Initial: 0

Minimum Adjusting Deviation: 10

Current: 0

Adjustment: 30

Adjustment was made as follows:

Adjusting Deviation Data Name: Economy (RPM)

Current: 0 rpm

Adjustment: 30 rpm

T103378

T103378 –19–29AUG96

9. Use the up and down cursor keys on keyboard to change the value which appears in the Adjustment box.

NOTE: *Clicking on the up and down arrows next to box will also change the value.*

10. Press the Enter key or click **OK** and the **Adjustment was made as follows:** window opens. Confirm the value and then press the Enter key or click **OK** button to return to the Adjustable Parameters.

NOTE: *Only one parameter can be change at a time. Repeat procedure from Adjustable Parameters to adjust additional parameters.*

11. Click on **Exit** to close the **Special Function** window.

12. Click on **Disconnect** Toolbar button.

13. Turn the key switch off.

14. Push learning switch down to the center position and wait 10 seconds.

NOTE: *Check the Status Bar at bottom of window that computer is in Main Mode after connecting.*

15. Start the engine and then check the adjusted parameter using a tachometer

TX,9025,GG2862 –19–22APR98–4/4

EXCAVATOR DIAGNOSTICS PROGRAM—SERVICE CODES LIST

LIST OF SERVICE CODES		
Service Code	**Trouble**	**Corrective Action**
01	EC sensor failure	1. Press Clear. 2. Check harness. 3. Replace the EC sensor.
02	Front pump delivery pressure sensor failure.	1. Press Clear. 2. Check harness. 3. Replace the pump delivery pressure sensor.
03	Rear pump delivery pressure sensor failure	1. Press Clear. 2. Check harness. 3. Replace the pump delivery pressure sensor.
04	Front pump control pressure sensor failure	1. Press Clear. 2. Check harness. 3. Replace the pump control pressure sensor.
05	Rear pump control pressure sensor failure	1. Press Clear. 2. Check harness. 3. Replace the pump control pressure sensor.
06	Arm Roll-in pilot pressure sensor failure	1. Press Clear. 2. Check harness. 3. Replace the arm in pilot pressure sensor.
07	Engine rpm dial failure	1. Press Clear. 2. Check harness 3. Replace the engine rpm dial.

TX,9025,GG2643 –19–22APR98–1/1

EXCAVATOR DIAGNOSTICS PROGRAM—MONITOR DATA ITEMS

NOTE: This chart lists engine and pump controller dynamic data items that can be monitored by the excavator diagnostics program.

230LCR EXCAVATOR MONITOR DATA ITEMS

Item	Display List	Units	Description
1	Front pump control pressure	psi	Pilot signal from the front pump control valve to pump regulator
2	EC angle	V	Feedback signal from the engine control sensor to the engine and pump controller
3	Front pump delivery pressure	psi	Pump supply pressure at front pump outlet.
4	Rear pump delivery pressure	psi	Pump supply pressure at rear pump outlet.
5	Arm in pilot pressure	psi	Pilot pressure from pilot controller to control valve pilot cap. Pressure measured at flow regulator valve.
6	Rear pump control pressure	psi	Pilot signal from rear pump control valve to pump regulator.
8	RPM dial angle	V	Electrical signal from engine rpm dial.
9	Arm regenerative control pressure	psi	Pilot pressure from arm regenerative solenoid valve to arm regenerative valve in left control valve. A calculated pressure, not actual pressure.
10	Propel motor control pressure	psi	Pilot pressure from propel speed change solenoid valve to speed selector valve in propel motors. A calculated pressure, not actual pressure.
11	Speed sense control pressure	psi	Pilot pressure from speed sense solenoid valve to front and rear pump regulators. A calculated pressure, not actual pressure.
12	Power boost control pressure	psi	Pilot pressure from power boost solenoid valve to the piston in the system relief valve. This is a calculated pressure, not the actual pressure.
13	Target engine speed	rpm	Set by engine rpm dial. Target speed for engine pull down when under load. (Approximately 150 rpm difference from engine speed under no load.)
14	Actual engine speed	rpm	Engine speed sensed by engine speed sensor. Sensor is located in the pump drive gearbox adjacent to front pump.
15	EC motor position	steps	Electrical signal from engine and pump controller to engine control motor.
20	Pressure switch	Boom Up, Dig, Propel	Electrical signal from pressure switches to engine and pump controller when function is actuated. Boom up is located on flow regulator valve. Dig and propel are located on control valve.
21	Selected work mode switch	Dig, Grading, Precision, Attachment	Signal from control module to engine and pump controller for selected work mode.
22	E mode switch	On, Off	Signal from control module to engine and pump controller for preset engine speed.
23	Auto-idle switch	On, Off	Signal from control module to engine and pump controller to actuate auto-idle function.
24	HP mode switch	On, Off	Signal from control module to engine and pump controller to actuate High power mode.
25	Power boost switch	On, Off	Signal from power boost switch, in right control lever, to engine and pump controller to actuate power boost function.
26	Selected propel speed switch	Fast, Slow	Signal from control module to engine and pump controller to change propel speed.
27	Key switch	On, Off	Signal from key switch to engine and pump controller.
28	Engine learning control	Done, Undone, Interruption	Engine and pump controller has to be originally matched to each machine. See engine learning procedure.
29	Attachment mode pressure switch	On, Off	Signal to engine and pump controller when attachment mode is active.

TX,9025,GG2677 –19–20MAY98–1/1

EXCAVATOR DIAGNOSTICS PROGRAM SPECIAL FUNCTION—ENGINE SPEED FACTORY SETTINGS PARAMETERS

SPECIFICATIONS	
Engine Slow Idle Speed	900 ± 25 rpm
Engine Auto Idle Speed	1200 ± 25 rpm
Engine E (Economy) Mode Speed	1980 ± 25 rpm
Engine Fast Idle in Standard Mode Speed	2180 ± 25 rpm
Engine Attachment Mode Speed	(As specified by supplier)

The factory settings for engine speeds can be changed using the excavator diagnostic program special function. (See Excavator Diagnostics Program Special Function—Engine Speed Adjustment in this group.)

Engine Slow Idle—Specification

Speed .... 900 ± 25 rpm

Engine Auto Idle—Specification

Speed .... 1200 ± 25 rpm

Engine E (Economy) Mode—Specification

Speed .... 1980 ± 25 rpm

Engine Fast Idle in Standard Mode—Specification

Speed .... 2180 ± 25 rpm

Engine Attachment Mode—Specification

Speed .... (As specified by supplier)

NOTE: For the engine speed to get a specified pump flow rate, see Engine Speed to Pump Flow Rate Chart in this group.

TX,9025,GG2678 –19–20MAY98–1/1

ENGINE SPEED TO PUMP FLOW RATE CHART

SPECIFICATIONS	
230LC Excavator Pump[a] Flow Rate to Engine Speed	132 L/min (35 gpm) at 1390 rpm and 14 479 kPa (145 bar) (2100 psi)
230LC Excavator Pump[a] Flow Rate to Engine Speed	151 L/min (40 gpm) at 1580 rpm and 14 479 kPa (145 bar) (2100 psi)
230LC Excavator Pump Flow Rate to Engine Speed	170 L/min (45 gpm) at 1790 rpm and 14 479 kPa (145 bar) (2100 psi)
230LC Excavator Pump Flow Rate to Engine Speed	189 L/min (50 gpm) at 2010 rpm and 14 479 kPa (145 bar) (2100 psi)
230LC Excavator Pump Flow Rate to Engine Speed	204 L/min (54 gpm) at 2175 rpm and 14 479 kPa (145 bar) (2100 psi)
[a]For engine speeds below the adjustable range, operate in Dig Mode and turn the engine rpm dial to obtain the desired engine speed.	

The adjustable range is a (minus) -500 to 200 rpm for Attachment in Attachment Mode. The minimum adjusting deviation is 10 rpm.

230LC Excavator Pump[1]—Specification

Flow Rate to Engine Speed	132 L/min (35 gpm) at 1390 rpm and 14 479 kPa (145 bar) (2100 psi)
Flow Rate to Engine Speed	151 L/min (40 gpm) at 1580 rpm and 14 479 kPa (145 bar) (2100 psi)

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[1] *For engine speeds below the adjustable range, operate in Dig Mode and turn the engine rpm dial to obtain the desired engine speed.*

Continued on next page

230LC Excavator Pump—Specification

Flow Rate to Engine Speed	170 L/min (45 gpm) at 1790 rpm and 14 479 kPa (145 bar) (2100 psi)
Flow Rate to Engine Speed	189 L/min (50 gpm) at 2010 rpm and 14 479 kPa (145 bar) (2100 psi)
Flow Rate to Engine Speed	204 L/min (54 gpm) at 2175 rpm and 14 479 kPa (145 bar) (2100 psi)

For engine speeds below the adjustable range, operate in Dig Mode and turn the engine rpm dial to obtain the desired engine speed.

For adjustment procedure, see Excavator Diagnostics Program Special Function—Engine Speed Adjustment in this group.

CED,OUOE003,1074 –19–13AUG98–2/2

EXCAVATOR DIAGNOSTICS PROGRAM TROUBLESHOOTING

Most software problems can be solved by the following:

1. Questions:
    - Is the key switch on the excavator turned on?
    - Are the connectors push in all of the way?
    - Is the software connected? If communication is broken momentarily between the computer and the engine and pump controller?
    - Is the program in the Main Mode or Service Mode? The program will tell you the current mode in the Status Bar at the bottom of window. If it is not in one of these modes you need to click on **Connection** and **Connect**.

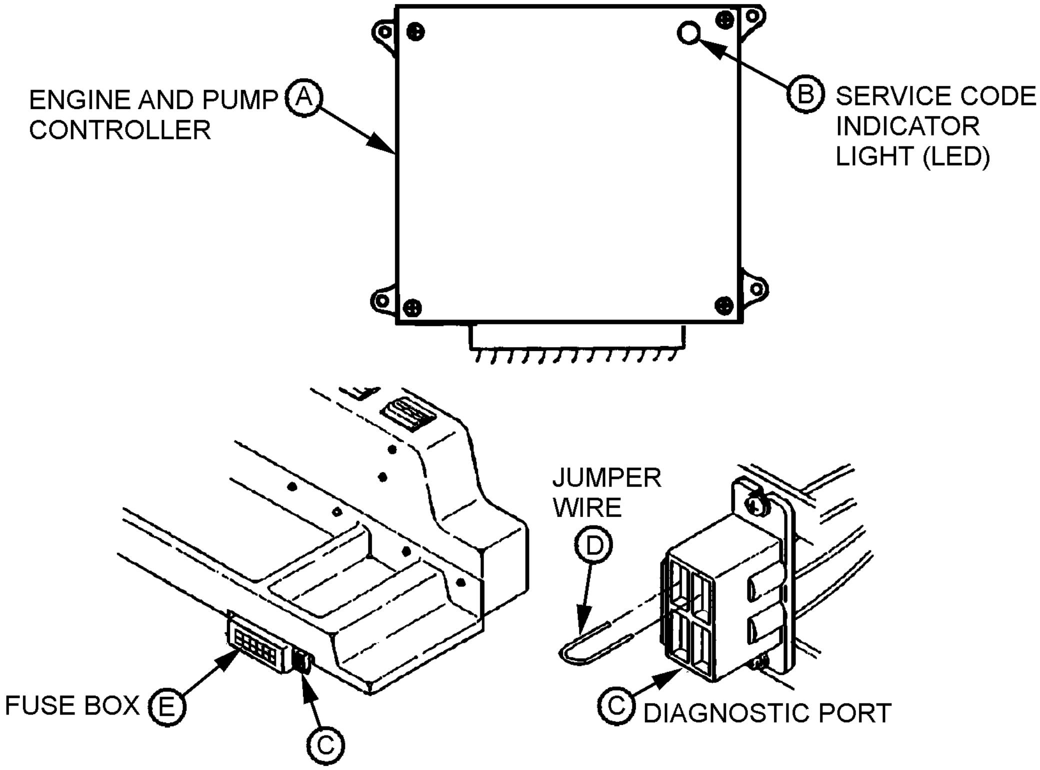
2. Turn key switch **Off.** Wait for 10 seconds.
3. Turn key switch **ON.**

NOTE: Disconnect and Connect does NOT mean to unplug and plug in computer cable.

4. Click on **Disconnect** and **Connect** under the **Connection** menu.
5. Try again.

TX,9025,CR103 –19–22APR98–1/1

READING SERVICE CODES WITHOUT EXCAVATOR DIAGNOSTICS PROGRAM



T113360

T113360 –19–13FEB98

With practice the self-diagnostic service codes can be read by counting the flashes of the Service Code Indicator Light (LED) (B) in the engine and pump controller (A).

Read the LED in the engine and pump controller several times to make sure the correct service code is read.

1. Lower the bucket to the ground. Stop the engine.

2. Remove the rear console cover from behind the operator’s seat. Remove the bracket that is over the engine and pump controller.

3. Install a jumper wire (D) into the two top terminals of the diagnostic port (C).

4. Turn the key switch ON.

   The LED comes ON steady for several seconds and then goes OFF.

5. For an existing service code, the LED starts a flashing sequence of 1 second ON, 1 second OFF intervals. After the last ON in a sequence, the LED remains OFF for approximately 3 seconds and then repeats the flashing sequence.

   Count the number of times LED is ON in a sequence for the service code number.

   Example, for a service code “03 Rear pump delivery pressure sensor failure,” the LED flashes ON three times in each sequence.

Continued on next page

For more than one, the LED will have a flashing sequence for each existing service code with an approximate 3 second interval between each sequence. The flashing sequence continues as long as the key switch in ON and jumper wire is installed.

NOTE: *If no service codes exist or trouble is beyond the scope of self-diagnosing function, the LED is ON for several seconds then goes OFF and remains OFF.*

With key switch ON but no jumper wire installed in the diagnostic port, the LED comes ON for several seconds, goes OFF, and then starts a steady one seconds ON, one seconds OFF flashing sequence.

6. Turn the key switch OFF.

7. Remove jumper wire from diagnostic port.

8. Make necessary repairs.

9. Use the following procedure to clear existing service codes:

   a. Install jumper wire into the top two terminals of diagnostic port.

   b. Turn the key switch ON.

   c. Remove jumper wire from diagnostic port.

   d. Wait for two second.

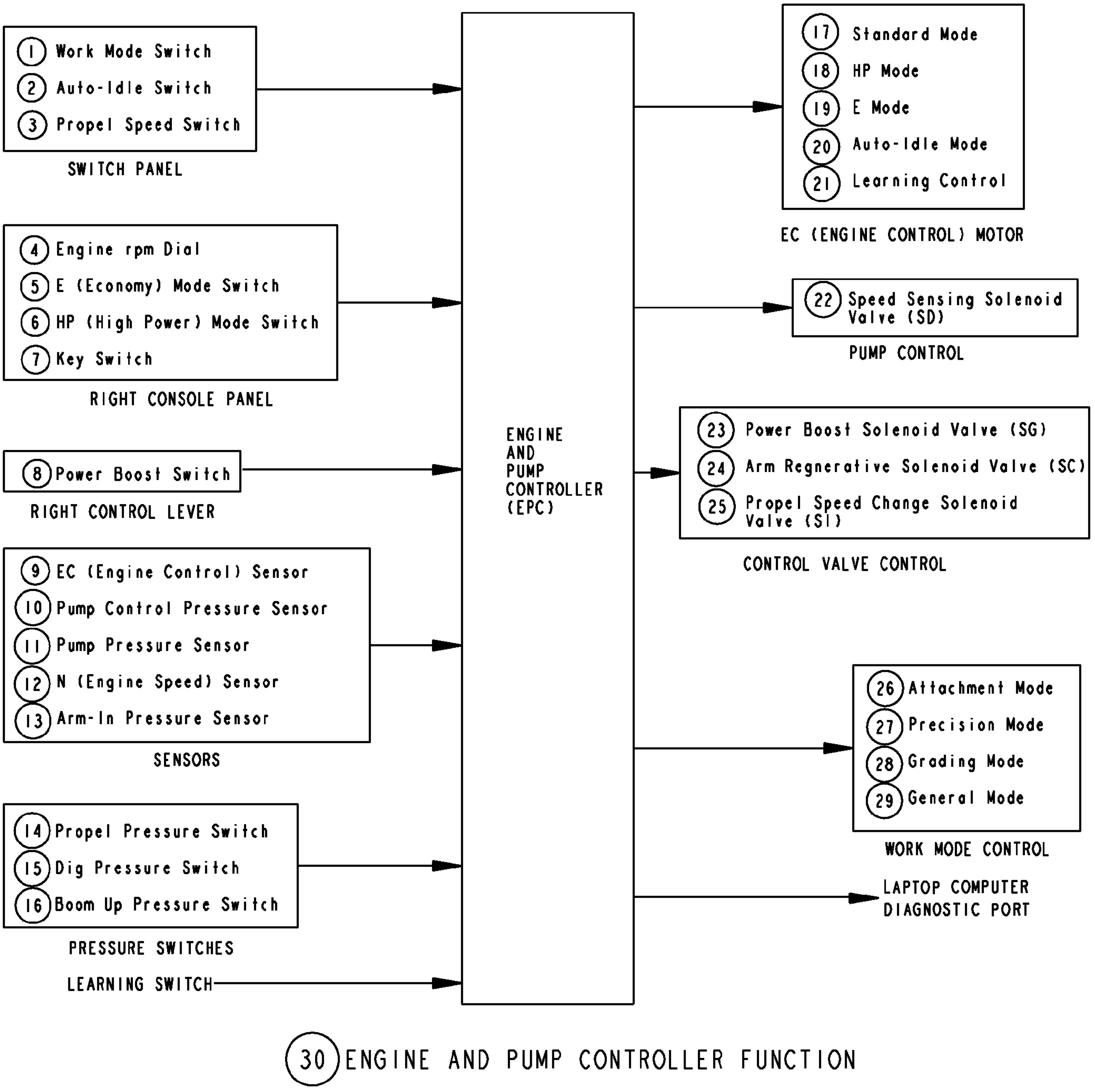
   e. Install jumper wire into the top two terminals of diagnostic port.

   f. Check for service codes. The LED is ON for several seconds then goes OFF and remains OFF if all necessary repairs were made.

   g. Turn the key switch OFF

   h. Remove jumper wire from diagnostic port.

ENGINE AND PUMP CONTROLLER FUNCTIONS



T115419 –19–27MAY98

T115419

9025
25
28

Continued on next page

The engine and pump controller (EPC) is used to control machine operation. Electronic input signals from the engine rpm dial (4), sensors (9—13), and switches (1—3, 5—7, and 14—16) are sent to the controller.

TX,9025,GG2603 –19–21MAY98–2/2

JT05801 CLAMP-ON ELECTRONIC TACHOMETER INSTALLATION

SERVICE EQUIPMENT AND TOOLS
JT05801 Clamp-On Electronic Tachometer

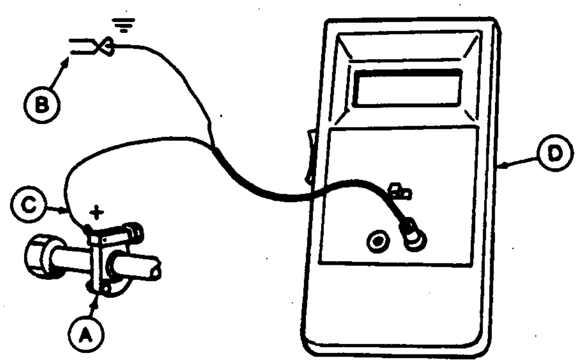
1. Before installing clamp-on electronic tachometer, remove the paint from a straight section of injection line within 100 mm (4 in.) of No. 1 injection nozzle. Use emery cloth to remove the paint.

2. Install the clamp-on transducer (A). Tighten finger tight only—DO NOT overtighten.

3. Connect the red clip (+) (C) to the clamp-on transducer.

4. Connect the black clip (-) (B) to a ground connection such as the head of a cap screw or other metal part on engine.

5. Start the engine. Check for a reading on the digital readout unit (D).



T6813AG –UN–28FEB89

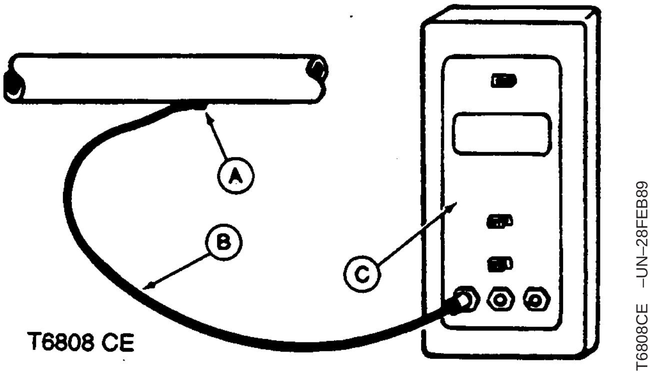
A—Clamp-On Transducer
B—Black Clip (-)
C—Red Clip (+)
D—Digital Readout Unit

CED,TX08227,2879 –19–11NOV97–1/1

JT05800 DIGITAL THERMOMETER INSTALLATION

SERVICE EQUIPMENT AND TOOLS
JT05800 Digital Thermometer

1. Fasten temperature probe (A) to a bare metal hydraulic line using a tie band.
2. Wrap temperature probe and line with a shop towel.



A—Temperature Probe
B—Cable
C—JT05800 Digital Thermometer

CED,TX08227,2895 –19–19NOV97–1/1

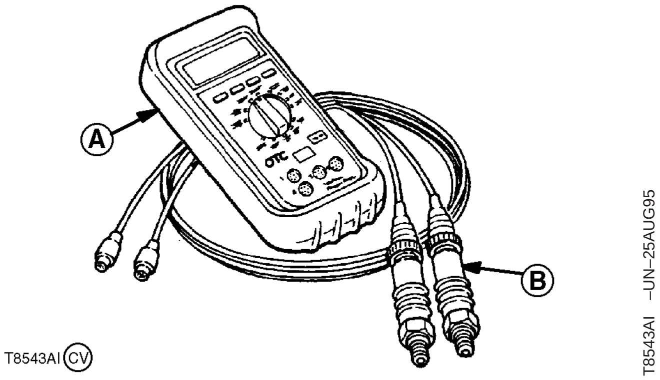
JT02156A DIGITAL PRESSURE AND TEMPERATURE ANALYZER INSTALLATION

SERVICE EQUIPMENT AND TOOLS
JT02156A Digital Pressure and Temperature Analyzer

Use the digital pressure and temperature analyzer (A), and transducers (B) in place of analog gauges and a separate temperature reader.

Transducers are temperature sensitive. Allow transducer to warm to system temperature. After transducer is warmed and no pressure applied, push sensor zero button for one second to set the true zero point.

When using for different pressures, turn selector to OFF for two seconds and then to the pressure range. Readings are inaccurate if proper range for transducer is not used.



A—Digital Pressure and Temperature Analyzer
B—3400 kPa (35 bar) (500 psi) Transducer
—34 000 kPa (350 bar) (5000 psi) Transducer
—70 000 kPa (700 bar) (10000 psi) Transducer

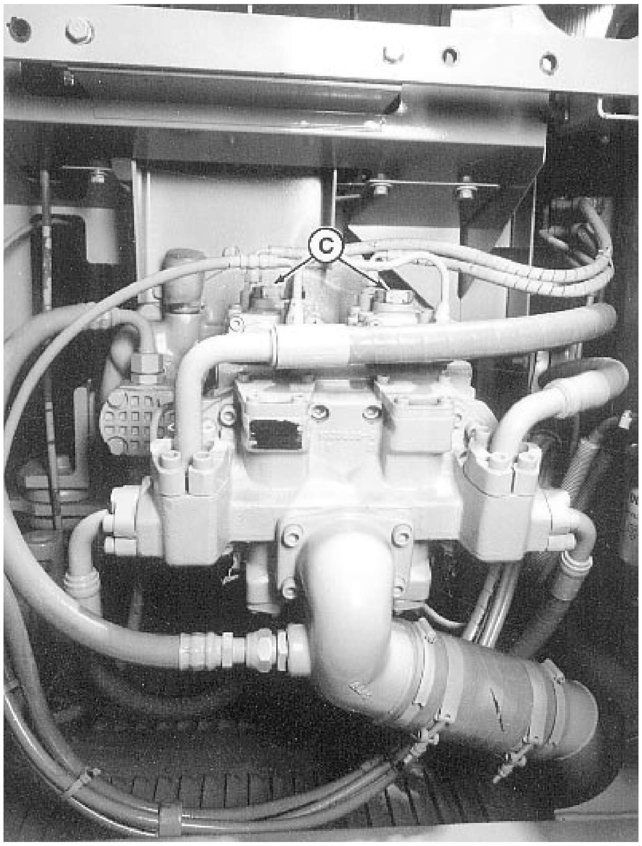
CED,TX08227,2896 –19–19NOV97–1/1

HYDRAULIC PUMP START-UP PROCEDURE

IMPORTANT: Hydraulic pump will be damaged if not filled with oil before starting engine. Procedure must be performed whenever a new hydraulic pump is installed or oil has been drained from the pump or hydraulic oil tank.

Procedure is to ensure the pumps are filled with oil and air is bled from suction side of pumps to prevent cavitation.

1. Add oil until it is between marks on hydraulic oil tank sight glass. (See Hydraulic Oil in Group 9000-04.)
2. Remove air bleed plugs (C) from the top of pump regulators to allow housing to fill with oil from the hydraulic tank and to let air escape.
3. When pump housing is full of oil, install plugs.
4. Check oil level in hydraulic tank. Add oil as necessary. Tighten hydraulic oil tank cap. Tighten vent plug.
5. Start engine and run at slow idle. Slowly raise boom to full height and then lower to pressurize hydraulic oil tank.
6. Purge air from the hydraulic system by slowly operating each function through three cycles. Air in pilot circuits are purged automatically.



T101875 –UN–15JUL96

C—Air Bleed Plugs

TX,25,GG2226 –19–08JUN98–1/1

SWING MOTOR START-UP PROCEDURE

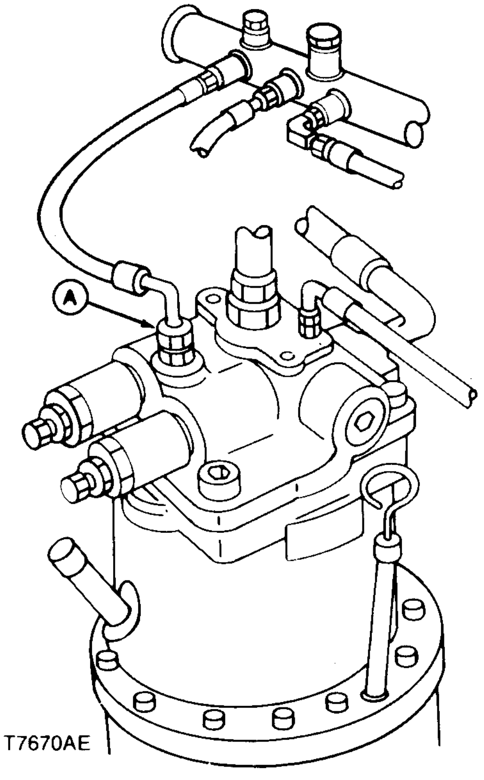
IMPORTANT: Swing motor will be damaged if not filled with oil before operating swing function. Procedure must be performed whenever a new swing motor is installed or oil has been drained from the motor.

Procedure is to ensure the swing motor is filled with oil.

1. Disconnect swing motor drain line (A).
2. Fill motor with hydraulic oil through drain port until oil reaches the level of drain port. (See Hydraulic Oil in Group 9000-04.)

NOTE: Air must be allowed to escape from the swing motor while filling.

3. Connect drain line.



T7670AE –UN–11DEC91

A—Swing Motor Drain Line

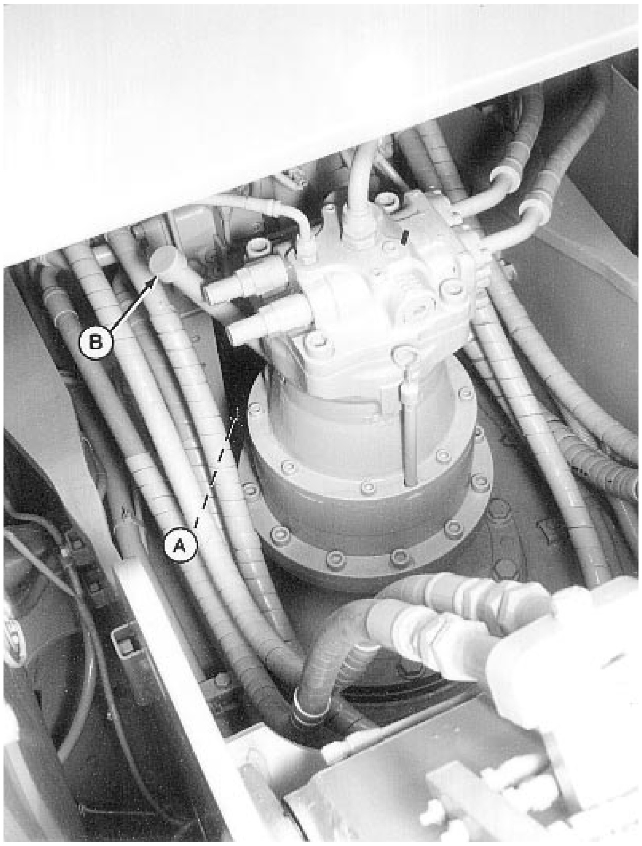
SWING GEARBOX START-UP PROCEDURE

IMPORTANT: Swing gearbox will be damaged if not filled with oil before operating swing function. Procedure must be performed whenever a new swing gearbox is installed or oil has been drained from the gearbox.

1. Check that drain line (A) plug is installed.

2. Remove fill cap (B). Add oil. (See Swing Gearbox, Propel Gearbox and Pump Gearbox Oils in Group 9000-04.)

3. Install fill cap. Check oil level on dipstick.



T102305 –UN–30JUL96

A—Swing Gearbox Drain Line
B—Fill Cap

PROPEL MOTOR START-UP PROCEDURE

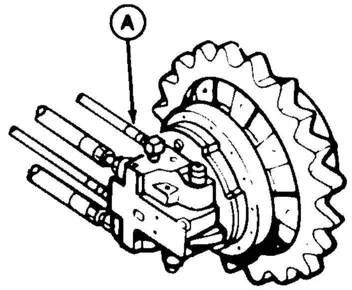
ESSENTIAL TOOLS
JT03221 (Parker No. 03CP—8) Plug

IMPORTANT: Propel motor will be damaged if not filled with oil before starting engine. Procedure must be performed whenever a new propel motor is installed or oil has been drained from the motor.

1. Disconnect motor drain line (A). Install plug.

2. Fill motor with hydraulic oil until oil reaches the top of the drain port. (See Hydraulic Oil in Group 9000-04.) Use a funnel with suitable diameter neck to allow air to escape while filling.

3. Connect drain line.



T7660BG

T7660BG –UN–11DEC91

A—Propel Motor Drain Line

TX,25,GG2229 –19–08JUN98–1/1

HYDRAULIC OIL FILTER INSPECTION PROCEDURE

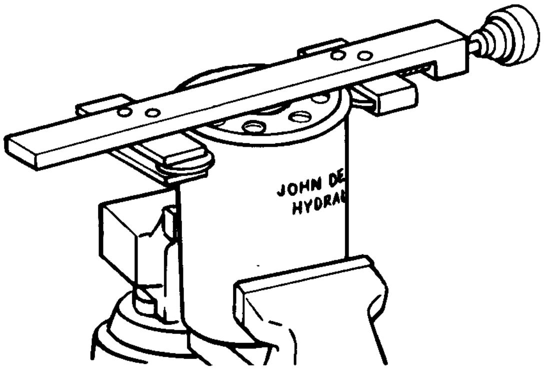
1. Pour oil out of filter to inspect for water contamination.

2. Use an oil filter cutting tool to cut top off filter.

3. Remove element and inspect for metal particles and debris in bottom of filter can.

   Excessive amounts of brass and steel particles can indicate a failed hydraulic pump or a pump failure in process.

   A rubber type of material can indicate cylinder packing failure.



IT4633 –UN–19JAN90

TX,25,GG2231 –19–28AUG96–1/1

HYDRAULIC OIL CLEANUP PROCEDURE USING PORTABLE FILTER CADDY

SPECIFICATIONS	
Hydraulic Oil Tank Capacity	148 L (39 gal) approximate
Hydraulic Oil Tank Filtering Time	13 minutes approximate
Hydraulic System Capacity	270 L (71 gal) approximate
Hydraulic System Filtering Time	43 minutes approximate

SERVICE EQUIPMENT AND TOOLS
Portable Filter Caddy
3658 mm (12 ft) x 3/4 in. ID 100R1 Hose with 3/4 M NPT Ends (2 used)
Quick Disconnect Fittings
Suction Wand
Discharge Wand

1. Install new return filter elements.

NOTE: *For a failure that creates a lot of debris, remove access cover from hydraulic tank. Drain hydraulic tank. Connect filter caddy suction line to drain port. Add a minimum of 19 L (5 gal) of oil to hydraulic oil tank. Operate filter caddy and wash out the hydraulic oil tank.*

IMPORTANT: The minimum ID for a connector is 1/2 in. to prevent cavitation of filter caddy pump.

2. Put filter caddy suction and discharge wands into hydraulic oil tank filler hole so ends are as far apart as possible to obtain a thorough cleaning of oil.

3. Start the filter caddy. Check to be sure oil is flowing through the filters.

   Operate filter caddy until all the oil in hydraulic oil tank has been circulated through the filter a minimum of four times.

Hydraulic Oil Tank—Specification

Capacity .... 148 L (39 gal) approximate
Filtering Time .... 13 minutes approximate

NOTE: *Filtering time for hydraulic oil tank is 0.089 minute x number of liters (0.33 minutes x number of gallons).*

4. Leave filter caddy operating for the next step.

5. Start the engine and run it at fast idle.

IMPORTANT: For the most effective results, cleaning procedure must start with the smallest capacity circuit then proceed to the next larger capacity circuit.

6. Starting with the smallest capacity circuit, operate each function through a complete cycle.

   Repeat procedure until the total system capacity has circulated through filter caddy seven times. Each function must go through a minimum of three complete cycles for a thorough cleaning of oil.

Hydraulic System—Specification

Capacity .... 270 L (71 gal) approximate
Filtering Time .... 43 minutes approximate

NOTE: *Filtering time for complete hydraulic system is 0.158 minute x number of liters (0.6 minute x number of gallons). Filtering time for machines with auxiliary hydraulic functions must be increased because system capacity is larger.*

7. Stop the engine. Remove the filter caddy.

8. Install new return filter elements.

9. Check oil level in hydraulic tank, add oil if necessary. (See Hydraulic Oil in Group 9000-04.)

HYDRAULIC SYSTEM WARM-UP PROCEDURE

SPECIFICATIONS	
Hydraulic System Warm-Up Oil Temperature	50 ± 5°C (120 ± 10°F)

SERVICE EQUIPMENT AND TOOLS
JT05800 Digital Thermometer

IMPORTANT: If the machine temperature is below -18 degrees C (0°F), start the engine with the speed control in the idle position. If the unit has been prepared for arctic operation with the MIL-L-46167 hydraulic oil, the suction strainer in the hydraulic tank should also have been changed to the coarser strainer for use in arctic conditions. Failure to do this could cause the hydraulic pump to cavitate which can cause pump failure. Operate engine at idle speed for at least 10 minutes before increasing the speed to half. Cover the radiator and oil cooler debris screens to restrict the air flow for faster warmup.

Below -18°C (0°F) an extended warm-up period may be necessary. Hydraulic function will move slowly and lubrication of parts may not be adequate with cold oil. Do not attempt normal machine operation until hydraulic functions move at or close to normal cycle times.

Hydraulic System Warm-Up Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10°F)

Operate functions slowly and avoid sudden movements until engine and hydraulic oils are thoroughly warmed. Operate a function by moving it a short distance in each direction. Continue operating the function increasing the distance traveled in each cycle until full stroke is reached.

For faster warm-up, restrict air flow through oil cooler using cardboard or other similar material. Use correct viscosity oil to minimize warm-up period. (See Hydraulic Oil in Group 9000-04.)

1. Connect digital thermometer. Install temperature probe on hydraulic oil tank-to-pump inlet line. (See JT05800 Digital Thermometer Installation in this group.)

⚠ **CAUTION: Avoid possible serious injury from machine movement during warm-up procedure. Clear the area of all bystanders before doing the warm-up procedure.**

2. Clear the area of all bystanders to allow for machine movement.
3. Start engine. Run engine at 1/2 speed for approximately 5 minutes before operating any functions. Do not run engine at fast or slow idle.
4. Check that work mode is in Dig Mode and power mode is in Standard Mode (no buttons pushed down, indicator lights off). Push auto-idle switch to turn off auto-idle function (auto-idle indicator off).
5. Slowly turn upperstructure so boom is to the side.

⚠ **CAUTION: Avoid possible serious injury from machine sliding backwards. Keep angle between boom and arm at 90—110°**

6. Keeping the angle between boom and arm at 90—110°, lower boom to raise one track off the ground.
7. Operate propel function for approximately 5 minute.
8. Once oil temperature is above -18°C (0°F), increase engine speed to fast idle.

Continued on next page

IMPORTANT: Holding a function over relief for more than 10 seconds can cause damage from hot spots in the control valve.

9. Operate the propel function (side with track off the ground). Also operate the bucket curl function over relief for 10 seconds and then stop for 5 seconds. Repeat the cycle until oil is heated to specifications.

10. Stop periodically and operate all hydraulic functions to distribute the heated oil.

TX,25,GG2232 –19–13AUG98–2/2

LOWER BOOM WITH ENGINE STOPPED (USING BOOM CYLINDER LOAD LOWERING VALVE)

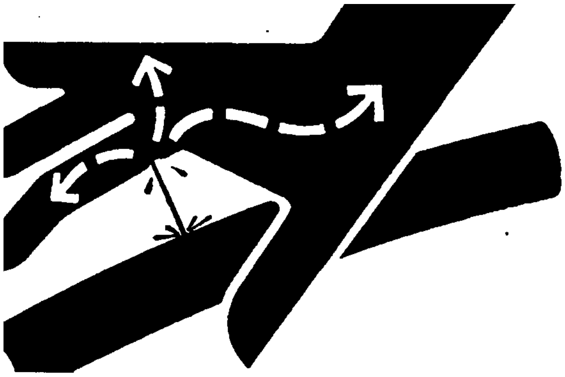
When an engine stops during operation, the boom cannot be lowered using the pilot controller because there is no pilot pressure oil to move the boom valve spool or to unlatch the boom load lowering valves.

Continued on next page

CED,OUOEBAS,6 –19–24JAN00–1/2

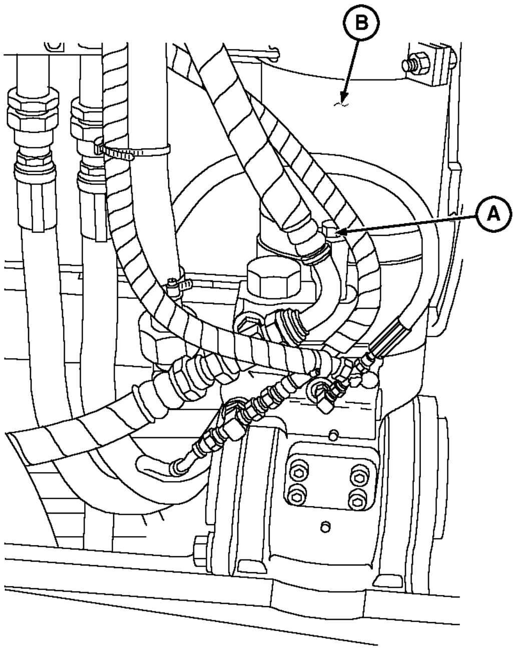
CAUTION: To avoid injury from escaping fluid under pressure, never loosen boom manual lower needle valve more than 4 turns from closed position as valve may come out of housing. Tighten valve and nut before applying pressure.

Prevent possible injury from unexpected machine movement. Clear all persons from the area before lowering the boom with the engine stopped.



X9811 –UN–23AUG88

1. Check that the area is clear of all persons before lowering boom.
2. Loosen jam nut on relief valve (A). Back off relief valve set screw, counting number of turns, until boom starts to lower slowly.
3. After bucket is on ground, reset relief valve (A) by turning set screw clockwise the same number of turns noted in step 2 and lock jam nut.



T127542 –UN–19JAN00

T127542

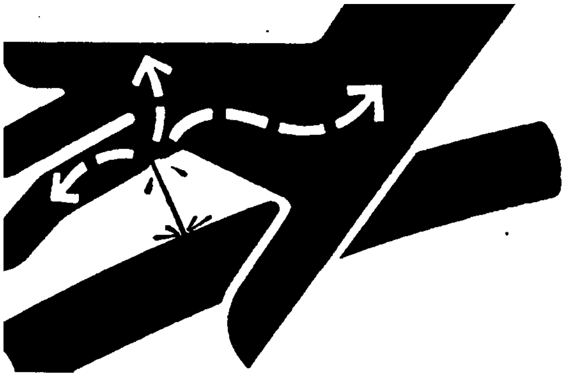
A—Relief Valve
B—Boom Cylinder

CED,OUOEBAS,6 –19–24JAN00–2/2

LOWER BOOM WITH ENGINE STOPPED (WHEN NOT EQUIPPED WITH BOOM CYLINDER LOAD LOWERING VALVE)

SPECIFICATIONS	
Boom Manual Lower Screw Torque	6.9 N•m (60 lb-in.)
Boom Manual Lower Screw-to-Housing Nut Torque	13 N•m (115 lb-in.)

SERVICE EQUIPMENT AND TOOLS
4 mm Hex Key Wrench
13 mm Combination Wrench



X9811 –UN–23AUG88

When an engine stops during operation, the boom cannot be lowered using the pilot controller because there is no pilot pressure oil to move the boom valve spool.

1. Remove the control valve access cover.

CAUTION: To avoid injury from escaping fluid under pressure, never loosen screw more than two turns as screw may come out. Tighten screw and nut before applying pressure.

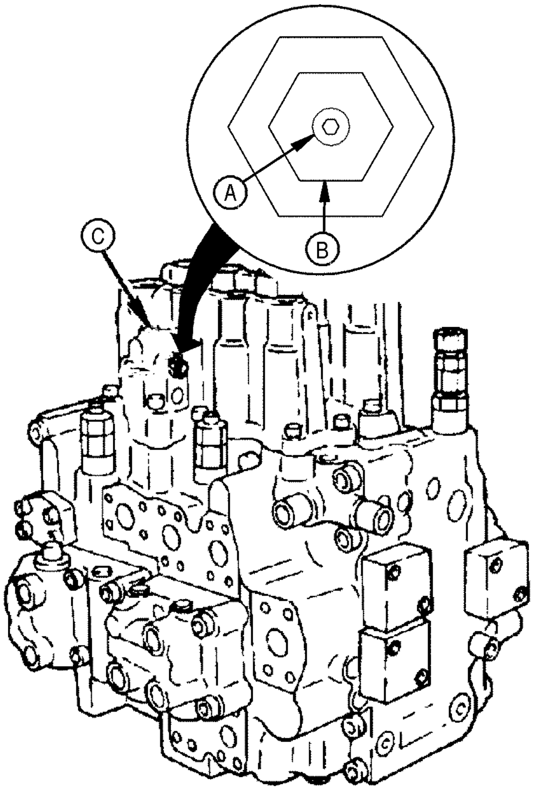
Prevent possible injury from unexpected machine movement. Clear all persons from the area before lowering the boom with the engine stopped.

2. Loosen the small nut (B) on the boom reduced leakage valve housing (C).

   Slowly loosen boom manual lower screw (A) 1/2 turn using a 4 mm hex key wrench. The boom will start to lower.

   The boom lowering speed can be increased somewhat by loosening screw an additional 1-1/2 turns. Never loosen screw more than two turns.

3. After bucket is lowered to the ground, tighten the screw to specification, and then the nut.



T102664 –UN–07AUG96

Boom Manual Lower Screw

A—Boom Manual Lower Screw
B—Small Nut
C—Boom Reduced Leakage Valve Housing

Continued on next page

Boom Manual Lower Screw—Specification

Torque .... 6.9 N•m (60 lb-in.)

Boom Manual Lower Screw-to-Housing Nut—Specification

Torque .... 13 N•m (115 lb-in.)

CED,OUOEBAS,9 –19–25JAN00–2/2

ARM REGENERATIVE PROPORTIONAL SOLENOID VALVE (SC) HARNESS TEST

ESSENTIAL TOOLS
JT07062 Test Harness

The purpose of harness test is to check continuity in wiring harness to the arm regenerative solenoid valve (A) coil and there is a electrical signal from engine and pump controller.

NOTE: Pressure reading shown on the laptop computer for “9 Arm regenerative control pressure” is a calculated pressure from the electrical signal in the engine and pump controller. A typical reading is 399.3 psi while operating the boom up and arm in functions in combined operation with engine speed at 1200 rpm or less. The reading indicates that the rear pump pressure sensor, arm in pressure sensor, and boom up pressure switch are OK and a electrical signal is generated. When all functions are in neutral, a typical reading of 170.4 psi is displayed at fast or slow idle. The reading can vary from machine to machine. What to look for is that there is a reading and it increases when arm in regenerative function is actuated. (For circuit operation, see Arm Regenerative Valve Operation in Group 9025-05.)

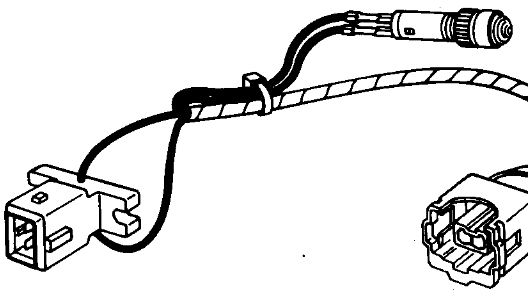
The arm in regenerative function does not operate in Grading and Precision Work Modes.

IMPORTANT: Disconnecting electrical connectors while engine is running or with key switch on can damage engine and pump controller or other electrical components.

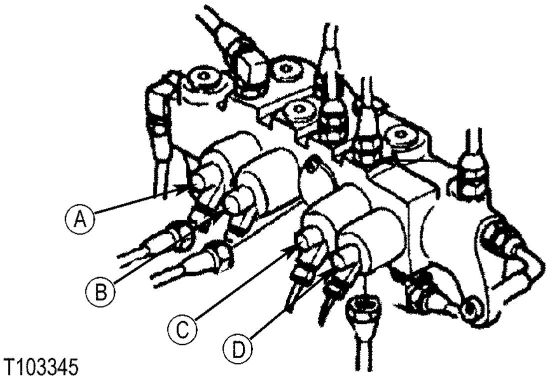
1. Stop engine. Turn key switch to OFF.

2. Remove wire clip. Wiggle connector half and pull apart; do not pull on wiring leads.

3. Install test harness in series with wiring harness and arm regenerative solenoid valve (A).



T7486AL –UN–19MAR91



T103345 –UN–28AUG96

A—Arm Regenerative Solenoid Valve (SC)
B—Speed Sensing Solenoid Valve (SD)
C—Propel Speed Change Solenoid (SI)
D—Power Boost Solenoid Valve (SG)

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Continued on next page

4. Turn key switch to ON but do not start engine.

   Indicator light must come ON indicating there is continuity in the wiring harness and there is a signal from engine and pump controller.

5. Start engine.

6. Actuate boom up function and then arm in function.

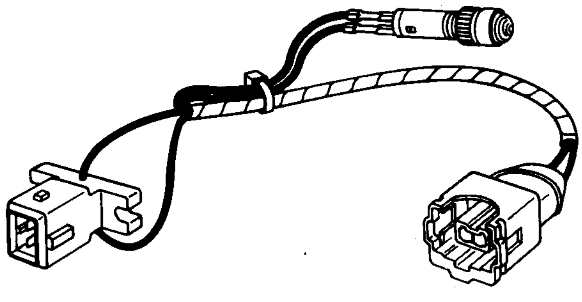
   Indicator light must be ON and the brightness must increase slightly.

   If light goes OUT or brightness does not increase, check wiring harnesses, solenoid coil, rear pump pressure sensor, arm in pilot pressure sensor, and boom up pressure switch. (See procedure in Group 9015-15.)

TX,25,GG2220 –19–21MAY98–2/2

SPEED SENSING SOLENOID VALVE (SD) HARNESS TEST

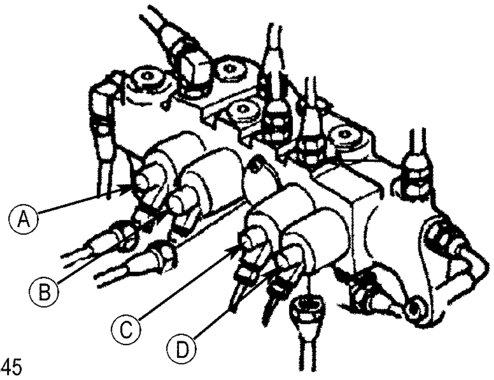
ESSENTIAL TOOLS
JT07062 Test Harness



T7486AL –UN–19MAR91

The purpose of test is to check continuity in wiring harness to the speed sensing solenoid valve (B) coil and there is a electrical signal from engine and pump controller.

NOTE: Pressure reading shown on the laptop computer for “11 Speed sense control pressure” is a calculated pressure from the electrical signal in the engine and pump controller. When all functions are in neutral, a typical reading of 532.8 psi is displayed at slow idle and 0 psi is displayed at fast idle. Run the engine at approximately 1700 rpm so the reading is less than 100 psi. Then actuate arm in to bottom the function. The pressure reading will increase momentarily and then return to its original reading. The readings indicates that the engine speed sensor is OK and a electrical signal is generated. (For circuit operation, see Engine Speed Sensing Control Circuit Operation in Group 9025-05.)



T103345

T103345 –UN–28AUG96

A—Arm Regenerative Solenoid Valve (SC)
B—Speed Sensing Solenoid Valve (SD)
C—Propel Speed Change Solenoid (SI)
D—Power Boost Solenoid Valve (SG)

9025
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42

IMPORTANT: Disconnecting electrical connectors while engine is running or with key switch on can damage engine and pump controller or other electrical components.

1. Stop engine. Turn key switch to OFF.

2. Remove wire clip. Wiggle connector half and pull apart; do not pull on wiring leads.

3. Install test harness in series with wiring harness and speed sensing solenoid valve (B).

4. Turn key switch to ON but do not start engine.

   Indicator light must come ON indicating there is continuity in the wiring harness and there is a signal from engine and pump controller.

Continued on next page

TX,25,GG2221 –19–01JUN98–1/2

5. Start engine.

6. Actuate arm in function over relief to load the engine.

   Indicator light must be ON.

   If indicator light goes OUT, check wiring harnesses, solenoid coil, engine rpm dial, and engine speed sensor. (See procedure in Group 9015-15.)

TX,25,GG2221 –19–01JUN98–2/2

PROPEL SPEED CHANGE PROPORTIONAL SOLENOID VALVE (SI) HARNESS TEST

ESSENTIAL TOOLS
JT07062 Test Harness

The purpose of test is to check continuity in wiring harness to the propel speed change solenoid valve (C) coil and there is a signal from engine and pump controller.

NOTE: Pressure reading shown on the laptop computer for “10 Propel motor control pressure” is a calculated pressure from the electrical signal in the engine and pump controller. A typical reading of 65.9 psi is displayed when propel function is in neutral or propelling in slow speed. A typical reading of 426 psi is displayed when propelling in fast speed with no other function actuated. The readings indicates that the propel speed switch, propel and dig pressure switches, front and rear pump control pressure sensors, and front and rear pump pressure sensors are OK and a electrical signal is generated. (For circuit operation, see Propel Motor Speed Change Circuit Operation in Group 9025-05.)

IMPORTANT: Disconnecting electrical connectors while engine is running or with key switch on can damage engine and pump controller or other electrical components.

1. Stop engine. Turn key switch to OFF.

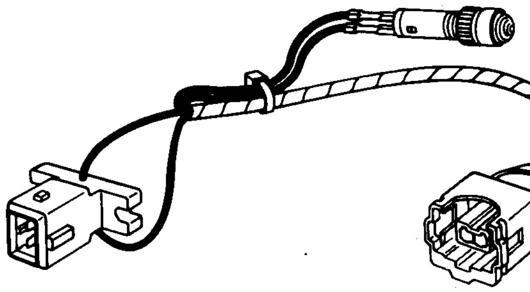
2. Remove wire clip. Wiggle connector half and pull apart; do not pull on wiring leads.

3. Install test harness in series with wiring harness and propel speed change solenoid valve (C).

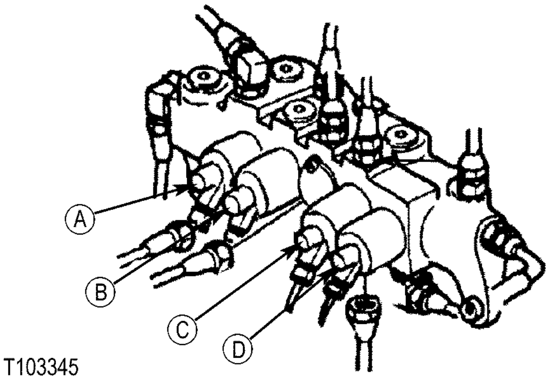
4. Turn key switch to ON but do not start engine.

5. Turn propel speed switch to fast speed (rabbit).

   Turn propel speed switch to slow speed propel (turtle).



T7486AL –UN–19MAR91



T103345 –UN–28AUG96

A—Arm Regenerative Solenoid Valve (SC)
B—Speed Sensing Solenoid Valve (SD)
C—Propel Speed Change Solenoid (SI)
D—Power Boost Solenoid Valve (SG)

Continued on next page

Indicator light must be ON indicating there is continuity in the wiring harness and there is a signal from engine and pump controller.

6. Start engine.

7. Actuate propel function.

8. Turn propel speed switch to fast speed (rabbit).

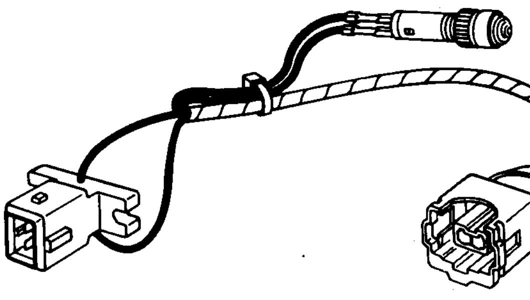
   The brightness of indicator light must increase slightly while propelling in fast speed.

   If light goes OUT or brightness does not increase, check wiring harnesses, solenoid coil, propel pressure switch, pump pressure, and pump control valve pressure sensors. (See procedure in Group 9015-15.)

NOTE: No dig functions can be actuated. The dig pressure switch must be OFF so it does not send an electrical signal to engine and pump controller.

POWER BOOST PROPORTIONAL SOLENOID VALVE (SG) HARNESS TEST

ESSENTIAL TOOLS
JT07062 Test Harness

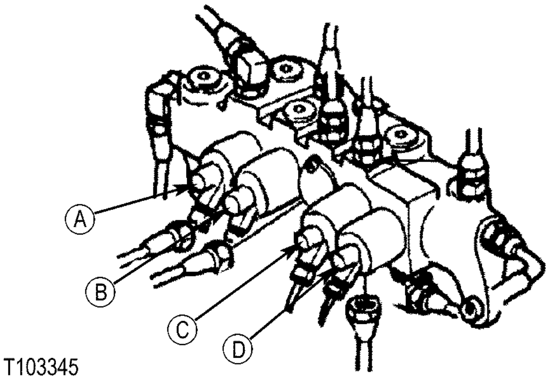


T7486AL –UN–19MAR91

The purpose of test is to check continuity in the wiring harness to the power boost solenoid valve (D) coil and there is a signal from the engine and pump controller.

NOTE: *Pressure reading shown on the laptop computer for "12 Power boost control pressure" is a calculated pressure from the electrical signal in the engine and pump controller. A typical reading of 426 psi is displayed when power boost switch on the right control lever is pushed. A reading of 0 psi is displayed when the switch is not pushed. The readings indicates that the power boost switch is OK and a electrical signal is generated. (For circuit operation, see Power Boost Control Circuit Operation in Group 9025-05.)*

The power boost solenoid valve is also actuated in Precision Work Mode when boom up function is actuated.



T103345 –UN–28AUG96

A—Arm Regenerative Solenoid Valve (SC)
B—Speed Sensing Solenoid Valve (SD)
C—Propel Speed Change Solenoid (SI)
D—Power Boost Solenoid Valve (SG)

9025
25
46

IMPORTANT: Disconnecting electrical connectors while engine is running or with key switch on can damage engine and pump controller or other electrical components.

1. Stop engine. Turn key switch to OFF.

2. Remove wire clip. Wiggle connector half and pull apart; do not pull on wiring leads.

3. Install test harness in series with wiring harness and power boost solenoid valve (D).

4. Turn key switch to ON but do not start engine.

   Indicator light must come ON indicating there is continuity in the wiring harness and there is a signal from engine and pump controller.

Continued on next page

TX,9025,GG2713 –19–01JUN98–1/2

Tests

5. Push the power boost switch on the right control lever.

   The brightness of indicator light must increase slightly.

   If light goes OUT or brightness does not increase slightly, check wiring harnesses, solenoid coil, and power boost switch. (See procedure in Group 9015-15.)

TX,9025,GG2713 –19–01JUN98–2/2

ENGINE CONTROL SENSOR (EC SENSOR) HARNESS TEST

SPECIFICATIONS	
Engine Control (EC) Sensor Resistance	2000 ± 400 ohms between ground and power terminals
Fast Idle in Standard Mode Voltage	3.3—3.7 volts typical
E (Economy) Mode Voltage	3.0—3.3 volts typical
Auto-Idle Mode Voltage	2.7—2.9 volts typical
Slow Idle Voltage	2.5—2.7 volts typical
HP (High Power) Mode With Arm In Function Over Relief Voltage	Fast idle in standard mode voltage plus 0.1 volt or more typical

ESSENTIAL TOOLS
JT07066 Test Harness

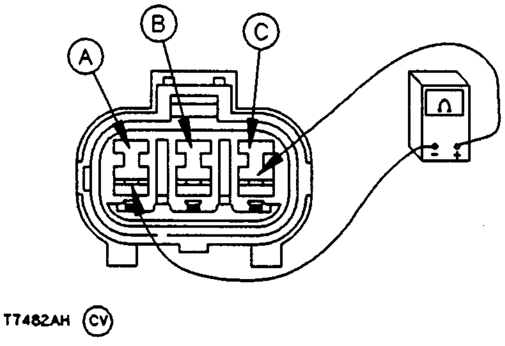
SERVICE EQUIPMENT AND TOOLS
JT07306 Analog/Digital Multimeter

The purpose of test is to check continuity in engine control sensor (EC sensor) wiring harness and there is a signal from the engine and pump controller (EPC).

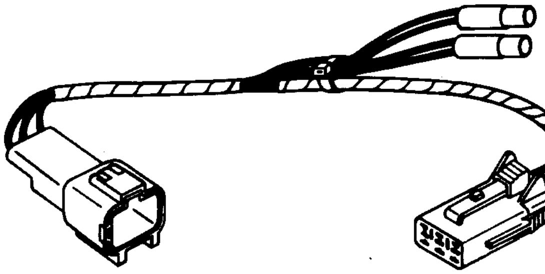
NOTE: The reading displayed on the laptop computer for “2 EC angle” is the feedback signal from the engine control sensor to the engine and pump controller. See the specification chart above for typical readings for fast idle, slow idle, E mode, HP mode, and auto-idle mode. The readings can vary from machine to machine. What to look for is that the readings change when the engine rpm dial is turned, and the E mode, HP mode, or auto-idle mode is actuated. The readings indicates engine control sensor is OK. (For circuit operation, see Engine Speed Control System Operation in Group 9010-05.)

IMPORTANT: Disconnecting electrical connectors while engine is running or with key switch on can damage engine and pump controller or other electrical components.

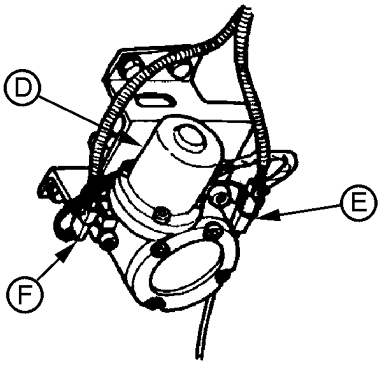
1. Stop engine. Turn key switch to OFF.



T7482AH –UN–19MAR91



T7486AB –UN–19MAR91



T106991

T106991 –UN–07FEB97

A—Ground Terminal
B—Signal Terminal
C—Power Terminal
D—Engine Control Motor
E—Engine Control Sensor Wiring Harness
F—Engine Control Motor Wiring Harness

Continued on next page

IMPORTANT: Retainer tab on male half of wiring harness connector halves must be pushed down before pulling halves apart. Never pull on wiring leads

2. Push retainer tab down then pull connector halves apart.

3. Measure resistance between the ground (A) and power (C) terminals of EC sensor. If resistance is to specification, go to next step. If resistance is not as specified, replace EC sensor.

Engine Control (EC) Sensor—Specification

Resistance .... 2000 ± 400 ohms between ground and power terminals

NOTE: EC sensor is on the inside of EC motor housing.

4. When using a volt meter, install test harness in series with wiring harness for EC sensor (E). Connect volt meter.

   When using the laptop computer with excavator diagnostics program, select “2 EC angle” from the Monitor Data Items. (See the installation procedure in this group.)

5. Turn the engine rpm dial to the slow idle position.

6. Turn key switch ON. EC motor (D) goes to the slow idle position.

7. Turn engine rpm dial to fast idle, push E mode switch, push auto-idle switch then wait 4 seconds, and then turn engine rpm dial to slow idle. EC motor must move to each position. Record voltage reading for each mode.

Fast Idle in Standard Mode—Specification

Voltage.. 3.3—3.7 volts typical

E (Economy) Mode—Specification

Voltage.. 3.0—3.3 volts typical

Continued on next page

Auto-Idle Mode—Specification

Voltage.. 2.7—2.9 volts typical

Slow Idle—Specification

Voltage.. 2.5—2.7 volts typical

For HP (high power) mode, run engine at fast idle, push HP mode switch, and then actuate arm in function over relief. Record voltage reading.

HP (High Power) Mode With Arm In Function Over Relief—Specification

Voltage... Fast idle in standard mode voltage plus 0.1 volt or more typical

TX,9025,GG2710 –19–13AUG98–3/3

ENGINE CONTROL MOTOR (EC MOTOR) HARNESS TESTS

ESSENTIAL TOOLS
JT07065 Test Harness

The purpose of test is to check continuity of EC motor wiring harness (F) and there is a signal from engine and pump controller (EPC).

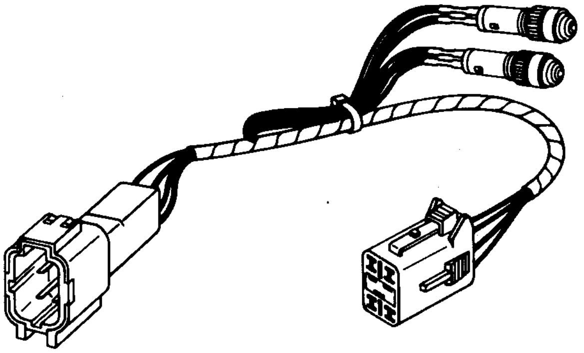
NOTE: The laptop computer with excavator diagnostics program can be used to check the electrical signal from the engine and pump controller to the engine control motor. Select “15 EC motor position” from Monitor Data Items. Typical readings are 72—76 steps at slow idle to 525—550 steps at fast idle. The readings can vary from machine to machine. What to look for is that the readings change when the engine rpm dial is turned, and the E mode, HP mode, or auto-idle mode is actuated.

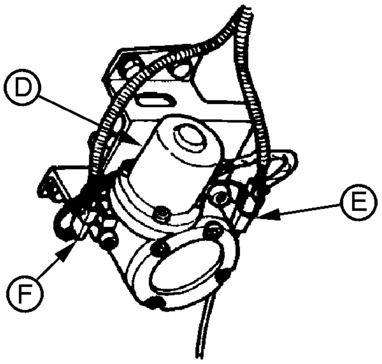
IMPORTANT: Disconnecting electrical connectors while engine is running or with key switch on can damage engine and pump controller or other electrical components.

1. Stop engine. Turn key switch to OFF.

IMPORTANT: Retainer tab on male half of wiring harness connector halves must be pushed down before pulling halves apart. Never pull on wiring leads.

2. Push retainer tab down then pull connector halves apart.
3. Install test harness in series with the engine control motor wiring harness (F).
4. Turn key switch to ON.
5. While observing test indicator lights,
   a. Turn engine rpm dial from slow idle to fast idle,





D—Engine Control Motor
E—Engine Control Sensor Wiring Harness
F—Engine Control Motor Wiring Harness

Continued on next page

b. Push E mode switch,

c. Push auto-idle switch; wait approximately 4 seconds,

d. And then turn engine rpm dial to slow idle.

EC motor (D) must move the speed control linkage to each position. Indicators must be ON and change randomly from bright to dim or dim to bright as engine rpm dial and switches are pushed to indicate there is continuity in the wiring harness and there is a signal from the engine and pump controller (EPC).

If one indicator is OFF, check continuity in that circuit. If both indicators are OFF, check the wiring harness and relay. (See procedure in Group 9015-15.)

MISCELLANEOUS COMPONENT HARNESS TEST

ESSENTIAL TOOLS
JT07067 Test Harness

The purpose of tests are to check continuity in miscellaneous circuits and wiring harnesses when a volt meter is not available.

IMPORTANT: Disconnecting electrical connectors while engine is running or with key switch on can damage engine and pump controller or other electrical components.

Retainer tab on male half of wiring harness connector halves must be pushed down before pulling halves apart. Never pull on wiring leads.

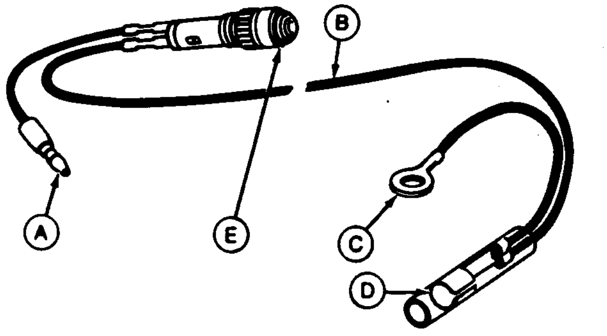
1. Test harness may be used as a probe light. Indicator light (E) comes ON when connector (A) contacts 24 volts while eyelet (C) or bullet connector (D) is grounded.

2. Test harness may also be connected in series with components using bullet connectors (A and D). When circuit is energized, indicator light (E) comes ON.

NOTE: Indicator light will not come ON if test harness is connected to the ground side of a component.

3. Energize circuit being tested.

4. Observe indicator light (E). If light come ON, the fuses, wiring harness, and switches to accessory have continuity to the battery.



T7486AG –UN–19MAR91

A—Bullet Connector
B—Harness
C—Eyelet
D—Bullet Connector
E—Indicator Light

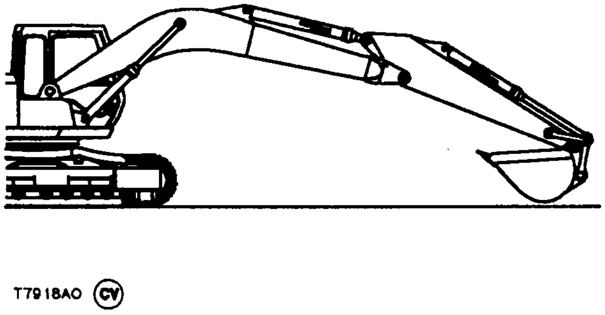
TX,25,GG2224 –19–22APR98–1/1

CYCLE TIME TEST

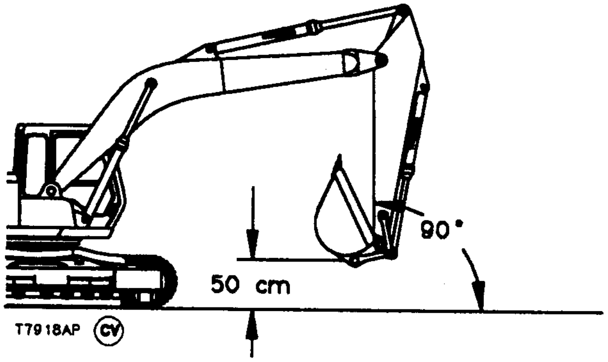
SPECIFICATIONS	
Hydraulic Oil Temperature	50 ± 5°C (120 ± 10°F)
Engine Speed	Fast Idle
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
Boom Up Cycle Time	3.1 ± 0.3 sec
Boom Down Cycle Time	2.5 ± 0.3 sec
Arm In Cycle Time	3.9 ± 0.3 sec
Arm Out Cycle Time	2.6 ± 0.3 sec
Bucket Load Cycle Time	4.1 ± 0.3 sec
Bucket Dump Cycle Time	2.5 ± 0.3 sec
Swing—Check Left and Right Cycle Time	14.4 ± 1.0 sec for three revolutions from a running start
Fast Speed Propel—Check Forward and Reverse Cycle Time	13.4 ± 1.0 sec for 20 m (65 ft) from a running start
Slow Speed Propel—Check Forward and Reverse Cycle Time	20.6 ± 2.0 sec for 20 m (65 ft) from a running start
Slow Speed Propel With Track Raised—Check Forward and Reverse Cycle Time	29.9 ± 2.0 sec for three revolutions from a running start

SERVICE EQUIPMENT AND TOOLS
JT05800 Digital Thermometer
Stop Watch

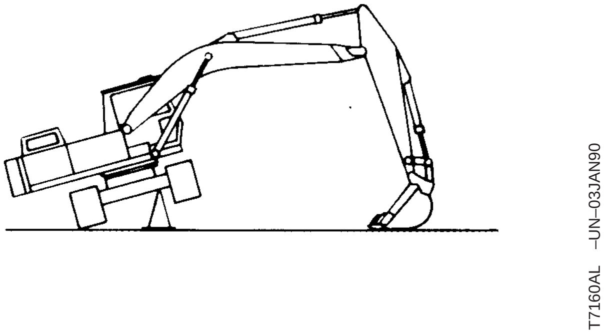
Test is used as an indication of overall engine and hydraulic system performance. A slow cycle time is an indication of a leaky or malfunctioning hydraulic system component or a weak engine.



Boom Position



Arm, Bucket, Swing and Propel Position



Propel 3-Revolution Position

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TX,9025,GG2645 –19–21MAY98–1/3

1. Adjust track sag to specifications. (See procedure in Group 9020-20.)

2. Install the temperature probe on the hydraulic tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)

3. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

Hydraulic Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10°F)

4. Move machine to position shown for each test. Run machine at specifications.

Engine—Specification

Speed .... Fast Idle

Work Mode Selector—Specification

Position .... Dig Mode

E Mode Switch—Specification

Position .... Off

HP Mode Switch—Specification

Position .... Off

Auto-Idle Switch—Specification

Position .... Off

5. Actuate control valve to full stroke for each function. Record the cycle time for each function.

Boom Up—Specification

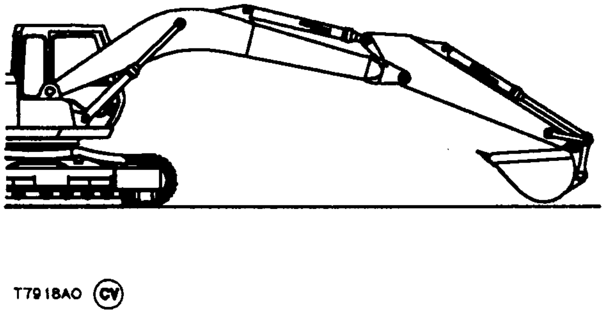
Cycle Time.. 3.1 ± 0.3 sec

Boom Down—Specification

Cycle Time.. 2.5 ± 0.3 sec

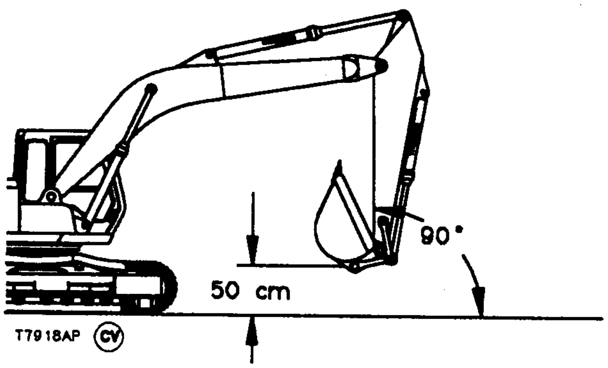
Arm In—Specification

Cycle Time.. 3.9 ± 0.3 sec



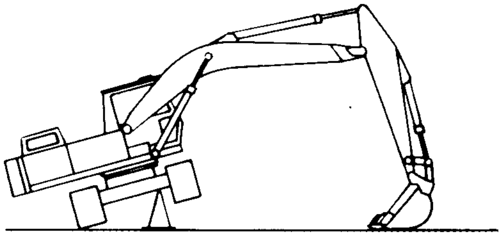
T7918AO –UN–11JAN93

Boom Position



T7918AP –UN–11JAN93

Arm, Bucket, Swing and Propel Position



T7160AL –UN–03JAN90

Propel 3-Revolution Position

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Arm Out—Specification

Cycle Time.. 2.6 ± 0.3 sec

Bucket Load—Specification

Cycle Time.. 4.1 ± 0.3 sec

Bucket Dump—Specification

Cycle Time.. 2.5 ± 0.3 sec

Swing—Check Left and Right—Specification

Cycle Time.. 14.4 ± 1.0 sec for three revolutions from a running start

Fast Speed Propel—Check Forward and Reverse—Specification

Cycle Time... 13.4 ± 1.0 sec for 20 m (65 ft) from a running start

Slow Speed Propel—Check Forward and Reverse—Specification

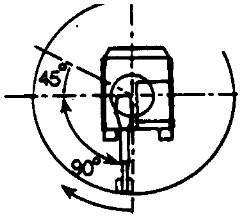
Cycle Time... 20.6 ± 2.0 sec for 20 m (65 ft) from a running start

Slow Speed Propel With Track Raised—Check Forward and Reverse—Specification

Cycle Time.. 29.9 ± 2.0 sec for three revolutions from a running start

TX,9025,GG2645 –19–21MAY98–3/3

SWING DYNAMIC BRAKING TEST



T6479AY –UN–19OCT88

SPECIFICATIONS	
Oil Temperature	50 ± 5°C (120 ± 10°F)
Engine Speed in Standard Mode	Fast Idle
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
After 90° (1/4 turn) Swing, Upperstructure Must Stop After Releasing Control Lever Within Distance	45° (1/8 turn)

SERVICE EQUIPMENT AND TOOLS
JT05800 Digital Thermometer

1. Install the temperature probe on the hydraulic tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)

2. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10°F)

CAUTION: Check that area is clear and large enough to swing upperstructure with arm and bucket extended. Machine must be on level ground.

3. Turn upperstructure so boom is to the front

4. Extend the arm and bucket. Lower boom so bucket is approximately 900 mm (3 ft) above the ground.

5. Operate machine at specifications.

Engine—Specification

Speed in Standard Mode .... Fast Idle

Work Mode Selector—Specification

Position .... Dig Mode

9025
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Continued on next page

E Mode Switch—Specification

Position .... Off

HP Mode Switch—Specification

Position .... Off

Auto-Idle Switch—Specification

Position .... Off

6. Actuate the swing control lever to full stroke. Swing 90° (1/4 turn) and then release control lever.

   Upperstructure must come to a stop within 45° (1/8 turn) after releasing control lever.

After 90° (1/4 turn) Swing, Upperstructure Must Stop After Releasing Control Lever Within—Specification

Distance .... 45° (1/8 turn)

Repeat procedure in the opposite direction.

If upperstructure does not stop within 45° (1/8 turn), check the following:

- Swing motor leakage. (See procedure in this group.)
- Swing motor crossover relief valves. (See procedure in this group.)
- Inspect swing valve spool. (See procedure in Group 3360.)

NOTE: The swing park brake does not stop the upperstructure. The engagement of swing park brake is delayed several seconds because hydraulic oil is released from the piston cavity through an orifice to return.

PILOT PRESSURE REGULATING VALVE TEST AND ADJUSTMENT

SPECIFICATIONS	
Oil Temperature	50 ± 5°C (120 ± 10°F)
Engine in Standard Mode Speed	Fast Idle
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
Pilot System Pressure	3925 + 980 - 490 kPa (39.2 + 9.8 - 4.9 bar) (570 + 140 - 70 psi)
Per 0.25 mm (0.010 in.) Shim Approximate Change Pressure	78 kPa (0.75 bar) (11 psi)
Per 0.5 mm (0.020 in.) Shim Approximate Change Pressure	157 kPa (1.57 bar) (23 psi)
Per 1.0 mm (0.040 in.) Shim Approximate Change Pressure	304 kPa (3.04 bar) (44 psi)
Plug-to-Pilot Pressure Regulating Housing Torque	25 N•m (215 lb-in.)

ESSENTIAL TOOLS
202862 (3/4-16 M 37° x 3/4-16 F 37° Sw x 7/16-20 M 37°) Tee
TH108328 Adapter
6 mm Hex Key Wrench

SERVICE EQUIPMENT AND TOOLS
Gauge 7000 kPa (70 bar) (1000 psi)
JT05800 Digital Thermometer
JT02156A Digital Pressure and Temperature Analyzer

Purpose of test is to ensure there is enough pilot pressure to operate all the pilot system functions and to adjust the pressure as necessary. The pilot pressure regulating valve is used to regulate the pilot system pressure.

Continued on next page

TX,9025,GG2646 –19–08JUN98–1/6

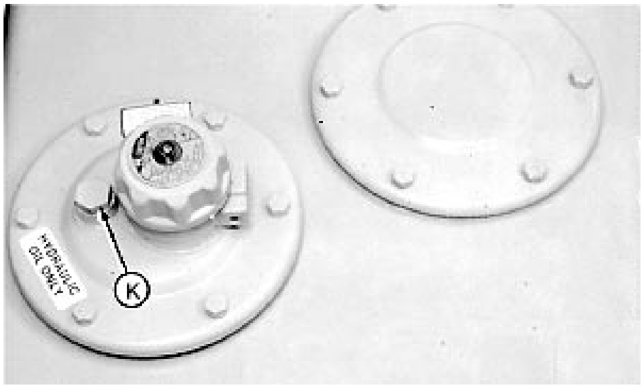
NOTE: The laptop computer with the excavator diagnostic software can be used to make a quick check of the pilot system pressure using the arm in function. Connect the computer and select “5 Arm roll-in pilot pressure” from monitor data menu. Run engine at fast idle and then actuate arm in function over relief. The pressure reading displayed is from the arm in pressure sensor located in the flow regulator valve.

Before making any adjustments, check the pilot pressure at the pilot pump using a pressure gauge.

1. Stop the engine.

TX,9025,GG2646 –19–08JUN98–2/6

2. Loosen vent plug (K) to release the air pressure in hydraulic oil tank.



T109340 –UN–29APR97

K—Vent Plug

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TX,9025,GG2646 –19–08JUN98–3/6

3. Disconnect pilot filter inlet line (D) at pilot filter. Install tee (B) and gauge (C).

   Pressure can also be checked at the test port in fitting at outlet port of pilot pump (F). Install adapter (G) and gauge (C).

NOTE: Because the plug is installed dry at the factory, the plug can be difficult to remove.

4. Install the temperature probe on the hydraulic tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)

5. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10°F)

6. Run machine at specifications. Record pressure reading for pilot pressure regulating valve (A).

Engine in Standard Mode—Specification

Speed .... Fast Idle

Work Mode Selector—Specification

Position .... Dig Mode

E Mode Switch—Specification

Position .... Off

HP Mode Switch—Specification

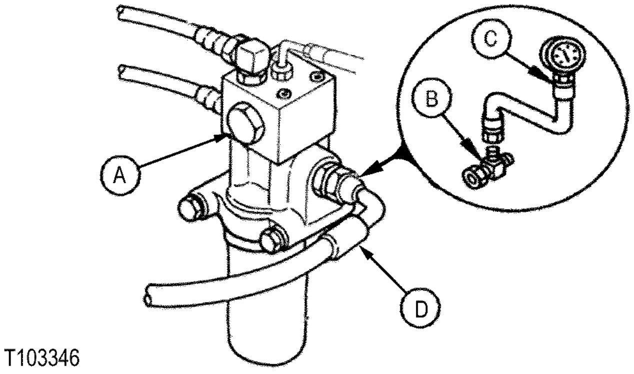
Position .... Off

Auto-Idle Switch—Specification

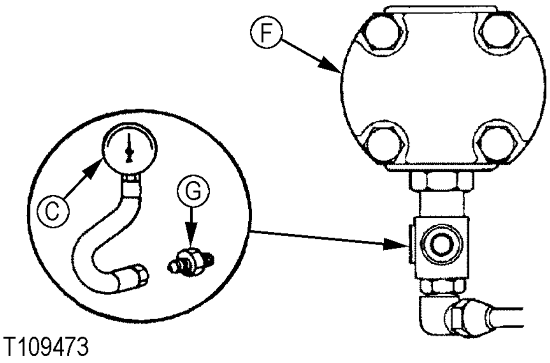
Position .... Off

Pilot System—Specification

Pressure .... 3925 + 980 - 490 kPa
(39.2 + 9.8 - 4.9 bar)
(570 + 140 - 70 psi)



T103346 –UN–11SEP96



T109473 –UN–12MAY97

A—Pilot Pressure Regulating Valve
B—Tee Fitting
C—Gauge
D—Pilot Filter Inlet Line
E—Pilot Pump
G—Adapter

Continued on next page

Per 0.25 mm (0.010 in.) Shim Approximate Change—Specification

Pressure .... 78 kPa (0.75 bar) (11 psi)

Per 0.5 mm (0.020 in.) Shim Approximate Change—Specification

Pressure .... 157 kPa (1.57 bar) (23 psi)

Per 1.0 mm (0.040 in.) Shim Approximate Change—Specification

Pressure .... 304 kPa (3.04 bar) (44 psi)

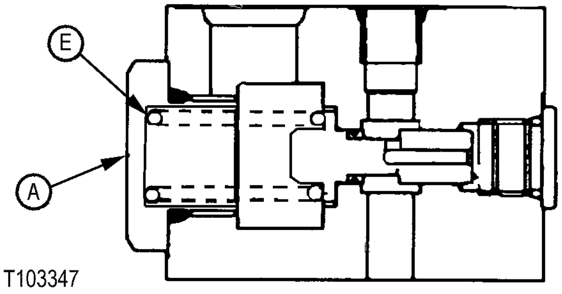
TX,9025,GG2646 –19–08JUN98–5/6

7. As necessary, remove plug for pilot pressure regulating valve (A). Add shims (E) to increase pressure; remove shims to decrease pressure.

8. Tighten plug.

Plug-to-Pilot Pressure Regulating Housing—Specification

Torque .... 25 N•m (215 lb-in.)



T103347 –UN–11SEP96

A—Pilot Pressure Regulating Valve
E—Shims

TX,9025,GG2646 –19–08JUN98–6/6

VALVE SPOOL ACTUATING PILOT PRESSURE TEST

SPECIFICATIONS	
Oil Temperature	50 ± 5°C (120 ± 10°F)
Engine Speed in Standard Mode	Slow Idle and Fast Idle
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
Valve Spool Actuating Pressure	3335—3920 kPa (33.3—39.2 bar) (485—570 psi)

ESSENTIAL TOOLS
203836 (9/16-18 M 37° x 9/16-18 Sw 37° x 7/16-20 M 37°) Tee

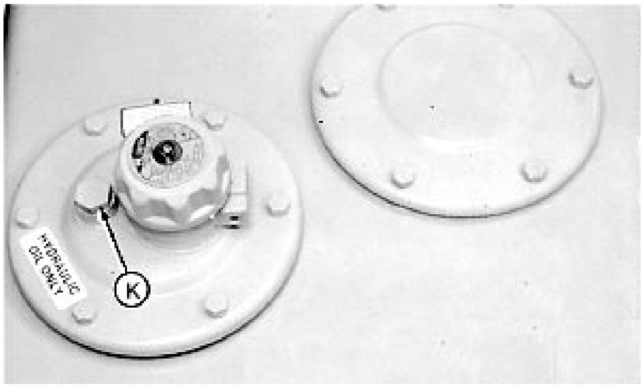
SERVICE EQUIPMENT AND TOOLS
Gauge 7000 kPa (70 bar) (1000 psi)
JT05800 Digital Thermometer

Purpose of test is to ensure that the pilot pressure to the valve spools is enough to shift the spools.

1. Stop engine.

TX,9025,GG2647 –19–08JUN98–1/4

2. Loosen vent plug (K) to release the air pressure in hydraulic oil tank.



T109340 –UN–29APR97

K—Vent Plug

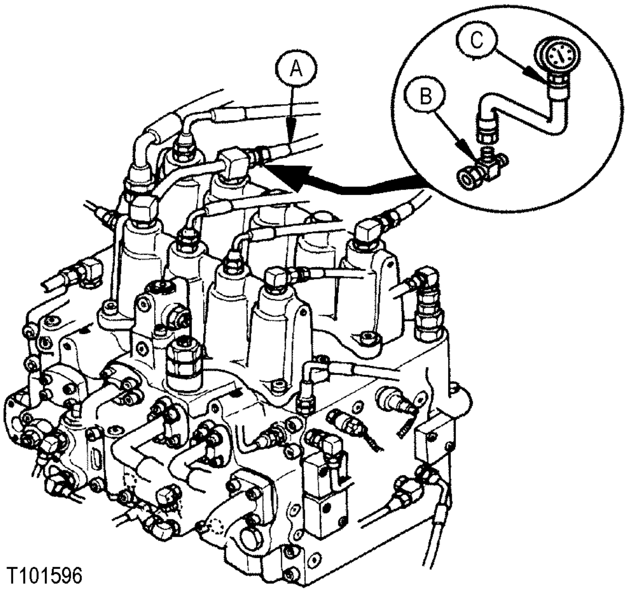
Continued on next page

TX,9025,GG2647 –19–08JUN98–2/4

3. Disconnect a pilot line (A) at pilot cap fitting. Install tee (B) and pressure gauge (C).

4. Install the temperature probe on the hydraulic tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)

5. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)



T101596 –UN–18JUN96

A—Pilot Line
B—Tee Fitting
C—Gauge

Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10°F)

6. Start and run engine at specification.

Engine—Specification

Speed in Standard Mode .... Slow Idle and Fast Idle

Work Mode Selector—Specification

Position .... Dig Mode

E Mode Switch—Specification

Position .... Off

HP Mode Switch—Specification

Position .... Off

Auto-Idle Switch—Specification

Position .... Off

Valve Spool Actuating—Specification

Pressure .... 3335—3920 kPa (33.3—39.2 bar)
(485—570 psi)

NOTE: Spool actuating pressure can be checked for each function by installing the tee and gauge in that pilot line and then actuating that function.

7. Actuate the function being checked to full stroke.

   If valve spool actuating pressure is not to specification, check pilot system pressure. (See Pilot Pressure Regulating Valve Test and Adjustment in this group.

Continued on next page

Tests

If pilot system pressure is to specification, then check pilot pressure at the pilot shutoff valve, pilot controllers, and flow regulator

TX,9025,GG2647 –19–08JUN98–4/4

SYSTEM RELIEF AND POWER BOOST VALVE TEST AND ADJUSTMENT

SPECIFICATIONS	
Oil Temperature	50 ± 5°C (120 ± 10°F)
Engine in Standard Mode Speed	Fast Idle
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
System Relief Valve Pressure	34 325 + 1960 - 0 kPa (343 + 19.6 - 0 bar) (4980 + 285 - 0 psi)
System Relief Valve Pressure	5295 kPa (53.0 bar) (770 psi) approximate change per 1/4 turn of second adjusting plug
Power Boost Pressure	36 285 + 1960 - 980 kPa (362.9 + 19.6 - 9.8 bar) (5265 + 285 - 140 psi)
Power Boost Pressure	7110 kPa (71.1 bar) (1030 psi) approximate change per 1/4 turn of first adjusting plug
32 mm Nut Torque	78—88 N•m (58—65 lb-ft)
27 mm Nut Torque	59—68 N•m (43—51 lb-ft)

9025
25
66

ESSENTIAL TOOLS
TH108328 Adapter (2 used)
XPD34BTX (1/8 x 7/16-20 F 37°) Male Quick Coupler

SERVICE EQUIPMENT AND TOOLS
JT07290 Laptop Computer
JT07274G Excavator Diagnostics Program Disk
JT07273 Cable
JT02156A Digital Pressure and Temperature Analyzer
JT02160 Transducer 70 000 kPa (700 bar) (10 000 psi)
Gauge 70 000 kPa (700 bar) (10 000 psi)
JT05800 Digital Thermometer
6 mm Hex Key Wrench
15, 17, 19, 27 and 32 mm Combination Wrenches

The purpose of the system relief valve is to limit the maximum pressure in the hydraulic system. The valve is checked and adjusted to protect components from damage cause by excessive pressures.

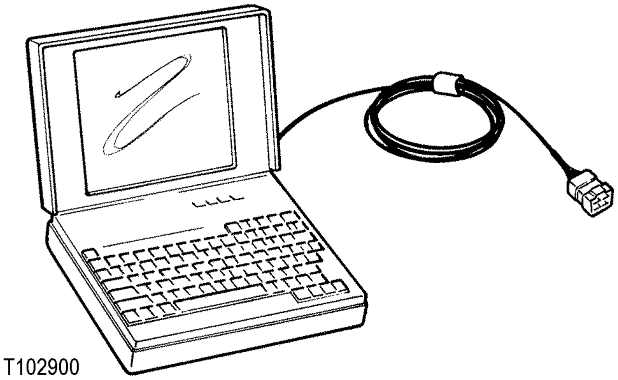
Continued on next page

Tests

1. Connect the laptop computer. (See the installation procedure in this group.)

   a. Start the engine.

   b. Select “3 Front pump delivery pressure” and “4 Rear pump delivery pressure” from the Monitor Data menu.



T102900 –19–29AUG96

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TX,9025,GG2648 –19–08JUN98–2/5

If laptop computer is not available, use the digital pressure and temperature analyzer, and transducers or gauges.

a. Stop the engine.

b. Loosen vent plug (K) to release the air pressure in hydraulic oil tank.

c. Install adapter (A) and male quick coupler to test port on front pump (C) or rear pump (B). Connect the analyzer and transducers or gauges.

2. Install the temperature probe on the hydraulic oil tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)
3. Raise and lower boom to pressurize hydraulic oil tank.
4. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10°F)

5. Run machine at specification.

Engine in Standard Mode—Specification

Speed .... Fast Idle

Work Mode Selector—Specification

Position .... Dig Mode

E Mode Switch—Specification

Position .... Off

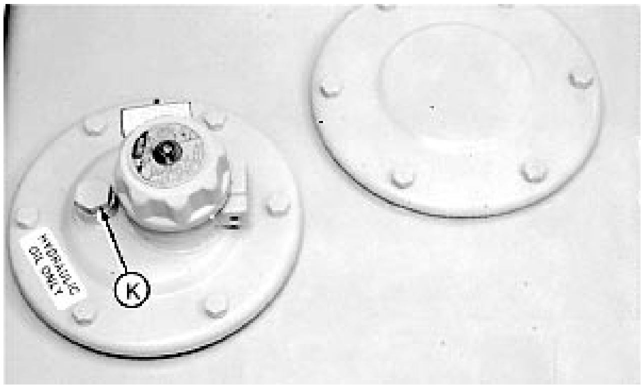
HP Mode Switch—Specification

Position .... Off

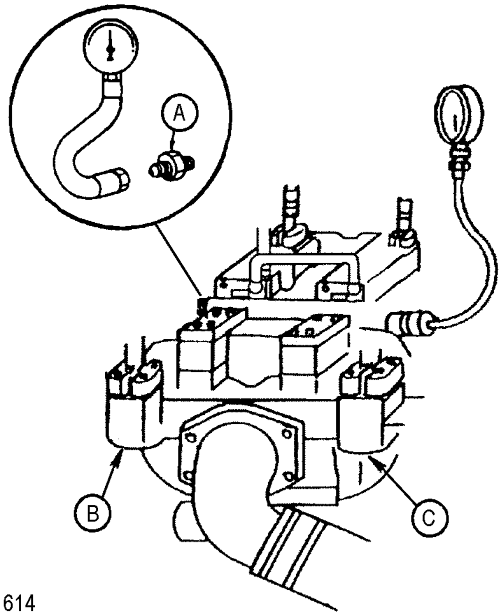
Auto-Idle Switch—Specification

Position .... Off

6. Actuate the arm in function over relief.



T109340 –UN–29APR97



T101614 –UN–18JUN96

A—Adapter
B—Rear Pump
C—Front Pump
K—Vent Plug

Continued on next page

Record the pressure reading for the system relief valve.

System Relief Valve—Specification

Pressure .... 34 325 + 1960 - 0 kPa
(343 + 19.6 - 0 bar)
(4980 + 285 - 0 psi)
Pressure .... 5295 kPa (53.0 bar) (770 psi)
approximate change per 1/4 turn
of second adjusting plug

7. Actuate the bucket curl function over relief and then push the power boost button on the right control lever.

   Record the pressure reading for power boost.

Power Boost—Specification

Pressure .... 36 285 + 1960 - 980 kPa
(362.9 + 19.6 - 9.8 bar)
(5265 + 285 - 140 psi)
Pressure .... 7110 kPa (71.1 bar) (1030 psi)
approximate change per 1/4 turn
of first adjusting plug

8. Adjust the power boost and system relief valve pressures as needed using the following steps.

Continued on next page

9. Disconnect pilot line from elbow in system relief valve (D) so adjustment can be made without twisting power boost pilot line. Connect pilot line before starting engine and applying pressure.

10. Loosen 27 mm nut (F).

11. Turn first adjusting plug (E) in until piston (I) is against bottom of bore in second adjusting plug (G). Tighten nut. Connect pilot line.

12. Loosen 32 mm nut (H).

13. Start engine. Actuate the arm in function over relief.

14. Turn second adjusting plug in to increase pressure; turn adjusting plug out to decrease pressure to get specified pressure for power boost.

    Hold adjusting plug and tighten 32 mm nut.

32 mm Nut—Specification

Torque	78—88 N•m (58—65 lb-ft)

15. Loosen 27 mm nut (F).

16. Actuate the arm in function over relief.

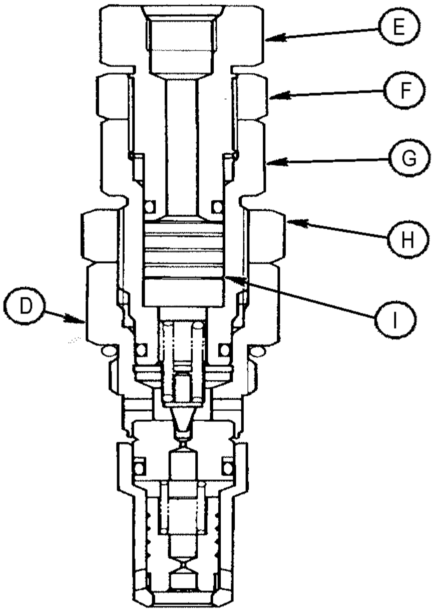
17. Turn first adjusting plug (E) out to decrease pressure to get specified pressure for system relief valve.

    Hold adjusting plug and tighten 27 mm nut.

27 mm Nut—Specification

Torque	59—68 N•m (43—51 lb-ft)

18. Check the pressures again.



T101616

T101616 –UN–18JUN96

D—System Relief Valve
E—First Adjusting Plug
F—27 mm Nut
G—Second Adjusting Plug
H—32 mm Nut
I—Piston

CIRCUIT RELIEF VALVE TEST AND ADJUSTMENT

SPECIFICATIONS	
Oil Temperature	50 ± 5°C (120 ± 10°F)
Engine in Standard Mode Speed	Slow Idle
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
Boom Up (Head End) Pressure	37 265 + 980 - 0 kPa (375 + 9.8 - 0 bar) (5405 + 140 - 0 psi)
Arm In (Head End) Pressure	37 265 + 980 - 0 kPa (375 + 9.8 - 0 bar) (5405 + 140 - 0 psi)
Bucket Dump (Rod End) Pressure	37 265 + 980 - 0 kPa (375 + 9.8 - 0 bar) (5405 + 140 - 0 psi)
Boom Down (Rod End) Pressure	37 265 + 980 - 0 kPa (375 + 9.8 - 0 bar) (5405 + 140 - 0 psi)
Arm Out (Rod End) Pressure	39 225 + 980 - 0 kPa (390 + 9.8 - 0 bar) (5690 + 140 - 0 psi)
Bucket Curl (Head End) Pressure	39 225 + 980 - 0 kPa (390 + 9.8 - 0 bar) (5690 + 140 - 0 psi)
Circuit Relief Valve Pressure	5295 kPa (53 bar) (770 psi) approximate change per 1/4 turn of adjusting screw

ESSENTIAL TOOLS
TH108328 Adapter (2 used)
XPD34BTX (1/8 x 7/16-20 F 37°) Male Quick Coupler

Continued on next page

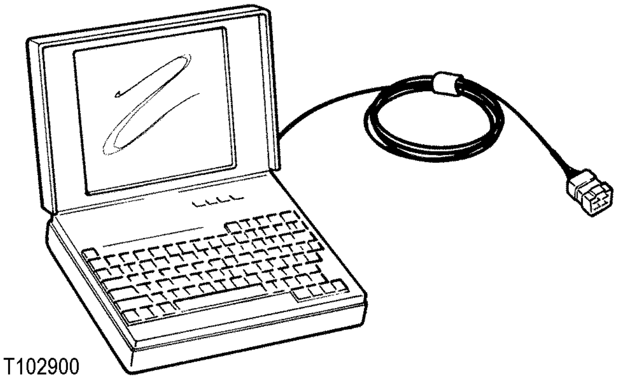
SERVICE EQUIPMENT AND TOOLS
JT07290 Laptop Computer
JT07274G Excavator Diagnostics Program Disk
JT07273 Cable
JT02156A Digital Pressure and Temperature Analyzer
JT02160 Transducer 70 000 kPa (700 bar) (10 000 psi)
Gauge 70 000 kPa (700 bar) (10 000 psi)
JT05800 Digital Thermometer
6 mm Hex Key Wrench
17 mm Combination Wrench

TX,9025,GG2649 –19–08JUN98–2/7

1. Connect the laptop computer. (See the installation procedure in this group.)

    a. Start the engine.

    b. Select “3 Front pump delivery pressure” and “4 Rear pump delivery pressure” from the Monitor Data menu.


T102900

T102900 –19–29AUG96

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TX,9025,GG2649 –19–08JUN98–3/7

If laptop computer is not available, use the digital pressure and temperature analyzer, and transducers, or gauges.

a. Stop the engine.

b. Loosen vent plug (K) to release the air pressure in hydraulic oil tank.

c. Install adapter (A) and male quick coupler to test port on front pump (C) or rear pump (B). Connect the analyzer and transducers or gauges.

2. Install the temperature probe on the hydraulic oil tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)
3. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10°F)

4. Extend the cylinder to check a head end circuit relief valve; retract the cylinder to check a rod end circuit relief valve.
5. Run machine at specifications.

Engine in Standard Mode—Specification

Speed .... Slow Idle

Work Mode Selector—Specification

Position .... Dig Mode

E Mode Switch—Specification

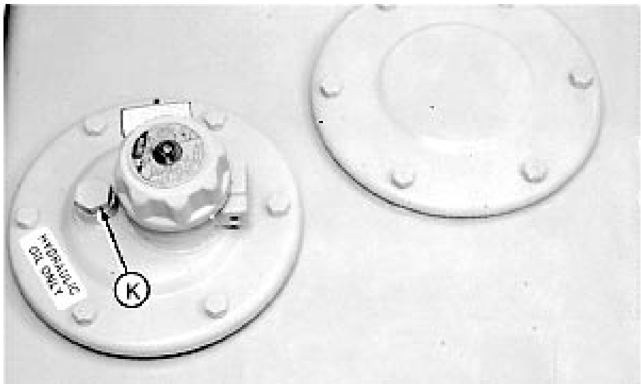
Position .... Off

HP Mode Switch—Specification

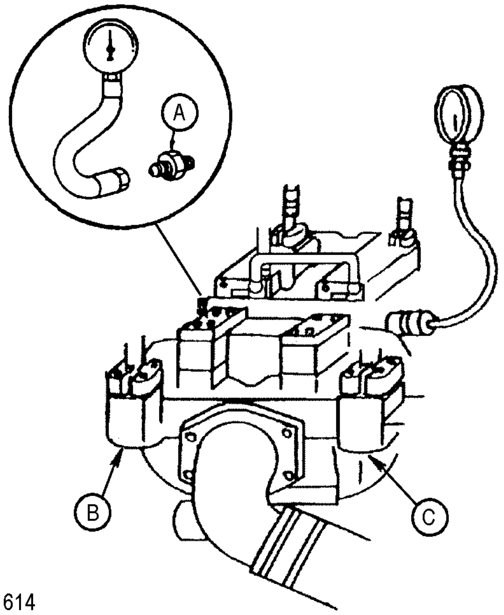
Position .... Off

Auto-Idle Switch—Specification

Position .... Off



T109340 –UN–29APR97



T101614

T101614 –UN–18JUN96

A—Adapter
B—Rear Pump
C—Front Pump
K—Vent Plug

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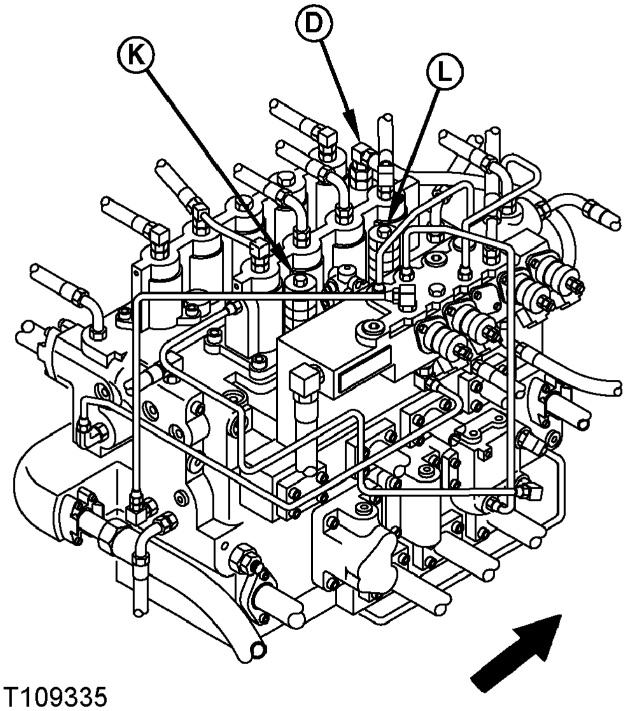
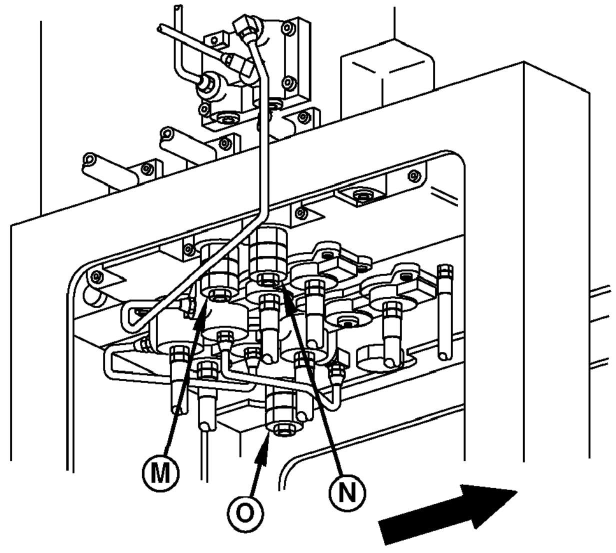


T109335

T109335 –UN–29APR97



T109336

T109336 –UN–29APR97

D—System Relief Valve
K—Boom Up Circuit Relief Valve
L—Bucket Dump Circuit Relief Valve
M—Boom Down Circuit Relief Valve
N—Bucket Curl Circuit Relief Valve
O—Arm In Circuit Relief Valve

6. Actuate function over relief for circuit relief valve (K, L, M, and O) being checked.

NOTE: Actuating the power boost function increases the system relief pressure enough to check and adjust the dig function circuit relief valves except arm out and bucket curl. For arm out and bucket curl circuit relief valves the second adjusting plug for system relief valve is turned in 1/4 turn to increase the pressure setting above the circuit relief valves.

7. Actuate the power boost function.

8. Record the pressure reading.

Boom Up (Head End)—Specification

Pressure.. 37 265 + 980 - 0 kPa
(375 + 9.8 - 0 bar)
(5405 + 140 - 0 psi)

Arm In (Head End)—Specification

Pressure.. 37 265 + 980 - 0 kPa
(375 + 9.8 - 0 bar)
(5405 + 140 - 0 psi)

Bucket Dump (Rod End)—Specification

Pressure.. 37 265 + 980 - 0 kPa
(375 + 9.8 - 0 bar)
(5405 + 140 - 0 psi)

Boom Down (Rod End)—Specification

Pressure.. 37 265 + 980 - 0 kPa
(375 + 9.8 - 0 bar)
(5405 + 140 - 0 psi)

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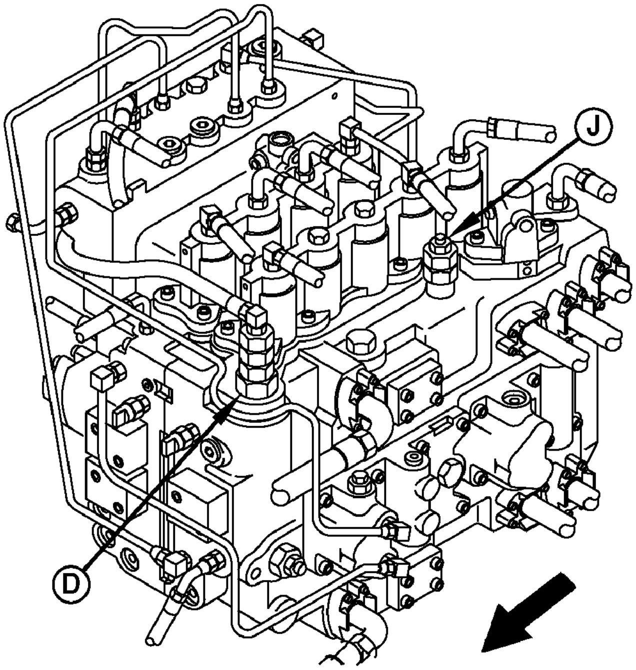
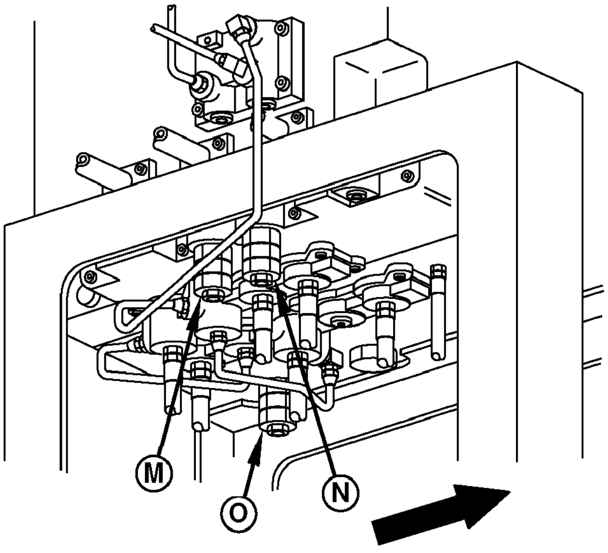
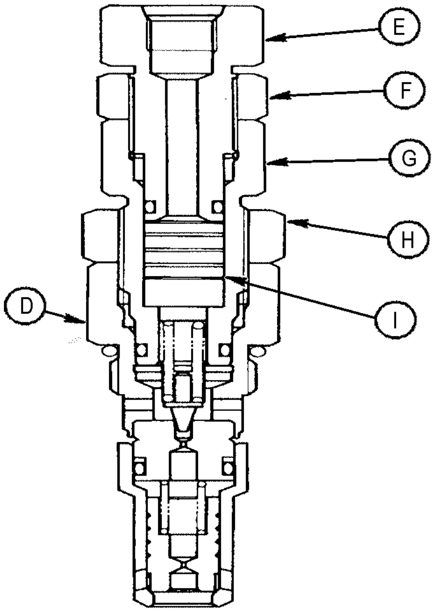


T109334 –UN–29APR97



T109336 –UN–29APR97



T101616 –UN–18JUN96

9. For arm out (J) and bucket curl (N) circuit relief valves, turn the second adjusting plug (G) for system relief valve (D) in 1/4 turn to increase the pressure setting.

10. Actuate the function over relief for circuit relief valve being checked.

    Record the pressure reading.

Arm Out (Rod End)—Specification

Pressure .... 39 225 + 980 - 0 kPa (390 + 9.8 - 0 bar) (5690 + 140 - 0 psi)

Bucket Curl (Head End)—Specification

Pressure .... 39 225 + 980 - 0 kPa (390 + 9.8 - 0 bar) (5690 + 140 - 0 psi)

Circuit Relief Valve—Specification

Pressure .... 5295 kPa (53 bar) (770 psi) approximate change per 1/4 turn of adjusting screw

D—System Relief Valve
E—First Adjusting Plug
F—27 mm Nut
G—Second Adjusting Plug
H—32 mm Nut
I—Piston
J—Arm Out Circuit Relief Valve
M—Boom Down Circuit Relief Valve
N—Bucket Curl Circuit Relief Valve
O—Arm In Circuit Relief Valve

Continued on next page

NOTE: If pressure reading fluctuates increase engine speed slightly.

11. Adjust the circuit relief valve as needed. Turn adjusting screw IN to increase pressure setting; turn adjusting screw out to decrease pressure setting. Hold screw and tighten nut.

12. Turn second adjusting plug (G) for system relief valve (D) out 1/4 turn. Hold plug and tighten 32 mm nut (H).

TX,9025,GG2649 –19–08JUN98–7/7

SWING MOTOR CROSSOVER RELIEF VALVE TEST AND ADJUSTMENT

SPECIFICATIONS	
Oil Temperature	50 ± 5°C (120 ± 10°F)
Engine in Standard Mode Speed	Slow Idle
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
Crossover Relief Valve Pressure	32 360 + 1960 - 0 kPa (323.6 + 19.6 - 0 bar) (4695 + 285 - 0 psi)
Crossover Relief Valve Pressure	2940 kPa (29.4 bar) (430 psi) approximate change per 1/4 turn of adjusting plug

ESSENTIAL TOOLS
TH108328 Adapter
XPD34BTX (1/8 x 7/16-20 F 37°) Male Quick Coupler

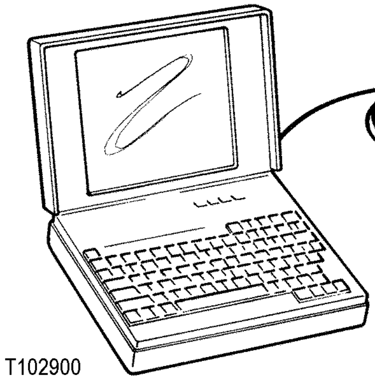
SERVICE EQUIPMENT AND TOOLS
JT07290 Laptop Computer
JT07274G Excavator Diagnostics Program Disk
JT07273 Cable
JT02156A Digital Pressure and Temperature Analyzer
JT02160 Transducer 70 000 kPa (700 bar) (10 000 psi)
Gauge 70 000 kPa (700 bar) (10 000 psi)
JT05800 Digital Thermometer
8 mm Hex Key Wrench
32 and 36 mm Combination Wrench
17 mm Combination Wrench

TX,9025,GG2650 –19–28APR97–1/5

1. Connect the laptop computer. (See the installation procedure in this group.)

    a. Start the engine.

    b. Select “4 Rear pump delivery pressure” from the Monitor Data menu.



T102900

T102900 –19–29AUG96

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TX,9025,GG2650 –19–28APR97–2/5

If laptop computer is not available, use the digital pressure and temperature analyzer, and transducer, or a gauge.

a. Stop the engine.

b. Loosen vent plug (K) to release the air pressure in hydraulic oil tank.

c. Install adapter (A) and male quick coupler to test port on rear pump (B). Connect the analyzer and transducers or gauges.

2. Install the temperature probe on the hydraulic tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)

3. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10°F)

4. Raise and lower boom to pressurize hydraulic tank.

5. Run machine at specifications.

Engine in Standard Mode—Specification

Speed .... Slow Idle

Work Mode Selector—Specification

Position .... Dig Mode

E Mode Switch—Specification

Position .... Off

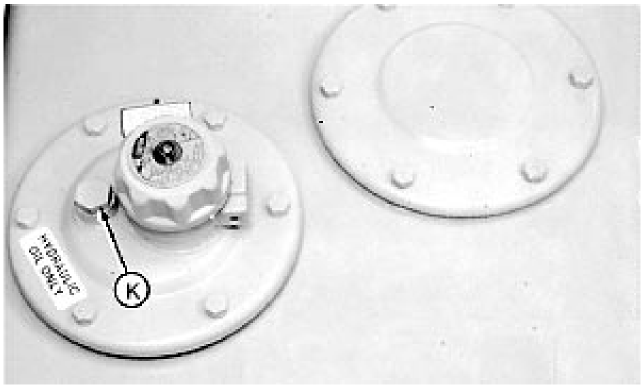
HP Mode Switch—Specification

Position .... Off

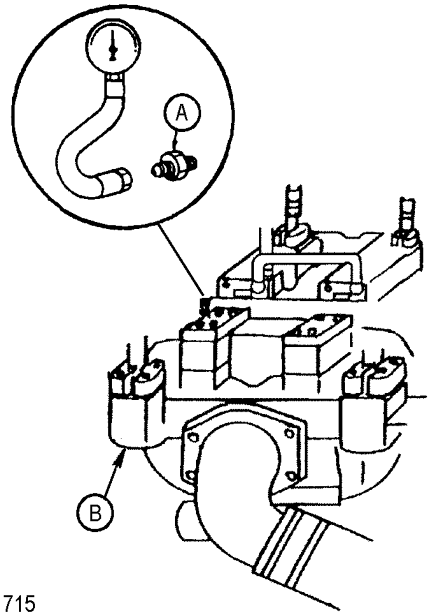
Auto-Idle Switch—Specification

Position .... Off

6. Operate the swing function at stall. To stall swing function, put bucket against an immovable object or in a trench then actuate the control lever to full stroke.



T109340 –UN–29APR97



T101715

T101715 –UN–20JUN96

A—Adapter
B—Rear Pump
K—Vent Plug

Continued on next page

Record the pressure reading.

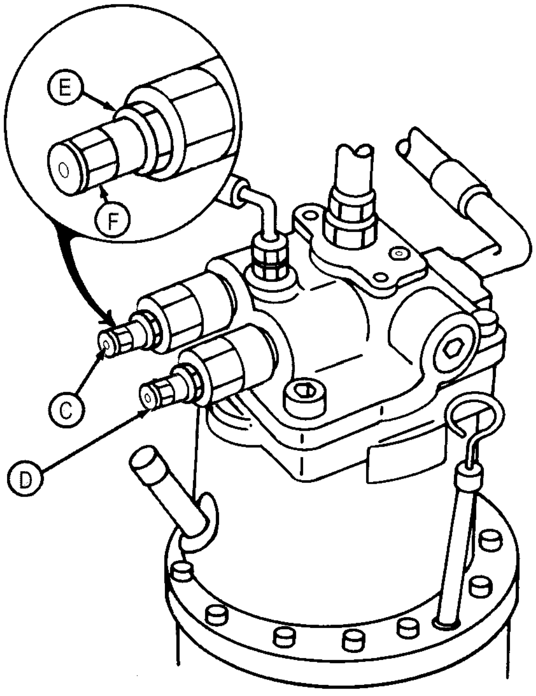
Repeat procedure for the opposite direction. Record the pressure reading.

Crossover Relief Valve—Specification

Pressure .... 32 360 + 1960 - 0 kPa
(323.6 + 19.6 - 0 bar)
(4695 + 285 - 0 psi)
Pressure .... 2940 kPa (29.4 bar) (430 psi)
approximate change per 1/4 turn
of adjusting plug

TX,9025,GG2650 –19–28APR97–4/5

7. Adjust the crossover relief valves (C or D) for left or right swing as needed. Loosen nut (E). Turn adjusting plug (F) in to increase pressure setting; turn adjusting plug out to decrease pressure setting.



T101716

T101716 –UN–20JUN96

C—Right Swing Crossover Relief Valve
D—Left Swing Crossover Relief Valve
E—Nut
F—Adjusting Plug

TX,9025,GG2650 –19–28APR97–5/5

PROPEL MOTOR CROSSOVER RELIEF VALVE TEST AND ADJUSTMENT

SPECIFICATIONS	
Oil Temperature	50 ± 5°C (120 ± 10°F)
Engine in Standard Mode Speed	Fast Idle
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
Crossover Relief Valve Pressure	34 324 + 1960 - 0 kPa (343.2 + 19.6 - 0 bar) (4980 + 285 - 0 psi)
Crossover Relief Valve Pressure	2940 kPa (29.4 bar) (430 psi) approximate change per 1/4 turn of adjusting screw

ESSENTIAL TOOLS
TH108328 Adapter (2 used)
XPD34BTX (1/8 x 7/16-20 F 37°) Male Quick Coupler

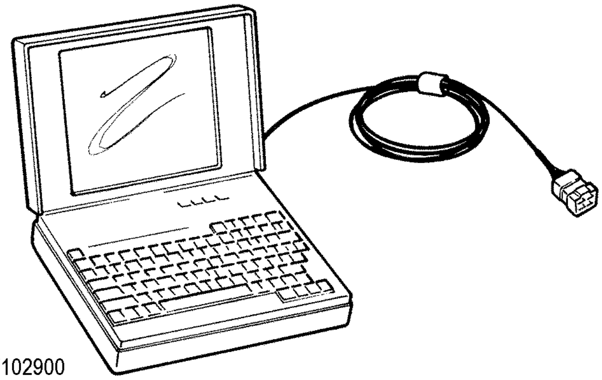
SERVICE EQUIPMENT AND TOOLS
JT07290 Laptop Computer
JT07274G Excavator Diagnostics Program Disk
JT07273 Cable
JT02156A Digital Pressure and Temperature Analyzer
JT02160 Transducer 70 000 kPa (700 bar) (10 000 psi)
Gauge 70 000 kPa (700 bar) (10 000 psi)
JT05800 Digital Thermometer
85 mm (3-3/8 in.) OD Pin or Length of Round Bar Stock (2 used)
6 mm Hex Key Wrench
19 mm Combination Wrench

TX,9025,GG2651 –19–28APR97–1/5

1. Connect the laptop computer. (See the installation procedure in this group.)

   a. Start the engine.

   b. Select “3 Front pump delivery pressure” and “4 Rear pump delivery pressure” from the Monitor Data menu.



T102900

T102900 –19–29AUG96

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TX,9025,GG2651 –19–28APR97–2/5

If laptop computer is not available, use the digital pressure and temperature analyzer, and transducers, or gauges.

a. Stop the engine.

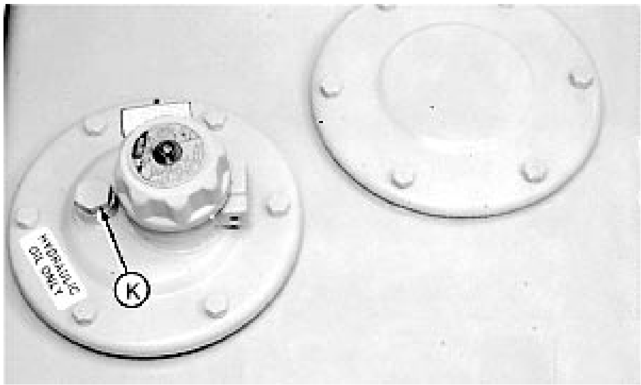
b. Loosen vent plug (K) to release the air pressure in hydraulic oil tank.

c. Install adapter (A) and male quick coupler to test port on front pump (C) and rear pump (B). Connect the analyzer and transducers or gauges.

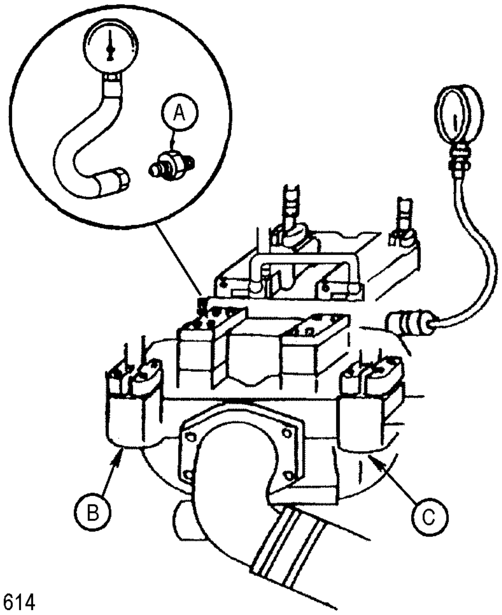
2. Install the temperature probe on the hydraulic tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)
3. Raise and lower boom to pressurize hydraulic oil tank.
4. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10°F)



T109340 –UN–29APR97



T101614

T101614 –UN–18JUN96

A—Adapter
B—Rear Pump
C—Front Pump
K—Vent Plug

Continued on next page

5. Install pins or round bar stock (D) between the sprockets and track frame to stall both propel motors.

6. Run machine at specifications.

Engine in Standard Mode—Specification

Speed .... Fast Idle

Work Mode Selector—Specification

Position .... Dig Mode

E Mode Switch—Specification

Position .... Off

HP Mode Switch—Specification

Position .... Off

Auto-Idle Switch—Specification

Position .... Off

NOTE: Actuating the power boost function increases the system relief pressure enough to check and adjust the propel motor crossover relief valves.

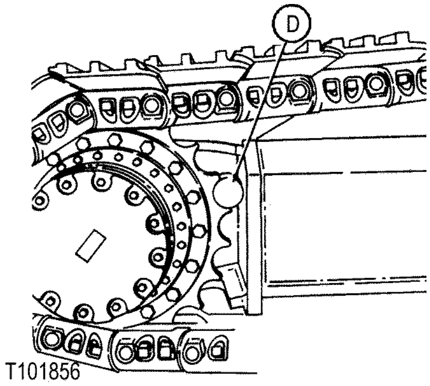
7. Slowly push propel pedal, for propel motor being stalled, to full travel in the direction for the crossover relief valve being checked.

   Push the power boost button on the right control lever.

   Record the pressure reading.

Crossover Relief Valve—Specification

Pressure .... 34 324 + 1960 - 0 kPa
(343.2 + 19.6 - 0 bar)
(4980 + 285 - 0 psi)
Pressure .... 2940 kPa (29.4 bar) (430 psi)
approximate change per 1/4 turn
of adjusting screw



T101856 –UN–02JUL96

D—Round Bar Stock

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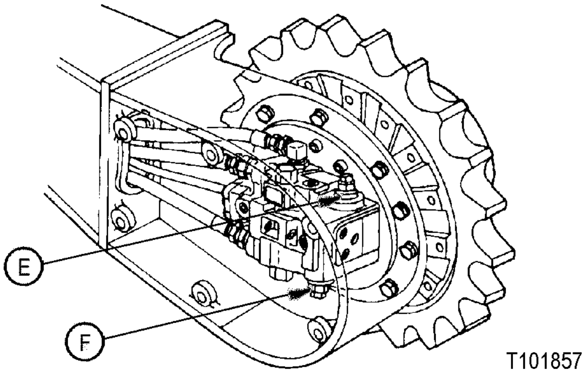
8. Adjust the crossover relief valves (E and F) as needed. Turn adjusting screw in to increase the pressure setting; turn adjusting screw out to decrease pressure.

9. Repeat procedure for the other crossover relief valves.



T101857 –UN–02JUL96

E—Forward Crossover Relief Valve
F—Reverse Crossover Relief Valve

TX,9025,GG2651 –19–28APR97–5/5

PROPORTIONAL SOLENOID VALVE TEST AND ADJUSTMENT

SPECIFICATIONS	
Oil Temperature	50 ± 5°C (120 ± 10°F)
Engine in Standard Mode Speed	Fast Idle
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Position	Off
Propel Speed Switch Position	Fast Speed
Arm Regenerative (SC) Pressure	Laptop computer reading ± 196 kPa (1.96 bar) (28 psi)
Speed Sensing (SD) Pressure	Laptop computer reading ± 196 kPa (1.96 bar) (28 psi)
Propel Speed Change (SI) Pressure	Laptop computer reading ± 196 kPa (1.96 bar) (28 psi)
Power Boost (SG) Pressure	Laptop computer reading ± 196 kPa (1.96 bar) (28 psi)
Proportional Solenoid Valve Pressure	98 kPa (0.98 bar) (14 psi) approximate change per 1/4 turn of adjusting screw
End of Adjusting Screw to Nut Must Not Exceed Length	4 mm (0.157 in.)
Adjusting Screw-to-Housing Nut Torque	8.8 N•m (78 lb-in.)

ESSENTIAL TOOLS
JT03464 (1/4 M BSPP ORB x 7/16-20 M 37° x M14-1.5 M 45°) Tee (for the steel line)
JT03001 (7/16-20 M 37° x 7/16-20 F 37° x 7/16-20 M 37°) (Parker No. 063T-4-4) Tee

SERVICE EQUIPMENT AND TOOLS
JT02156A Digital Pressure and Temperature Analyzer
JT02162 Transducer 35 000 kPa (350 bar) (5000 psi)
Gauge 7000 kPa (70 bar) (1000 psi)
JT07290 Laptop Computer
JT07274G Excavator Diagnostics Program Disk
JT07273 Cable
JT05800 Digital Thermometer
4 mm Hex Key Wrench
13 mm Combination Wrench

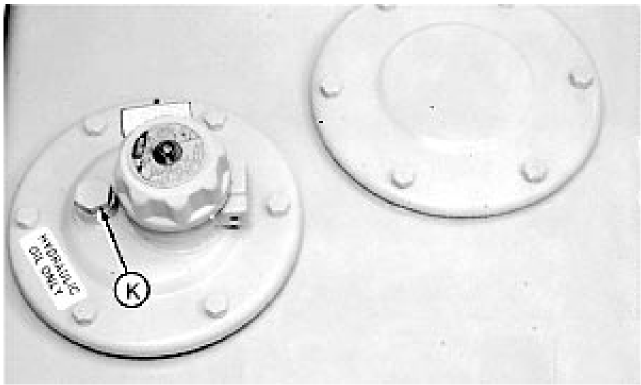
Continued on next page

Procedure is to check that the hydraulic pressure output for the proportional solenoid valves are within the specified pressure range of the pressure shown on the laptop computer. The pressure shown on computer is a calculated pressure from the electrical signal from the engine and pump controller (EPC).

TX,9025,GG2121 –19–21MAY98–2/6

1. Stop the engine.

   Loosen vent plug (K) to release the air pressure in hydraulic oil tank.



T109340 –UN–29APR97

K—Vent Plug

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TX,9025,GG2121 –19–21MAY98–3/6

NOTE: Proportional solenoid valve output pressure must be measured using a pressure gauge. The pressure shown on laptop computer is calculated from an electrical signal from the engine and pump controller and does not change as the solenoid valve adjustment is made.

2. Disconnect the line (D, E, F, or G) at solenoid valve manifold (A) for solenoid valve (H) being checked. Install test connection (B and C). For steel line (D) from the arm regenerative solenoid valve (SC) use the JT03464 Tee. Use the JT03001 Tee for the others. Install the digital pressure and temperature analyzer, and transducer, or a gauge (C).

3. Connect the laptop computer.

4. Install the temperature probe on the hydraulic tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)

5. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

Oil—Specification

Temperature	50 ± 5°C (120 ± 10°F)

6. Run the machine at specification. To check each solenoid valve, operate the machine as follows and then record the pressure reading from gauge and laptop computer:

Engine in Standard Mode—Specification

Speed	Fast Idle

Work Mode Selector—Specification

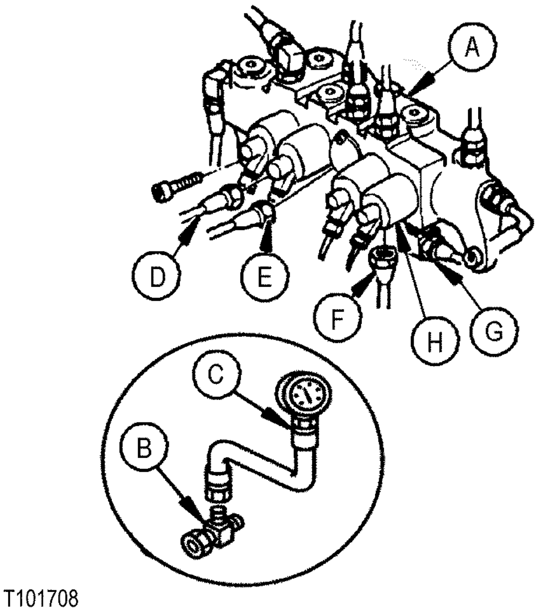
Position	Dig Mode

E Mode Switch—Specification

Position	Off

HP Mode Switch—Specification

Position	Off



T101708

T101708 –UN–20JUN96

A—Solenoid Valve Manifold
B—JT03464 Tee or JT03001 Tee
C—Gauge
D—Arm Regenerative Solenoid Valve (SC) Line
E—Speed Sensing Solenoid Valve (SD) Line
F—Propel Speed Change Solenoid Valve (SI) Line
G—Power Boost Solenoid Valve (SG) Line
H—Solenoid Valve (4 used)

Continued on next page

Auto-Idle—Specification

Position.. Off

Propel Speed Switch—Specification

Position... Fast Speed

Arm Regenerative (SC)—Specification

Pressure .... Laptop computer reading
± 196 kPa (1.96 bar) (28 psi)

Speed Sensing (SD)—Specification

Pressure .... Laptop computer reading
± 196 kPa (1.96 bar) (28 psi)

Propel Speed Change (SI)—Specification

Pressure .... Laptop computer reading
± 196 kPa (1.96 bar) (28 psi)

Power Boost (SG)—Specification

Pressure .... Laptop computer reading
± 196 kPa (1.96 bar) (28 psi)

- For arm regenerative solenoid valve (SC), operate boom up and arm in functions in combined operation.
- For speed sensing solenoid valve (SD), operate arm in function over relief and boom up function to load the engine.
- For propel speed change solenoid valve (SI), drive the machine at fast speed propel.
- For power boost solenoid valve (SG), push and release power boost button on right control lever.

7. Compare pressure readings from the gauge and laptop computer. The pressure reading from gauge must be within the specified range of calculated pressure reading on the computer.

Continued on next page

TX,9025,GG2121 –19–21MAY98–5/6

8. Adjust the solenoid valve (H) as needed. Turn adjusting screw (I) IN to increase pressure setting; turn adjusting screw out to decrease pressure setting. Hold screw and tighten nut (J).

    - Make a mark on the end of adjusting screw for the original position of screw. Do not mark on threads of screw.

IMPORTANT: Turning adjusting screw out too far may cause oil leakage because the O-ring has come off its seat. The length from end of adjusting screw to nut must not exceed 4 mm (0.157 in.).

- Loosen nut just enough so adjusting screw can be turned. Turn adjusting screw in to increase pressure; turn adjusting screw out to decrease pressure.

Proportional Solenoid Valve—Specification

Pressure .... 98 kPa (0.98 bar) (14 psi) approximate change per 1/4 turn of adjusting screw

End of Adjusting Screw to Nut Must Not Exceed—Specification

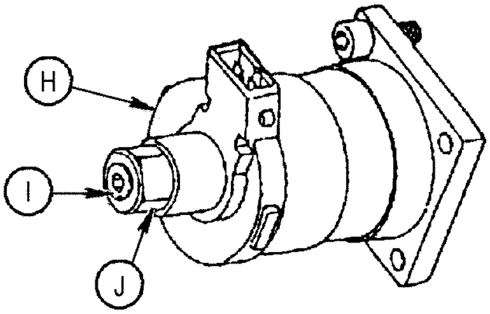
Length.. 4 mm (0.157 in.)

- Hold adjusting screw and then tighten nut.

Adjusting Screw-to-Housing Nut—Specification

Torque .... 8.8 N•m (78 lb-in.)

- Check the pressure again.



T101709

T101709 –UN–20JUN96

H—Solenoid Valve
I—Adjusting Screw
J—Nut

TX,9025,GG2121 –19–21MAY98–6/6

PUMP CONTROL VALVE TEST

SPECIFICATIONS	
Oil Temperature	50 ± 5°C (120 ± 10°F)
Engine in Standard Mode Speed	Slow and Fast Idle
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
Typical Front or Rear Pump Control Valve Pilot Oil Control Signal Pressure	1655—1930 kPa (16.5—19.3 bar) (240—280 psi) at slow idle with all functions in neutral
Typical Front or Rear Pump Control Valve Pilot Oil Control Signal Pressure	1035—1520 kPa (10.3—15.2 bar) (150—220 psi) at fast idle with all functions in neutral
Typical Front or Rear Pump Control Valve Pilot Oil Control Signal Pressure	3310—3515 kPa (33.1—35.2 bar) (480—510 psi) at slow idle with arm in function over relief
Typical Front or Rear Pump Control Valve Pilot Oil Control Signal Pressure	3380—3585 kPa (33.8—35.9 bar) (490—520 psi) at fast idle with arm in function over relief

ESSENTIAL TOOLS
JT03001 (7/16-20 M 37° x 7/16-20 M 37° x 7/16-20 F 37°) (Parker No. 063T-4-4) Tee (2 used)
XPD34BTX (1/8 x 7/16-20 F 37°) Male Quick Coupler

SERVICE EQUIPMENT AND TOOLS
JT07290 Laptop Computer
JT07274G Excavator Diagnostics Program Disk
JT07273 Cable
JT02156A Digital Pressure and Temperature Analyzer
JT02162 Transducer 35 000 kPa (350 bar) (5000 psi)
Gauge 7000 kPa (70 bar) (1000 psi) (2 used)
JT05800 Digital Thermometer
8 mm Hex Key Wrench
22 mm Combination Wrench

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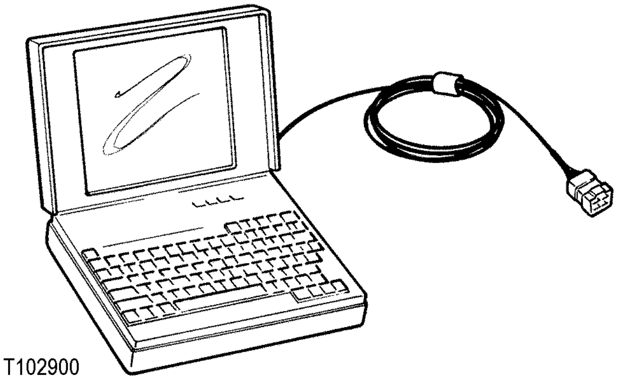
The function of pump control valves is to send a regulated pilot oil control signal to its respective pump regulator to change pump flow in response to the actuation of control valve spools. (See Pump Control Valve Operation in Group 9025-05.) The purpose of test is to check that the regulated pilot oil control signal increases as a function is actuated and decreases when function is returned to neutral by monitoring the front and rear pump control pressure sensor readings. The valves are adjusted at the factory and there should never be any need for an adjustment in the field.

TX,9025,GG2652 –19–21MAY98–2/6

1. Connect the laptop computer. (See the installation procedure in this group.)
    a. Start the engine.
    b. Select “1 Front pump control pressure” and “6 Rear pump control pressure” from the Monitor Data menu.



T102900 –19–29AUG96

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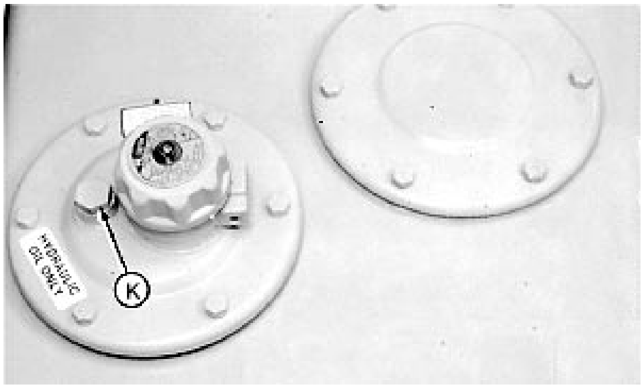
TX,9025,GG2652 –19–21MAY98–3/6

If laptop computer is not available, use the digital pressure and temperature analyzer, and transducers, or gauges.

a. Stop the engine.

b. Loosen vent plug (K) to release the air pressure in hydraulic oil tank.

c. Install tees (C) and male quick couplers in line with pump control valve pilot lines at rear (A) and front (B) pump regulators. Connect the analyzer and transducers or gauges (D).



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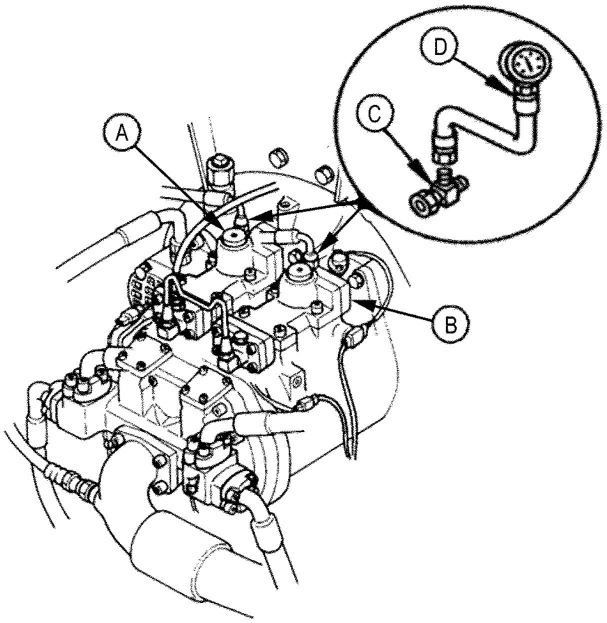

T103348 –UN–11SEP96

A—Pump Control Valve Pilot Line
B—Pump Regulator
C—Tee Fitting
D—Gauge
K—Vent Plug

2. Install the temperature probe on the hydraulic tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)
3. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10°F)

4. Run machine as specified.

Engine in Standard Mode—Specification

Speed .... Slow and Fast Idle

Work Mode Selector—Specification

Position .... Dig Mode

E Mode Switch—Specification

Position .... Off

HP Mode Switch—Specification

Position .... Off

Auto-Idle Switch—Specification

Position .... Off

5. Run engine at slow idle with all functions in neutral. Record pressure readings.

9025
25
91

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Typical Front or Rear Pump Control Valve Pilot Oil Control Signal—Specification

Pressure .... 1655—1930 kPa (16.5—19.3 bar) (240—280 psi) at slow idle with all functions in neutral

6. Run engine at fast idle with all functions in neutral. Record pressure readings.

Typical Front or Rear Pump Control Valve Pilot Oil Control Signal—Specification

Pressure .... 1035—1520 kPa (10.3—15.2 bar) (150—220 psi) at fast idle with all functions in neutral

7. Run engine at slow idle. Actuate arm in function over relief. Record pressure readings.

Typical Front or Rear Pump Control Valve Pilot Oil Control Signal—Specification

Pressure .... 3310—3515 kPa (33.1—35.2 bar) (480—510 psi) at slow idle with arm in function over relief

8. Run engine at fast idle. Actuate arm in function over relief. Record pressure readings.

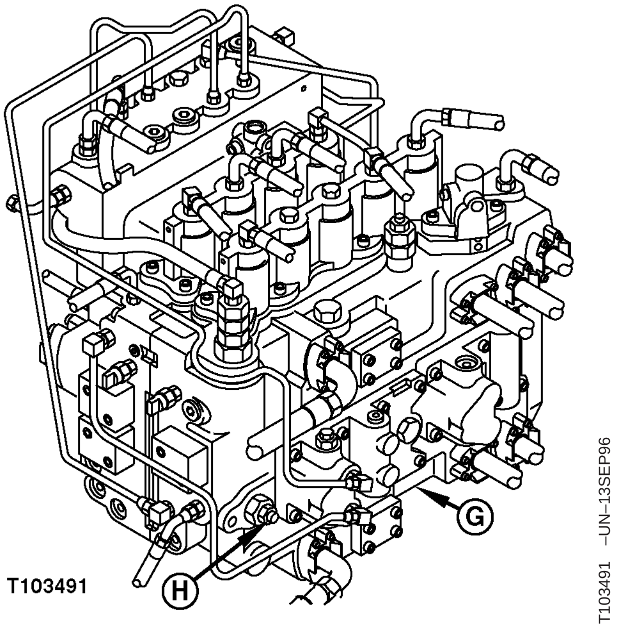
Typical Front or Rear Pump Control Valve Pilot Oil Control Signal—Specification

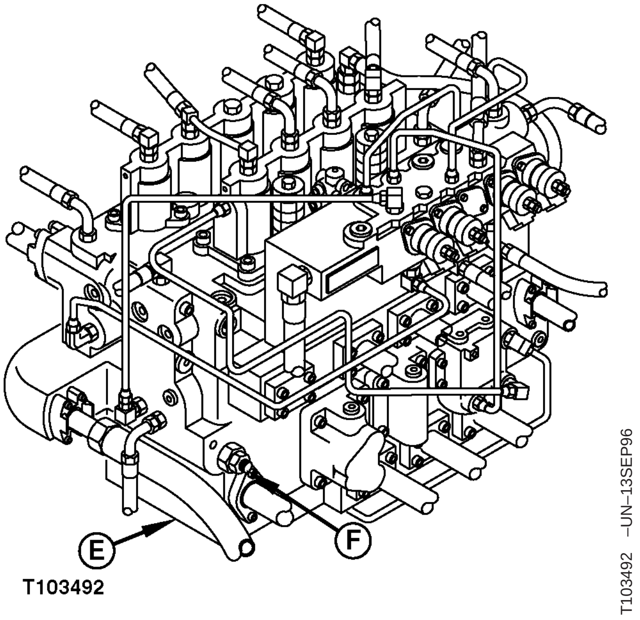
Pressure .... 3380—3585 kPa (33.8—35.9 bar) (490—520 psi) at fast idle with arm in function over relief

Continued on next page

9. A pressure reading not in the ranges given can be an indication of contamination or sticking spools in the front (F) or rear (H) pump control valve. Before making any adjustments, check the front and rear pump control valve pressure sensors and the operation of remote control spool in front and rear pump regulators.

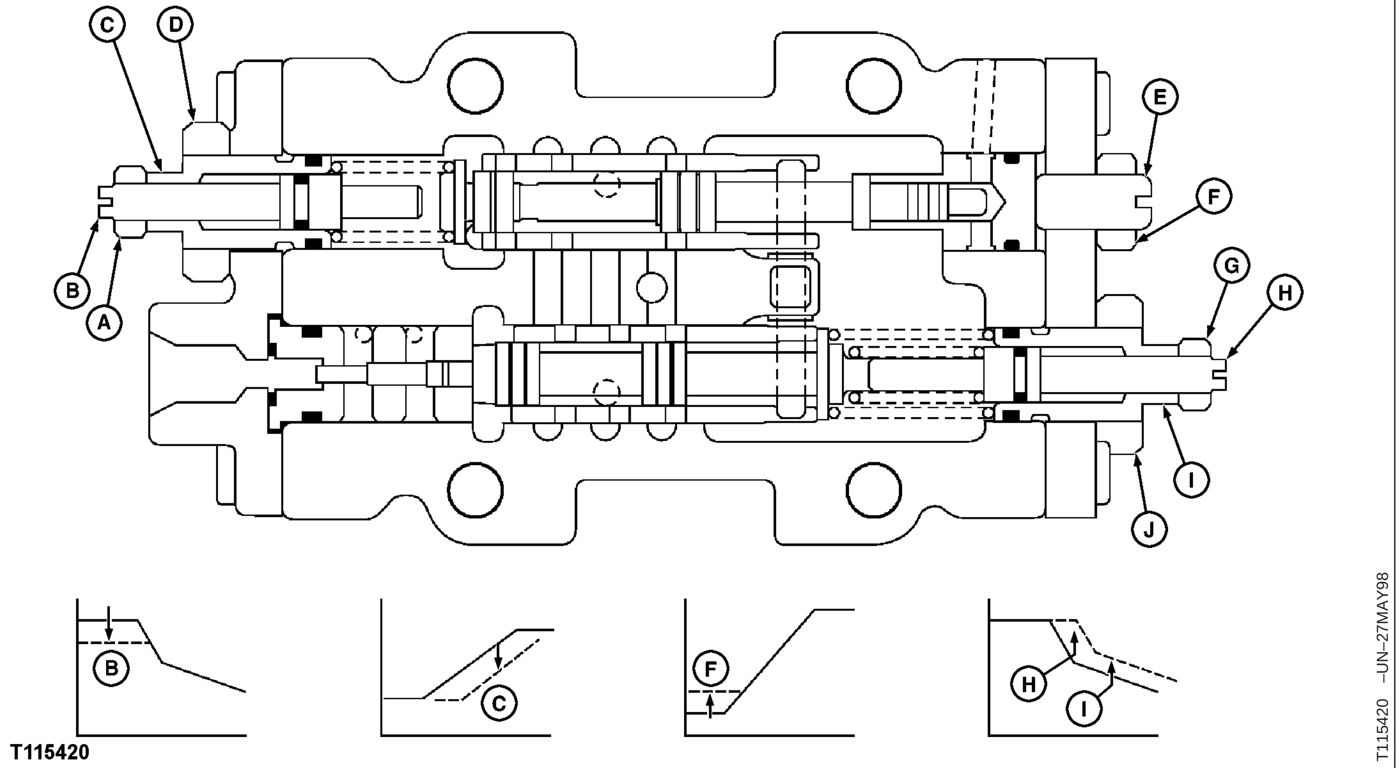
   Turn the adjusting screw in to increase pressure reading; turn adjusting screw out to decrease pressure reading.





E—Right Control Valve
F—Front Pump Control Valve
G—Left Control Valve
H—Rear Pump Control Valve

HYDRAULIC PUMP REGULATOR ADJUSTMENTS



A—13 mm Nut
B—Maximum Flow Adjusting Screw
C—Flow Adjusting Cartridge (Track Cycle Time)
D—30 mm Nut
E—Minimum Flow Adjusting Screw
F—17 mm Nut
G—13 mm Nut
H—Load Adjusting Screw (Inner Spring) (Engine Pulldown at High Pressure)
I—Load Adjusting Cartridge (Outer Spring) (Engine Pulldown at Medium Pressure)
J—30 mm Nut

Continued on next page

SPECIFICATIONS	
Regulator Maximum Flow Adjusting Screw Turn	1/4 turn IN decreases maximum pump flow rate approximately 11.75 L/min (3.11 gpm)
Regulator Flow Adjusting Cartridge (Track Cycle Time) Turn	1/4 turn IN decreases pump flow rate approximately 23.5 L/min (6.23 gpm)
Regulator Minimum Flow Adjusting Screw Turn	1/4 turn IN increases minimum pump flow rate approximately 14.1 L/min (3.68 gpm)
Regulator Load Adjusting Screw (Inner Spring) (Engine Pulldown at High Pressure) Turn	1/4 turn IN increases pump flow rate approximately 5.67 L/min (1.51 gpm)
Regulator Load Adjusting Cartridge (Outer Spring) (Engine Pulldown at Medium Pressure) Turn	1/4 turn IN increases pump flow rate approximately 23.5 L/min (6.23 gpm)

The pumps are driven at engine speed.

IMPORTANT: Random adjustment will cause engine and hydraulic systems malfunctions. See Pump Regulator Tests and Adjustment for Minimum Flow, Maximum Flow and Engine Pulldown in this group.

Maximum Flow Adjusting Screw (B):
Turning adjusting screw IN decreases maximum pump flow rate.

Regulator Maximum Flow Adjusting Screw—Specification

Turn.. 1/4 turn IN decreases maximum pump flow rate approximately 11.75 L/min (3.11 gpm)

Do not turn adjusting screw in more than two turns. Tighten nut (A) after adjustment. Maximum flow adjusting screw must not be turned out to try to increase pump flow rate except after the adjustment of flow adjusting cartridge (C). For adjustment, see Hydraulic Pump Regulator Test and Adjustment—Maximum Flow in this group.

Flow Adjusting Cartridge (Track Cycle Time) (C):
Turning adjusting cartridge IN decreases pump flow rate.

Regulator Flow Adjusting Cartridge (Track Cycle Time)—Specification

Turn... 1/4 turn IN decreases pump flow rate approximately 23.5 L/min (6.23 gpm)

Do not turn adjusting cartridge more than one turn. Tighten nut (D) after adjustment. When flow adjusting cartridge (C) is turned in or out the maximum flow rate for the pump also changes. To maintain the pump's maximum flow rate, turn maximum flow adjusting screw (B) out twice as much as flow adjusting cartridge (C) is turned in; turn maximum flow adjusting screw (B) in twice as much as flow adjusting cartridge (C) is turned out.

For adjustment, see Hydraulic Pump Regulator Test and Adjustment—Maximum Flow in this group.

Minimum Flow Adjusting Screw (E):
Turning adjusting screw IN increases minimum flow rate.

Regulator Minimum Flow Adjusting Screw—Specification

Turn.. 1/4 turn IN increases minimum pump flow rate approximately 14.1 L/min (3.68 gpm)

For adjustment, see Hydraulic Pump Regulator Test and Adjustment—Minimum Flow in this group.

Do not turn adjusting more than two turns. Tighten nut (F) after adjustment.

Load Adjusting Screw (Inner Spring) (Engine Pulldown at High Pressure) (H):
Turning load adjusting screw IN increases flow rate.

Continued on next page

Regulator Load Adjusting Screw (Inner Spring) (Engine Pulldown at High Pressure)—Specification

Turn.. 1/4 turn IN increases pump flow rate approximately 5.67 L/min (1.51 gpm)

Do not turn adjusting screw more than one turn. Tighten nut (G) after adjustment.

For adjustment, see Hydraulic Pump Regulator Test and Adjustment—Engine Pulldown in this group.

Load Adjusting Cartridge (Outer Spring) (Engine Pulldown at Medium Pressure) (I):
Turning adjusting cartridge IN increases flow rate.

Regulator Load Adjusting Cartridge (Outer Spring) (Engine Pulldown at Medium Pressure)—Specification

Turn.. 1/4 turn IN increases pump flow rate approximately 23.5 L/min (6.23 gpm)

Do not turn adjusting cartridge more than one turn. Tighten nut (J) after adjustment.

For adjustment, see Hydraulic Pump Regulator Test and Adjustment—Engine Pulldown in this group.

TX,9025,GG2653 –19–21MAY98–3/3

HYDRAULIC PUMP REGULATOR TEST AND ADJUSTMENT—MINIMUM FLOW

SPECIFICATIONS	
Oil Temperature	50 ± 5°C (120 ± 10°F)
Engine Speed in Standard Mode	Fast Idle
Work Mode Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
Propel Speed Switch Position	Slow Speed (Turtle)
Slow Speed Propel With Track Raised Cycle Time	33 ± 5 sec for one revolution from a running start with pump control valve pilot line disconnect

ESSENTIAL TOOLS
7/16-20 M 37° (Parker No. 03CP-4) Plug (2 used)

SERVICE EQUIPMENT AND TOOLS
JT05800 Digital Thermometer
Stop Watch
17 mm Combination Wrench
Flat Blade Screwdriver

The purpose of check is to test and adjust the minimum flow rate of pumps using the cycle time for propel as an indicator of pump flow rate.

1. Adjust the track sag for both tracks to specification. (See procedure in Group 9020-20.)

2. Install the temperature probe on the hydraulic tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)

3. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10°F)

4. Stop the engine.

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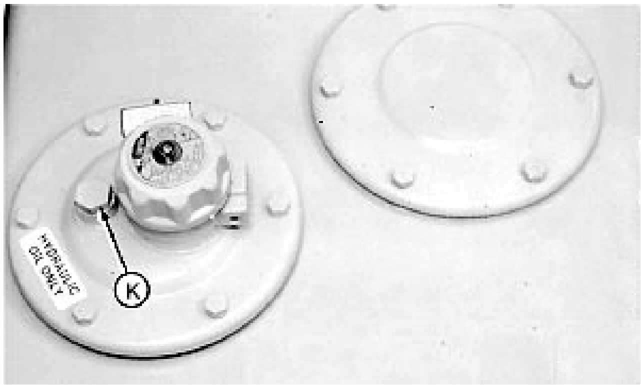
5. Loosen vent plug (K) to release the air pressure in hydraulic oil tank.



K—Vent Plug

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6. Disconnect pump control valve pilot lines at rear pump regulator (A) and front pump regulator (B). Install plug (C) in lines. Leave the fittings on regulator open. Lay a shop towel over the fittings.

7. Run machine as specified.

Engine—Specification

Speed in Standard Mode .... Fast Idle

Work Mode—Specification

Position .... Dig Mode

E Mode Switch—Specification

Position .... Off

HP Mode Switch—Specification

Position .... Off

Auto-Idle Switch—Specification

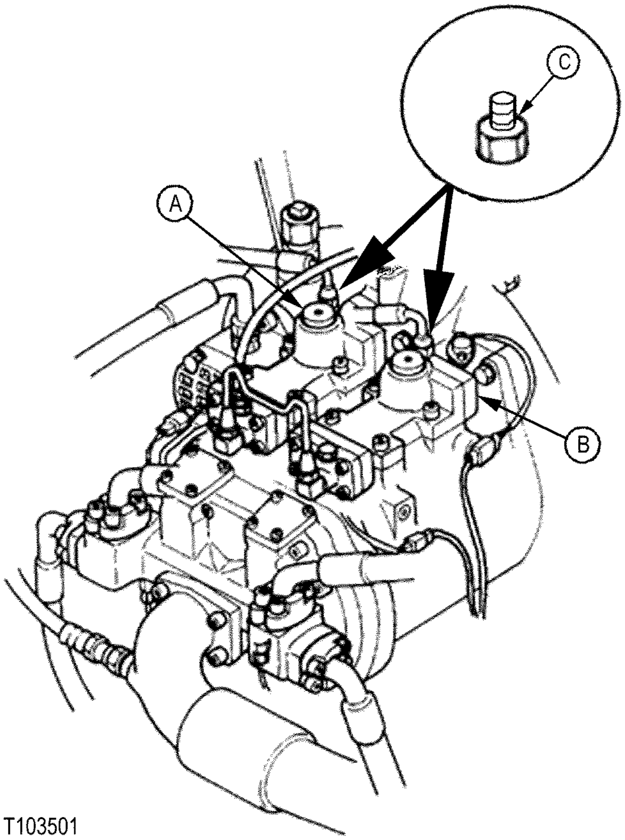
Position .... Off

Propel Speed Switch—Specification

Position .... Slow Speed (Turtle)

8. Raise the left track off ground for rear pump or the right track for front pump.

9. Actuate propel function to full speed. Record the cycle time for one revolution.



T103501 –UN–11SEP96

A—Rear Pump Regulator
B—Front Pump Regulator
C—Plugs

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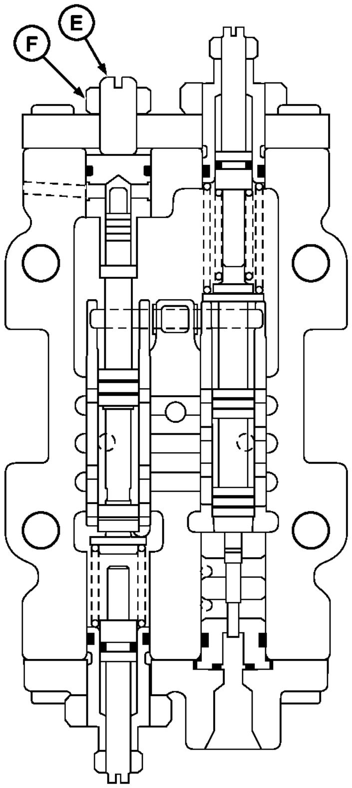
10. Adjust the minimum flow adjusting screw (E) as needed to obtain the specified cycle time. Turn screw in to decrease the cycle time (the minimum flow rate increases), turn screw out to increase the cycle time (the minimum flow rate decreases). Hold the screw and tighten the nut (F).

Slow Speed Propel With Track Raised—Specification

Cycle Time.. 33 ± 5 sec for one revolution from a running start with pump control valve pilot line disconnect

11. Repeat procedure for other pump.

    Adjust regulators so cycle times are the same.



T103502

T103502 –UN–24AUG98

E—Minimum Flow Adjusting Screw
F—17 mm Nut

TX,9025,GG2655 –19–08JUN98–4/4

HYDRAULIC PUMP REGULATOR TEST AND ADJUSTMENT—MAXIMUM FLOW

SPECIFICATIONS	
Oil Temperature	50 ± 5°C (120 ± 10°F)
Engine in Standard Mode Speed	Fast Idle
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
Propel Speed Switch Position	Slow Speed (Turtle)
Track Raised—3 Revolutions From a Running Start Cycle Time	29.9 ± 2.0 sec.

SERVICE EQUIPMENT AND TOOLS
JT05800 Digital Thermometer
Stop Watch
17, 22, and 32 mm Combination Wrenches
Flat Blade Screwdriver

Purpose of check is to test and adjust the maximum flow rate of pumps so the cycle times (travel speed) for left and right propel are approximately the same.

1. Adjust track sag for both tracks to specification. (See procedure in Group 9020-20.).

2. Install temperature probe on the hydraulic oil tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)

3. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10°F)

4. Run machine as specified.

Engine in Standard Mode—Specification

Speed .... Fast Idle

Work Mode Selector—Specification

Position .... Dig Mode

Continued on next page

E Mode Switch—Specification

Position .... Off

HP Mode Switch—Specification

Position .... Off

Auto-Idle Switch—Specification

Position .... Off

Propel Speed Switch—Specification

Position .... Slow Speed (Turtle)

5. Raise the left track off ground for rear pump or the right track for front pump.

6. Actuate propel function to full speed. Record cycle time for three revolutions.

   Repeat procedure for the other pump.

Continued on next page

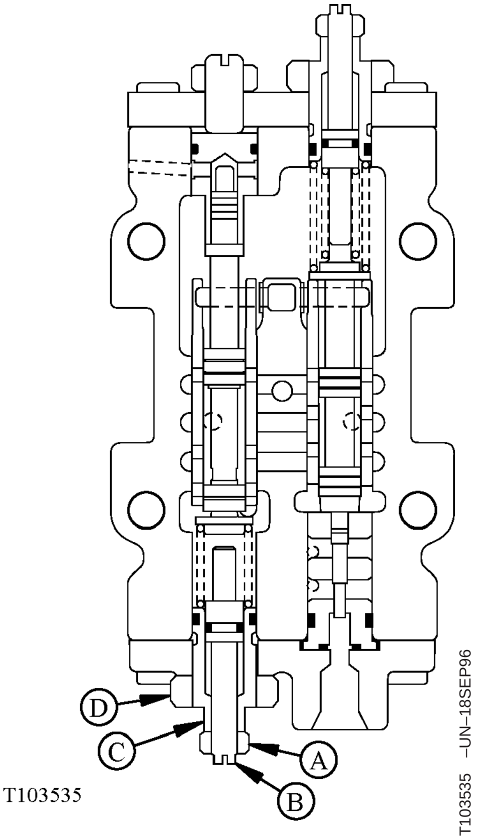
7. Adjust flow adjusting cartridge (C) on front and rear pump regulators so cycle times are within the specification and are the same.

Track Raised—3 Revolutions From a Running Start—Specification

Cycle Time.. 29.9 ± 2.0 sec.

Loosen 30 mm nut (D). Turn flow adjusting cartridge (C) in to decrease the cycle time; turn flow adjusting cartridge out to increase the cycle time. Never turn flow adjusting cartridge more than one turn. Tighten 30 mm nut after adjustment.

When flow adjusting cartridge (C) is turned in or out the maximum flow rate for the pump also changes. To maintain the pump's maximum flow rate, turn maximum flow adjusting screw (B) out twice as much as flow adjusting cartridge (C) is turned in; turn maximum flow adjusting screw (B) in twice as much as flow adjusting cartridge (C) is turned out.



A—13 mm Nut
B—Maximum Flow Adjusting Screw
C—Flow Adjusting Cartridge (Track Cycle Time)
D—30 mm Nut

TX,9025,GG2656 –19–08JUN98–3/3

HYDRAULIC PUMP REGULATOR TEST AND ADJUSTMENT—ENGINE PULLDOWN

SPECIFICATIONS	
Oil Temperature	50 ± 5°C (120 ± 10°F)
Engine Fast Idle in Standard Mode Speed	2180—2205 rpm
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
Propel Speed Switch Position	Slow Speed (Turtle)
Load Adjusting Cartridge (Outer Spring)—Combined Pump Engine Pulldown Speed	2070—2080 rpm at 17 235 kPa (172 bar) (2500 psi) with tracks stalled
Load Adjusting Screw (Inner Spring)—Combined Pump Engine Pulldown Speed	2070—2080 rpm at 24 130 kPa (240 bar) (3500 psi) with tracks stalled
System Relief Valve Pressure	34 325 + 1960 - 980 kPa (343 + 19.6 - 9.8 bar) (4980 + 285 - 0 psi)

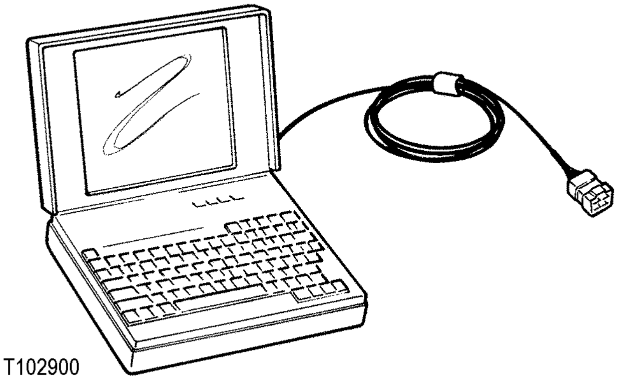
ESSENTIAL TOOLS
TH108328 Adapter (2 used)
XPD34BTX (1/8 x 7/16-20 F 37°) Male Quick Coupler

SERVICE EQUIPMENT AND TOOLS
JT07290 Laptop Computer
JT07274G Excavator Diagnostics Program Disk
JT07273 Cable
JT02156A Digital Pressure and Temperature Analyzer
JT02160 Transducer 70 000 kPa (700 bar) (10 000 psi)
Gauge 70 000 kPa (700 bar) (10 000 psi)
JT05800 Digital Thermometer
JT05801 Clamp-On Electronic Tachometer
85 mm (3-3/8 in.) OD Pin or Length of Round Bar Stock (2 used)
Flat Blade Screwdriver
13, 17, 19, 27, 30 and 32 mm Combination Wrenches

Continued on next page

IMPORTANT: In this procedure the pump regulators are adjusted to load the engine to rated speed so all available engine horsepower is used. Prior to performing this adjustment, proper engine performance with number two diesel fuel must be verified. The fast idle speed must be adjusted to specifications.

Pump regulators are sensitive to adjust.



T102900 –19–29AUG96

1. Connect the laptop computer. (See the installation procedure in this group.)
    a. Start the engine.
    b. Select “3 Front pump delivery pressure” and “4 Rear pump delivery pressure” from the Monitor Data menu.

Continued on next page

TX,9025,GG2661 –19–06MAY97–2/14

If laptop computer with excavator diagnostics program is not available, use the digital pressure and temperature analyzer, and transducer, or a gauges.

   a. Stop the engine.

   b. Loosen vent plug (K) to release the air pressure in hydraulic oil tank.

   c. Install adapters (A) and male quick coupler to test ports in rear (B) and front (C) pumps. Connect the analyzer and transducer or gauges.

2. Install the temperature probe on the hydraulic oil tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)

3. Install the electronic tachometer. (See JT05801 Clamp-On Electronic Tachometer Installation in this group.)

4. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

Oil—Specification

Temperature	50 ± 5°C (120 ± 10°F)

5. Check that fast idle is 2180—2205 rpm. Adjust as needed before continuing test. Record the fast idle speed.

Engine Fast Idle in Standard Mode—Specification

Speed	2180—2205 rpm

Work Mode Selector—Specification

Position	Dig Mode

E Mode Switch—Specification

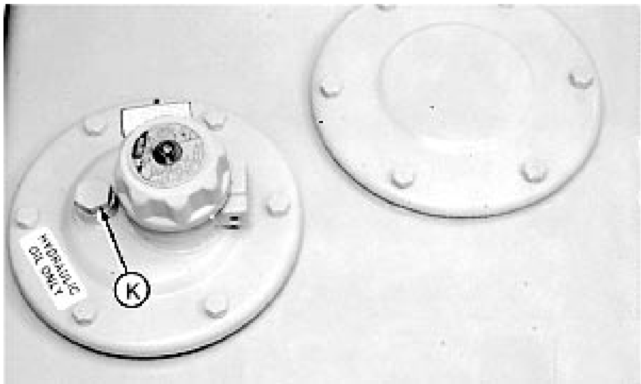
Position	Off

HP Mode Switch—Specification

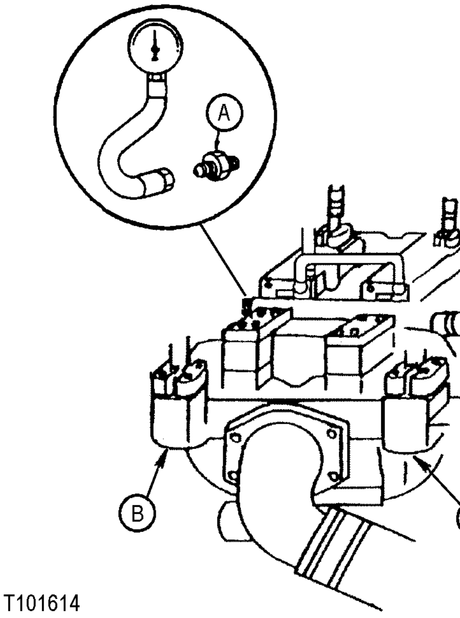
Position	Off

Auto-Idle Switch—Specification

Position	Off



T109340 –UN–29APR97



T101614

T101614 –UN–18JUN96

A—Adapter
B—Rear Pump
C—Front Pump
K—Vent Plug

Continued on next page

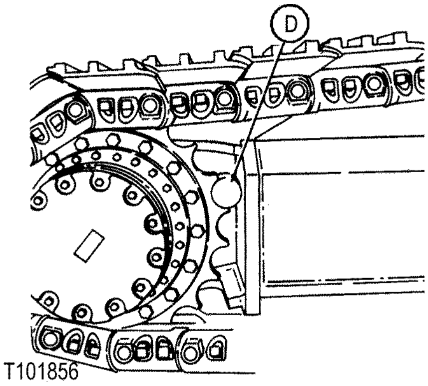
Propel Speed Switch—Specification

Position... Slow Speed (Turtle)

TX,9025,GG2661 –19–06MAY97–4/14

NOTE: Procedure is written using the propel functions operated over relief. Procedure will also work using dig functions over relief. Front pump—right propel or bucket function. Rear pump—left propel or swing function. Both front and rear pumps—both propel functions or arm in function.

6. Install two 85 mm (3-3/8 in.) OD pins or round bar stock between both sprockets and track frame to stall the propel motors.



T101856 –UN–02JUL96

D—Pin or Round Bar Stock

Continued on next page

TX,9025,GG2661 –19–06MAY97–5/14

7. Adjust the Load Adjusting Cartridge (Outer Spring) (Engine Pulldown at Medium Pressure) (L):

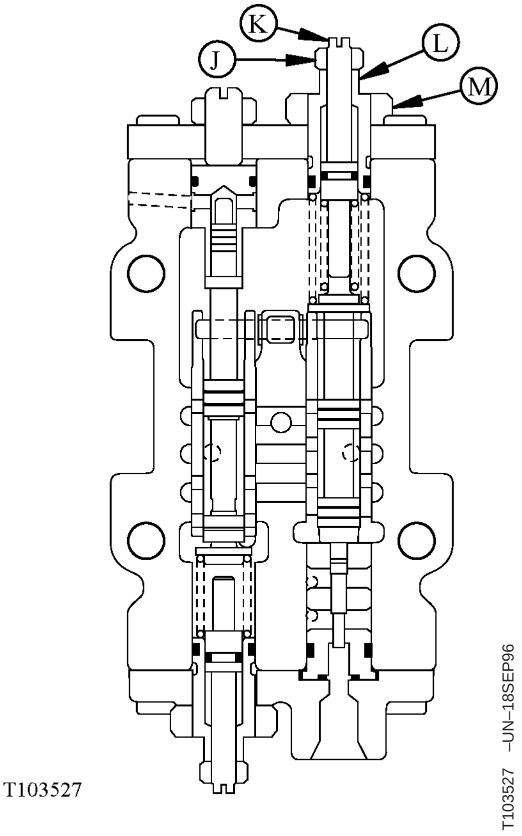
NOTE: The load adjusting screw (K) and load adjusting cartridge (L) are located on the end of regulator towards the engine.

a. Loosen 13 mm nut (J) on both regulators.

b. Turn load adjusting screws (K) out 1-1/2 turns. Tighten nuts.

c. Loosen 30 mm nuts (M) on both regulators.

d. Turn load adjusting cartridges (L) out 1-1/4 turns. Leave nuts loose.



J—13 mm Nut
K—Load Adjusting Screw
L—Load Adjusting Cartridge
M—30 mm Nut

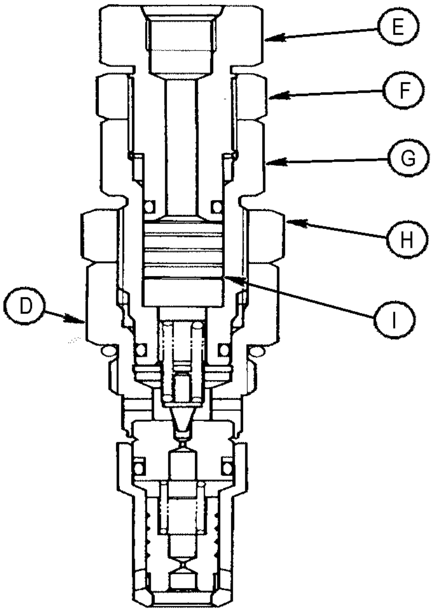
Continued on next page

e. Adjust system relief valve (D):

- Run engine at fast idle.
- Actuate and hold both propel functions over relief.
- Loosen 32 mm nut (H). Turn second adjusting plug (G) out to obtain 17 235 kPa (172 bar) (2500 psi). Tighten nut.

f. Run engine at fast idle.

g. Actuate and hold both propel functions over relief.



T101616

T101616 –UN–18JUN96

D—System Relief Valve
E—First Adjusting Plug
F—27 mm Nut
G—Second Adjusting Plug
H—32 mm Nut
I—Piston

Continued on next page

NOTE: Initial procedure is to adjust the load adjusting cartridges (L) to match the two pumps before making the final adjustment to get the combined pump engine pulldown at medium pressure.

Hydraulic pressure increases as the load adjusting cartridges are turned in because the pump flow is increasing.

h. Turn the load adjusting cartridge (L) on front pump regulator in until engine speed just starts to decrease. Then, slowly turn the load adjusting cartridge out and in to verify the exact point where engine speed starts to decrease (0—10 rpm).

i. Turn the load adjusting cartridge (L) on rear pump regulator in until engine speed just starts to decrease. Then, slowly turn the load adjusting cartridge out and in to verify the exact point where engine speed starts to decrease (0—10 rpm).

j. Release both propel functions.

NOTE: To avoid heating the oil excessively, only operate the propel functions over relief to check the pulldown after each adjustment of cartridge.

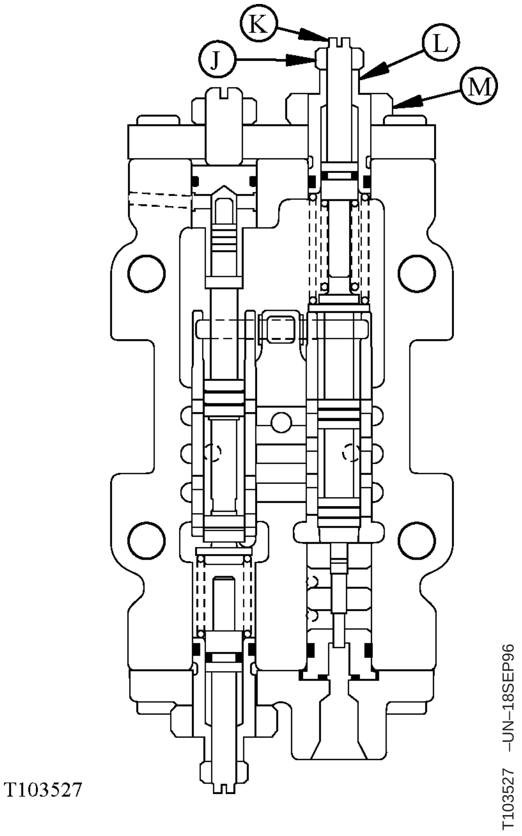
k. Turn both load adjusting cartridges (L) in equal amounts. Start with 1/4 turn.

l. Actuate and hold both propel functions over relief to check that engine pulldown speed is 2070—2080 rpm. Record the rpm reading. Release propel functions.

Load Adjusting Cartridge (Outer Spring)—Combined Pump Engine Pulldown—Specification

Speed .... 2070—2080 rpm at 17 235 kPa (172 bar) (2500 psi) with tracks stalled

m. Hold the cartridge and tighten large nut on both regulators.



J—13 mm Nut
K—Load Adjusting Screw
L—Load Adjusting Cartridge
M—30 mm Nut

Continued on next page

IMPORTANT: If the load adjusting cartridge are not turned in equal amounts, the engine speed will pulldown to the specified rpm but the pump flow rates will not be equal and the machine will mistrack.

n. Check the adjustments:

- Run the engine at fast idle.
- Actuate and hold right propel function over relief. Record rpm reading. Release propel function.
- Actuate and hold left propel function over relief. Record rpm reading. Release propel function.
- The rpm reading for front and rear pumps must be within 10 rpm of each other to prevent machine from mistracking.

Continued on next page

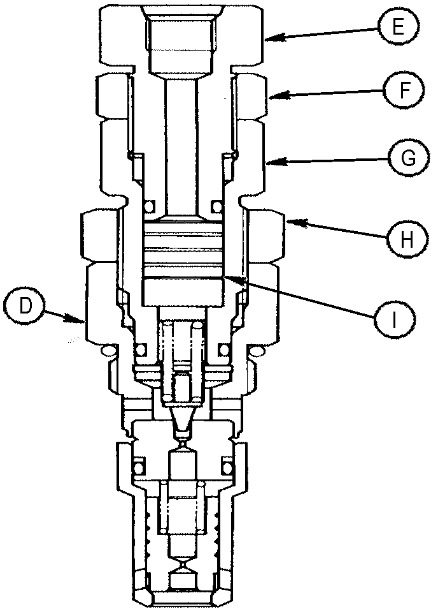
8. **Adjust the Load Adjusting Screw (Inner Spring) (Engine Pulldown at High Pressure):**

   a. Adjust the system relief valve (D):

      - Run engine at fast idle.
      - Actuate and hold both propel functions over relief.
      - Loosen 32 mm nut (H). Turn second adjusting plug (G) in to obtain Tighten nut.

   b. Run engine at fast idle.

   c. Actuate and hold both propel functions over relief.



T101616

T101616 –UN–18JUN96

D—System Relief Valve
E—First Adjusting Plug
F—27 mm Nut
G—Second Adjusting Plug
H—32 mm Nut
I—Piston

Continued on next page

NOTE: Initial procedure is to adjust the load adjusting screws (K) to match the two pumps before making the final adjustment to get the combined pump engine pulldown at high pressure.

d. Turn load adjusting screw (K) on front pump regulator in until engine speed just starts to decrease. Then, slowly turn load adjusting screw out and in to verify the exact point where the engine speed just starts to decrease (0—10 rpm).

e. Turn load adjusting screw (K) on rear pump regulator in until engine speed just starts to decrease. Then, slowly turn load adjusting screw out and in to verify the exact point where the engine speed just starts to decrease (0—10 rpm).

f. Release both propel functions.

NOTE: To avoid heating the oil excessively, only operate the propel function over relief to check the pulldown after each adjustment of screws

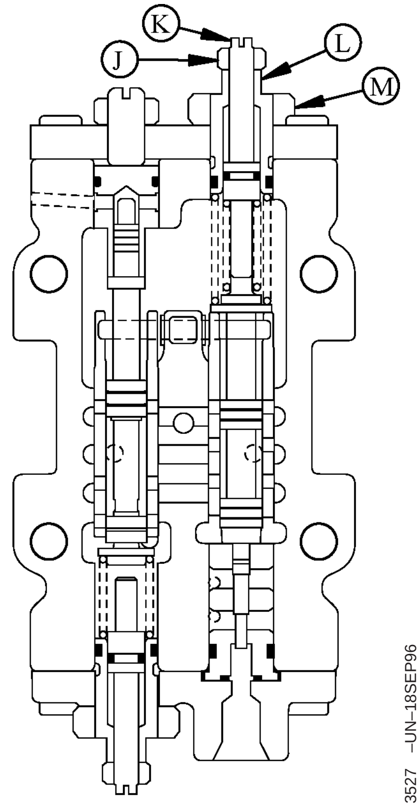
g. Turn both load adjusting screws in equal amounts. Start with 1/4 turn.

h. Actuate and hold both propel functions over relief to check that engine pulldown speed is 2070—2080 rpm.

Load Adjusting Screw (Inner Spring)—Combined Pump Engine Pulldown—Specification

Speed	2070—2080 rpm at 24 130 kPa (240 bar) (3500 psi) with tracks stalled

i. Hold the load adjusting screw and tighten nut on both regulators.



T103527 –UN–18SEP96

J—13 mm Nut
K—Load Adjusting Screw (Inner Spring)
L—Load Adjusting Cartridge (Outer Spring)
M—30 mm Nut

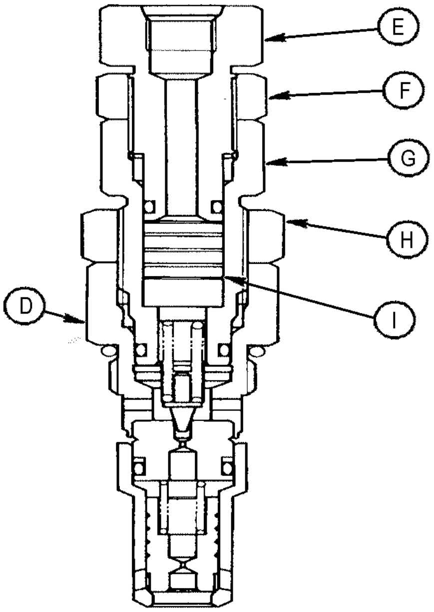
Continued on next page

j. Adjust the system relief valve (D) to operating pressure:

- Run the engine at fast idle.
- Actuate and hold both propel functions over relief.
- Loosen 32 mm nut (H). Turn second adjusting plug (G) in to obtain specified pressure. Tighten nut.

System Relief Valve—Specification

Pressure .... 34 325 + 1960 - 980 kPa
(343 + 19.6 - 9.8 bar)
(4980 + 285 - 0 psi)



T101616

T101616 –UN–18JUN96

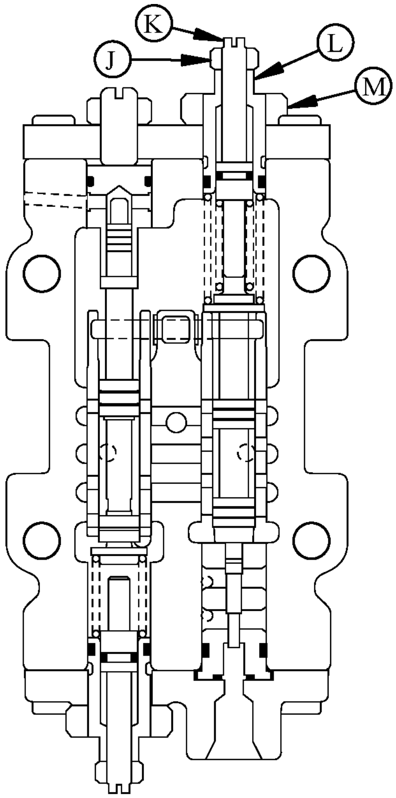
D—System Relief Valve
E—First Adjusting Plug
F—27 mm Nut
G—Second Adjusting Plug
H—32 mm Nut
I—Piston

Continued on next page

k. Check the adjustments:

- Actuate and hold right propel function over relief. Engine pulldown must not go below 2080 rpm. If it does, turn front pump load adjusting cartridge (L) out until pulldown is 2080—2100 rpm. Record rpm reading. Release propel function.
- Actuate and hold left propel function over relief. Engine pulldown must not go below 2080 rpm. If it does, turn rear pump load adjusting cartridge (L) out until pulldown is 2080—2100 rpm. Record rpm reading. Release propel function.
- The pulldown rpm reading for front and rear pumps must be within 10 rpm of each other to prevent machine from mistracking.

l. Make final pump regulator adjustments by observing how straight the machine tracks under load.



T103527

T103527 –UN–18SEP96

J—13 mm Nut
K—Load Adjusting Screw (Inner Spring)
L—Load Adjusting Cartridge (Outer Spring)
M—30 mm Nut

Continued on next page

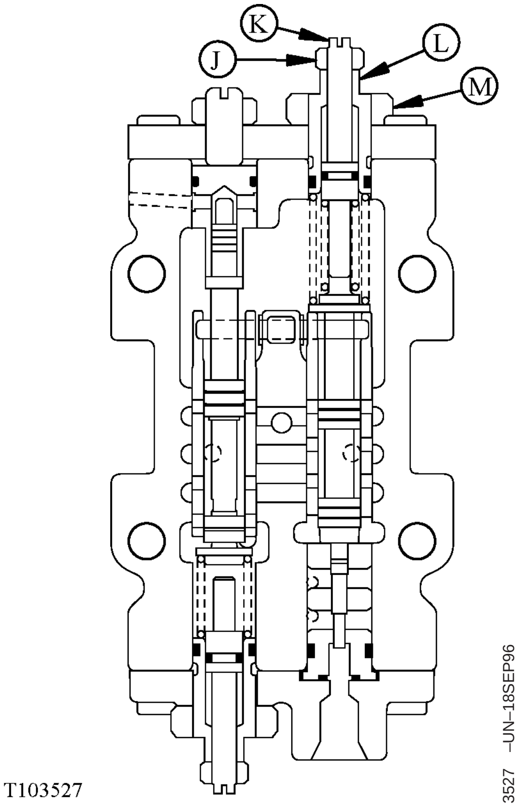
9. **Do the Final Tracking Checks:**

   a. Propel machine forward on a flat area of naturally compacted soil and then on a slope of naturally compacted soil.

   b. If machine mistracks to the left on the flat area, turn the load adjusting cartridge (L) on the front pump regulator out to slow the right track.

   c. If the machine mistracks to the right under load on the slope, turn the load adjusting screw (K) on the rear pump regulator out to slow the left track.

   d. If the machine mistracks to the left under load on the slope, turn the load adjusting screw (K) on the front pump regulator out to slow the right track.



T103527 –UN–18SEP96

J—13 mm Nut
K—Load Adjusting Screw (Inner Spring)
L—Load Adjusting Cartridge (Outer Spring)
M—30 mm Nut

HYDRAULIC PUMP FLOW TEST

SPECIFICATIONS	
Engine in Standard Mode Speed	2000 ± 10 rpm
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
Oil Temperature	50 ± 5°C (120 ± 10°F)
One New Pump Flow Rate	193 ± 4 L/min (51 ± 1 gpm) typical at 13 790 kPa (138 bar) (2000 psi) and 2000 ± 10 rpm
One New Pump Flow Rate	155 ± 4 L/min (41 ± 1 gpm) typical at 20 685 kPa (207 bar) (3000 psi) and 2000 ± 10 rpm
One Used Pump Flow Rate	162 ± 15 L/min (43 ± 4 gpm) minimum at 13 790 kPa (138 bar) (2000 psi) and 2000 ± 10 rpm
One Used Pump Flow Rate	128 ± 15 L/min (34 ± 4 gpm) minimum at 20 685 kPa (207 bar) (3000 psi) and 2000 ± 10 rpm

ESSENTIAL TOOLS
TH108328 Adapter (2 used)
TH108325 (1 M BSPP ORB x —16 M ORFS) Elbow
JT03410 (SAE Code 62 Split Flange High Pressure 1 SF x 1-5/16-12 M 37°) 90° Flange Fitting (2 used)
JT03452 Split Flange Connector Plate Kit
202862 (3/4-16 M 37° x 3/4-16 F 37° Sw x 7/16-20 M 37°) Tee (2 used)
JT05484 (7/16-20 F 37°) (Parker No. 06CP-4) Cap (2 used)

SERVICE EQUIPMENT AND TOOLS
Flow Meter
JT07290 Laptop Computer
JT07274G Excavator Diagnostics Program Disk
JT07273 Cable
Gauge 70 000 kPa (700 bar) (10 000 psi) (2 used)
JT05800 Digital Thermometer
JT05801 Clamp-On Electronic Tachometer

Continued on next page

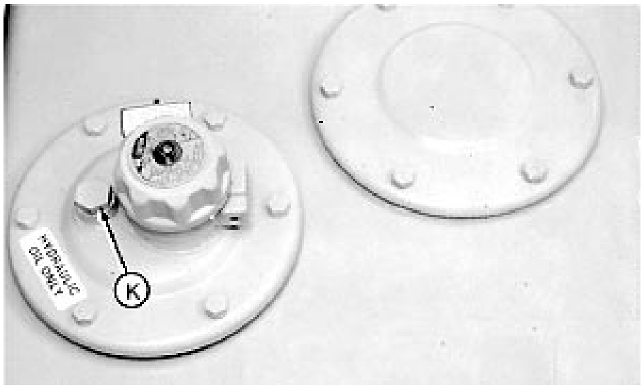
TX,9025,GG2662 –19–08JUN98–1/5

Tests

Test is used to determine pump condition and should be performed only if a comparison of actual machine cycle times to specified cycle times indicates low pump flow.

TX,9025,GG2662 –19–08JUN98–2/5

1. Stop the engine.
2. Loosen vent plug (K) to release the air pressure in hydraulic oil tank.



T109340 –UN–29APR97

K—Vent Plug

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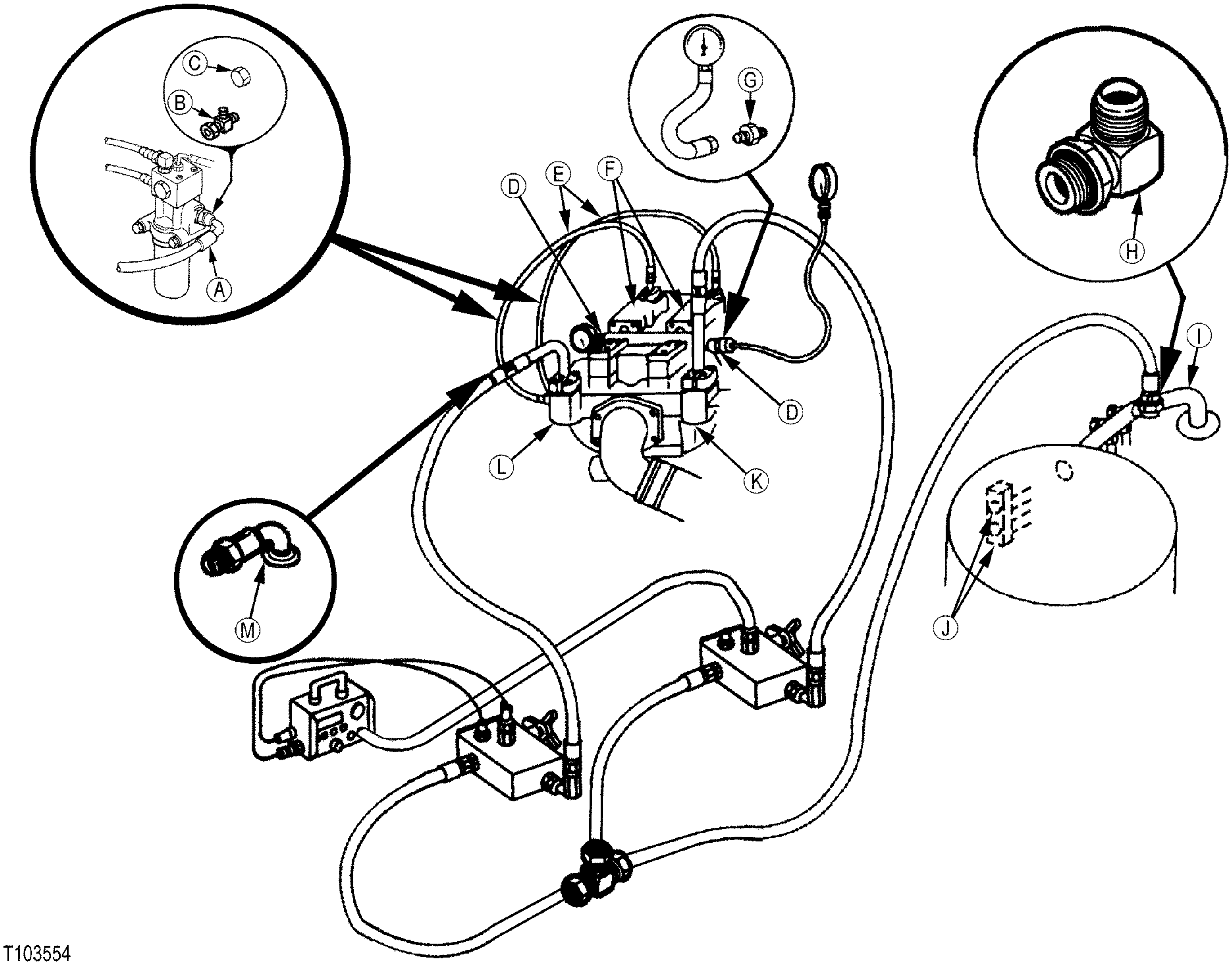
TX,9025,GG2662 –19–08JUN98–3/5



T103554 –UN–16SEP96

A—Pilot Pressure Inlet Line
B—202862 Tee (2 used)
C—JT05484 Cap
D—Test Port
E—Pump Control Valve Pilot Lines
F—Front and Rear Pump Regulator Valves
G—TH108328 Adapter
H—TH108325 Elbow
I—Return Manifold
J—Bulkhead
K—Front Pump Outlet Port
L—Rear Pump Outlet Port
M—JT03410 90° Flange Fitting

3. Connect the flow meter using 90° flange fitting (M). If available, connect a flow meter to front (K) and rear (L) pumps.

   Connect the return hose from flow meter to the return manifold (I). Install plates, from the split flange connector plate kit, on end of hoses to control valve.

   To monitor pump delivery pressure, use the pressure gauge on flow meter, or install adapters (G) and gauges to test ports (D) in pump housing, or use the laptop computer.

4. Disconnect pilot pressure inlet line (A) at pilot filter. Install tees (B). Connect pilot pressure inlet line to tee.

Continued on next page

Disconnect the two pump control valve pilot lines (E) at bulkhead (J) on hydraulic oil tank. Connect the pilot lines to the tees installed at pilot filter. Install caps (C) on fittings at bulkhead.

NOTE: Pilot pressure is routed to the pump regulator valves so the pumps operate at maximum displacement.

5. Install the temperature probe on the hydraulic tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)

6. Install the tachometer. (See JT05801 Clamp-On Electronic Tachometer Installation in this group.)

7. Check that the flow meter loading valve is open.

8. Operate the machine at specification.

Engine in Standard Mode—Specification

Speed.. 2000 ± 10 rpm

Work Mode Selector—Specification

Position .... Dig Mode

E Mode Switch—Specification

Position .... Off

HP Mode Switch—Specification

Position .... Off

Auto-Idle Switch—Specification

Position .... Off

9. Heat the hydraulic oil to the specified temperature by closing flow meter loading valve to increase pressure to 20 685 kPa (207 bar) (3000 psi).

Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10°F)

10. Adjust the flow meter loading valve to obtain the specified test pressures. Adjust engine speed to specified rpm. Record pump flow at each pressure.

    If pump flow in low, repair or replace pump.

One New Pump—Specification

Flow Rate.. 193 ± 4 L/min (51 ± 1 gpm) typical at 13 790 kPa (138 bar) (2000 psi) and 2000 ± 10 rpm

Flow Rate.. 155 ± 4 L/min (41 ± 1 gpm) typical at 20 685 kPa (207 bar) (3000 psi) and 2000 ± 10 rpm

One Used Pump—Specification

Flow Rate.. 162 ± 15 L/min (43 ± 4 gpm) minimum at 13 790 kPa (138 bar) (2000 psi) and 2000 ± 10 rpm

Flow Rate.. 128 ± 15 L/min (34 ± 4 gpm) minimum at 20 685 kPa (207 bar) (3000 psi) and 2000 ± 10 rpm

PILOT PUMP FLOW TEST

SPECIFICATIONS	
Oil Temperature	50 ± 6°C (120 ± 10°F)
Engine in Standard Mode Speed	2000 rpm
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
Pilot Pump Flow Rate	25.0 L/min (6.6 gpm) at 3925 kPa (39 bar) (570 psi) and 2000 rpm

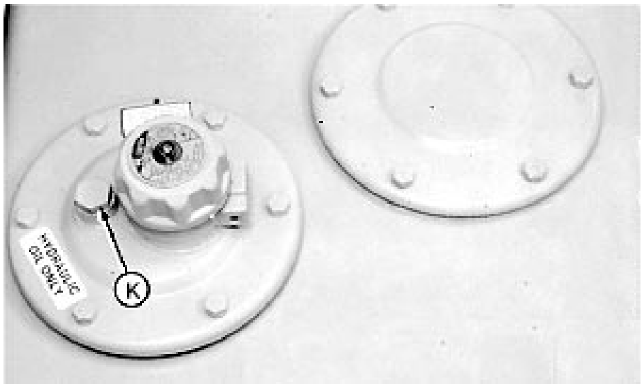
SERVICE EQUIPMENT AND TOOLS
Flow Meter
JT05800 Digital Thermometer
JT05801 Clamp-On Electronic Tachometer

Test will determine the condition of pilot pump. The pump is driven at engine speed. Inspect pilot filter and suction screen for indications of hydraulic system problems.

TX,9025,GG2663 –19–08JUN98–1/4

1. Stop the engine.

   Loosen vent plug (K) to release the air pressure in hydraulic oil tank.



T109340 –UN–29APR97

K—Vent Plug

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TX,9025,GG2663 –19–08JUN98–2/4

2. Connect flow meter in series with pilot pressure inlet line (A) at pilot filter (B).

   Open the flow meter loading valve.

3. Install the temperature probe on the hydraulic tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)

4. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

Oil—Specification

Temperature .... 50 ± 6°C (120 ± 10°F)

NOTE: The pilot pressure regulating valve will regulate pump discharge pressure. It is not necessary to load the pump using flow meter loading valve.

5. Run engine at test specifications. Record flow meter reading.

   If pressure is low, check the pilot pressure regulating valve.

   If flow is low, check inlet hose to pump for restriction. If there is no restriction, replace pump.

Engine in Standard Mode—Specification

Speed .... 2000 rpm

Work Mode Selector—Specification

Position .... Dig Mode

E Mode Switch—Specification

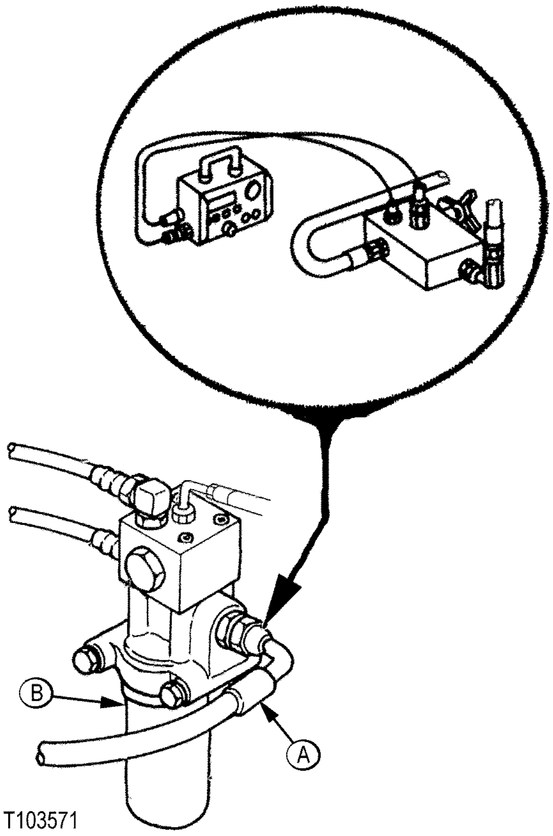
Position .... Off

HP Mode Switch—Specification

Position .... Off

Auto-Idle Switch—Specification

Position .... Off



T103571 –UN–11SEP96

A—Pilot Pressure Inlet Line
B—Pilot Filter

Continued on next page

Pilot Pump—Specification

Flow Rate .... 25.0 L/min (6.6 gpm) at 3925 kPa (39 bar) (570 psi) and 2000 rpm

TX,9025,GG2663 –19–08JUN98–4/4

PROPEL SYSTEM TRACKING TEST

SPECIFICATIONS	
Engine in Standard Mode Speed	Fast Idle
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
Oil Temperature	50 ± 5°C (120 ± 10°F)
Mistrack at 20 m (65 ft) Distance	200 mm (7-7/8 in.) or less

SERVICE EQUIPMENT AND TOOLS
Tape Measure
JT05800 Digital Thermometer
JT02156A Digital Pressure and Temperature Analyzer

Test is used to check the overall condition of the propel system from the hydraulic pumps to the propel motors.

1. Lay out a course on a hard flat surface that is 20 m (65 ft) in length plus an additional 3—5 m (10—15 ft) at each end for acceleration and deceleration. Mark a straight line the length of course.

2. Adjust the track sag so both sides are equal and within specification before doing test. (See Adjust Track Sag in Group 9020-20.)

Engine in Standard Mode—Specification

Speed .... Fast Idle

Work Mode Selector—Specification

Position .... Dig Mode

E Mode Switch—Specification

Position .... Off

HP Mode Switch—Specification

Position .... Off

Auto-Idle Switch—Specification

Position .... Off

Continued on next page

3. Install the temperature probe on the hydraulic tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)

4. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10°F)

5. Lower the boom so bucket is approximately 300—500 mm (12—20 in.) off the ground with the arm retracted and the bucket curled.

6. Start propelling with the machine at the end of course and the tracks aligned with the straight line. Actuate the propel pilot controller to full stroke.

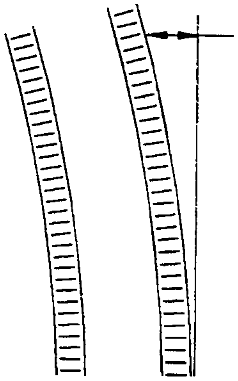
TX,9025,GG2664 –19–08JUN98–2/3

7. Measure the amount of mistrack from the straight line to the track at the 20 m (65 ft) mark. The amount of mistrack has a tendency to be less if done on a concrete surface.

Mistrack at 20 m (65 ft)—Specification

Distance... 200 mm (7-7/8 in.) or less

Turn the upperstructure 180 degrees and repeat procedure for reverse propel.



T6998AS (CV)

T6998AS –UN–23MAR89

TX,9025,GG2664 –19–08JUN98–3/3

CYLINDER DRIFT TEST—BOOM, ARM, AND BUCKET

SPECIFICATIONS	
Oil Temperature	50 ± 5°C (120 ± 10°F)
Engine in Standard Mode Speed	Off
Arm Length	2.96 (9 ft 9 in.)
Bucket Capacity	1.0 m^3 (1.38 yd^3)
Bucket Load Weight	1315 kg (2900 lb)
Arm Cylinder Length	50 mm (2.00 in.) approximate extension
Bucket Cylinder Length	50 mm (2.00 in.) approximate retraction
Boom Cylinder Height	Bucket pivot pin at the same height as boom-to-main frame pin
Engine Speed	Off
Arm Cylinder Drift	20 mm (13/16 in.) maximum allowable for 5 minutes
Bucket Cylinder Drift	20 mm (13/16 in.) maximum allowable for 5 minutes
Boom Cylinder Drift	20 mm (13/16 in.) maximum allowable for 5 minutes
Bottom of Bucket to Ground Drift	150 mm (6 in.) maximum allowable for 5 minutes

SERVICE EQUIPMENT AND TOOLS
JT05800 Digital Thermometer
Tape Measure

Procedure is used to check the leakage past the cylinder piston seals, control valve spools, circuit relief valves, boom reduced leakage valve, and arm reduced leakage valve.

1. Install the temperature probe on the hydraulic tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)

2. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10°F)

Continued on next page

Engine in Standard Mode—Specification

Speed .... Off

3. Fill the bucket to get the specified bucket load with the standard arm and bucket.

Arm—Specification

Length.. 2.96 (9 ft 9 in.)

Bucket—Specification

Capacity.. 1.0 m^3 (1.38 yd^3)

Bucket Load—Specification

Weight.. 1315 kg (2900 lb)

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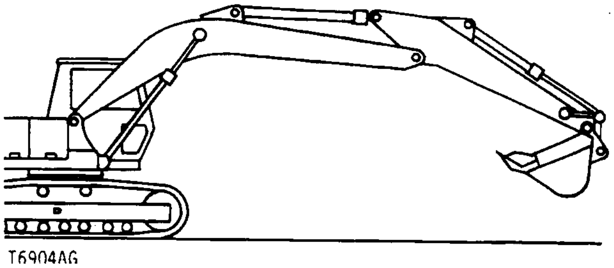
TX,9025,GG2665 –19–09MAY97–2/3

4. Position arm cylinder so rod is extended the specified length from the retracted position.



T6904AG –UN–06DEC88

Arm Cylinder—Specification

Length	50 mm (2.00 in.) approximate extension

5. Position bucket cylinder so rod is retracted the specified length from the extended position.

Bucket Cylinder—Specification

Length	50 mm (2.00 in.) approximate retraction

6. Position the boom cylinders so bucket pivot pin is at the same height as the boom-to-main frame pin.

Boom Cylinder—Specification

Height	Bucket pivot pin at the same height as boom-to-main frame pin

7. Stop the engine.

Engine—Specification

Speed	Off

8. After 5 minutes, measure the amount of movement for boom, arm and bucket cylinders and from bottom of bucket to the ground.

Arm Cylinder—Specification

Drift	20 mm (13/16 in.) maximum allowable for 5 minutes

Bucket Cylinder—Specification

Drift	20 mm (13/16 in.) maximum allowable for 5 minutes

Boom Cylinder—Specification

Drift	20 mm (13/16 in.) maximum allowable for 5 minutes

Bottom of Bucket to Ground—Specification

Drift	150 mm (6 in.) maximum allowable for 5 minutes

SWING MOTOR LEAKAGE TEST

SPECIFICATIONS	
Oil Temperature	50 ± 5°C (120 ± 10° F)
Engine in Standard Mode Speed	Fast Idle
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
Swing Motor Leakage	0.2—1.0 L/min (0.05—0.26 gpm) new acceptable while swinging
Swing Motor Leakage	2 L/min (0.53 gpm) used maximum acceptable while swinging
Swing Motor Leakage	8 L/min (2.2 gpm) new acceptable while stalled
Swing Motor Leakage	16 L/min (4.2 gpm) used maximum acceptable while stalled

ESSENTIAL TOOLS
JT03023 (9/16-18 F 37°) (Parker No. 06CP-6) Cap

SERVICE EQUIPMENT AND TOOLS
JT05800 Digital Thermometer
Calibrated Container

The purpose of test is to check the efficiency of swing motor. Leakage can occur between the cylinder block and valve plate and the slippers and swash plate when parts are worn or damaged. The motor must be checked in more than one position in order to check all pistons and the circumference of valve plate and cylinder block.

1. Install the temperature probe on the hydraulic tank-to-pump suction line. (See JT05800 Digital Thermometer Installation in this group.)

2. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

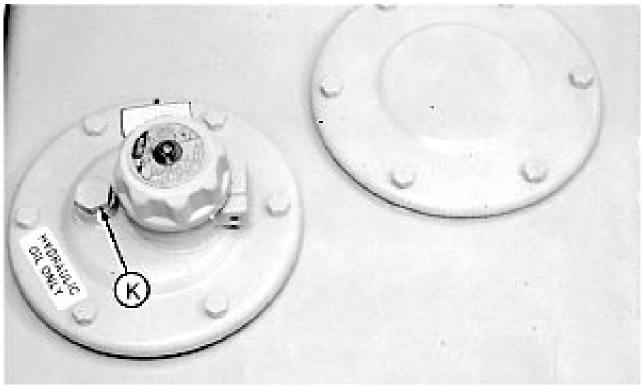
Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10° F)

3. Stop the engine.

Continued on next page

4. Loosen vent plug (K) to release the air pressure in hydraulic oil tank.



T109340 –UN–29APR97

K—Vent Plug

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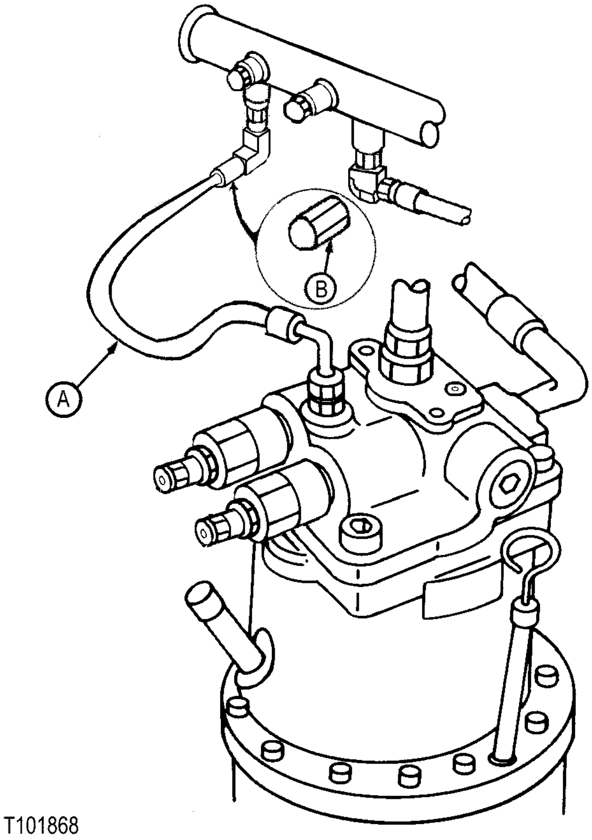
5. Disconnect drain line (A) from return manifold. Install a cap on elbow. Put drain line in a calibrated container.



A—Swing Motor Drain Line
B—Cap

⚠ **CAUTION: To avoid personnel injury, clear area of all bystanders before doing test. Slowly swing through one complete revolution to ensure that the area is clear of objects before doing test.**

6. Raise and lower boom to pressurize hydraulic oil tank.

7. Operate swing function for one minute. Compare amount of leakage to specifications. Repeat for swing in opposite direction.

Engine in Standard Mode—Specification

Speed	Fast Idle

Work Mode Selector—Specification

Position	Dig Mode

E Mode Switch—Specification

Position	Off

HP Mode Switch—Specification

Position	Off

Auto-Idle Switch—Specification

Position	Off

Swing Motor—Specification

Leakage	0.2—1.0 L/min (0.05—0.26 gpm) new acceptable while swinging
Leakage	2 L/min (0.53 gpm) used maximum acceptable while swinging

8. Operate swing function at stall for one minute. Put the bucket against an immovable object or in a trench then hold swing control lever fully actuated to stall swing function. Compare the amount of leakage to specifications.

Continued on next page

Swing Motor—Specification

Leakage	8 L/min (2.2 gpm) new acceptable while stalled
Leakage	16 L/min (4.2 gpm) used maximum acceptable while stalled

Repeat procedure by stalling the motor in several position and then take an average of the readings.

Repeat procedure in the opposite direction.

9. If leakage is greater than the maximum specified, repair or replace swing motor.

10. Connect drain line to return manifold.

PROPEL MOTOR LEAKAGE TEST

SPECIFICATIONS	
Oil Temperature	50 ± 5°C (120 ± 10° F)
Engine in Standard Mode Speed	Fast Idle
Work Mode Selector Position	Dig Mode
E Mode Switch Position	Off
HP Mode Switch Position	Off
Auto-Idle Switch Position	Off
Propel Speed Switch Position	Slow Speed (Turtle)
Propel Motor Leakage	1.5—2.0 L/min (0.4—0.53 gpm) new acceptable while propelling with track raised
Propel Motor Leakage	3.4 L/min (0.80 gpm) used maximum acceptable while propelling with track raised
Propel Motor Leakage	1.5—4.8 L/min (0.40—1.20 gpm) new acceptable while stalled
Propel Motor Leakage	5.2 L/min (1.40 gpm) used maximum acceptable while stalled

ESSENTIAL TOOLS
JT03025 (3/4-16 F 37°) (Parker No. 06CP—8) Cap
JT03221 (3/4-16 M 37°) (Parker No. 03CP—8) Plug

SERVICE EQUIPMENT AND TOOLS
JT05800 Digital Thermometer
Calibrated Container
85 mm (3-3/8 in.) OD Pin or Round Bar Stock (2 used)

1. Stop the engine.

2. Heat hydraulic oil to the specified temperature. (See Hydraulic System Warm-Up Procedure in this group.)

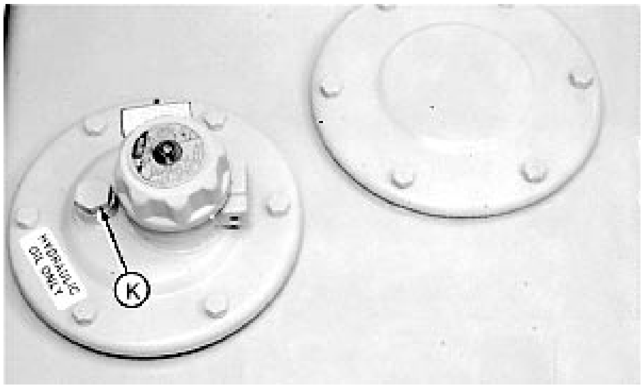
Oil—Specification

Temperature .... 50 ± 5°C (120 ± 10° F)

3. Stop the engine.

Continued on next page

4. Loosen vent plug (K) to release the air pressure in hydraulic oil tank.



T109340 –UN–29APR97

K—Vent Plug

Continued on next page

5. Disconnect the drain line (A) at return manifold. Put line in a calibrated container (D). Install a cap (B) on the open fitting (C).

6. Raise track off the ground for side being checked.

7. Run machine at specifications.

Engine in Standard Mode—Specification

Speed .... Fast Idle

Work Mode Selector—Specification

Position .... Dig Mode

E Mode Switch—Specification

Position .... Off

HP Mode Switch—Specification

Position .... Off

Auto-Idle Switch—Specification

Position .... Off

Propel Speed Switch—Specification

Position .... Slow Speed (Turtle)

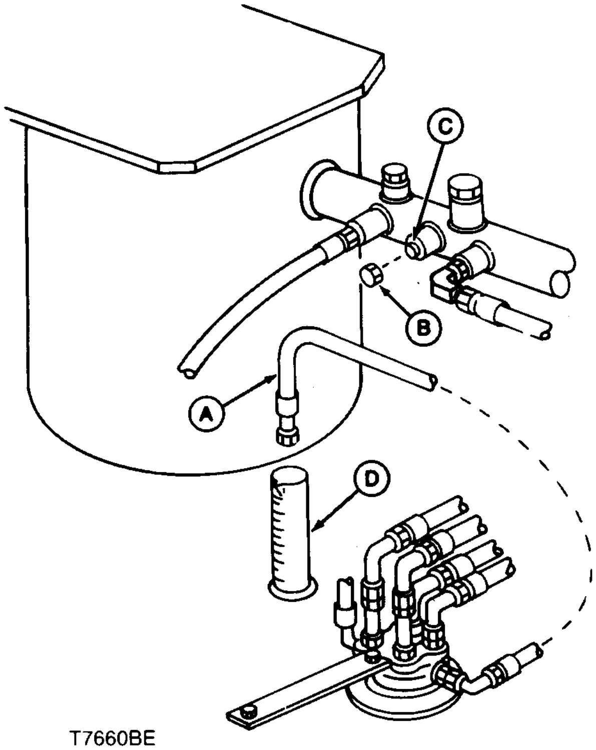
8. For propel motor being checked, actuate propel forward function at full speed for one minute. Record amount of leakage. Repeat procedure for reverse.

   If leakage is more than specification, repair or replace motor.

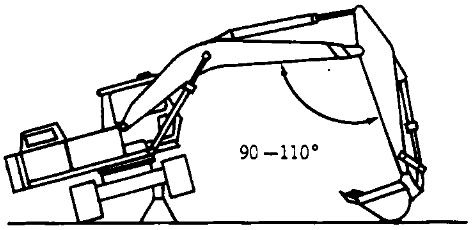
Propel Motor—Specification

Leakage .... 1.5—2.0 L/min (0.4—0.53 gpm) new acceptable while propelling with track raised
Leakage .... 3.4 L/min (0.80 gpm) used maximum acceptable while propelling with track raised

If leakage is substantially more in one direction than the other, a seal in the rotary manifold may be leaking. To isolate leakage to the propel motor or rotary manifold, check leakage at the propel motor.



T7660BE –UN–11DEC91



T6876FG –UN–06DEC88

A—Propel Motor Drain Line
B—Cap
C—Fitting
D—Calibrated Container

Continued on next page

9. To check propel motor for leakage at stall, install pins or round bar stock (D) between the sprockets and track frame.

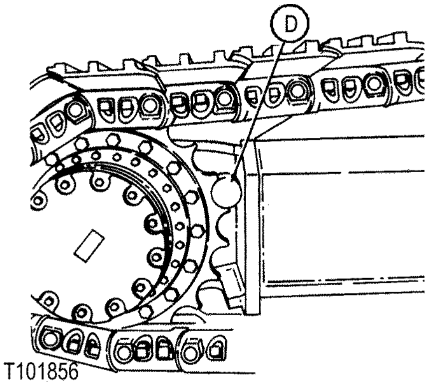
Propel Motor—Specification

Leakage .... 1.5—4.8 L/min (0.40—1.20 gpm) new acceptable while stalled

Leakage .... 5.2 L/min (1.40 gpm) used maximum acceptable while stalled

Actuate propel pedal for function being checked to full stroke for one minute. Record the amount of leakage.Repeat procedure by stalling the motor in several positions and then take an average of readings.

Repeat procedure for the opposite direction.

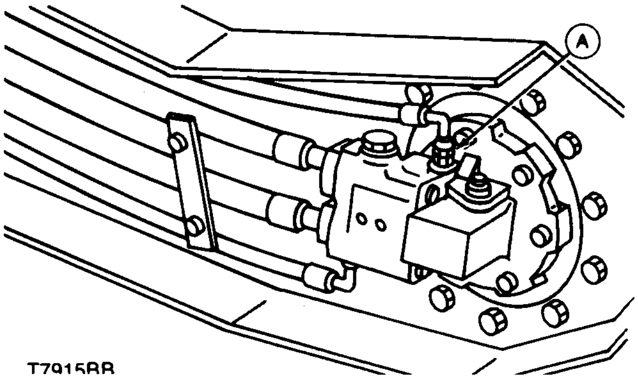


A—Pin or Round Bar Stock

TX,9025,GG2667 –19–09MAY97–4/5

10. To check leakage at the propel motor, disconnect drain line (A) at propel motor. Install JT03221 Plug in the line. Connect a line to fitting on motor. Put line in a calibrated container.

    Repeat Steps 7 and 8. If leakage is more than specification, repair or replace motor. If leakage is within specification, repair or replace rotary manifold.



A—Propel Motor Drain Line

TX,9025,GG2667 –19–09MAY97–5/5

BOOM CYLINDER CONTROLLED LOAD LOWERING VALVE TEST

SPECIFICATIONS	
Circuit Relief Pressure	5400 psi

SERVICE EQUIPMENT AND TOOLS
Gauge 70000 kPa (700 bar) (10000 psi)
AT126362 T-fitting

Test is used to measure circuit relief pressure at the load lowering valves.

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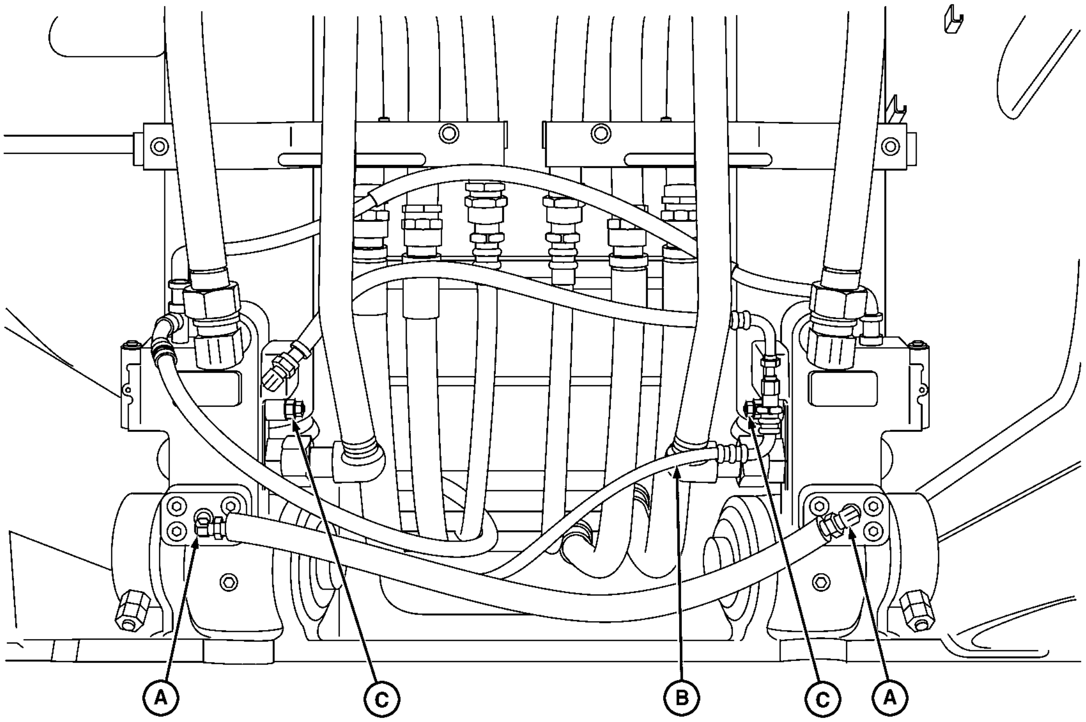


T121085

A—Pressure Port
B—Pilot Hose
C—Pressure Relief Valve Adjusting Screw and Jam Nut

1. Connect a pressure gauge and T-fitting between both load lowering valves at pressure port (A).

2. Place a heavy load on the bucket.

3. Extend the boom arm all the way out.

4. Disconnect and plug pilot hose (B).

5. Move boom lever to the down position to force the load lowering valve over relief.

6. Record the relief pressure reading.

Circuit Relief—Specification

Pressure... 37232 kPa (372 bar) (5400 psi)

7. If circuit relief pressure is below specifications, the circuit relief valves need to be reset.

    a. Loosen the jam nut (C) on the circuit relief valve.

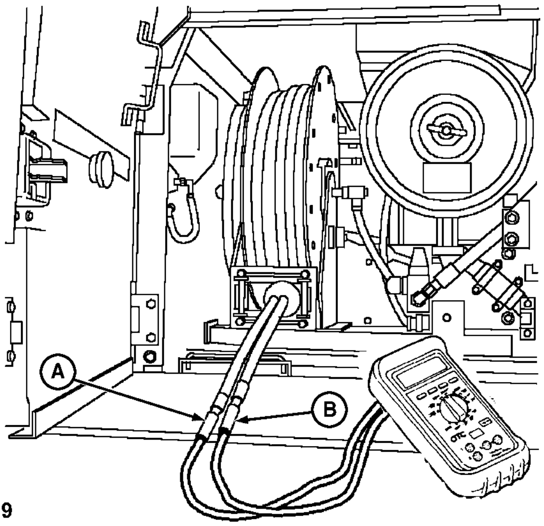
    b. Turn adjusting screw (C) in to increase circuit relief pressure.

    c. Hold adjusting screw and then tighten the jam nut.

8. Check the pressure setting again.

HOSE REEL TEST

Connect a pressure gauge between both hoses of the hose reel. Turn the micro switch located behind the cab to the ON position and set the flow regulator to maximum flow. The pressure at the gauge should be 2000 psi. If the pressure is lower than 2000 psi.



T121689

A—Male Hose End
B—Female Hose End

CED,OUOE020,77 –19–04JUN99–1/1

CHAPTER 7

SECTION 9031

AIR CONDITIONING SYSTEM

BLANK

Group 05
Theory of Operation

PROPER REFRIGERANT HANDLING

The U.S. Environmental Protection Agency prohibits discharge of any refrigerant into the atmosphere, and requires that refrigerant be recovered using the approved recovery equipment.

IMPORTANT: To meet government standards relating to the use of refrigerants, R134a is used in the air conditioning system. Because it does not contain chlorine, R134a is not detrimental to the ozone in the atmosphere. However, it is illegal to discharge any refrigerant into the atmosphere. It must be recovered using the appropriate recovery stations.

IMPORTANT: Use correct refrigerant recovery, recycling and charging stations. DO NOT mix refrigerants, hoses, fittings, components or refrigerant oils.

Recovery, recycling and charging stations for R12 and R134a refrigerants MUST NOT be interchanged. Systems containing R12 refrigerant use a different oil than systems using R134a. Certain seals are not compatible with both types of refrigerants.

TX,9031,UU3135 –19–13AUG96–1/1

R134A REFRIGERANT CAUTIONS

CAUTION: DO NOT allow liquid refrigerant to contact eyes or skin. Liquid refrigerant will freeze eyes or skin on contact. Wear goggles, gloves and protective clothing.

If liquid refrigerant contacts eyes or skin, DO NOT rub the area. Splash large amounts of COOL water on affected area. Go to a physician or hospital immediately for treatment.

DO NOT allow refrigerant to contact open flames or very hot surfaces such as electric welding arc, electric heating element and lighted smoking materials.

DO NOT heat refrigerant over 52°C (125°F) in a closed container. Heated refrigerant will develop high pressure which can burst the container.

Keep refrigerant containers away from heat sources. Store refrigerant in a cool place.

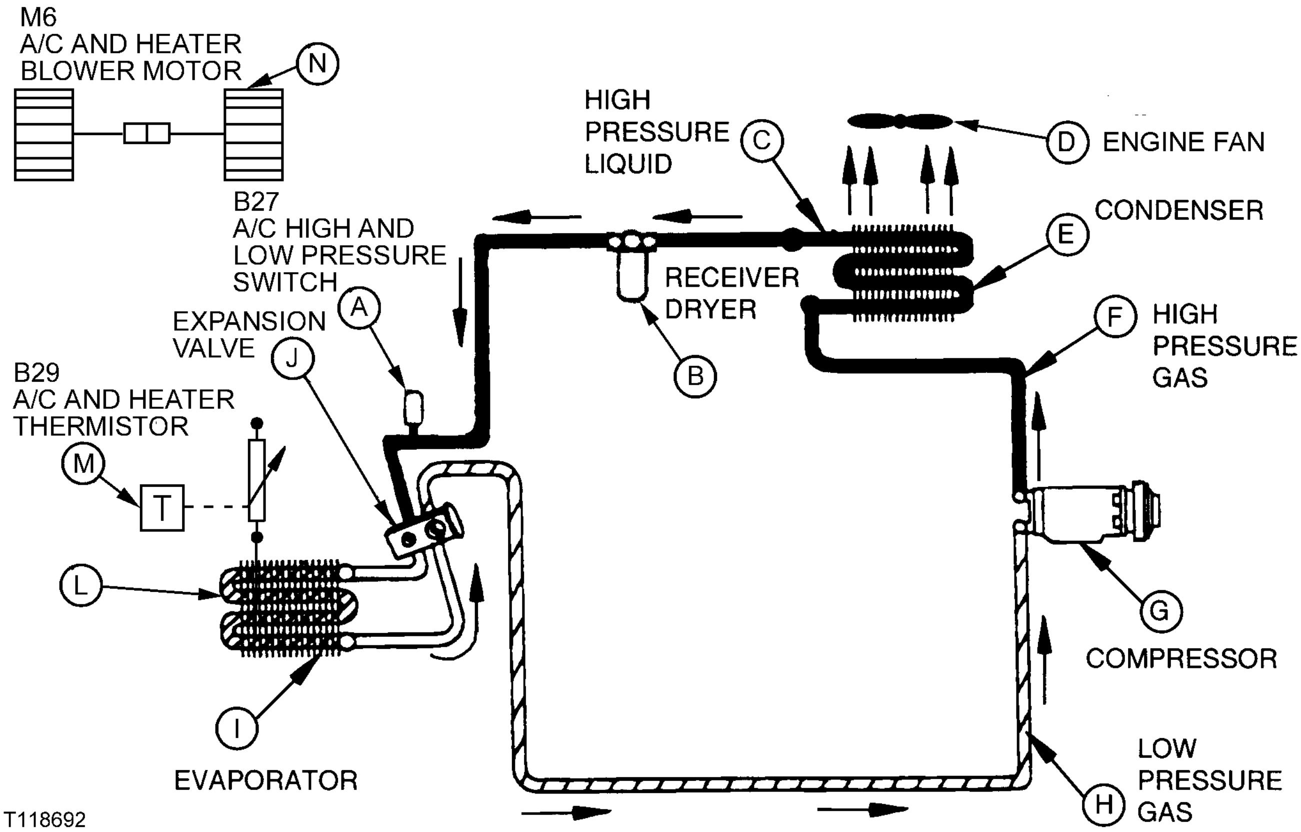
DO NOT handle damp refrigerant container with your bare hands. Skin may freeze to container. Wear gloves.

If skin freezes to container, pour COOL water over container to free the skin. Go to a physician or hospital immediately for treatment.

(R12 ONLY) Refrigerant exposed to high temperature forms phosgene gas. Inhaling toxic phosgene gas may result in serious illness or death. Phosgene gas has an odor like new mown hay or green corn. If you inhale phosgene gas, go to a physician or hospital immediately for treatment.

TX,9031,UU3136 –19–13AUG96–1/1

REFRIGERANT THEORY OF OPERATION



T118692 –19–30NOV98

A—B27 A/C High and Low Pressure Switch	**E—Condenser**	**J—Expansion Valve**	**N—M6 A/C and Heater Blower Motor**
B—Receiver/Dryer	**F—High Pressure Gas**	**K—Not Used**	
C—High Pressure Liquid	**G—Compressor**	**L—Low Pressure Liquid**	
D—Engine Fan	**H—Low Pressure Gas**	**M—B29 A/C Heater Thermistor**	
	I—Evaporator		

The compressor (G) draws low pressure gas (H) from the evaporator (I) and compresses it into high pressure gas (F). This causes the temperature of the refrigerant to rise higher than that of the outside air.

High pressure gas leaves the compressor and is sensed by the high pressure part of the B27 A/C high and low pressure switch (A). The switch monitors refrigerant pressure. If the pressure becomes too high, the switch will open and stop the compressor, interrupting the cycle.

As the high pressure gas flows through the condenser (E), heat is removed and transferred to the outside air being drawn through the condenser core by the condenser fan (D). Cooling the refrigerant causes it to condense and it leaves the condenser as a high pressure liquid (C). The high pressure liquid flows into the receiver-dryer (B) where moisture and contaminants (acid, solids, etc.) are removed. The receiver-dryer also acts as a reservoir for refrigerant.

The refrigerant flows from the receiver-dryer to the expansion valve (J) and is sensed by the low pressure part of the B27 A/C high and lower pressure switch (A). The switch monitors refrigerant pressure. If the pressure becomes too low from refrigerant loss, the switch will open and stop the compressor, interrupting the cycle.

Continued on next page

The actual cooling and drying of cab air takes place at the evaporator. Flow of the high pressure liquid refrigerant is controller by the expansion valve. The expansion valve causes the temperature and pressure of the refrigerant to drop, where it becomes a low pressure liquid (L). The expansion valve is a valve that uses a variable orifice to control the flow of high pressure liquid refrigerant into the evaporator to maintain a constant pressure and temperature.

The M6 A/C and heater blower motor (N) pulls a mixture of warm cab and outside air through the evaporator where it is cooled by the refrigerant. The heat absorbed by the evaporator causes the refrigerant to vaporize into a low pressure gas.

A freeze control switch (M) senses temperature of the evaporator coil through a refrigerant filled capillary tube. The switch closes when the evaporator is above the switch setting and opens when the evaporator is cooled to the switch setting. The switch has a low temperature setting that prevents the evaporator from becoming cold enough to freeze moisture that condenses on the coil.

The B28 A/C and heater thermistor senses temperature of the evaporator coil through a refrigerant filled capillary tube.

The moisture, from the warm air, is condensed as it contacts the cool evaporator coil during the cooling process and is drained away through drain tubes connected to the drain pan under the evaporator. With the cab air cooled and dehumidified, the refrigerant cycle is complete.

TX,9031,UU3137 –19–13AUG96–2/2

HEATER AND AIR CONDITIONER CIRCUIT OPERATIONAL INFORMATION

The following conditions must exist for air conditioning circuit to function:

- Key switch ON
- Machine running
- Air conditioning switch turned ON
- Any of the four blower motor On speeds selected on air conditioner controller

TX,9031,UU3138 –19–13AUG96–1/1

HEATER AND AIR CONDITIONER CIRCUIT THEORY OF OPERATION

Power flows from the A/C Controller and Relays 5 amp Fuse to the air conditioner controller and energizes the following relays:

- A/C compressor clutch relay (K25)
- A/C blower motor (medium low speed) relay (K26)
- A/C blower motor (medium speed) relay (K27)
- A/C blower motor (high speed) relay (K28)
- A/C blower motor and main power (low speed) relay (K24)

Power from the blower motor 20 amp fuse is applied to terminal 1 of the A/C compressor clutch relay (K25).

Power from the 20 amp fuse also goes through the A/C blower motor and main power (low speed) relay to operate the A/C and heater blower motor (M6).

The air conditioner controller (A3) operates the blower motor in four different speeds:

- Low speed
- Medium low speed
- Medium speed
- High speed

When any of the first three speeds is selected, power flows through the dropping resistor block (R11) and then to the blower motor. When the high speed is selected, the resistor block is bypassed and the blower motor operates at maximum speed.

With air conditioning switch turned ON in the air conditioner controller, power flows to the A/C high and low pressure switch (B27). The switch (B27) contains both a low pressure switch and a high pressure switch. With low pressure switch closed, power flows through high pressure switch. With high pressure switch closed, power flows through the A/C compressor clutch relay (K25) to operate the A/C compressor clutch (Y1).

The low pressure switch opens if the air conditioning system loses its refrigerant charge. The switch opens to stop current flow to the compressor, which prevents compressor engagement.

The high pressure switch protects the system from high pressure. If a malfunction or line restriction causes the high pressure to increase above the setting of the switch, will open to stop current flow to the compressor clutch.

The A/C and heater thermistor (B29) is used to sense the temperature in the evaporator core. When the temperature in the evaporator core raises, the blower thermistor senses the warmer temperature and the air conditioner controller applies voltage to the compressor.

TX,9031,UU3139 –19–13AUG96–1/1

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HEATER CIRCUIT (MACHINES WITHOUT AIR CONDITIONER) OPERATIONAL INFORMATION

The key switch must be in the ACC or On position for the heater circuit to function.

CED,OUTX782,3 –19–18NOV98–1/1

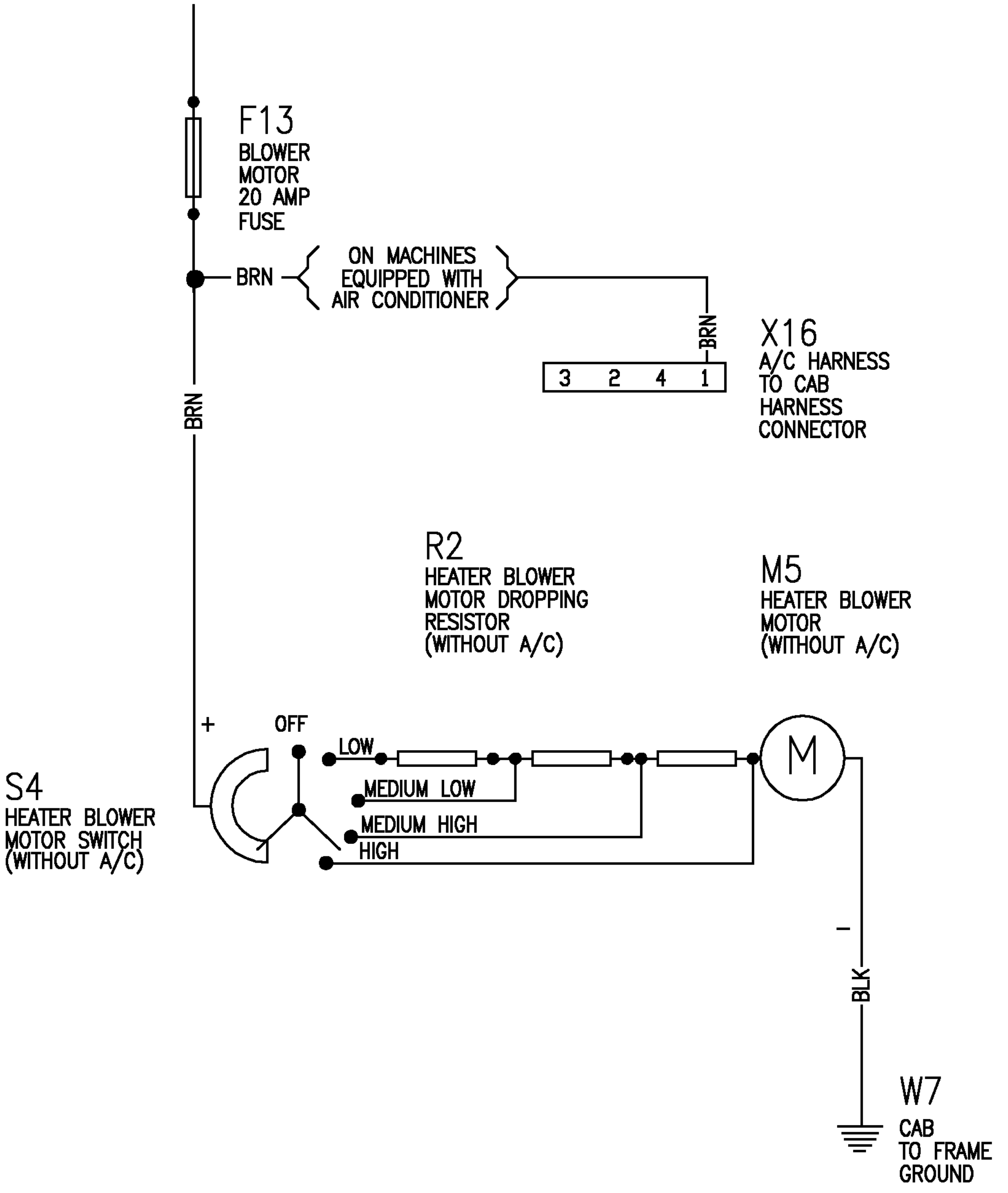
HEATER CIRCUIT (MACHINES WITHOUT AIR CONDITIONER) THEORY OF OPERATION

Power from the F13 Blower Motor 20 amp Fuse is applied to the plus (+) terminal of the S4 Heater Blower Motor Switch. On machines equipped with air conditioner, power is also applied to the X16 Air Conditioner Harness to Cab Harness Connector.

Power from the blower motor switch is applied through R2 Heater Blower Motor Dropping Resistor Block. The resistor block applies different voltages to the motor, depending on the blower speed selected. For low speed, power is applied through the maximum resistance, resulting in the lowest voltage. For high speed, the resistors are bypassed and full voltage is applied to the motor. Motor ground is applied to the minus (-) motor terminal.

CED,OUTX782,4 –19–18NOV98–1/1

HEATER CIRCUIT (MACHINES WITHOUT AIR CONDITIONER) FUNCTIONAL SCHEMATIC



HEATER CIRCUIT (MACHINES WITHOUT AIR CONDITIONER)

T117937

T117937 –19–18NOV98

CED,TX02661,251 –19–04NOV98–1/1

RECEIVER/DRYER OPERATION

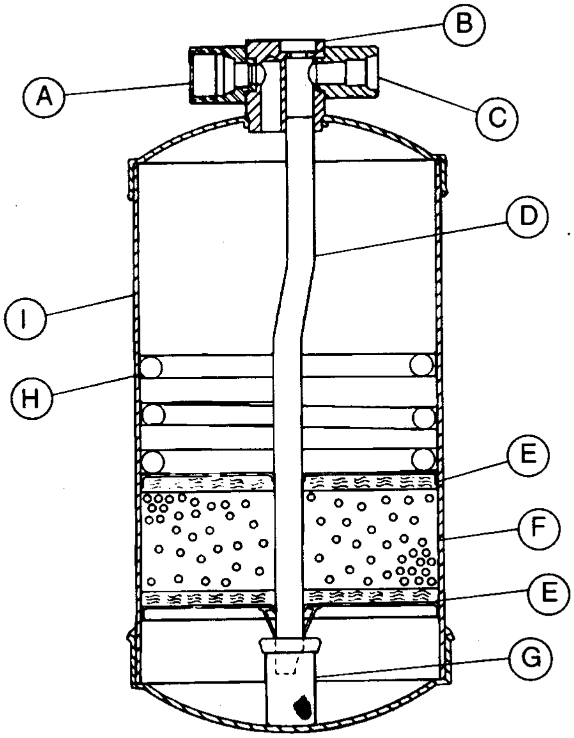
The receiver/dryer is a reservoir to store excess liquid refrigerant in the system. Excess refrigerant is required for two reasons:

Outside air temperature and humidity have an effect on the minimum quantity of refrigerant required in the system for the air conditioner to operate at maximum efficiency. The higher the temperature and humidity, the more refrigerant required in the system. More refrigerant is required due to the expansion valve opening farther allowing more refrigerant into the low pressure side of the system.

Refrigerant hoses allow a small amount of refrigerant to migrate through their walls. Extra refrigerant stored in the system allows for a longer period of time before additional refrigerant is needed.

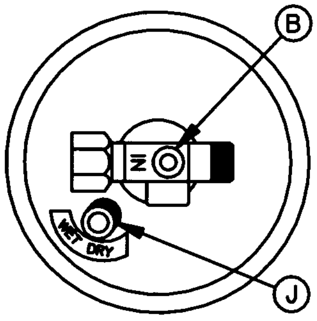
The receiver/dryer also contains two filters (E) and desiccant (F) between the filters. The filters remove solid materials which could be generated by a compressor failure, debris left in the system due to improper service procedures, or particles caused by corrosion of metal parts due to moisture and acids in the system (also caused by improper service procedures).

Desiccant is used to absorb moisture. If too much moisture gets into the system, the desiccant may not be able to absorb it all. When moisture is combined with refrigerant oil, a sludge is formed. This sludge does not permit moving parts to be adequately lubricated. When moisture is combined with refrigerant, hydrofluoric and hydrochloric acids are formed. These acids are very corrosive to metal surfaces and leakage will eventually develop. If the air conditioning system is left open for a period of time or if the plugs are removed from the receiver/dryer, the desiccant will also absorb moisture from the air. The receiver/dryer contains a color moisture indicator. (Blue) indicates dryer is dry. (Pink) indicates moisture in the desiccant. Evacuating the system will not remove moisture from the desiccant. You must replace the receiver/dryer.



T8104AE CV

T8104AE –UN–19OCT93



T8104AF CV

T8104AF –UN–10JAN94

A—Inlet Port
B—Sight Glass
C—Outlet Port
D—Pickup Tube
E—Filter
F—Desiccant
G—Strainer
H—Spring
I—Receiver/Dryer
J—Wet/Dry Indicator

Continued on next page

A sight glass is installed in the receiver/dryer outlet port. If the refrigerant level is low, a steady stream of gas bubbles will be present in the liquid flowing from the receiver/dryer. These gas bubbles can be seen in the sight glass and are an indication that the system needs charging. However, bubbles may be present when the compressor clutch first engages but must disappear after a few seconds. If the sight glass is clear, the system either has a sufficient charge or is completely discharged.

TX,9031,UU3144 –19–13AUG96–2/2

COMPRESSOR RELIEF VALVE OPERATION

The compressor relief valve is a direct acting pressure limiting valve. If a malfunction in the system occurs that would cause high pressure, such as a restricted line, the valve will open near 4137 kPa (41.4 bar) (600 psi) and remain open until pressure drops to below the valve setting.

If the relief valve opens, a loud popping noise will be heard. Some oil may also be lost from the system. Correct any condition that would cause the valve to open.

TX,9031,UU3146 –19–13AUG96–1/1

TEMPERATURE CONTROL

Temperature control is adjusted by the position of the heater temperature switch in the cab. This switch is mechanically connected to the water valve at the base of the heater core. Turning the heater temperature switch towards maximum and/or towards off opens and closes the water valve controlling engine coolant flow through the heater core, thus controlling the temperature inside the cab.

In certain conditions when the air conditioning switch is turned on and the blower switch is in low position, the cab temperature may still be too cool. It may be necessary to blend heat with cooling to get a comfortable cab temperature.

TX,9031,UU3147 –19–13AUG96–1/1

Group 10
System Operational Checks

AIR CONDITIONING OPERATIONAL CHECKS

This procedure is designed so the mechanic can make a quick check of the system using a minimum amount of diagnostic equipment. If you need additional information, read Theory of Operation (Group 9031-05).

The engine or other major components must be at operating temperature for some checks.

Locate system check in the left column and read completely, following this sequence from left to right. Read each check completely before performing.

At the end of each check, if no problem is found, that check is complete. When a problem is indicated, additional checks or repair information will be given. The technical manual group number required for repair will be given. If verification is needed, you will be given next best source of information:

Group: 10 (System Operational Checks)

Group: 15 (Diagnostic Information)

Group: 20 (Adjustments)

Group: 25 (Tests)

TX,9031,UU3148 –19–13AUG96–1/1

❶ VISUAL INSPECTION OF COMPONENTS

– – –1/1

ALL LINES AND HOSES	Engine OFF. Inspect all lines and hoses. Are lines and hoses straight, NOT kinked or worn from rubbing on other machine parts or “weather checked”? Are hose and line connections clean NOT showing signs of leakage, such as oil or dust accumulation at fittings? All hose and line clamps must be in place and tight. Clamps must have rubber inserts or cushions in place to prevent clamps from crushing or wearing into hoses or lines?	**YES:** Check complete. **NO:** Reposition hoses or lines and tighten or replace clamps. Tighten fittings or replace O-rings in fittings. Replace hoses or lines as required.

– – –1/1

System Operational Checks

CONDENSER CHECK	Engine OFF. Inspect condenser cores. Is condenser core free of dirt or debris? Does condenser show signs of leakage, dust accumulation or oily areas? Are condenser fins straight, not bent or damaged? Inspect engine fan. Are fan blades in good condition, not worn, bent, broken or missing?	**YES:** Check complete. **NO:** Clean, repair or replace condenser core. Replace engine fan. – – –1/1

EVAPORATOR CORE CHECK	Engine OFF. Inspect core. Are fins straight? Is evaporator core free of dirt and debris?	**YES:** Check complete. **NO:** Repair, replace or clean evaporator. – – –1/1

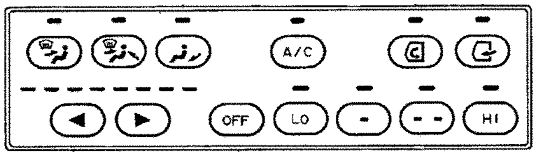
AIR CONDITIONER COMPRESSOR CHECK	Engine OFF. Inspect compressor. Is compressor drive belt tight? Is belt in good condition? Is belt tightening strap straight? Is compressor belt pulley in good condition? Are compressor to bracket and bracket to engine mounting cap screws tight? Is compressor pulley aligned with engine pulley? Are electrical connections to compressor clutch clean and tight? Is wiring to compressor in good condition?	**YES:** Go to next check. **NO:** Repair or replace components as required. – – –1/1

CAB DOOR AND WINDOW SEALS CHECK	Open and close door and windows. Inspect seals. Do door and windows contact seals evenly? Are seals in position and in good condition?	**YES:** Check complete. **NO:** Adjust door and windows to close against seals properly. Replace seals as necessary.

– – –1/1

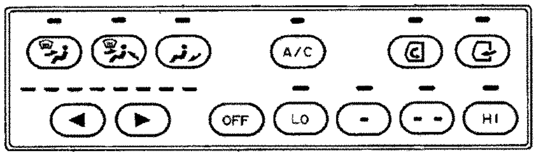
SYSTEM OPERATING CHECKS

– – –1/1

BLOWER MOTOR CHECK	 T103130 T103130 –19–29AUG96 Engine OFF. Key switch ON. Press blower motor switch to select each of the four speeds. Does fan operate in four speeds? Does air exit from ducts?	**YES:** Check complete. **NO:** See Circuit Checks in Group 9031-10. Check wiring harness.

– – –1/1

HEATER



T103130

T103130 –19–29AUG96

Start engine and allow to warm several minutes.

Press heater temperature switch to maximum heat position. Press blower switch to high speed position.

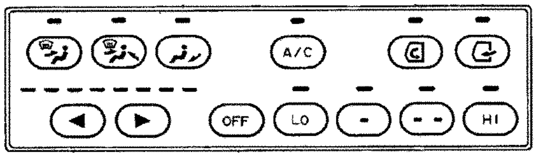
Does warm air exit from ducts?

YES: Check complete.

NO: See Circuit Checks in Group 9031-10. Check wiring harness.

– – –1/1

AIR CONDITIONER (IF EQUIPPED)



T103130

T103130 –19–29AUG96

Start engine and run at fast idle.

Press air conditioner switch to ON position.

Press blower switch to high speed position.

Wait for any warm air in duct system to dissipate.

Is air from ducts cool?

YES: Check complete.

NO: See Blower/Air Conditioning Circuit Checks in Group 9031-10. See Charging the system in Group 9031-20.

– – –1/1

COMPRESSOR CLUTCH CHECK

Engine OFF. Key switch ON. Blower switch on LOW. Air conditioner switch ON.

Does compressor clutch “click” as switch is pushed?

YES: Check complete.

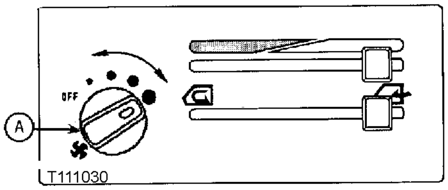
NO: Replace compressor clutch.

– – –1/1

❸ HEATER CIRCUIT CHECKS (MACHINES EQUIPPED WITH HEATER ONLY)

– – –1/1

3a BLOWER MOTOR 20 AMP FUSE (F13) CHECK	Remove fuse block cover. Remove fuse from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. **NO:** Replace fuse. If fuse blows again, check for short. – – –1/1

3b HEATER BLOWER MOTOR SWITCH (S4) CHECK (MACHINES EQUIPPED WITH HEATER ONLY)	 T111030 –UN–07AUG97 Disconnect wire harness from heater blower motor switch. Connect ohmmeter to brown wire in switch connector and positive terminal of heater blower motor. Turn heater blower motor switch to Low speed. Does ohmmeter read approximately 7.6 ohms resistance? Turn heater blower motor switch to Medium Low speed. Does ohmmeter read approximately 3.7 ohms resistance? Turn heater blower motor switch to Medium High speed. Does ohmmeter read approximately 1.2 ohms resistance? Turn heater blower motor switch to High speed. Does ohmmeter read a lower resistance than 1.2 ohms?	**YES:** Go to next check. **NO:** Replace heater blower motor switch. – – –1/1

3c **HEATER BLOWER MOTOR (M5) CHECK (MACHINES EQUIPPED WITH HEATER ONLY)**	Disconnect harness from heater blower motor. Connect 24 volts to heater blower motor, and ground motor. Does heater blower motor operate?	**YES:** Heater blower motor is good. Check wiring harness. **NO:** Replace heater blower motor.

– – –1/1

④ HEATER AND AIR CONDITIONER CIRCUIT CHECKS

– – –1/1

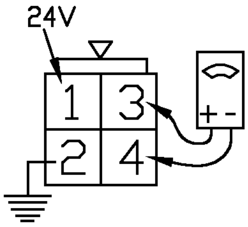
BLOWER MOTOR 20 AMP FUSE (F13) CHECK	Remove fuse block cover. Remove fuse from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. **NO:** Replace fuse. If fuse blows again, check for short.

– – –1/1

A/C CONTROLLER AND RELAYS 5 AMP FUSE (F14) CHECK	Remove fuse block cover. Remove fuse from fuse block. Using ohmmeter, check fuse for continuity. Is continuity measured?	**YES:** Fuse is OK. **NO:** Replace fuse. If fuse blows again, check for short.

– – –1/1

AIR CONDITIONER RELAY (K24, K25, K26, K27 AND K28) CHECK



T118624 –UN–23NOV98

Disconnect harness from relay.

Connect 24 volts to relay terminal 1 and ground terminal 2.

Does relay click?

Connect ohmmeter to terminals 3 and 4.

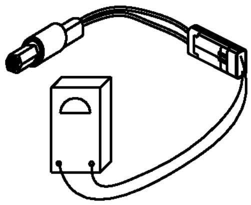
Does ohmmeter read continuity?

YES: Relay is OK.

NO: Relay has failed. Replace.

– – –1/1

AIR CONDITIONER HIGH AND LOW PRESSURE SWITCH (B27) CHECK



T101619 –19–13JUN96

Disconnect harness from switch.

Check for continuity between terminals.

Is continuity measured?

YES: Switch is good.

NO: Go to High and Low Pressure Switch Test, Group 9031-25.

– – –1/1

A/C AND HEATER BLOWER MOTOR (M6) CHECK

Disconnect harness from blower motor.

Ground blk/red wire terminal in connector. Connect 24 volts to red/wht wire terminal in connector.

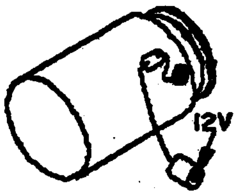
Does blower motor operate in high speed?

YES: Blower motor is good. Check wiring harness.

NO: Replace blower motor.

– – –1/1

AIR CONDITIONING COMPRESSOR CLUTCH (Y1) CHECK



T6534CV –UN–19OCT88

Disconnect harness from clutch.

Connect battery voltage to clutch terminal that has black/yellow wire. Ground black wire terminal.

Does Clutch "click"?

YES: A/C compressor clutch coil is good. Check wiring harness.

NO: Replace clutch coil.

– – –1/1

Group 15
Diagnostic Information

DIAGNOSE AIR CONDITIONING ELECTRICAL MALFUNCTIONS

NOTE: Diagnostic charts are arranged from most probable and simplest to verify, to least likely more difficult to verify. Remember the following steps when diagnosing a problem:

- *Step 1. Operational Check Out Procedure*
- *Step 2. Diagnostic Charts*
- *Step 3. Adjustments and/or Tests*

Symptom	Problem	Solution
Heating System Does Not Operate	Blower motor 20 amp fuse (F13)	Replace fuse, Group 9031-10.
	Heater blower motor switch (S4)	Check heater blower motor switch, Group 9031-10.
	Heater blower motor (M5)	Check heater blower motor, Group 9031-10.
Air Conditioning System Does Not Operate	A/C controller and relays 5 amp fuse (F14)	Replace fuse.
	Blower motor 20 amp fuse (F13)	Replace fuse, Group 9031-10.
	Air conditioner relays (K24, K25, K26, K27, or K28)	Check air conditioner relays, Group 9031-10.
	A/C high and low pressure switch (B27)	Check high and low pressure switch, Group 9031-10.
	A/C and heater blower motor (M6)	Check A/C and heater blower motor, Group 9031-10.
	Compressor clutch (Y1)	Check compressor clutch, Group 9031-10.

TX,9031,UU3149 –19–13AUG96–1/1

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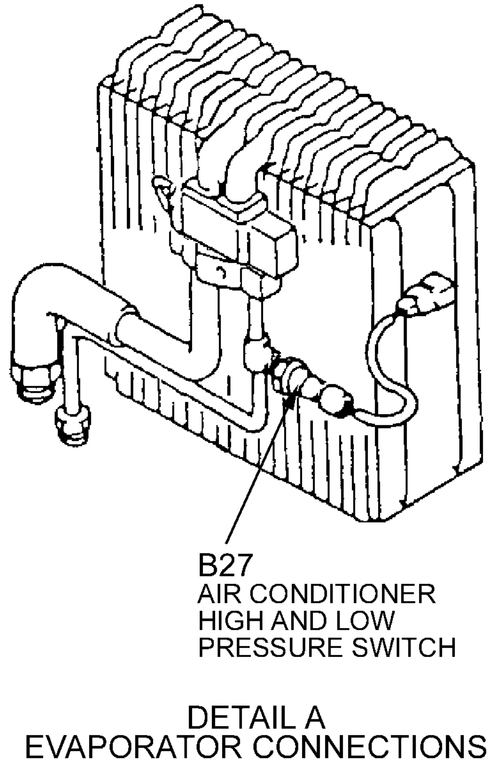


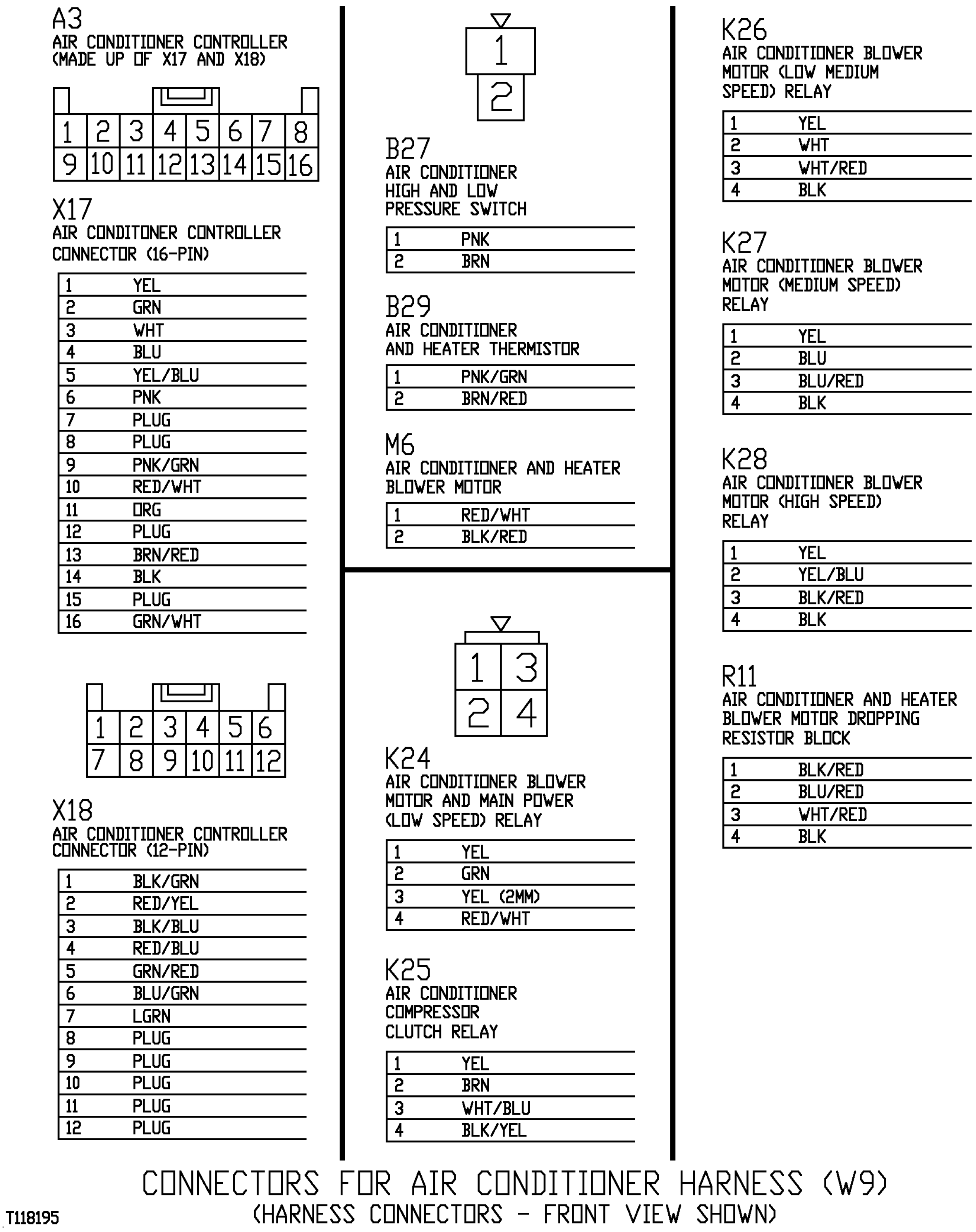
T118670 –19–24NOV98

T118670

A/C Harness (W9) Component Location—Detail A

TX,9031,GG2243 –19–12SEP96–2/2

AIR CONDITIONER HARNESS (W9) CONNECTORS, WIRE AND PIN LOCATION



A3
AIR CONDITIONER CONTROLLER
(MADE UP OF X17 AND X18)

X17
AIR CONDITIONER CONTROLLER
CONNECTOR (16-PIN)

1	YEL
2	GRN
3	WHT
4	BLU
5	YEL/BLU
6	PNK
7	PLUG
8	PLUG
9	PNK/GRN
10	RED/WHT
11	ORG
12	PLUG
13	BRN/RED
14	BLK
15	PLUG
16	GRN/WHT

X18
AIR CONDITIONER CONTROLLER
CONNECTOR (12-PIN)

1	BLK/GRN
2	RED/YEL
3	BLK/BLU
4	RED/BLU
5	GRN/RED
6	BLU/GRN
7	LGRN
8	PLUG
9	PLUG
10	PLUG
11	PLUG
12	PLUG

B27
AIR CONDITIONER
HIGH AND LOW
PRESSURE SWITCH

1	PNK
2	BRN

B29
AIR CONDITIONER
AND HEATER THERMISTOR

1	PNK/GRN
2	BRN/RED

M6
AIR CONDITIONER AND HEATER
BLOWER MOTOR

1	RED/WHT
2	BLK/RED

K24
AIR CONDITIONER BLOWER
MOTOR AND MAIN POWER
(LOW SPEED) RELAY

1	YEL
2	GRN
3	YEL (2MM)
4	RED/WHT

K25
AIR CONDITIONER
COMPRESSOR
CLUTCH RELAY

1	YEL
2	BRN
3	WHT/BLU
4	BLK/YEL

K26
AIR CONDITIONER BLOWER
MOTOR (LOW MEDIUM
SPEED) RELAY

1	YEL
2	WHT
3	WHT/RED
4	BLK

K27
AIR CONDITIONER BLOWER
MOTOR (MEDIUM SPEED)
RELAY

1	YEL
2	BLU
3	BLU/RED
4	BLK

K28
AIR CONDITIONER BLOWER
MOTOR (HIGH SPEED)
RELAY

1	YEL
2	YEL/BLU
3	BLK/RED
4	BLK

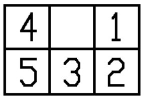
R11
AIR CONDITIONER AND HEATER
BLOWER MOTOR DROPPING
RESISTOR BLOCK

1	BLK/RED
2	BLU/RED
3	WHT/RED
4	BLK

CONNECTORS FOR AIR CONDITIONER HARNESS (W9)
(HARNESS CONNECTORS - FRONT VIEW SHOWN)

T118195

Continued on next page



M9
AIR CONDITIONER
INTERNAL AND EXTERNAL
CAB AIR SERVOMOTOR

1	GRN/RED
2	BLU/GRN
3	
4	
5	

M10
AIR CONDITIONER
BLOWER PORT
CHANGE SERVOMOTOR

1	BLK/GRN
2	RED/YEL
3	ORG
4	LGRN
5	BRN/RED

M11
AIR CONDITIONER
AIR MIXER
SERVOMOTOR

1	BLK/BLU
2	RED/BLU
3	RED/WHT
4	GRN/WHT
5	BRN/RED

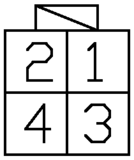
X17
AIR CONDITONER CONTROLLER
CONNECTOR (16-PIN)

SEE A3

X18
AIR CONDITIONER CONTROLLER
CONNECTOR (12-PIN)

SEE A3

Y1
AIR CONDITIONER
COMPRESSOR CLUTCH



X16
AIR CONDITIONER
TO CAB HARNESS CONNECTOR

1	YEL
2	BLK
3	BLK/YEL POWER TO Y1
4	YEL

CONNECTORS FOR AIR CONDITIONER HARNESS (W9)
(HARNESS CONNECTORS - FRONT VIEW SHOWN)

T118196

T118196 –19–18NOV98

PROPER REFRIGERANT HANDLING

The U.S. Environmental Protection Agency prohibits discharge of any refrigerant into the atmosphere, and requires that refrigerant be recovered using the approved recovery equipment.

IMPORTANT: To meet government standards relating to the use of refrigerants, R134a is used in the air conditioning system. Because it does not contain chlorine, R134a is not detrimental to the ozone in the atmosphere. However, it is illegal to discharge any refrigerant into the atmosphere. It must be recovered using the appropriate recovery stations.

IMPORTANT: Use correct refrigerant recovery, recycling and charging stations. DO NOT mix refrigerants, hoses, fittings, components or refrigerant oils.

Recovery, recycling and charging stations for R12 and R134a refrigerants MUST NOT be interchanged. Systems containing R12 refrigerant use a different oil than systems using R134a. Certain seals are not compatible with both types of refrigerants.

TX,9031,UU3151 –19–13AUG96–1/1

R134A REFRIGERANT CAUTIONS

⚠ **CAUTION: DO NOT allow liquid refrigerant to contact eyes or skin. Liquid refrigerant will freeze eyes or skin on contact. Wear goggles, gloves and protective clothing.**

If liquid refrigerant contacts eyes or skin, DO NOT rub the area. Splash large amounts of COOL water on affected area. Go to a physician or hospital immediately for treatment.

DO NOT allow refrigerant to contact open flames or very hot surfaces such as electric welding arc, electric heating element and lighted smoking materials.

DO NOT heat refrigerant over 52°C (125°F) in a closed container. Heated refrigerant will develop high pressure which can burst the container.

Keep refrigerant containers away from heat sources. Store refrigerant in a cool place.

DO NOT handle damp refrigerant container with your bare hands. Skin may freeze to container. Wear gloves.

If skin freezes to container, pour COOL water over container to free the skin. Go to a physician or hospital immediately for treatment.

(R12 ONLY) Refrigerant exposed to high temperature forms phosgene gas. Inhaling toxic phosgene gas may result in serious illness or death. Phosgene gas has an odor like new mown hay or green corn. If you inhale phosgene gas, go to a physician or hospital immediately for treatment.

TX,9031,UU3152 –19–13AUG96–1/1

R134A COMPRESSOR OIL CHARGE CHECK

Remove compressor if R134a leakage was detected and repaired. See Remove and install Compressor in Repair Manual.

Drain oil from the compressor and record the amount. See Compressor Oil Removal procedure in this group.

NOTE: Drain oil and save if this is a new compressor.

If the oil drained from a compressor removed from operation is very black or the amount of oil is less than 6 mL (0.2 fl oz), perform the following:

1. Remove and discard the receiver-dryer.
2. Remove, clean, but do not disassemble the expansion valve.
3. Flush the complete system with TY16134 air conditioning flushing solvent.
4. If the compressor is serviceable, pour flushing solvent in the manifold ports and internally wash out the old oil.
5. Install a new receiver-dryer.
6. Install required amount of TY22025 refrigerant oil in the compressor. (See R134a Component Oil Charge in this group.)
7. Connect all components, evacuate and charge the system.

TX,9031,UU3153 –19–13AUG96–1/1

R134A COMPRESSOR OIL REMOVAL

1. Remove compressor from machine. See Remove and Install Compressor in Repair Manual.
2. Remove inlet/outlet manifold from compressor, and clutch dust cover.
3. Drain oil into graduated container while rotating compressor shaft.
4. Record measured oil and discard oil properly.
5. Install new oil. See R134a Component Oil Charge in this Group.
6. Install compressor. See Remove and Install Compressor in Repair Manual.

TX,9031,UU3154 –19–13AUG96–1/1

R134A COMPONENT OIL CHARGE

SPECIFICATIONS	
New Compressor Oil Capacity	230 ± 20 mL (7.7 ± 0.7 fl oz)
Amount Of New Oil Capacity	100 mL (3.4 fl oz)
Flushed Compressor New Oil Capacity	330 ± 20 mL (11.1 ± 0.7 fl oz)
New Compressor, Drained Oil Capacity	45 mL (1.5 fl oz)
Used Compressor, Drained Oil Capacity	45 mL (1.5 fl oz)
Evaporator Oil Charge	130 mL (4.4 fl oz)
Condenser Oil Charge	65 mL (2.2 fl oz)
Receiver-Dryer Oil Charge	30 mL (1.0 fl oz)
Hoses Oil Charge	60 mL (2.0 fl oz) or 3 mL per 30 cm (0.1 fl oz per ft)
Hoses Approximate Total Length	600 cm (20 ft)

⚠ **CAUTION: All new compressors are charged with a mixture of nitrogen, R134a refrigerant and TY22025 (R134a) refrigerant oil. Wear safety goggles and discharge the compressor slowly to avoid possible injury.**

Compressors can be divided into three categories when determining the correct oil charge for the system.

- New compressor from parts depot
- Used compressor removed from operation
- Compressor internally washed with flushing solvent

Determining the amount of system oil charge prior to installation of compressor on a machine.

1. When the complete system, lines, and components were flushed add the correct amount of oil as described.

   - New compressor from parts depot contains the amount of new oil of 230 ± 20 mL (7.7 ± 0.7 fl oz).

New Compressor Oil—Specification

Capacity .... 230 ± 20 mL (7.7 ± 0.7 fl oz)

System requires an additional amount of new oil of 100 mL (3.4 fl oz) of new oil.

Amount Of New Oil—Specification

Capacity .... 100 mL (3.4 fl oz)

- Used compressor removed from operation, oil drained, and flushed requires 330 ± 20 mL (11.1 ± 0.7 fl oz) of new oil.

Flushed Compressor New Oil—Specification

Capacity .... 330 ± 20 mL (11.1 ± 0.7 fl oz)

2. When the complete system was not flushed add the correct amount of oil for the compressor plus amount of oil for each component that was serviced.

   - New compressor from parts depot, drain and return 45 mL (1.5 fl oz) of oil to the compressor.

New Compressor, Drained Oil—Specification

Capacity .... 45 mL (1.5 fl oz)

(See Compressor Oil Removal procedure in this group)

Continued on next page

- Used compressor removed from operation and oil drained, (See Compressor Oil Removal procedure in this group.) Add 45 mL (1.5 fl oz) of new oil.

Used Compressor, Drained Oil—Specification

Capacity	45 mL (1.5 fl oz)

- Used compressor removed from operation, oil drained, and flushed add 60 mL (2.0 fl oz) of new oil.
  Components listed which have been removed, drained or flushed, require the removal of the compressor to determine the correct oil charge. Use the chart as a guide for adding oil to components.

Evaporator—Specification

Oil Charge	130 mL (4.4 fl oz)

Condenser—Specification

Oil Charge	65 mL (2.2 fl oz)

Receiver-Dryer—Specification

Oil Charge	30 mL (1.0 fl oz)

Hoses—Specification

Oil Charge	60 mL (2.0 fl oz) or 3 mL per 30 cm (0.1 fl oz per ft)
Approximate Total Length	600 cm (20 ft)

If any section of hose is removed and flushed or replaced, measure the length of hose and use the formula to determine the correct amount of oil to be added.

⚠ **CAUTION: DO NOT leave the system or R134a compressor oil containers open. This oil easily absorbs moisture. DO NOT spill R134a compressor oil on acrylic or ABS plastic. This oil will deteriorate these materials rapidly. Identify R134a oil containers and measures to eliminate accidental mixing of different oils.**

CED,TX14795,4338 –19–04MAR98–2/2

R134A REFRIGERANT RECOVERY, RECYCLING, AND CHARGING STATION INSTALLATION PROCEDURE

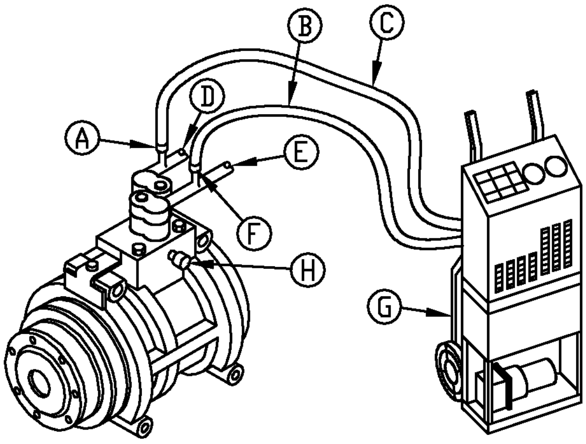
ESSENTIAL TOOLS
JT02045 R134a Refrigerant Recovery/Recycling and Charging Station
JT02046 R134a Refrigerant Recovery/Recycling and Charging Station (Alternate)
JT02050 R134a Refrigerant Recovery/Recycling and Charging Station (Alternate)

CAUTION: Do not remove high pressure relief valve (H). Air conditioning system will discharge rapidly causing possible injury.

IMPORTANT: Use correct refrigerant recovery, recycling and charging stations. DO NOT mix refrigerant, hoses, fittings, components or refrigerant oils.

NOTE: JT02046 and JT02050 R134a Refrigerant Recovery/Recycling and Charging Station can be substituted for the JT02045 R134a Refrigerant Recovery/Recycling and Charging Station.

1. Close both high and low pressure valves on refrigerant recovery, recycling and charging station (G).
2. Remove cap from low pressure test port (F).
3. Connect low pressure blue hose (B) from refrigerant recovery, recycling and charging station (G) to low pressure test port (F) on compressor.
4. Connect high pressure red hose (C) to high pressure quick disconnect.
5. Follow the manufacturer’s instructions when using the refrigerant recovery, recycling and charging station.



T118687 –UN–01DEC98

A—High Pressure Test Port
B—Blue Hose
C—Red Hose
D—High Pressure Hose
E—Low Pressure Hose
F—Low Pressure Test Port
G—Refrigerant Recovery/Recycling and Charging Station
H—High Pressure Relief Valve

9031
20
5

CED,TX14795,4339 –19–04MAR98–1/1

RECOVER R134A SYSTEM

ESSENTIAL TOOLS
JT02045 R134a Refrigerant Recovery/Recycling and Charging Station
JT02046 R134a Refrigerant Recovery/Recycling and Charging Station (Alternate)
JT02050 R134a Refrigerant Recovery/Recycling and Charging Station (Alternate)

CAUTION: Do not remove high pressure relief valve (H). Air conditioning system will discharge rapidly causing possible injury.

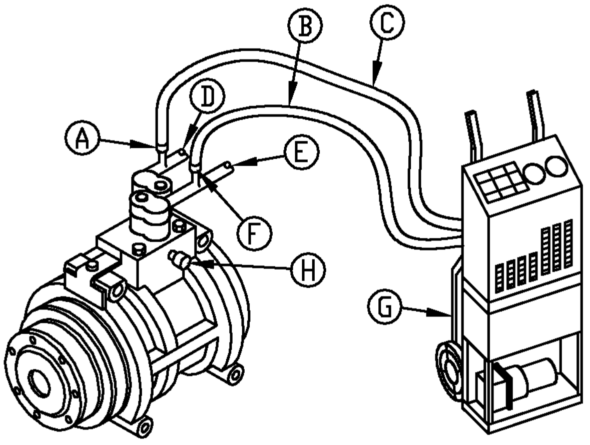
IMPORTANT: Use correct refrigerant recovery, recycling and charging stations. DO NOT mix refrigerant, hoses, fittings, components or refrigerant oils.

NOTE: JT02046 and JT02050 recovery and charging stations can be substituted for the JT02045 station.

1. Run the air conditioning system for three minutes to help in the recovery process. Turn air conditioning system off before proceeding with recovery steps.

2. Connect refrigerant recovery, recycling and charging station. (See installation procedure in this group.)

3. Follow the manufacturer’s instructions when using the refrigerant recovery, recycling and charging station.



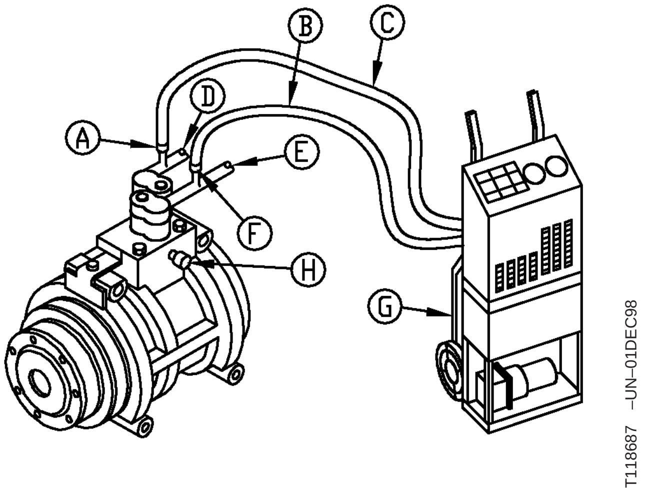
T118687 –UN–01DEC98

A—High Pressure Test Port
B—Blue Hose
C—Red Hose
D—High Pressure Hose
E—Low Pressure Hose
F—Low Pressure Test Port
G—Refrigerant Recovery/Recycling and Charging Station
H—High Pressure Relief Valve

EVACUATE R134A SYSTEM

SPECIFICATIONS	
System Evacuation Vacuum Pressure	98 kPa (980 mbar) (29 in Hg)
If System Evacuation Vacuum Cannot Be Obtained, Test System For Leaks. Time	15 Minutes
Evacuation Time	15 minutes
Subtract Pressure For Each 300 m (1000 ft) Elevation Pressure	3.4 kPa (34 bar) (1 in. Hg)
Leak If Vacuum Decreases More Than Pressure	3.4 kPa (34 mbar) (1 in. Hg)
Evacuate System Time	For 30 min. After 98 kPa (980 mbar) (29 in. Hg) Vacuum

ESSENTIAL TOOLS
JT02045 R134a Refrigerant Recovery/Recycling and Charging Station
JT02046 R134a Refrigerant Recovery/Recycling and Charging Station (Alternate)
JT02050 R134a Refrigerant Recovery/Recycling and Charging Station (Alternate)



A—High Pressure Test Port
B—Blue Hose
C—Red Hose
D—High Pressure Hose
E—Low Pressure Hose
F—Low Pressure Test Port
G—Refrigerant Recovery/Recycling and Charging Station
H—High Pressure Relief Valve

CAUTION: Do not remove high pressure relief valve (H). Air conditioning system will discharge rapidly causing possible injury.

IMPORTANT: Use correct refrigerant recovery, recycling and charging stations. DO NOT mix refrigerant, hoses, fittings, components or refrigerant oils.

Do not run compressor while evacuating.

NOTE: JT02046 and JT02050 recovery and charging stations can be substituted for the JT02045 station.

1. Connect refrigerant recovery, recycling and charging station. (See installation procedure in this group.)

2. Open low and high pressure valves on refrigerant recovery, recycling and charging station.

Continued on next page

3. Follow the manufacturer's instructions and evacuate the system.

NOTE: The vacuum specifications listed are for sea level conditions.

4. Evacuate system until low pressure gauge registers 98 kPa (980 mbar) (29 in. Hg) vacuum.

   Subtract 3.4 kPa (34 mbar) (1 in. Hg) from 98 kPa (980 mbar) (29 in. Hg) for each 300 m (1000 ft) elevation above sea level.

System Evacuation Vacuum—Specification

Pressure .... 98 kPa (980 mbar) (29 in Hg)

Subtract Pressure For Each 300 m (1000 ft) Elevation—Specification

Pressure .... 3.4 kPa (34 bar) (1 in. Hg)

If 98 kPa (980 mbar) (29 in. Hg) vacuum cannot be obtained in 15 minutes, test the system for leaks.

If System Evacuation Vacuum Cannot Be Obtained, Test System For Leaks.—Specification

Time.. 15 Minutes

(See Leak Testing in Group 9031-25).

Evacuation—Specification

Time.. 15 minutes

Correct any leaks.

5. When vacuum is 98 kPa (980 mbar) (29 in. Hg), close low-side and high-side valves. Turn vacuum pump off.

6. If the vacuum decreases more than 3.4 kPa (34 mbar) (1 in. Hg) in 5 minutes, there is a leak in the system.

Leak If Vacuum Decreases More Than—Specification

Pressure .... 3.4 kPa (34 mbar) (1 in. Hg)

7. Repair leak.

8. Start to evacuate.

Continued on next page

9. Open low-side and high-side valves.

10. Evacuate system for 30 minutes after 98 kPa (980 mbar) (29 in. Hg) vacuum is reached.

Evacuate System—Specification

Time.. For 30 min. After 98 kPa (980 mbar) (29 in. Hg) Vacuum

11. Close low-side and high-side valves. Stop evacuation.

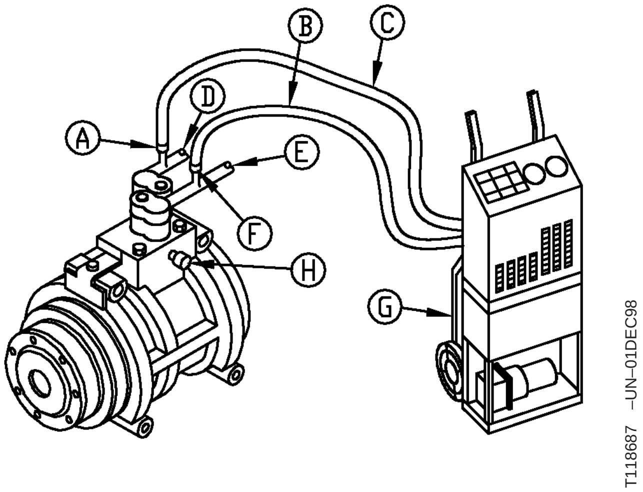
12. Charge the system. (See procedure in this group.)

CED,TX14795,4341 –19–18AUG98–3/3

CHARGE R134A SYSTEM

SPECIFICATIONS	
Pump Must Be Capable Of Pulling Vacuum	28.6 in. Hg at Sea Level
Subtract From Standard Vacuum For Each 300 m (1000 ft) Above Sea Level Vacuum	3.4 kPa (34 mbar) (1 in. Hg)
Refrigerant Added To Charge Weight	2.43 kg (5.25 lb)

ESSENTIAL TOOLS
JT02045 R134a Refrigerant Recovery/Recycling and Charging Station
JT02046 R134a Refrigerant Recovery/Recycling and Charging Station (Alternate)
JT02050 R134a Refrigerant Recovery/Recycling and Charging Station (Alternate)



A—High Pressure Test Port
B—Blue Hose
C—Red Hose
D—High Pressure Hose
E—Low Pressure Hose
F—Low Pressure Test Port
G—Refrigerant Recovery/Recycling and Charging Station
H—High Pressure Relief Valve

⚠ **CAUTION: Do not remove high pressure relief valve (H). Air conditioning system will discharge rapidly causing possible injury.**

IMPORTANT: Use correct refrigerant recovery, recycling and charging stations. DO NOT mix refrigerant, hoses, fittings, components or refrigerant oils.

NOTE: JT02046 and JT02050 recovery and charging stations can be substituted for the JT02045 station.

1. Connect refrigerant recovery, recycling and charging station. (See installation procedure in this group.)

2. Evacuate the system. (See Evacuate Air Conditioning System, this group.)

Continued on next page

NOTE: Before beginning to charge air conditioning system, the following conditions must exist: Engine STOPPED, the pump must be capable of pulling at least 28.6 in. Hg vacuum (sea level). Subtract 3.4 kPa (34 mbar) (1 in. Hg) from 98 kPa (980 mbar) (29 in. Hg) for each 300 m (1000 ft) elevation above sea level.

Pump Must Be Capable Of Pulling—Specification

Vacuum .... 28.6 in. Hg at Sea Level

Subtract From Standard Vacuum For Each 300 m (1000 ft) Above Sea Level—Specification

Vacuum .... 3.4 kPa (34 mbar) (1 in. Hg)

3. Follow the manufacturers instructions and charge the system.

4. Add refrigerant until system is charged with 2.43 kg (5.25 lb).

Refrigerant Added To Charge—Specification

Weight... 2.43 kg (5.25 lb)

5. Do air conditioner checks and tests in Groups 9031-10 and 9031-25.

CED,TX14795,4342 –19–04MAR98–2/2

CHECK AND ADJUST COMPRESSOR BELT TENSION

SPECIFICATIONS	
Belt Deflection at 400 N (90 lb force) Deflection	19 mm (0.75 in.)
If Belt Deflection Not To Specification Cool Time	8—10 Minutes

SERVICE EQUIPMENT AND TOOLS
Belt Tension Gauge

IMPORTANT: Never over tighten belt. Over tightening may cause belt cord damage and excessive load on bearings.

1. Run engine for five minutes. Stop the engine, then immediately check tension using a belt tension gauge.

2. Measure strand tension or deflection at a point halfway between pulleys. Belt must deflect 19 mm (0.75 in.) at 400 N (90 lb force).

Belt Deflection—Specification

Deflection .... 19 mm (0.75 in.) at 400 N (90 lb force)

If belt deflection excessive , allow belt to cool for 8—10 minutes and try again.

If Belt Deflection Excessive—Specification

Cool.. 8—10 Minutes

IMPORTANT: Force to adjust belt must be applied to front of compressor housing only to prevent damage to compressor.

3. Loosen compressor mounting cap screws. Apply force to front of compressor housing to tighten belt. Tighten cap screws.

4. Repeat Steps 1 and 2 to check belts.

CED,TX14795,4343 –19–04MAR98–1/1

PROPER REFRIGERANT HANDLING

The U.S. Environmental Protection Agency prohibits discharge of any refrigerant into the atmosphere, and requires that refrigerant be recovered using the approved recovery equipment.

IMPORTANT: To meet government standards relating to the use of refrigerants, R134a is used in the air conditioning system. Because it does not contain chlorine, R134a is not detrimental to the ozone in the atmosphere. However, it is illegal to discharge any refrigerant into the atmosphere. It must be recovered using the appropriate recovery stations.

IMPORTANT: Use correct refrigerant recovery, recycling and charging stations. DO NOT mix refrigerants, hoses, fittings, components or refrigerant oils.

Recovery, recycling and charging stations for R12 and R134a refrigerants MUST NOT be interchanged. Systems containing R12 refrigerant use a different oil than systems using R134a. Certain seals are not compatible with both types of refrigerants.

TX,9031,UU3151 –19–13AUG96–1/1

R134A REFRIGERANT CAUTIONS

CAUTION: DO NOT allow liquid refrigerant to contact eyes or skin. Liquid refrigerant will freeze eyes or skin on contact. Wear goggles, gloves and protective clothing.

If liquid refrigerant contacts eyes or skin, DO NOT rub the area. Splash large amounts of COOL water on affected area. Go to a physician or hospital immediately for treatment.

DO NOT allow refrigerant to contact open flames or very hot surfaces such as electric welding arc, electric heating element and lighted smoking materials.

DO NOT heat refrigerant over 52°C (125°F) in a closed container. Heated refrigerant will develop high pressure which can burst the container.

Keep refrigerant containers away from heat sources. Store refrigerant in a cool place.

DO NOT handle damp refrigerant container with your bare hands. Skin may freeze to container. Wear gloves.

If skin freezes to container, pour COOL water over container to free the skin. Go to a physician or hospital immediately for treatment.

(R12 ONLY) Refrigerant exposed to high temperature forms phosgene gas. Inhaling toxic phosgene gas may result in serious illness or death. Phosgene gas has an odor like new mown hay or green corn. If you inhale phosgene gas, go to a physician or hospital immediately for treatment.

TX,9031,UU3152 –19–13AUG96–1/1

R134A AIR CONDITIONING SYSTEM TEST

SPECIFICATIONS	
Engine Speed	2180 rpm
Temperature Control Switch Position	Maximum Cooling
Blower Speed	High
Run Unit For At Least Time	5 Minutes

Ambient Temperature	Air Duct Temperature	Low Pressure Gauge	High Pressure Gauge
16°C (60°F)	13°C (55°F)	7—165 kPa (0.07—1.6 bar) (1—24 psi)	630—1095 kPa (6—11 bar) (90—160 psi)
21°C (70°F)	16°C (60°F)	7—180 kPa (0.07—1.8 bar) (1—26 psi)	785—1225 kPa (7.6—12 bar) (110—175 psi)
27°C (80°F)	18°C (65°F)	7—205 kPa (0.07—2.1 bar) (1—30 psi)	955—1410 kPa (9.6—14.1 bar) (140—205 psi)
32°C (90°F)	21°C (70°F)	7—240 kPa (0.07—2.4 bar) (1—35 psi)	1145—1645 kPa (11.4—16.5 bar) (165—240 psi)
38°C (100°F)	27°C (80°F)	7—280 kPa (0.07—2.7 bar) (1—40 psi)	1355—1935 kPa (13.4—19.3 bar) (195—280 psi)
43°C (110°F)	29°C (85°F)	7—330 kPa (0.07—3.3 bar) (1—48 psi)	1580—2275 kPa (15.8—22.7 bar) (230—330 psi)

ESSENTIAL TOOLS
JT02045 R134a Refrigerant Recovery/Recycling and Charging Station
JT02046 R134a Refrigerant Recovery/Recycling and Charging Station (Alternate)
JT02050 R134a Refrigerant Recovery/Recycling and Charging Station (Alternate)

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IMPORTANT: Use correct refrigerant recovery, recycling and charging stations. DO NOT use refrigerant, hoses, fittings, components or refrigerant oils intended for R12 refrigerant.

1. Connect refrigerant recovery, recycling and charging station. (See installation procedure in this group.)

2. Close both low and high pressure valves on refrigerant recovery, recycling and charging station.

3. Open cab doors and windows.

Continued on next page

4. Connect low pressure blue hose (B) from refrigerant recovery, recycling and charging station (G) to low pressure test port (F) on compressor.

5. Connect high pressure red hose (D) to high pressure quick-disconnect on compressor.

6. Follow the manufacturer's instructions when using the refrigerant recovery, recycling and charging station.

7. Start engine and run at fast idle.

Engine—Specification

Speed .... 2180 rpm

8. Press temperature control switch at the maximum cooling position.

Temperature Control Switch—Specification

Position .... Maximum Cooling

9. Press blower switch at high speed position.

Blower—Specification

Speed .... High

10. Check sight glass in receiver-dryer for bubbles or if clean.

11. Run unit for at least 5 minutes.

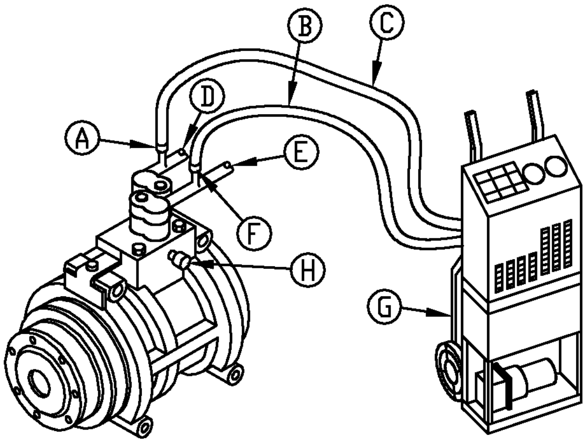
Run Unit For At Least—Specification

Time.. 5 Minutes

12. Measure air temperature at condenser air inlet and at air ducts in air conditioning unit. Record readings.

13. Read low and high pressure gauges on refrigerant recovery, recycling and charging station. Record readings.

14. Compare pressure and temperature readings to the specifications shown.



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A—High Pressure Test Port
B—Blue Hose
C—Red Hose
D—High Pressure Hose
E—Low Pressure Hose
F—Low Pressure Test Port
G—Refrigerant Recovery/Recycling and Charging Station
H—High Pressure Relief Valve

Continued on next page

Ambient Temperature	Air Duct Temperature	Low Pressure Gauge	High Pressure Gauge
16°C (60°F)	13°C (55°F)	7—165 kPa (0.07—1.6 bar) (1—24 psi)	630—1095 kPa (6—11 bar) (90—160 psi)
21°C (70°F)	16°C (60°F)	7—180 kPa (0.07—1.8 bar) (1—26 psi)	785—1225 kPa (7.6—12 bar) (110—175 psi)
27°C (80°F)	18°C (65°F)	7—205 kPa (0.07—2.1 bar) (1—30 psi)	955—1410 kPa (9.6—14.1 bar) (140—205 psi)
32°C (90°F)	21°C (70°F)	7—240 kPa (0.07—2.4 bar) (1—35 psi)	1145—1645 kPa (11.4—16.5 bar) (165—240 psi)
38°C (100°F)	27°C (80°F)	7—280 kPa (0.07—2.7 bar) (1—40 psi)	1355—1935 kPa (13.4—19.3 bar) (195—280 psi)
43°C (110°F)	29°C (85°F)	7—330 kPa (0.07—3.3 bar) (1—48 psi)	1580—2275 kPa (15.8—22.7 bar) (230—330 psi)

15. Use the Operating Pressure Diagnostic Chart in this group to diagnose the malfunction.

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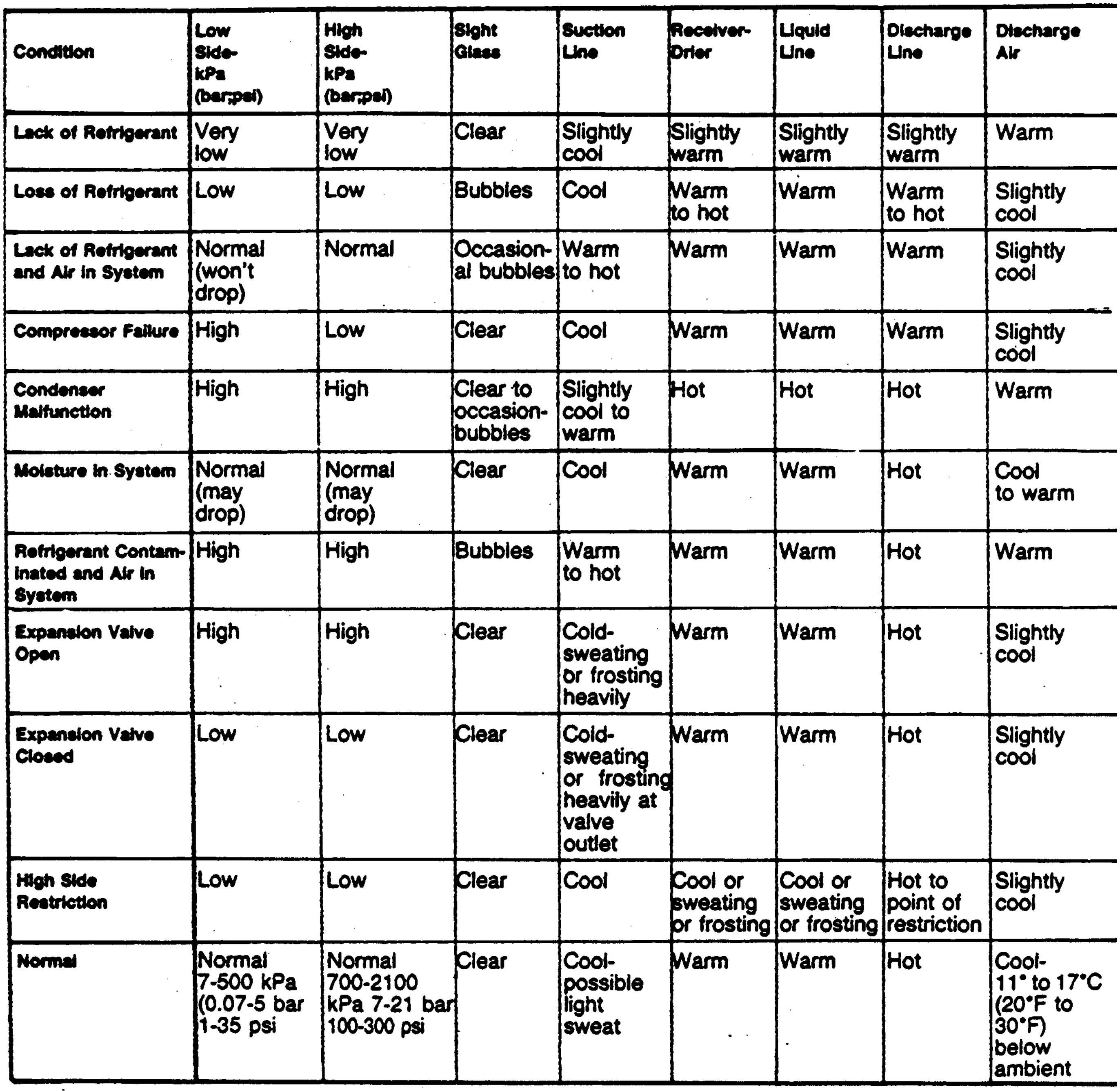
OPERATING PRESSURE DIAGNOSTIC CHART



Condition	Low Side-kPa (bar;psi)	High Side-kPa (bar;psi)	Sight Glass	Suction Line	Receiver-Drier	Liquid Line	Discharge Line	Discharge Air
Lack of Refrigerant	Very low	Very low	Clear	Slightly cool	Slightly warm	Slightly warm	Slightly warm	Warm
Loss of Refrigerant	Low	Low	Bubbles	Cool	Warm to hot	Warm	Warm to hot	Slightly cool
Lack of Refrigerant and Air in System	Normal (won't drop)	Normal	Occasional bubbles	Warm to hot	Warm	Warm	Warm	Slightly cool
Compressor Failure	High	Low	Clear	Cool	Warm	Warm	Warm	Slightly cool
Condenser Malfunction	High	High	Clear to occasion- bubbles	Slightly cool to warm	Hot	Hot	Hot	Warm
Moisture in System	Normal (may drop)	Normal (may drop)	Clear	Cool	Warm	Warm	Hot	Cool to warm
Refrigerant Contaminated and Air in System	High	High	Bubbles	Warm to hot	Warm	Warm	Hot	Warm
Expansion Valve Open	High	High	Clear	Cold-sweating or frosting heavily	Warm	Warm	Hot	Slightly cool
Expansion Valve Closed	Low	Low	Clear	Cold-sweating or frosting heavily at valve outlet	Warm	Warm	Hot	Slightly cool
High Side Restriction	Low	Low	Clear	Cool	Cool or sweating or frosting	Cool or sweating or frosting	Hot to point of restriction	Slightly cool
Normal	Normal 7-500 kPa (0.07-5 bar 1-35 psi	Normal 700-2100 kPa 7-21 bar 100-300 psi	Clear	Cool-possible light sweat	Warm	Warm	Hot	Cool-11° to 17°C (20°F to 30°F) below ambient

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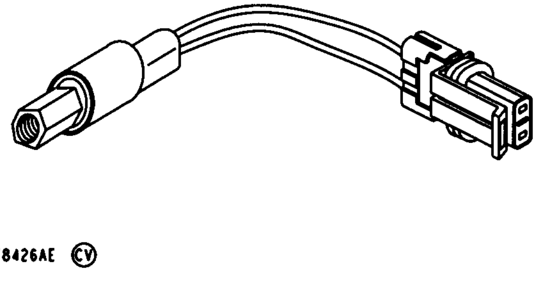
HIGH AND LOW PRESSURE SWITCH TEST



SPECIFICATIONS	
Low Pressure Switch (Normally Open) Closes on Increasing Pressure	345 ± 35 kPa (3.45 ± 0.3 bar) (50 ± 5 psi)
Low Pressure Switch (Normally Open) Opens on Decreasing Pressure	173 ± 35 kPa (1.73 ± 0.3 bar) (25 ± 53 psi)
High Pressure Switch (Normally Closed) Opens on Increasing Pressure	2760 ± 138 kPa (27.6 ± 1.38 bar) (400 ± 20 psi)
High Pressure Switch (Normally Closed) Closes on Decreasing Pressure	1310 ± 138 kPa (13.11 ± 1.38 bar) (190 ± 20 psi)

SERVICE EQUIPMENT AND TOOLS
Volt-Ohm-Amp Meter
JT02051 3-Gauge Manifold w/Hose And Quick Coupler

NOTE: The line that attaches the high and low pressure switch has a valve installed to prevent discharging the air conditioning system when switch is removed. The high pressure switch is normally closed when removed from the machine. It does not open when installed in the A/C system until pressure exceeds specification.

1. Remove high and low pressure switch.

2. Connect a portable pressure source, such as a hydraulic hand pump, to high and low pressure switch.

3. Using an ohmmeter measure continuity between terminals A and B until low pressure switch pressure increases to switch closing pressure specification.

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Low Pressure Switch (Normally Open)—Specification

Closes on Increasing Pressure .... 345 ± 35 kPa (3.45 ± 0.3 bar) (50 ± 5 psi)

Low Pressure Switch (Normally Open)—Specification

Opens on Decreasing Pressure .... 173 ± 35 kPa (1.73 ± 0.3 bar) (25 ± 53 psi)

Continued on next page

4. Slowly increase pressure. Switch must have continuity until pressure increases to high pressure switch opening pressure specification.

High Pressure Switch (Normally Closed)—Specification

Opens on Increasing Pressure .... 2760 ± 138 kPa (27.6 ± 1.38 bar) (400 ± 20 psi)

High Pressure Switch (Normally Closed)—Specification

Closes on Decreasing Pressure................ 1310 ± 138 kPa (13.11 ± 1.38 bar) (190 ± 20 psi)

5. The low pressure switch can also be checked when installed in air conditioning system, however, pressure is slow to increase to test specification. High test switch is not easily tested in system.

   Connect an 3-gauge manifold for R134a to service fittings at compressor. Cover condenser with paper or plastic to stop air flow. Operate air conditioner on maximum cooling. Note high-side pressure when high pressure switch opens and then closes.

CED,TX14795,4346 –19–04MAR98–2/2

LEAK TESTING

1. Inspect all lines, fittings, and components for oily or dusty spots. When refrigerant leaks from the system, a small amount of oil is carried out with it.
2. A soap and water solution can be sprayed on the components in the system to form bubbles at the source of the leak.
3. If a leak detector is used, move the leak detector probe under the hoses and around the connections at a rate of 25 mm (1 in.) per second.
4. Some refrigerant manufacturers add dye to refrigerant to aid in leak detection.

TX,9031,UU3168 –19–13AUG96–1/1

REFRIGERANT HOSES AND TUBING INSPECTION

When a component is disconnected from the system, special care should be given to inspecting hoses and tubing for moisture, grease, dirt, rust, or other foreign material. If such contamination is present in hoses, tubing, or fittings and cannot be removed by cleaning, then replace parts.

Fittings that have grease or dirt on them should be wiped clean with a cloth dampened with alcohol. Chlorinated solvents (such as trichloroethylene) are contaminants, and must not be used for cleaning.

To assist in making leak-proof joints, use a small amount of clean correct viscosity refrigerant oil on all hose and tube connections. Dip O-rings in correct viscosity oil before assembling.

IMPORTANT: Hose used for air conditioning systems contains special barriers in its walls to prevent migration of refrigerant gas.

DO NOT use hydraulic hoses as replacement hoses in the air conditioning system. Use ONLY certified hose meeting SAE J51B requirements.

TX,9031,UU3169 –19–13AUG96–1/1

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CHAPTER 8

SECTION 9035

ARCTIC/COLD WEATHER HEATER

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Group 05
Theory of Operation

ARCTIC/COLD WEATHER HEATER CAUTIONS

⚠ **CAUTION: Heater must be turned off while refueling.**

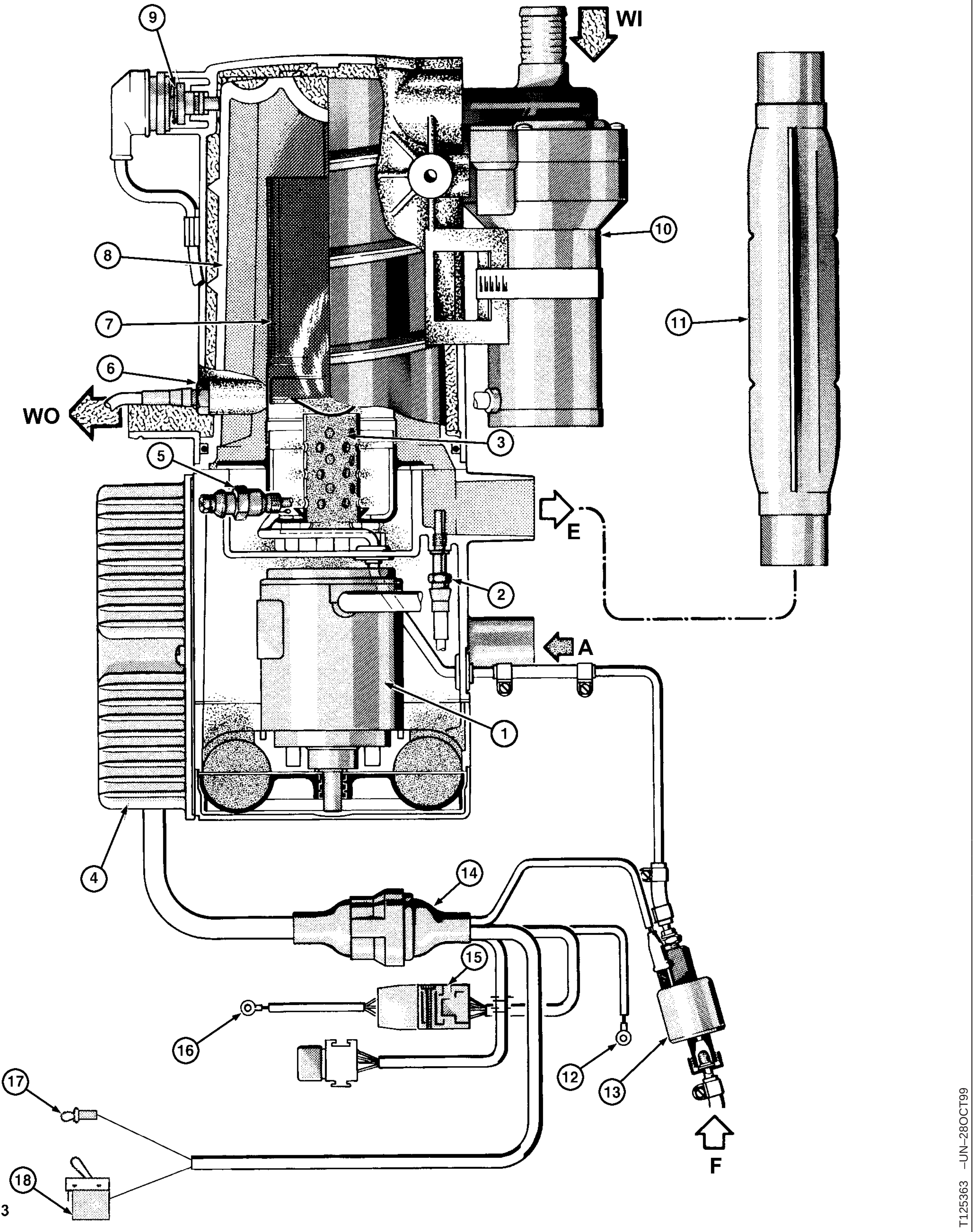
Do not operate heater in enclosed areas where combustible fumes may be present.

Prior to operating the heater, ensure that the fuel system is intact and there are no leaks.

Extreme care should be taken to ensure a proper mixture of water and antifreeze is used in the coolant system to be heated, to prevent coolant from freezing or slushing. If the coolant becomes slushy or frozen, the heater's coolant pump cannot move the coolant causing a blockage of the circulating system. Once this occurs, pressure will build up rapidly in the heater and the coolant hose will either burst or blow off at the connection point to the heater. This situation could cause engine damage and/or personal injury.

CED,OUOE012,174 –19–14APR99–1/1

ARCTIC/COLD WEATHER HEATER THEORY OF OPERATION



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1—Burner Motor
2—Flame Sensor
3—Combustion Chamber
4—Control Unit
5—Glow Plug
6—Temperature Sensor
7—Flame Tube
8—Heat Exchanger
9—Overheat Sensor
10—Water Pump
11—Exhaust
12—Battery—Ground
13—Fuel Metering Pump
14—Wiring Harness
15—Fuse Holder
16—Battery—Power
17—LED Light
18—Toggle Switch
A—Combustion Air
E—Exhaust
F—Fuel Supply Line
WO—Water Outlet
WI—Water Inlet

The arctic/cold weather heater is an oil fired heater that pumps coolant from the machine engine, heats it and returns it to the engine. The heater utilizes machine 24-volt power and fuel, and operates independently of the machine engine. A temperature regulating switch in the unit regulates the coolant temperature between a low of 53°C (127°F) and a high of 85°C (185°F)

When the heater switch is turned ON, the following sequence occurs:

NOTE: If the heater fails to start the first time, it will automatically attempt a second start. If the second attempt fails, the heater will shut off completely. On the initial start up, the heater may require several start attempts to self-prime the fuel system.

- The control unit does a system check (flame sensor, temperature, safety thermal cut-out fuse and various other control unit checks).
- The water pump starts circulating the coolant.
- The combustion air blower starts.
- The glow plug begins to preheat for 20—50 seconds.
- After 20—50 seconds the fuel metering pump starts delivering fuel and the combustion air blower ramps up gradually.

Once ignition takes place, the flame sensor alerts the control unit, and the control unit shuts off the glow plug.

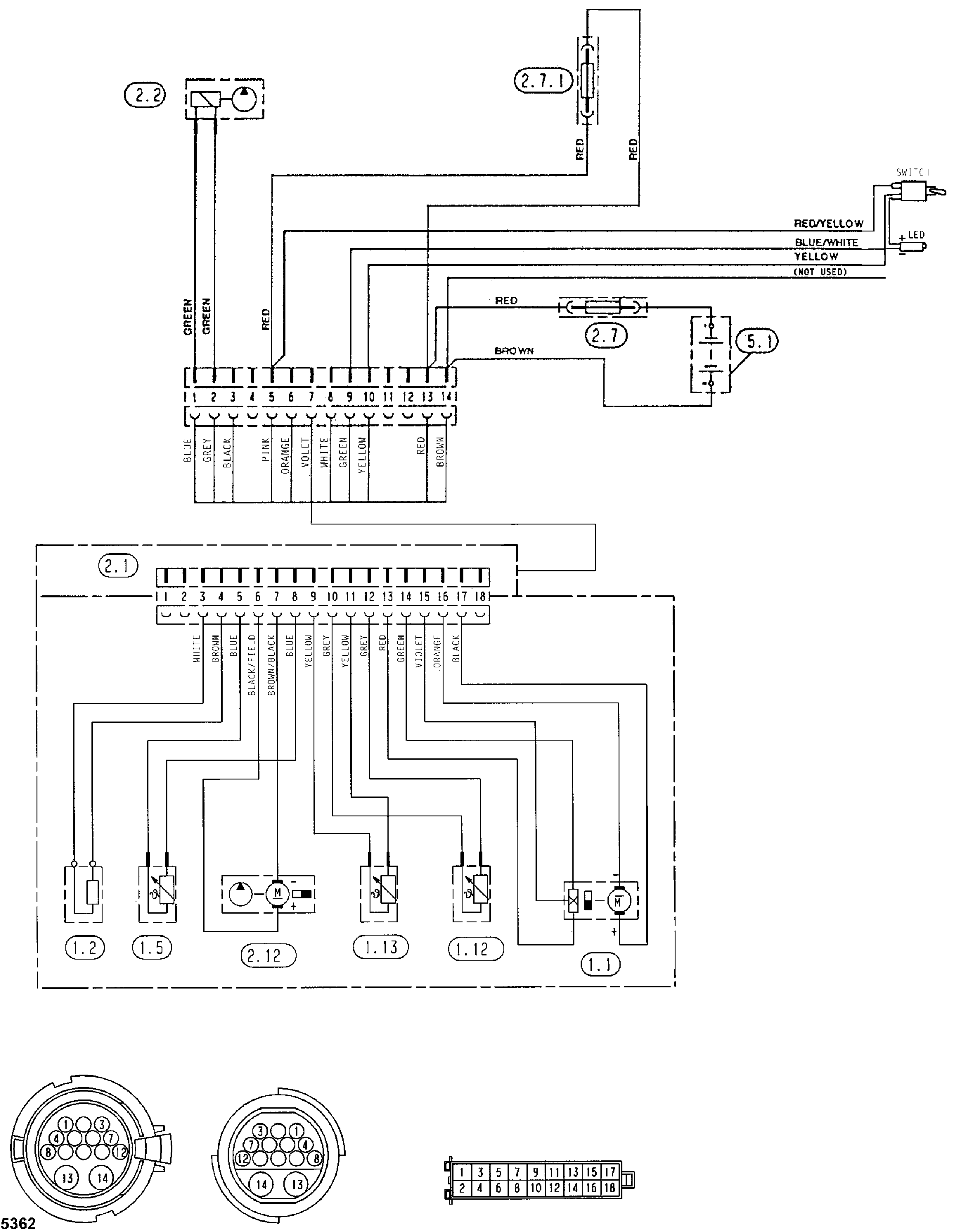
When started, the heater runs in the full heat mode and the temperature is monitored at the heat exchanger. When the coolant temperature reaches 72°C (162°F) the heater starts cycling up and down between levels (high, medium, low). If the coolant temperature continues to rise, the heater will automatically shut off. This occurs when the temperature reaches 85°C (185°F).

The water pump continues to circulate coolant after heater shutdown, to allow the heater to monitor coolant temperature. The heater will automatically restart when the coolant temperature drops below 68°C (154°F).

The heater continues to run as described above, until the heater switch is turned OFF.

When the heater switch is turned OFF, the fuel metering pump stops delivering fuel and the flame is extinguished. The combustion air blower and water pump continue to run for 130 seconds to cool down.

ARCTIC/COLD WEATHER HEATER WIRING DIAGRAM



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Theory of Operation

1.1—Blower Motor
1.2—Glow Pin
1.5—Overheat Sensor
1.12—Flame Sensor
1.13—Temperature Sensor
2.1—Control Unit
2.12—Water Pump
2.2—Fuel Metering Pump
2.7—15-Amp Main Fuse
2.7.1—5-Amp Switch Fuse
5.1—Battery

CED,OUOE012,177 –19–15APR99–2/2

Group 10
Operational Checks

ARCTIC/COLD WEATHER HEATER CHECKS

The following checks should be performed periodically to ensure the system is in good operating condition:

- Check coolant hoses and clamps, and make sure all valves are open.
- Maintain the proper engine coolant level and ensure that the heater is properly bled after service to or involving the cooling system.
- Visually check all fuel lines for leaks. Check fuel filter inserts and replace if necessary.
- Visually inspect all electrical lines and connections for corrosion.
- Maintain the electrical system in good condition. The heater will not start with insufficient power, and will automatically shut down if high or low voltage fluctuations occur.
- Use fuel suitable for the climate.
- Check the glow plug and replace if necessary.
- Run the heater at least once a month for at least 15 minutes.

CED,OUOE012,180 –19–16APR99–1/1

DIAGNOSE ARCTIC/COLD WEATHER HEATER MALFUNCTIONS

In the event of a malfunction, the following items should be checked before performing the heater diagnostic procedure:

- Fuel supply
- Fuses, electrical lines and connections.
- Battery voltage.
- Coolant flow.
- Interference in the combustion air and exhaust pipes

If combustion is sooty, check the following:

- combustion air and exhaust ducts. Clear if necessary.
- Fuel metering pump. Measure for excessive delivery, and replace if necessary.

CED,OUOE012,179 –19–16APR99–1/1

ARCTIC/COLD WEATHER HEATER DIAGNOSTIC PROCEDURE

The heater system utilizes the green LED light located next to the arctic/cold weather heater switch, located on the right hand console inside the cab, to provide fault information. The light provides different illumination sequences depending on the malfunction as shown in the function and fault test chart.

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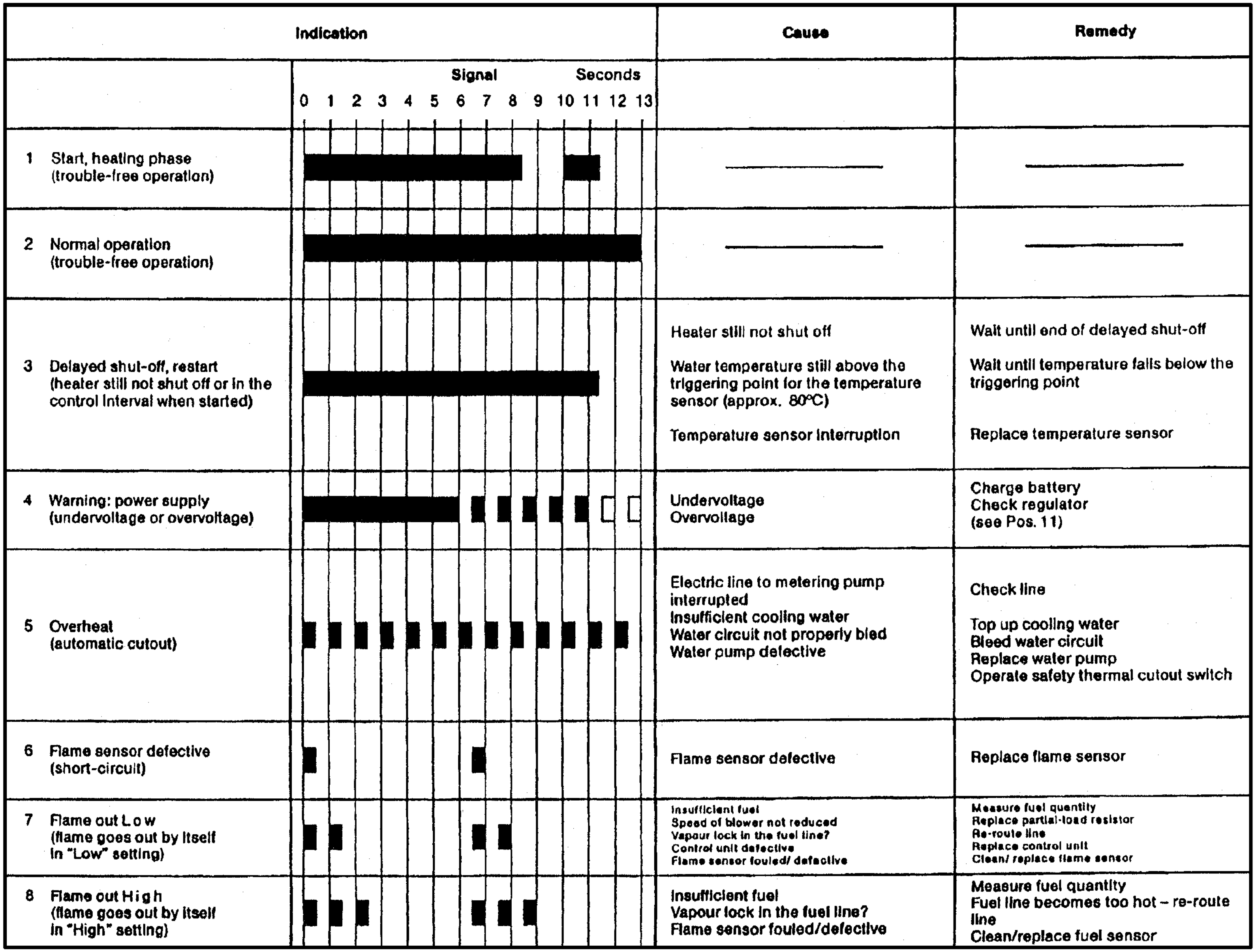
CED,OUOE012,181 –19–16APR99–1/3

Function and Fault Test Chart



Indication		Cause	Remedy
	Signal Seconds 0 1 2 3 4 5 6 7 8 9 10 11 12 13		
1 Start, heating phase (trouble-free operation)		———	———
2 Normal operation (trouble-free operation)		———	———
3 Delayed shut-off, restart (heater still not shut off or in the control interval when started)		Heater still not shut off Water temperature still above the triggering point for the temperature sensor (approx. 80°C) Temperature sensor interruption	Wait until end of delayed shut-off Wait until temperature falls below the triggering point Replace temperature sensor
4 Warning: power supply (undervoltage or overvoltage)		Undervoltage Overvoltage	Charge battery Check regulator (see Pos. 11)
5 Overheat (automatic cutout)		Electric line to metering pump interrupted Insufficient cooling water Water circuit not properly bled Water pump defective	Check line Top up cooling water Bleed water circuit Replace water pump Operate safety thermal cutout switch
6 Flame sensor defective (short-circuit)		Flame sensor defective	Replace flame sensor
7 Flame out Low (flame goes out by itself in "Low" setting)		Insufficient fuel Speed of blower not reduced Vapour lock in the fuel line? Control unit defective Flame sensor fouled/ defective	Measure fuel quantity Replace partial-load resistor Re-route line Replace control unit Clean/ replace flame sensor
8 Flame out High (flame goes out by itself in "High" setting)		Insufficient fuel Vapour lock in the fuel line? Flame sensor fouled/defective	Measure fuel quantity Fuel line becomes too hot – re-route line Clean/replace fuel sensor

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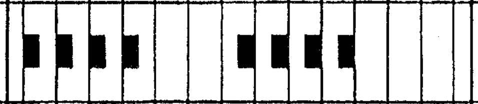
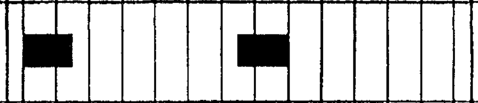
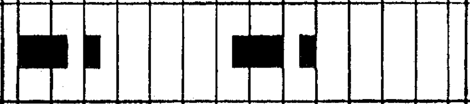
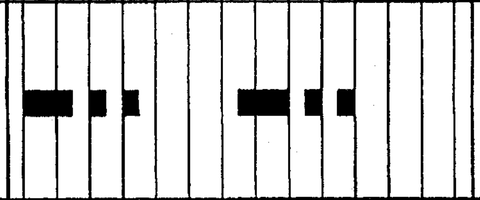
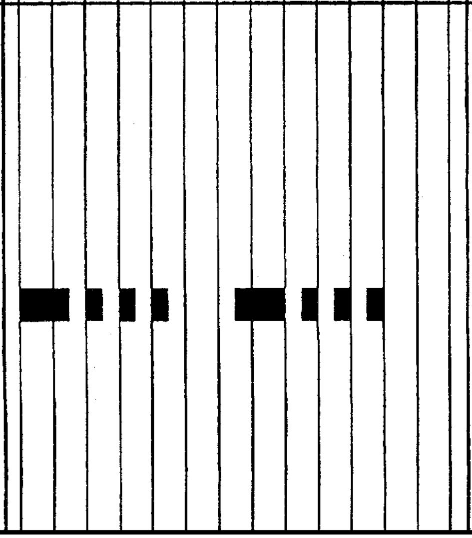
Function and Fault Test Chart (Continued)

Indication		Cause	Remedy
	Signal Seconds 0 1 2 3 4 5 6 7 8 9 10 11 12 13		
9 Glow plug defective		Glow plug fuse defective Glow plug defective Flame sensor fouled/ defective	Replace fuse Replace glow plug Clean/ replace flame sensor
10 Burner motor defective		Heater fuse defective Electric motor defective or blower blocked Flame sensor fouled/defective	Replace fuse Replace blower Clean/replace flame sensor
11 Cutout due to undervoltage		Undervoltage Corrosion on electrical connections	Charge battery, check battery Clean electrical connections
12 Cutout due to overvoltage		Overvoltage	Check regulator Connect heater to battery
13 Non-start Safety time exceeded and automatic cutout		**No fuel** Metering pump defective Short-circuit at metering pump No pulses at metering pump Fuel line not filled Insufficient fuel Glow plug defective **Automatic cutout after 3–5 mins.** Flame sensor wrongly poled Flame sensor fouled Flame sensor interruption Insufficient fuel	Replace metering pump Check plug Replace control unit Restart, check fuel line Measure fuel quantity Replace glow plug Check connection against wiring diagram Clean flame sensor Replace flame sensor Measure fuel quantity

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CHAPTER 9

SECTION 9040

AIR COMPRESSOR

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GROUP 25 - Trouble Shooting

INTRODUCTION

Trouble shooting for a portable air compressor is an organized study by a particular problem or series of problems and a planned method of procedure for investigation and correction. The trouble shooting chart that follows includes some of the problems that an operator may encounter during the operation of a portable compressor. The chart does not attempt to list all of the troubles that may occur, not does it attempt to give all of the answers for correction of the problems. The chart does give those problems that are most apt to occur. To use the trouble shooting chart:

A. Find the "complaint" depicted as a bold heading.

B. Follow down that column to find the potential cause or causes. The causes are listed in order (1,2,3 etc.) to suggest an order to follow in trouble shooting.

ACTION PLAN

A. Think Before Acting

Study the problem thoroughly and ask yourself these questions**:**

(1) What were the warning signals that preceded the trouble?

(2) Has a similar trouble occurred before?

(3) What previous maintenance work has been done?

(4) If the compressor will still operate, is it safe to continue operating it to make further checks?

B. Do The Simplest Things First

Most troubles are simple and easily corrected. For example, most complaints are "low capacity" which may be caused by too low an engine speed or compressor "over-heats" which may be caused by low oil level. Always check the easiest and most obvious things first; following this simple rule will save time and trouble.

Note: For trouble shooting electrical problems, refer to the Wiring Diagram Schematic found in Section 9 – Parts List.

C. Double Check Before Disassembly

The source of most compressor troubles can be traced not to one component alone, but to the relationship of one component with another. Too often, a compressor can be partially disassembled in search of the cause of a certain trouble and all evidence is destroyed during disassembly. Check again to be sure an easy solution to the problem has not be overlooked.

D. Find And Correct Basic Cause

After a mechanical failure has been corrected, be sure to locate and correct the cause of the trouble so the same failure will not be repeated. A complaint of "premature breakdown" may be corrected by repairing any improper wiring connections, but something caused the defective wiring. The cause may be excessive vibration.

TROUBLE SHOOTING CHART

Bold Headings depict the COMPLAINT - Subheadings depict the CAUSE

Note: Subheadings suggest order to follow in cause of troubleshooting.

Short Air Cleaner Life:
- Dirty Operating Conditions
- Inadequate Element Cleaning
- Defective Service Indicator
- Incorrect Stopping Procedure
- Wrong Air Filter Element
- Oil Pump Drive Coupling

Excessive Oil In Air:
- High Oil Level
- Out of Level > 15 degrees
- Clogged Scavenge Orifice
- Scavenge Tube Blocked
- Defective Scavenge Check Valve
- Sep. Tank Blown Down Too Quickly
- Defective Minimum Pressure Valve

Oil Seal Leak:
- Contaminated Lube Oil
- Blocked or Restricted Oil Lines
- Malfunctioning Seal
- Scored Shaft

Will Not Unload:
- Leaks in Regulator Piping
- Incorrect Pressure Regulator Adjustment
- Malfunctioning Pressure Regulator
- Malfunctioning Inlet Unloader/Butterfly Valve
- Ice in Regulation Lines/Orifice

Oil In Air Cleaner:
- Incorrect Stopping Procedure
- Oil Pump Drive Coupling
- Discharge Check Valve Faulty

Safety Valve Relieves:
- Operating Pressure Too High
- Leaks In Regulator Piping
- Incorrect Pressure Regulator Adjustment
- Malfunctioning Pressure Regulator
- Malfunctioning Inlet Unloader/Butterfly Valve
- Defective Safety Valve
- Defective Separator Element
- Ice in Regulation Lines/Orifice

Excessive Compressor Oil Temperature:
- Ambient Temp. > 125♉F (52♉C)
- Out of Level > 15 degrees
- Low Oil Level
- Wrong Lube Oil
- Dirty Cooler
- Dirty Operating Conditions
- Clogged Oil Filter Elements
- Loose or Broken Belts
- Operating Pressure Too High
- Recirculation Of Cooling Air
- Malfunctioning Thermostat
- Malfunctioning Tan
- Defective Oil Cooler Relief Valve
- Defective Minimum Pressure Valve
- Blocked or Restricted Oil Lines
- Airend Malfunctioning

Engine RPM Down:
- Clogged Fuel Filter
- Operating Pressure Too High
- Incorrect Pressure Regulator Adjustment
- Malfunctioning Pressure Regulator
- Incorrect Linkage Adjustment
- Dirty Air Filter
- Malfunctioning Air Cylinder
- Wrong Air Filter Element
- Defective Separator Element
- Ice In Regulation Lines/Orifice
- Engine Malfunctioning
- Airend Malfunctioning

Excessive Vibration:
- Rubber Mounts Damaged
- Malfunctioning Fan
- Drive Coupling Defective
- Engine Malfunctioning
- Airend Malfunctioning

Low CFM:
- Dirty Air Filter
- Incorrect Linkage Adjustment
- Incorrect Pressure Regulator Adjustment
- Malfunctioning Pressure Regulator
- Operating Pressure Too High
- Malfunctioning Inlet Unloader/Butterfly Valve
- Malfunctioning Air Cylinder
- Defective Minimum Pressure Valve
- Defective Separator Element
- Wrong Air Filter Element
- Ice in Regulation Lines/Orifice

Unit Shutdown:

Out of Fuel
Compressor Oil Temp. Too High
Engine Water Temp. Too High
Engine Oil Pressure Too Low
Broken Engine Fan Belt
Loose Wire Connection
Low Fuel Level Shutdown Switch
Defective Discharge Air Temp. Switch
Defective Engine Belt Break Switch
Defective Engine Oil Pressure Switch
Defective Shutdown Solenoid
Malfunctioning Relay
< 9 Volts at Shutdown Solenoid
Blown Fuse
Engine Malfunctioning
Airend Malfunctioning

Unit Fails To Shutdown:

Low Fuel Shutdown Switch
Defective Discharge Air Temperature Switch
Defective Engine Belt Break Switch
Defective Engine Oil Pressure Switch
Defective Shutdown Solenoid
Malfunctioning Relay
Defective Safety Bypass Switch

Alternator Lamp Stays On:

Loose or Broken Belts
Loose Wire Connection
Low Battery Voltage
Malfunctioning Alternator
Malfunctioning Circuit Board

Alternator Lamp Stays Off:

Bulb Burned Out
Loose Wire Connection
Malfunctioning Circuit Board

Won’t Start/Run:

Low Battery Voltage
<9 Volts at Shutdown Solenoid
Blown Fuse
Malfunctioning Start Switch
Defective Safety Bypass Switch
Clogged Fuel Filters
Out of Fuel
Compressor Oil Temp. Too High
Engine Water Temp. Too High
Engine Oil Pressure Too Low
Loose Wire Connection
Defective Discharge Air Temp. Switch
Defective Engine Belt Break Switch
Defective Engine Oil Pressure Switch
Defective Shutdown Solenoid
Malfunctioning Relay
Engine Malfunctioning
Airend Malfunctioning

Engine Temperature Lamps Stays On:

Broken Engine Fan Belt
Malfunctioning Circuit Board
Defective Engine Belt Break Switch
Ambient Temp. > 125♉F (52♉C)
Dirty Operating Conditions
Dirty Cooler
Out of Level >15 degrees
Operating Pressure Too High
Recirculation of Cooling Air

Engine Oil Pressure Lamp Stays On:

Low Oil Level
Out of Level >15 degrees
Wrong Lube Oil
Clogged Oil Filter Elements
Engine Malfunctioning

Engine Temperature Lamps Stays Off:

Bulb Burned Out
Loose Wire Connection
Malfunctioning Circuit Board
Defective Engine Belt Break Switch

Engine Oil Pressure Lamp Stays Off:

Bulb Burned Out
Malfunctioning Circuit Board
Defective Engine Oil Pressure Switch
Malfunctioning Fan
Engine Malfunctioning

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CHAPTER 10

SECTION 9045

ROCK DRILL ATTACHMENT

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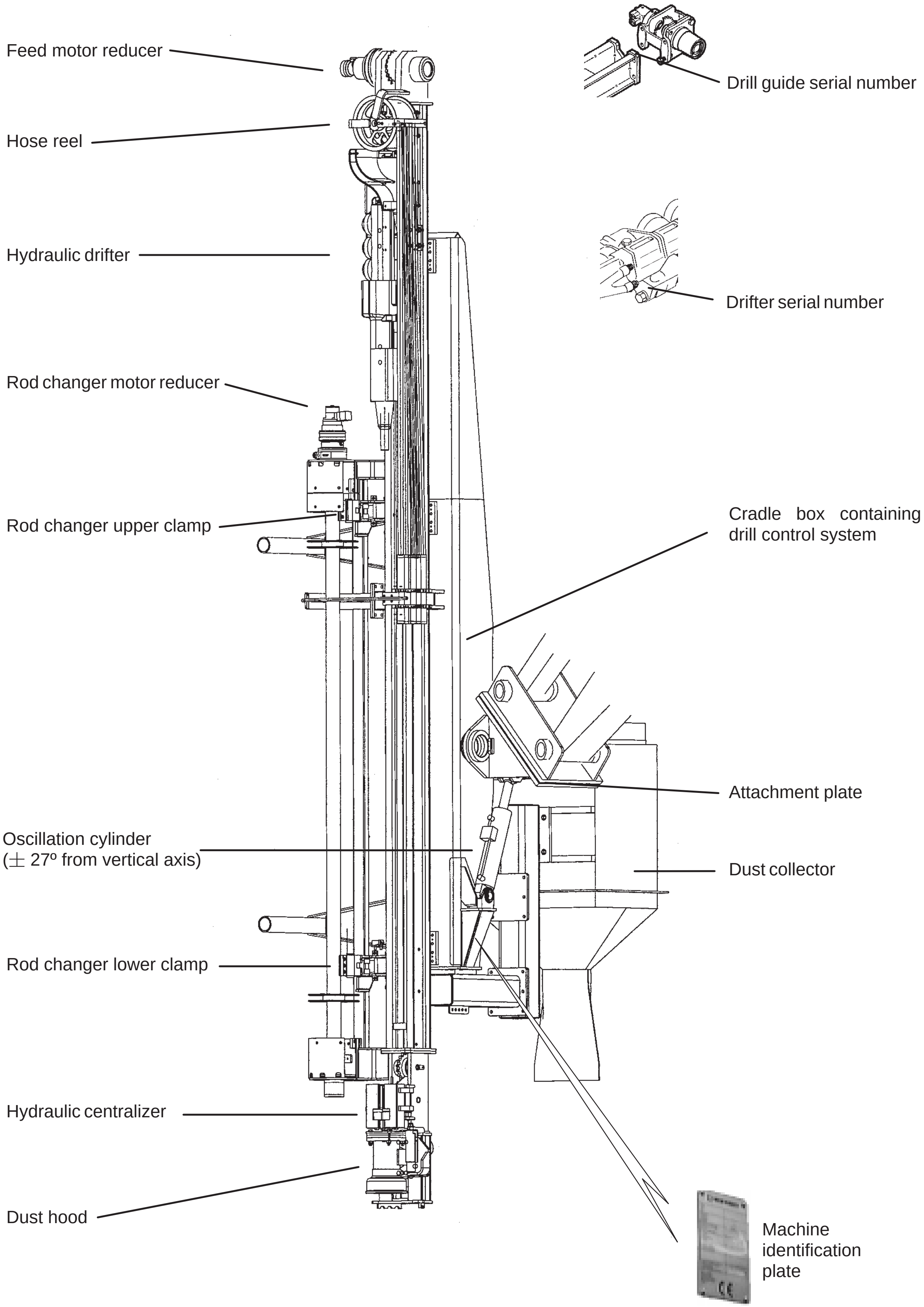
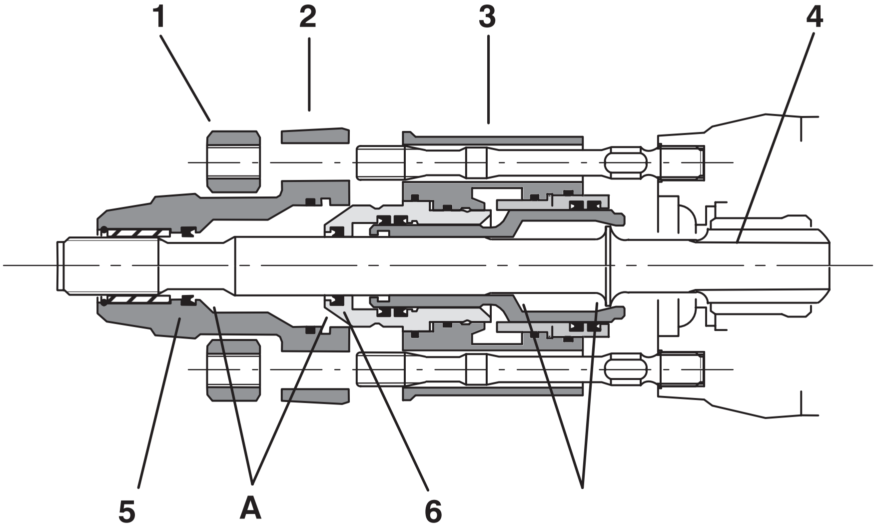
CPA X-TEND


Feed motor reducer
Hose reel
Hydraulic drifter
Rod changer motor reducer
Rod changer upper clamp
Oscillation cylinder
(± 27º from vertical axis)
Rod changer lower clamp
Hydraulic centralizer
Dust hood
Drill guide serial number
Drifter serial number
Cradle box containing drill control system
Attachment plate
Dust collector
Machine identification plate

SHANK REPLACEMENT



The CPA should be lowered in its rest position.

Loosen the 2 nuts (Pos.1).

Remove the front guide (Pos. 2) and the front box (Pos. 3)

Pull the shank (Pos. 4) out.

Check the condition of the bronze nut splines. Replace the bronze nut if damaged.

Change the flushing seals (Pos. 5,6).

Mind the orientation of the seals.

Refer to “Flushing seal replacement” chapter for the use of the mounting tool.

Check the wear of the front guide bronze bush.

maximum wear = shank diameter+1 mm *(.04 in)*.

If out off limits, replace the bronze bush.

Inspect the contact area:

- A between the hydraulic retainer and the front lining.
- B between the shank shoulder and the hydraulic retainer.

Replace part as necessary.

Mount the shank in the drifter.

Slide the front box on the shank.

Mount the front guide.

Tighten the 2 nuts (Pos. 1) to 650 Nm (470 ft.lb).

FLUSHING SEAL REPLACEMENT

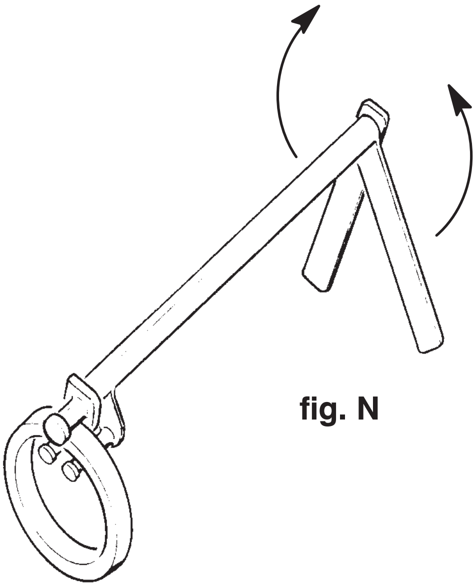


fig. N

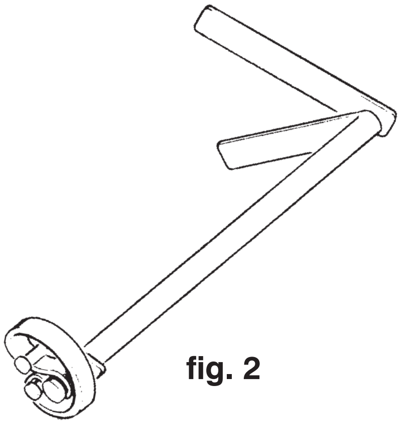
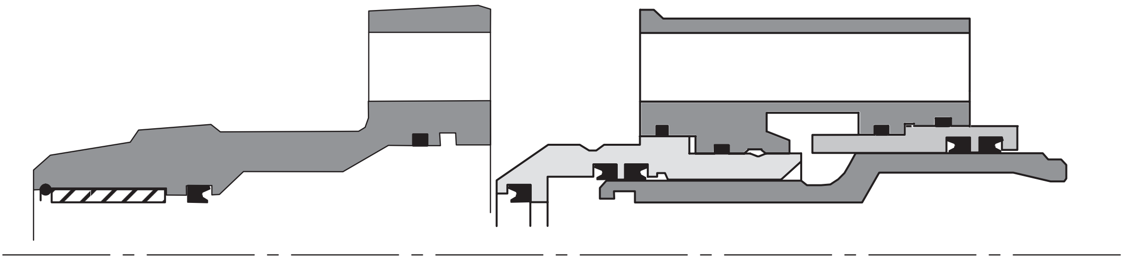


fig. 2



Dismantle the flushing seals and the retainer bush, extract the faulty seals.

Mount the seal in the mounting apparatus, lips oriented towards the tool or towards the outside depending of the seal position when mounted. (fig 1).

Turning the handle of the apparatus, put the seal in position for mounting (fig 2).

If necessary correct the position of the seal.

With the apparatus bring the seal into the groove.

Mind the orientation of the seals.

Release it by turning the handle of the apparatus.

Remove the apparatus.

With a plastic rod, re–form the seal in it’s groove.

Tool number		Seal Diameter
Cpn	**Montabert pn**	
86352572	73N25	38
86352564	73N24	45 / 5N

GUIDE RING REPLACEMENT

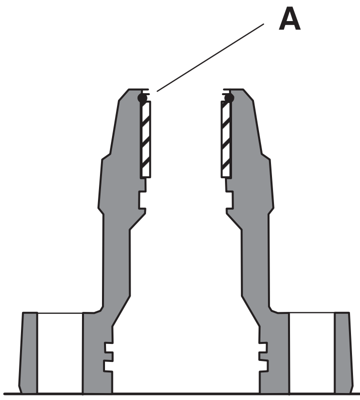


fig. 1

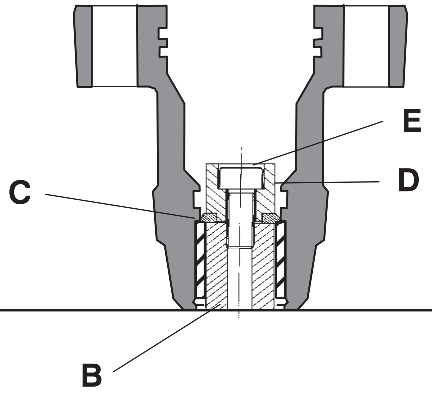


fig. 2

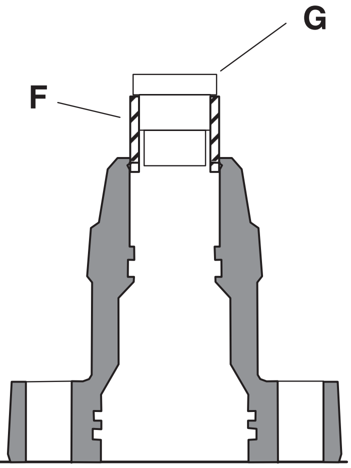


fig. 3

With a screwdriver remove the rush A.

Take all necessary precautions to avoid projecting the rush.

With a press extract the worn bushing.

Fig. 2

Put down the ring B.

Slide the front guide on the ring.

Put the two half–segments C into the groove.

Put the centering ring D into position.

Tighten the screw E to hold all parts together.

Fig. 3

Turn the front guide round.

Put the new bronze bushing F into position.

Mount the shoulder axle G on the bushing.

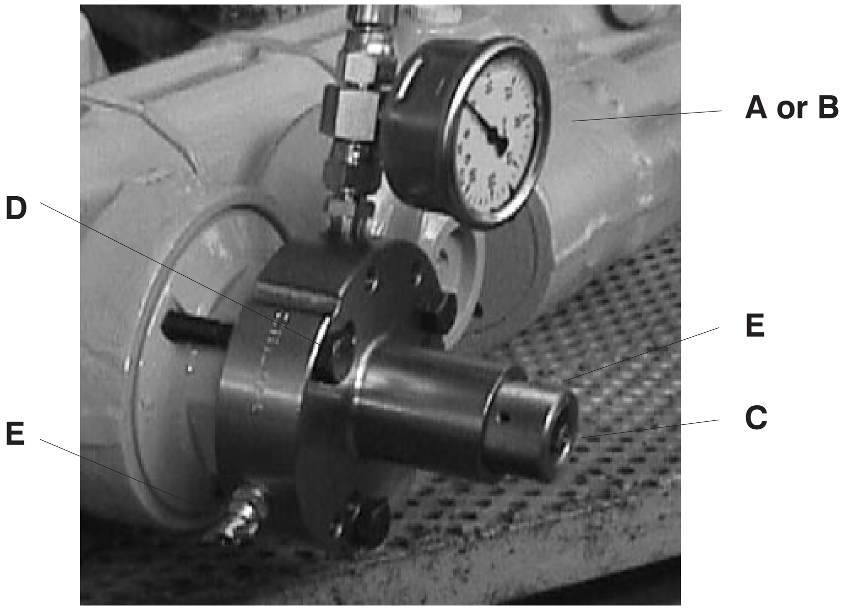
Put the bushing into position with a press.

Push it well in.

Mount a new rush A.

Item	cpn	Ref
B	86365475	77794
C	86365483	77795
D	86365467	77793
E	96717202	8861
G	86323557	59834

ACCUMULATOR CHECK



The control of the inflation pressure or the reparation of an accumulator can be done, drifter in place on the guide rail.

Make sure that the drifter's energy supply has been cut and that the hoses are not under pressure.

Onto the inflation tool, mount a gauge corresponding to the pressure to be checked :

– LP accumulator = 10 bar gauge A.

– HP accumulator = 60 bar gauge B.

Attach the inflation tool (cpn 86490364) to the accumulator lid ;

– Make sure that the key C to unblock the inflating screw is well engaged on the screw head.

– Tighten the fixing screws D progressively so that the inflating device rests correctly on the accumulator.

– Fully tighten setting screw (E).

Connect the inflation tool to the bottle of nitrogen.

Shut the drain cock E.

Open the bottle of nitrogen and set the pressure reducer to the theoretical inflating pressure of the accumulator to be controlled.

– LP accumulator = 4 bar.

– HP accumulators = 40 bar.

When the pressure has been stabilized shut the nitrogen bottle off.

Unblock and unscrew the inflating screw C for some turns.

If the pressure indicated on the gauge falls more than 3 bar replace the accumulator diaphragm.

If the pressure is correct re–block the inflating screw.

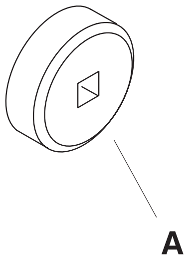
Open the drain cock E.

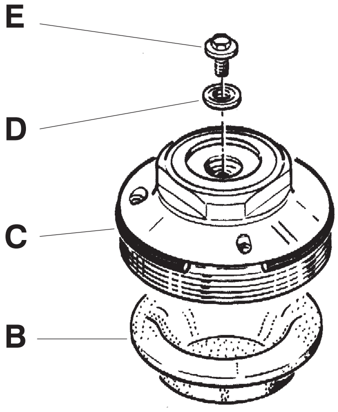
Remove the inflation tool.

<u>NB</u> : Due to the weak pressure of the LP accumulator an accurate control is difficult.

If necessary change the diaphragm and re–inflate systematically.

ACCUMULATOR REPAIRS





The control of the inflation pressure or the reparation of an accumulator can be done, drifter in place on the guide rail.

Make sure that the drifter's energy supply has been cut and that the hoses are not under pressure.

Unscrew the inflating screw on the accumulator to lower the residual pressure.

Using the special socket A (cpn 86493392) and a torque wrench, unscrew the accumulator lid.

Remove the faulty diaphragm.

Carefully wipe the accumulator flange to remove any traces of oil.

Mount the new diaphragm B (clean and dry). Grease the visible part of the diaphragm with silicone (ref 67714) or some other good quality lubricant.

Put a new 0'ring C on the accumulator lid.

Oil the thread of the lid and block it at 1400 mN (1030 ft.lbs).

Mount a tight ring D and a new inflating screw E.

Fix the inflation tool equipped with its gauge on the accumulator lid (see Accumulator Check).

Turn off the drain cock.

Open the nitrogen bottle and set the pressure reducer to the required pressure :

- 4 bar for LP accumulator
- 40 bar for HP accumulators.

When the pressure has been stabilized, block the inflating screw at 22 mN (16 ft.lbs).

Shut the nitrogen bottle off, turn on the drain cock to relieve pressure from the tool.

Remove the inflation tool.

According to the position of the drifter, fill up the housing for the inflating screw with oil and check that there are no bubbles.

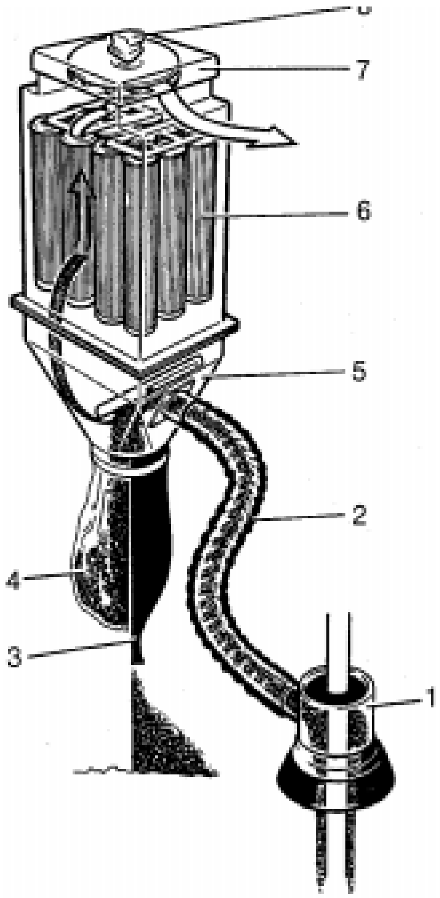
DUST COLLECTOR THEORY OF OPERATION

Looking at a drill rig with a dust collector mounted, all you see is: the pick up hood (1), the suction hose (2), and a big box mounted somewhere on the rig, and hopefully no dust. Every time a new drill rod is added, the big box will drop its contents of drill chips and dust in a plastic sack (4), or just on the ground in a neat pile via the rubber dump valve (3).

What is happening inside the dust collector?

Flushing air and drill chips enter the filter housing through the rubber hose. Inside air and chips hit a heavy steel wear plate, and the heavier chips ricochet downwards, into the cortical part (5). Air and fine dust moves upwards towards the cylindrical filter elements (6). The fine dust settles on the filter surface, the clean air passes through, and is picked up by the fan (7) (or the venturi on the pneumatic models) and expelled out of the top of the dust collector.

Every time the operator stops to add on another drill rod, suction stops so that the accumulated chips can fall down. At the same time the filter elements are cleaned by repeated air blasts from the inside. This happens automatically every time when drilling is interrupted on the hydraulic units. The pneumatically driven dust collectors are all equipped with a manual filter cleaning system.



1. Pick up hood
2. Suction hose
3. Rubber dump valve
4. Plastic sack
5. **Bottom housing section**
6. Filter elements
7. Fan
8. Hydraulic Motor

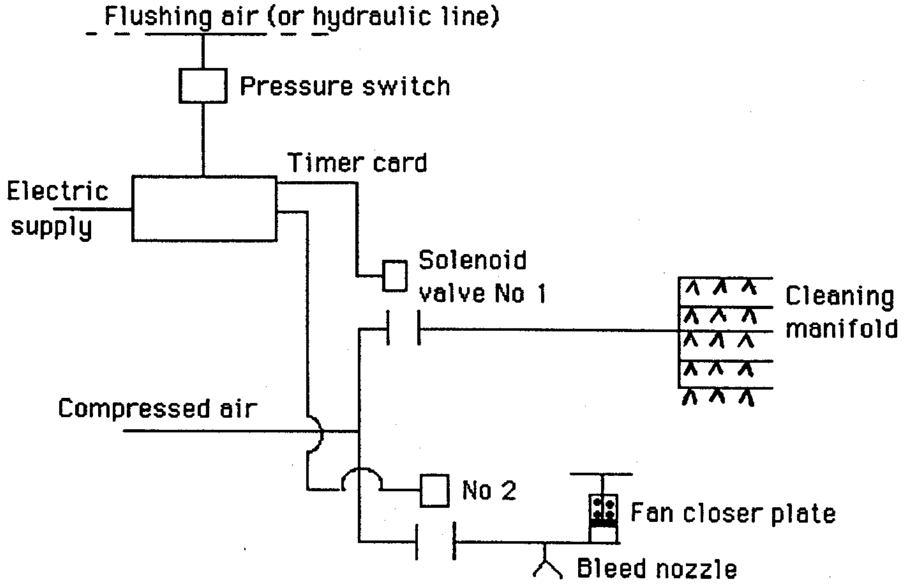
We find several components inside the dust collector whose function is vital to the dust collecting system.

B: **The automatic cleaning cycle**

In the dust collector the heavy chips fall to the bottom, but the fine dust collects on the filter surface. When adding on a new drill rod there is time to clean the filter elements.
In the dust collectors, compressed air is used for cleaning the filters. This method gives the best cleaning results and does not destroy the filter elements with hard mechanical vibration.
The system works as follows:

As the operator stops the rock drill, the flushing air (or the hydraulic pressure) is also, shut off. In the air line or the hydraulic line there is an electric pressure switch. As the pressure drops, the switch is closed and an electric signal goes to a small control unit mounted inside the dust collector. This signal starts the cleaning cycle.

The fan creates the suction that makes the dust collector work

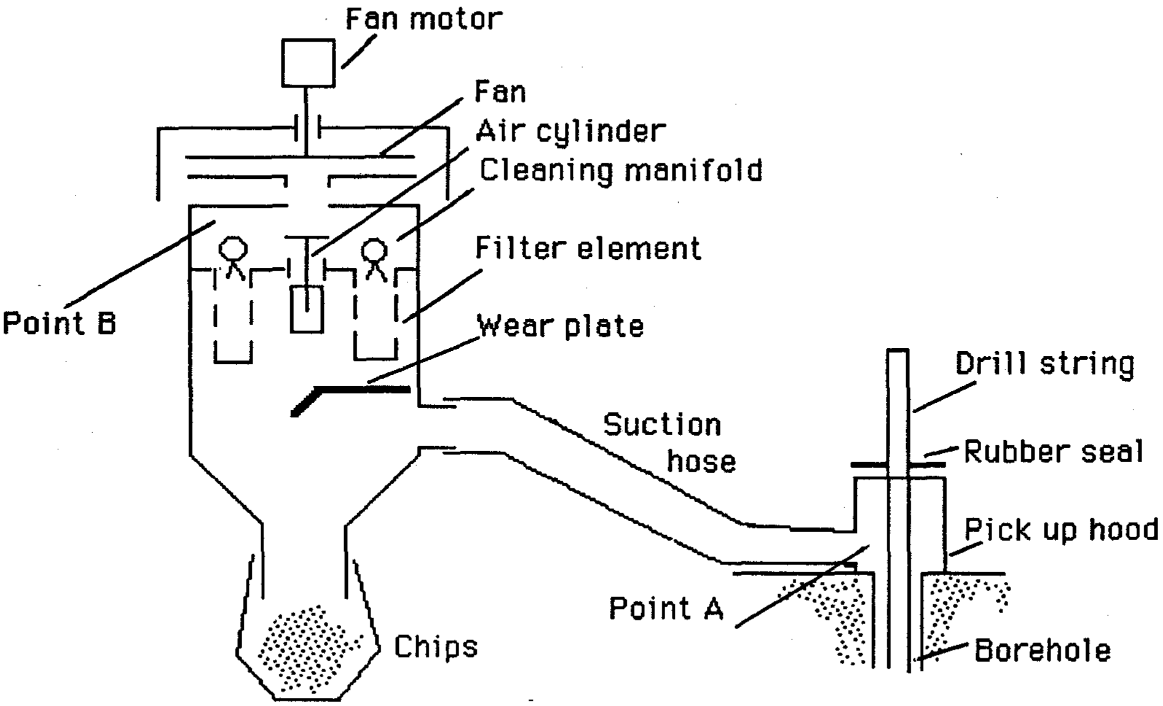


Cleaning cycle:

1. Pressure switch sends signal to the timer card when the rock drill is stopped.
2. Timer card activates solenoid valve N2 2 and the fan inlet is closed, which means no air passes through the filters
3. Timer card activates solenoid valve NQ 1 with a series of pulses. Altogether 10 pulses, 1 sec between them. As an option there is available Timer card with 3 sec. interval between pulses. The air blasts from the inside of the filters clean the filter surface.
4. After the ten pulses, solenoid valve N° 2 closes, the spring loaded air cylinder returns.
5. If drilling is started before the cleaning cycle is finished the built in pressure switch terminates the cleaning cycle.

C: The fan

The dust collecting system:



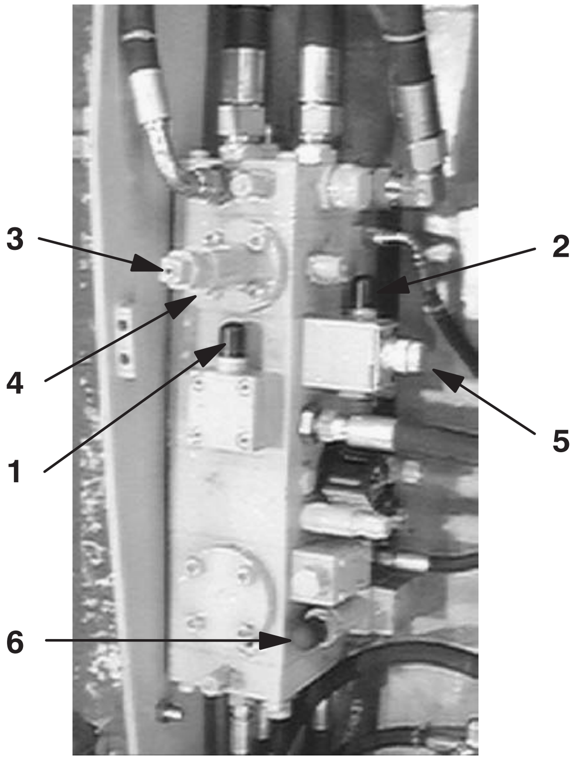
The fan pumps out the air from. the clean side of the filters thus creating a vacuum at Point B. During drilling air speed is higher at Point A than at Point B. The difference in speed forces the air (in this case the flushing air) to move from Point A to Point B.
The air volume moved depends on the pressure difference and the flow resistance between A and B.
As explained above it is necessary that the capacity of the dust collector is somewhat higher than the volume of the flushing air coming out of the bore hole

Summing up:

1. The fan capacity and the flow resistance through the dust collector give the volume of air that will pass through the dust collector.
2. This volume must be higher than the volume of the flushing air.
3. The air speed through the suction hose must be high enough (25 ni/sec +) to prevent fallout.
4. The rig hydraulic system must be able to deliver sufficient oil volume (measured in litters/minute) and oil pressure (in Bars) to run the fan motor at the required RPM’s.

ADJUSTMENT OF DRILLING AUTOMATISMS

LOCATION OF ADJUSTING SCREWS



1) V1 Feed pressure

This valve setting is made while setting up the machine on site, to suit bit type and diameter.

Presetting can be made in a static mode prior to drilling by feeding the bit against some resistance.

Final setting is made at full percussion power while drilling in the hardest, most homogeneous competent rock encountered.

2) MP Maximum percussion pressure

It sets the drifter maximum percussion pressure when drilling with cold oil while starting up.

This factory setting **must not be altered**.

3) V2 Operating percussion pressure

It sets the drifter percussion power to a suitable level for bit size and rock hardness. The setting should be approximately :

- 120 – 130 bar (1715– 1850 psi) for Hc 80
- 130 – 140 bar (1850 – 2000 psi) for Hc 120
- 140 – 160 bar (2000 – 2285 psi) for Hc 150

depending upon the appropriate drifter power level.

4) V3 Drifter power regulation

V3 measures actual feed force by sensing both forward and return feed pressures.

The V3 adjustment sets the feed pressure limit below which the drifter power will be reduced.

This control will continue to reduce the drifter power level to a 60 bar (870 psi) preset minimum as rock resistance decreases.

5) Feed flow regulator

This flow regulator adjusts the feed maximum flow to slightly above the drill rate in the hardest rock encountered.

If the feed flow while drilling in softer rock conditions reaches the preset maximum, the resulting back pressure makes the feed force to decrease and act on V3.

This acts as both an Anti–Void and Collaring Control.

6) V4 Progressive feed control and anti–jam

V4 is an adjustable regulator which senses the pressure differential across the rotation motor and acts directly upon feed flows.

As drilling torque exceeds the presetting, V4 spool begins to shift to reduce the feed flows. These restricted feed flows result in lower feed force and feed motion slows down. As a second step and separate from the V4 adjustment described, V3 lowers drifter percussion pressure in response to the feed force reduction.

Far above the V4 setting, feed motion will first stop and then reverse before the bit gets stuck.

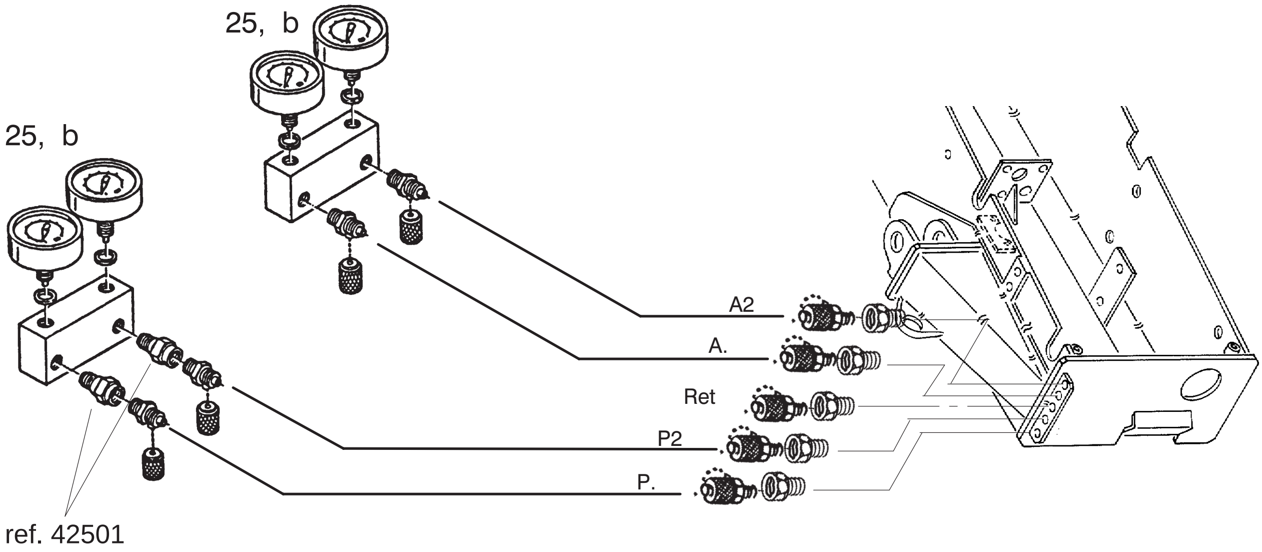
V4 setting is made just above normal drilling conditions to avoid reaction in homogeneous rock.

7) Flushing control valve

A flushing control valve will fully shift the V4 spool causing reverse feed motion when the bit is plugged. Drifter cycle operation clears the bit while the bit is retracting.

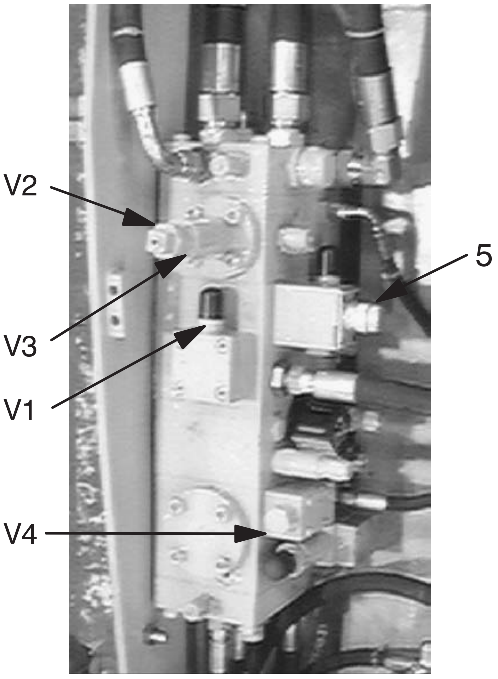
This feature is fully operative with reverse percussion drifters.

E.53734 PRESSURE GAUGES



Connect the pressure gauges with hydraulic dampers (ref. 42501) to the pulsating P1 and P2 circuits.
Connect the two other pressure gauges to the A1 and A2 feed circuits.

PRESETTING BEFORE DRILLING



Machine off:

12) Unlock safety nut and loosen V3 screw until the internal spring becomes free (V3 screw returns to free rotation).

13) Unlock safety nut and fully tighten V2 screw (hold V3 screw to prevent re−tightening).

14) Set the feed flow regulator 5 on position 10.

15) Remove V4 cap, and fully tighten V4 setting.

Machine running:

16) Press the bit against the rock by acting on feed lever.

17) Preset drilling feed pressure (V1 setting) to 80 − 100 bar (1140 − 1430 psi).

PRESETTING WHILE DRILLING

These settings must be carried out when oil has reached its normal operation temperature.

18) Start drilling (flushing, rotation, percussion, feed) **in homogeneous, non fractured rock** with drifter percussion control in “Auto” position.

19) Set the operating percussion pressure to
− 140 − 155 bar (2000− 2215 psi) for Hc 150
(or less depending of the bit size, rod diameters, rock hardness...) by loosening V2 screw. Check the pressure on “P2” gauge.

20) By acting on V1 screw, reset feed pressure for correct coupling motion : about 1 millimeter vibration and coupling temperature less than 100° C.

Control simultaneously penetration rate and coupling temperature.

If coupling temperature is above limit although coupling vibration is correct, reduce operating percussion pressure by tightening V2 screw.

SETTING WHILE DRILLING

Adjust flow regulator on feed return A2

21) While drilling the starter rod (or the rod drilled at the highest drilling rate) progressively close the flow regulator 5 until the feed back−pressure reaches 5 bar (check the pressure on “A2” gauge).

22) Then, re−open the flow regulator 5 by 1 division.

For example : if position 6 creates 5 bar back pressure, re−open the flow regulator to position 7.

V3 drifter power regulator setting

This setting must be carried out when drilling conditions allow maximum percussion pressure and actual feed force (i.e. hard, non fractured rock, feed back pressure “A2” = 0 bar).

23) With a wrench, hold V2 screw in position.

24) Tighten V3, until percussion pressure drops (check the pressure on “P2” gauge).

25) Loosen so as to recover the initial pressure plus an additional 1/4 turn.

26) While drilling with drifter percussion control alternatively in “Auto” and “Manual” positions, verify that the percussion pressure remains the same.

27) Secure all locking nuts.

V4 – Progressive feed control setting.

28) While drilling the last rod (or the rod drilled with the highest rotation torque) **in homogeneous ground**, loosen V4 setting until the feed back pressure slightly increases (check the pressure on “A2” gauge).

29) Then re−tighten V4 setting for 1 turn.

Air flushing valve

While drilling with the drifter percussion control in “auto” position, switch off air flushing and check the drifter reverses.

EXCEPTIONAL ADJUSTMENTS

Reverse percussion pressure

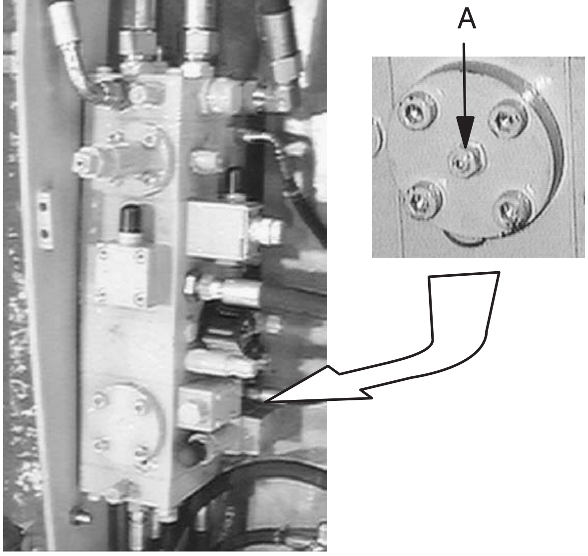
Note : The full drifter reverse percussion pressure is only obtained when drilling in “manual” position.

The factory set pressure (130 bar – 1860 psi) can be modified by setting the stop screw A :

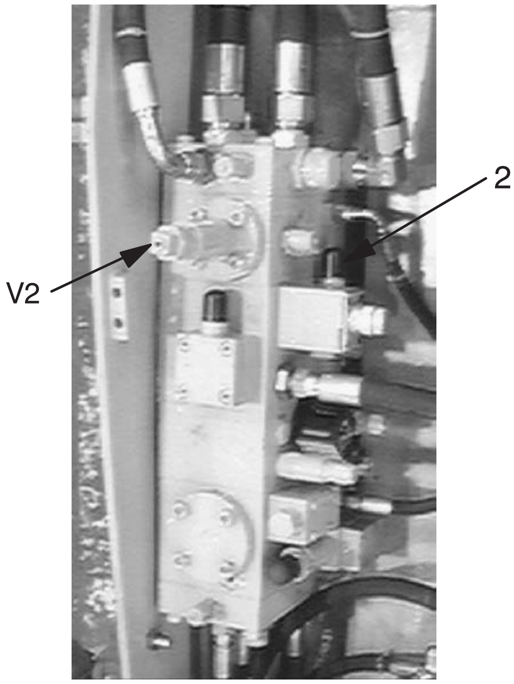
−e Tighten to reduce the pressure.
−e Loosen to increase.

Check the pressure on “P2” gauge.

Do not exceed 130 bar (1860 psi)



Maximum percussion pressure



For checking or setting after part replacement,

1)e Disconnect and plug the drifter percussion hose.

2)e Remove the protection cap and loosen MP maximum percussion pressure relief valve (2).

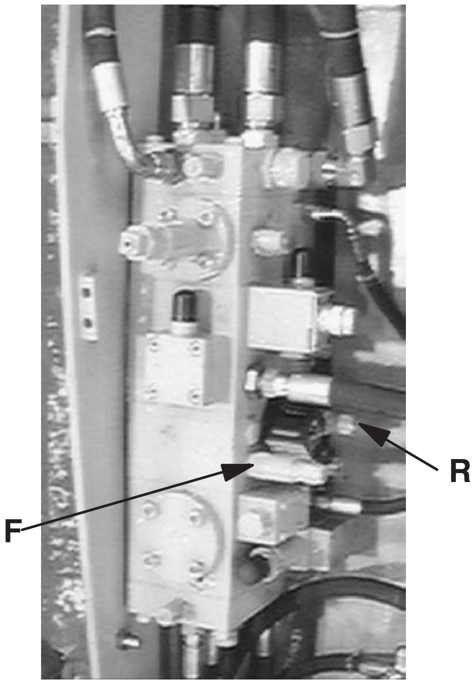
30) Set the maximum percussion pressure to 190 bar (2720 psi) by tightening the relief valve (2). Check the pressure on “P2” gauge.

31) Secure the safety nut, remount the protection cap.

THREAD COUPLING/UNCOUPLING ADJUSTMENTS

The drifter displacement, during thread coupling/uncoupling operations, must be synchronized with the rotation speed in accordance with the thread pitch.

The drifter rotation/displacement synchronization is obtained by controlling the drifter speed by means of 2 flow limiters located on the drilling automatism block.

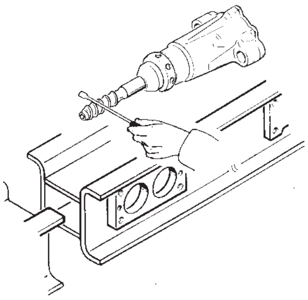


The flow regulator F controls the drifter forward speed.

The flow regulator R controls the drifter reverse speed.

Thread coupling synchronization

The verification of the synchronized drifter displacement/rotation is done by checking the displacement of a screwdriver placed in the shank thread.



Rest the hand holding the screwdriver on the guide.

Place the screwdriver in the thread.

Ask a helper to operate the rod changer manipulator lever in thread coupling position.

The synchronization is correct if the screwdriver remains in position (the drifter displacement corresponds exactly to the thread pitch).

If the screwdriver tends to move up or down, adjust the drifter displacement by setting the flow regulator F:

– The drifter displacement is too fast, loosen the setting F.

– The drifter displacement is too slow, tighten the setting F.

Thread uncoupling synchronization

The checking procedure is the same, but, operate the rod changer lever in thread uncoupling position and set the flow regulator R :

– Tighten the setting R if the drifter displacement is too fast,

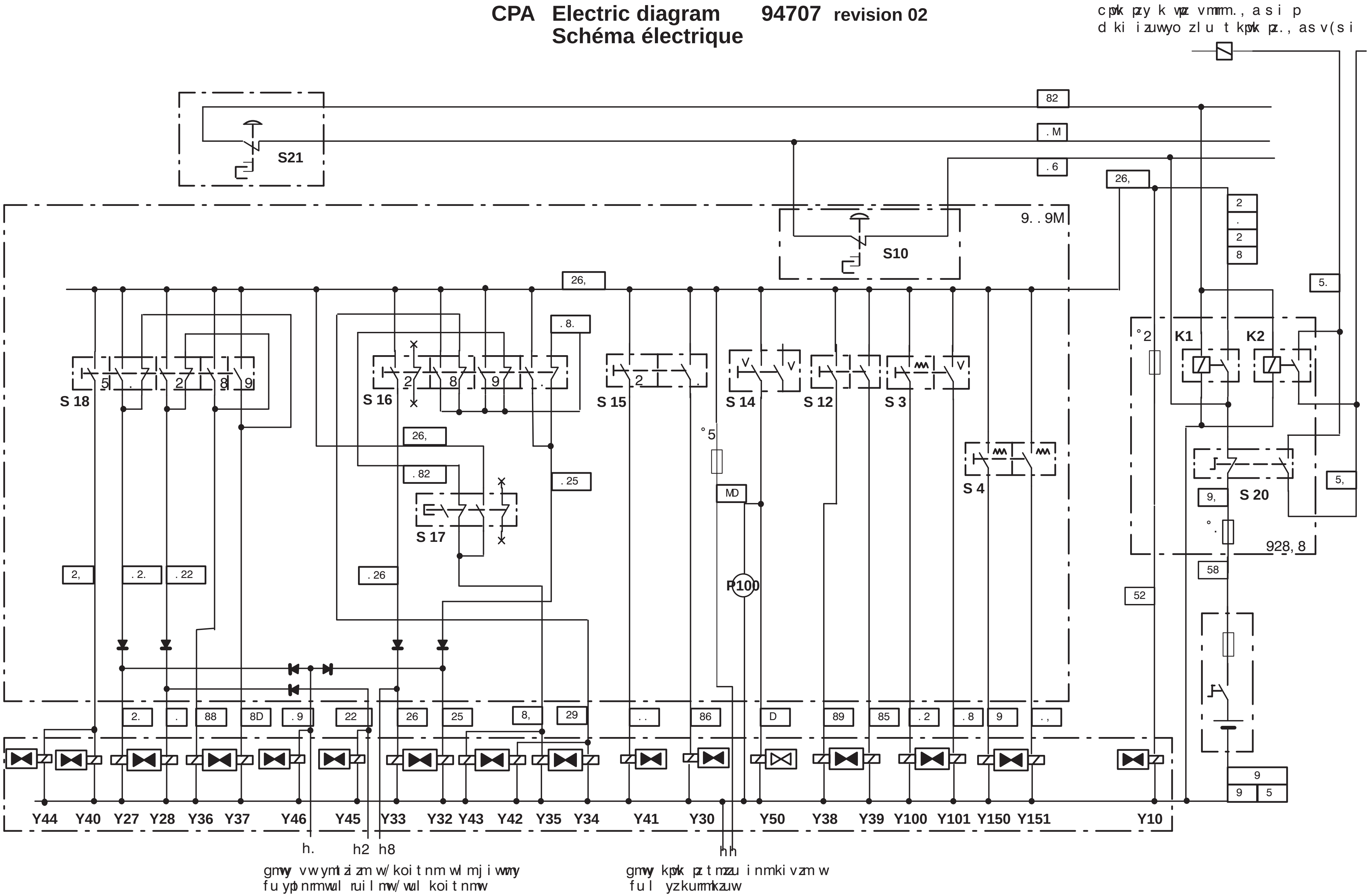
– Loosen the setting R if the drifter displacement is too slow.

9045

GROUP 20

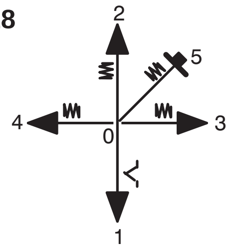
DIAGRAMS

CPA **Electric diagram** **94707** **revision 02**
Schéma électrique



CPA Electric diagram / Schéma électrique 94707 revision 02

S 18



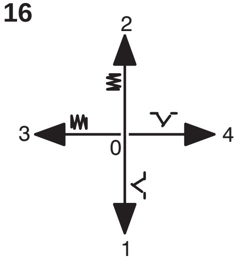
1	Avance foration	Feed forward
1+5	Avance amorçage	Feed for collaring
2	Recul dévissage	Feed backward (thread uncoupling)
2+5	Recul lent	Feed forward
3	Avance rapide	Fast feed forward
4	Recul rapide	Fast feed backward

Contact	Position						
	1	1+5	2	2+5	3	4	0
121–37			X	X	X	X	X
260–121	X	X					
122–33	X	X			X	X	X
260–122			X	X			
260–33						X	
260–37					X		
260–20		X		X			

S 17

0	Repos	Off
1	Rotation inverse + frappe	Reverse rotation + hammering

S 16



1	Rotation	Rotation
2	Rotation inverse	Reverse rotation
3	Foration sans automatismes	Drilling without automatisms
4	Foration avec automatismes	Drilling with automatisms

Contact	**S 17**		**S 16**				
	0	1	1	2	3	4	0
260–126				X			
260–30		X					
132–30	X						
131–125				X	X	X	X
131–132			X	X	X		X
260–131					X	X	
260–125			X				
131–29			X	X		X	X

Wiring chart

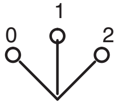
Grille numérotation filerie

Ten's

Dizaines

	0	1	2	3	4	5	6	7	8	9
0		X	X	X	X	X	X	X	X	X
1	X	X	X	X			X		X	X
2	X	X	X			X	X			X
3	X		X	X	X	X	X	X		
4	X									
5	X	X	X	X						
12		X	X			X	X			
13		X								
26	X									

S 15



0	Repos	Off
1	HP	HP
2	HP + capteur	HP + dust collector

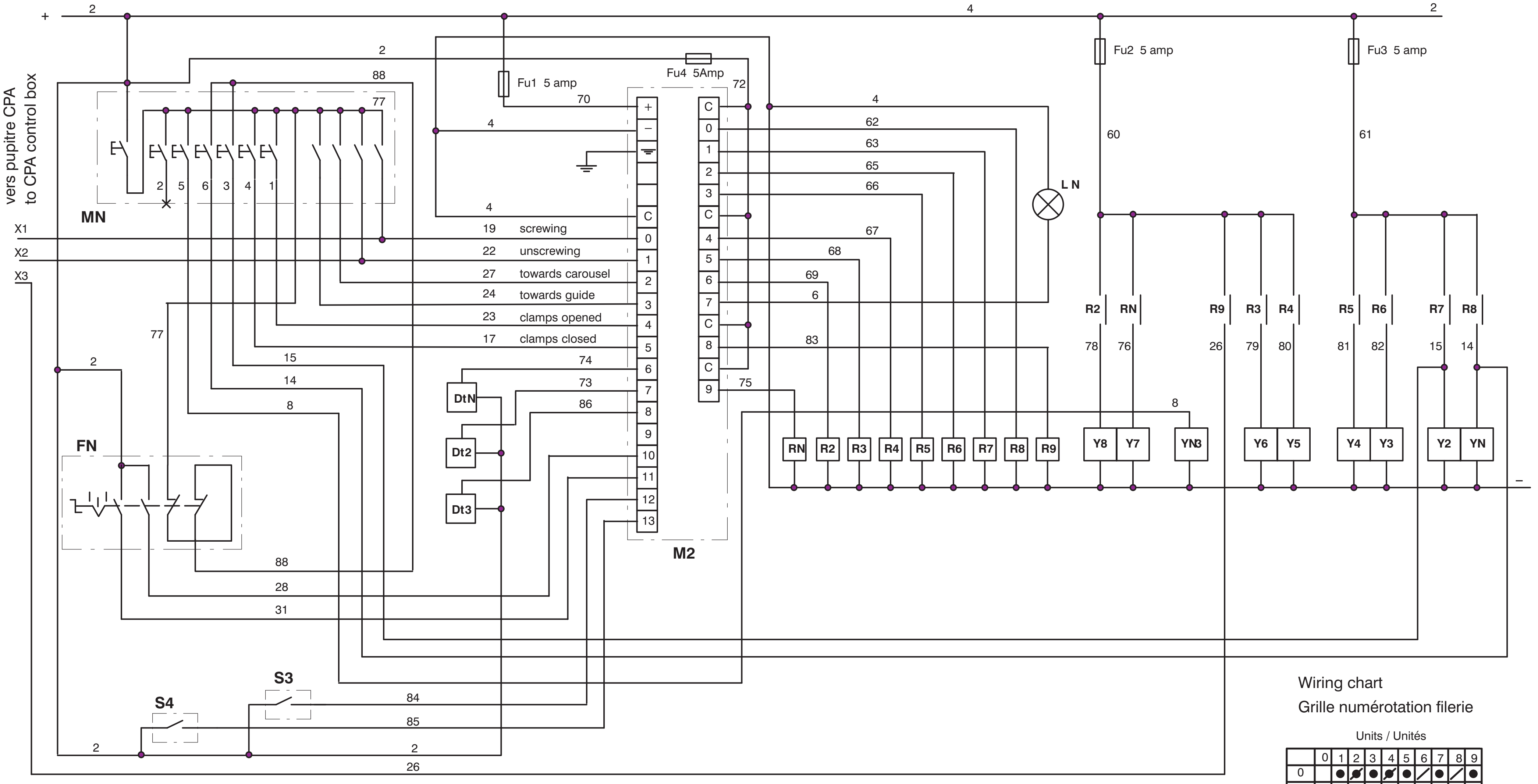
Contact	Position		
	0	1	2
260–11			X
260–36		X	

Schéma électrique : 94707
Electric diagram : 86480910

Item	CPN	Ref.	Qty	Part name	Désignation	Page
F1	86340197	66840	1	15 Amp. fuse	Fusible 15 A	
	86328234	+ 61972		Fuse holder	Porte fusible	
F2	86220670	65011	1	3.15 Amp. fuse	Fusible 3,15 A	
	86328234	+61972		Fuse holder	Porte fusible	
F5	86367455	78349	1	5 Amp. fuse	Fusible 5 A	
P100	86350709	72088	1	Hourmeter	Horamètre	
S3	86300118	48557	1	Electric manipulator (hydraulic centralizer)	Manipulateur électrique (lunette)	
S4	86420924	93842	1	Electric manipulator (dust hood)	Manipulateur électrique (tête de captage)	
S10	86223674	32095	1	Emergency stop	Arrêt d’urgence	
S12	86223633	48198	1	Electric manipulator (swing cylinder)	Manipulateur électrique (vérin d’orientation)	
S14	86330859	62917	1	Electric manipulator (air flushing)	Manipulateur électrique (injection d’air)	
S15	86333804	64348	1	Electric manipulator (HP + dust collector)	Manipulateur électrique (HP + capteur de poussières)	
S16	86391935	84550	1	Electric manipulator (drilling)	Manipulateur électrique (foration)	
S17	86221785	49130 +	1	Electric manipulator (Bit release)	Manipulateur électrique (déblocage taillant)	
	86223682	49634		Additionnal switch	Contact auxiliaire	
S18	86377991	81033	1	Electric manipulator (feed)	Manipulateur électrique (avanceur)	
S20	86289931	42904	1	Selector (excavator/CPA)	Commutateur pelle/CPA	
S21	86415650	90880	1	Emergency stop	Arrêt d’urgence	
Y10				CPA oil supply valve (to be supply locally)	Alimentation CPA (non fournie)	
	86390291	84100	1	Solenoid valve	Electro–distributeur	
Y27				feed forward	avance	
Y28				reverse feed	recul	
	86476413	94547	1	Solenoid valve	Electro–distributeur	
Y32				drifter rotation	rotation à gauche	
Y33				reverse rotation	rotation à droite	
	86476421	94548	2	Solenoid valve	Electro–distributeur	
Y34–Y42				drifter percussion	frappe perforateur	
Y35–Y43				percussion without automatisms	frappe sans automatismes	
	86476421	94548	1	Solenoid valve	Electro–distributeur	
Y36				fast feed forward	recul rapide	
Y37				fast reverse feed	avance rapide	
	86222007	43736	1	Solenoid valve	Electro–distributeur	
Y38				swing cylinder	vérin d’orientation	
Y39				swing cylinder	vérin d’orientation	
Y40	86411642	89757		Solenoid valve (hole collaring)	Electro–distributeur (amorçage)	

Item	CPN	Ref.	Qty	Part name	Désignation	Page
Y41	86355435	74209		Solenoid valve (dust collector)	Electro–distributeur (capteur de poussières)	
Y30	86355435	74209		Solenoid valve (HP)	Electro–distributeur (HP)	
Y50	86330776	62888		Solenoid valve (air flushing)	Electro–distributeur (injection d’air)	
	86222007	43736	1	Solenoid valve	Electro–distributeur	
Y100				hyd. centralizer opening	ouverture lunette hyd.	
Y101				hyd. centralizer closing	fermeture lunette hyd	
	86222007	43736	1	Solenoid valve	Electro–distributeur	
Y150				dust hood down	descente tête de captage	
Y151				dust hood up	montée tête de captage	
Y44	86300274	48678		Solenoid valve (colllaring air)	Electro–distributeur (injection d’amorcage)	
Y45	86418431	93492		Solenoid valve (uncoupling)	Electro–distributeur (retour synchro)	
Y46	86418449	93493		Solenoid valve (coupling)	Electro–distributeur (avance synchro)	

Rod changer Electric diagram 9483N revision C
Schéma électrique



Wiring chart

Grille numérotation filerie

Units / Unités

Ten's

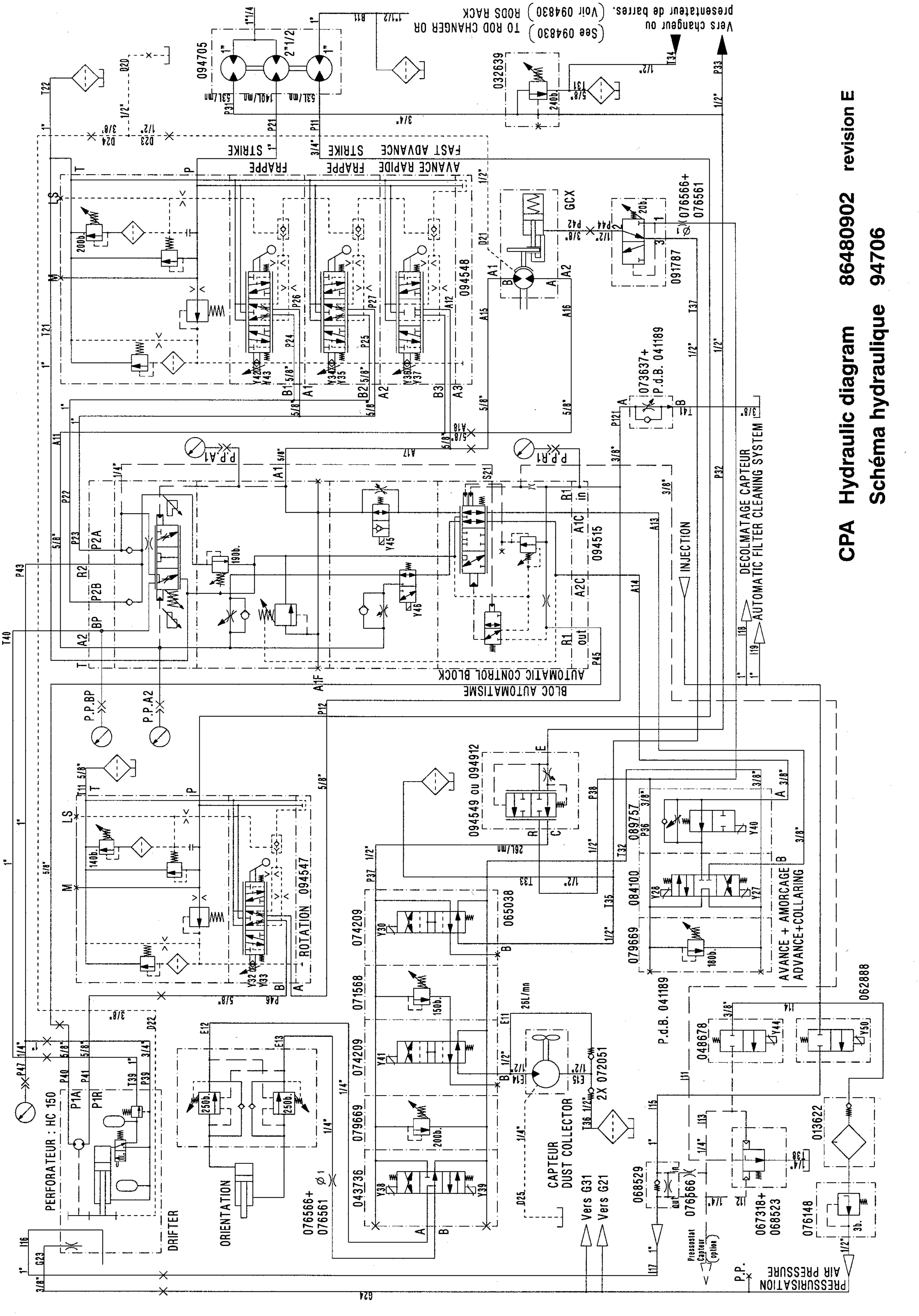
Dizaines

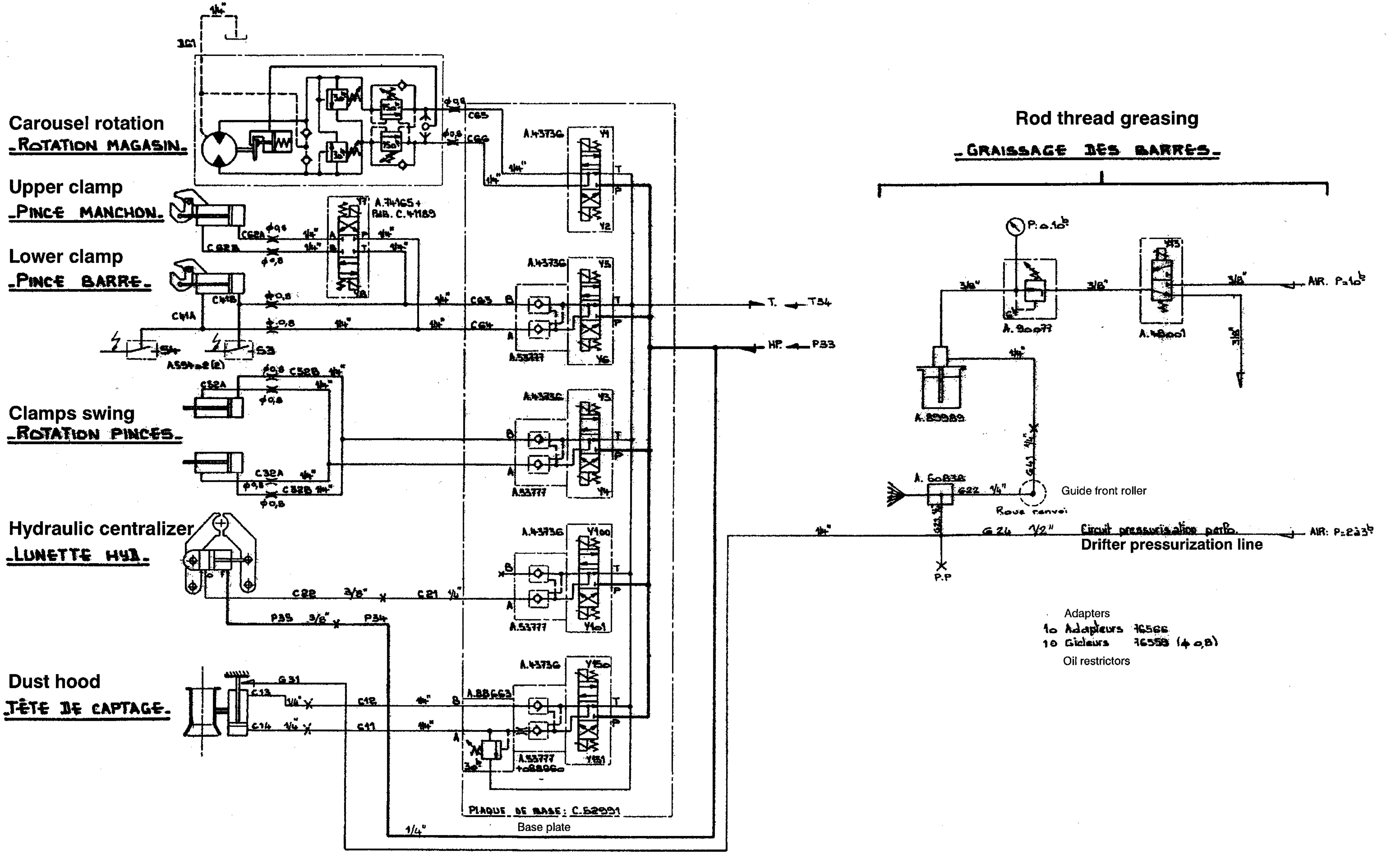
	0	1	2	3	4	5	6	7	8	9
0		●	●/	●	●/	●	/	●	/	●
1	●	●	●	●	/	/	●	/	●	●/
2	●	●	●/	/	/	●	●/	/	/	●
3	●	/	●	●	●	●	●	●		
4	●									
5	●	●	●	●						
6	/	/	/	/		/	/	/	/	/
7	/	/	/	/	/	/	/	/	/	/
8	/	/	/	/	/	/	/		/	

● = CPA / = Rod changer
Changeur

Schéma électrique : 94831
Electric diagram : 86482817

Item	CPN	Ref.	Qty	Part name	Désignation	Page
Fu1	86367455	78349	1	5 Amp. fuse	Fusible 5 A	
Fu2	86367455	78349	1	5 Amp. fuse	Fusible 5 A	
	86397783	+85927		Fuse holder	Porte fusible	
Fu3	86367455	78349	1	5 Amp. fuse	Fusible 5 A	
Fu4	86367455	78349	1	5 Amp. fuse	Fusible 5 A	
M1	86481199	94726	1	Electric manipulator (rod changer)	Manipulateur électrique (changeur de barres)	
M2	86449594	94201	1	PLC	Automate programmable	
F1	86481215	94728	1	Knob	Bouton	
	86481223	+94729	1	Complete body	Corps complet	
	86348133	+70944	1	Additional switch	Bloc additif	
	86348059	+70889	1	Additional switch	Bloc additif	
S3	86322427	59402	1	Pressure switch	Manostat	
S4	86322427	59402	1	Pressure switch	Manostat	
Dt1	86482700	94816	1	Inductive switch	Détecteur de proximité	
Dt2	86482700	94816	1	Inductive switch	Détecteur de proximité	
Dt3	86482791	94828	1	Inductive switch	Détecteur de proximité	
L1	86342276	67902	1	Indicator	Voyant	
	86256450	+22176	1	Bulb	Ampoule	
R1 to R9	86482684	94814	9	Relay	Relais	
	86355245	74165	1	Solenoid valve	Electro–distributeur	
Y7 Y8				upper and lower clamps opening/closing inversion	inversion ouverture/fermeture des pinces hautes et basses	
Y13	86299492	48001	1	Solenoid valve	Electro–distributeur	
				rod thread lubrication	graissage	
	86222007	43736	1	Solenoid valve	Electro–distributeur	
Y6				clamps closing	fermeture pinces	
Y5				clamps opening	ouverture pinces	
	86222007	43736	1	Solenoid valve	Electro–distributeur	
Y4				clamps swing towards guide	rotation des pinces vers glissière	
Y3				clamps swing towards carousel	rotation des pinces vers magasin	
	86222007	43736	1	Solenoid valve	Electro–distributeur	
Y2				carousel rotation	rotation du magasin	
Y1				carousel rotation	vérin d’orientation	


CPA Hydraulic diagram 86480902 revision E
Schéma hydraulique 94706
TO ROD CHANGER OR RODS RACK (See 094830)
Vers changeur ou presentateur de barres. (Voir 094830)
094705
032639
FRAPPE
STRIKE
AVANCE RAPIDE
FAST ADVANCE
094548
GCX
091787
076566+
076561
073637+
P.d.B. 041189
P.P.A1
P.P.R1
094515
AUTOMATIC CONTROL BLOCK
BLOC AUTOMATISME
INJECTION
DECOLMATAGE CAPTEUR
AUTOMATIC FILTER CLEANING SYSTEM
P.P.BP
P.P.A2
094549 ou 094912
ROTATION 094547
089757
084100
079669
AVANCE + AMORCAGE
ADVANCE+COLLARING
P.d.B. 041189
074209
065038
071568
074209
079669
043736
076566+
076561
PERFORATEUR : HC 150
DRIFTER
ORIENTATION
CAPTEUR
DUST COLLECTOR
2X 072051
Vers G31
Vers G21
048678
062888
013622
067318+
068523
068529
076566
076148
Pressostat Capteur (option)
P.P.
PRESSURISATION
AIR PRESSURE



Rod changer Hydraulic diagram 86482825 94830 revision C

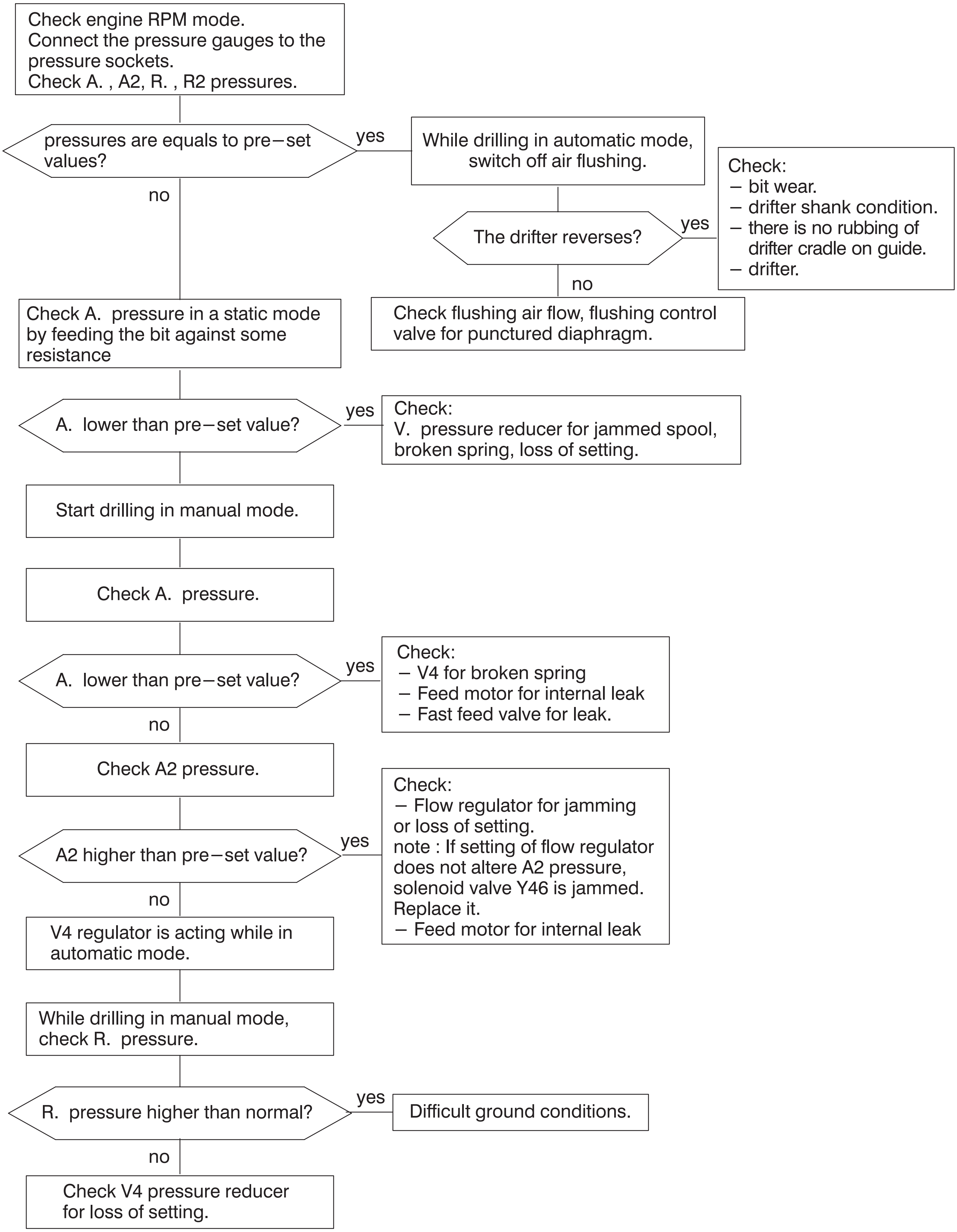
Schéma hydraulique 94830

9045

GROUP 25

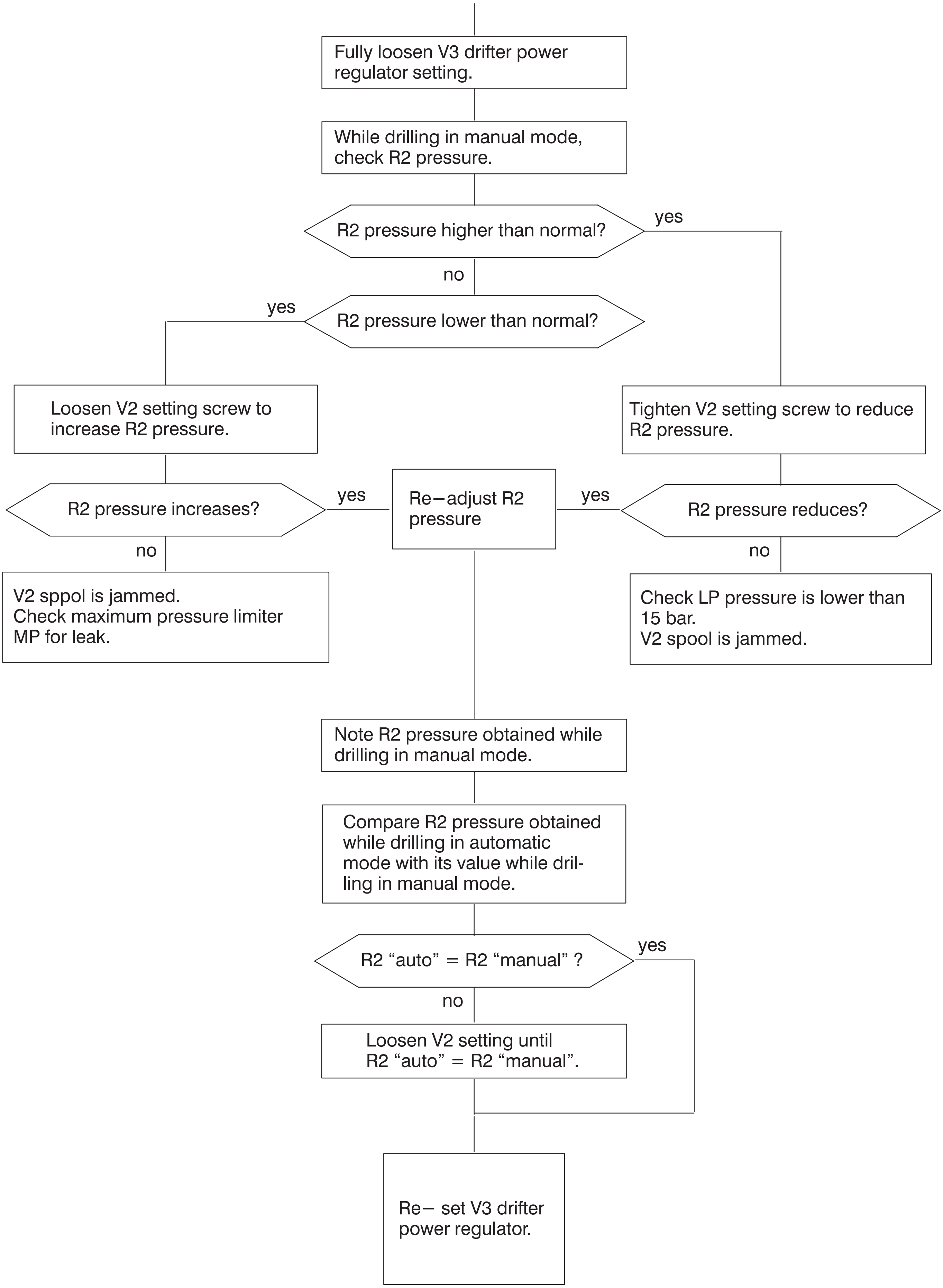
TROUBLESHOOTING

Too low penetration rate



to be continued on next page.

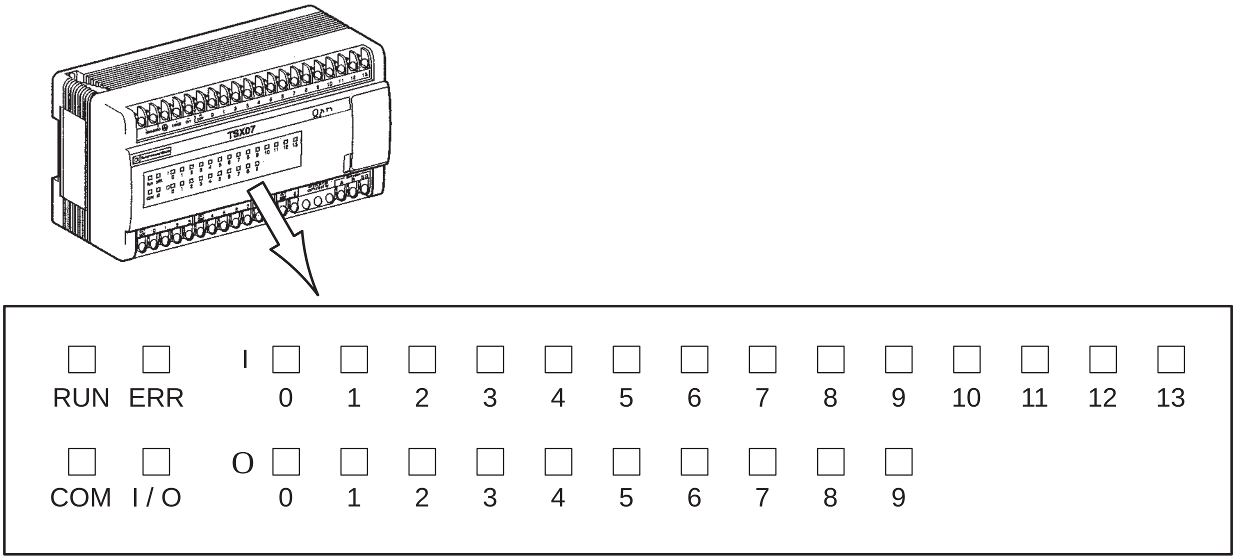
Too low penetration rate (cont'd)



Problem	Possible reasons
1) Important vibration of drifter hoses	P2 hose : Deflated or punctured HP accumulators. LP, P2 hoses : Deflated or punctured LP accumulator.
2) Overheating on drifter front part	Check : – Pressurization circuit – Air pressure reducer. – Oiler. – Feed pressure if too low.
3) Coupling sleeve overheating, important vibration level or erratic motion.	Feed pressure too low. Increase feed pressure. If unsuccessful, check : – Bit wear – Flushing (insufficient) – Rubbing of drifter cradle on guide – Feed motor if internal leak.
4) Rotation speed irregular or too low.	If rotation back to normal while drilling in manual mode, check rotation circuit relief valve setting. If still irregular while drilling in manual mode, check the drifter rotation motor for internal leak.

CHECKING OF PLC

The result of PLC auto–test and the state of each input / output can be visualized on the front panel of the PLC.



Auto–test

The “RUN” indicator must be alight when the CPA is under tension.

“ERR”, “COM” and “I / O” indicators must be off.

If not, the PLC is faulty and must be replaced (be sure all fuses are OK).

Inputs / outputs

Input indicators (I 0 to I 13) or output indicators (O0 to O9) are alight when the corresponding input / output is active.

CHECK LIST

Follow the check list to determine if all input and output information are entering and leaving the PLC properly.

State (alight or off) of the indicators must be conform to the list. If not, check the input / output wiring and components (refer to electric diagrams 94707 and / or 94831).

Note : some other indicators should be alight or off at the same time, only consider the state of the listed one.

Prior proceeding the following tests, remove the starter rod from the guide and make sure the drifter is pulled back.

Note: If the carousel rotation is working in manual mode but not in automatic mode (rod adding or rod removing) , check the output indicators O0 or O1 are alight (depending of the carousel direction of rotation).

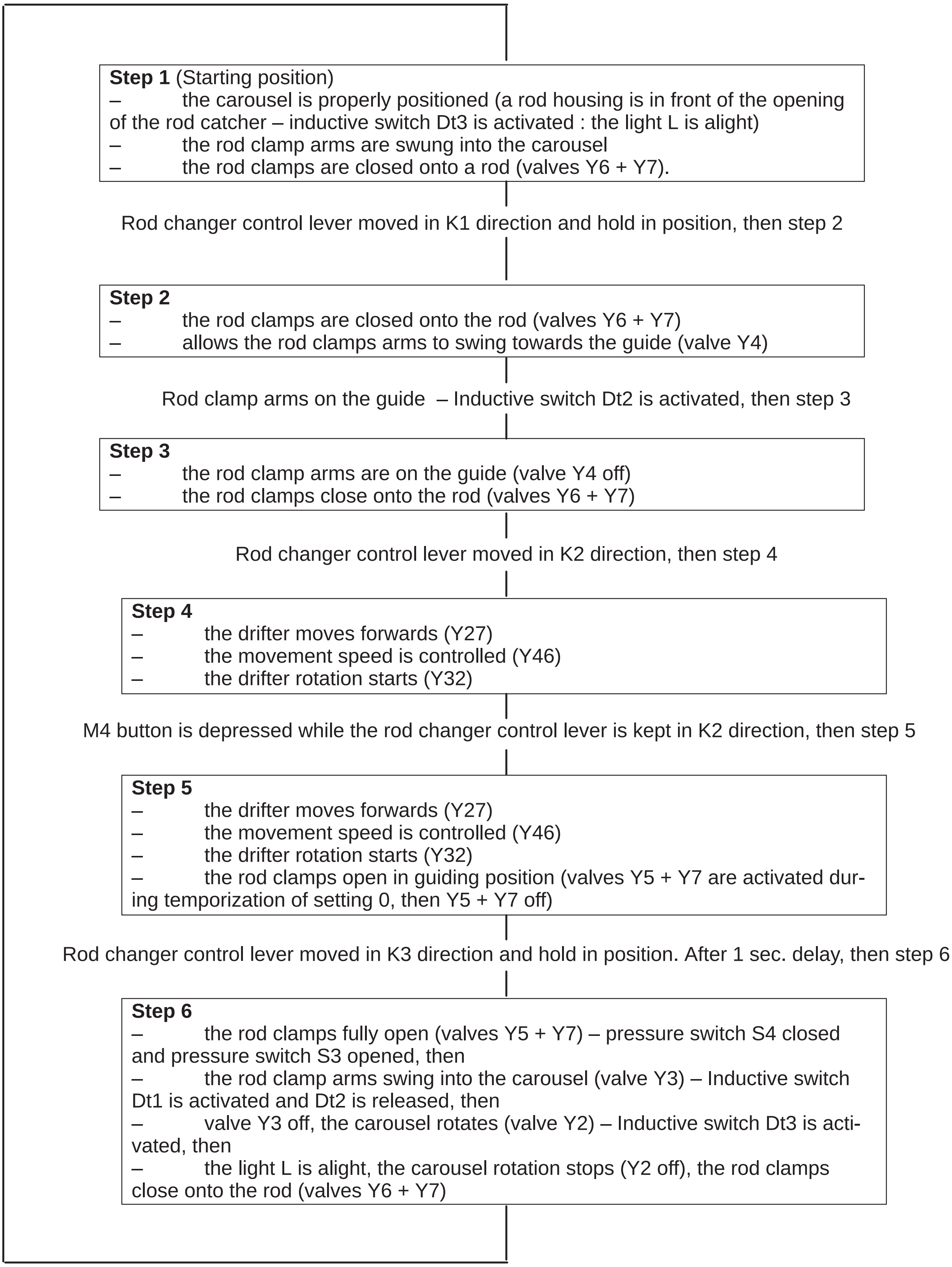
Troubleshooting procedure for rod changer

	Action or control position	Indicator “alight”	Indicator “Off”	Comments
1	None		I9	
2	Selector mode in rod adding position (S1)	I10	I11	
3	Selector mode in rod removing position (S2)	I11	I10	
4	Selector mode in manual position (S0)		I10 , I11	
For the following test, the selector mode will be kept in manual mode (position S0)				
5	Carousel positioned for rod adding or rod removing (rod housing in front of the opening of the rod catcher).	I8		I8 “off”, check inductive switch Dt3 mounted on upper support close to the reducer.
		O7		Indicator L should be alight
6	Rod clamp arms swung into the carousel	I6		I6 “off”, check inductive switch Dt1 mounted on the lower clamp support.
			I7	I7 alight, check inductive switch Dt2 mounted on the lower clamp support (close to the guide).
7	Depress M4 button (Upper and lower rod clamps opening)	I4	I5	I5 alight, check the wiring for short cut.
		O4 , O9	O5 , O6	
8	Rod clamps opened. Depress M4 button.	I4 , I13	I5 , I12	If I12 stays alight, screw in S4 pressure switch setting.
		O4 , O9	O5 , O6	
9	Depress M1 + M4 buttons (Upper rod clamp opening, lower rod clamps closing)	I4 , I5		
		O5 , O6	O9	
11	Depress M1 button (Upper and lower rod clamps closing)	I5	I4	I4 alight, check the wiring for short cut.
		O5 , O9	O4 , O6	
11	Rod clamps closed onto a rod. Depress M1 button	I5 , I12	I4 , I13	If I13 stays alight, screw in S3 pressure switch setting.
		O5 , O9	O4 , O6	
12	Move the the rod changer control lever in K1 direction (rod clamp arms swing towards the guide)	I3	I2	I2 alight, check the wiring for short cut.
		O3	O2	
13	Rod clamps arms on the guide	I7		I7 “off”, check inductive switch Dt2 mounted on the lower clamp support.
			I6	I6 alight, check inductive switch Dt1 mounted on the lower clamp support (close to the guide).
14	Pull and hold the rod changer control lever in K2 direction (rod coupling)	I0	I1	I1 alight, check the wiring for short cut.
15	Push and hold the rod changer control lever in K4 direction (rod uncoupling)	I1	I0	I0 alight, check the wiring for short cut
		O8		O8 indicator is alight after 1 sec. delay.
16	Move the the rod changer control lever in K3 direction (rod clamp arms swing into the carousel)	I2	I3	I3 alight, check the wiring for short cut.
		O2	O3	

Troubleshooting procedure for rod changer

SEQUENCE DESCRIPTION

Rod adding (selector mode on S1 position)



Step 1 (Starting position)
– the carousel is properly positioned (a rod housing is in front of the opening of the rod catcher – inductive switch Dt3 is activated : the light L is alight)
– the rod clamp arms are swung into the carousel
– the rod clamps are closed onto a rod (valves Y6 + Y7).

Rod changer control lever moved in K1 direction and hold in position, then step 2

Step 2
– the rod clamps are closed onto the rod (valves Y6 + Y7)
– allows the rod clamps arms to swing towards the guide (valve Y4)

Rod clamp arms on the guide – Inductive switch Dt2 is activated, then step 3

Step 3
– the rod clamp arms are on the guide (valve Y4 off)
– the rod clamps close onto the rod (valves Y6 + Y7)

Rod changer control lever moved in K2 direction, then step 4

Step 4
– the drifter moves forwards (Y27)
– the movement speed is controlled (Y46)
– the drifter rotation starts (Y32)

M4 button is depressed while the rod changer control lever is kept in K2 direction, then step 5

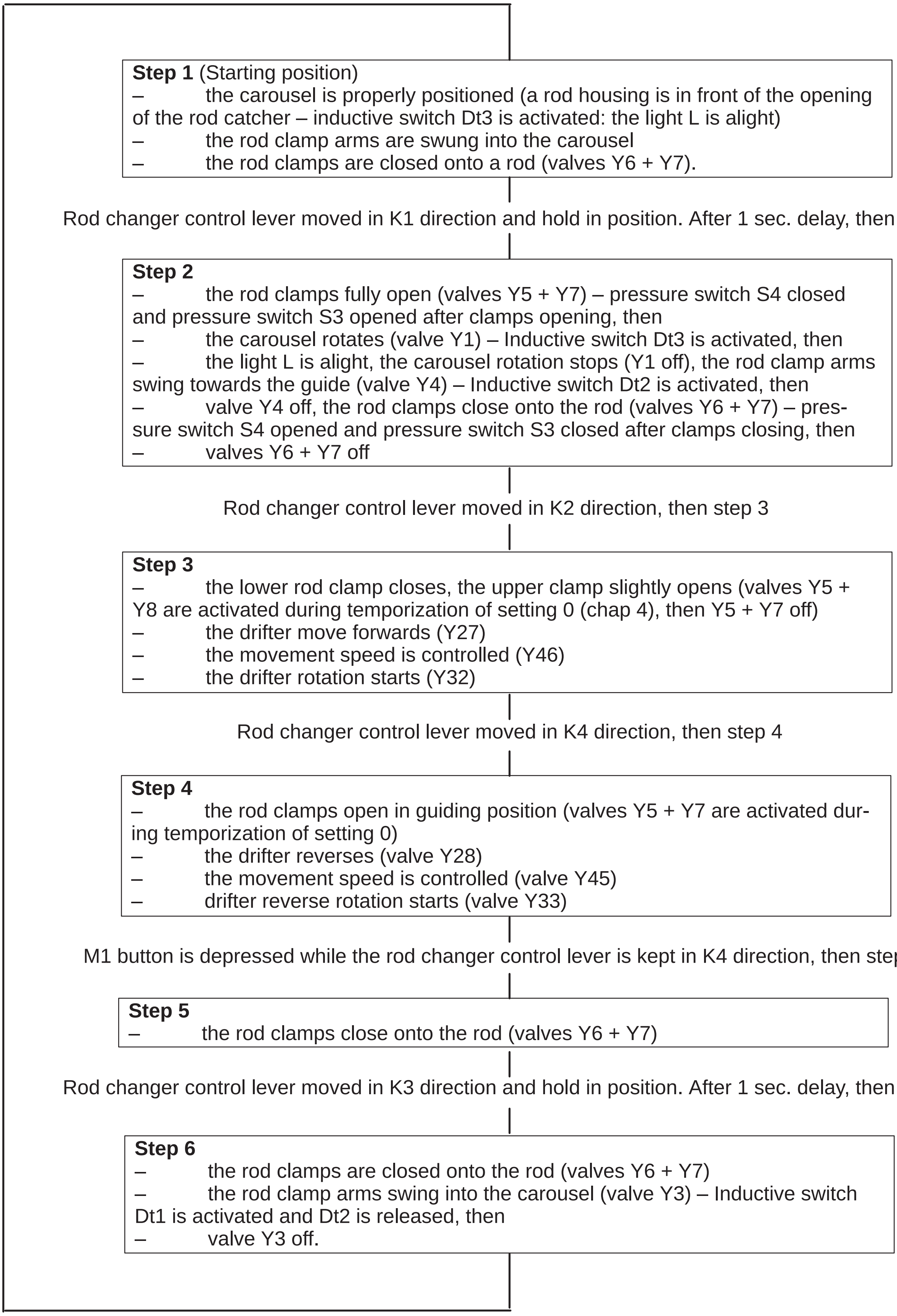
Step 5
– the drifter moves forwards (Y27)
– the movement speed is controlled (Y46)
– the drifter rotation starts (Y32)
– the rod clamps open in guiding position (valves Y5 + Y7 are activated during temporization of setting 0, then Y5 + Y7 off)

Rod changer control lever moved in K3 direction and hold in position. After 1 sec. delay, then step 6

Step 6
– the rod clamps fully open (valves Y5 + Y7) – pressure switch S4 closed and pressure switch S3 opened, then
– the rod clamp arms swing into the carousel (valve Y3) – Inductive switch Dt1 is activated and Dt2 is released, then
– valve Y3 off, the carousel rotates (valve Y2) – Inductive switch Dt3 is activated, then
– the light L is alight, the carousel rotation stops (Y2 off), the rod clamps close onto the rod (valves Y6 + Y7)

Troubleshooting procedure for rod changer

Rod removing (selector mode on S2 position)



Step 1 (Starting position)

– the carousel is properly positioned (a rod housing is in front of the opening of the rod catcher – inductive switch Dt3 is activated: the light L is alight)
– the rod clamp arms are swung into the carousel
– the rod clamps are closed onto a rod (valves Y6 + Y7).

Rod changer control lever moved in K1 direction and hold in position. After 1 sec. delay, then step 2

Step 2

– the rod clamps fully open (valves Y5 + Y7) – pressure switch S4 closed and pressure switch S3 opened after clamps opening, then
– the carousel rotates (valve Y1) – Inductive switch Dt3 is activated, then
– the light L is alight, the carousel rotation stops (Y1 off), the rod clamp arms swing towards the guide (valve Y4) – Inductive switch Dt2 is activated, then
– valve Y4 off, the rod clamps close onto the rod (valves Y6 + Y7) – pressure switch S4 opened and pressure switch S3 closed after clamps closing, then
– valves Y6 + Y7 off

Rod changer control lever moved in K2 direction, then step 3

Step 3

– the lower rod clamp closes, the upper clamp slightly opens (valves Y5 + Y8 are activated during temporization of setting 0 (chap 4), then Y5 + Y7 off)
– the drifter move forwards (Y27)
– the movement speed is controlled (Y46)
– the drifter rotation starts (Y32)

Rod changer control lever moved in K4 direction, then step 4

Step 4

– the rod clamps open in guiding position (valves Y5 + Y7 are activated during temporization of setting 0)
– the drifter reverses (valve Y28)
– the movement speed is controlled (valve Y45)
– drifter reverse rotation starts (valve Y33)

M1 button is depressed while the rod changer control lever is kept in K4 direction, then step 5

Step 5

– the rod clamps close onto the rod (valves Y6 + Y7)

Rod changer control lever moved in K3 direction and hold in position. After 1 sec. delay, then step 6

Step 6

– the rod clamps are closed onto the rod (valves Y6 + Y7)
– the rod clamp arms swing into the carousel (valve Y3) – Inductive switch Dt1 is activated and Dt2 is released, then
– valve Y3 off.

TIMER SETTING

The delays required for:

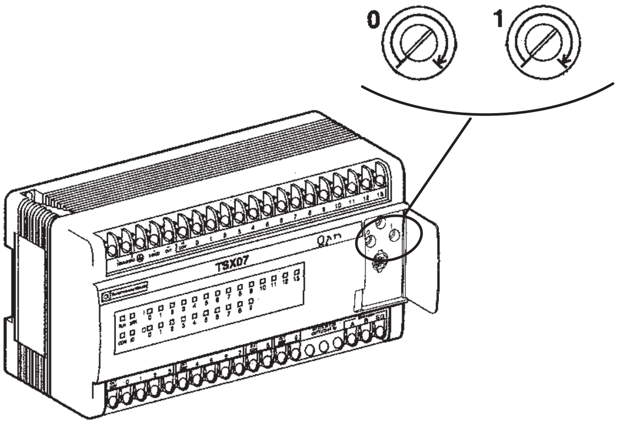
– allowing the opening of the upper clamp to allow re–tightening of the upper coupling before unscrewing a rod (when removing a rod), or reduced opening of the upper and lower clamps for guiding the rod during screwing in the coupling held in the centralizer (when adding a rod),

– controlling the detection of the carousel rotation disregarding the direction of the movement,

are set by acting on the 2 small potentiometers of the PLC.

Setting 0, adjusts the time for clamp opening in guiding position (setting range O to 200 millisecond).

Setting 1, adjust the delay for the detection of the carousel rotation (setting range O to 100 millisecond).



These settings should be re–adjusted according to the variation of the oil viscosity which in winter will reduce the speed of the movements.

TROUBLE SHOOTING HYDRAULIC DUST COLLECTOR

If your dust collector performance is inefficient though maintained daily, check the following:

1 Check suction hose for blockages. Clean any water or dirt from hose.

2. Check rubber dump valve (or plastic sack). If wom or otherwise damaged, change to a new one.

3. Check that compressor gives OIL FREE AIR at recommended pressure 7-12 bar (100- 172 PSi) for the filter cleaning.

4.Pressure indicating switch

Pressure switch is set on 3,5 bar from factory. Can be adjusted by tuming screw (left = lower pressure, right = higher). Se sketch...

4.1Check function of switch by short circuiting the cables in switch. If cleaning cycle is then started, switch is faulty. Change to a new one.

4.2 If cleaning does not start when short circuiting cables, check power supply ail the way up to timer card in dust collector.

4.3 Check that all cables are unbroken.

5.TIMER CARD

5.1Lift off hydraulic fan top A) to get into the clean air chamber B).

5.2 Simulate a cleaning cycle by short circuiting pressure indicating switch as in 4. above.

5.3 Listen if solenoid valve indicates 10 cleaning pulses with 1 sec interval. If not, change solenoid A).

5.4Check that cables between timer card and solenoid valves are not damaged.

5.5 If no faults in 5.2-5.4 are found, timer card is faulty and has to be replaced!

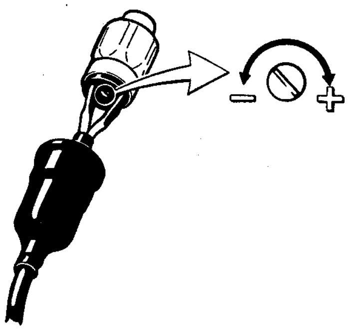
6. SOLENOID VALVES FOR FILTER CLEANING

6.1 If solenoid valves allow air to blow continuously, the diaphragm in valve is broken. Change!

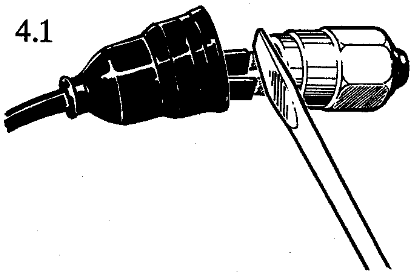
6.2 If solenoid valves do not open, i e no air is allowed into the cleaning system, check hole B) in diaphragm C). If clogged, blow clean and refit diaphragm into solenoid valve.

If valves still not open, change the solenoid A

4



4.1



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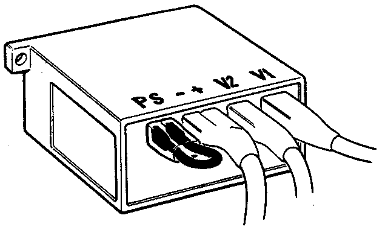
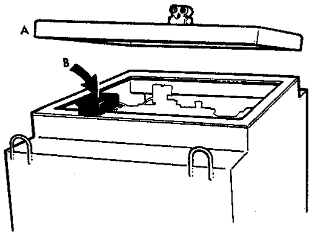
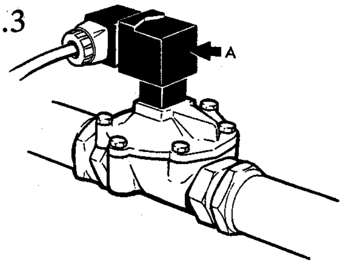


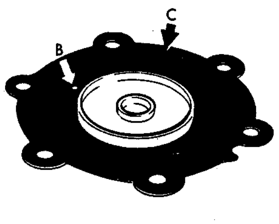
5.1



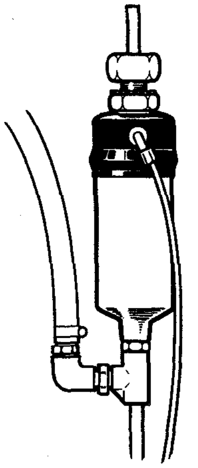
5.3



6.2



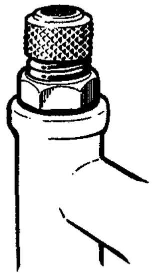
7.AIR CYLINDER


7

7.1If air cylinder puts the fan closer plate in closed position during drilling, the dust collector does not work.
Check diaphragm C) in the 1/2" solenoid valve that controls air cylinder movements.
If diaphragm is broken, change to a new one.
If hole is clogged, blow clean.

7.2 Check solenoid by simulating a cleaning cycle as described in 5.2 above.

7.3 Check and clean the adjustable relief valves. NOTE! After refitting adjustable relief valves you must adjust them to achieve correct movements of air cylinder.


7.3

How to adjust
Open relief valve by turning 2.5 turns from closed.

7.4 Check and clean the bleed filter.

7.5 If air cylinder still is not working, change to a new one.

7.6 Check fan closer plate. Ensure that ass'y is secure and sealed against bottom plate. This is very important for perfect filter cleaning and full suction capacity.

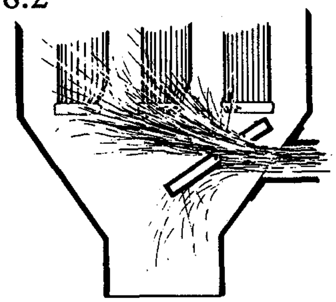

7.6

8. If dust escapes through fan top, one or more filters arc broken. STOP DRILLING IMMEDIATELY and check which filters are broken. Exchange broken filters for new ones.

IMPORTANT! When opening filter housing from bottom section, follow instructions given below. Also check the clean air chamber and clean away any dust which otherwise can fall down inside the clean filters. If necessary, clean filter housing and bottom section.

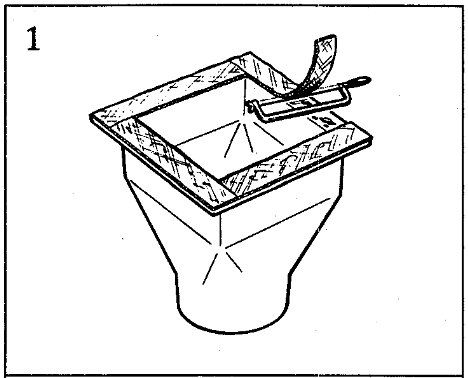
8.1Check if filters- are clogged. If impossible to clean, change to new filters.

8.2Check wear plate inside dust collector inlet.

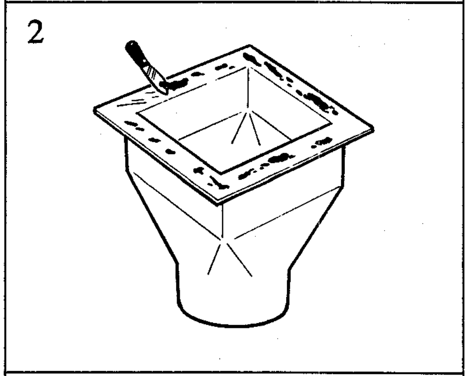

8.2

If plate is worn out, high-speed dust will blow directly into the filters and destroy them in a very short time.

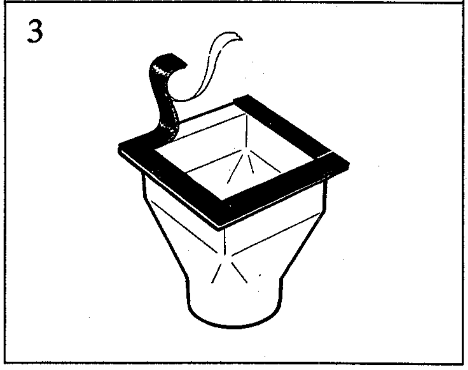
WHEN OPENING FILTER HOUSING FROM BOTTOM, ALWAYS:



Remove
damaged
foam rubber
seal



Clean
carefully



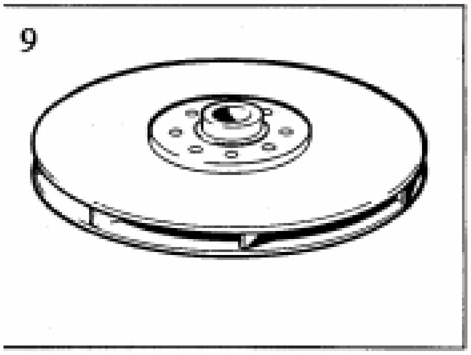
Fit new
seal

9. FAN

If broken filters have caused dust to blow up through the fan, this will very quickly cause unbalance.

Fan has to be dismounted immediately, cleaned and checked. If still not in balance, fan has to be replaced by a new one.

If the fan is driven while unbalanced, the hydraulic motor bearing will be affected and can lead to replacement of the complete motor unit.



10. HYDRAULIC MOTOR

10.1 Check that the motor gets necessary oil volume at correct working pressure

10.2 Also check that the motor is correctly connected with hydraulic hoses of recommended diameter

If points 10. 1 and 10.2 are fulfilled and the fan still is not running at 4500- 5000 rpm, there is probably an internal leakage in the motor. The motor should then be replaced

CHAPTER 11

SECTION 01

TRACKS REPAIR

BLANK

Group 0130
Track System

SERVICE EQUIPMENT AND TOOLS

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC). Some tools may be available from a local supplier.

SERVICEGARD is a trademark of Deere & Company.

CED,OUOE003,1220 –19–26SEP98–1/17

Special Roller Caliper. . . . . JT05519[1]

To measure undercarriage component wear.

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[1] *Tools are available in a kit such as the JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.*

CED,OUOE003,1220 –19–26SEP98–2/17

17-1/2 and 30-Ton Puller Set

To remove brackets and bushings from track rollers and front idler.

CED,OUOE003,1220 –19–26SEP98–3/17

Rubber Stopper/Leak Detector Kit. D05361ST

To test lower track roller and front idler for oil leakage.

CED,OUOE003,1220 –19–26SEP98–4/17

8 mm Hex Key Wrench

To remove track carrier roller plug.

Continued on next page

CED,OUOE003,1220 –19–26SEP98–5/17

8 mm Hex Head Wrench

To remove track carrier roller thrust washer-to-support shaft cap screws.

CED,OUOE003,1220 –19–26SEP98–6/17

Depth Gauge (200 mm Ruler) . . . . JT05521[1]

To measure undercarriage components for wear.

[1] *Tools are available in a kit such as the JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.*

CED,OUOE003,1220 –19–26SEP98–7/17

Right Angle Attachment . . . . JT05534[1]

To measure undercarriage components for wear.

[1] *Tools are available in a kit such as the JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.*

CED,OUOE003,1220 –19–26SEP98–8/17

300 mm Ruler . . . . D05231ST[1]

To measure undercarriage components for wear.

[1] *Tools are available in a kit such as the JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.*

Continued on next page

CED,OUOE003,1220 –19–26SEP98–9/17

100 mm Caliper . . . . D17524C1[1]

To measure undercarriage components for wear.

[1] *Tools are available in a kit such as the JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.*

CED,OUOE003,1220 –19–26SEP98–10/17

Metric Tape Measure . . . . JT05520[1]

To measure undercarriage components for wear.

[1] *Tools are available in a kit such as the JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.*

CED,OUOE003,1220 –19–26SEP98–11/17

50-Ton Master Pin Pusher Installer D01030AA

To remove and install master pin in track chain master link.

CED,OUOE003,1220 –19–26SEP98–12/17

Grease Gun

To apply grease to adjust track sag.

Continued on next page

CED,OUOE003,1220 –19–26SEP98–13/17

Service Jack 18-t (20-Ton)

To place under track recoil spring disassembly and assembly tool.

CED,OUOE003,1220 –19–26SEP98–14/17

Track Recoil Spring Disassembly and Assembly Tool . . . . ST4920[1]

To compress the track recoil spring for disassembly and assembly.

[1] *Fabricated tool, dealer made. (See Section 99 for instructions to make tool.)*

CED,OUOE003,1220 –19–26SEP98–15/17

Spacer . . . . DFT1110[1]

Installed on bottom plate of ST4920 Track Recoil Spring Disassembly and Assembly Tool to protect piston from downward force during disassembly and assembly.

[1] *Fabricated tool, dealer made. (See Section 99 for instructions to make tool.)*

CED,OUOE003,1220 –19–26SEP98–16/17

Track Recoil Spring Disassembly and Assembly Guard Tool . . . . DFT1087[1]

Used with ST4920 Track Recoil Spring Disassembly and Assembly Tool.

[1] *Fabricated tool, dealer made. (See Section 99 for instructions to make tool.)*

CED,OUOE003,1220 –19–26SEP98–17/17

OTHER MATERIAL

Number	Name	Use
PT569 (U.S.) TY6332 (Canadian)	NEVER-SEEZ® Anti-Seize Lubricant	Apply to pin, bracket bore, and shaft for carrier and lower track rollers and front idler.
TY16285 (U.S.) TY9485 (Canadian) 7649 (LOCTITE®)	Cure Primer	Cleans and cures surfaces prior to application of adhesives or sealants.
TY9375 (U.S.) TY9480 (Canadian) 592 (LOCTITE®)	Pipe Sealant	Apply to threads of plug for installation.
TY2098 (U.S.)	Multi-Purpose Grease	To provide a light seal between surfaces.
T43513 (U.S.) TY9474 (Canadian) 271 (LOCTITE®)	Thread Lock and Sealer (High Strength)	Apply to threads of sprocket mounting cap screws.
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Apply to threads of front idler plug.

NEVER-SEEZ is a trademark of Emhart Chemical Group.
LOCTITE is a trademark of Loctite Corp.

CED,OUOE003,503 –19–14MAY98–1/1

SPECIFICATIONS

Item	Measurement	Specification
Track Roller:		
Track Roller Tread	OD OD	155.0 mm (6.10 in.) new 149.0 mm (5.87 in.) minimum used
Machine	Weight	23 773 kg (52,410 lb) approximate
Track Roller	Weight	38 kg (84 lb) approximate
Roller-to-Frame Cap Screw	Torque	450 N•m (335 lb-ft)
Roller Guard-to-Frame Cap Screw	Torque	450 N•m (335 lb-ft)
Oil Cavity Air Test	Pressure	110 ± 18 kPa (1.1 ± 0.3 bar) (16 ± 4 psi)
Track Carrier Roller:		
Track Carrier Roller Tread	OD OD	120.0 mm (4.72 in.) new 110.0 mm (4.33 in.) minimum used
Roller-to-Track Frame Cap Screw	Torque	265 N•m (195 lb-ft)
Thrust Washer-to-Support Shaft Cap Screw	Torque	64 N•m (47 lb-ft)
Track Shoe (SN —599999):		
Three Bar Grouser	Height Height	26.0 mm (1.02 in.) new 15.0 mm (0.59 in.) minimum used
Shoe-to-Link Cap Screw	Torque	298 N•m (220 lb-ft) plus 1/2 turn
Track Shoe (SN 600000—):		
Three Bar Grouser	Height Height	25.5 mm (1.00 in.) new 15.0 mm (0.59 in.) minimum used
Shoe-to-Link Cap Screw	Torque	298 N•m (220 lb-ft) plus 1/2 turn

Continued on next page

Track System

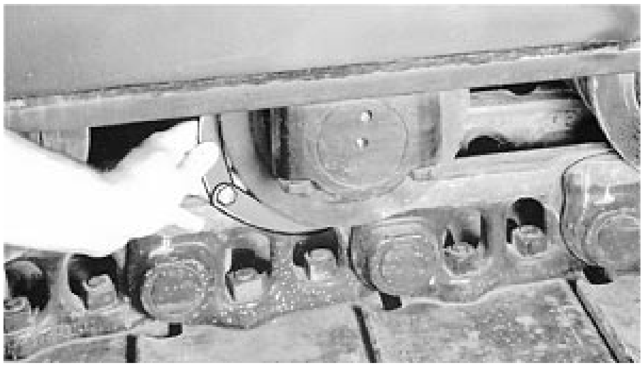
Item	Measurement	Specification
Track Chain:		
Track Chain Link	Height	105.0 mm (4.13 in.) new
	Height	98.0 mm (3.86 in.) minimum used
Track Chain Bushing	OD	59.0 mm (2.32 in.) new
	OD	54.0 mm (2.13 in.) minimum used
Track Chain	Pitch	762.0 mm (30.00 in.) new
	Pitch	780.0 mm (30.71 in.) maximum used
Track with 800 mm (32 in.) Shoe	Weight	1745 kg (3846 lb) approximate
Shoe-to-Link Cap Screw	Torque	298 N•m (220 lb-ft) plus 1/2 turn
Machine	Weight	23 773 kg (52,410 lb) approximate
Track	Sag	300—335 mm (11-13/16—13-3/16 in.)
Nut and Valve Assembly	Torque	147 N•m (108 lb-ft)
Sprocket:		
Sprocket	Weight	45 kg (98 lb) approximate
Sprocket Cap Screw	Torque	470 N•m (350 lb-ft)
Front Idler:		
Front Idler Flange	Height	19.0 mm (0.75 in.) new
	Height	23.0 mm (0.91 in.) maximum used
Front Idler with Yoke	Weight	113 kg (250 lb) approximate
Yoke-to-Bracket Cap Screw	Torque	206 N•m (152 lb-ft)
Oil Cavity Air Test	Pressure	110 ± 28 kPa (1.1 ± 0.3 bar) (16 ± 4 psi)
Track Adjuster and Recoil Spring:		
Track Adjuster Cylinder and Recoil Spring	Weight	118 kg (260 lb) approximate

Continued on next page

Item	Measurement	Specification
Track Recoil Spring Disassembly and Assembly Tool	Weight	225 kg (496 lb) approximate
Recoil Spring	Free Length Compressed Length	689 mm (27 in.) approximate 577 mm (22.7 in.)
Valve	Torque	147 N•m (110 lb-ft)
Flange-to-Cylinder Cap Screw	Torque	64 N•m (47 lb-ft)

CED,OUOE003,1153 –19–18SEP98–3/3

MEASURE TRACK ROLLER WEAR



Minimum used is the maximum allowable wear for rebuilding roller tread.

Under some conditions roller wear can be uneven. If wear is uneven, rollers may be interchanged to even out the wear.

Measure roller tread diameter using a caliper such as the JT05519 Special Roller Caliper from JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.

TX,01,UU3837 –19–08MAY98–1/1

CARRIER ROLLER TREAD DIAMETER

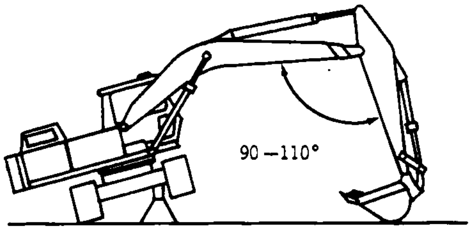
Allowable Wear—10.0 mm (0.39 in.)

Dimension	Percent Worn
120.0 mm (4.72 in.)	0
119.5 mm (4.70 in.)	5
119.0 mm (4.69 in.)	10
118.5 mm (4.67 in.)	15
118.0 mm (4.65 in.)	20
117.5 mm (4.63 in.)	25
117.0 mm (4.61 in.)	30
116.5 mm (4.59 in.)	35
116.0 mm (4.57 in.)	40
115.5 mm (4.55 in.)	45
115.0 mm (4.53 in.)	50
114.5 mm (4.51 in.)	55
114.0 mm (4.49 in.)	60
113.5 mm (4.47 in.)	65
113.0 mm (4.45 in.)	70
112.5 mm (4.43 in.)	75
112.0 mm (4.41 in.)	80
111.5 mm (4.39 in.)	85
111.0 mm (4.37 in.)	90
110.5 mm (4.35 in.)	95
110.0 mm (4.33 in.)	**100**
109.5 mm (4.31 in.)	105
109.0 mm (4.29 in.)	110
108.5 mm (4.27 in.)	115
108.0 mm (4.25 in.)	120

T6813AQ –UN–29JAN98

AG,OUOE042,32 –19–10MAR99–1/1

REMOVE AND INSTALL TRACK ROLLER



T6876FG –UN–06DEC88

1. Swing upperstructure 90° and lower bucket to raise track off ground. Keep angle between boom and arm 90—110° and position round side of bucket on ground.

CAUTION: Prevent possible injury from unexpected machine movement. Put shop stands under frame to support machine while removing lower track roller.

The approximate weight of machine is 23 773 kg (52,410 lb).

Machine—Specification

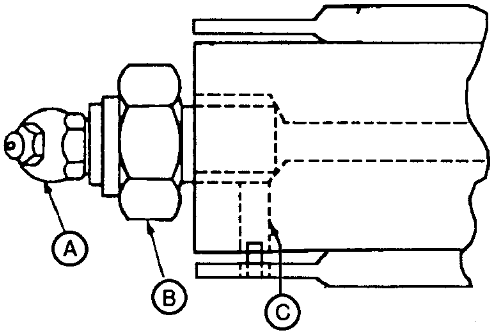
Weight	23 773 kg (52,410 lb) approximate

2. Put shop stands under machine.

TX,01,UU3838 –19–18SEP98–1/3

CAUTION: Prevent possible injury from high pressure grease. Do not remove grease fitting (A) from valve (B).

3. Loosen valve (B) one to two turns to release grease through bleed hole (C).



T7396DZ –UN–28NOV90

A—Grease Fitting
B—Valve
C—Bleed Hole

Continued on next page

TX,01,UU3838 –19–18SEP98–2/3

CAUTION: The approximate weight of track roller is 38 kg (84 lb).

Track Roller—Specification

Weight.. 38 kg (84 lb) approximate

4. Attach hoist to track roller (B). Remove cap screws (A) and track roller (B).

5. Repair or replace parts where necessary. (See following procedure in this group.)

6. Install roller on track link with flat portion of bracket pointing toward undercarriage.

7. Lower excavator enough to allow cap screws (A) to be installed.

8. Tighten cap screws.

Roller-to-Frame Cap Screw—Specification

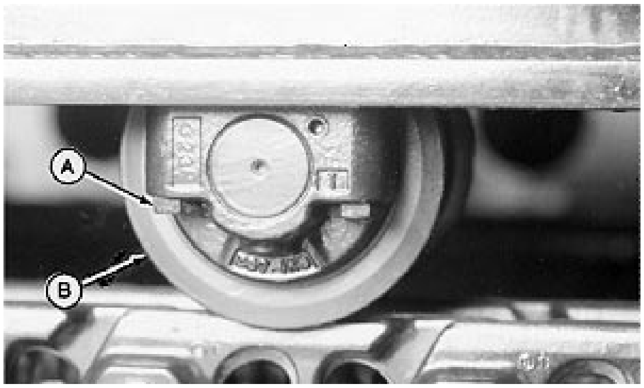
Torque .... 450 N•m (335 lb-ft)

9. Install roller guard and tighten cap screws.

Roller Guard-to-Frame Cap Screw—Specification

Torque .... 450 N•m (335 lb-ft)

10. Adjust track sag. (See procedure in this group).

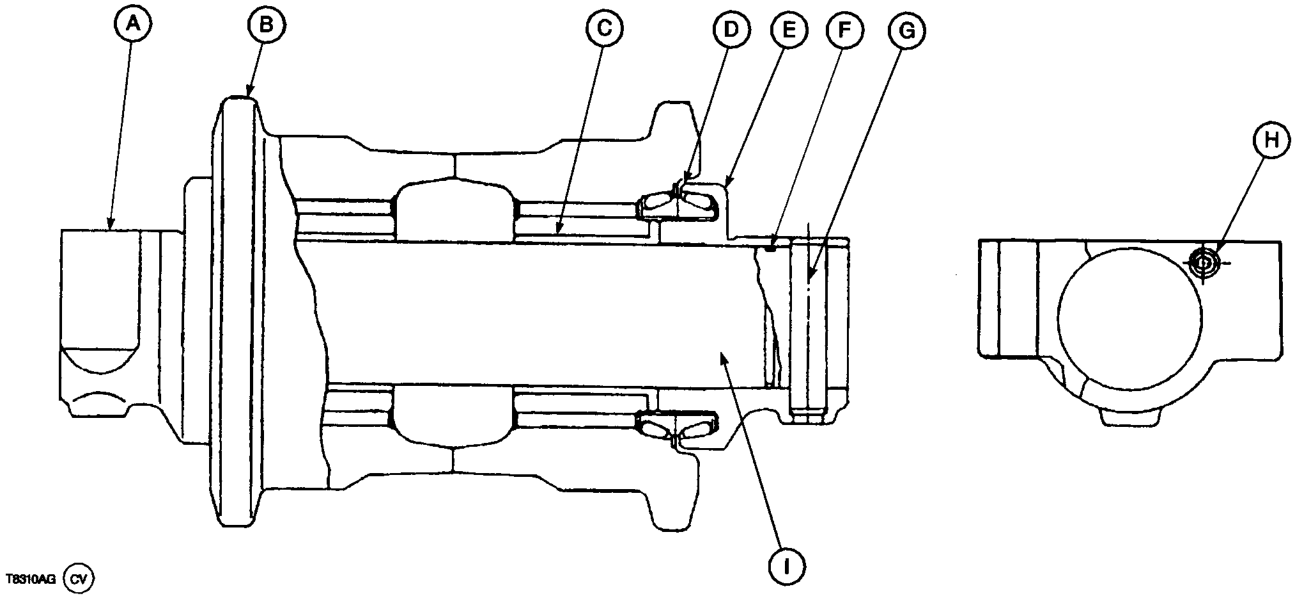


T6585TN –UN–25OCT88

A—Cap Screw (4 used)
B—Track Roller

TX,01,UU3838 –19–18SEP98–3/3

DISASSEMBLE AND ASSEMBLE TRACK ROLLER



A—Bracket
B—Roller
C—Bushing (2 used)
D—Metal Face Seal (2 used)
E—Bracket
F—O-Ring
G—Pin (2 used)
H—Plug (2 used) (SN —599999) Plug (1 used) (SN 600000—)
I—Axle

1. Remove plug (H) using a 6 mm hex key wrench and drain oil.

2. Remove pin (G) using a 14 mm driver.

3. Remove bracket (E) using a bearing puller attachment and adapters from puller set.

IMPORTANT: Metal face seals can be reused if they are not worn or damaged. A used seal must be kept together as a set because of wear patterns on seal ring face.

4. Remove metal face seal (D) from roller and bracket. Keep seal rings together as a matched set with seal ring faces together to protect surfaces.

5. Inspect metal face seals. (See procedure in this group.) For seals that will be reused, put a piece of cardboard between seal rings to protect seal face.

6. Remove axle (I) from roller (B).

NOTE: Only remove bushing if replacement is necessary.

7. Remove bushing (C) using a 2 jaw puller and adapters from puller set.

8. Replace parts as necessary.

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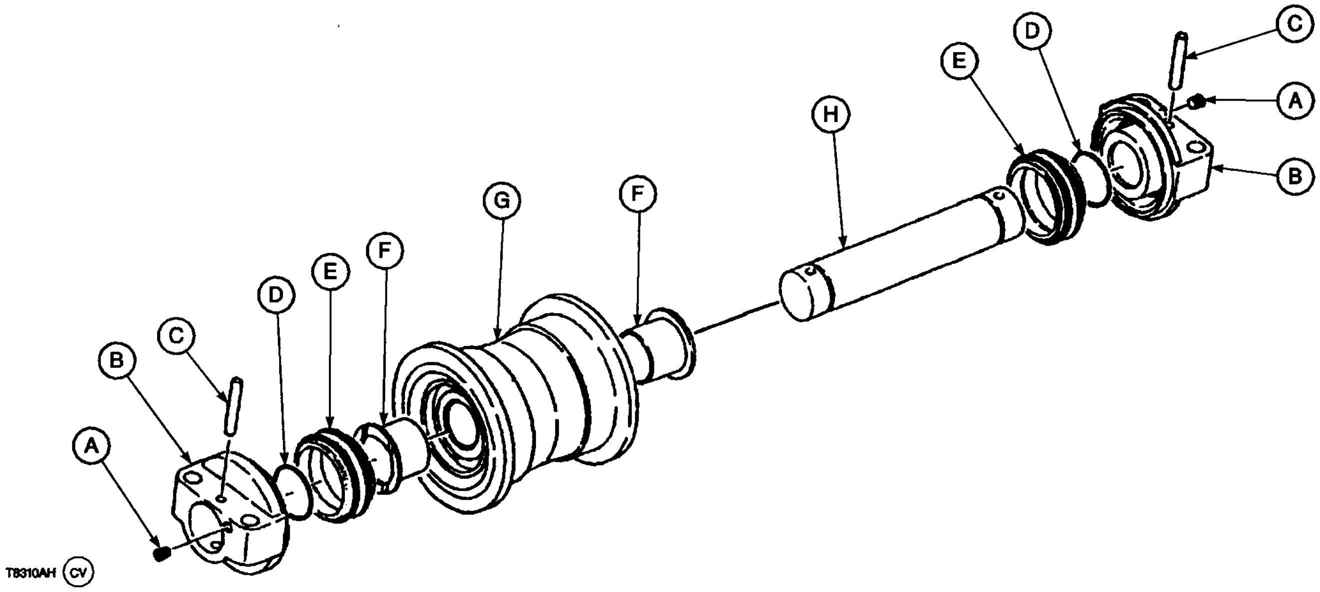


T8310AH –UN–21SEP94

A—Plug (2 used) (SN —599999) Plug (1 used) (SN 600000—)
B—Bracket (2 used)
C—Pin (2 used)
D—O-Ring (2 used)
E—Metal Face Seal (2 used)
F—Bushing (2 used)
G—Roller
H—Axle

9. Apply a thin film of oil to bushings (F). Install bushings.

10. Install O-ring (D) on axle (H).

IMPORTANT: O-rings and seat surfaces for O-rings must be clean, dry, and oil free so O-rings do not slip when roller is turning.

11. Thoroughly clean O-rings and seat surfaces in brackets (B) and in seal rings using volatile, non-petroleum base solvent and lint-free tissues.

12. Install O-ring in seal rings.

13. Install seals (E) in brackets (B) and in roller (G). Apply equal pressure with fingers at four equally spaced points on seal face. Seal must “pop” down into place so O-ring is tight against seal bore. A volatile, non-petroleum base solvent or talcum powder may be used as a lubricant.

14. Wipe finger prints and foreign material off seal ring face using clean oil and lint-free tissues. Apply a thin film of oil to each seal ring face.

15. Apply a thin layer of NEVER-SEEZ® lubricant or an equivalent to pin (C). Install pin even with the flat surface of bracket.

16. Install axle to bracket.

17. Apply NEVER-SEEZ® lubricant or equivalent to pin (C). Install pin flush with the flat surface of bracket.

18. Install axle and assembled parts to roller (G).

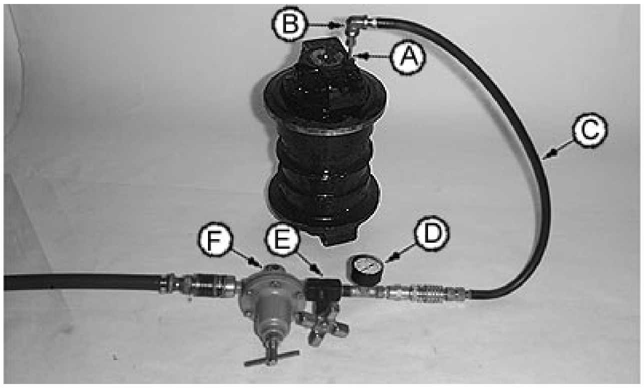
19. Add approximately 256 mL (8.66 fl oz) of oil. (See Track Roller, Front Idler, and Carrier Roller Oil in Group 0004).

20. Repeat procedure for other side of axle.

NEVER-SEEZ is a trademark of Emhart Chemical Group.

TX,01,UU3839 –19–18SEP98–2/2

TEST TRACK ROLLER FOR OIL LEAKAGE



T109691B –UN–02JUN97

A—Adapter, Connector and Rubber Plug
B—Connector 1/8 M NPT x 7/16-20 M 37°
C—Air Hose
D—Pressure Gauge
E—Snubber (Needle) Valve
F—Air Pressure Regulator

1. Hold the shaft and turn shell several turns to seat metal face seals.

2. Remove the hex socket plug from end of roller.

3. Install parts (A—F). Plug, adapter and connector are from a leak detector kit such as the D05361ST Rubber Stopper/Leak Detector Kit.

4. Holding plug so it is not pushed out, slowly pressurize oil cavity using air.

Oil Cavity Air Test—Specification

Pressure .... 110 ± 18 kPa (1.1 ± 0.3 bar)
(16 ± 4 psi)

5. Close valve and wait for a minimum of 30 seconds. Check for oil leakage. Check gauge to see if air pressure has decreased.

6. If there is leakage, disassemble roller and replace parts as necessary.

7. Clean threads of plug using cure primer. Apply pipe sealant to threads. Install plug.

TX,01,UU3840 –19–18SEP98–1/1

MEASURE TRACK CARRIER ROLLER WEAR

Used minimum tread diameter is the maximum allowable wear for rebuilding wear surface.

Measure roller tread diameter using a caliper such as the JT05519 Special Roller Caliper from JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.

T6813AQ –UN–29JAN98

TX,01,UU3841 –19–17SEP98–1/1

CARRIER ROLLER TREAD DIAMETER

Allowable Wear—10.0 mm (0.39 in.)

Dimension	**Percent Worn**
150.0 mm (5.91 in.)	0
149.5 mm (5.89 in.)	5
149.0 mm (5.87 in.)	10
148.5 mm (5.85 in.)	15
148.0 mm (5.83 in.)	20
147.5 mm (5.81 in.)	25
147.0 mm (5.79 in.)	30
146.5 mm (5.77 in.)	35
146.0 mm (5.75 in.)	40
145.5 mm (5.73 in.)	45
145.0 mm (5.71 in.)	50
144.5 mm (5.69 in.)	55
144.0 mm (5.67 in.)	60
143.5 mm (5.65 in.)	65
143.0 mm (5.63 in.)	70
142.5 mm (5.61 in.)	75
142.0 mm (5.59 in.)	80
141.5 mm (5.57 in.)	85
141.0 mm (5.55 in.)	90
140.5 mm (5.53 in.)	95
140.0 mm (5.51 in.)	**100**
139.5 mm (5.49 in.)	105
139.0 mm (5.47 in.)	110
138.5 mm (5.45 in.)	115
138.0 mm (5.43 in.)	120

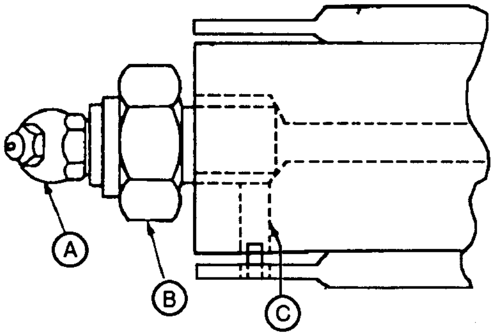
T6813AQ –UN–29JAN98

AG,OUOE042,34 –19–10MAR99–1/1

REMOVE AND INSTALL TRACK CARRIER ROLLER

CAUTION: Prevent possible injury from high pressure grease. Do not remove grease fitting (A) from valve (B).

1. Loosen valve (B) one to two turns to release grease through bleed hole (C).



T7396DZ –UN–28NOV90

A—Grease Fitting
B—Valve
C—Bleed Hole

TX,01,UU3842 –19–18SEP98–1/4

2. Raise track link, using a jack, enough to permit carrier roller removal.

CAUTION: Prevent accidental lowering of track by securely supporting track before attempting service procedure.

3. Install wooden blocks between track link and frame.

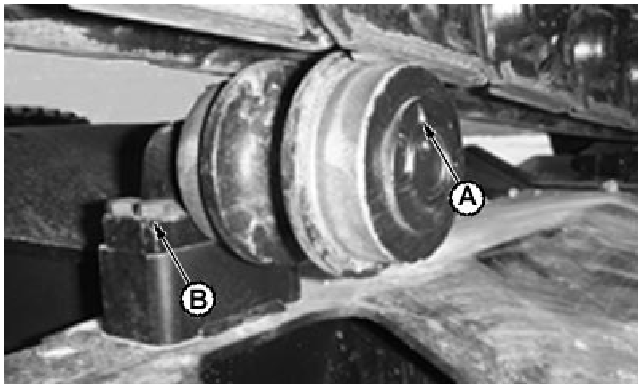
T108834B –UN–02JUN97

TX,01,UU3842 –19–18SEP98–2/4

4. Remove cap screws (B) and carrier roller (A).
5. Repair or replace parts as necessary. (See following procedure in this group.)
6. Install carrier roller and tighten cap screws (B).

Roller-to-Track Frame Cap Screw—Specification

Torque .... 265 N•m (195 lb-ft)



T108835B –UN–03APR97

Continued on next page

TX,01,UU3842 –19–18SEP98–3/4

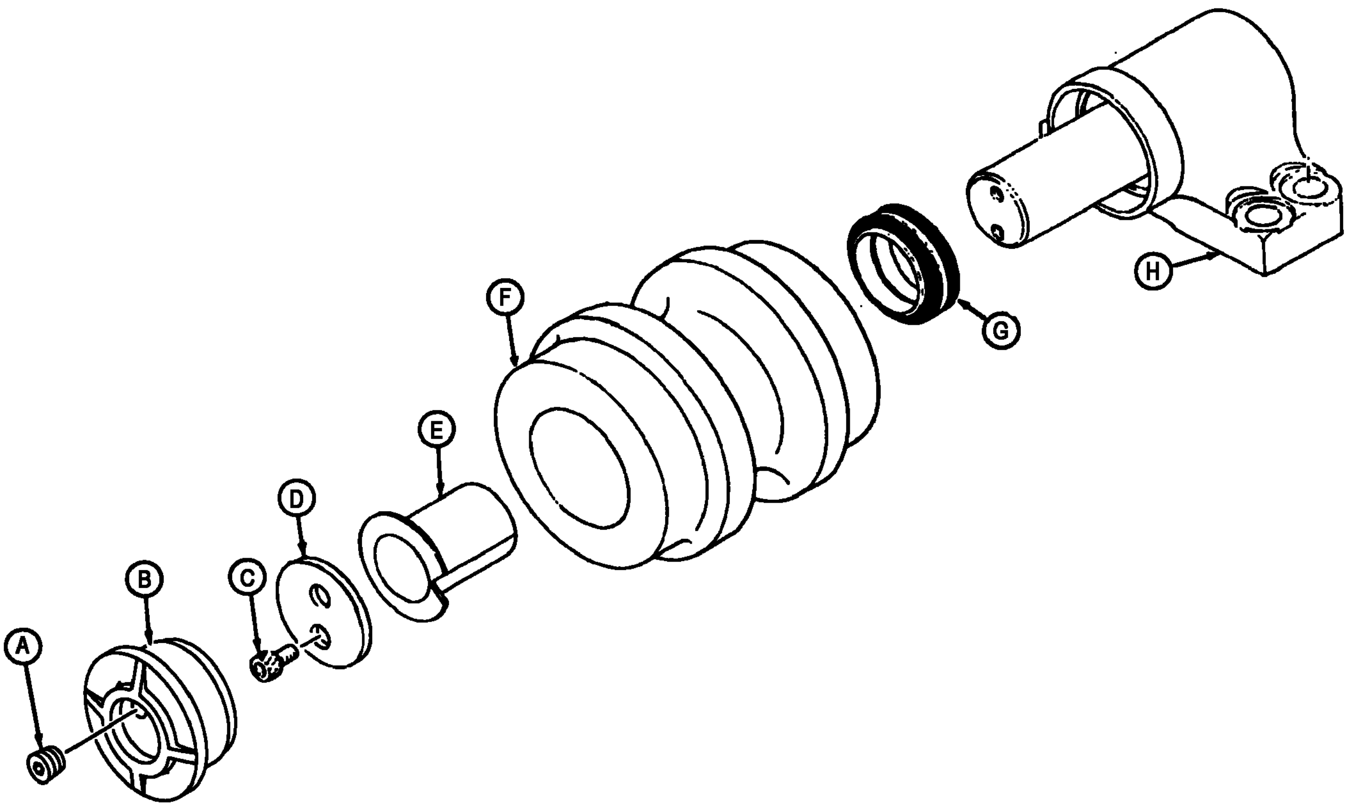
7. Remove wooden blocks and jack.

8. Adjust track sag. (See procedure in this group).

T108834B –UN–02JUN97

TX,01,UU3842 –19–18SEP98–4/4

DISASSEMBLE AND ASSEMBLE TRACK CARRIER ROLLER



T114725

T114725 –UN–30APR98

A—Plug	**C—Cap Screw (2 used)**	**E—Bushing**	**G—Metal Face Seal**
B—Cover	**D—Thrust Washer**	**F—Roller**	**H—Support**

1. Remove plug (A), using an 8 mm hex key wrench, to drain oil.
2. Remove two cap screws (C) using an 8 mm hex head wrench through oil plug drain hole.

Continued on next page

3. Remove roller (F) from support (H).

IMPORTANT: Replace entire roller assembly if bushing (E) and shaft surfaces are damaged. Bushing (E) is no longer serviceable because cover (B) cannot be removed.

4. Inspect bushing (E) and shaft on support (H).

IMPORTANT: Leaks may occur if reused seals are not kept together as a matched set.

5. Remove metal face seal (G) from roller (F) and support (H). Keep seal rings together as a matched set with faces together to protect surfaces.

6. Inspect metal face seal. (See procedure listed in this group.) Metal face seals may be reused if they are not worn or damaged.

7. Replace parts as necessary.

IMPORTANT: O-rings may slip when roller is turning if O-rings and seat surfaces are not clean, dry and oil free.

8. Thoroughly clean the O-rings and seat surfaces in roller, support, and seal bushings using a volatile, non-petroleum base solvent and lint-free tissue.

9. Install O-ring on seal rings.

NOTE: Current carrier roller metal face seals use a tapered fit. There is no longer the “pop” into place fit previously used.

A volatile, non-petroleum base solvent or talcum power may be used as a lubricant.

10. Install one half of metal face seal into support (H).

11. Apply a thin coat of oil to the metal faces on each half of the seal. (See Track Roller, Front Idler, and Carrier Roller Oil in Group 0004.)

12. Install the other half of metal face seal on the half already in place in support (H).

13. Install roller (F) over shaft on support (H) being sure to keep cap screws (C) in alignment with holes on shaft.

14. Tighten cap screws (C).

Thrust Washer-to-Support Shaft Cap Screw—Specification

Torque... 64 N•m (47 lb-ft)

15. Fill carrier roller with approximately 85 mL (2.9 oz) of clean oil through plug (A) hole. (See Track Roller, Front Idler, and Carrier Roller Oil in Group 0004.)

16. Clean threads of plug (B) using cure primer.

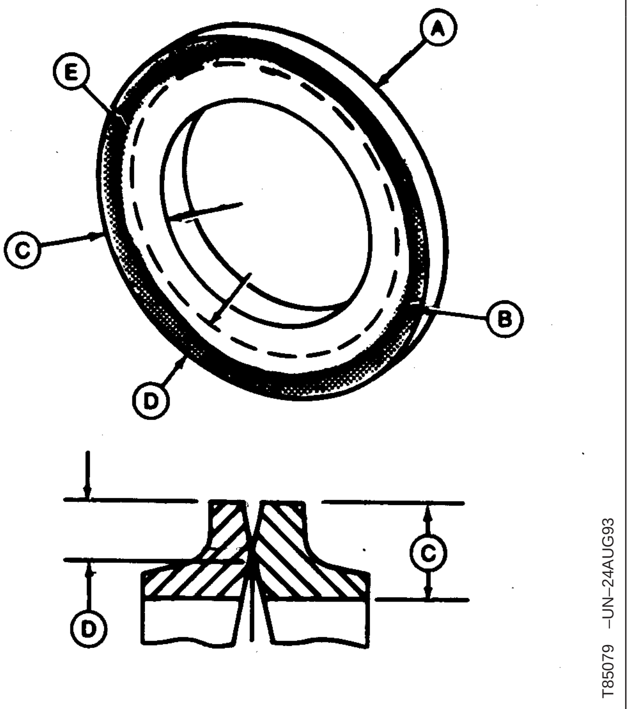
17. Apply pipe sealant to thread of plug. Install plug.

TX,01,UU3843 –19–18SEP98–2/2

INSPECT METAL FACE SEALS

1. Inspect for the following conditions to determine if seal rings (A) can be reused:

   - The narrow, highly polished sealing area (E) must be in the outer half of seal ring face (D).
   - Sealing area must be uniform and concentric with the ID and OD of seal ring (A).
   - Sealing area must not be chipped, nicked, or scratched.



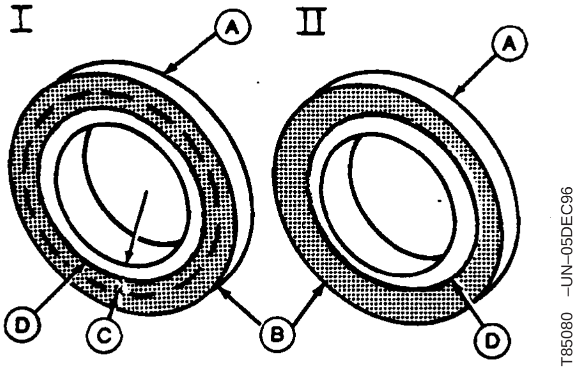
A—Seal Ring
B—Worn Area (Shaded Area)
C—Seal Ring Face
D—Outer Half of Seal Ring Face
E—Sealing Area (Dark Line)

TX,01,VV2870 –19–05DEC96–1/3

2. Illustration shows examples of worn seal rings (A).

   I—Sealing area (D) is in inner half of seal ring face (C).

   II—Sealing area (D) not concentric with ID and OD of seal ring.



A—Seal Ring
B—Worn Area (Shaded Area)
C—Inner Half of Seal Ring Face
D—Sealing Area (Dark Line)

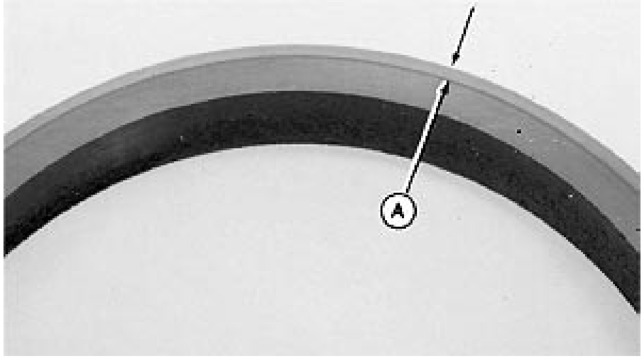
Continued on next page

TX,01,VV2870 –19–05DEC96–2/3

3. Clean seals to be reused by removing all foreign material from seal rings, except seal face (A), using a scraper or a stiff bristled fiber brush.

4. Wash seal rings and O-rings using a volatile, non-petroleum base solvent to remove all oil. Thoroughly dry parts using a lint-free tissue.

5. Apply a thin film of oil to seal ring face. Put face of seal rings together and hold using tape.



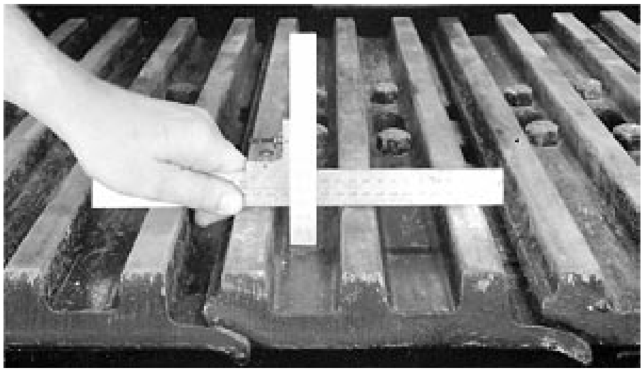
A—Seal Face

TX,01,VV2870 –19–05DEC96–3/3

MEASURE TRACK SHOE GROUSER WEAR

Minimum used is the maximum allowable wear for rebuilding grouser bars with weld.

Measure grouser height of several track shoes to find an average using a depth gauge such as the JT05521 200 mm Ruler, JT05534 Right Angle Attachment, and D05231ST 300 mm Ruler from JT05518A or JT0552 Undercarriage Inspection Service Tool Kit.



Three Bar Grouser—Specification

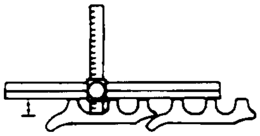
Height .... 25.5 mm (1.00 in.) new
Height .... 18.0 mm (0.71 in.) minimum used

AG,OUOE042,35 –19–10MAR99–1/1

1010 THREE BAR GROUSER HEIGHT

Allowable Wear—6.5 mm (0.26 in.)

Dimension	Percent Worn
15.5 mm (0.61 in.)	0
15.2 mm (0.60 in.)	5
14.9 mm (0.58 in.)	10
14.5 mm (0.57 in.)	15
14.2 mm (0.56 in.)	20
13.9 mm (0.55 in.)	25
13.6 mm (0.53 in.)	30
13.2 mm (0.52 in.)	35
12.9 mm (0.51 in.)	40
12.6 mm (0.50 in.)	45
12.3 mm (0.48 in.)	50
11.9 mm (0.47 in.)	55
11.6 mm (0.46 in.)	60
11.3 mm (0.44 in.)	65
11.0 mm (0.43 in.)	70
10.6 mm (0.42 in.)	75
10.3 mm (0.41 in.)	80
10.0 mm (0.39 in.)	85
9.7 mm (0.38 in.)	90
9.3 mm (0.37 in.)	95
9.0 mm (0.35 in.)	**100**
8.7 mm (0.34 in.)	105
8.4 mm (0.33 in.)	110
8.0 mm (0.32 in.)	115
7.7 mm (0.30 in.)	120



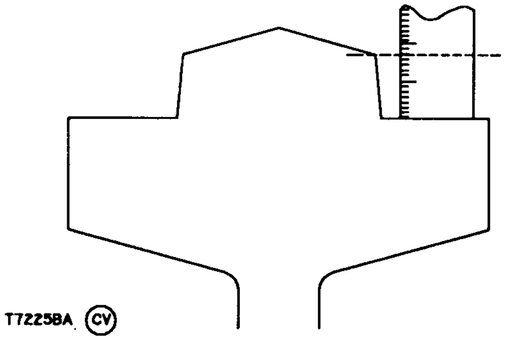
T6813AP –UN–29JAN98

TX,07,SB3033 –19–26SEP97–1/1

1010 FRONT IDLER FLANGE HEIGHT

Allowable Wear—3.9 mm (0.15 in.)

Dimension	**Percent Worn**
19.1 mm (0.75 in.)	0
19.3 mm (0.76 in.)	5
19.5 mm (0.77 in.)	10
19.7 mm (0.78 in.)	15
19.9 mm (0.78 in.)	20
20.1 mm (0.79 in.)	25
20.3 mm (0.80 in.)	30
20.5 mm (0.81 in.)	35
20.7 mm (0.81 in.)	40
20.9 mm (0.82 in.)	45
21.1 mm (0.83 in.)	50
21.2 mm (0.84 in.)	55
21.4 mm (0.84 in.)	60
21.6 mm (0.85 in.)	65
21.8 mm (0.86 in.)	70
22.0 mm (0.87 in.)	75
22.2 mm (0.87 in.)	80
22.4 mm (0.88 in.)	85
22.6 mm (0.89 in.)	90
22.8 mm (0.90 in.)	95
23.0 mm (0.91 in.)	**100**
23.2 mm (0.91 in.)	105
23.4 mm (0.92 in.)	110
23.6 mm (0.93 in.)	115
23.8 mm (0.94 in.)	120



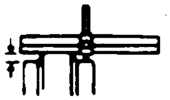
T7225BA –UN–21FEB90

TX,07,SB3034 –19–08APR99–1/1

FRONT IDLER FLANGE HEIGHT

Allowable Wear—4.0 mm (0.16 in.)

Dimension	Percent Worn
19.0 mm (0.75 in.)	0
19.2 mm (0.76 in.)	5
19.4 mm (0.76 in.)	10
19.6 mm (0.77 in.)	15
19.8 mm (0.78 in.)	20
20.0 mm (0.79 in.)	25
20.2 mm (0.80 in.)	30
20.4 mm (0.80 in.)	35
20.6 mm (0.81 in.)	40
20.8 mm (0.82 in.)	45
21.0 mm (0.83 in.)	50
21.2 mm (0.83 in.)	55
21.4 mm (0.84 in.)	60
21.6 mm (0.85 in.)	65
21.8 mm (0.86 in.)	70
22.0 mm (0.87 in.)	75
22.2 mm (0.87 in.)	80
22.4 mm (0.88 in.)	85
22.6 mm (0.89 in.)	90
22.8 mm (0.90 in.)	95
23.0 mm (0.91 in.)	**100**
23.2 mm (0.91 in.)	105
23.4 mm (0.92 in.)	110
23.6 mm (0.93 in.)	115
23.8 mm (0.94 in.)	120



T6813AR –UN–29JAN98

AG,OUOE042,36 –19–10MAR99–1/1

REMOVE AND INSTALL TRACK SHOE

1. Remove nuts, cap screws, and shoe.

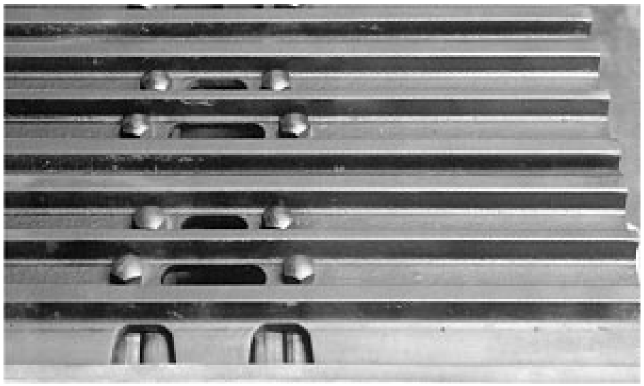
2. Apply a light coat of oil to cap screw threads and install shoe.

3. Install all track shoe nuts with rounded corners (A) against the link and chamfered edges (B) away from the link. Be sure nut is properly positioned in the link so there is full contact between the nut and the link.

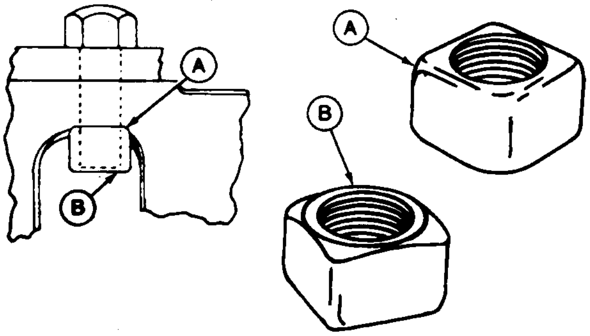
4. Tighten cap screws in pattern shown.

Shoe-to-Link Cap Screw—Specification

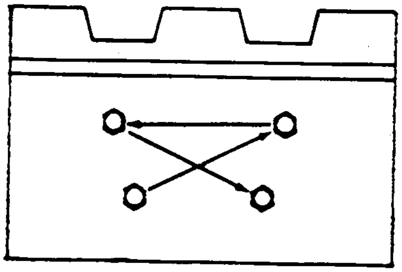
Torque .... 298 N•m (220 lb-ft) plus 1/2 turn



T6557DO –UN–25OCT88



T6794AM –UN–23FEB89



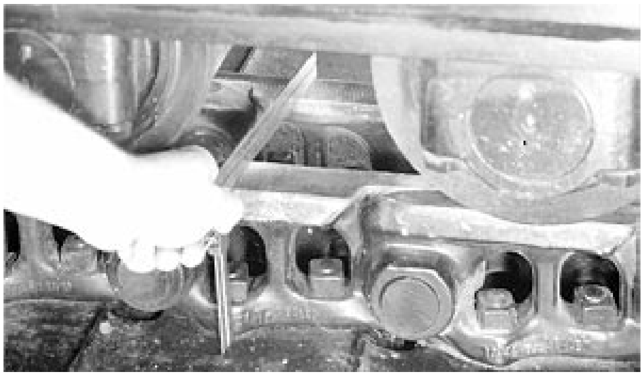
T6352AH –UN–23FEB89

Track Shoe Tightening Pattern

A—Rounded Edge
B—Chamfered Edge

TX,01,UU3845 –19–18SEP98–1/1

MEASURE TRACK CHAIN LINK WEAR



T82864 –UN–08NOV88

Minimum used is the maximum allowable wear for rebuilding links.

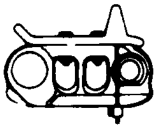
Measure height of several links to find an average using a depth gauge such as the JT05521 200 mm Ruler, JT05534 Right Angle Attachment, and D05231ST 300 mm Ruler from JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.

TX,01,UU3846 –19–03APR98–1/1

230LCR/230LCRD LINK HEIGHT

Allowable Wear—7.0 mm (0.28 in.)

Dimension	**Percent Worn**
105.0 mm (4.13 in.)	0
104.7 mm (4.12 in.)	5
104.3 mm (4.11 in.)	10
104.0 mm (4.09 in.)	15
103.6 mm (4.08 in.)	20
103.3 mm (4.06 in.)	25
102.9 mm (4.05 in.)	30
102.6 mm (4.04 in.)	35
102.2 mm (4.02 in.)	40
101.9 mm (4.01 in.)	45
101.5 mm (4.00 in.)	50
101.2 mm (3.98 in.)	55
100.8 mm (3.97 in.)	60
100.5 mm (3.95 in.)	65
100.1 mm (3.94 in.)	70
99.8 mm (3.93 in.)	75
99.4 mm (3.91 in.)	80
99.1 mm (3.90 in.)	85
98.7 mm (3.89 in.)	90
98.4 mm (3.87 in.)	95
98.0 mm (3.86 in.)	**100**
97.7 mm (3.84 in.)	105
97.3 mm (3.83 in.)	110
97.0 mm (3.82 in.)	115
96.6 mm (3.80 in.)	120



T6813AO –UN–29JAN98

TX,07,SB5509 –19–26SEP97–1/1

MEASURE TRACK CHAIN BUSHING WEAR

Minimum used is the maximum allowable wear for turning pins and bushings.

Measure bushing outer diameter at the two worn places using a caliper such as the D17524C1 100 mm Caliper from JT05518A Undercarriage Inspection Service Tool Kit.

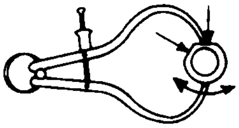
T82865 –UN–08NOV88

TX,01,UU3847 –19–03APR98–1/1

BUSHING OUTER DIAMETER

Allowable Wear—5.0 mm (0.20 in.)

Dimension	Percent Worn
59.0 mm (2.32 in.)	0
58.8 mm (2.31 in.)	5
58.5 mm (2.30 in.)	10
58.3 mm (2.29 in.)	15
58.0 mm (2.28 in.)	20
57.8 mm (2.27 in.)	25
57.5 mm (2.26 in.)	30
57.3 mm (2.25 in.)	35
57.0 mm (2.24 in.)	40
56.8 mm (2.23 in.)	45
56.5 mm (2.22 in.)	50
56.3 mm (2.21 in.)	55
56.0 mm (2.20 in.)	60
55.8 mm (2.19 in.)	65
55.5 mm (2.19 in.)	70
55.3 mm (2.18 in.)	75
55.0 mm (2.17 in.)	80
54.8 mm (2.16 in.)	85
54.5 mm (2.15 in.)	90
54.3 mm (2.14 in.)	95
54.0 mm (2.13 in.)	**100**
53.8 mm (2.12 in.)	105
53.5 mm (2.11 in.)	110
53.3 mm (2.10 in.)	115
53.0 mm (2.09 in.)	120



T6813AK –UN–29JAN98

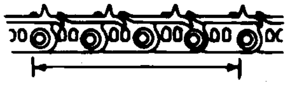
AG,OUOE042,37 –19–10MAR99–1/1

MEASURE TRACK CHAIN PITCH

Maximum used is the maximum allowable wear for turning pins and bushings.

1. Remove slack by putting a wooden block between sprocket and chain; then slowly move machine in reverse to tighten chain.

2. Measure pitch across several four-link sections as shown, except section on either side of master pin, to find average chain wear. Use a tape measure such as the JT05520 Metric Tape from JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.



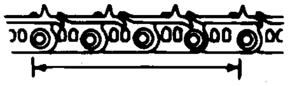
T6813AL —UN–29JAN98

TX,01,UU3848 –19–06MAY98–1/1

PITCH 190.50 MM (7.50 IN.)

Allowable Wear—18.0 mm (0.71 in.)

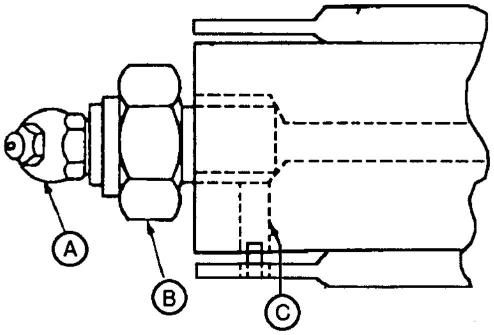
Dimension	Percent Worn
762.0 mm (30.00 in.)	0
762.9 mm (30.04 in.)	5
763.8 mm (30.07 in.)	10
764.7 mm (30.11 in.)	15
765.6 mm (30.14 in.)	20
766.5 mm (30.18 in.)	25
767.4 mm (30.21 in.)	30
768.3 mm (30.25 in.)	35
769.2 mm (30.28 in.)	40
770.1 mm (30.32 in.)	45
771.0 mm (30.35 in.)	50
771.9 mm (30.39 in.)	55
772.8 mm (30.43 in.)	60
773.7 mm (30.46 in.)	65
774.6 mm (30.50 in.)	70
775.5 mm (30.53 in.)	75
776.4 mm (30.57 in.)	80
777.3 mm (30.60 in.)	85
778.2 mm (30.64 in.)	90
779.1 mm (30.67 in.)	95
780.0 mm (30.71 in.)	**100**
780.9 mm (30.74 in.)	105
781.8 mm (30.78 in.)	110
782.7 mm (30.81 in.)	115
783.6 mm (30.85 in.)	120



T6813AL –UN–29JAN98

AG,OUOE042,38 –19–10MAR99–1/1

REMOVE TRACK CHAIN



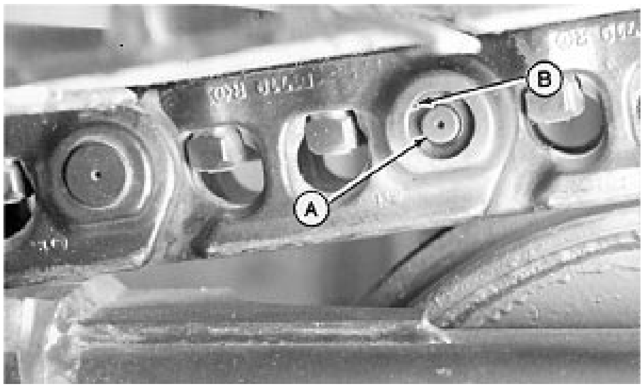
T7396DZ –UN–28NOV90

A—Grease Fitting
B—Valve
C—Bleed Hole

CAUTION: Prevent possible injury from high pressure grease. Do not remove grease fitting (A) from valve (B).

1. Loosen valve (B) one to two turns to release grease through bleed hole (C).

TX,01,UU3849 –19–18SEP98–1/3



T6585TH –UN–25OCT88

A—Master Pin
B—Snap Ring

NOTE: Disconnect track chain at the end of track frame where the work is to be done.

2. Move track chain so master pin (A) is over front idler.
3. Remove snap ring (B).
4. Remove the track shoe on each side of master pin.
5. Put wooden blocks in front of idler and under chain so chain does not fall when master pin is removed.
6. Raise machine so sprocket teeth clear chain.

Continued on next page

TX,01,UU3849 –19–18SEP98–2/3

NOTE: The OD of master pin at the snap ring end is larger than the other end. The master pin OD differences shown are exaggerated.

7. Remove master pin (A) through SNAP RING SIDE of track using a 50-Ton Master Pin Pusher Installer.

8. Pry apart chain and lower end of track.

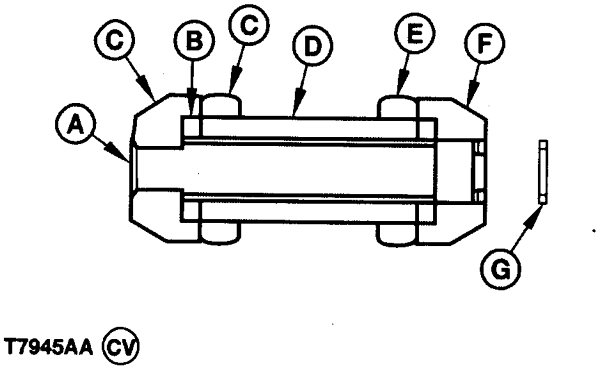
9. Remove spacers (B).

CAUTION: The approximate weight of each track with 800 mm (32 in.) shoes is 1745 kg (3846 lb).

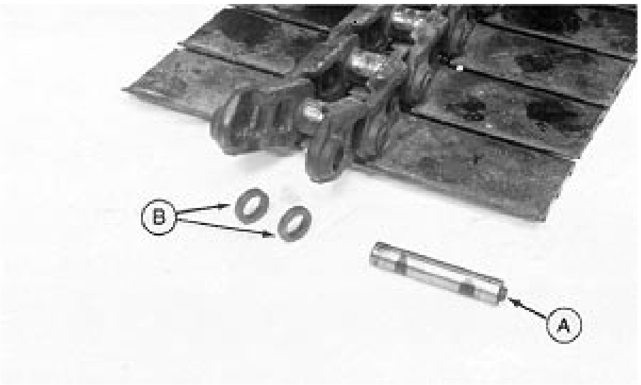
Type I Track 800 mm (32 in.) Shoe—Specification

Weight... 1745 kg (3846 lb) approximate

10. Slowly turn sprocket in reverse direction to remove track chain from excavator.



T7945AA –UN–23APR93



T6876BO –UN–06DEC88

A—Master Pin
B—Spacer (2 used)
C—Link
D—Master Bushing
E—Link
F—Master Link
G—Snap Ring

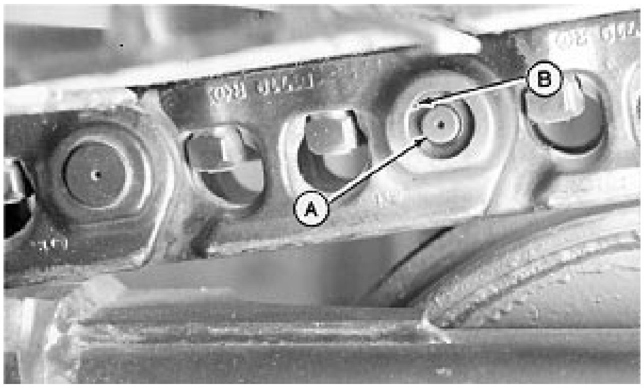
INSTALL TRACK CHAIN

1. Position track chain so section on ground has pin boss on links toward rear of unit.
2. Install end of chain on sprocket and slowly turn sprocket in forward direction to pull chain across top of frame to front idler.
3. Install spacers. Pull ends of chain together.

T6557DN –UN–25OCT88

TX,01,UU3850 –19–18SEP98–1/3

4. Install master pin (A) and snap ring (B) from SNAP RING SIDE of track.
5. Lower machine.



T6585TH –UN–25OCT88

A—Master Pin
B—Snap Ring

Continued on next page

TX,01,UU3850 –19–18SEP98–2/3

6. Apply a light coat of oil to cap screws threads and install shoes.

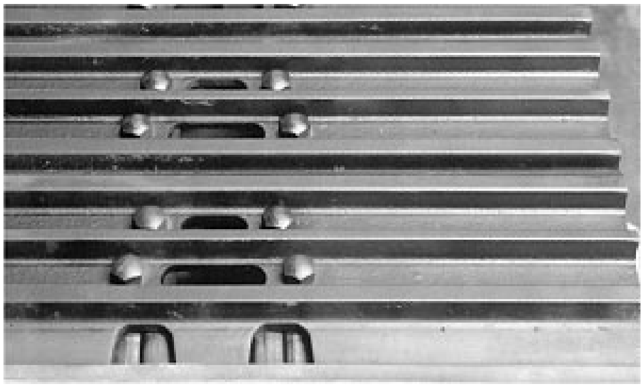
7. Install all track shoe nuts with rounded edges (A) against the link and chamfered edges (B) away from the link. Be sure nut is properly positioned in the link so there is full contact between the nut and the link.

8. Tighten cap screws in the sequence shown.

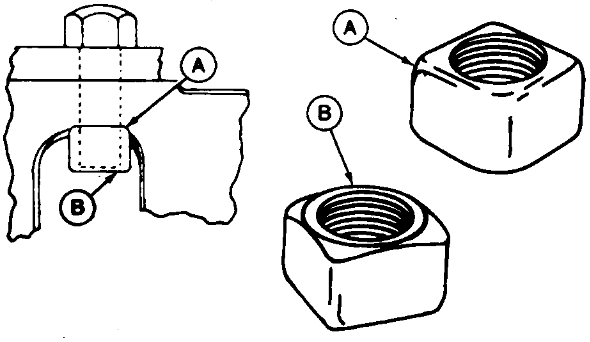
Shoe-to-Link Cap Screw—Specification

Torque .... 298 N•m (220 lb-ft) plus 1/2 turn

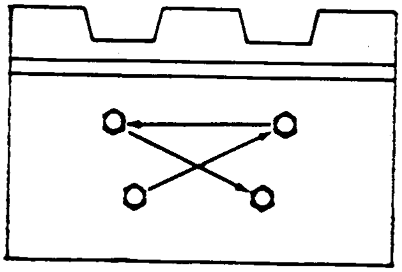
9. Adjust track sag. (See procedure in this group.)



T6557DO –UN–25OCT88



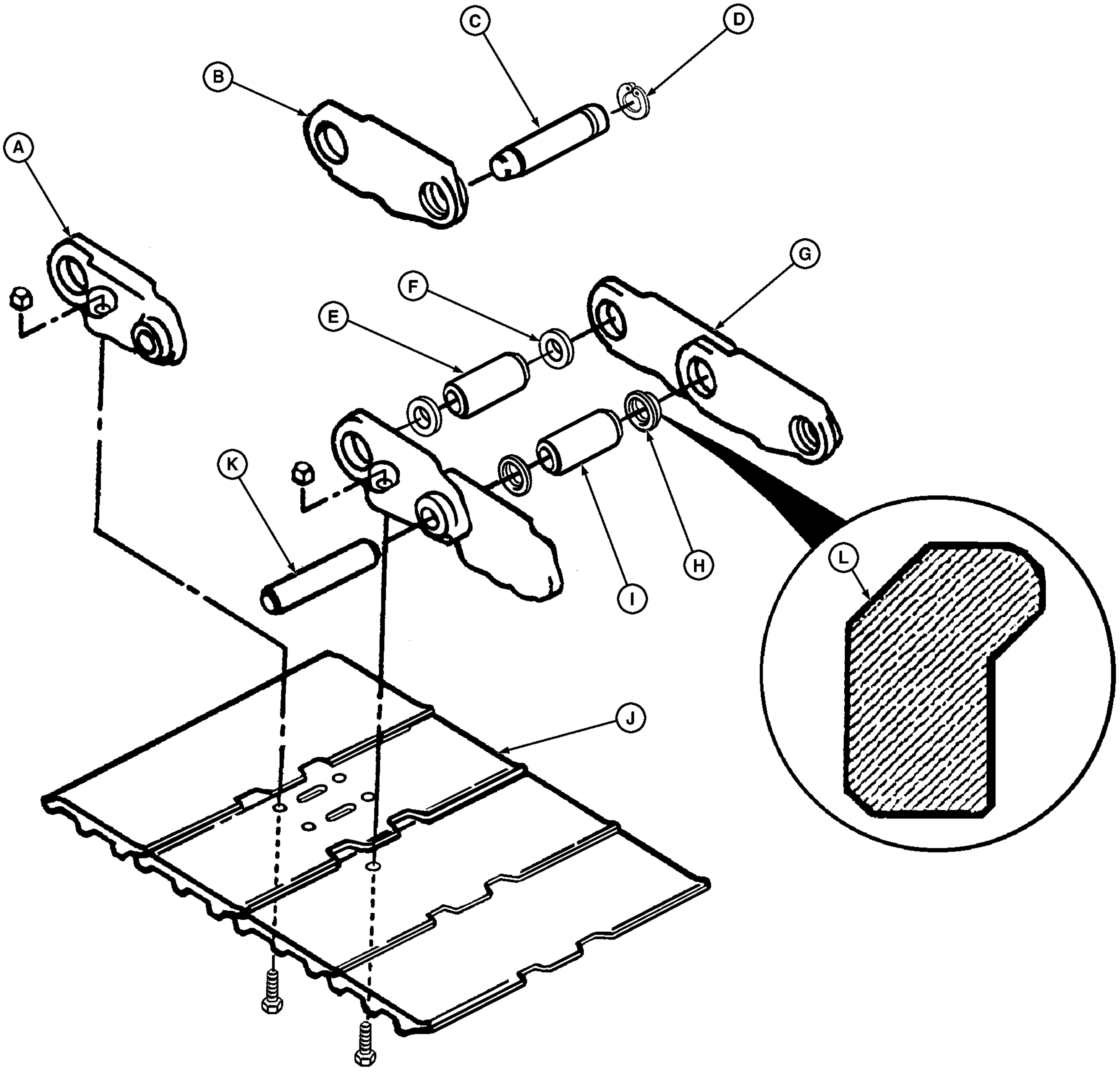
T6794AM –UN–23FEB89



T6352AH –UN–23FEB89

A—Rounded Edge
B—Conferred Edge

DISASSEMBLE AND ASSEMBLE TRACK CHAIN



T117027

T117027 –UN–09SEP98

A—Track Link (51 used)	E—Master Bushing	I—Bushing (50 used)	L—Chamfer Side (Bushing Side)
B—Master Track Link	F—Spacer (2 used)	J—Shoe (51 used)	
C—Master Pin	G—Track Link (50 used)	K—Pin (50 used)	
D—Snap Ring	H—Seal (100 used)		

1. Measure track components (A—K). (See procedures in this group. For more detailed measurements, see the SP326 Undercarriage Appraisal Manual.)

Continued on next page

NOTE: Wear on pins and bushings does not extend over the entire surface. Turning pins and bushing is determined by the amount of wear.

2. Turn pins (C and K) and bushings (E and I). (See the manufacturer's operator manual for your track press.)

3. Clean any dust or rust from the surfaces of track link pin bores and counterbores and the ends of bushings.

4. Apply grease to the counterbore in track links, the seals, and the ends of bushings.

5. For each joint, fill the clearance between the pin OD and bushing ID with grease.

6. Install seal (H) so tapered side (L) is toward bushing.

AG,OUOE042,39 –19–10MAR99–2/2

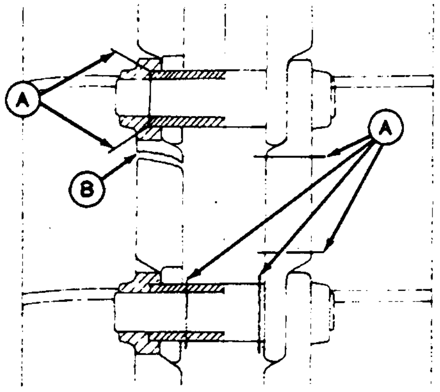
DISASSEMBLE AND ASSEMBLE TRACK CHAIN TO REPLACE BROKEN PART

NOTE: It is not necessary to completely disassemble a chain to replace a broken part. If a track press is available, refer to the operator's manual. If a track press is not available, do the following procedure.

1. Remove track shoe from broken link assembly. Remove the track. (See procedure in this group.)

IMPORTANT: When making cuts using cutting torch, be careful not to cut or gouge good parts.

2. Cut links, bushing, and pin at points (A) to remove broken link (B).



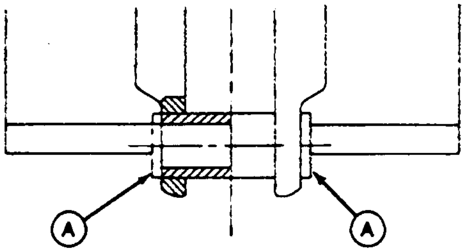
T5821AG –UN–26OCT88

A—Cut Locations
B—Broken Link

Continued on next page

TX,01,UU3852 –19–26SEP98–1/4

3. Grind the ends of bushing (A) even with links to make it into a master bushing.

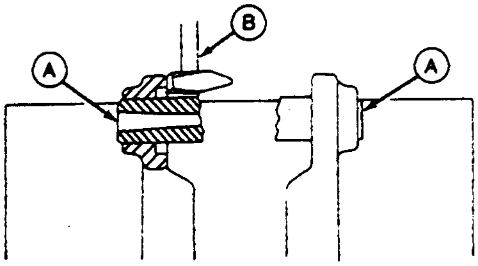


T5821AH –UN–26OCT88

A—Bushing

TX,01,UU3852 –19–26SEP98–2/4

4. Burn holes through center of pin stubs (A).
5. Hold a heavy hammer (B) against the link while pin stub is being driven out.



T5821AI –UN–26OCT88

A—Pin Stub
B—Hammer

Continued on next page

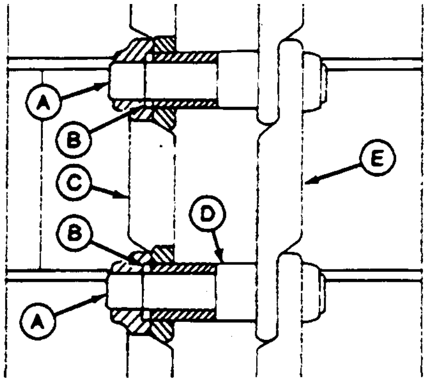
TX,01,UU3852 –19–26SEP98–3/4

NOTE: When new parts are ordered, have dealer assemble the new links and master bushing.

6. Install links (C and E) on master bushing (D). Check cap screw hole spacing using a track shoe.

7. Install spacers (B) into counterbore of links.

8. Install link assembly. Install the master pins (A).

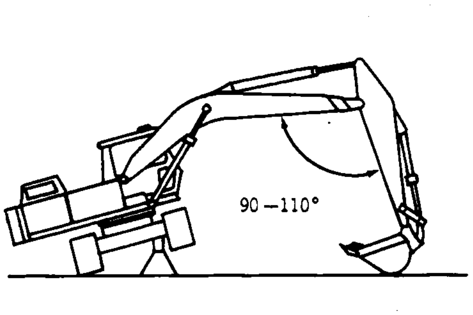


T5821AJ –UN–24MAY89

A—Master Pin
B—Spacer
C—Right Link
D—Master Bushing
E—Left Link

TX,01,UU3852 –19–26SEP98–4/4

ADJUST TRACK SAG



T6876FG –UN–06DEC88

1. Swing upperstructure to side. Lower boom to raise track off the ground.

   Keep the angle between boom and arm at 90—110° with the round side of bucket on the ground.

CAUTION: Prevent possible injury from unexpected machine movement. Put blocks or shop stands under machine frame to support machine while measuring track sag.

The approximate weight of machine is 23 773 kg (52,410 lb).

Machine—Specification

Weight.. 23 773 kg (52,410 lb) approximate

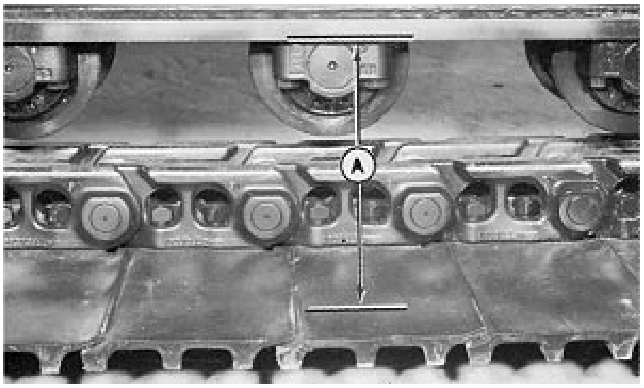
2. Put blocks or shop stands under the machine to support machine.
3. Slowly turn the track forward for two revolutions and then in reverse for two revolutions. Stop the track while moving in reverse direction so all track sag is at the bottom.

Continued on next page

4. Measure track sag (A) at middle track roller from the bottom of tack frame to the top surface of track shoe.

Track—Specification

Sag .... 300—335 mm
(11-13/16—13-3/16 in.)



T6457DL –UN–23FEB89

A—Track Sag

Continued on next page

TX,01,UU3853 –19–18SEP98–2/3

CAUTION: High pressure grease in track adjuster cylinder. Do not remove grease fitting or nut and valve assembly to release grease.

IMPORTANT: Prevent possible damage to track components. Do not use the grease fitting on track adjuster cylinder for lubrication. Use this grease fitting only for track sag adjustment.

5. To decrease track sag, add multi-purpose grease to track adjuster cylinder through grease fitting (A) located in access hole (D) in track frame. Use a grease gun with a maximum capacity of 68 950 kPa (690 bar) (10 000 psi).

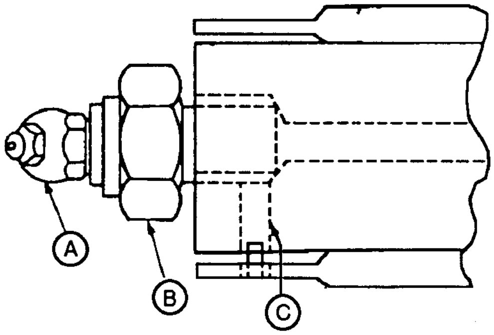
   To increase track sag, loosen nut and valve assembly (B) one turn to release grease from track adjuster cylinder through bleed hole (C) in rod.

   Tighten nut and valve assembly when track sag is correct.

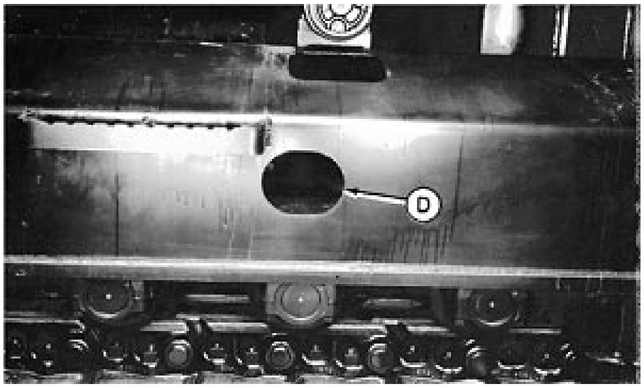
Nut and Valve Assembly—Specification

Torque .... 147 N•m (108 lb-ft)

NOTE: If piston in track adjuster cylinder does not move, remove the cylinder to make repairs. (See Remove and Install Track Adjuster in this group.)



T7396DZ –UN–28NOV90



T7869AQ –UN–22OCT92

A—Grease Fitting
B—Nut and Valve Assembly
C—Bleed Hole
D—Access Hole

REMOVE AND INSTALL SPROCKET

IMPORTANT: Sprocket must be replaced when the tooth tips become excessively rounded, worn, or chipped to prevent excessive wear to chain. If unit is driven in one direction a majority of the time, wear will be on one side of teeth. To extend service life, change sprockets from one side of unit to the other.

1. Disconnect and remove track chain from sprocket (A). (See procedure in this group.)
2. Lift side of unit so sprocket teeth clear chain.
3. Remove cap screws (B).

CAUTION: Approximate weight of sprocket is 45 kg (98 lb).

Sprocket—Specification

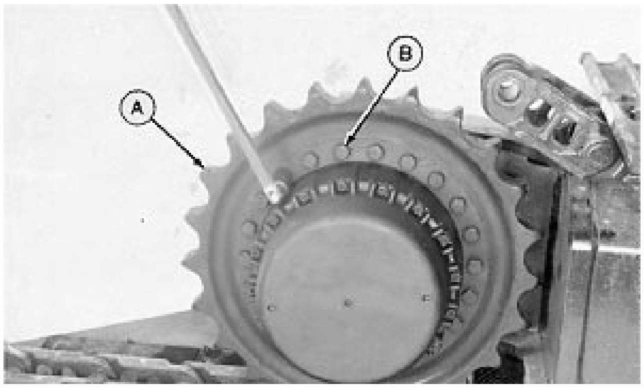
Weight.. 45 kg (98 lb) approximate

4. Attach sprocket to hoist. Remove sprocket from final drive, or move sprocket to other side of machine or replace.
5. Clean threads of cap screws (B) using cure primer. Apply thread lock and sealer (high strength).
6. Install sprocket (A) and tighten cap screws (B).

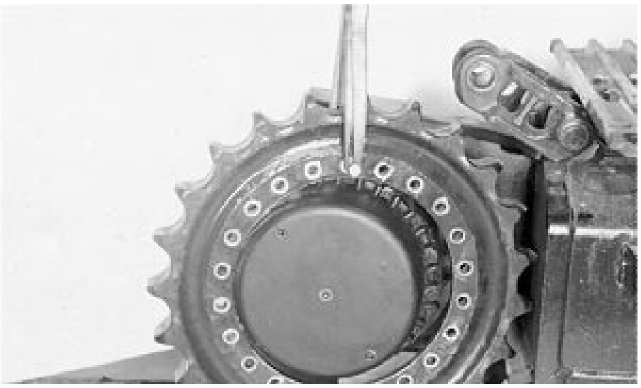
Sprocket Cap Screw—Specification

Torque .... 470 N•m (350 lb-ft)

7. Lower machine.
8. Install track chain. (See procedure in this group.)
9. Adjust track sag. (See procedure in this group.)



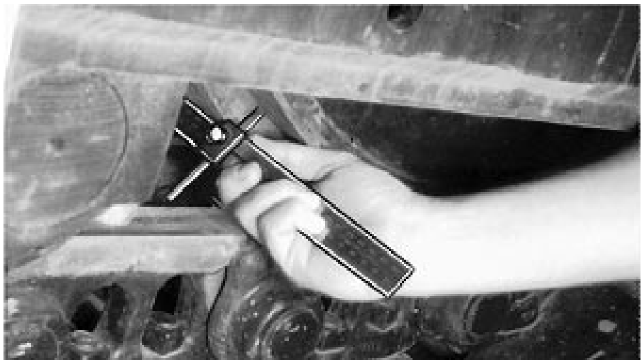
T6876AL –UN–25OCT88



T6876AM –UN–25OCT88

A—Sprocket
B—Cap Screws

MEASURE FRONT IDLER WEAR



T87972 –UN–08NOV88

Maximum used flange height is the maximum allowable height of flange for rebuilding wear surface.

Measure height of flange using a depth gauge such as the JT05521 200 mm Ruler, JT05534 Right Angle Attachment, and D05231ST 300 mm Ruler from JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.

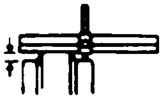
NOTE: See Undercarriage Appraisal Manual SP326 for additional information.

TX,01,UU3855 –19–18SEP98–1/1

FRONT IDLER FLANGE HEIGHT

Allowable Wear—4.0 mm (0.16 in.)

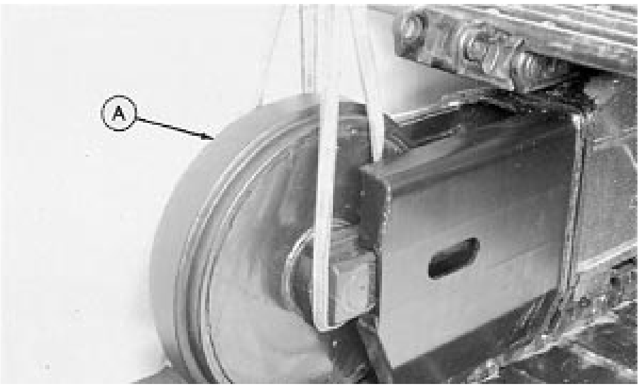
Dimension	Percent Worn
19.0 mm (0.75 in.)	0
19.2 mm (0.76 in.)	5
19.4 mm (0.76 in.)	10
19.6 mm (0.77 in.)	15
19.8 mm (0.78 in.)	20
20.0 mm (0.79 in.)	25
20.2 mm (0.80 in.)	30
20.4 mm (0.80 in.)	35
20.6 mm (0.81 in.)	40
20.8 mm (0.82 in.)	45
21.0 mm (0.83 in.)	50
21.2 mm (0.83 in.)	55
21.4 mm (0.84 in.)	60
21.6 mm (0.85 in.)	65
21.8 mm (0.86 in.)	70
22.0 mm (0.87 in.)	75
22.2 mm (0.87 in.)	80
22.4 mm (0.88 in.)	85
22.6 mm (0.89 in.)	90
22.8 mm (0.90 in.)	95
23.0 mm (0.91 in.)	**100**
23.2 mm (0.91 in.)	105
23.4 mm (0.92 in.)	110
23.6 mm (0.93 in.)	115
23.8 mm (0.94 in.)	120



T6813AR –UN–29JAN98

AG,OUOE042,40 –19–10MAR99–1/1

REMOVE AND INSTALL FRONT IDLER



T6876BU –UN–25OCT88

A—Front Idler

1. Disconnect track chain. (See procedure in this group.)

2. Slide front idler (A) forward, using pry bar.

⚠ **CAUTION: The approximate weight of front idler with yoke is 113 kg (250 lb).**

Front Idler with Yoke—Specification

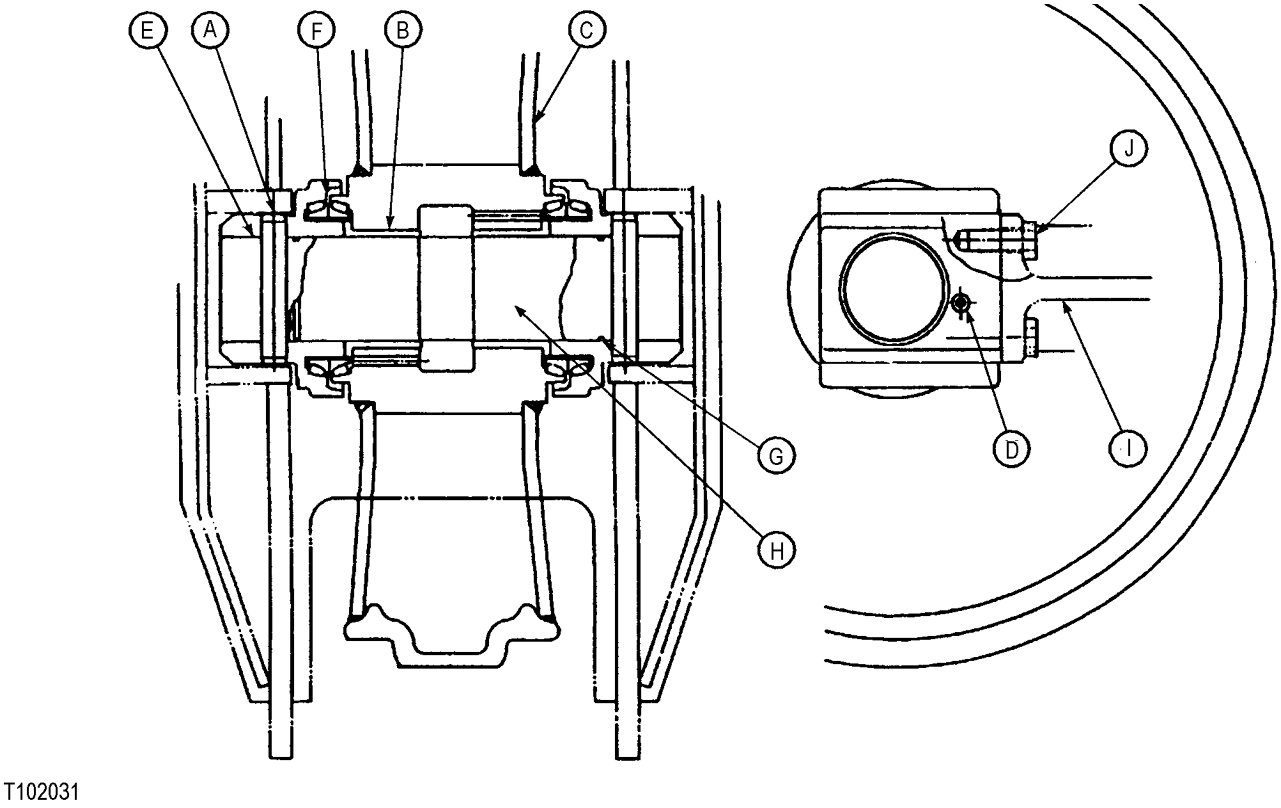
Weight... 113 kg (250 lb) approximate

3. Attach front idler to hoist, remove from frame, and repair or replace idler. (See procedure in this group.)

4. Install front idler and slide rearward into frame as far as possible.

TX,01,UU3856 –19–18SEP98–1/1

DISASSEMBLE FRONT IDLER



T102031 –UN–12JUL96

A—Pin (2 used)	D—Plug (2 used)	F—Metal Face Seal (2 used)	H—Axle
B—Bushing (2 used)	E—Bracket (Bearing) (2 used)	G—O-Ring (2 used)	I—Yoke
C—Idler			J—Cap Screw (4 used)

1. Remove cap screws (J). Remove yoke (I).

2. Remove drain plug (D) and drain oil.

IMPORTANT: Metal face seals can be reused if they are not worn or damaged. A used seal must be kept together as a set because of wear patterns on seal ring face.

3. Remove pins (A), brackets (E), O-rings (G) and metal face seals (F).

4. Inspect metal face seals. (See procedure in this group.) Keep seal rings together as a matched set with seal ring faces together to protect surfaces.

5. Remove axle (H). Inspect axle and bushing for scoring or excessive wear.

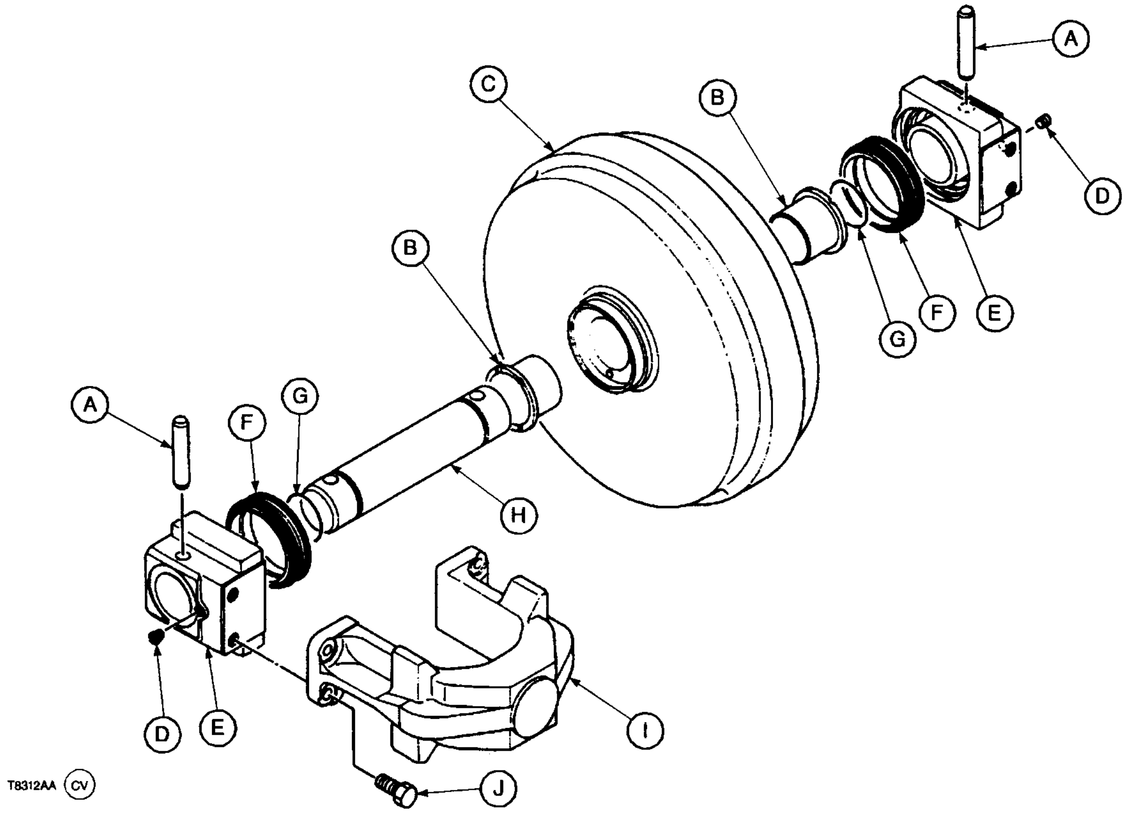
NOTE: Remove bushings only if replacement is necessary.

6. Remove bushing using a 2-jaw puller and adapters from 17-1/2 and 30-ton puller set.

7. Replace parts as necessary.

TX,01,UU3857 –19–18SEP98–1/1

ASSEMBLE FRONT IDLER



T8312AA –UN–21SEP94

A—Pin (2 used)
B—Bushing (2 used)
C—Idler
D—Plug (2 used)
E—Bracket (Bearing) (2 used)
F—Metal Face Seal (2 used)
G—O-Ring (2 used)
H—Axle
I—Yoke
J—Cap Screw (4 used)

1. Apply a thin film of oil to bushings (B). Install bushings so flange is tight against shoulder of idler.

2. Install O-rings (G) on axle.

3. Apply a thin layer of NEVER-SEEZ® lubricant or an equivalent to end of axle from O-ring to end of axle and to bore in bracket (E).

4. Install axle into bracket.

5. Apply NEVER-SEEZ® lubricant or an equivalent to pin (A). Install pin.

IMPORTANT: O-rings and seat surfaces for O-rings must be clean, dry, and oil free so O-rings do not slip when idler is turning.

6. Thoroughly clean the O-rings and seat surfaces in idler, brackets, and seal rings using volatile, non-petroleum base solvent and lint-free tissues.

7. Install O-ring on seal rings.

NOTE: A volatile, non-petroleum base solvent or talcum powder may be used as a lubricant.

8. Install seals in bracket and idler. Apply equal pressure with fingers at four equally spaced points on seal face. Seal must “pop” down into place so O-ring is tight against seal bore.

NEVER-SEEZ is a trademark of Emhart Chemical Group.

Continued on next page

9. Wipe finger prints and foreign material off seal ring face using clean oil and lint-free tissues. Apply a thin film of oil to each seal face.
10. Install axle (H) into idler.
11. Repeat procedure for other side of idler.
12. Fill front idler with approximately 265 mL (8.96 oz) of oil. (See Track Roller, Front Idler and Carrier Roller Oil in Group 0004.)
13. Clean threads of drain plug (D) using cure primer.
14. Apply thread lock and sealer (medium strength) to threads of plug and install.
15. Install yoke (I). Tighten cap screws (J).

Yoke-to-Bracket Cap Screw—Specification

Torque.. 206 N•m (152 lb-ft)

TX,01,UU3858 –19–18SEP98–2/2

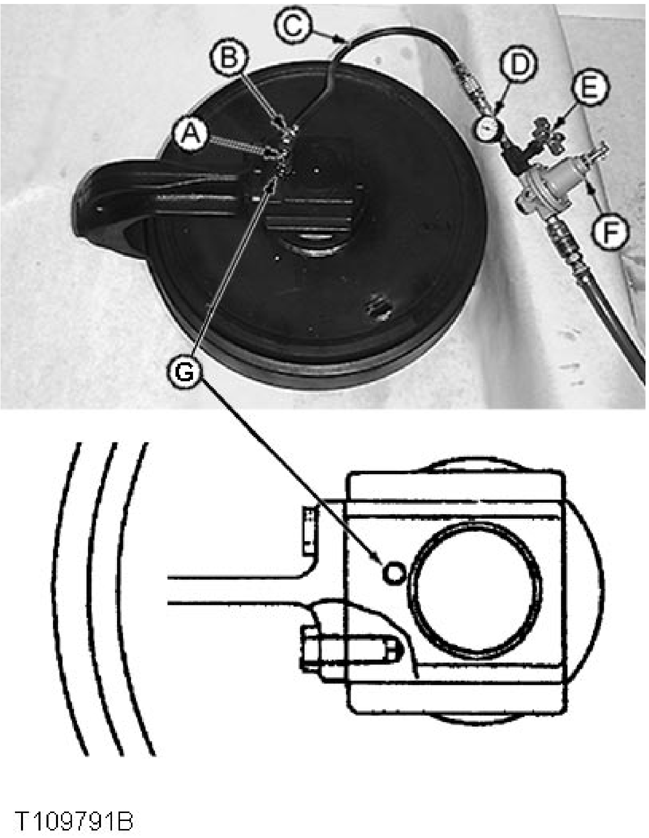
TEST FRONT IDLER FOR OIL LEAKAGE

1. Turn the shaft several turns to seat metal face seals.
2. Remove plug (G).
3. Install parts (A—F) as shown. Plug, adapter, and connector are from a leak detector kit such as the D05361ST Rubber Stopper/Leak Detector Kit.
4. Holding plug so it is not pushed out, slowly pressurize oil cavity using air.

Oil Cavity Air Test—Specification

Pressure .... 110 ± 28 kPa (1.1 ± 0.3 bar) (16 ± 4 psi)

5. Close valve and wait for a minimum of 30 seconds to check for oil leakage. Check gauge to see if air pressure has decreased.
6. If there is external leakage, disassemble idler and replace parts as necessary.
7. Check oil level in idler. If the oil level is down and there is no external leakage, check for a leak from oil cavity to interior of idler wheel.
8. Clean threads of plug using cure primer.
9. Apply thread lock and sealer (medium strength) to threads of plug. Install and tighten plug.



T109791B –UN–13JUN97

A—Plug, Adapter and Connector
B—Connector 1/8 M NPT x 7/16-20 M 37°
C—Hose
D—Pressure Gauge
E—Snubber (Needle) Valve
F—Air Pressure Regulator
G—Drain Plug

TX,01,UU3859 –19–18SEP98–1/1

REMOVE AND INSTALL TRACK ADJUSTER AND RECOIL SPRING

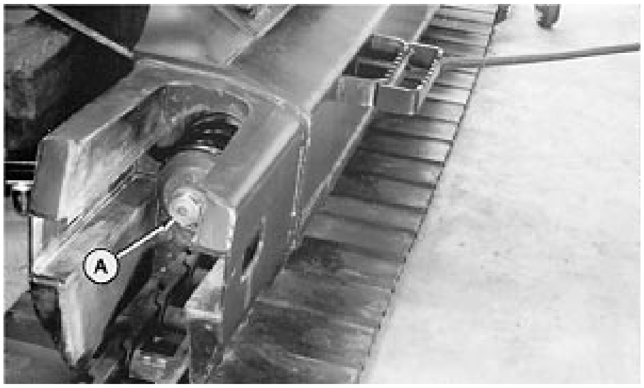
1. Remove track chain and front idler. (See procedures in this group.)

TX,01,UU3860 –19–18SEP98–1/3

CAUTION: Spring or rod may break if dropped while handling, transporting or disassembling. Nicks or weld craters in spring and rod assembly can cause stress concentration resulting in a weak spot. Weak spots may result in immediate or eventual failure creating a risk of personal injury. Put a heavy protective covering around spring assembly when handling, transporting, or disassembling track adjuster.

A compression tool must be used for disassembly and assembly because of the extreme preload on spring.

2. Slide track adjuster (A) forward, using a pry bar.



T6557CX –UN–25OCT88

A—Track Adjuster

Continued on next page

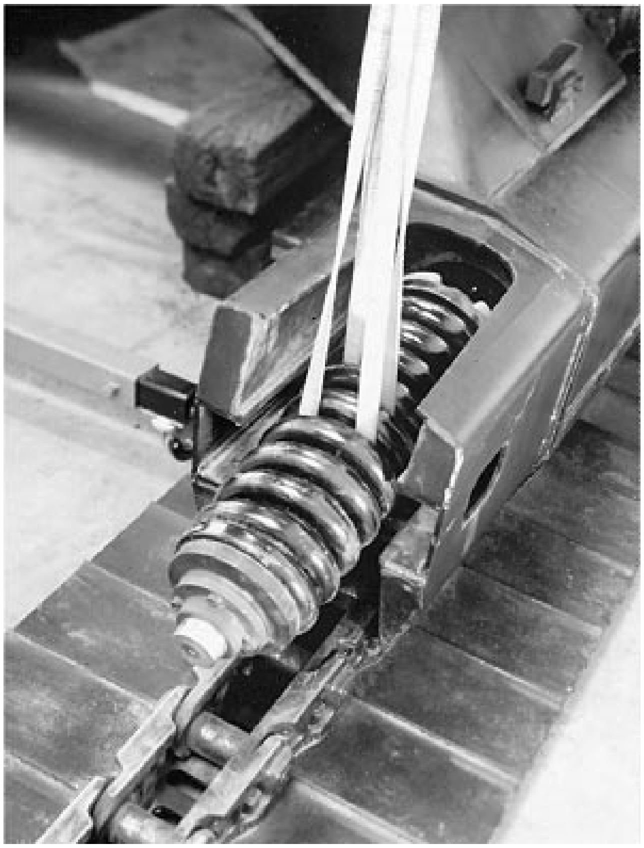
TX,01,UU3860 –19–18SEP98–2/3

CAUTION: The approximate weight of track adjuster cylinder and recoil spring is 118 kg (260 lb).

Track Adjuster Cylinder and Recoil Spring—Specification

Weight.. 118 kg (260 lb) approximate

3. Attach track adjuster to hoist, remove from frame, and repair or replace.



T6557CY –UN–25OCT88

TX,01,UU3860 –19–18SEP98–3/3

DISASSEMBLE AND ASSEMBLE TRACK ADJUSTER AND RECOIL SPRING

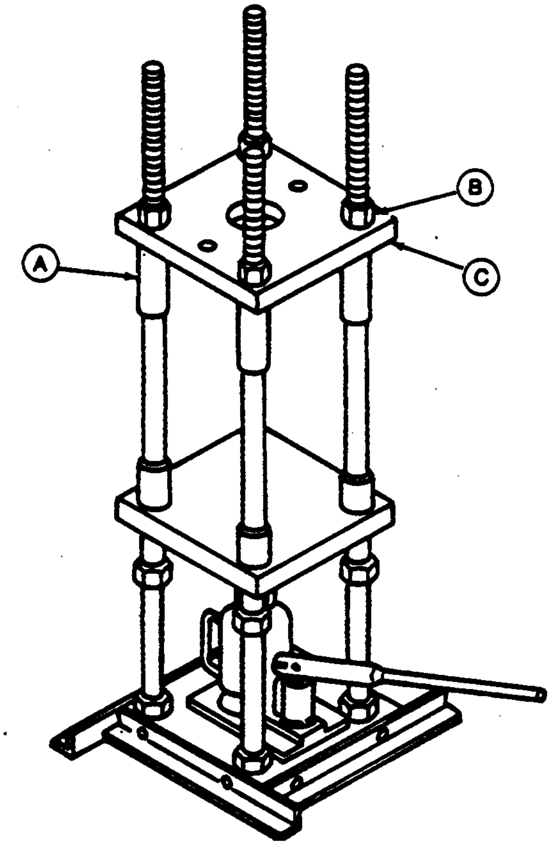
⚠ **CAUTION: Spring or rod may break if dropped while handling, transporting or disassembling. Nicks or weld craters in spring and rod assembly can cause stress concentration resulting in a weak spot. Weak spots may result in immediate or eventual failure creating a risk of personal injury. Put a heavy protective covering around spring assembly when handling, transporting, or disassembling track adjuster.**

A compression tool must be used for disassembly and assembly because of the extreme preload on spring.

⚠ **CAUTION: The approximate weight of track recoil spring disassembly and assembly tool is 225 kg (496 lb).**

Track Recoil Spring Disassembly and Assembly Tool—Specification

Weight.. 225 kg (496 lb) approximate



T6557DY –UN–25OCT88

A—Recoil Spring Disassembly and Assembly Tool
B—Nuts
C—Top Plate

1. Place an 18-t (20-ton) jack on bottom of ST4920 Track Recoil Spring Disassembly and Assembly Tool (A). Remove nuts (B) and top plate (C). (See Section 99 for instruction to make tool.)

NOTE: It is not necessary to remove the recoil spring to replace wear ring and U-ring packing on piston. To replace O-ring in the cylinder, remove recoil spring and rod.

2. Remove nuts (B). Remove top plate (C).

Continued on next page

CAUTION: The approximate weight of track adjuster and recoil spring is 118 kg (260 lb).

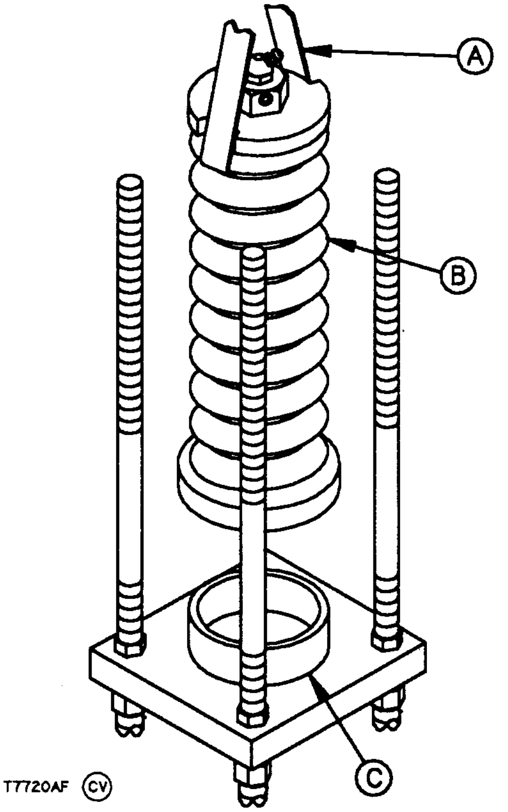
Track Adjuster Cylinder and Recoil Spring—Specification

Weight... 118 kg (260 lb) approximate

3. Connect track adjuster (B) to a hoist using a lifting strap (A).

4. Put track adjuster in assembly tool with cylinder end on DFT1110 Spacer (C). (See Section 99 For Instructions To Make Tool.)

5. Remove lifting strap.



T7720AF –UN–28APR92

A—Lifting Strap
B—Track Adjuster
C—DFT1110 Spacer

Continued on next page

6. Install DFT1087 Track Recoil Spring Disassembly and Assembly Guard Tool (F). (See Section 99 for instruction to make tool.)

7. Install plate (A) (plate with smallest opening to allow access to nut (D)) and nuts (B) .

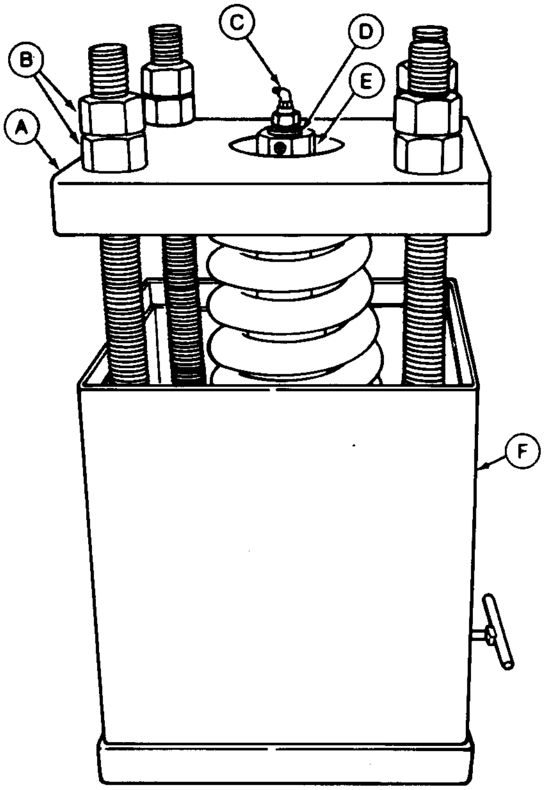
8. Extend jack ram so there is enough travel to release recoil spring to the approximate free length.

Recoil Spring—Specification

Free Length .... 689 mm (27 in.) approximate

9. Tighten nuts (B) so plate is tight against retainer plate.

10. Remove valve (C). Remove special plug (E).



T7720AG –UN–28APR92

A—Top Plate
B—Nut (8 used)
C—Valve
D—Nut
E—Special Plug
F—DFT1087 Track Recoil Spring Disassembly and Assembly Guard Tool

Continued on next page

11. Raise upper half of guard tool (F). Tighten T-handles.

12. Operate jack to compress spring just enough so nut (D) can be removed.

13. Lower jack ram to release spring force.

14. Disassemble and assemble track adjuster cylinder. (See procedure in this group.)

15. Put track adjuster cylinder in assembly in assembly tool with cylinder end on spacer.

16. Install spacer on rod.

17. Install spring using a hoist and lifting strap.

18. Install retainer plate.

19. Install guard tool.

20. Install top plate. Install nuts.

21. Raise upper half of guard tool. Tighten T-handles.

22. Operate jack to compress spring to the compressed length.

Recoil Spring—Specification

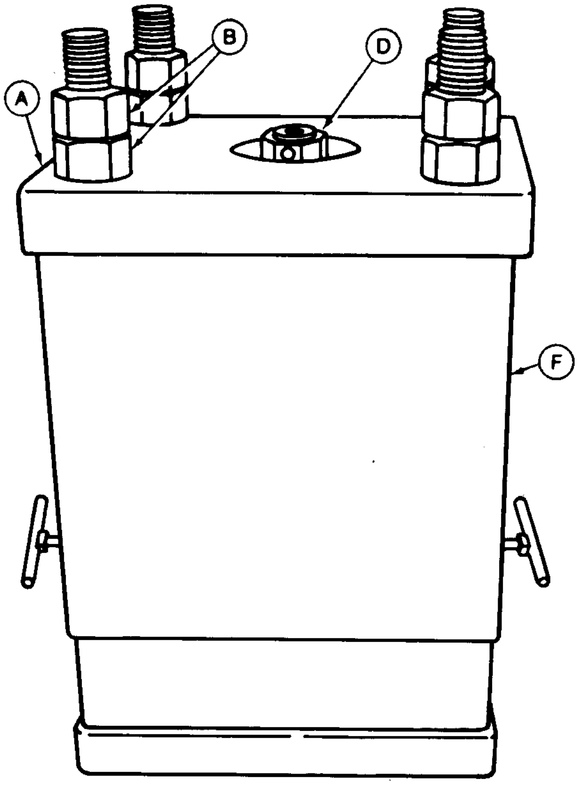
Compressed Length .... 577 mm (22.7 in.)

23. Install nut (D) so hole is aligned with hole in rod. Install special plug.

24. Tighten valve.

Valve—Specification

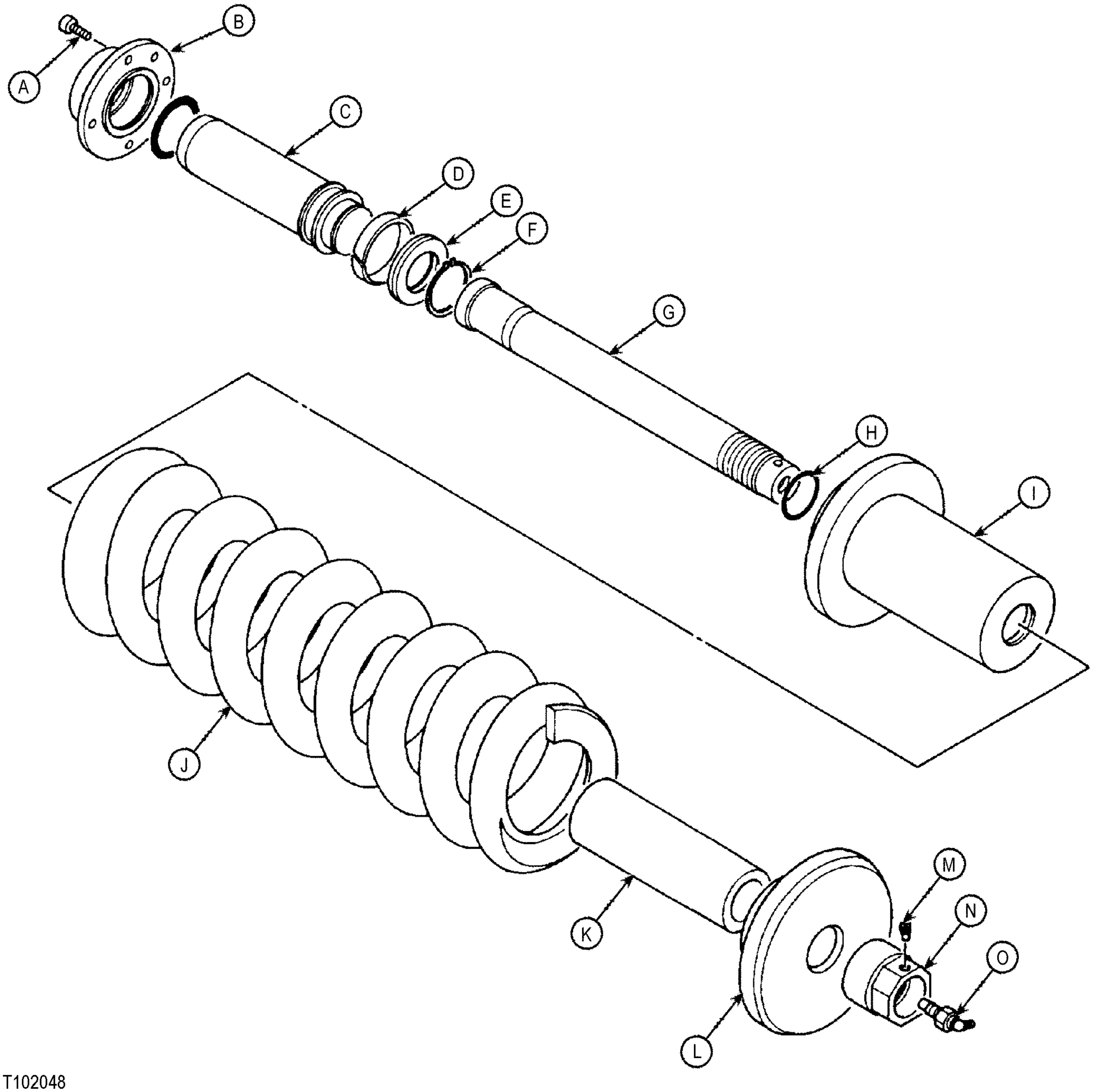
Torque .... 147 N•m (110 lb-ft)



T7720AH –UN–28APR92

A—Top Plate
B—Nut (8 used)
D—Nut
F—DFT1087 Track Recoil Spring Disassembly and Assembly Guard Tool

DISASSEMBLE AND ASSEMBLE TRACK ADJUSTER CYLINDER



T102048 –UN–15JUL96

A—Cap Screw
B—Flange
C—Piston (Rod)
D—Wear Ring
E—U-Ring Packing
F—Snap Ring
G—Rod
H—O-Ring
I—Cylinder
J—Recoil Spring
K—Spacer
L—Retainer Plate
M—Special Plug
N—Nut
O—Valve

Continued on next page

CAUTION: Spring or rod may break if dropped while handling, transporting or disassembling. Nicks or weld craters in spring and rod assembly can cause stress concentration resulting in a weak spot. Weak spots can result in immediate or eventual failure of spring or rod creating a risk of personal injury. Put a heavy protective covering around spring assembly when handling, transporting, or disassembling.

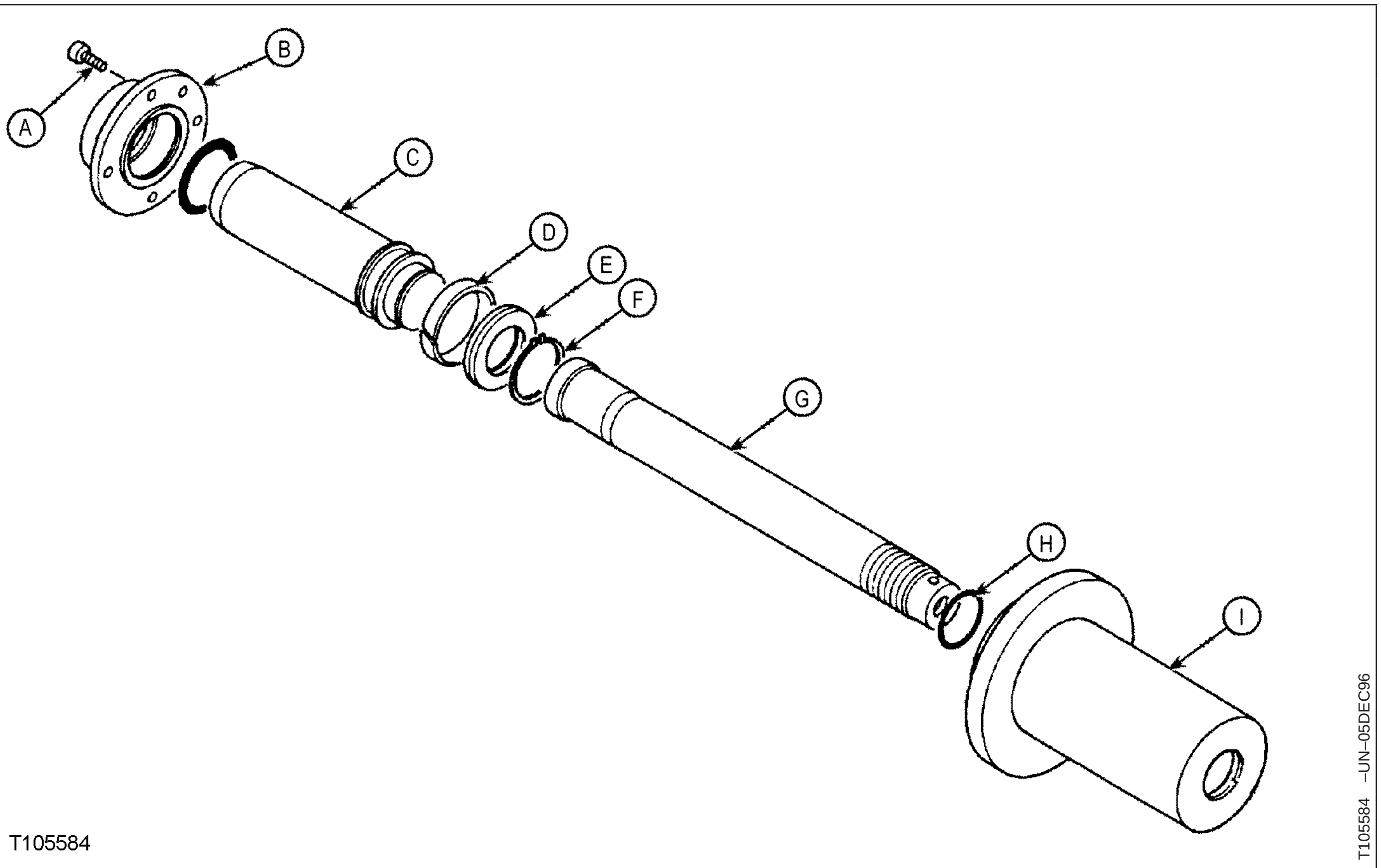
A compression tool must be used for disassembly and assembly because of the extreme preload on spring.

NOTE: It is not necessary to remove the recoil spring to replace wear ring (D) and U-ring packing (E). To replace O-ring (H), remove recoil spring (J) and rod (G). The recoil spring is removed using the ST4920 Track Recoil Spring Disassembly and Assembly Tool. (See procedure in this group.)

1. Remove recoil spring if necessary. (See Disassemble and Assemble Track Adjuster and Recoil Spring in this group.)

Continued on next page

TX,01,UU3862 –19–18SEP98–2/3



A—Cap Screw
B—Flange
C—Piston (Rod)
D—Wear Ring
E—U-Ring Packing
F—Snap Ring
G—Rod
H—O-Ring
I—Cylinder

2. If necessary, remove rod (G) from cylinder (I) using a press.

3. Repair or replace parts as necessary.

4. Apply multi-purpose grease to U-ring packing (E), wear ring (D), and O-ring (H). Fill grooves inside flange (B) with grease.

5. Install U-ring packing (E) with lip towards inside of cylinder.

6. Tighten cap screws (A).

Flange-to-Rod Cap Screw—Specification

Torque... 64 N•m (47 lb-ft)

TX,01,UU3862 –19–18SEP98–3/3

CHAPTER 12

SECTION 02

AXLES AND SUSPENSION SYSTEMS (PROPEL) REPAIR

BLANK

Group 0250
Axle Shaft, Bearings, and Reduction Gears

SERVICE EQUIPMENT AND TOOLS

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC). Some tools may be available from a local supplier.

SERVICEGARD is a trademark of Deere & Company.

CED,OUOE003,506 –19–15MAY98–1/4

Propel Gearbox Nut Wrench . . . . DFT1036A[1]

To remove and install propel gearbox nut.

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[1] *Fabricated tool, dealer made. (See Section 99 for instructions to make tool.)*

CED,OUOE003,506 –19–15MAY98–2/4

Holding Bar . . . . DFT1109[1]

Used as a support guide when removing and installing propel gearbox nut.

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[1] *Fabricated tool, dealer made. (See Section 99 for instructions to make tool.)*

CED,OUOE003,506 –19–15MAY98–3/4

Lifting Bracket JT01748

To remove and install ring gear, drum and sprocket.

CED,OUOE003,506 –19–15MAY98–4/4

OTHER MATERIAL

Number	Name	Use
TY16285 (U.S.) TY9485 (Canadian) 7649 (LOCTITE®)	Cure Primer	Cleans and cures surface prior to application of adhesives or sealants.
T43513 (U.S.) TY9474 (Canadian) 271 (LOCTITE®)	Thread Lock and Sealer (High Strength)	Apply to threads of sprocket cap screws.
17430 (LOCTITE®) TY16021 (U.S.) TY9484 (Canadian)	High Flex Form-in-Place Gasket	Apply to mounting surface of drum.
T43514 (U.S.) TY9475 (Canadian) 277 (LOCTITE®)	Plastic Gasket	To provide a gasket-type seal between propel gearbox and cover.
TY9375 (U.S.) TY9480 (Canadian) 592 (LOCTITE®)	Pipe Sealant	Apply to threads of gearbox fill plug.

LOCTITE is a trademark of Loctite Corp.

CED,OUOE003,568 –19–19MAY98–1/1

SPECIFICATIONS

Item	Measurement	Specification
Propel Gearbox:		
Propel Motor and Gearbox	Weight	330 kg (728 lb) approximate
Propel Gearbox and Motor-to-Frame Cap Screw	Torque	620 N•m (460 lb-ft)
Third Planet Carrier and Gears	Weight	40 kg (88 lb) approximate
Ring Gear, Drum, and Sprocket	Weight	140 kg (310 lb)
Sprocket-to-Drum Cap Screw	Torque	470 N•m (345 lb-ft)
Ring Gear-to-Drum Cap Screw	Torque	265 N•m (195 lb-ft)
Roller Bearing Cone	Temperature	50—70°C (122—158°F)
Hub-to-Propel Motor Housing Bearing Nut	Torque	785 N•m (580 lb-ft) then tap on ring gear using a plastic hammer, turn three times right and left to seat bearing, repeat procedure
Bearing Nut-to-Hub Dowel Pin	Distance	14 mm (0.55 in.) below surface of bearing nut
Cover-to-Ring Gear Cap Screw	Torque	110 N•m (80 lb-ft)
Fill Plug	Torque	50 N•m (35 lb-ft)

CED,OUOE003,1154 –19–18SEP98–1/1

TOWING THE EXCAVATOR

CAUTION: Prevent possible injury from unexpected machine movement. Block both tracks when disconnecting propel gearboxes. When propel gearboxes are disconnected, machine has no brakes and can move. The machine will roll free on a slope or while being towed.

IMPORTANT: Planetary drive shaft must be removed when towing unit to prevent damage to equipment.

1. Block tracks.

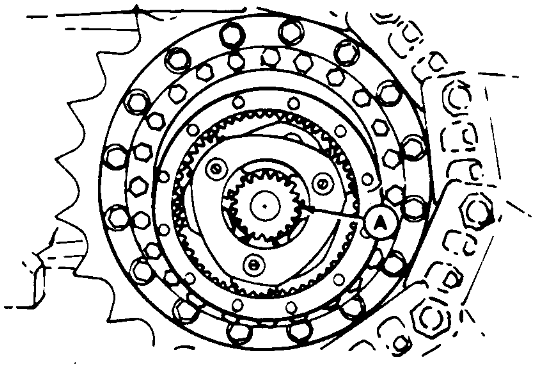
2. Drain oil from each propel gearbox. Approximate oil capacity is 6.0 L (6.5 qt).

3. Remove cover from each gearbox.

TX,02,UU3720 –19–06MAY98–1/3

4. Remove sun gear (A) from each gearbox.

5. Install cover. Fill gearbox with oil. (See Swing Gearbox and Propel Gearbox Oils in Group 0004.)



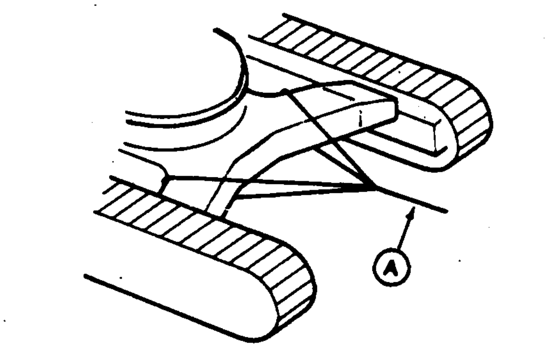
T6879EG –UN–06DEC88

A—Sun Gear

Continued on next page

TX,02,UU3720 –19–06MAY98–2/3

6. Attach a tow line (A) around machine's frame as shown.



T6457DV –UN–18OCT88

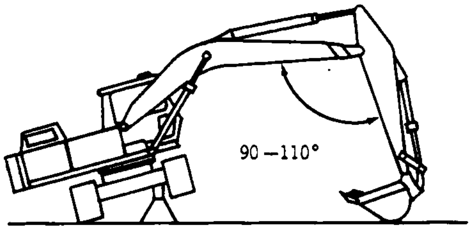
A—Tow Line

TX,02,UU3720 –19–06MAY98–3/3

REMOVE AND INSTALL PROPEL GEARBOX

1. Swing upperstructure 90° and lower bucket to raise track off ground. Keep angle between boom and arm 90—110° and position round side of bucket on ground.

2. Disconnect track. (See Remove Track Chain, Group 0130.)



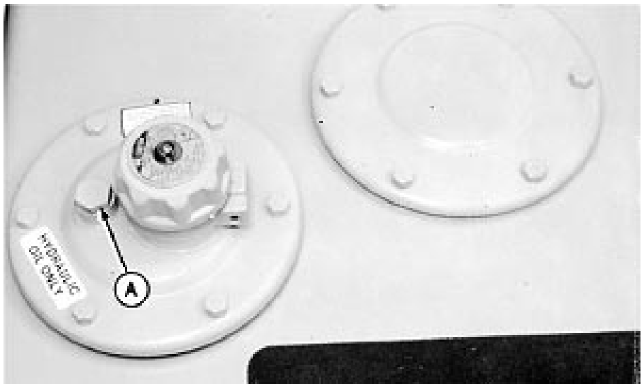
T6876FG –UN–06DEC88

TX,02,UU3721 –19–18SEP98–1/3

CAUTION: Explosive release of oil from pressurized system can cause serious burns or penetrating injury. The hydraulic oil tank is pressurized.

3. Loosen vent plug (A) to relieve hydraulic pressure in hydraulic oil tank.

4. Remove propel motor cover.



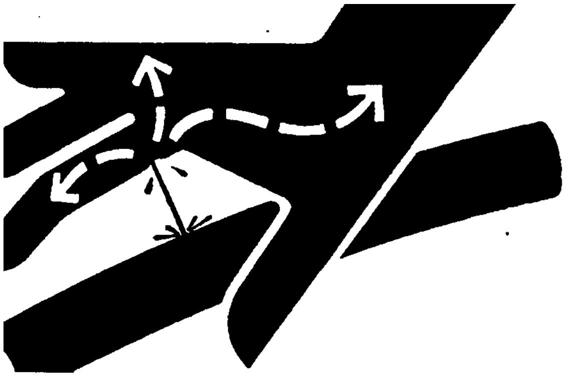
T7869AT –UN–12NOV92

A—Vent Plug

Continued on next page

TX,02,UU3721 –19–18SEP98–2/3

CAUTION: To avoid injury from escaping fluid under pressure, stop engine, and relieve the pressure in the system before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.



X9811 –UN–23AUG88

5. Disconnect and plug hoses (A, B, E, and F).

CAUTION: The approximate weight of propel motor and gearbox is 330 kg (728 lb).

Propel Motor and Gearbox—Specification

Weight... 330 kg (728 lb) approximate

6. Attach propel gearbox and motor to hoist using lifting straps.

NOTE: Propel motor is removed with the gearbox because motor housing is part of gearbox. For propel motor repair, see Group 0260.

7. Remove cap screws and washers (C). Remove gearbox and motor.

8. Replace parts as necessary.

9. Install propel gearbox and motor to frame. Tighten cap screws.

Propel Gearbox and Motor-to-Frame Cap Screw—Specification

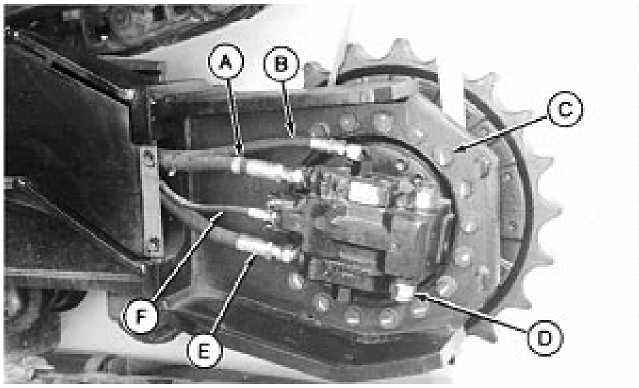
Torque .... 620 N•m (460 lb-ft)

10. Connect lines (A, B, E, and F).

11. Install propel motor cover.

12. Fill propel gearbox.

13. Perform propel motor start-up procedure. (See procedure in Group 0260.)

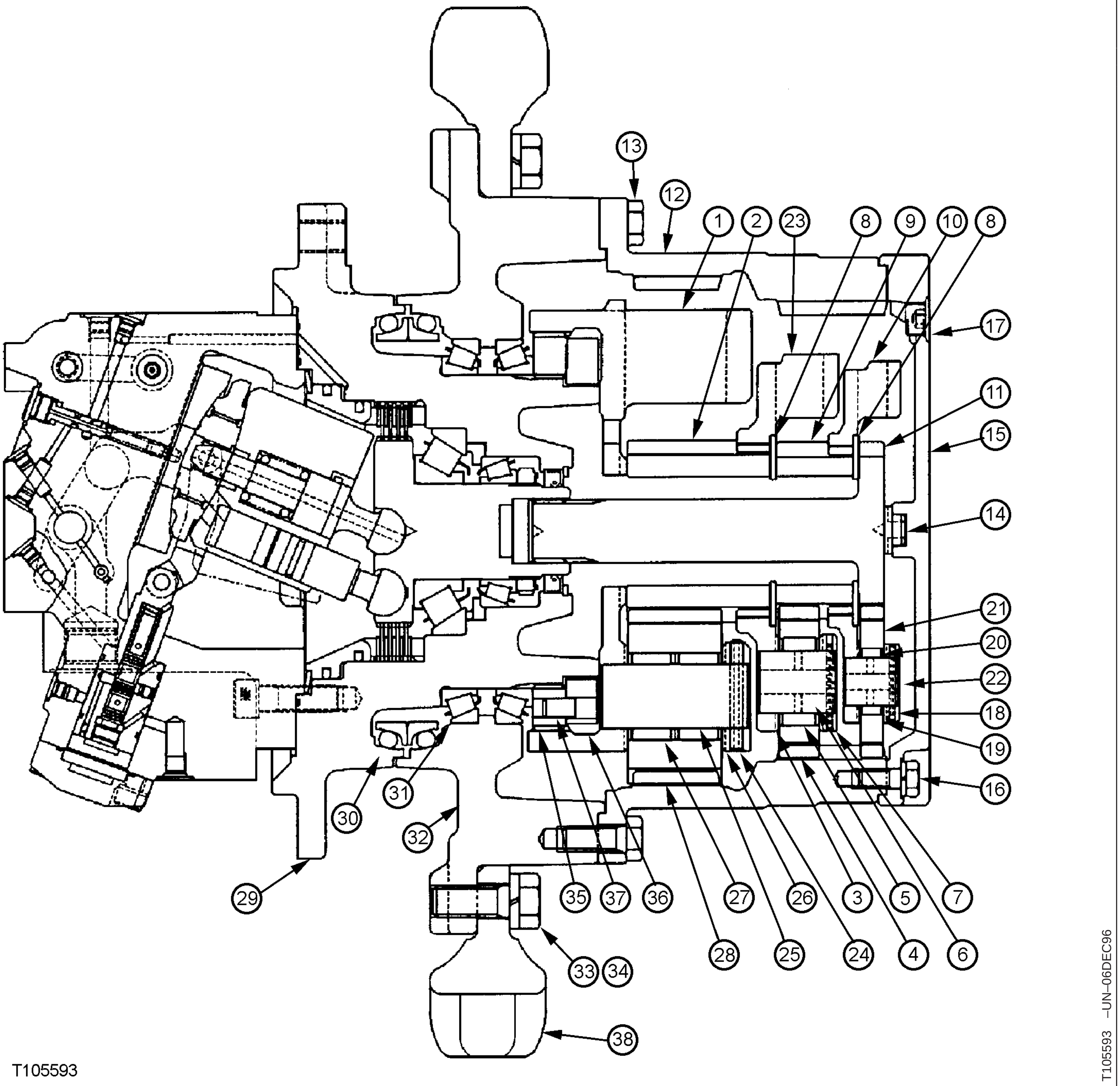


T7685HI –UN–10APR92

Right Propel Motor Shown

A—Right Propel Top Port (Reverse)-to-Rotary Manifold Bottom Port
—Left Propel Bottom Port (Reverse)-to-Rotary Manifold Bottom Port
B—Drain Port-to-Rotary Manifold Drain Port
C—Cap Screw and Washer (14 used)
D—Crossover Relief Valve (2 used)
E—Right Propel Bottom Port (Forward)-to-Rotary Manifold Top Port
—Left Propel Top Port (Forward)-to-Rotary Manifold Top Port
F—Speed Change Port-to-Rotary Manifold Port

DISASSEMBLE PROPEL GEARBOX



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Axle Shaft, Bearings, and Reduction Gears

1—Third Planet Carrier
2—Third Planet Sun Gear
3—Thrust Plate (6 used)
4—Second Planet Gear
5—Needle Bearing (3 used)
6—Pin (3 used)
7—Spring Pin (3 used)
8—Washer (2 used)
9—Second Planet Sun Gear
10—First Planet Carrier
11—Input Shaft
12—Ring Gear
13—Cap Screw (24 used)
14—Thrust Pad
15—Cover
16—Cap Screw (12 used)
17—Plug (3 used)
18—Spring Pin (3 used)
19—Thrust Plate (6 used)
20—Needle Bearing (3 used)
21—First Planet Gear
22—Pin (3 used)
23—Second Planet Carrier
24—Spring Pin (3 used)
25—Pin (3 used)
26—Thrust Plate (6 used)
27—Needle Bearing (6 used)
28—Third Planet Gear (3 used)
29—Propel Motor
30—Metal Face Seal
31—Roller Bearing (2 used)
32—Drum
33—Spring Washer (16 used)
34—Cap Screw (16 used)
35—Hub
36—Bearing Nut
37—Dowel Pin
38—Sprocket

TX,02,UU3672 –19–18SEP98–2/11

CAUTION: The approximate weight of propel motor and gearbox is 330 kg (728 lb).

Propel Motor and Gearbox—Specification

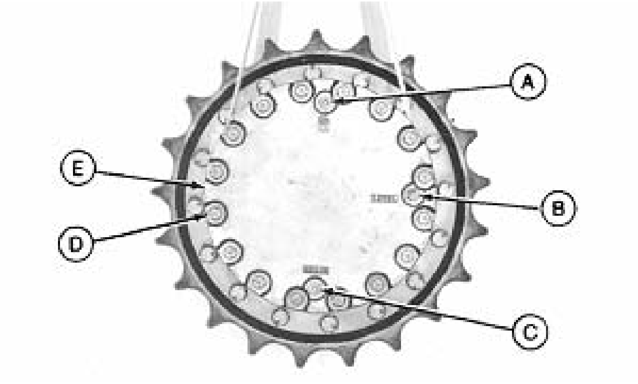
Weight.. 330 kg (728 lb) approximate

1. Remove propel gearbox.(See procedure in this group.)

2. Loosen fill plug (A).

3. Remove drain plug (C). Drain oil. Approximate capacity is 6.0 L (6.5 qt).

4. Remove cap screws (D). Remove cover.



T7685HK –UN–10APR92

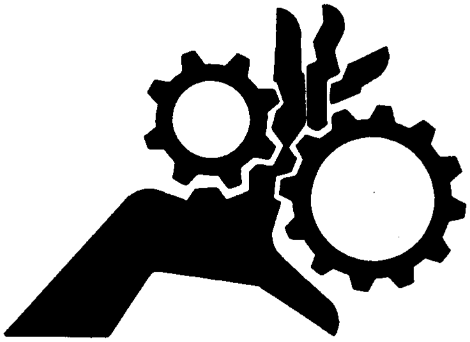
A—Fill Plug
B—Level Plug
C—Drain Plug
D—Cap Screw (16 used)
E—Cover

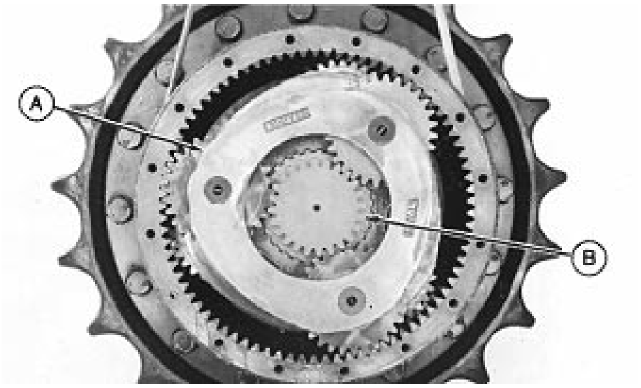
Continued on next page

TX,02,UU3672 –19–18SEP98–3/11

CAUTION: Planet gears may turn. Keep fingers away from gears.

5. Remove input shaft (B) and first planet carrier and gears (A).


T6639GK –UN–19OCT88



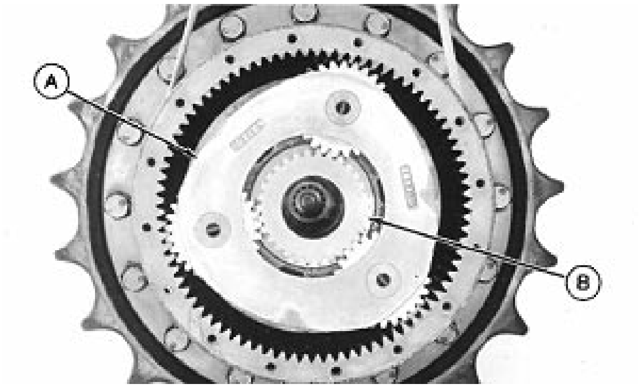
T7685HL –UN–10APR92

A—First Planet Carrier and Gears
B—Input Shaft

TX,02,UU3672 –19–18SEP98–4/11

CAUTION: Planet gears may turn. Keep fingers away from gears.

6. Remove second planet sun gear (B) and second planet carrier and gears (A).



T7685HM –UN–10APR92

A—Second Planet Carrier and Gears
B—Second Planet Sun Gear

Continued on next page

TX,02,UU3672 –19–18SEP98–5/11

CAUTION: Planet gears may turn. Keep fingers away from gears.

The approximate weight of third planet carrier and gears is 40 kg (88 lb).

Third Planet Carrier and Gears—Specification

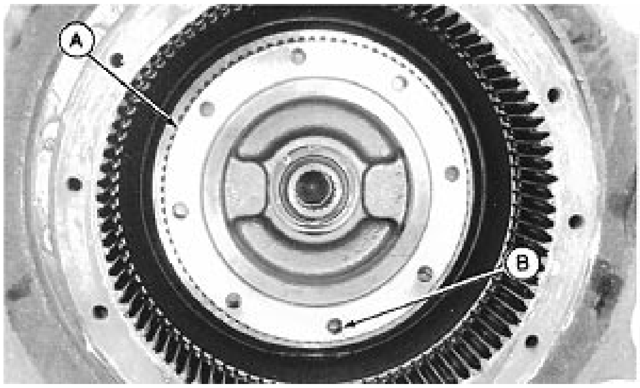
Weight.. 40 kg (88 lb) approximate

7. Remove third planet sun gear and third planet carrier and gears (A).

A—Third Planet Carrier and Gears

TX,02,UU3672 –19–18SEP98–6/11

8. Push in dowel pin (B) until it completely disengages from bearing nut (A).



A—Bearing Nut
B—Dowel Pin

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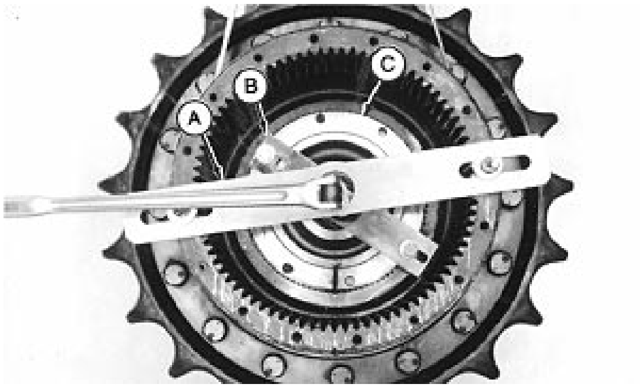
TX,02,UU3672 –19–18SEP98–7/11

9. Remove nut (C) using DFT1036A Propel Gearbox Nut Wrench (B) and DFT1109 Holding Bar (A). Fasten holding bar to ring gear. (See Section 99 for instructions to make tool.)



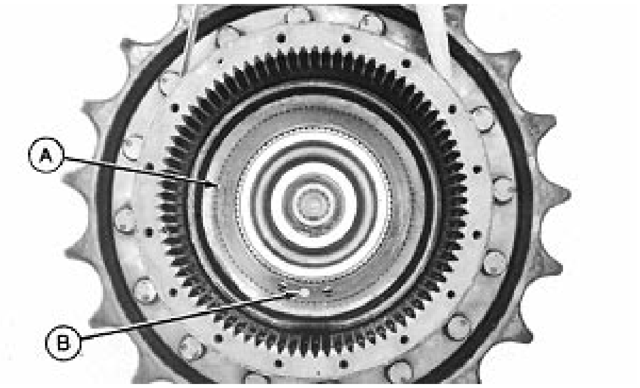
T7685HR –UN–10APR92

A—DFT1109 Holding Bar
B—DFT1036A Propel Gearbox Nut Wrench
C—Bearing Nut

TX,02,UU3672 –19–18SEP98–8/11

10. Remove hub (A).

11. Remove dowel pin (B).



T7685HS –UN–10APR92

A—Hub
B—Dowel Pin

Continued on next page

TX,02,UU3672 –19–18SEP98–9/11

CAUTION: The approximate weight of ring gear, drum, and sprocket is 140 kg (310 lb).

Ring Gear, Drum, and Sprocket—Specification

Weight... 140 kg (310 lb)

12. Remove ring gear, drum, and sprocket (A) as an assembly using lifting brackets, such as JT01748 Lifting Brackets, lifting strap, and hoist.

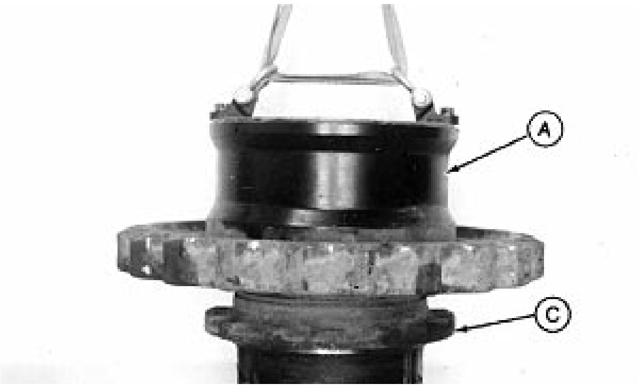
    Outer roller bearing (B) cone is a press fit on propel motor (C) housing.

IMPORTANT: Metal face seals can be reused if they are not worn or damaged. A used seal must be kept together as a set because of wear patterns on seal ring face.

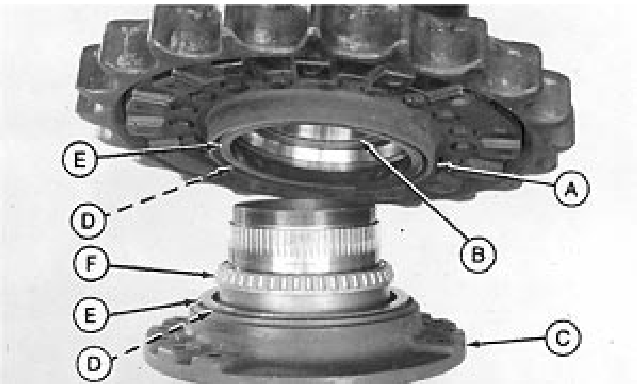
13. Remove seal rings (E) and O-rings (D). Always keep seal rings together as a matched set with metal faces together to protect surfaces.

14. Inspect metal face seal. (See procedure in this group.) For seals that are reused, put a piece of cardboard between seal rings to protect seal ring face.

15. Remove inner roller bearing (F) cone and cups only if replacement is necessary. Bearing cone and cups are a press fit.



T7685AW –UN–19MAR92



T7685AX –UN–19MAR92

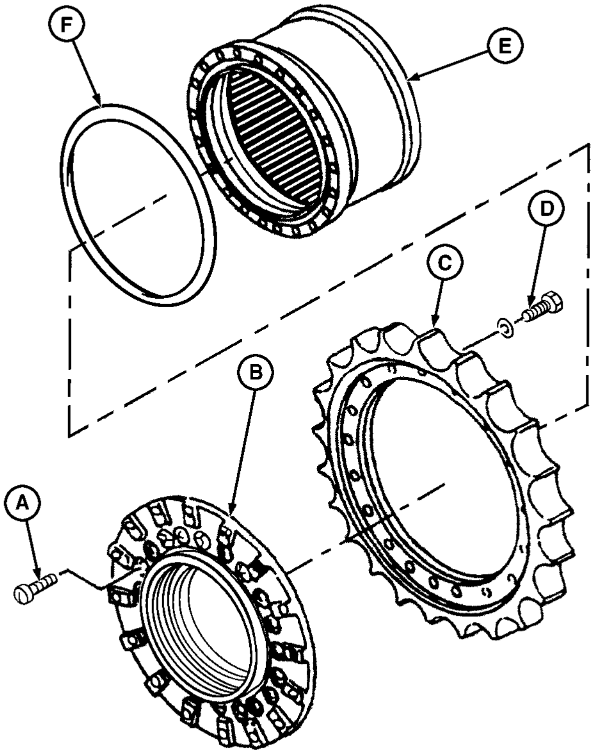
A—Ring Gear, Drum, and Sprocket
B—Outer Roller Bearing
C—Propel Motor
D—O-Ring (2 used)
E—Seal Ring (2 used)
F—Inner Roller Bearing

Continued on next page

TX,02,UU3672 –19–18SEP98–10/11

16. Remove cap screws (D). Remove sprocket (C).

17. Remove cap screws (A). Remove drum (B) from ring gear (E).



T117026

T117026 –UN–09SEP98

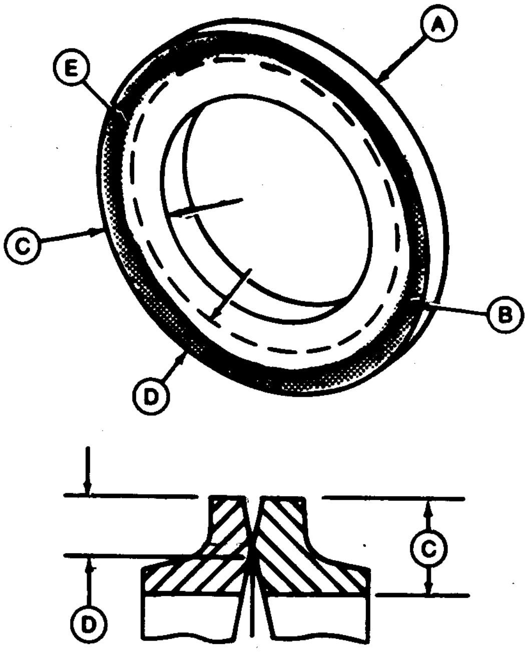
A—Cap Screw (20 used)
B—Drum
C—Sprocket
D—Cap Screw (16 used)
E—Ring Gear
F—O-Ring

TX,02,UU3672 –19–18SEP98–11/11

INSPECT METAL FACE SEALS

1. Inspect for the following conditions to determine if seal rings (A) can be reused:

   - The narrow, highly polished sealing area (E) must be in the outer half of seal ring face (D).
   - Sealing area must be uniform and concentric with the ID and OD of seal ring (A).
   - Sealing area must not be chipped, nicked, or scratched.



T85079 –UN–24AUG93

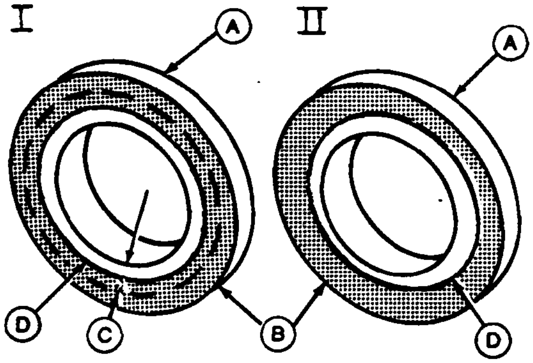
A—Seal Ring
B—Worn Area (Shaded Area)
C—Seal Ring Face
D—Outer Half of Seal Ring Face
E—Sealing Area (Dark Line)

TX,02,UU3673 –19–18SEP98–1/3

2. Illustration shows examples of worn seal rings (A).

   I—Sealing area (D) is in inner half of seal ring face (C).

   II—Sealing area (D) not concentric with ID and OD of seal ring.



T85080 –UN–05DEC96

A—Seal Ring
B—Wear Area (Shaded Region)
C—Inner Half of Seal Ring Face
D—Sealing Area (Dark Line)

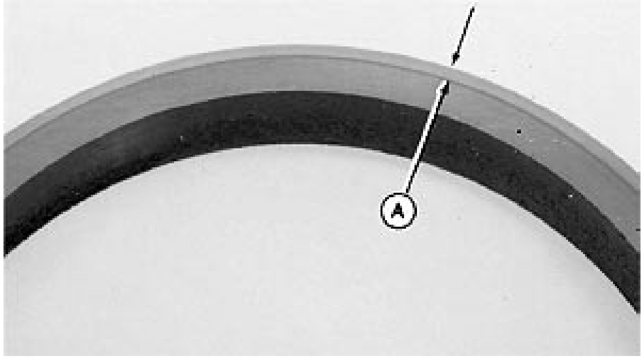
Continued on next page

TX,02,UU3673 –19–18SEP98–2/3

3. Clean seals to be reused by removing all foreign material from seal rings, except seal face (A), using a scraper or a stiff bristled fiber brush.

4. Wash seal rings and O-rings using a non-petroleum base solvent to remove all oil. Thoroughly dry parts using a lint-free tissue.

5. Apply a thin film of oil to seal ring face. Using tape, put face of seal rings together to protect surfaces.



T82840 –UN–23FEB89

A—Seal Face

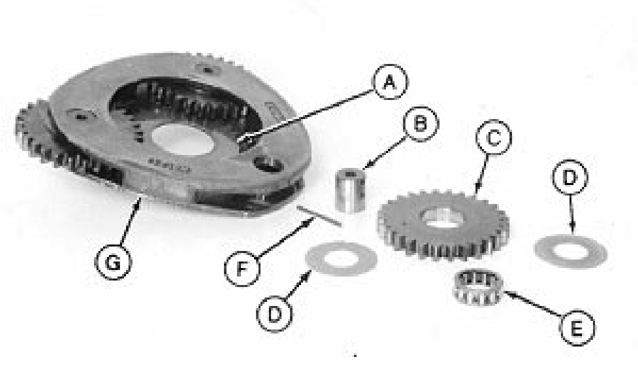
TX,02,UU3673 –19–18SEP98–3/3

DISASSEMBLE AND ASSEMBLE FIRST AND SECOND PLANET CARRIERS

NOTE: Disassembly and assembly of first and second planet carriers is the same. Keep parts for each planet carrier together.

1. Replace parts (A—G) as necessary.

2. Install thrust plates (D) so oil grooves are toward planet gear (C).



T7685HU –UN–10APR92

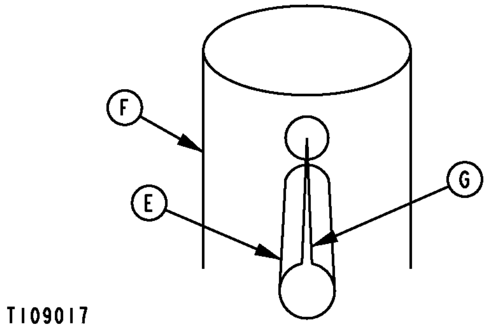
First Planet Carrier

A—Washer
B—Pin (3 used)
C—Planet Gear (3 used)
D—Thrust Plate (6 used)
E—Needle Bearing (3 used)
F—Spring Pin
G—Planet Carrier

Continued on next page

TX,02,UU3674 –19–10DEC96–1/2

3. Install spring pin (E) with slit (G) toward end of pin (F).



T109017 –UN–17APR97

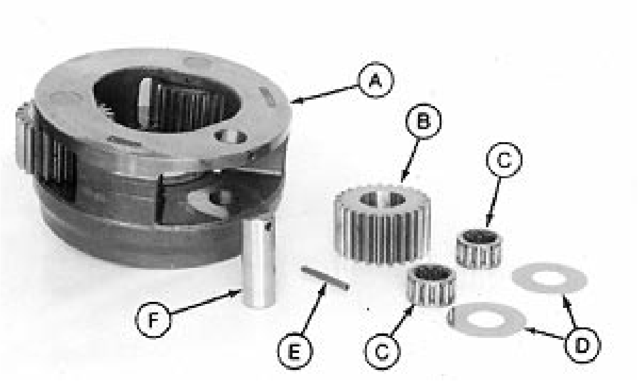
E—Spring Pin
F—Pin
G—Slit

TX,02,UU3674 –19–10DEC96–2/2

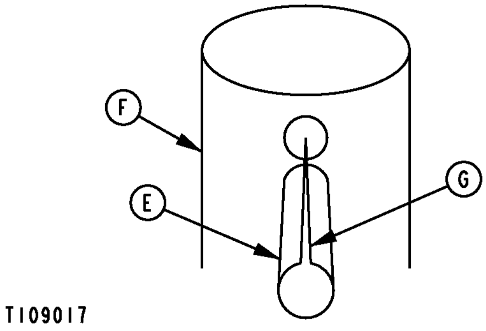
DISASSEMBLE AND ASSEMBLE THIRD PLANET CARRIER

1. Install spring pin (E) with the slit (G) towards the end of pin (F). Replace parts (A—F) as necessary.

2. Install thrust plates (D) so oil grooves are toward third planet gear (B).



T7685HV –UN–10APR92

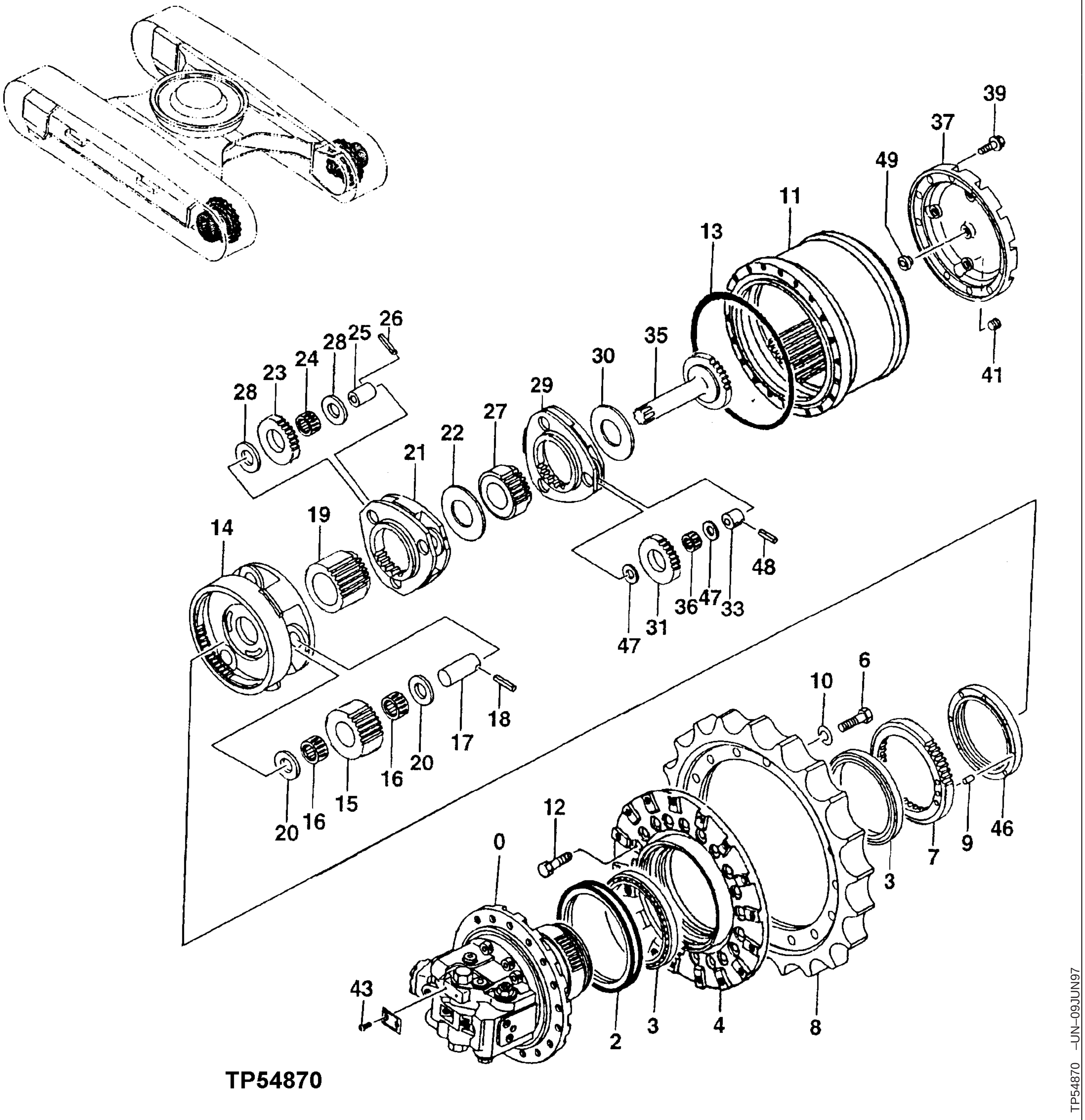


T109017 –UN–17APR97

A—Third Planet Carrier
B—Third Planet Gear (3 used)
C—Needle Bearing (6 used)
D—Thrust Plate (6 used)
E—Spring Pin (3 used)
F—Pin (3 used)
G—Slit

TX,02,UU3675 –19–10DEC96–1/1

ASSEMBLE PROPEL GEARBOX



TP54870 –UN–09JUN97

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TX,02,UU3676 –19–06MAY98–1/11

Axle Shaft, Bearings, and Reduction Gears

0—Propel Motor
2—Metal Face Seal
3—Roller Bearing (2 used)
4—Drum
6—Cap Screw (16 used)
7—Hub
8—Sprocket
9—Dowel Pin
10—Lock Washer (16 used)
11—Ring Gear
12—Cap Screw (20 used)
13—O-Ring
14—Third Planet Carrier
15—Third Planet Gear (3 used)
16—Needle Bearing (6 used)
17—Pin (3 used)
18—Spring Pin (3 used)
19—Third Planet Sun Gear
20—Thrust Plate (Shim) (6 used)
21—Second Planet Carrier
22—Washer
23—Second Planet Gear (3 used)
24—Needle Bearing (3 used)
25—Pin (3 used)
26—Spring Pin (3 used)
27—Second Planet Sun Gear
28—Thrust Plate (Shim) (6 used)
29—First Planet Carrier
30—Washer
31—First Planet Gear (3 used)
33—Pin (3 used)
35—Input Shaft
36—Needle Bearing (3 used)
37—Cover
39—Cap Screw and Lock Washer (16 used)
41—Plug (3 used)
43—Screw (2 used)
46—Bearing Nut
47—Thrust Plate (6 used)
48—Spring Pin (3 used)
49—Thrust Pad

Continued on next page

TX,02,UU3676 –19–06MAY98–2/11

1. Install sprocket (C) on drum (B).
2. Clean threads of cap screws (A) using cure primer.
3. Apply thread lock and sealer (high strength) to threads.

   Install cap screws and tighten.

Sprocket-to-Drum Cap Screw—Specification

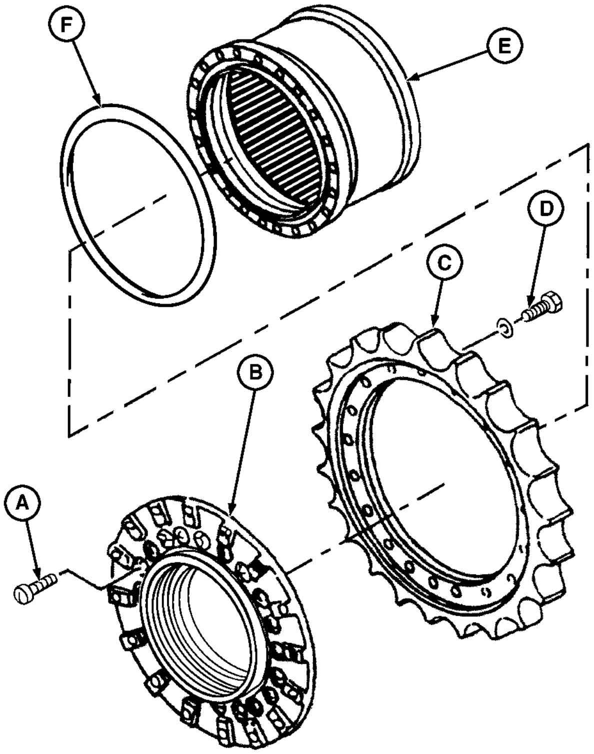
Torque .... 470 N•m (345 lb-ft)

4. Clean ring gear mounting surface of drum (B).
5. Install O-ring (F).
6. Apply high flex form-in-place gasket to the mounting surface.
7. Install sprocket and drum on ring gear (E).
8. Clean threads of cap screws (D) using cure primer.
9. Apply thread lock and sealer (high strength) to threads.

   Install cap screws and tighten.

Ring Gear-to-Drum Cap Screw—Specification

Torque .... 265 N•m (195 lb-ft)



T117026

T117026 –UN–09SEP98

A—Cap Screw (20 used)
B—Drum
C—Sprocket
D—Cap Screw (16 used)
E—Ring Gear
F—O-Ring

Continued on next page

CAUTION: DO NOT heat oil over 182°C (260°F). Oil fumes or oil can ignite above 193°C (380°F). Use a thermometer. DO NOT allow a flame or heating element to come in direct contact with the oil. Heat the oil in a well ventilated area. Plan a safe handling procedure to avoid burns.

TS227 –UN–23AUG88

10. Heat inner roller bearing (F) cone to 50—70°C (122—158°F). Install cone tight against shoulder.

Roller Bearing Cone—Specification

Temperature .... 50—70°C (122—158°F)

IMPORTANT: O-ring and seat surfaces for O-ring must be clean, dry, and oil free so O-ring does not slip.

11. Thoroughly clean O-ring and seat surfaces in housing, drum, and seal ring using volatile, non-petroleum base solvent and lint-free tissues.

12. Install O-ring on seal ring.

NOTE: A volatile, non-petroleum base solvent or talcum powder can be used as a lubricant. Solvent must not damage the O-ring or leave an oil residue.

13. Apply equal pressure with fingers at four equally spaced points on seal face. Seal must "pop" down into place so O-ring is tight against seal bore and seal ring is installed squarely.

14. Wipe finger prints and foreign material off seal ring face using clean oil and lint-free tissues.

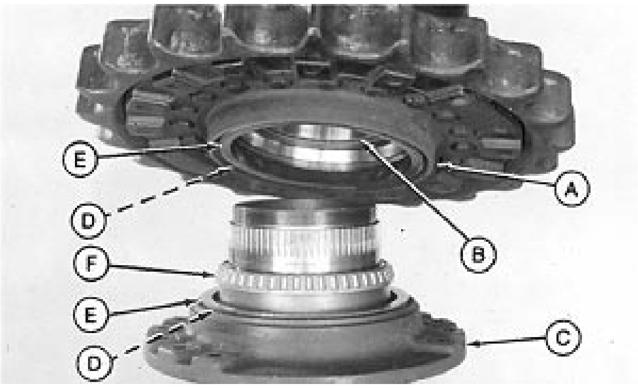
15. Apply a thin film of clean oil on each seal ring face.

16. Install ring gear, drum, and sprocket (A) on propel motor (C) housing.

17. Heat outer roller bearing (B) cone to 50—70°C (122—158°F). Install bearing cone.

Roller Bearing Cone—Specification

Temperature .... 50—70°C (122—158°F)

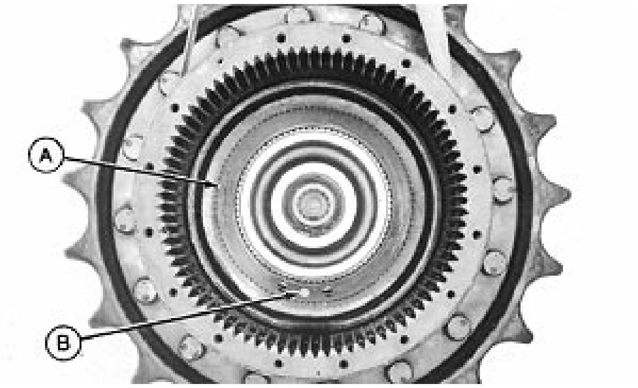


T7685AX –UN–19MAR92

A—Ring Gear, Drum, and Sprocket
B—Outer Roller Bearing
C—Propel Motor
D—O-Ring (2 used)
E—Seal Ring (2 used)
F—Inner Roller Bearing

Continued on next page

18. Install hub (A). Note location of holes (B) in hub for dowel pin.



T7685HS –UN–10APR92

A—Hub
B—Hole Location

TX,02,UU3676 –19–06MAY98–5/11

19. Install nut (D) with the 0.5 mm (0.020 in.) step (E) towards hub.

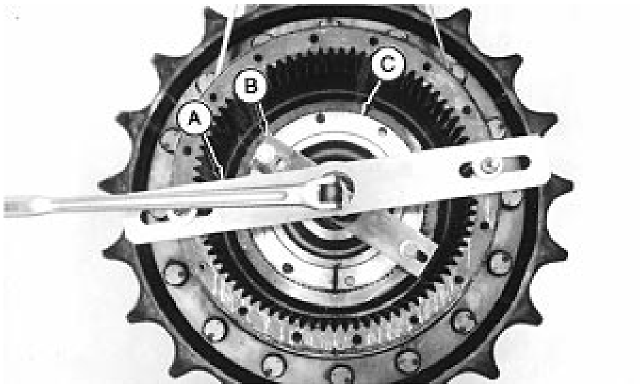
    Tighten nut using DFT1036A Propel Gearbox Nut Wrench (B) and DFT1109 Holding Bar (A). Fasten holding bar to ring gear. (See Section 99 for instructions to make tools.)

Hub-to-Propel Motor Housing Bearing Nut—Specification

Torque .... 785 N•m (580 lb-ft) then tap on ring gear using a plastic hammer, turn three times right and left to seat bearing, repeat procedure

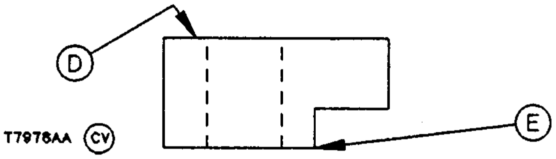
20. Tap on ring gear using a plastic hammer. Then turn drum three times to the right and left to seat the roller bearings.

21. Repeat procedure again to be sure roller bearings are seated.



T7685HR –UN–10APR92

T7978AA –UN–01APR93



A—DFT1109 Holding Bar
B—DF1036A Propel Gearbox Nut Wrench
C—Ring Gear
D—Bearing Nut
E—0.5 mm (0.020 in.) Step

Continued on next page

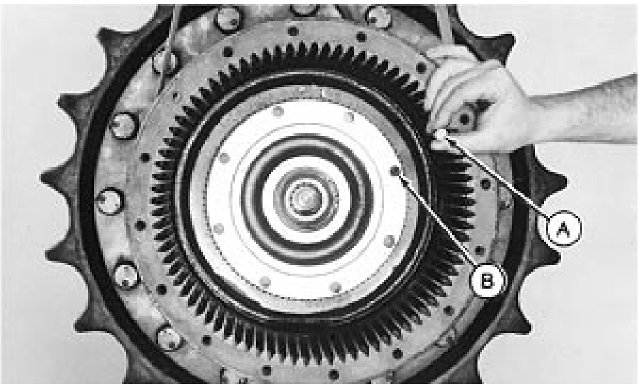
TX,02,UU3676 –19–06MAY98–6/11

22. Align hole (B) in nut with hole in hub.

23. Install dowel pin (A) so end is recessed below surface of bearing nut.

Bearing Nut-to-Hub Dowel Pin—Specification

Distance.. 14 mm (0.55 in.) below surface of bearing nut

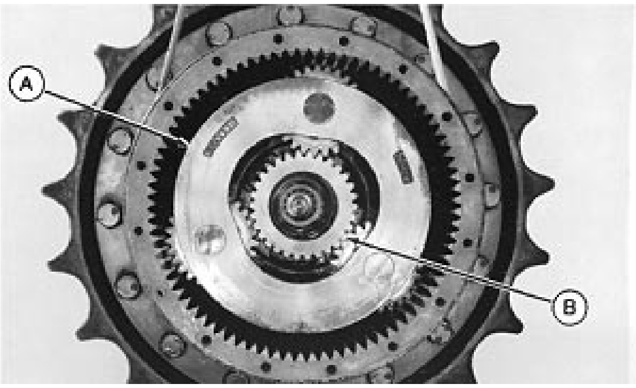


A—Dowel Pin
B—Hole

TX,02,UU3676 –19–06MAY98–7/11

24. Install third planet carrier (A).

25. Install third planet sun gear (B).



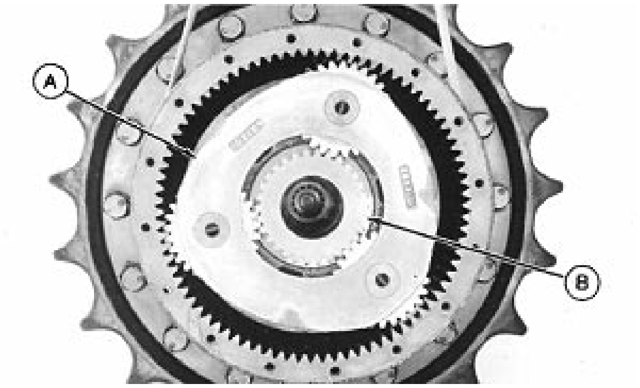
A—Third Planet Carrier
B—Third Planet Sun Gear

Continued on next page

TX,02,UU3676 –19–06MAY98–8/11

26. Install second planet carrier (A).

27. Install second planet sun gear (B).



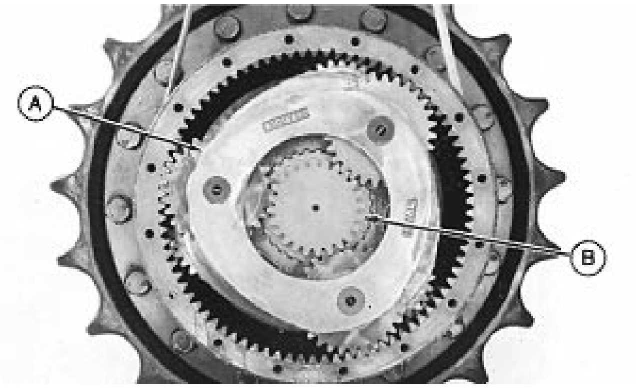
T7685HM –UN–10APR92

A—Second Planet Carrier
B—Second Planet Sun Gear

TX,02,UU3676 –19–06MAY98–9/11

28. Install first planet carrier (A).

29. Install input shaft (B).



T7685HL –UN–10APR92

A—First Planet Carrier
B—Input Shaft

Continued on next page

TX,02,UU3676 –19–06MAY98–10/11

30. Clean cover and ring gear mounting surfaces using cure primer. Apply plastic gasket.

31. Install cover. Tighten cap screws.

Cover-to-Ring Gear Cap Screw—Specification

Torque .... 110 N•m (80 lb-ft)

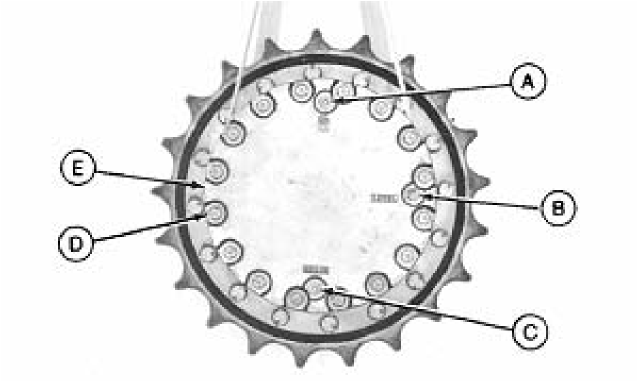
32. Add gear oil to propel gearbox. Approximate capacity is 6.0 L (6.5 qt). (See Swing Gearbox and Propel Gearbox Oils in Group 0004.)

33. Clean threads of fill plug using cure primer. Apply pipe sealant.

34. Install fill plug (A). Tighten plug.

Fill Plug—Specification

Torque .... 50 N•m (35 lb-ft)



T7685HK –UN–10APR92

A—Fill Plug
B—Level Plug
C—Drain Plug
D—Cap Screw (16 used)
E—Cover

Group 0260
Hydraulic System

ESSENTIAL TOOLS

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company.

CED,OUOE003,508 –19–15MAY98–1/3

Plug . . . . .JT03221 (3/4-16 M 37°) (Parker No. 03CP—8)

To seal drain line during propel motor start-up procedure.

CED,OUOE003,508 –19–15MAY98–2/3

Spanner Wrench. JDG769

To remove and install spanner nut.

T7782AH –UN–19JUN92

CED,OUOE003,508 –19–15MAY98–3/3

SERVICE EQUIPMENT AND TOOLS

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC). Some tools may be available from a local supplier.

SERVICEGARD is a trademark of Deere & Company.

CED,OUOE003,1156 –19–18SEP98–1/9

10 mm Hex Key Wrench

To loosen propel motor fill plug.

CED,OUOE003,1156 –19–18SEP98–2/9

14 mm Hex Key Wrench

To remove and install brake valve housing cap screws.

Continued on next page

CED,OUOE003,1156 –19–18SEP98–3/9

8 mm Hex Key Wrench

To remove propel motor and brake pivot bolt.

CED,OUOE003,1156 –19–18SEP98–4/9

5 mm Hex Key Wrench

To remove servo piston shuttle and brake release shuttle seat.

CED,OUOE003,1156 –19–18SEP98–5/9

Rotary Manifold Lifting Tool[1]

To remove and install rotary manifold.

[1] *Fabricated tool, dealer made. (See Section 99 for instructions to make tools.)*

CED,OUOE003,1156 –19–18SEP98–6/9

Push-Puller (Mechanical) D01200AA

To align ports on rotary manifold to existing lines.

CED,OUOE003,1156 –19–18SEP98–7/9

Service Wrench D05242ST

To align ports on rotary manifold to existing lines.

Continued on next page

CED,OUOE003,1156 –19–18SEP98–8/9

Air Test Plug JDG185

To seal port and apply air pressure to rotary manifold for pressure test.

CED,OUOE003,1156 –19–18SEP98–9/9

OTHER MATERIAL

Number	**Name**	**Use**
TY16285 (U.S.) TY9485 (Canadian) 7649 (LOCTITE®)	Cure Primer	Cleans and cures surfaces prior to application of adhesives or sealants.
TY9375 (U.S.) TY9480 (Canadian) 592 (LOCTITE®)	Pipe Sealant	Apply to threads of plug.
T43513 (U.S.) TY9474 (Canadian) 271 (LOCTITE®)	Thread Lock and Sealer (High Strength)	Apply to outer surface of propel motor drive shaft seal and threads of valve plate pivot plug.
TY6347 (U.S.)	Multi-Purpose Grease	Apply to end of propel motor and brake pivot bolt.
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Apply to servo piston shuttle and brake release shuttle seat.

LOCTITE is a trademark of Loctite Corp.

CED,OUOE003,1157 –19–18SEP98–1/1

SPECIFICATIONS

Item	**Measurement**	**Specification**
Propel Motor and Brake:		
Propel Gearbox with Motor	Weight	330 kg (730 lb) approximate
Gearbox and Motor-to-Frame Cap Screw	Torque	620 N•m (460 lb-ft)
Propel Motor Cover-to-Frame Cap Screw	Torque	180 N•m (80 lb-ft)
Link-to-Servo Piston Pivot Bolt	Torque	49 N•m (36 lb-ft)
Pivot Bolt Access Plug	Torque	15 N•m (132 lb-in.)
Roller Bearing Inner Race	Temperature	70—90°C (160—194°F)
Drive Shaft Bearing	Rolling Drag Torque	1—2 N•m (9—17 lb-in.)
Brake Valve-to-Housing Cap Screw	Torque	215 N•m (160 lb-ft)
Crossover Relief Valve Plug	Torque	540 N•m (400 lb-ft)
Counterbalance Valve Plug	Torque	215 N•m (160 lb-ft)
Check Valve Plug	Torque	235 N•m (173 lb-ft)
Brake Pressure Reducing Valve Plug	Torque	69 N•m (51 lb-ft)
Brake Release Shuttle Valve Seat	Torque	14.5 N•m (128 lb-in.)
Brake Release Shuttle Valve Plug	Torque	34 N•m (301 lb-in.)
Servo Piston Shuttle Valve Seat	Torque	14.5 N•m (128 lb-in.)
Servo Piston Shuttle Valve Plug	Torque	34 N•m (301 lb-in.)
Rotary Manifold:		
Rotary Manifold	Weight	27 kg (60 lb) approximate
Manifold-to-Frame Cap Screw	Torque	34 N•m (25 ft-lb)

Continued on next page

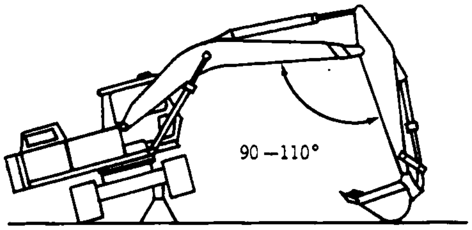
Item	Measurement	Specification
Stop-to-Frame Cap Screw	Torque	40 N•m (30 lb-ft)
Rotary Manifold	Torque	373 N•m (275 lb-ft) first rotation
	Torque	237 N•m (175 lb-ft) second rotation
	Torque	170 N•m (125 lb-ft) third rotation
Cover-to-Housing Cap Screw	Torque	49 N•m (36 lb-ft)

CED,OUOE003,1158 –19–18SEP98–2/2

REMOVE AND INSTALL PROPEL MOTOR AND BRAKE

1. Disconnect track. (See Remove Track Chain, Group 0130.)

2. Swing upperstructure 90° and lower bucket to raise track off ground. Keep angle between boom and arm 90—100° and position round side of bucket on ground. Put a support stand under the carriage.



T6876FG –UN–06DEC88

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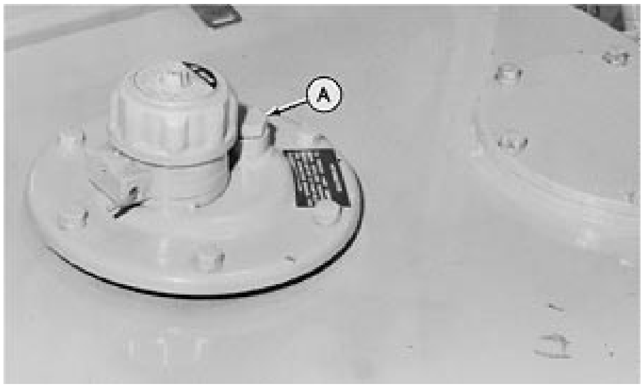
TX,02,UU3722 –19–18SEP98–1/4

CAUTION: Hydraulic oil tank is pressurized. Loosen vent plug to release pressure.

3. Loosen vent plug (A) to release hydraulic oil tank pressure



A—Vent Plug

TX,02,UU3722 –19–18SEP98–2/4

4. Loosen fill plug (A) using a 10 mm hex key wrench.

5. Install a clean oil collection container under propel motor gearbox.

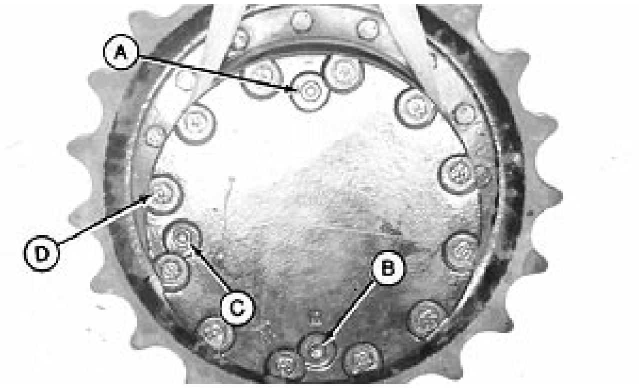
NOTE: Approximate oil capacity of propel motor gearbox is 6.0 L (6.5 qt.)

6. Remove plug (B) to drain gearbox oil.

7. Clean threads of plugs using cure primer. Apply pipe sealant to threads before installing plugs.

8. Remove propel motor cover cap screws.

9. Remove propel motor cover.

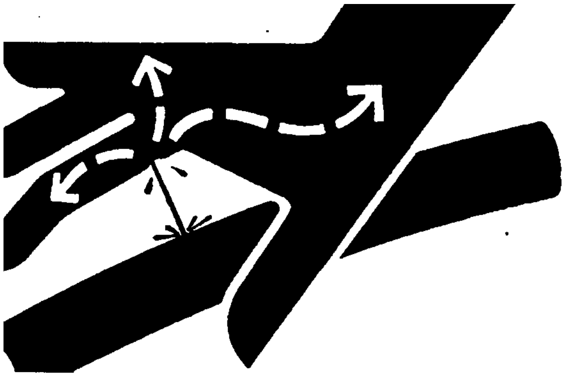


A—Fill Plug
B—Drain Plug
C—Cap Screw
D—Cap Screw (12 used)

Continued on next page

TX,02,UU3722 –19–18SEP98–3/4

CAUTION: To avoid injury from escaping fluid under pressure, stop engine, and relieve the pressure in the system before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.



X9811 –UN–23AUG88

10. Disconnect lines (A—D).

CAUTION: The approximate weight of propel gearbox with motor is 330 kg (730 lb).

Propel Gearbox with Motor—Specification

Weight.. 330 kg (730 lb) approximate

11. Connect propel gearbox and motor to a hoist using lifting straps.
12. Using a 30 mm socket, remove propel motor-to-frame cap screws and washers (E).
13. Replace parts as necessary.
14. Install propel gearbox and motor to frame. Tighten cap screws (E).

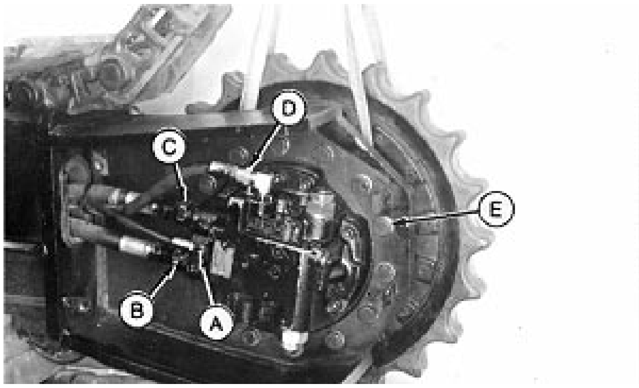
Gearbox and Motor-to-Frame Cap Screw—Specification

Torque .... 620 N•m (460 lb-ft)

15. Connect lines.
16. Perform propel motor start-up procedure. (See procedure in this group.)
17. Install propel motor cover.
18. Using a 19 mm socket, tighten propel motor cover cap screws.

Propel Motor Cover-to-Frame Cap Screw—Specification

Torque .... 180 N•m (80 lb-ft)



T7685AV –UN–19MAR92

A—Pilot Oil Port-to-Rotary Manifold “P1” Port Line
B—Bottom Port (Forward)-to-Rotary Manifold “1” or “3” Port Line
C—Top Port (Reverse)-to-Rotary Manifold “2” or “4” Port Line
D—Drain Port-to-Rotary Manifold “D” Port Tee
E—Cap Screw and Washer (14 used)

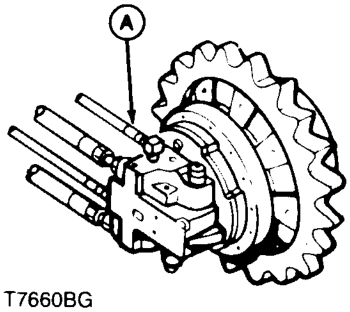
PROPEL MOTOR AND BRAKE START-UP PROCEDURE

IMPORTANT: Propel motor will be damaged if not filled with oil before starting engine. Procedure must be performed whenever a new propel motor is installed or oil has been drained from the motor.

1. Disconnect motor drain line (A). Install plug such as JT03221 (3/4-16 M 37°) (Parker No. 03CP—8) Plug.

2. Fill motor with hydraulic oil until oil reaches the top of the drain port. (See Hydraulic Oil in Group 0004.) Use a funnel with suitable diameter neck to allow air to escape while filling.

3. Connect drain line.

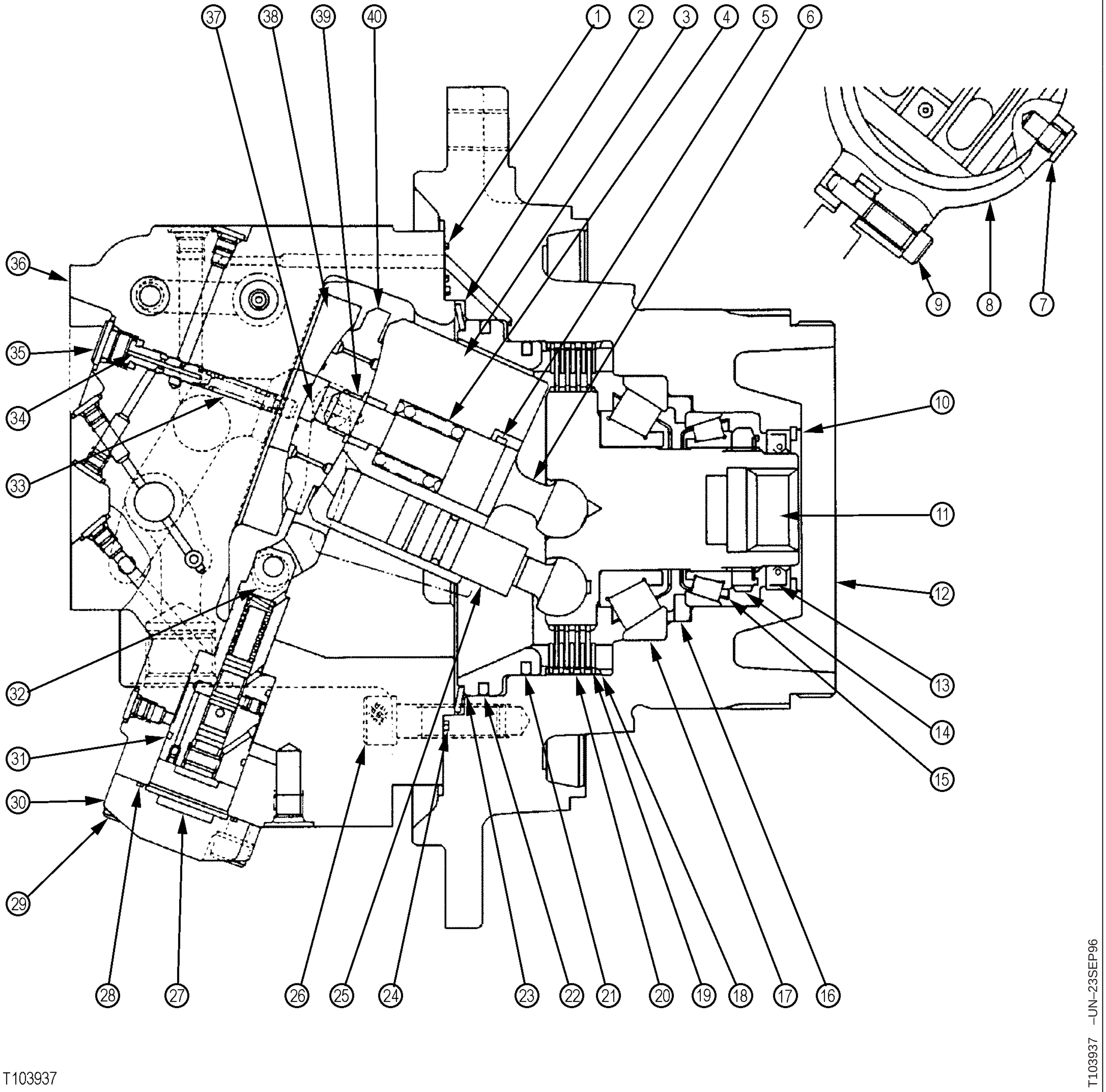


T7660BG –UN–11DEC91

A—Drain Line

TX,02,VV2718 –19–18SEP98–1/1

DISASSEMBLE PROPEL MOTOR AND BRAKE



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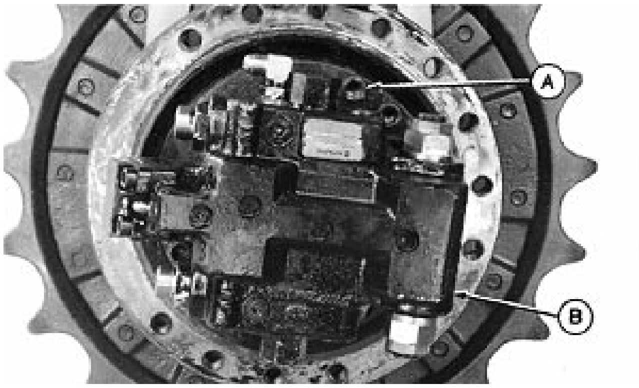
1—O-Ring
2—Disc Spring
3—Rotor
4—Center Spring
5—Pin
6—Center Shaft
7—Plug (2 used)
8—Link
9—Reamer Bolt
10—Retaining Ring
11—Drive Shaft
12—Housing
13—Oil Seal
14—Bearing Nut
15—Bearing
16—Spacer
17—Bearing
18—Spacer
19—Plate (5 used)
20—Friction Plate (4 used)
21—Packing
22—Packing
23—Piston
24—O-Ring
25—Plunger (7 used)
26—Cap Screw (8 used)
27—Servo Piston
28—O-Ring
29—Cap Screw (4 used)
30—Cover
31—Piston Ring (2 used)
32—Plug
33—Spring
34—Pressure Relief Valve Spool
35—Plug
36—Brake Valve
37—Plug
38—Plate
39—Bushing
40—Valve Plate

TX,02,UU3723 –19–18SEP98–2/11

1. Using a 14 mm hex key wrench, remove cap screws (A). Remove brake valve housing (B). (For disassembly and assembly of brake valve, see procedure in this group.)



T7685HJ –UN–27APR92

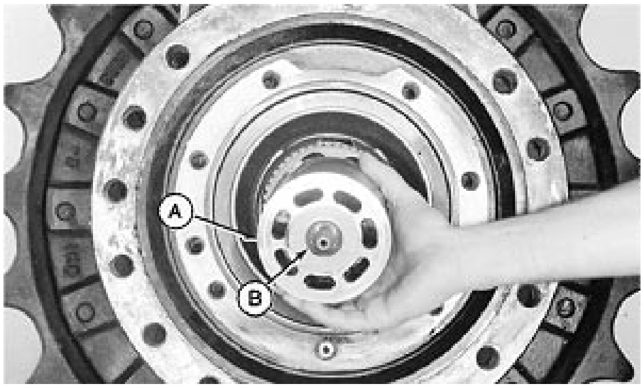
A—Cap Screw (8 used)
B—Brake Valve Housing

Continued on next page

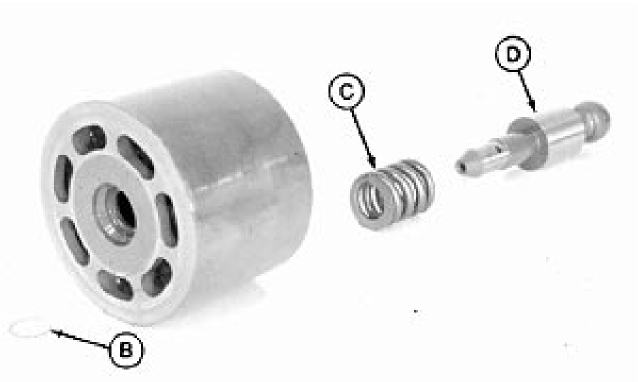
TX,02,UU3723 –19–18SEP98–3/11

IMPORTANT: Pistons must be installed into the same bores because of wear pattern. Mark pistons and respective rotor bores for assembly.

2. Mark pistons and rotor (A) bores for assembly.
3. Remove snap ring (B). Remove rotor (A).
4. Remove spring (C) and shaft (D).
5. Remove pin from center shaft (D) if replacement is necessary.



T7685HW –UN–27APR92



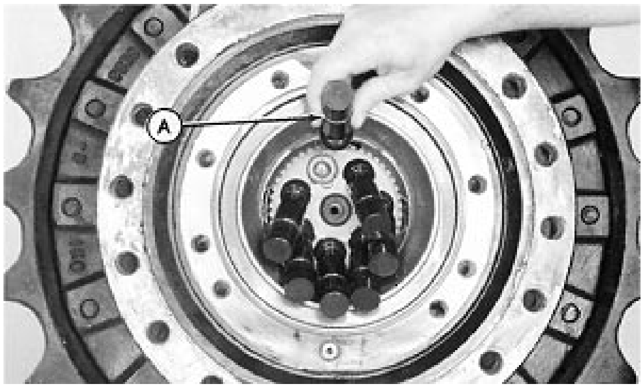
T7685HX –UN–27APR92

A—Rotor
B—Snap Ring
C—Spring
D—Center Shaft

TX,02,UU3723 –19–18SEP98–4/11

IMPORTANT: Pistons must be installed into the same seats in drive shaft because of wear pattern. Mark pistons and respective gear seats for assembly.

6. Mark pistons and drive shaft so pistons (A) can be installed into the same seats at assembly. Remove pistons.



T7685HY –UN–27APR92

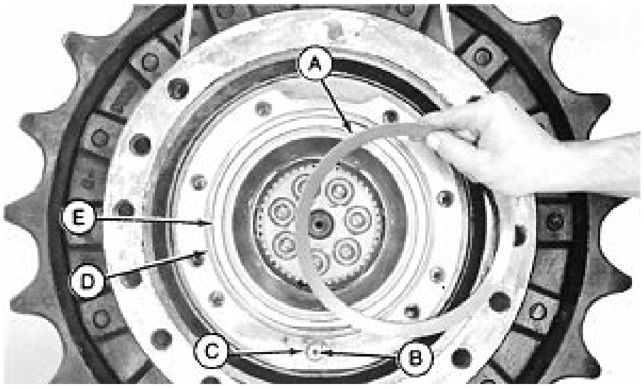
A—Pistons

Continued on next page

TX,02,UU3723 –19–18SEP98–5/11

7. Remove O-rings (C and D).
8. Remove disk spring (A).
9. Remove piston (E).

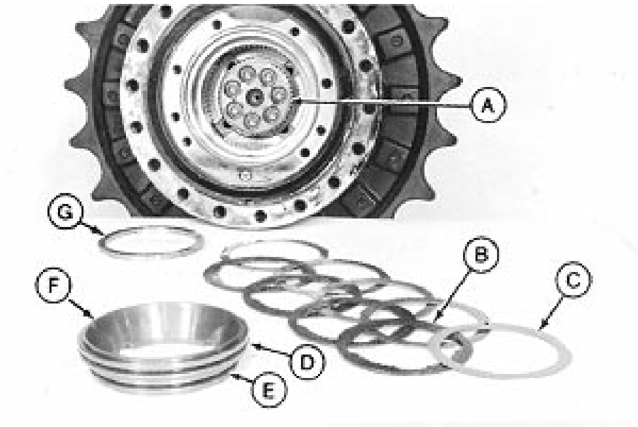
   Check and clean brake release port (B).



A—Disk Spring
B—Brake Release Port
C—O-Ring
D—O-Ring
E—Piston

TX,02,UU3723 –19–18SEP98–6/11

10. Remove parts (A—G).



A—Drive Shaft
B—Disk (4 used)
C—Plate (5 used)
D—O-Ring
E—O-Ring
F—Piston
G—Spacer

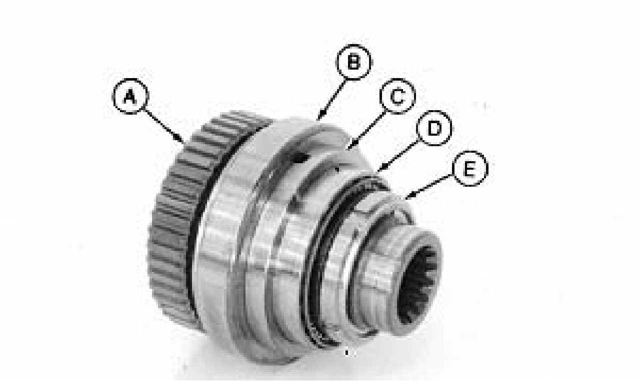
Continued on next page

TX,02,UU3723 –19–18SEP98–7/11

11. Remove parts (A—E).

    Remove spanner nut (E) using JDG769 Spanner Wrench.

    Inner race of roller bearings (B and D) are a press fit on shaft.



T7685IB –UN–27APR92

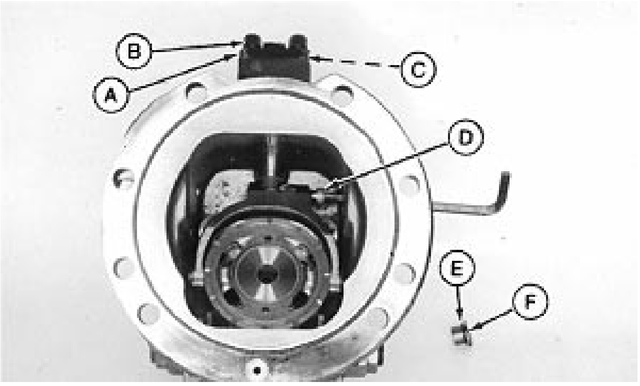
A—Drive Shaft
B—Roller Bearing
C—Spacer
D—Roller Bearing
E—Spanner Nut

TX,02,UU3723 –19–18SEP98–8/11

12. Remove cap screws (B), cover (A), and O-ring (C).

13. Remove plug (F) and O-ring (E).

14. Remove pivot bolt (D) using an 8 mm hex key wrench.



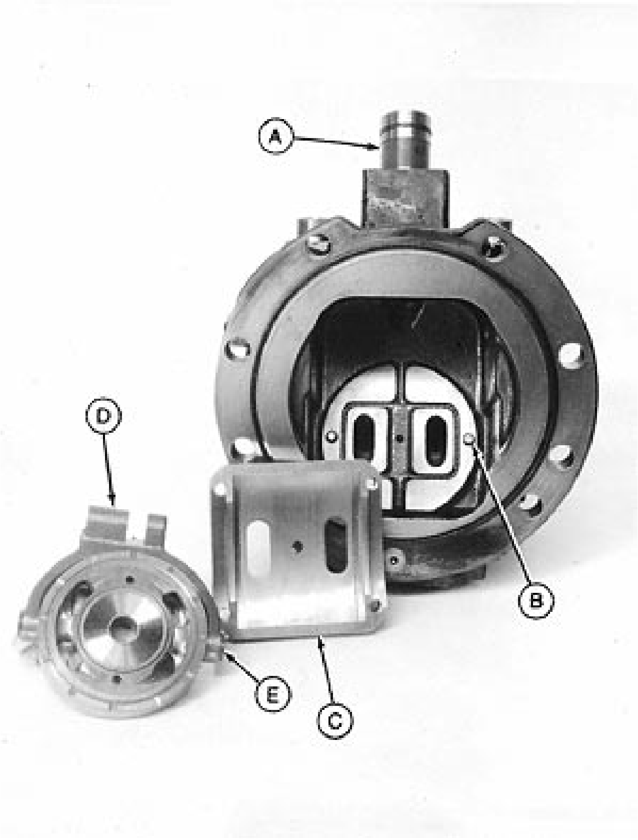
T7685IC –UN–27APR92

A—Cover
B—Cap Screw (4 used)
C—O-Ring
D—Pivot Bolt
E—O-Ring
F—Plug

Continued on next page

TX,02,UU3723 –19–18SEP98–9/11

15. Remove parts (A—E).

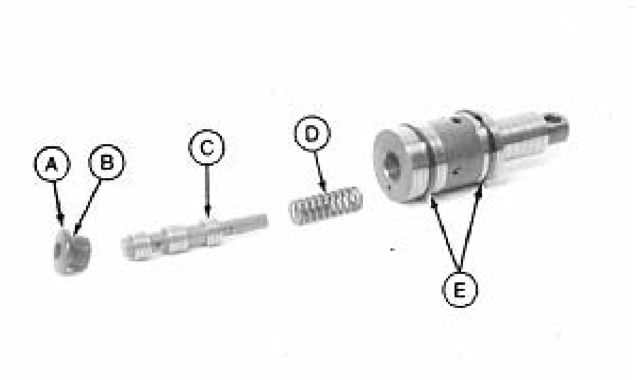


T7685ID –UN–27APR92

A—Servo Piston
B—Dowel Pin
C—Plate
D—Valve Plate and Link
E—Pivot Plug

Continued on next page

16. Disassemble servo piston (A—E).

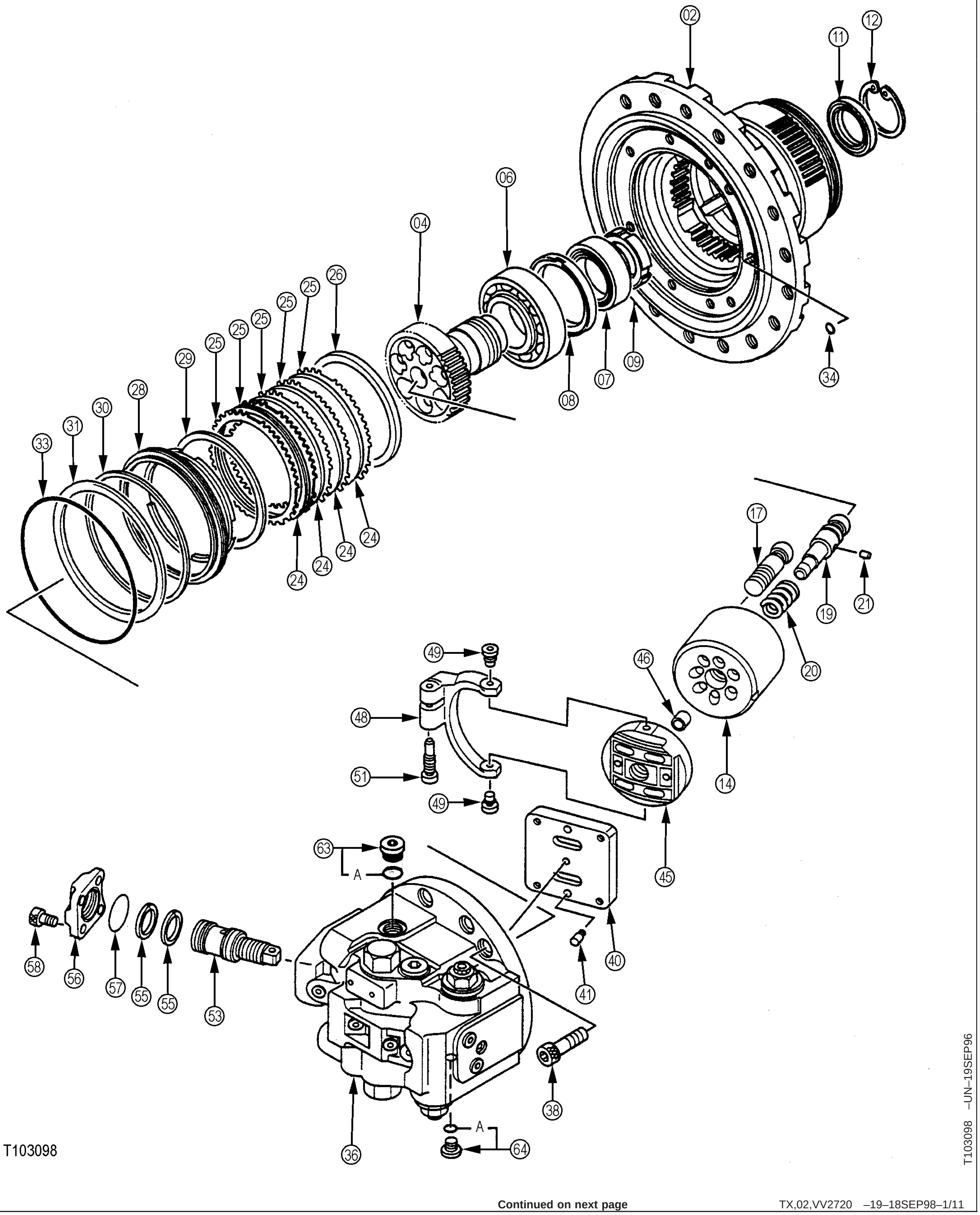


T7685IE –UN–27APR92

A—Plug
B—O-Ring
C—Spool
D—Spring
E—Piston Ring (2 used)

TX,02,UU3723 –19–18SEP98–11/11

ASSEMBLE PROPEL MOTOR AND BRAKE



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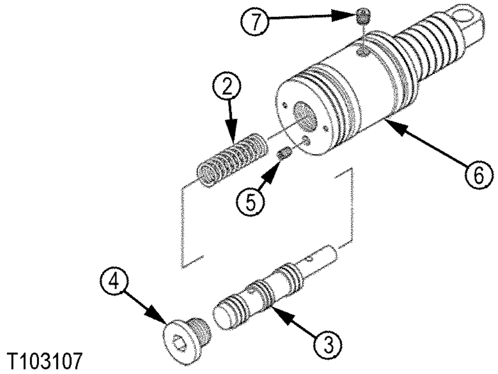
02—Housing
04—Drive Shaft
06—Roller Bearing
07—Roller Bearing
08—Spacer
09—Nut
11—Seal
12—Snap Ring
14—Rotor
17—Piston (7 used)
19—Center Shaft
20—Spring
21—Pin
24—Disk (4 used)
25—Plate (5 used)
26—Spacer
28—Piston
29—O-Ring
30—O-Ring
31—Disk Spring
33—O-Ring
34—O-Ring
36—Brake Valve Housing
38—Cap Screw (8 used)
40—Plate
41—Pin (2 used)
45—Valve
46—Bushing
48—Link
49—Pivot Plug (2 used)
51—Pivot Bolt
53—Servo Piston
55—Piston Ring (2 used)
56—Cover
57—O-Ring
58—Screw (4 used)
63—Plug
63A—O-Ring
64—Plug
64A—O-Ring

1. Apply thread lock and sealer (high strength) to outer surface of seal (11). Apply petroleum jelly to seal lips.

TX,02,VV2720 –19–18SEP98–2/11

2. Assemble servo piston (2—7).



T103107 –UN–19SEP96

2—Spring
3—Speed Selector Valve Spool
4—Plug
5—Orifice
6—Servo Piston
7—Plug

Continued on next page

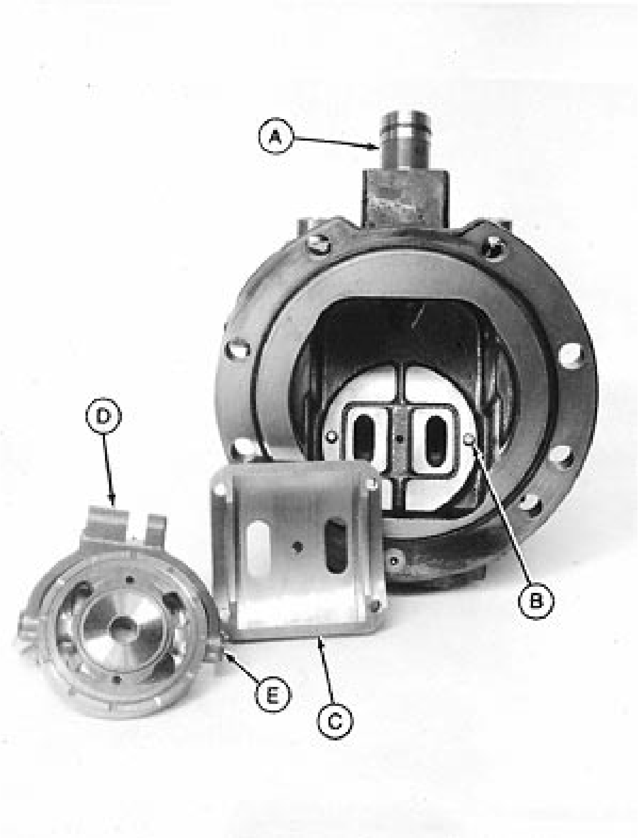
TX,02,VV2720 –19–18SEP98–3/11

3. Install plate (C) so holes engage dowel pins (B).

4. Install servo piston (A).

5. Install valve plate in link. Apply thread lock and sealer (high strength) to threads of pivot plug (E). Tighten pivot plug.

6. Install valve plate and link. Align groove in link with servo piston.



T7685ID –UN–27APR92

A—Servo Piston
B—Dowel Pin (2 used)
C—Plate
D—Valve Plate and Link
E—Pivot Plug

Continued on next page

TX,02,VV2720 –19–18SEP98–4/11

7. Apply multi-purpose grease to the end of pivot bolt (D).

8. Install pivot bolt (D), through plug hole, link and servo piston. Tighten bolt.

Link-to-Servo Piston Pivot Bolt—Specification

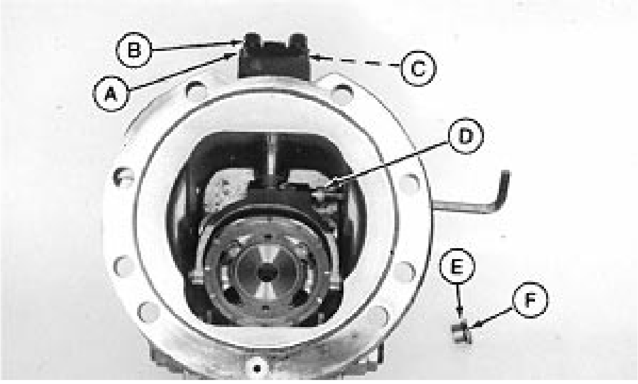
Torque .... 49 N•m (36 lb-ft)

9. Install O-ring (C)

10. Install O-ring (E) and plug (F). Tighten plug.

Pivot Bolt Access Plug—Specification

Torque .... 15 N•m (132 lb-in.)



T7685IC –UN–27APR92

A—Cover
B—Cap Screw
C—O-Ring
D—Pivot Bolt
E—O-Ring
F—Plug

Continued on next page

⚠ **CAUTION: DO NOT heat oil over 182°C (360°F). Oil fumes or oil can ignite above 193°C (380°F). Use a thermometer. DO NOT allow a flame or heating element to come in direct contact with the oil. Heat the oil in a well ventilated area. Plan a safe handling procedure to avoid burns.**

TS227 –UN–23AUG88

11. Heat roller bearing (B) inner race to 70—90°C (160—194°F). Install on drive shaft (A).

Roller Bearing Inner Race—Specification

Temperature .... 70—90°C (160—194°F)

12. Install outer race of bearing (B).
13. Install roller bearing (D) outer race onto spacer (C).
14. Install spacer with outer race onto drive shaft.
15. Heat inner race of roller bearing (D) to 70—90°C (160—194°F). Install race onto drive shaft.

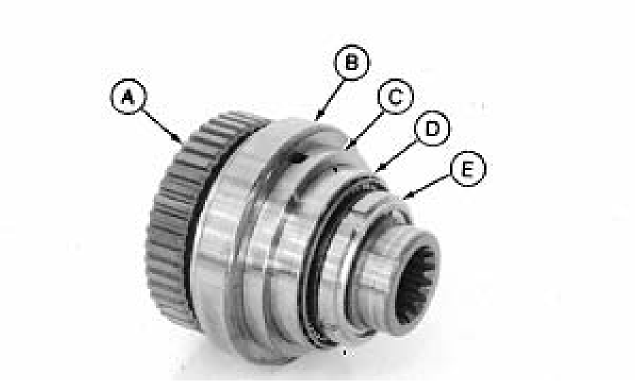
Roller Bearing Inner Race—Specification

Temperature .... 70—90°C (160—194°F)

16. Apply clean oil to threads of nut (E). Install nut (E). Tighten spanner nut (E) using JDG769 Spanner Wrench. Check rolling drag torque.

Drive Shaft Bearing—Specification

Rolling Drag Torque .... 1—2 N•m (9—17 lb-in.)



T7685IB –UN–27APR92

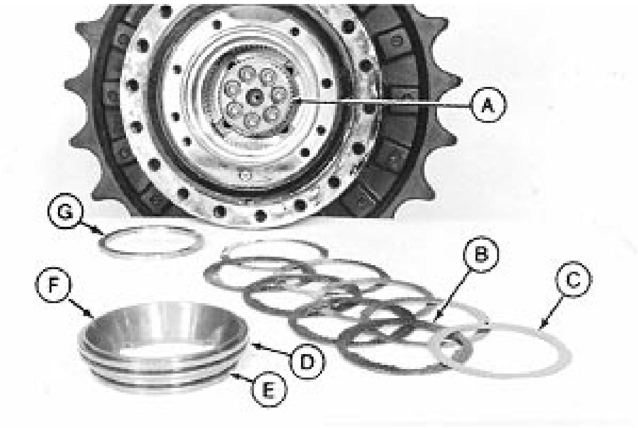
A—Drive Shaft
B—Roller Bearing
C—Spacer
D—Roller Bearing
E—Spanner Nut

Continued on next page

17. Install parts (A—G).

18. Install spacer (G) with notches towards and aligned with notches in housing.

19. Install plates (C) and disks (B) with notches aligned with notches in housing.



T7685IA –UN–27APR92

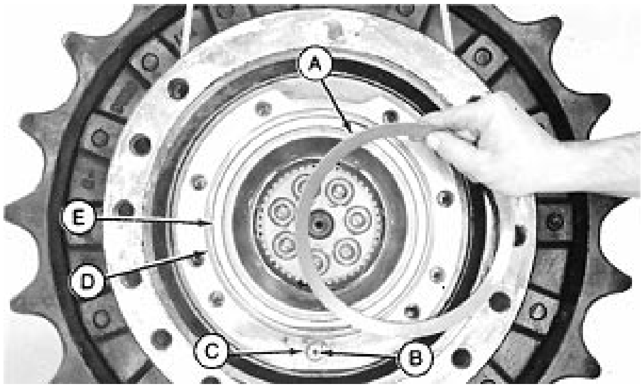
A—Drive Shaft
B—Disk (4 used)
C—Plate (5 used)
D—O-Ring
E—O-Ring
F—Piston
G—Spacer

TX,02,VV2720 –19–18SEP98–7/11

20. Install piston (E) so notches are aligned with notches in disks, plates, and housing.

21. Install disk spring (A).

22. Install O-rings (C and D).



T7685HZ –UN–27APR92

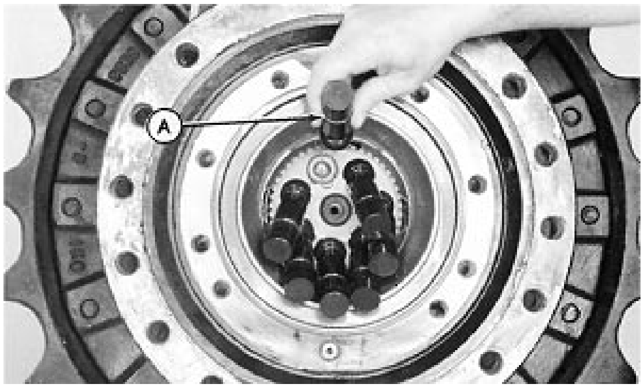
A—Disk Spring
B—Brake Release Port
C—O-Ring
D—O-Ring
E—Piston

Continued on next page

TX,02,VV2720 –19–18SEP98–8/11

IMPORTANT: Pistons must be installed into the same seats because of wear patterns.

23. Install pistons (A) into their original seats.



A—Pistons

TX,02,VV2720 –19–18SEP98–9/11

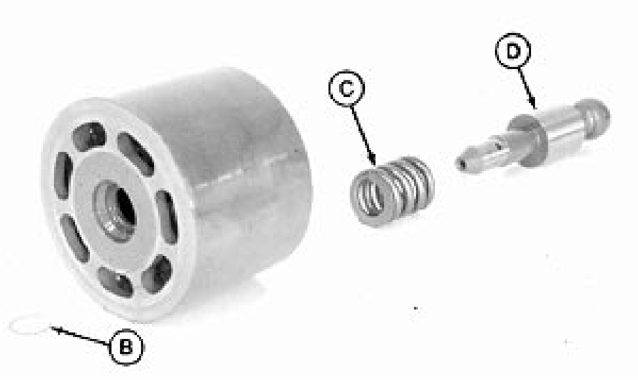
24. Install spring (C) on center shaft (D).

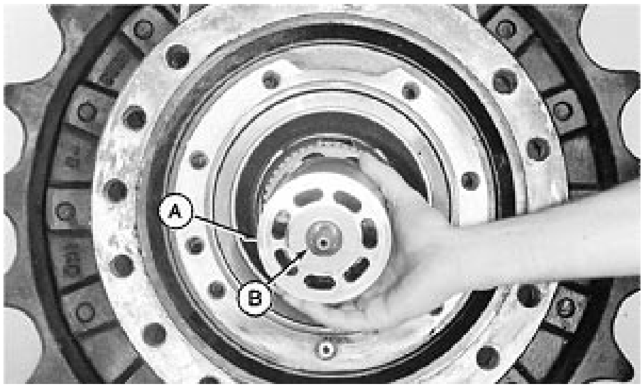
25. Install center shaft into rotor making sure that the pin on shaft aligns with groove in rotor.

26. Install snap ring (B).

IMPORTANT: Pistons must be installed into the same bores because of wear patterns.

27. Install rotor (A) so pistons are installed into their original bores.





A—Rotor
B—Snap Ring
C—Spring
D—Center Shaft

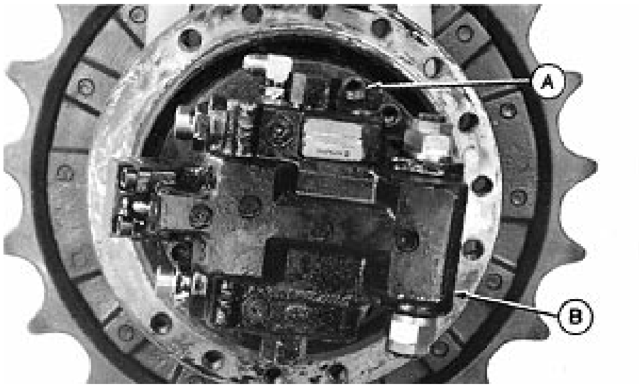
Continued on next page

TX,02,VV2720 –19–18SEP98–10/11

28. Install brake valve (B) on housing aligning hole in valve plate with center shaft. Using a 14 mm hex key wrench, tighten cap screws (A).

Brake Valve-to-Housing Cap Screw—Specification

Torque .... 215 N•m (160 lb-ft)

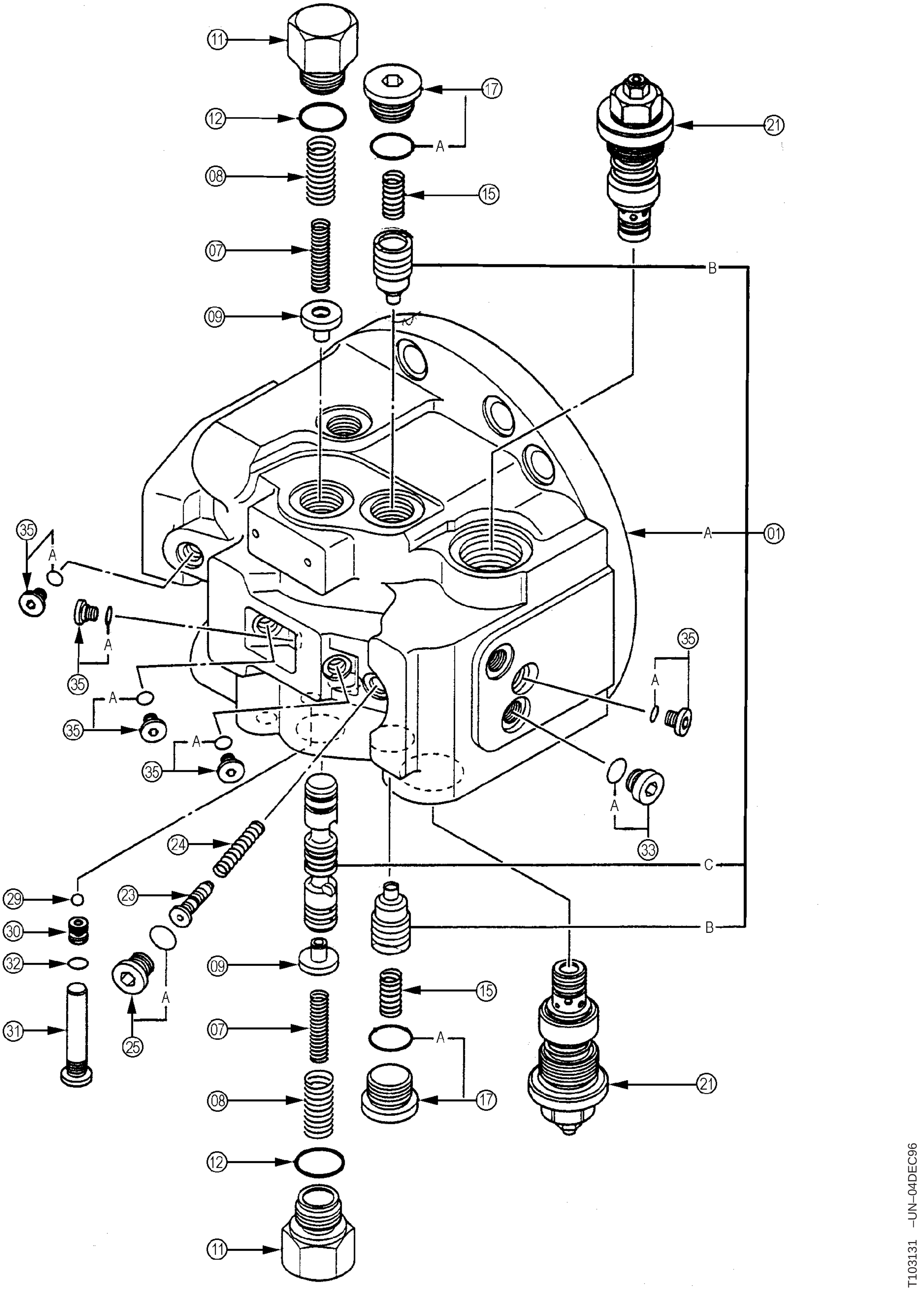


T7685HJ –UN–27APR92

A—Cap Screw (8 used)
B—Brake Valve

TX,02,VV2720 –19–18SEP98–11/11

DISASSEMBLE AND ASSEMBLE PROPEL MOTOR BRAKE VALVE HOUSING



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1A—Brake Valve Housing
1B—Check Valve Poppet
1C—Counterbalance Valve
07—Spring (2 used)
08—Spring (2 used)
09—Stop (2 used)
11—Plug (2 used)
12—O-Ring (2 used)
15—Spring (2 used)
17—Plug (2 used)
17A—O-Ring (2 used)
21—Crossover Relief Valve (2 used)
23—Pressure Reducing Valve Spool
24—Spring
25—Plug
25A—O-Ring
29—Servo Piston Shuttle and Brake Release Shuttle Ball (2 used)
30—Servo Piston Shuttle and Brake Release Shuttle Seat (2 used)
31—Plug
32—O-Ring
33—Plug (2 used)
33A—O-Ring (2 used)
35—Plug (5 used)
35A—O-Ring (5 used)

NOTE: Valves can be removed with propel motor on the machine.

Apply a film of clean hydraulic oil to parts before assembly.

CROSSOVER RELIEF VALVE

1. Remove crossover relief valves (21).

2. Check and adjust pressure setting. (See Propel Motor Crossover Relief Valve Test and Adjustment in Group 9025-25.)

3. Tighten crossover relief valve plug.

Crossover Relief Valve Plug—Specification

Torque.. 540 N•m (400 lb-ft)

COUNTERBALANCE VALVE

1. Remove counterbalance valves (1C, 7—9, 11, and 12).

2. Tighten plug (11).

Counterbalance Valve Plug—Specification

Torque.. 215 N•m (160 lb-ft)

CHECK VALVES

1. Remove check valves (1B, 15, and 17).

2. Tighten plug (1B).

Check Valve Plug—Specification

Torque.. 235 N•m (173 lb-ft)

BRAKE PRESSURE REDUCING VALVE

1. Remove brake pressure reducing valves (23—25).

2. Tighten plug (25).

Brake Pressure Reducing Valve Plug—Specification

Torque... 69 N•m (51 lb-ft)

BRAKE RELEASE SHUTTLE VALVE

1. Remove brake release shuttle valves (29—32).

2. Remove seat (30) using a 5 mm hex key wrench.

3. Seat may need to be heated to break down thread lock and sealer. This can be done by inserting a steel rod into the hole and heating the rod to transfer the heat to the seat.

IMPORTANT: Oil will leak past ball if it is not seated properly.

4. Install ball (29).

5. Place ball on seat and tap ball with a hammer to obtain a tight fit between ball and seat. After installing ball insert a metal bar into the plug hole so it rests on the ball. Tap other end of bar with a hammer to obtain a tight fit between ball and housing.

Continued on next page

6. Apply thread lock and sealer (medium strength) to seat (30). Tighten seat.

Brake Release Shuttle Valve Seat—Specification

Torque.. 14.5 N•m (128 lb-in.)

7. Tighten plug.

Brake Release Shuttle Valve Plug—Specification

Torque... 34 N•m (301 lb-in.)

SERVO PISTON SHUTTLE VALVE

1. Remove servo piston shuttle valves (29—32).

2. Remove seat (30) using a 5 mm hex key wrench.

3. Seat may need to be heated to break down thread lock and sealer. This can be done by inserting a steel rod into the hole and heating the rod to transfer the heat to the seat.

IMPORTANT: Oil will leak past ball if it is not seated properly.

4. Install ball (29).

5. Place ball on seat and tap ball with a hammer to obtain a tight fit between ball and seat. After installing ball, but before tightening seat, insert a metal bar into the plug hole so it rests on the ball. Tap other end of bar with a hammer to obtain a tight fit between ball and housing.

6. Apply thread lock and sealer (medium strength) to seat (30). Using a 5 mm hex key wrench, tighten seat.

Servo Piston Shuttle Valve Seat—Specification

Torque.. 14.5 N•m (128 lb-in.)

7. Tighten plug (31).

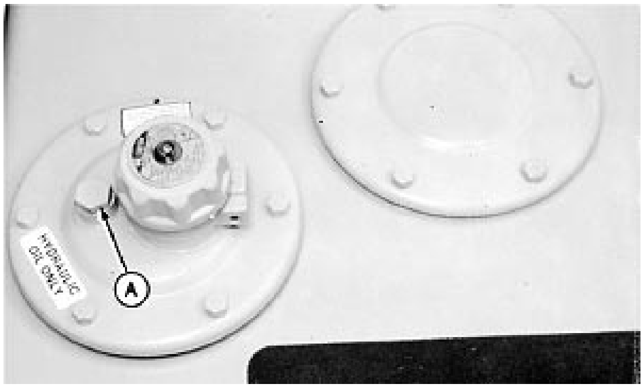
Servo Piston Shuttle Valve Plug—Specification

Torque.. 34 N•m (301 lb-in.)

TX,02,UU3724 –19–18SEP98–3/3

REMOVE AND INSTALL ROTARY MANIFOLD

1. Loosen vent plug to relieve hydraulic oil tank pressure.



A—Vent Plug

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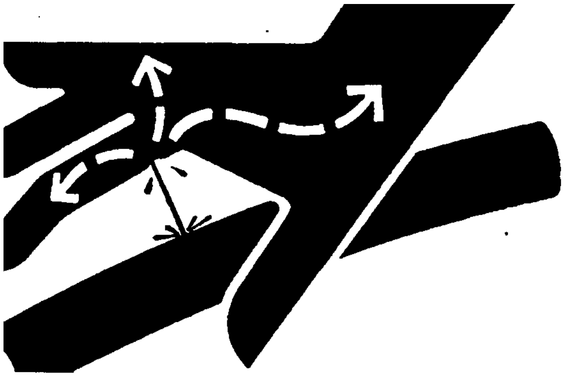
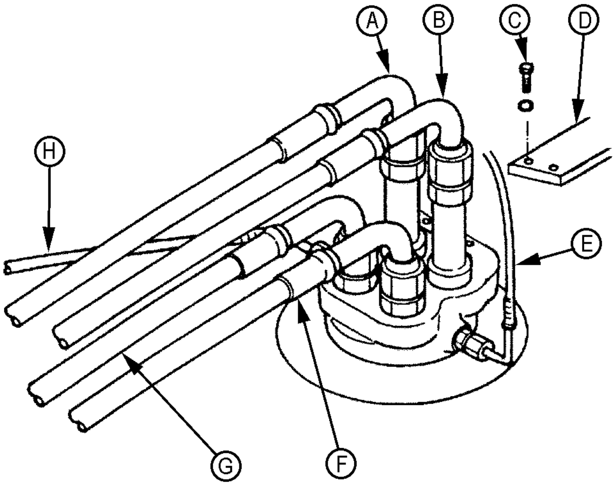
TX,02,VV2722 –19–18SEP98–1/7

CAUTION: To avoid injury from escaping fluid under pressure, stop engine, and relieve the pressure in the system before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.


X9811 –UN–23AUG88

2. Disconnect lines (A, B, E—H).

3. Remove cap screws (C) and stop (D).



T103964

T103964 –UN–23SEP96

A—Left Front Port To Left Propel Top Port
B—Right Front Port To Right Propel Top Port
C—Cap Screw
D—Stop
E—Right Side Port To Propel Speed Change Solenoid Valve
F—Right Rear To Right Propel Bottom Port
G—Left Rear To Left Propel Bottom Port
H—Left Side Port To Return Manifold

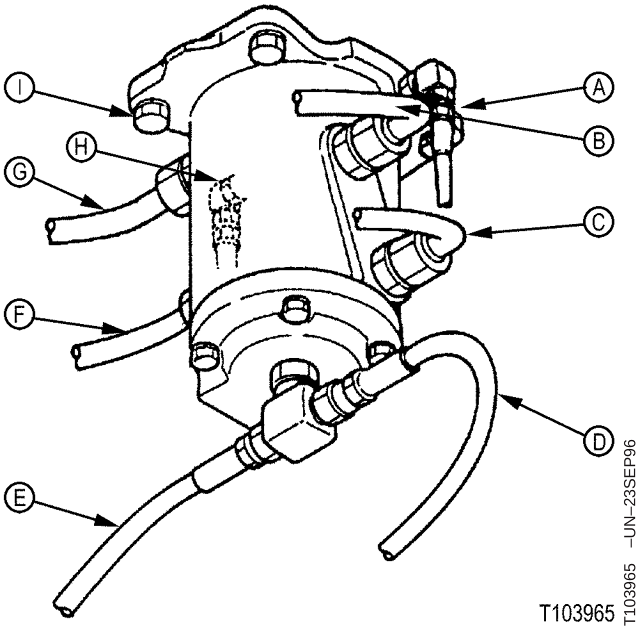
Continued on next page

CAUTION: The approximate weight of rotary manifold is 27 kg (60 lb).

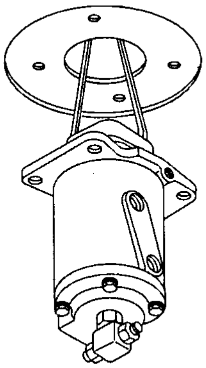
Rotary Manifold—Specification

Weight.. 27 kg (60 lb) approximate

4. Attach the rotary manifold to a hoist using a lifting strap and two rotary manifold lifting tools. (See Section 99 for instructions to make tools.)



T103965 –UN–23SEP96



T7685JC –UN–27APR92

A—To Right Propel Motor Speed Change Port
B—To Right Propel Motor Top Port (Reverse)
C—To Right Propel Motor Bottom Port (Forward)
D—To Right Propel Motor Drain Port
E—To Left Propel Motor Drain Port
F—Port To Left Propel Motor Bottom Port (Forward)
G—Port To Left Propel Motor Top Port (Reverse)
H—To Left Propel Motor Speed Change Port
I—Cap Screw

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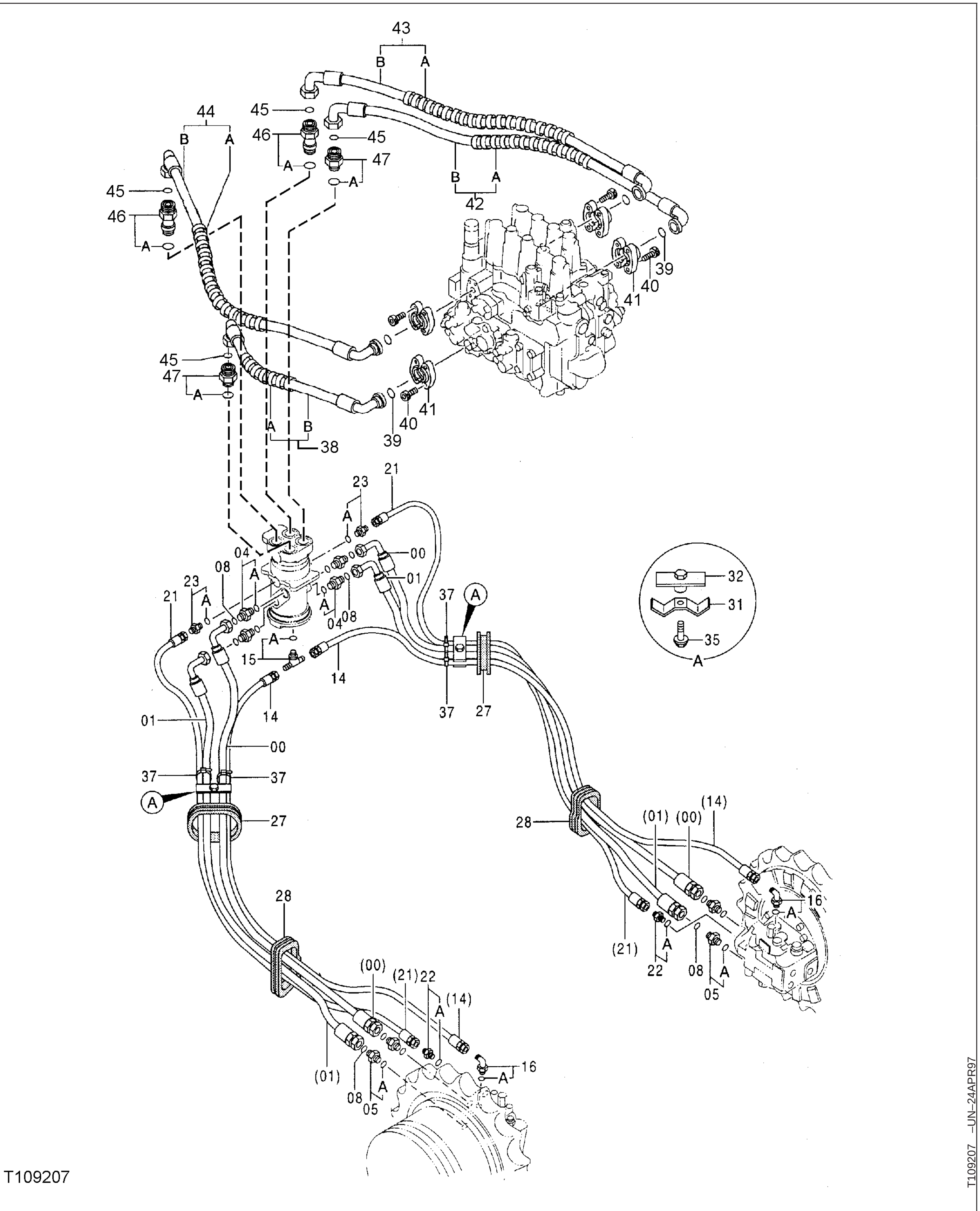

T109207

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00—Hose (2 used)
01—Hose (2 used)
04—Adapter (4 used)
04A—O-Ring (4 used)
05—Adapter (4 used)
05A—O-Ring (4 used)
08—O-Ring (8 used)
14—Hose (2 used)
15—Tee Fitting
15A—O-Ring
16—elbow (2 used)
16A—O-Ring (2 used)
21—Hose (2 used)
22—Adapter (2 used)
22A—O-Ring (2 used)
23—Adapter (2 used)
23A—O-Ring (2 used)
27—Rubber Bushing (2 used)
28—Rubber Bushing 2 used)
31—Hose Clamp (2 used)
32—Hose Clamp (2 used)
35—Cap Screw (2 used)
37—Tie Band (4 used)
38A—Hose Protector
38B—Hose
39—O-Ring (4 used)
40—Cap Screw (16 used)
41—Split Flange (8 used)
42A—Hose Protector
42B—Hose
43A—Hose Protector
43B—Hose
44A—Hose Protector
44B—Hose
45—O-Ring (4 used)
46—Adapter (2 used)
47—Adapter (2 used)
47A—O-Ring (2 used)

5. Disconnect hoses (00, 01, and 21) from each side of rotary manifold.

6. Disconnect hoses (38B, 42B, 43B, and 44B) from top of rotary manifold.

7. Remove rotary manifold-to-mainframe cap screws. Lower rotary manifold.

8. Replace parts as necessary.

9. Raise rotary manifold into position. Tighten flange-to-mainframe cap screws.

Manifold-to-Frame Cap Screw—Specification

Torque.. 34 N•m (25 ft-lb)

10. Connect all hoses to appropriate ports.

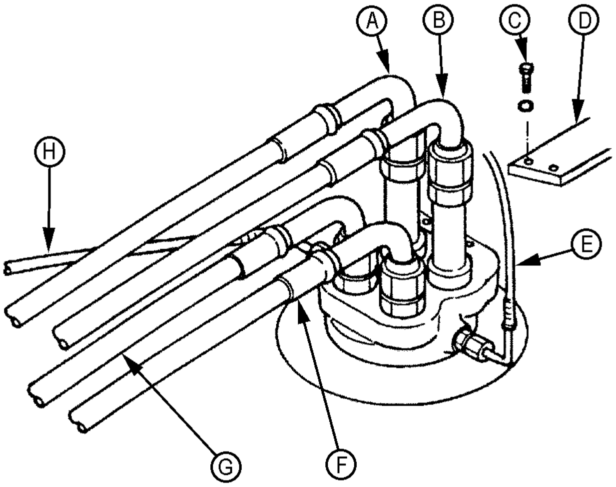
Continued on next page

11. Remove lifting device. Install stop (D). Tighten cap screws (C).

Stop-to-Frame Cap Screw—Specification

Torque .... 40 N•m (30 lb-ft)

12. Connect lines (A, B, E—H). If ports on rotary manifold do not align with lines, lower rotary manifold and do the following steps.



T103964

T103964 –UN–23SEP96

A—Left Front Port To Left Propel Top Port
B—Right Front Port To Right Propel Top Port
C—Cap Screw
D—Stop
E—Right Side Port To Propel Speed Change Solenoid Valve
F—Right Rear To Right Propel Bottom Port
G—Left Rear To Left Propel Bottom Port
H—Left Side Port To Return Manifold

Continued on next page

TX,02,VV2722 –19–18SEP98–6/7

13. Install cap screws (O) in spindle. Clamp cap screws in a vise.

14. Install cap screw (N), washer (J), and nut (K). Install puller on rotary manifold using cap screws (L). Use an extra thin service wrench (I) such as the D05242ST Service Wrench to hold cap screw (N).

15. Rotate manifold three times using nut (K) and a torque wrench.

Rotary Manifold—Specification

Torque .... 373 N•m (275 lb-ft) first rotation
Torque .... 237 N•m (175 lb-ft) second rotation
Torque .... 170 N•m (125 lb-ft) third rotation

16. Raise rotary manifold into position against machine mainframe. Tighten cap screws.

Manifold-to-Frame Cap Screw—Specification

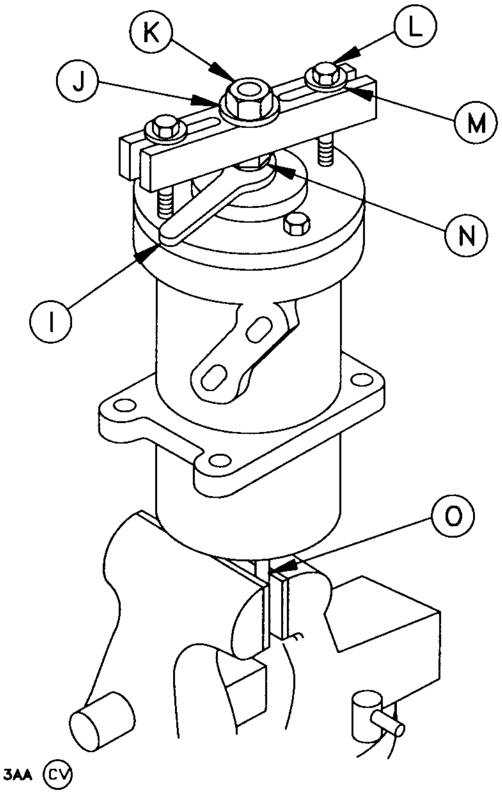
Torque .... 34 N•m (25 lb-ft)

17. Remove lifting device. Install stop. Tighten cap screws (C).

Stop-to-Frame Cap Screw—Specification

Torque .... 40 N•m (30 lb-ft)

18. Connect lines.



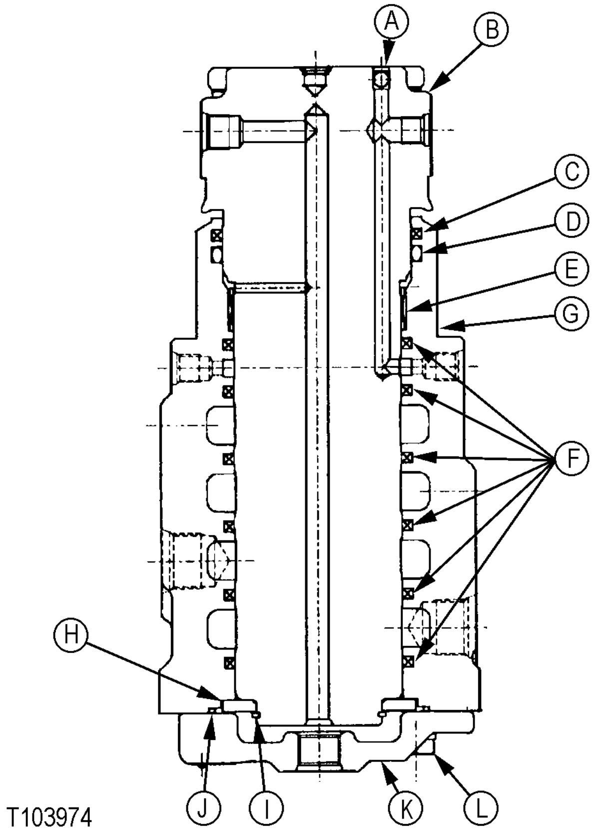
T8313AA –UN–20SEP94

I—Service Wrench
J—Washer
K—Nut
L—Cap Screw (2 used)
M—Washer (2 used)
N—Cap Screw
O—Cap Screw (2 used)

TX,02,VV2722 –19–18SEP98–7/7

DISASSEMBLE AND ASSEMBLE ROTARY MANIFOLD

1. Mark spindle (B), housing (F), and cover (K) to aid in assembly.
2. Remove cap screws (L) and cover (K). Inspect O-ring (J) and replace if necessary.
3. Remove snap ring (I) and ring (H).
4. Carefully, remove spindle assembly (A—F) from housing (G).
5. Remove plugs in spindle to clean ports. Install plugs.
6. Remove O-ring (D), seal (C), oil seal rings (F) and bushing (E) from housing (G).



A—Plug
B—Spindle
C—Dust Seal
D—O-Ring
E—Bushing
F—Oil Seal Rings (6 used)
G—Housing
H—Ring
I—Snap Ring
J—O-Ring
K—Cover
L—Cap Screw

Continued on next page

7. Inspect and repair as necessary. Keep hydraulic oil on all disassembled parts.

8. Install bushing (E), O-ring (D), and seal (C) in housing (G).

9. Install oil seal rings (F) into housing (G)

IMPORTANT: Avoid damage to seals when installing spindle into rotary manifold housing. Clearance between spindle and housing is approximately 0.1 mm (0.004 in.) Spindle must not be tilted when inserted into housing.

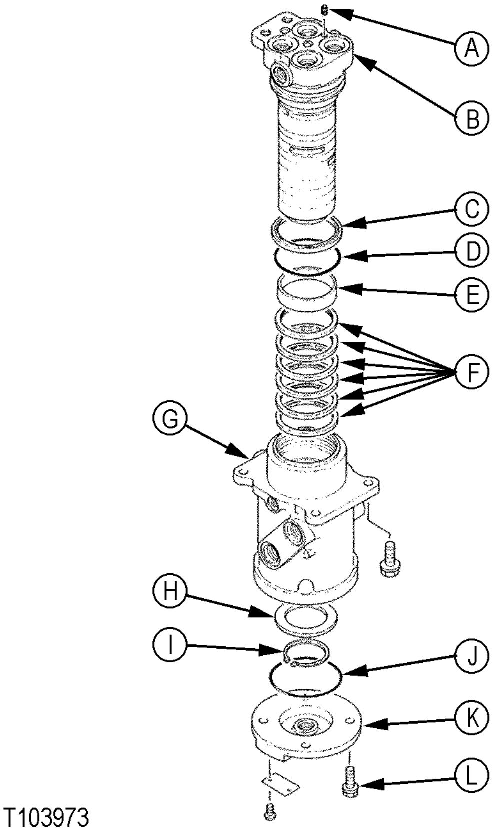
10. Carefully install spindle (B) into housing (G) so that match marks align.

11. Install ring (H) with chamfered side down and snap ring (I) with chamfered side down.)

12. Install O-ring (J) and cover (K) with cap screws (L). Tighten cap screws.

Cover-to-Housing Cap Screw—Specification

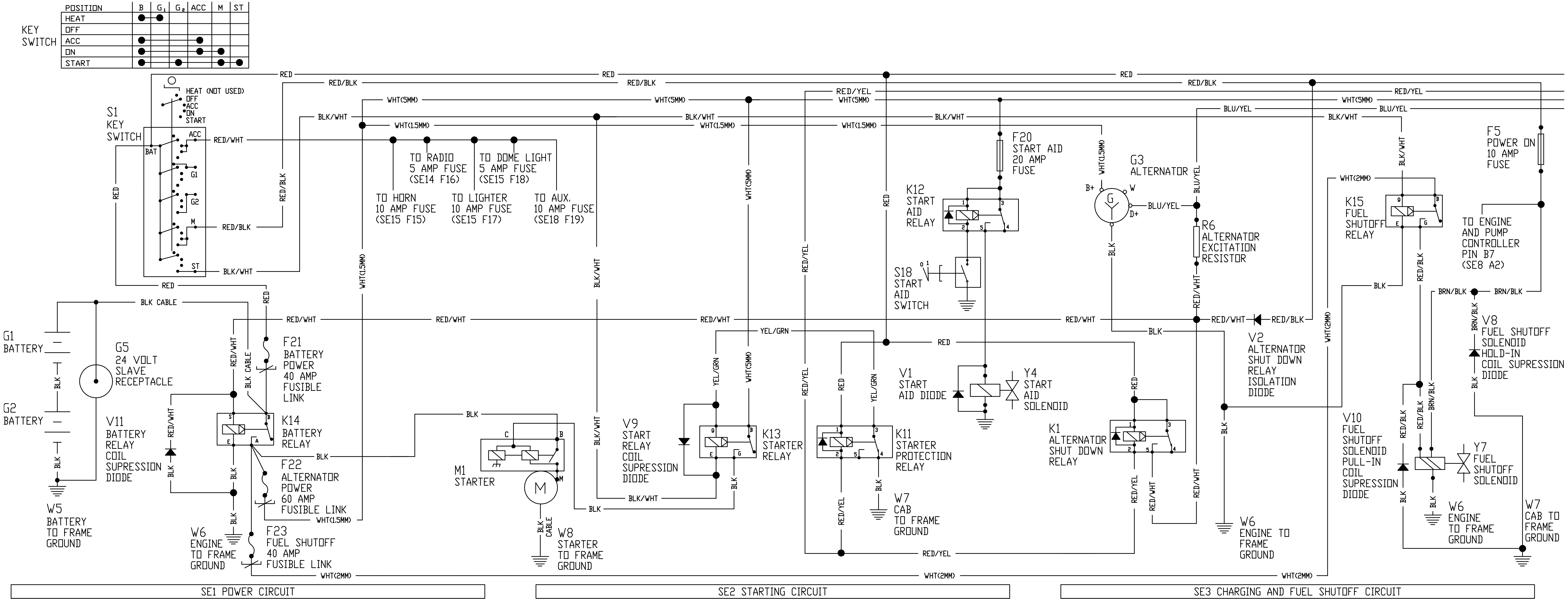
Torque .... 49 N•m (36 lb-ft)



T103973 –UN–24SEP96

A—Plug
B—Spindle
C—Dust Seal
D—O-Ring
E—Bushing
F—Oil Seal Ring (6 used)
G—Housing
H—Ring
I—Snap Ring
J—O-Ring
K—Cover
L—Cap Screw

TX,02,VV2723 –19–18SEP98–2/2



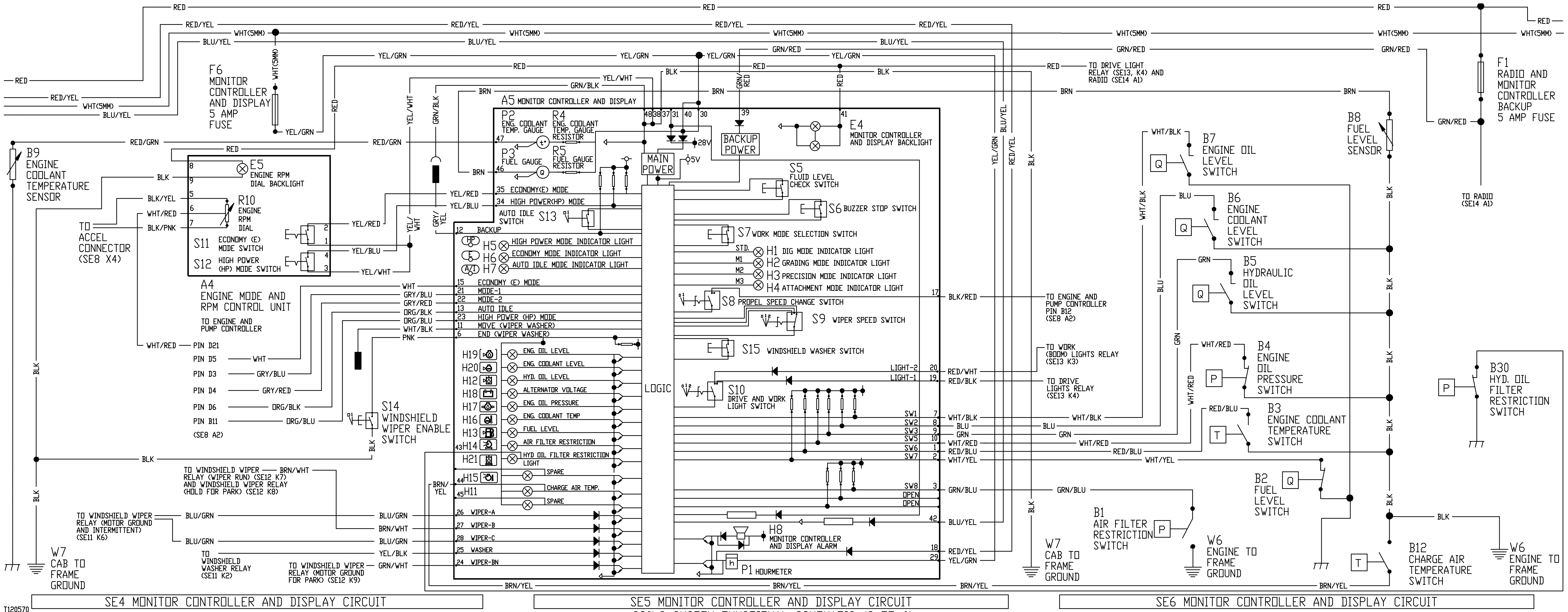
KEY SWITCH

POSITION	B	G_1	G_2	ACC	M	ST
HEAT	●	●				
OFF						
ACC	●			●		
ON	●			●	●	
START	●		●		●	●

T120569

230LC SYSTEM FUNCTIONAL SCHEMATIC (1 OF 6)

CONTINUED ON NEXT PAGE



T120570

230LC SYSTEM FUNCTIONAL SCHEMATIC (2 OF 6)

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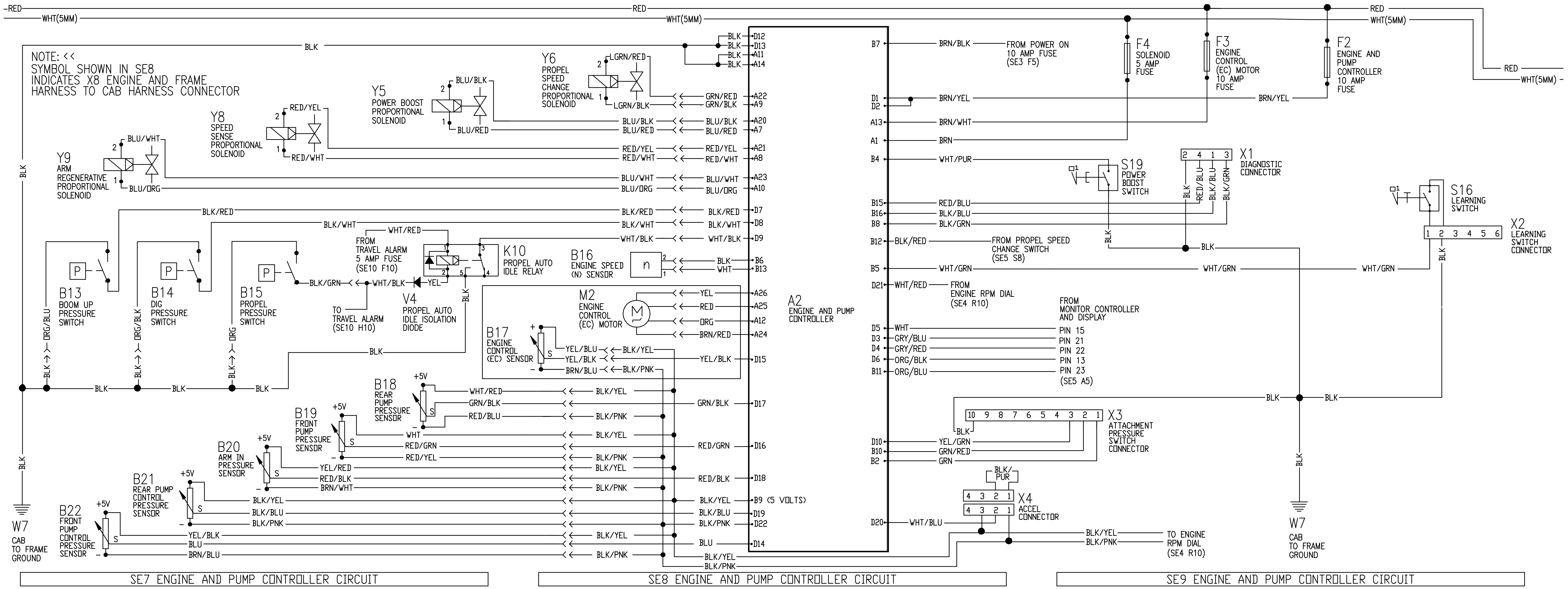

230LC SYSTEM FUNCTIONAL SCHEMATIC (3 OF 6)

T117691

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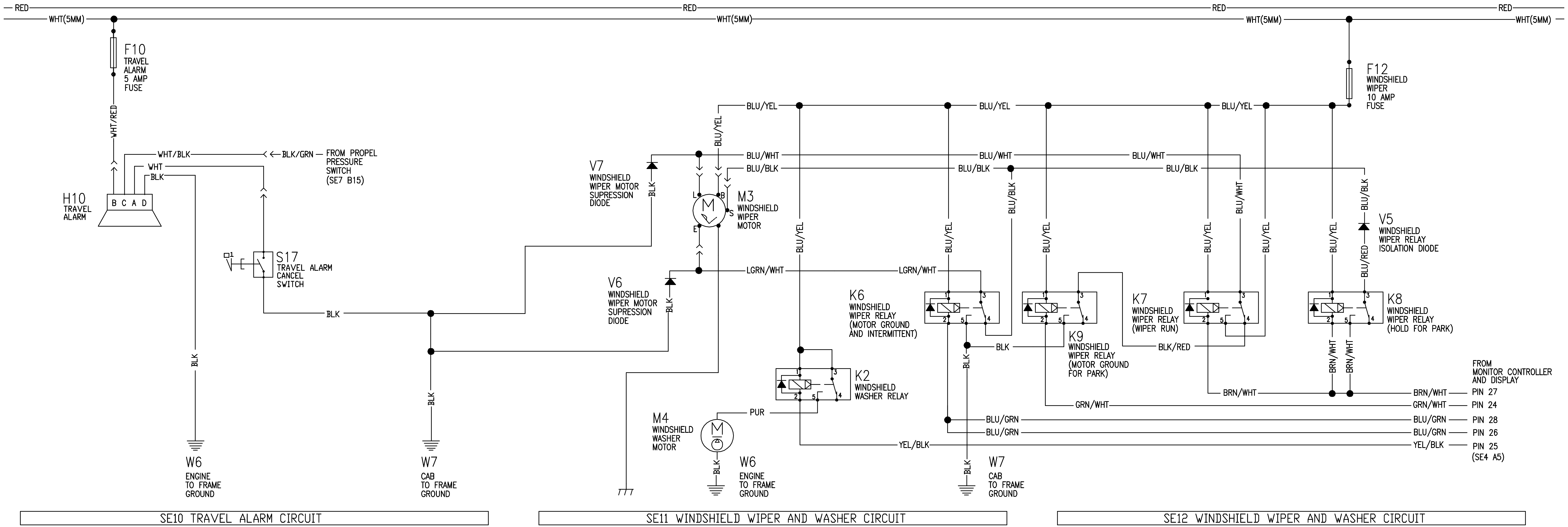

T117692

230LC SYSTEM FUNCTIONAL SCHEMATIC (4 OF 6)

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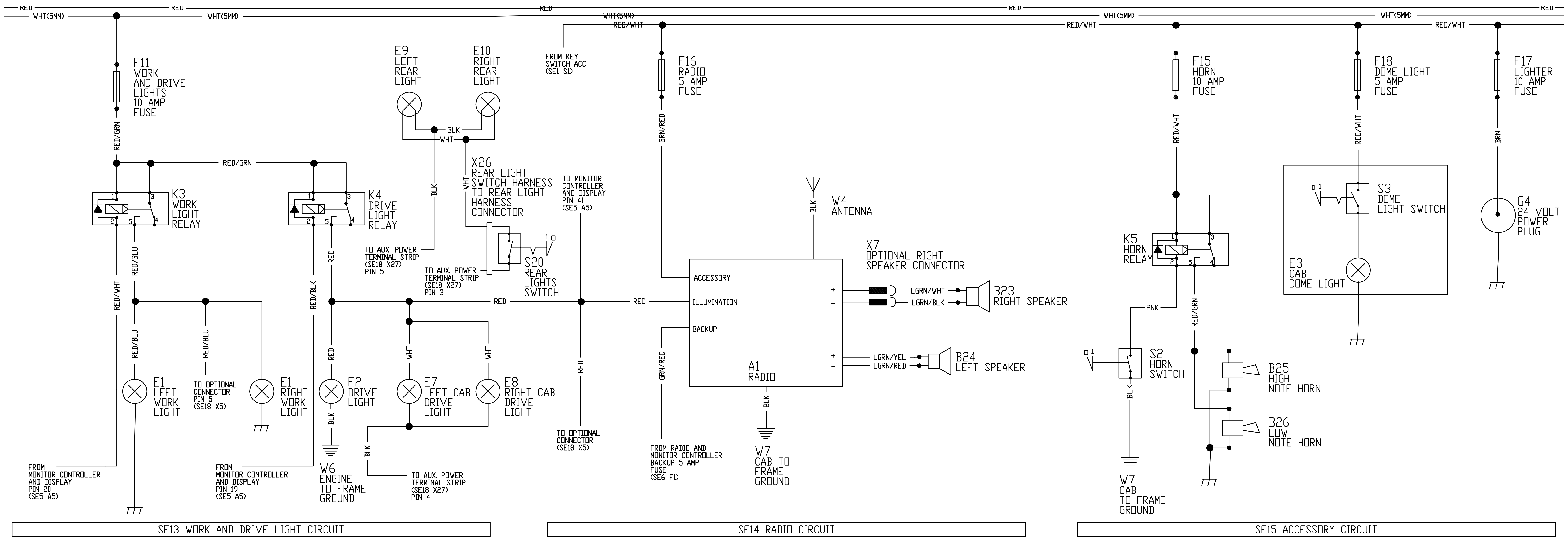

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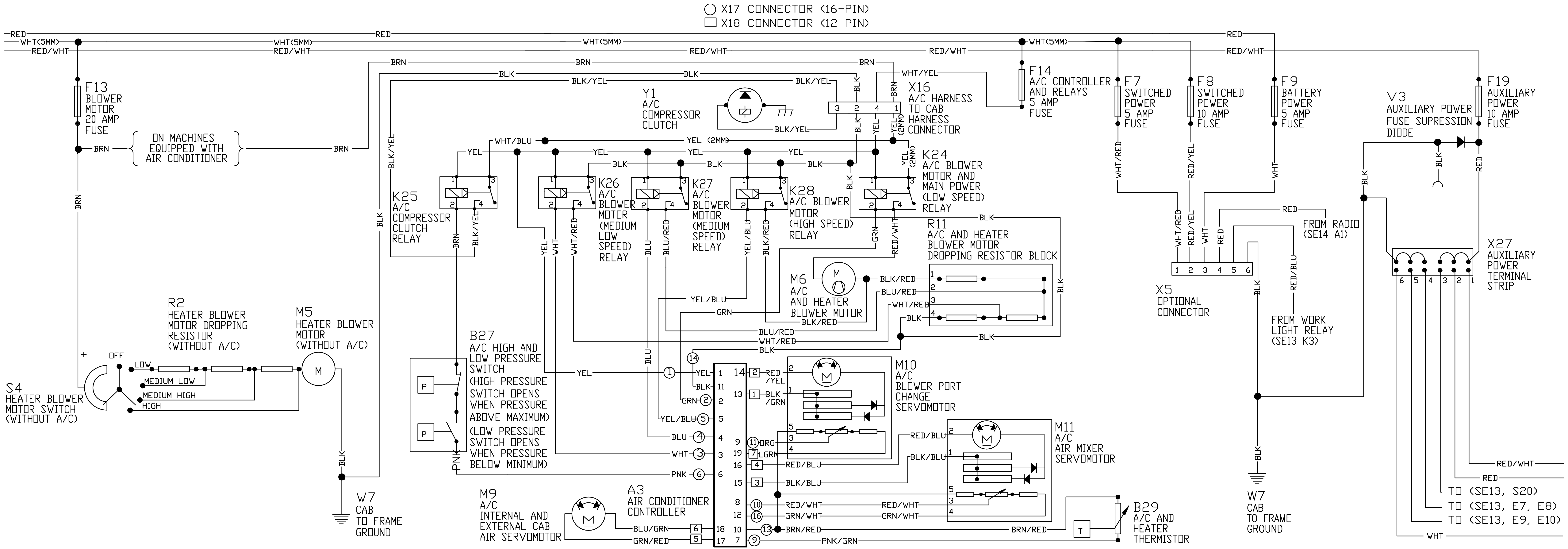
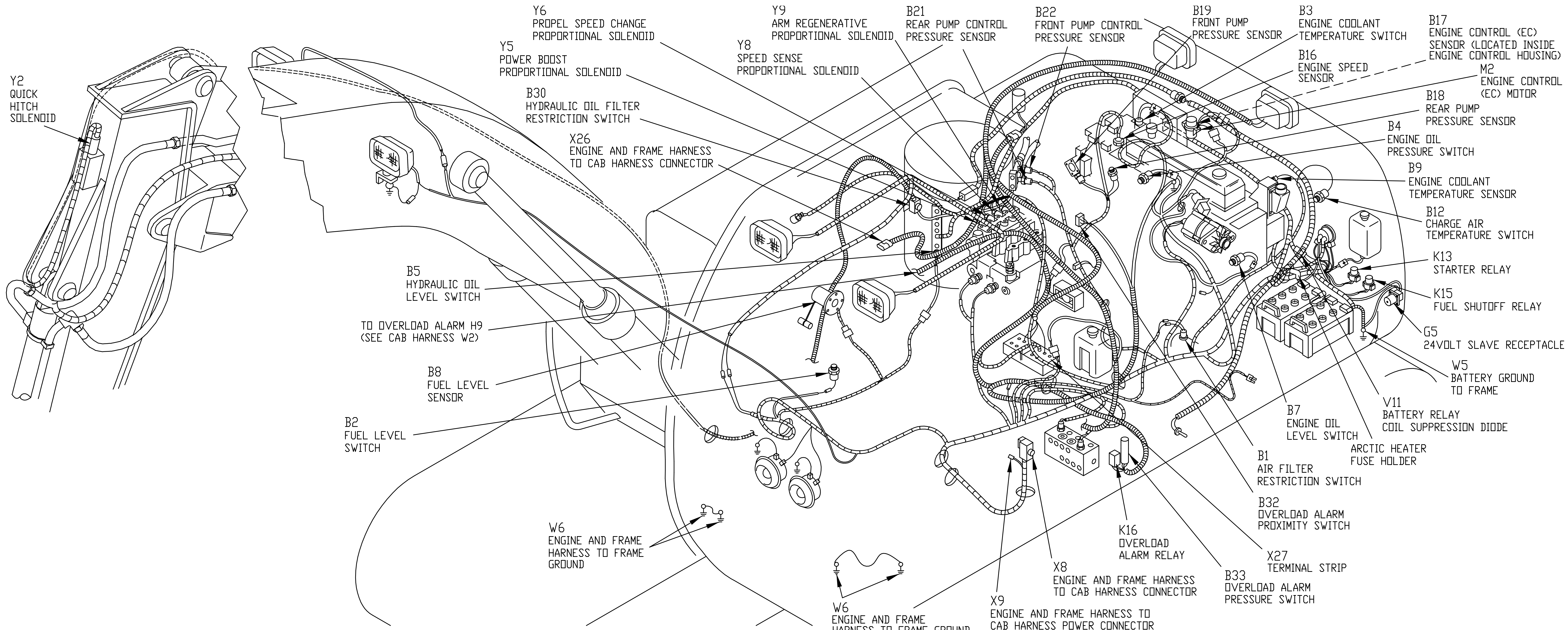
T120571

230LC SYSTEM FUNCTIONAL SCHEMATIC (5 OF 6)



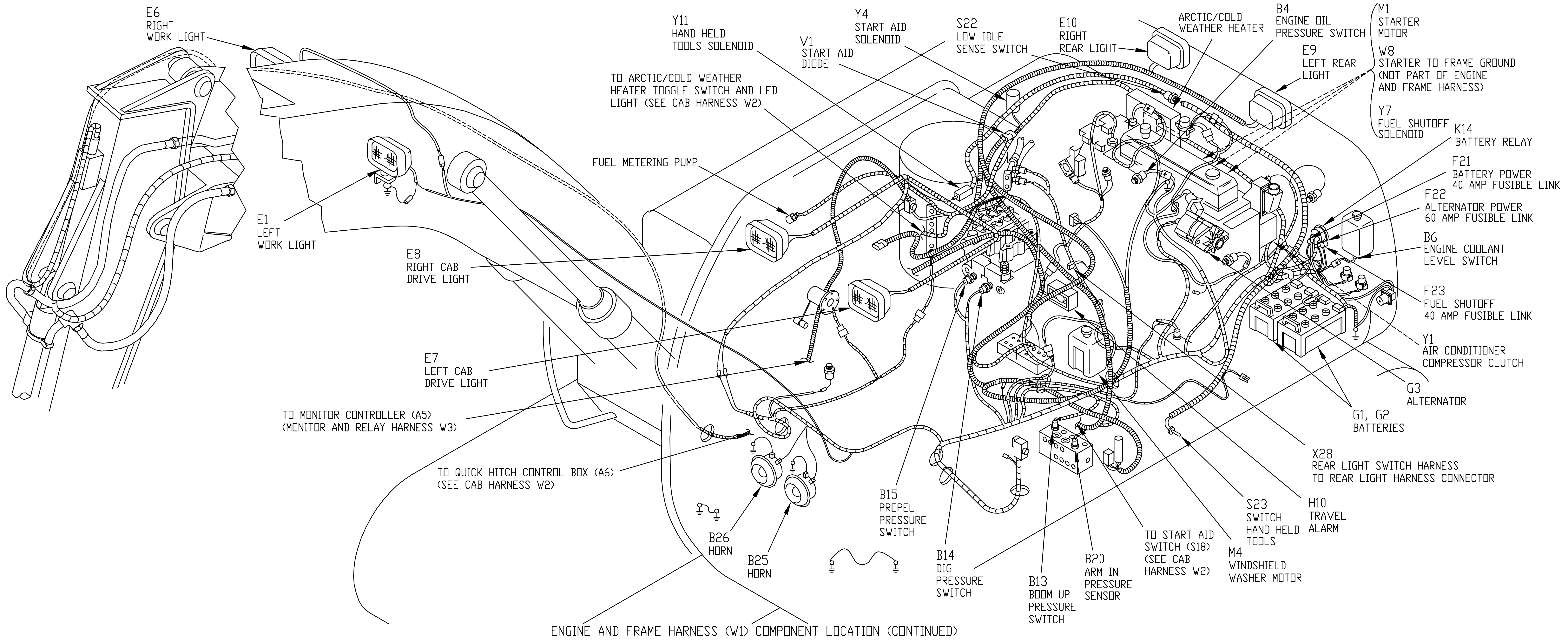
T120572

230LC SYSTEM FUNCTIONAL SCHEMATIC (6 OF 6)

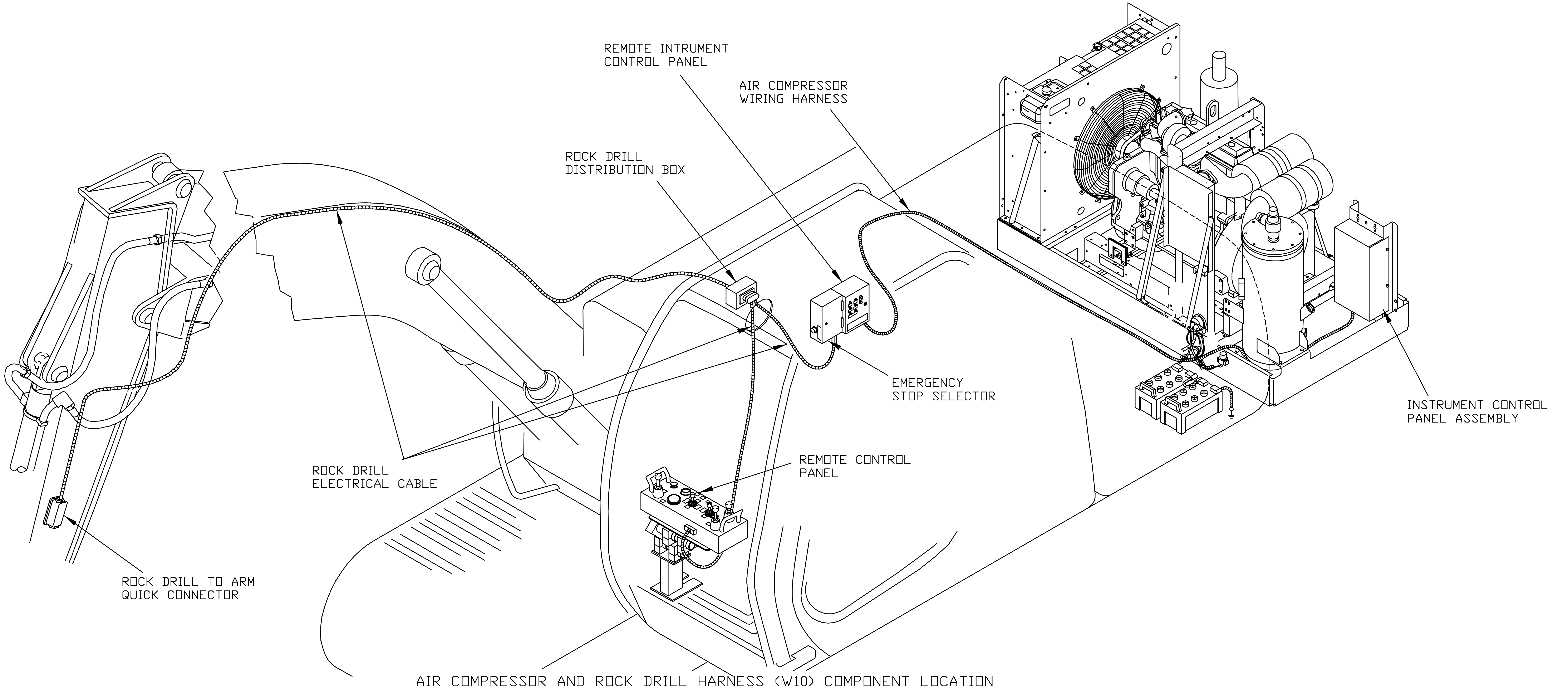


T120573

ENGINE AND FRAME HARNESS (W1) COMPONENT LOCATION

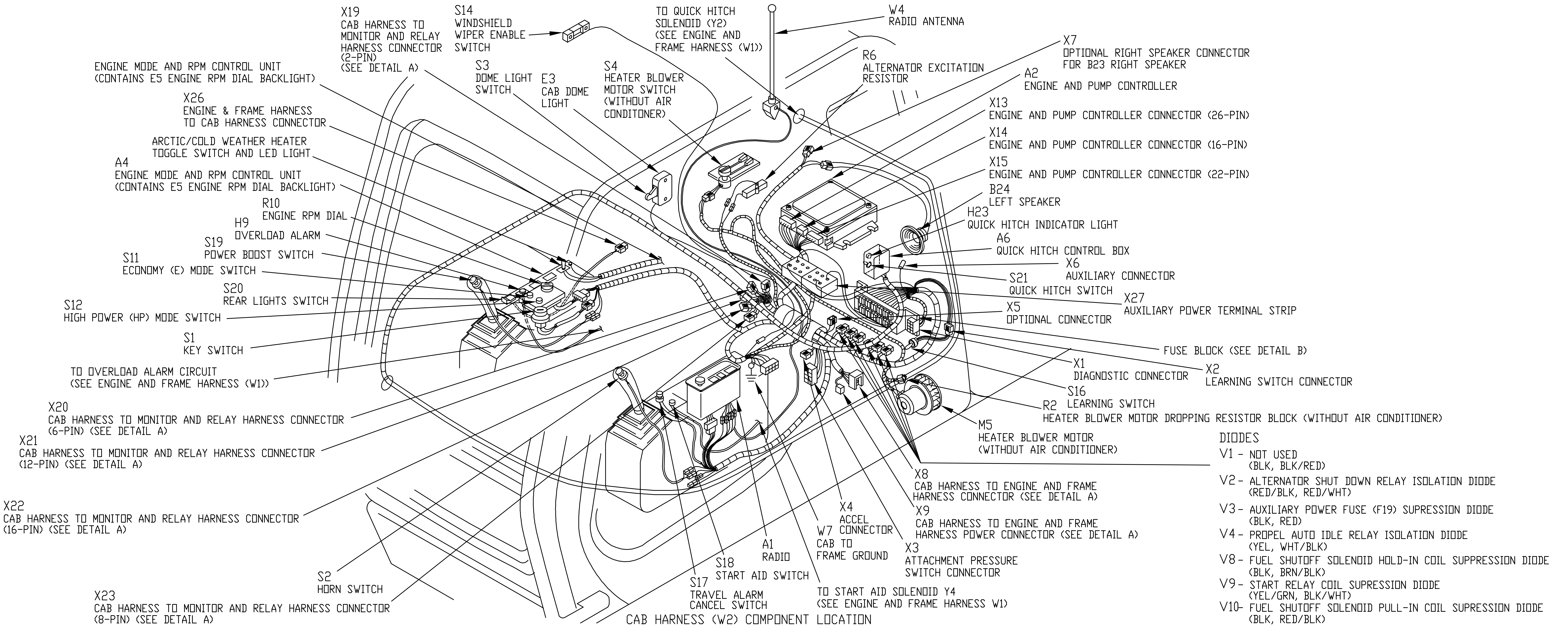


ENGINE AND FRAME HARNESS (W1) COMPONENT LOCATION (CONTINUED)



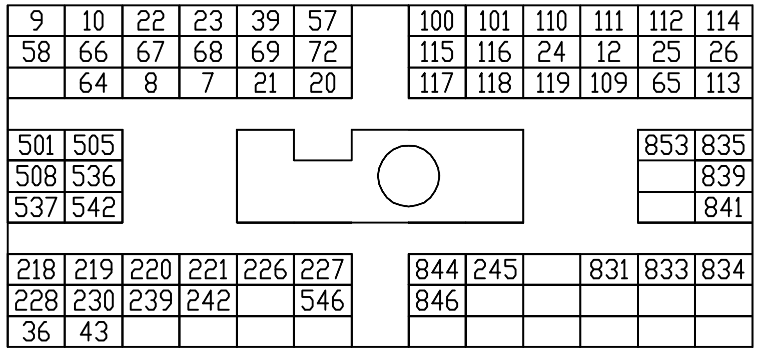
AIR COMPRESSOR AND ROCK DRILL HARNESS (W10) COMPONENT LOCATION

T121476



CAB HARNESS (W2) COMPONENT LOCATION

X8
CAB HARNESS TO ENGINE
AND FRAME HARNESS
CONNECTOR



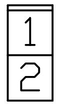
9	10	22	23	39	57		100	101	110	111	112	114
58	66	67	68	69	72		115	116	24	12	25	26
	64	8	7	21	20		117	118	119	109	65	113
501	505										853	835
508	536											839
537	542											841
218	219	220	221	226	227		844	245		831	833	834
228	230	239	242		546		846					
36	43											

X13	PIN A7	BLU/RED	7
X13	PIN A8	RED/WHT	8
X13	PIN A9	LGRN/BLK	9
X13	PIN A10	BLU/ORG	10
X13	PIN A12	ORG	12
X13	PIN A20	BLU/BLK	20
X13	PIN A21	RED/YEL	21
X13	PIN A22	LGRN/RED	22
X13	PIN A23	BLU/WHT	23
X13	PIN A24	BRN/RED	24
X13	PIN A25	RED	25
X16	PIN A26	YEL	26
X14	PIN B6	BLK	36
X14	PIN B9	BLK/YEL	39
X14	PIN B13	WHT	43
X15	PIN D7	BLK/RED	57
X15	PIN D8	BLK/WHT	58
X15	PIN D14	BLU	64
X15	PIN D15	YEL/BLK	65
X15	PIN D16	RED/GRN	66
X15	PIN D17	GRN/BLK	67
X15	PIN D18	RED/BLK	68
X15	PIN D19	BLK/BLU	69

X15	PIN D22	BLK/PNK	72
X13	PIN A11	BLK	100
X13	PIN A11	BLK	101
X14	PIN B9	BLK/YEL	109
X14	PIN B9	BLK/YEL	110
X14	PIN B9	BLK/YEL	111
X14	PIN B9	BLK/YEL	112
X15	PIN D22	BLK/PNK	113
X15	PIN D22	BLK/PNK	114
X15	PIN D22	BLK/PNK	115
X15	PIN D22	BLK/PNK	116
X14	PIN B9	BLK/YEL	117
X15	PIN D22	BLK/PNK	118
X13	PIN A11	BLK	119
X22	PIN 1	WHT/RED	218
X22	PIN 2	GRN	219
X22	PIN 3	BLU	220
X22	PIN 4	WHT/BLK	221
X22	PIN 6	GRN/BLU	226
X22	PIN 7	WHT/YEL	227
X22	PIN 8	RED/BLU	228
X22	PIN 10	BLU/YEL	230
X21	PIN 1	BRN	239

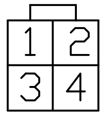
X21	PIN 3	RED/GRN	242
X22	PIN 14	BRN/YEL	245
X19	PIN 2, W7	BLK	501
S1	PIN 6	BLK/WHT	505
V2	PIN K	RED/WHT	508
X20	PIN 2	RED/BLU	536
X20	PIN 3	RED	537
X21	PIN 12	RED/GRN	542
X21	PIN 2	PUR	546
F10 X23	PIN 10 PIN 2	WHT/RED	831
V4	PIN K	WHT/BLK	833
V4	PIN K	WHT/BLK	834
V9 X23	PIN A PIN 5	YEL/GRN	835
W7		BLK	839
V10	PIN K	RED/BLK	841
F5 X14	PIN 5 PIN B7	BRN/BLK	844
S17		WHT	846
X16	PIN 3	BLK/YEL	853

X9
CAB HARNESS TO
ENGINE AND FRAME
HARNESS POWER
CONNECTOR



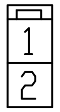
F11 F12 F13	PIN 17 PIN 17 PIN 17	WHT	1
S1	PIN 1	RED	2

X16
CAB HARNESS TO
AIR CONDITIONER
HARNESS CONNECTOR



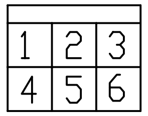
F13	PIN 24	BRN	1
W7		BLK	2
X8	PIN 853	BLK/YEL	3
F14	PIN 25	WHT/YEL	4

X19
CAB HARNESS TO
MONITOR AND RELAY
HARNESS CONNECTOR



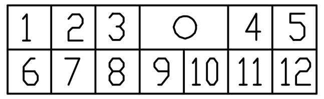
F17	PIN 28	BRN	1
W7		BLK	2

X20
CAB HARNESS TO
MONITOR AND RELAY
HARNESS CONNECTOR



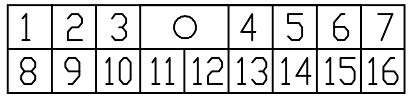
F11	PIN 22	RED/GRN	1
X8	PIN 536	RED/BLU	2
X8	PIN 537	RED	3
S1	PIN 1	RED	4
V2	PIN K	RED/WHT	5
		PLUG	6

X21
CAB HARNESS TO
MONITOR AND RELAY
HARNESS CONNECTOR



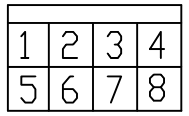
X8	PIN 239	BRN	1
X8	PIN 546	PUR	2
X8	PIN 242	RED/GRN	3
X15	PIN D3	GRY/BLU	4
F15	PIN 26	RED/WHT	5
X15	PIN D6	ORG/BLK	6
X15	PIN D4	GRY/RED	7
X14	PIN B12	BLK/RED	8
X14	PIN B11	ORG/BLU	9
X15	PIN D5	WHT	10
S2	PIN 1	PNK	11
X8	PIN 542	RED/GRN	12

X22
CAB HARNESS
TO MONITOR AND RELAY
HARNESS CONNECTOR



X8	PIN 218	WHT/RED	1
X8	PIN 219	GRN	2
X8	PIN 220	BLU	3
X8	PIN 221	WHT/BLK	4
S14	PIN 1	PNK	5
X8	PIN 226	GRN/BLU	6
X8	PIN 227	WHT/YEL	7
X8	PIN 228	RED/BLU	8
A4	PIN 1	YEL/BLU	9
X8	PIN 230	BLU/YEL	10
F6	PIN 6	YEL/GRN	11
F1	PIN 1	GRN/RED	12
A4	PIN 3	YEL/RED	13
X8	PIN 245	BRN/YEL	14
F12	PIN 23	BLU/YEL	15
A4	PIN 4	YEL/WHT	16

X23
CAB HARNESS TO
MONITOR AND RELAY
HARNESS CONNECTOR

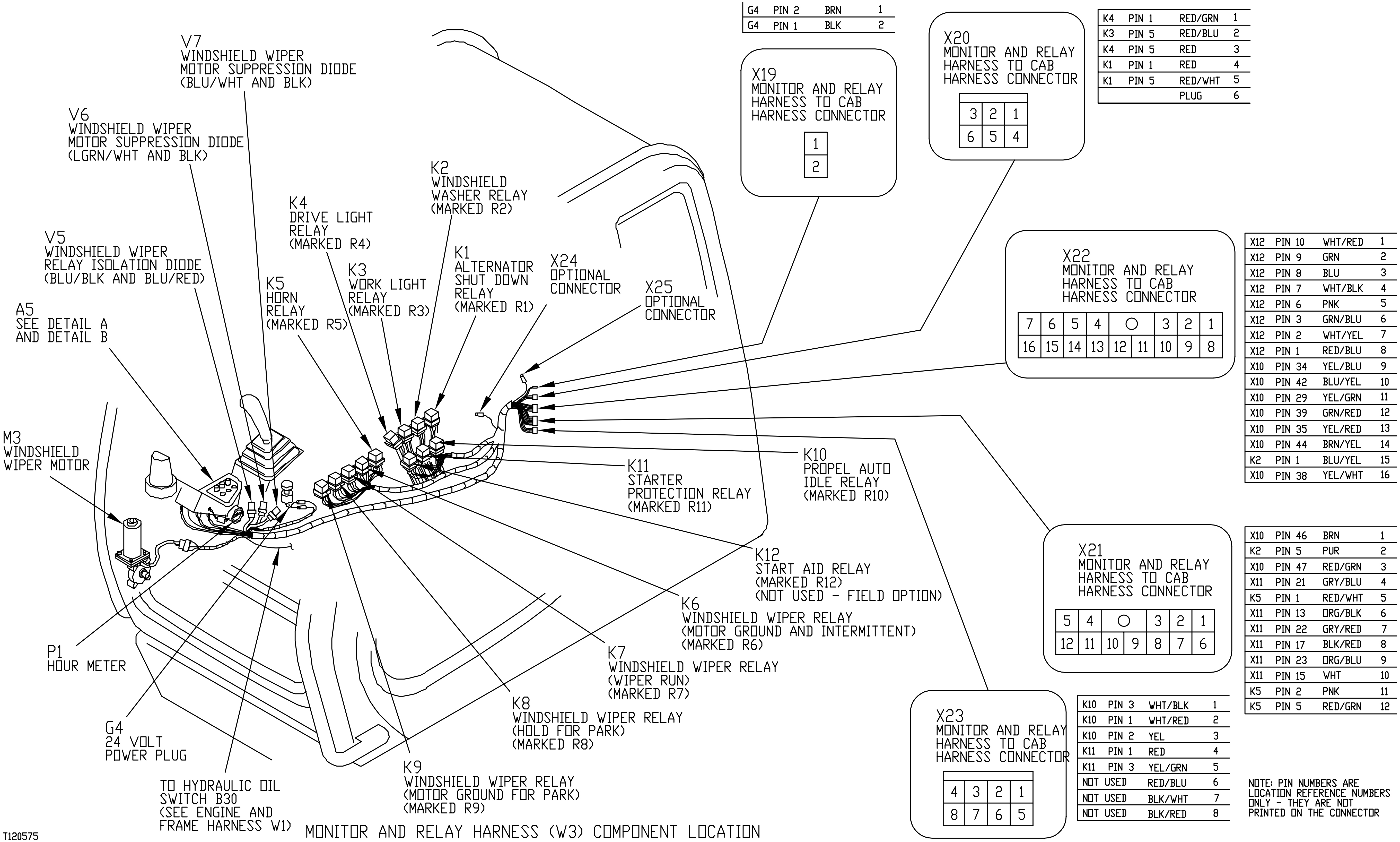


X15	PIN D9	WHT/BLK	1
F10	PIN 10	WHT/RED	2
V4	PIN A	YEL	3
S1	PIN 1	RED	4
V9	PIN A	YEL/GRN	5
F20	PIN 31	RED/BLU	6
NOT USED		BLK/WHT	7
V1	PIN K	BLK/RED	8

NOTE: PIN NUMBERS ARE
LOCATION REFERENCE NUMBERS
ONLY - THEY ARE NOT
PRINTED ON THE CONNECTOR

CAB HARNESS (W2) COMPONENT LOCATION
(DETAIL A) (HARNESS MATING CONNECTORS - FRONT VIEW SHOWN)

T118412



G4	PIN 2	BRN	1
G4	PIN 1	BLK	2

K4	PIN 1	RED/GRN	1
K3	PIN 5	RED/BLU	2
K4	PIN 5	RED	3
K1	PIN 1	RED	4
K1	PIN 5	RED/WHT	5
		PLUG	6

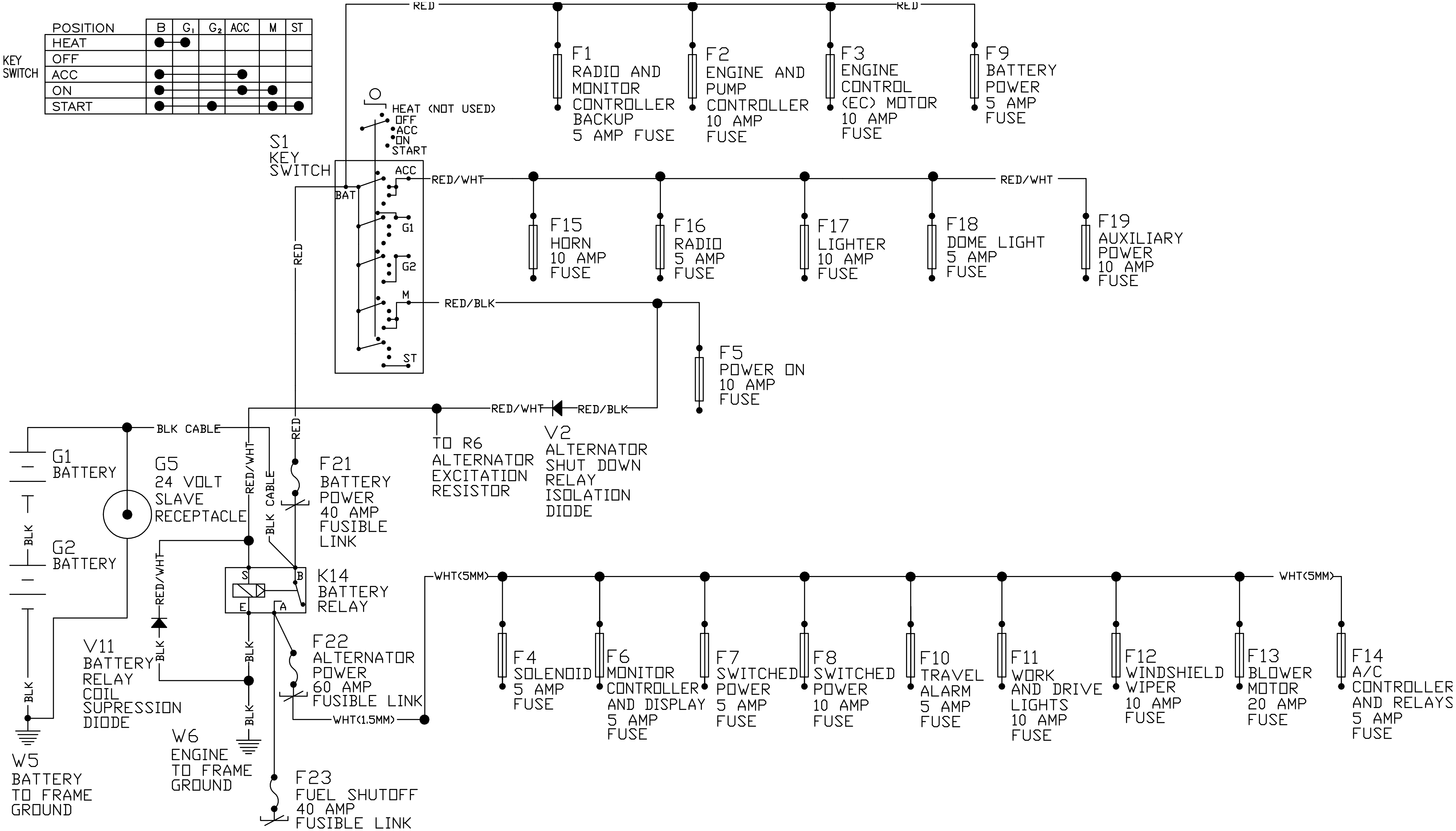
X12	PIN 10	WHT/RED	1
X12	PIN 9	GRN	2
X12	PIN 8	BLU	3
X12	PIN 7	WHT/BLK	4
X12	PIN 6	PNK	5
X12	PIN 3	GRN/BLU	6
X12	PIN 2	WHT/YEL	7
X12	PIN 1	RED/BLU	8
X10	PIN 34	YEL/BLU	9
X10	PIN 42	BLU/YEL	10
X10	PIN 29	YEL/GRN	11
X10	PIN 39	GRN/RED	12
X10	PIN 35	YEL/RED	13
X10	PIN 44	BRN/YEL	14
K2	PIN 1	BLU/YEL	15
X10	PIN 38	YEL/WHT	16

X10	PIN 46	BRN	1
K2	PIN 5	PUR	2
X10	PIN 47	RED/GRN	3
X11	PIN 21	GRY/BLU	4
K5	PIN 1	RED/WHT	5
X11	PIN 13	ORG/BLK	6
X11	PIN 22	GRY/RED	7
X11	PIN 17	BLK/RED	8
X11	PIN 23	ORG/BLU	9
X11	PIN 15	WHT	10
K5	PIN 2	PNK	11
K5	PIN 5	RED/GRN	12

K10	PIN 3	WHT/BLK	1
K10	PIN 1	WHT/RED	2
K10	PIN 2	YEL	3
K11	PIN 1	RED	4
K11	PIN 3	YEL/GRN	5
NOT USED		RED/BLU	6
NOT USED		BLK/WHT	7
NOT USED		BLK/RED	8

NOTE: PIN NUMBERS ARE LOCATION REFERENCE NUMBERS ONLY - THEY ARE NOT PRINTED ON THE CONNECTOR

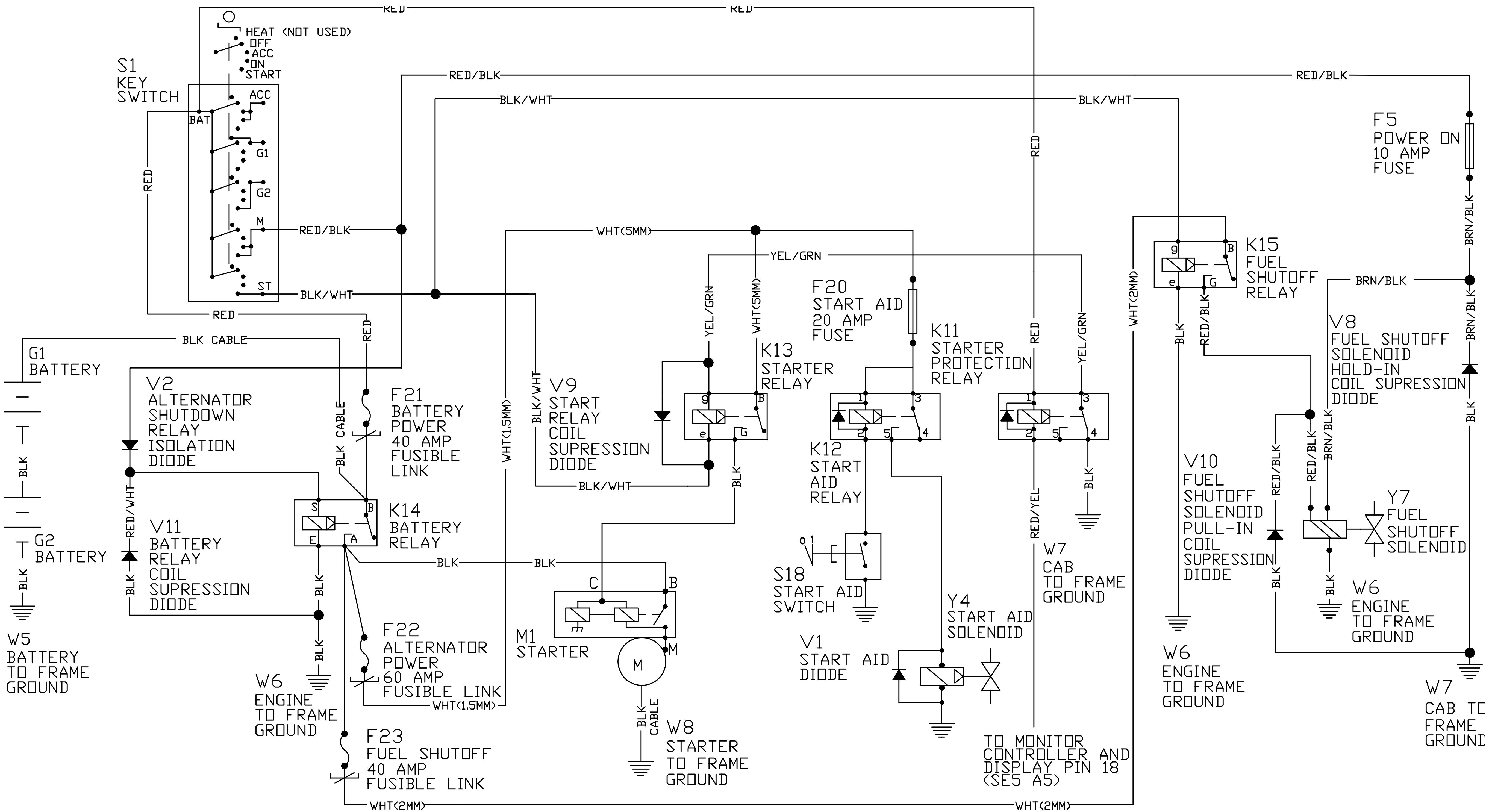
MONITOR AND RELAY HARNESS (W3) COMPONENT LOCATION



KEY SWITCH

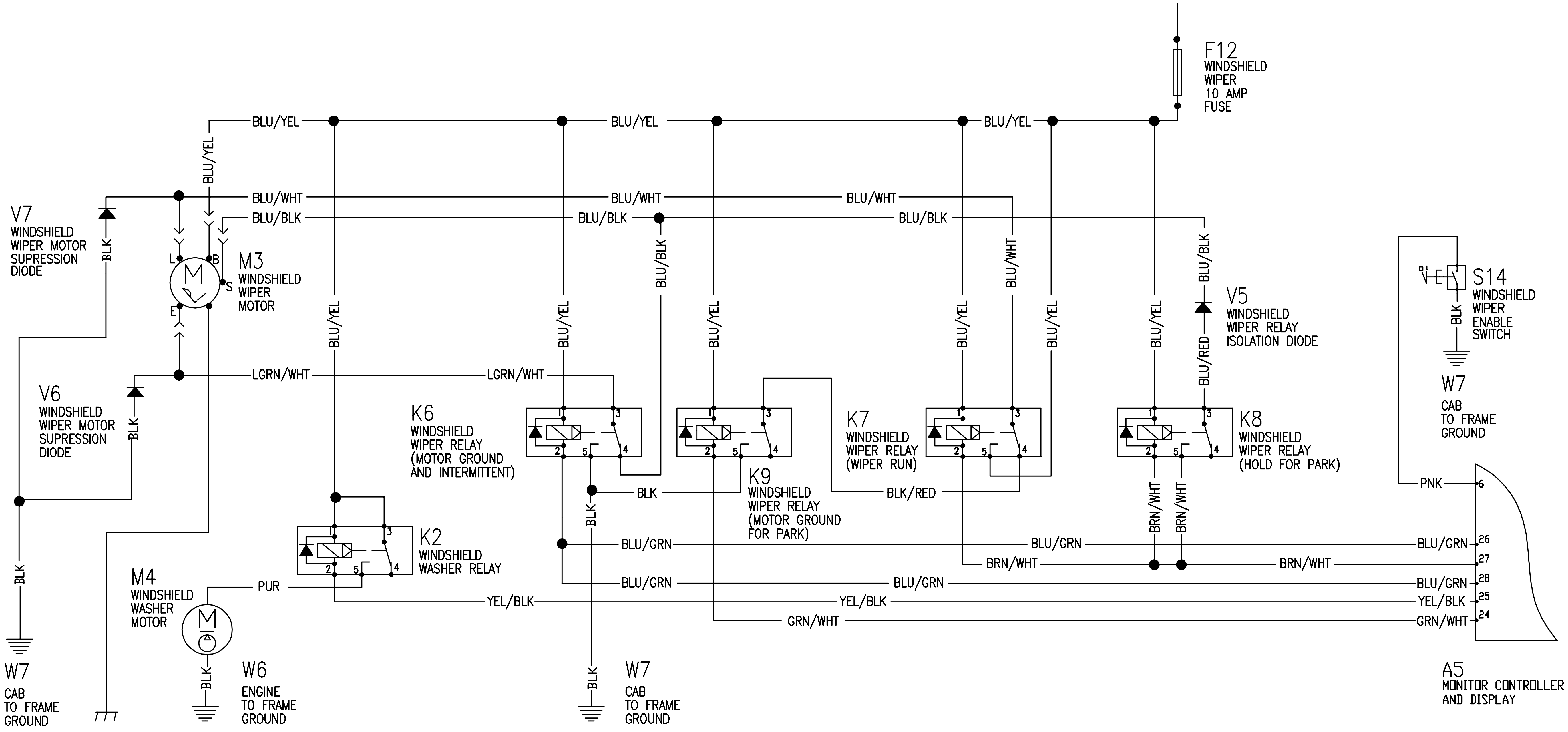
POSITION	B	G_1	G_2	ACC	M	ST
HEAT	●	●				
OFF						
ACC	●			●		
ON	●			●	●	
START	●		●		●	●

POWER CIRCUIT



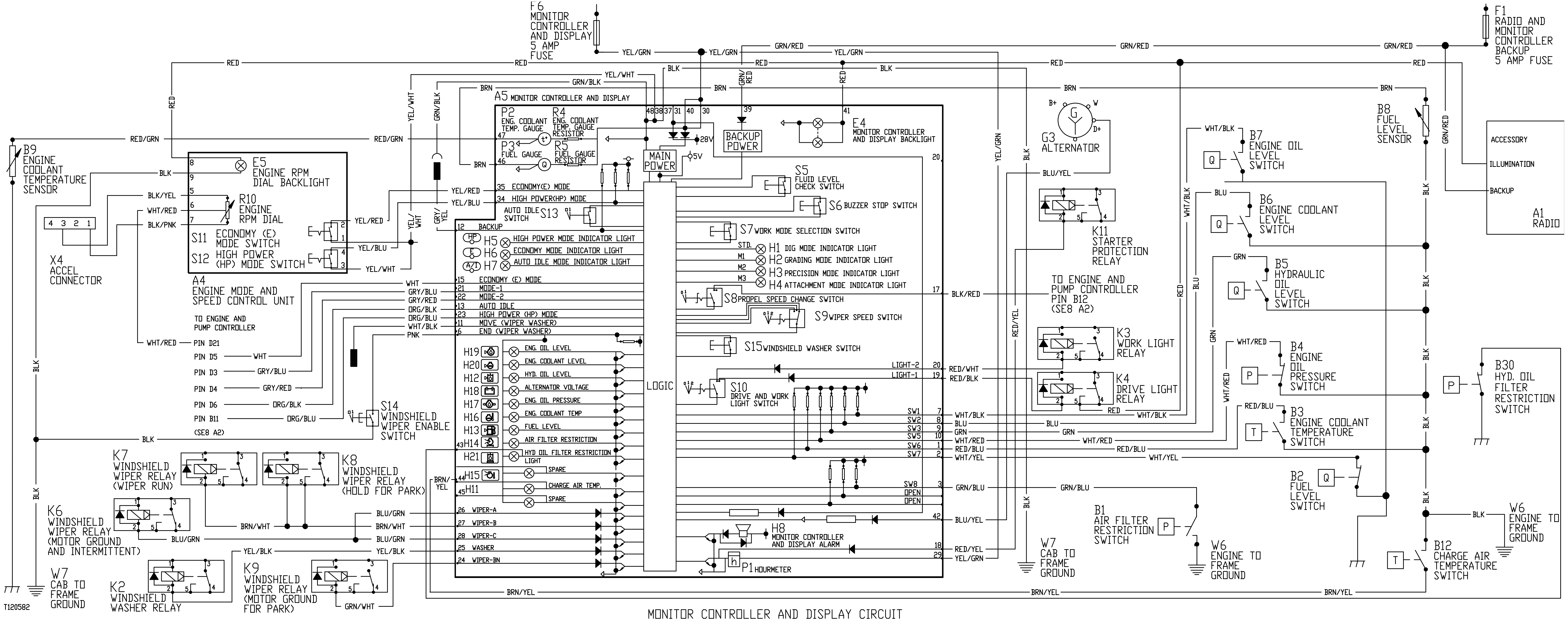
T120580

STARTING AND FUEL SHUTOFF CIRCUIT

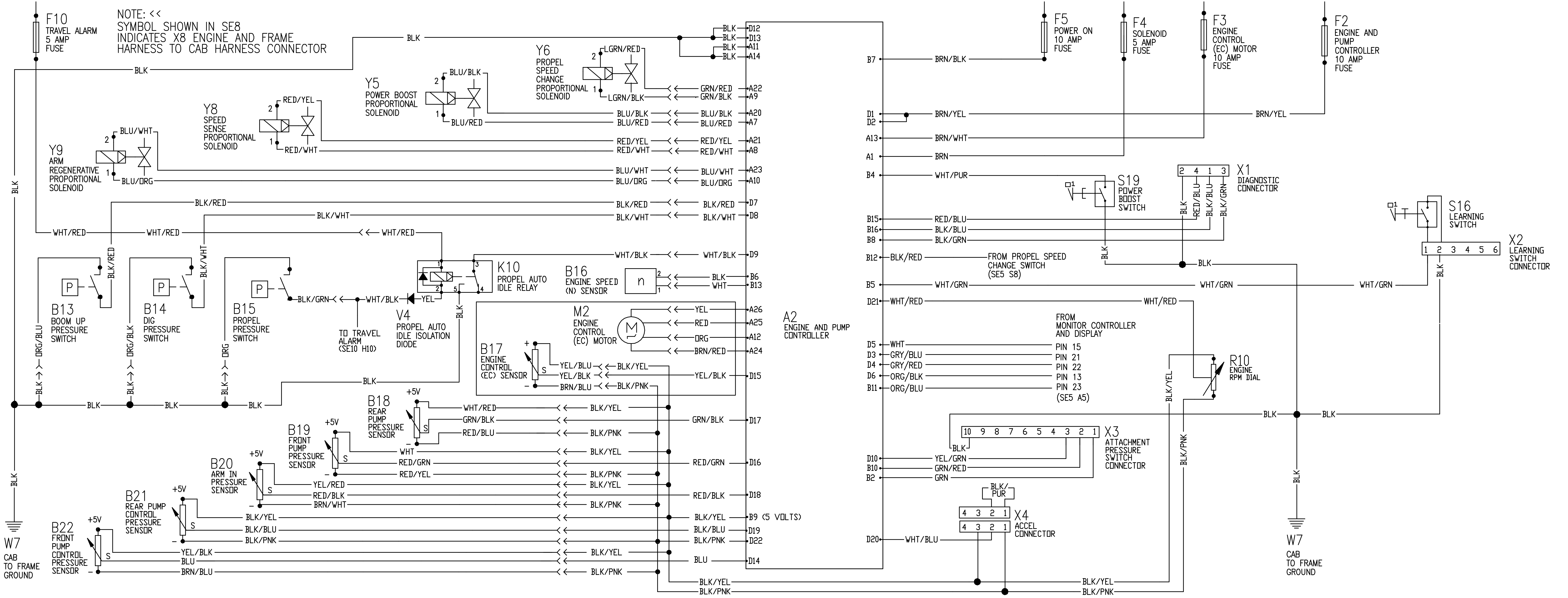


T117933

WINDSHIELD WIPER AND WASHER CIRCUIT

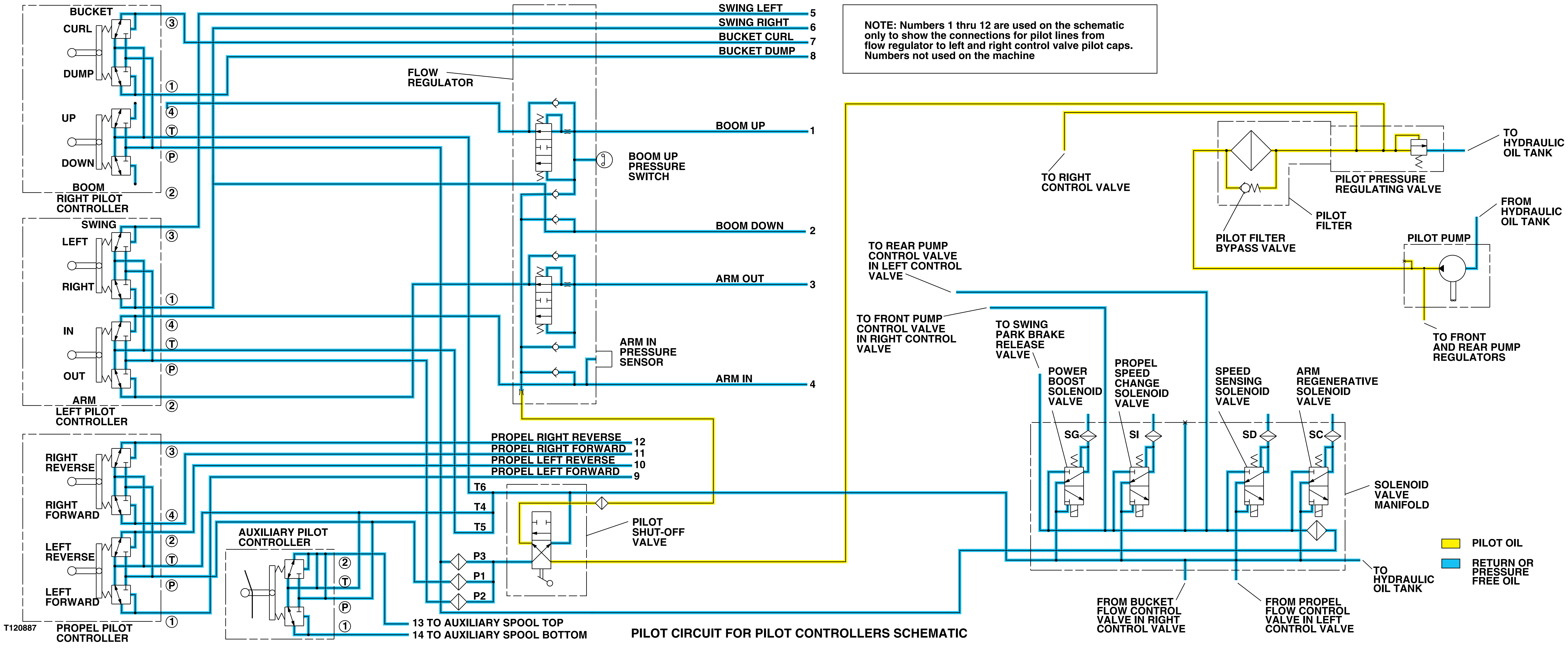


MONITOR CONTROLLER AND DISPLAY CIRCUIT



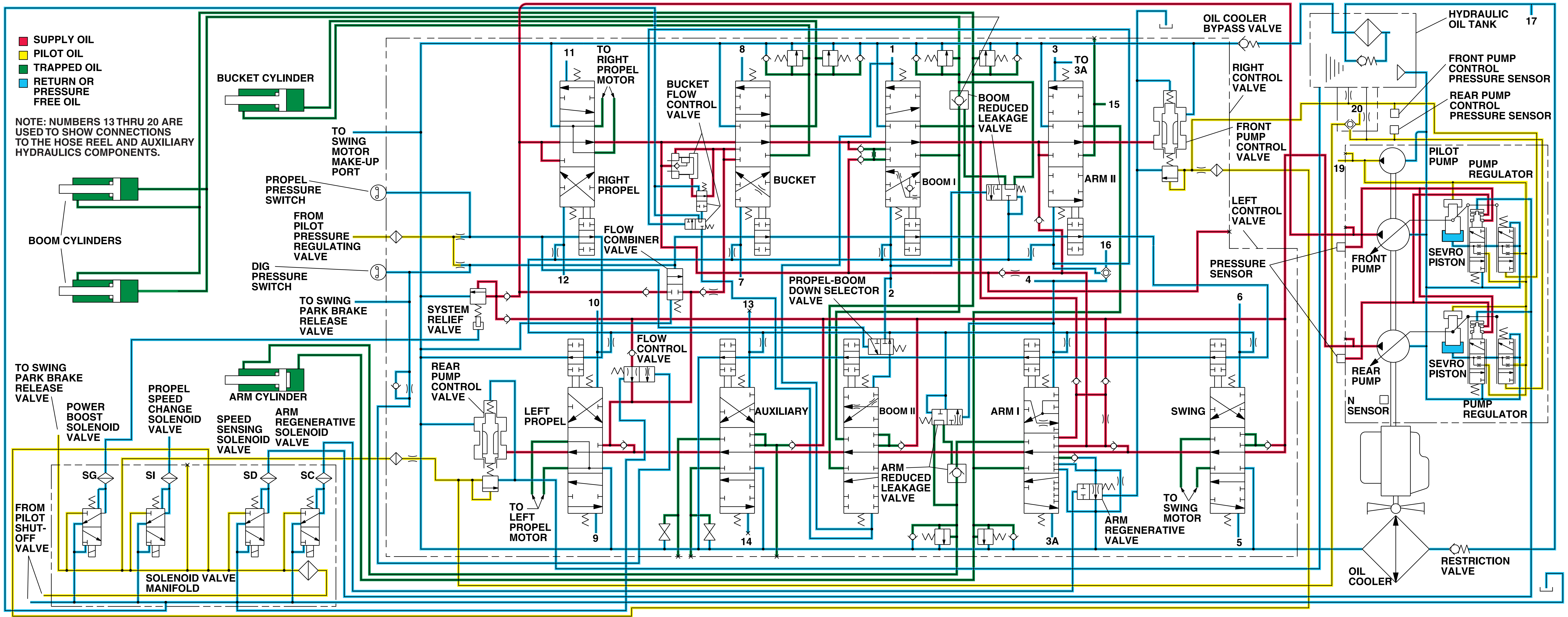
T117931

ENGINE AND PUMP CONTROLLER CIRCUIT



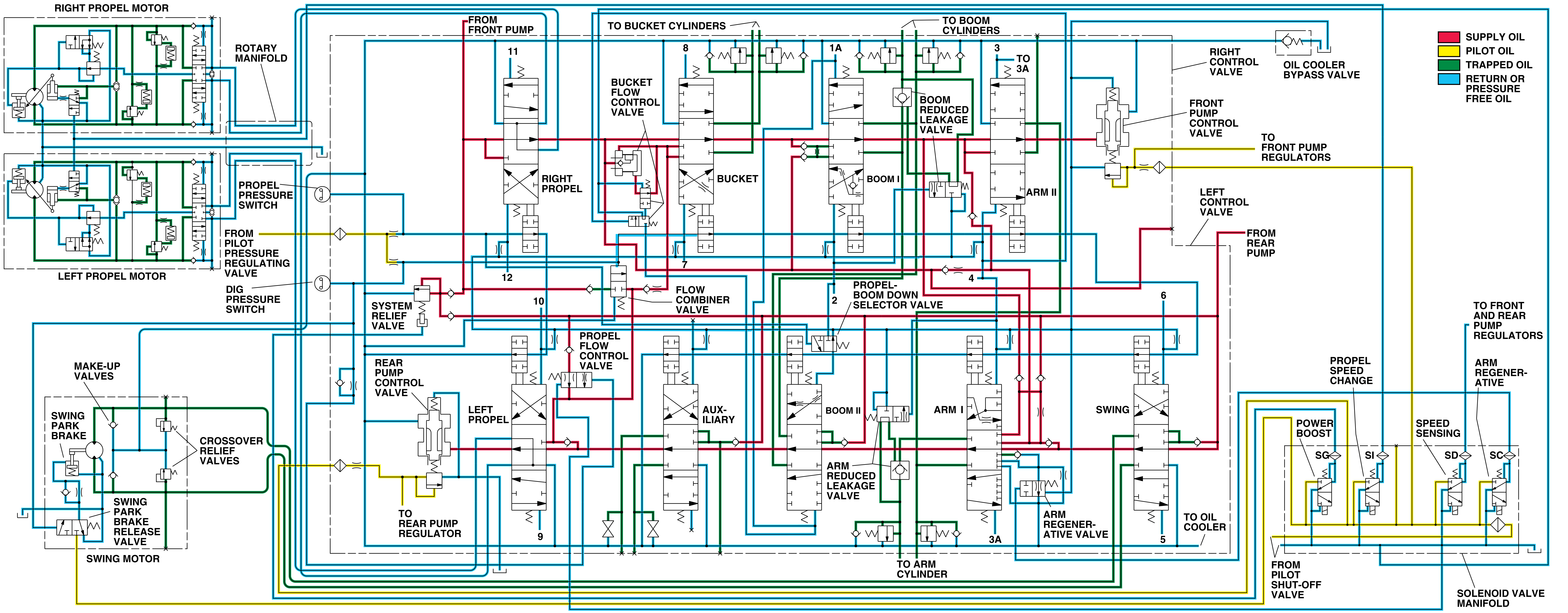
NOTE: Numbers 1 thru 12 are used on the schematic only to show the connections for pilot lines from flow regulator to left and right control valve pilot caps. Numbers not used on the machine

PILOT CIRCUIT FOR PILOT CONTROLLERS SCHEMATIC



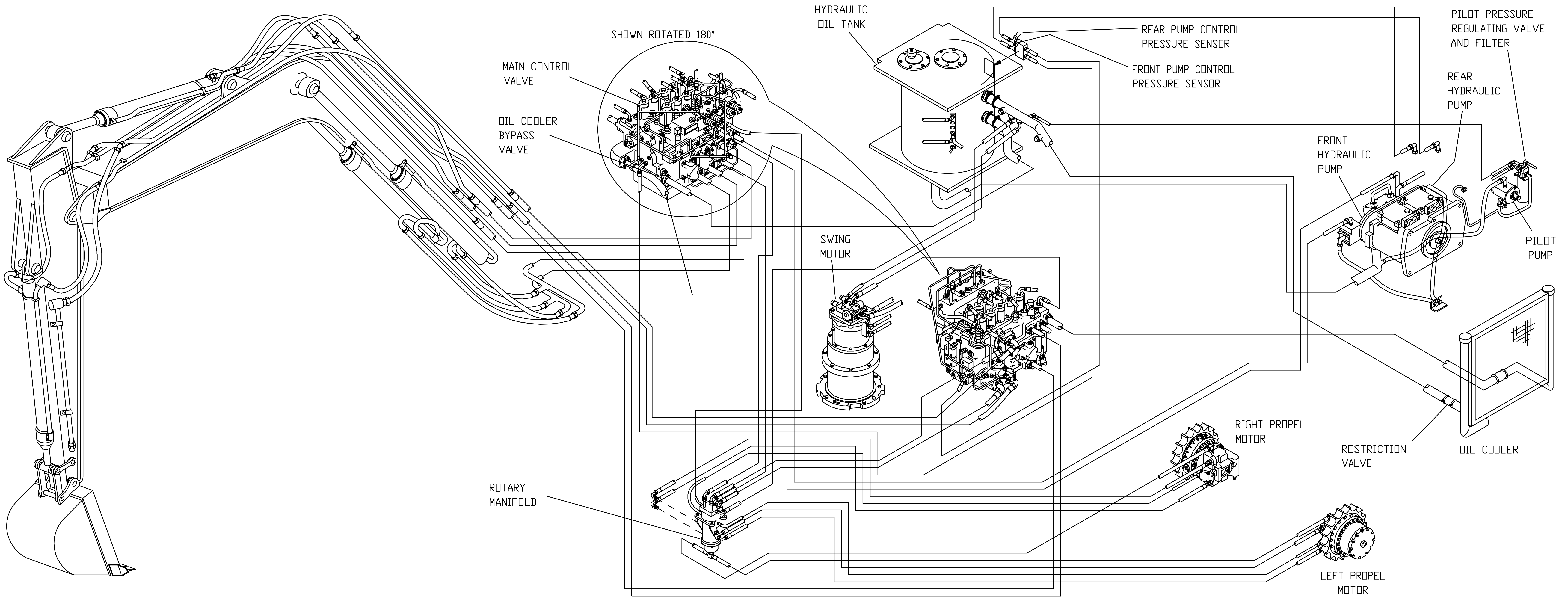
T121641

HYDRAULIC PUMP AND CONTROL VALVE SCHEMATIC



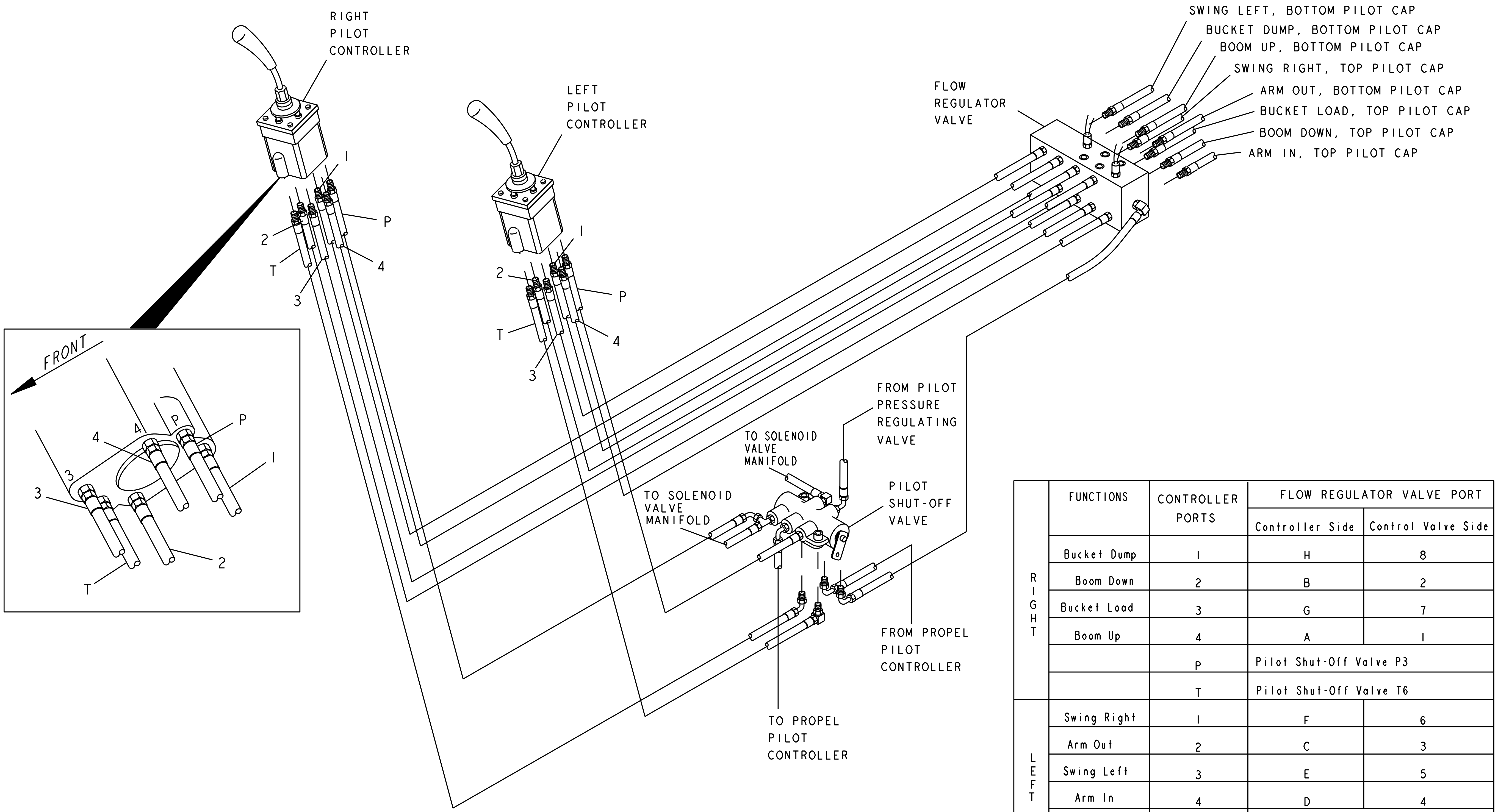
T115418

SWING AND PROPEL MOTOR CIRCUIT SCHEMATIC



MAIN HYDRAULIC SYSTEM

T125365

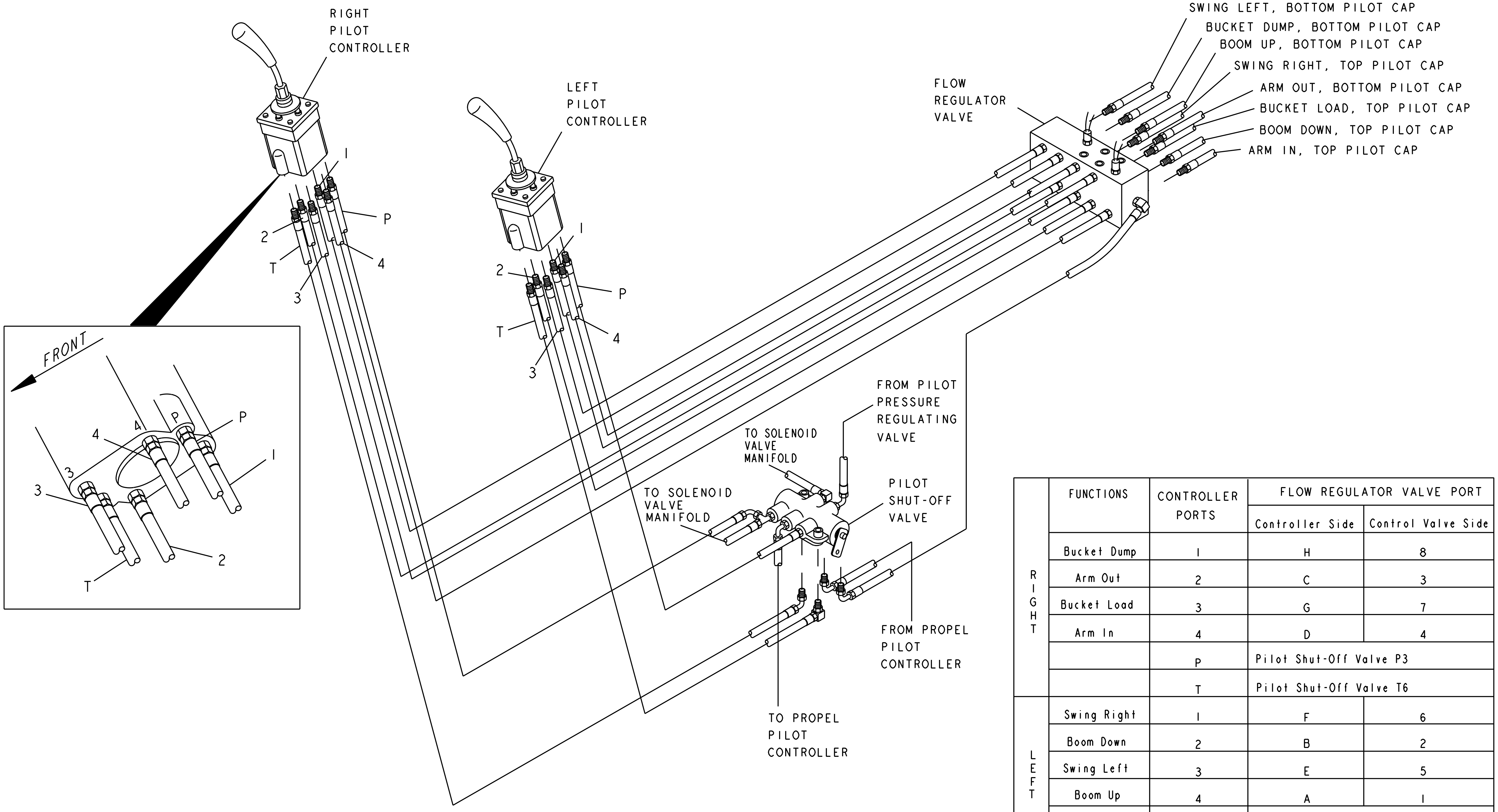


PILOT SYSTEM-CONTROLLERS TO FLOW REGULATOR VALVE-SAE PATTERN

T109220

	FUNCTIONS	CONTROLLER PORTS	FLOW REGULATOR VALVE PORT	
			Controller Side	Control Valve Side
RIGHT	Bucket Dump	1	H	8
	Boom Down	2	B	2
	Bucket Load	3	G	7
	Boom Up	4	A	1
		P	Pilot Shut-Off Valve P3	
		T	Pilot Shut-Off Valve T6	
LEFT	Swing Right	1	F	6
	Arm Out	2	C	3
	Swing Left	3	E	5
	Arm In	4	D	4
		P	Pilot Shut-Off Valve P2	
		T	Pilot Shut-Off Valve T5	

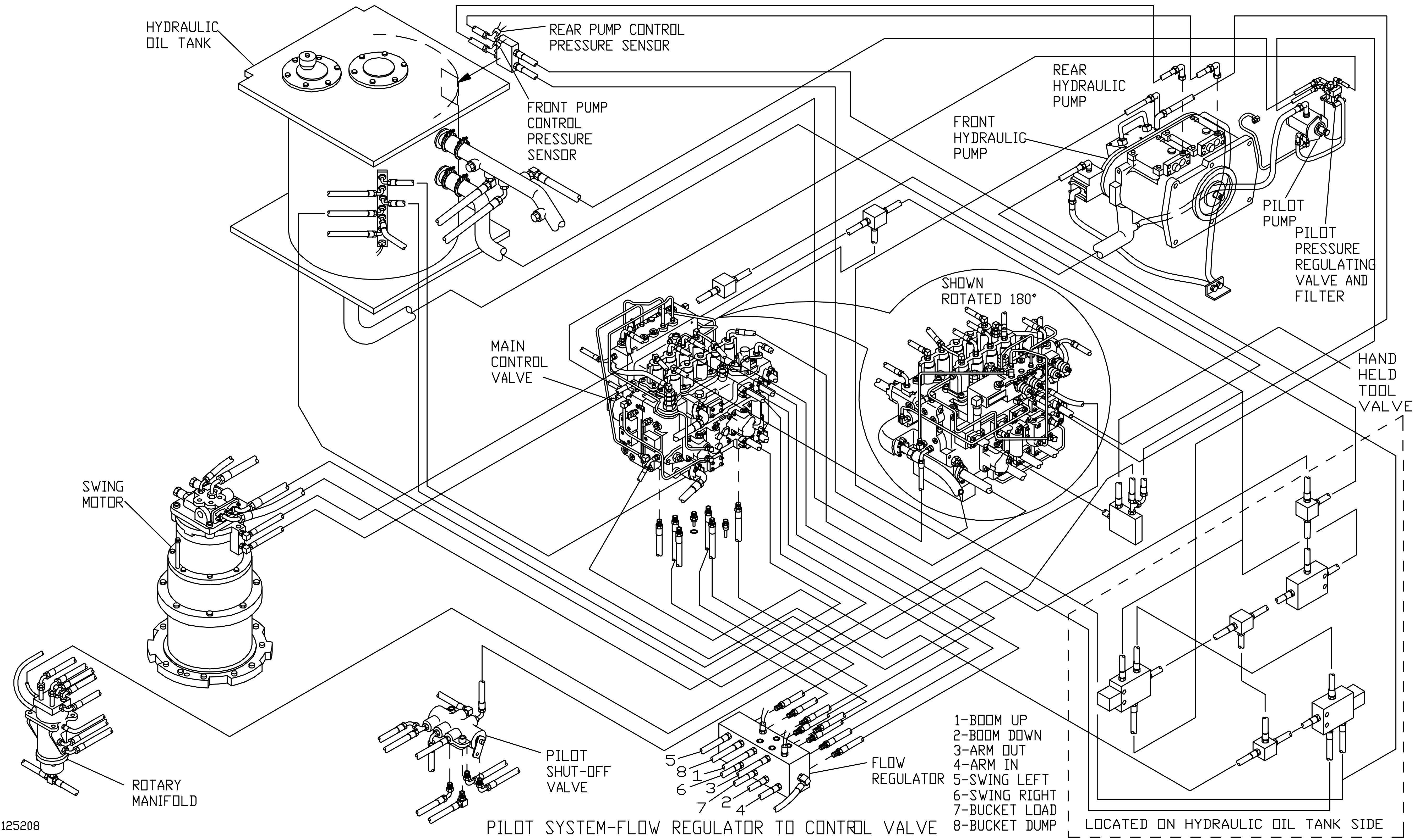
Note: Letters and numbers are on the housings next to the ports



	FUNCTIONS	CONTROLLER PORTS	FLOW REGULATOR VALVE PORT	
			Controller Side	Control Valve Side
RIGHT	Bucket Dump	I	H	8
	Arm Out	2	C	3
	Bucket Load	3	G	7
	Arm In	4	D	4
		P	Pilot Shut-Off Valve P3	
		T	Pilot Shut-Off Valve T6	
LEFT	Swing Right	I	F	6
	Boom Down	2	B	2
	Swing Left	3	E	5
	Boom Up	4	A	I
		P	Pilot Shut-Off Valve P2	
		T	Pilot Shut-Off Valve T5	
Note: Letters and numbers are on the housings next to the ports				

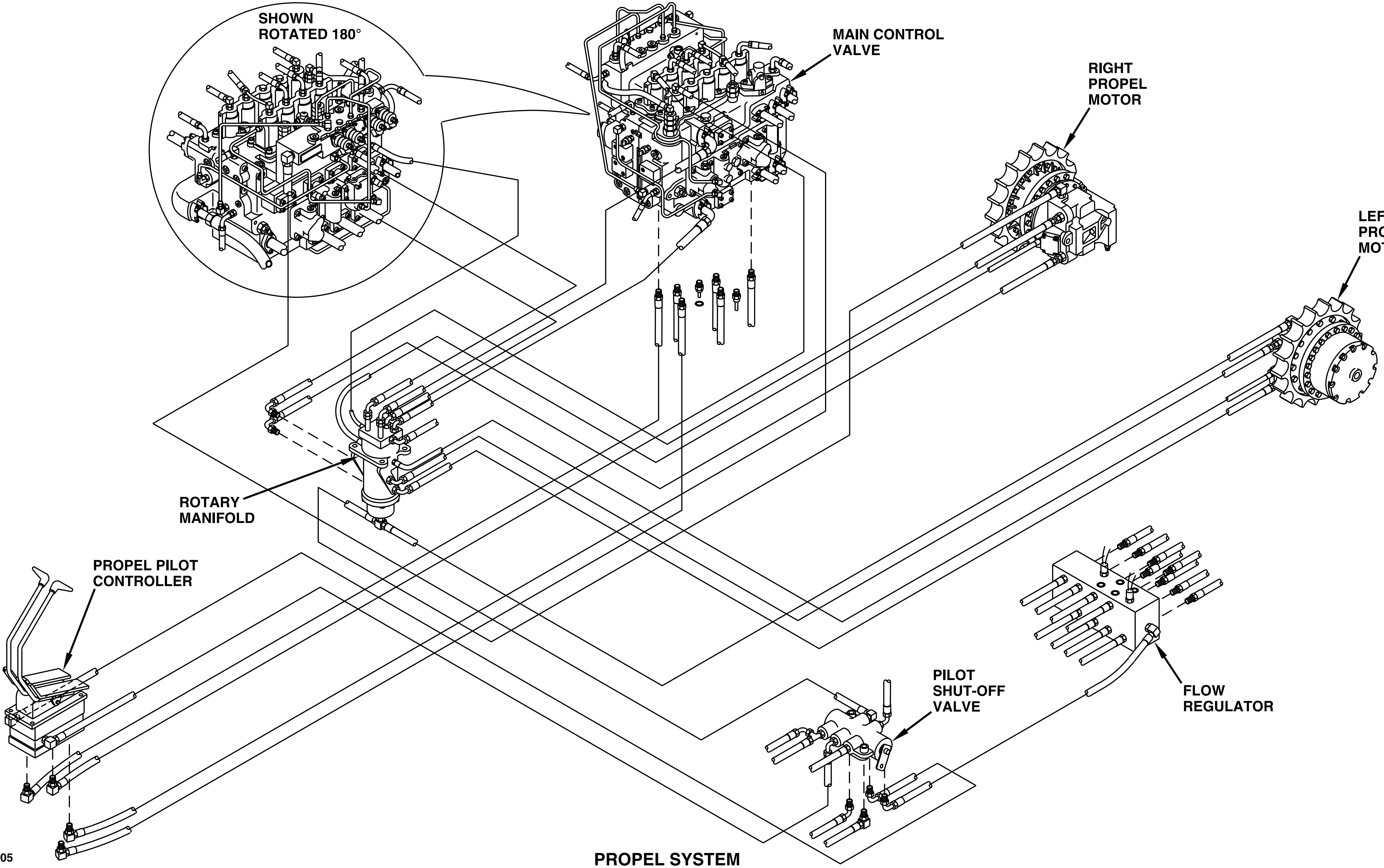
PILOT SYSTEM-CONTROLLERS TO FLOW REGULATOR VALVE-JOHN DEERE PATTERN

TI09221

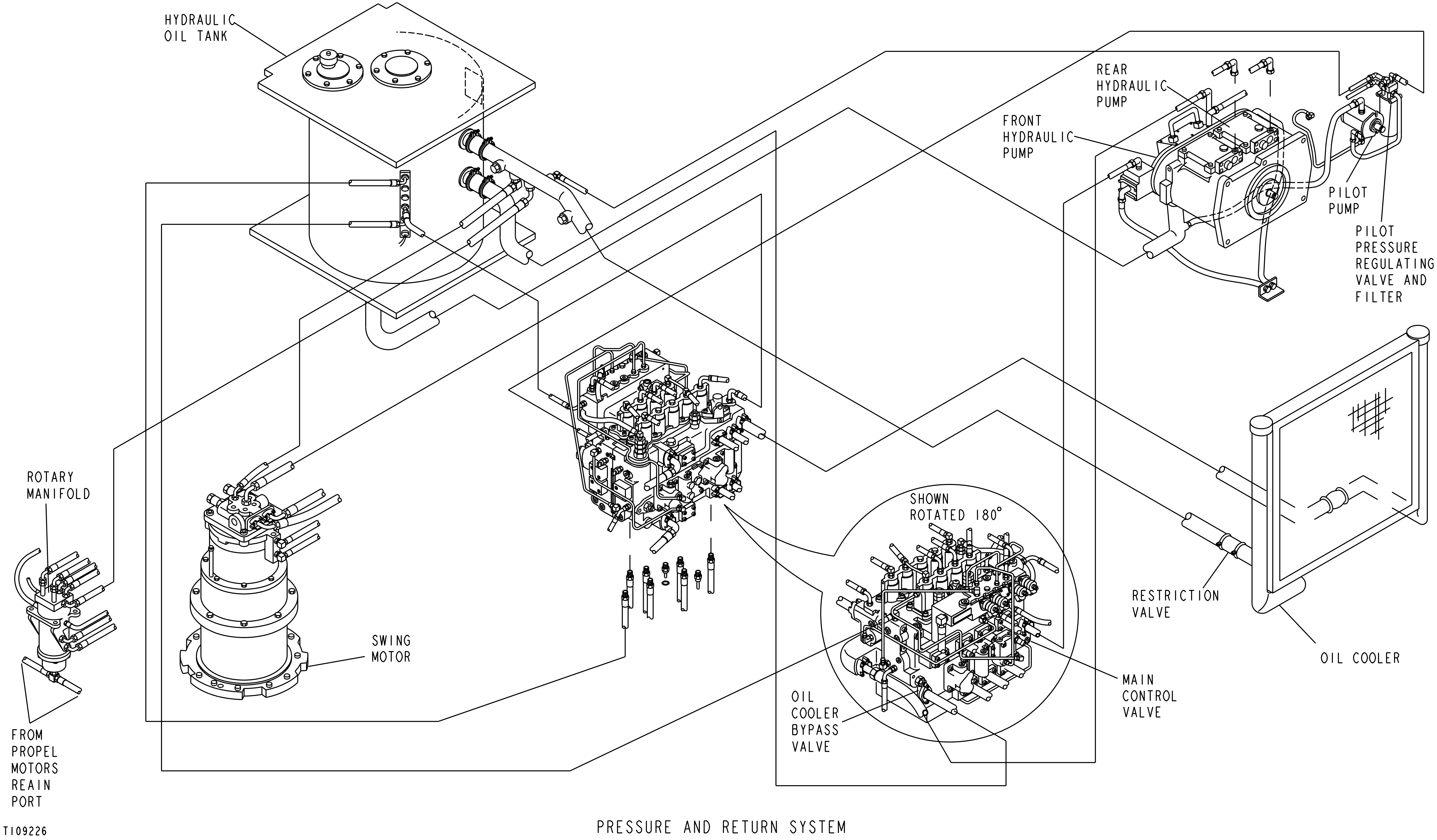


1-BOOM UP
2-BOOM DOWN
3-ARM OUT
4-ARM IN
5-SWING LEFT
6-SWING RIGHT
7-BUCKET LOAD
8-BUCKET DUMP

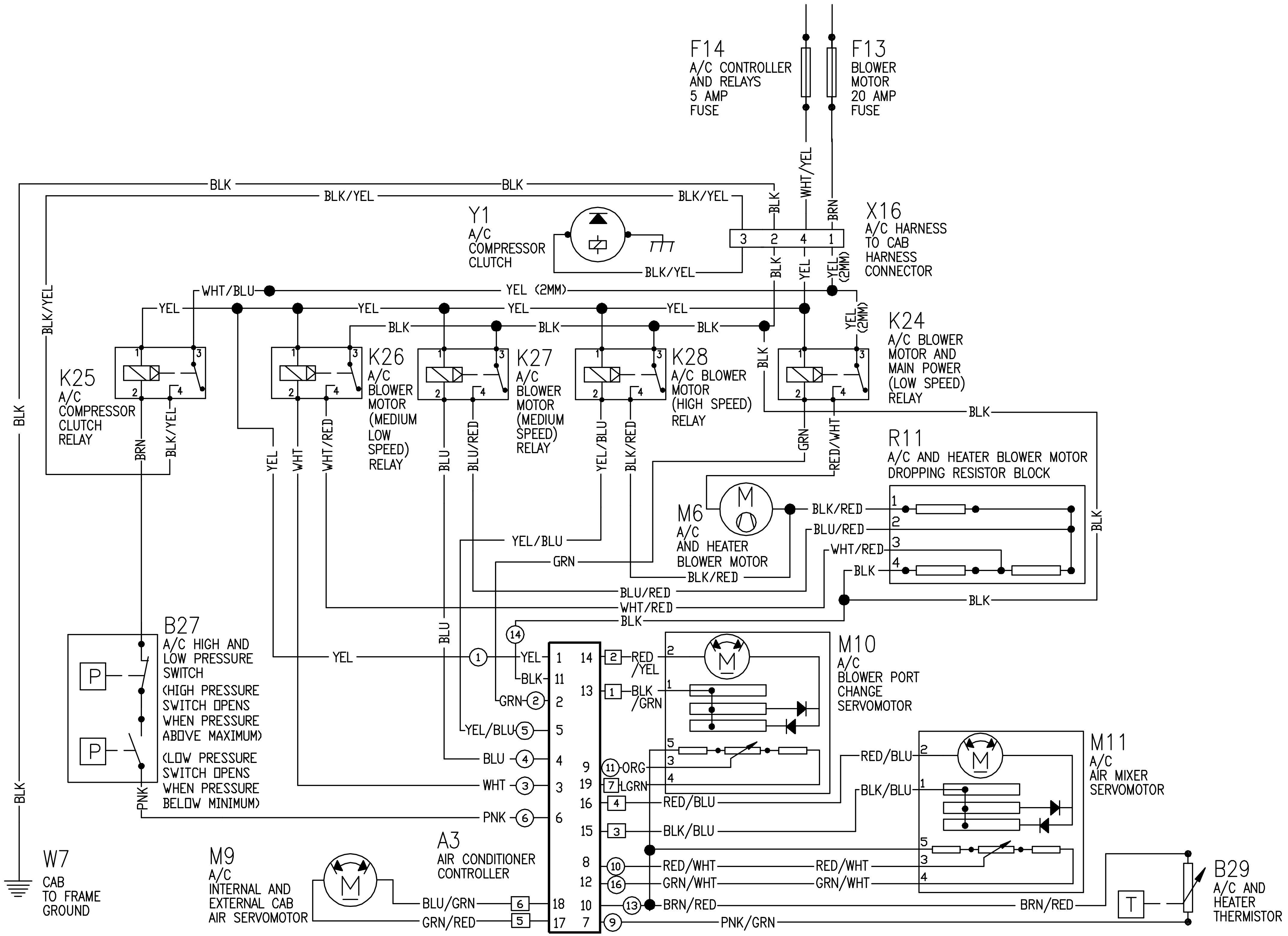
PILOT SYSTEM-FLOW REGULATOR TO CONTROL VALVE



PROPEL SYSTEM



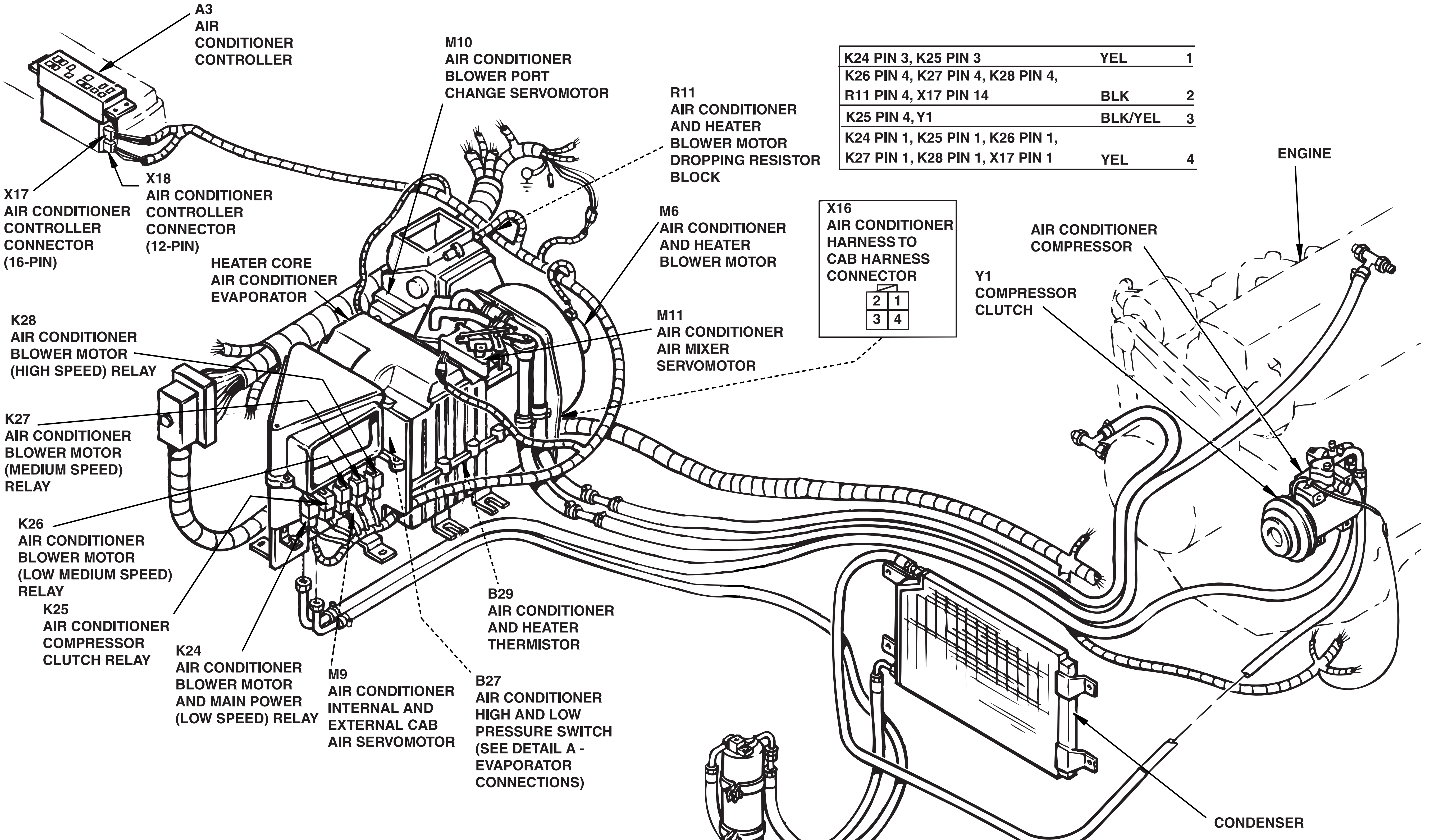
PRESSURE AND RETURN SYSTEM



HEATER AND AIR CONDITIONER CIRCUIT

○ X17 CONNECTOR (16-PIN)
□ X18 CONNECTOR (12-PIN)

T117938

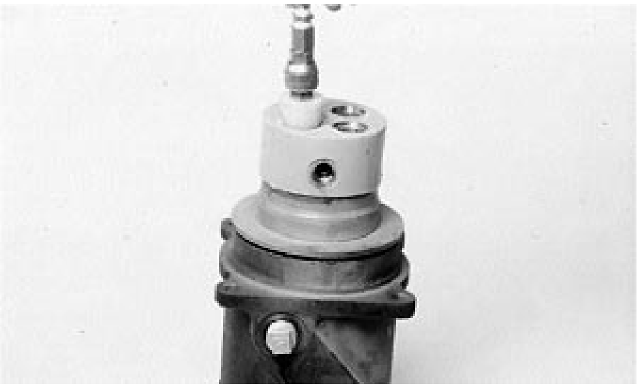


K24 PIN 3, K25 PIN 3	YEL	1
K26 PIN 4, K27 PIN 4, K28 PIN 4, R11 PIN 4, X17 PIN 14	BLK	2
K25 PIN 4, Y1	BLK/YEL	3
K24 PIN 1, K25 PIN 1, K26 PIN 1, K27 PIN 1, K28 PIN 1, X17 PIN 1	YEL	4

T118135

AIR CONDITIONER HARNESS (W9) COMPONENT LOCATION

ROTARY MANIFOLD AIR TEST



T6557JB –UN–01NOV88

1. Install a plug in one port.
2. Apply air pressure using JDG185 Air Test Plug and shop air pressure through the other port in that passage.
3. Listen for air leaks at ports on either side of pressurized port.

TX,02,VV2724 –19–18SEP98–1/1

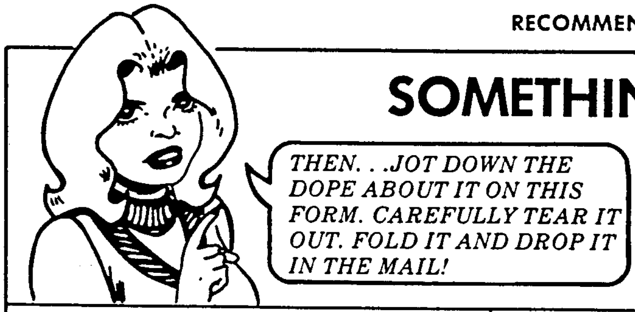
By order of the Secretary of the Army:

ERIC K. SHINSEKI
General United States Army
Chief of Staff

Official:
JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army
9930502

Distribution: To be distributed in accordance with Initial Distribution Number (IDN) 256561, requirements for TM 5-3805-280-24-1.

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



SOMETHING WRONG WITH THIS PUBLICATION?

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS) Your mailing address

DATE SENT Date you fill out this form

PUBLICATION NUMBER	**PUBLICATION DATE**	**PUBLICATION TITLE**
TM 5-2350-262-34	Date of TM	M9 DS/GS MAINTENANCE MANUAL

BE EXACT . .PIN-POINT WHERE IT IS				**IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:**
PAGE NO.	**PARA-GRAPH**	**FIGURE NO.**	**TABLE NO.**	
2-2				Fuel tank removal and installation is now a DS/GS task. Delete this task from the unit maintenance list.
4-185	B			There are three clamps securing air cleaner duct, not the two as shown. Suggest changing text and art to show three clamps.
B-5		1		Roadwheel jack does not have an NSN or P/N listed and cannot be found on AMDF. Request correct NSN and P/N be furnished.

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBERS Joe Doe, SFC 555-1212

SIGN HERE: Joe Doe, Sfc

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.—IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

REVERSE OF DA FORM 2028-2

FILL IN YOUR UNIT'S ADDRESS

FOLD BACK

TEAR ALONG PERFORATED LINE

DEPARTMENT OF THE ARMY

____

____

PLACE
POSTAGE
HERE

Commander
U.S. Army Tank-automotive and Armaments Command
ATTN: AMSTA-AC-NML
Rock Island, IL 61299-7630

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SOMETHING WRONG WITH THIS PUBLICATION?

THEN . . . JOT DOWN THE DOPE ABOUT IT ON THIS FORM. CAREFULLY TEAR IT OUT. FOLD IT AND DROP IT IN THE MAIL!

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE
TM 5-3805-280-24-1		Hydraulic Excavator 230LCR/230LCRD UNIT, DS, GS Maintenance Manual

BE EXACT. . .PIN-POINT WHERE IT IS

PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBERS

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Commander
U.S. Army Tank-automotive and Armaments Command
ATTN: AMSTA-AC-NML
Rock Island, IL 61299-7630

THE METRIC SYSTEM AND EQUIVALENTS

'NEAR MEASURE

. Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

'EIGHTS

Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 lb.
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

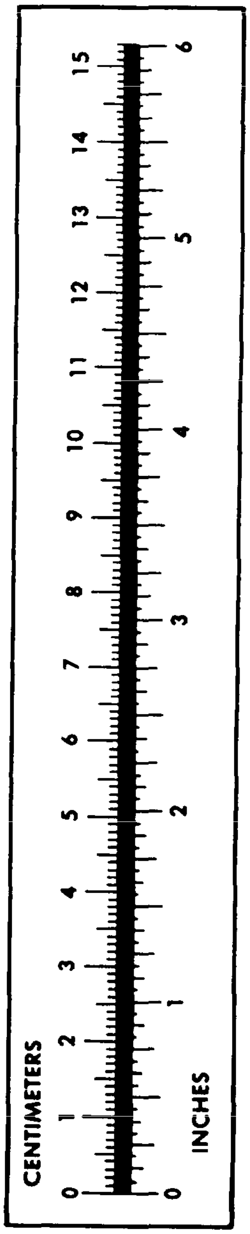
TEMPERATURE

5/9(°F - 32) = °C
212° Fahrenheit is evuivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
9/5C° + 32 =°F

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
ıts	Liters	0.473
arts	Liters	0.946
allons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
'ers	Gallons	0.264
ms	Ounces	0.035
ograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pounds-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
'lometers per Liter	Miles per Gallon	2.354
meters per Hour	Miles per Hour	0.621



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