



528

(Operator Manual)

MM193
Rev. 08 (3-95)



This manual is furnished with each new TENNANT Model 528. It provides necessary operating and preventive maintenance instructions. Read this manual completely and understand the machine before operating or servicing it.

This manual covers all machine variations and standard options. The instruction portion of the manual consists of the Specification, Operation, Maintenance, and Appendix sections. The parts portion consists of the Standard Model Parts; LPG Parts; Diesel Parts; SRS® Parts; Options; Miscellaneous Components; Hydraulic Components; Engine Parts, Gasoline, LPG; Engine Parts, DIS, Gasoline, LPG; Engine Parts, Diesel; and Cross Reference sections.

All right side and left side references to the machine are determined by facing the direction of forward travel. All hardware considered to be of a common nature or locally available has been omitted from the parts sections. Be aware that this machine may contain metric hardware. Make sure you use equivalent hardware when replacement becomes necessary.

This machine will provide excellent service. However, the best results will be obtained at minimum costs if:

- The machine is operated with reasonable care.
- The machine is maintained regularly – per the maintenance instructions provided.
- The machine is maintained with Tennant Company supplied or equivalent parts.

Parts and supplies may be ordered by phone or mail from any Tennant Company parts and service center, distributor, or from any of the Tennant Company subsidiaries. Before ordering parts or supplies, be sure to have your machine model number and serial number handy. Fill out the data block below for future reference.

MACHINE DATA <i>Please fill out at time of installation.</i>
Machine Serial Number – _____
Engine Serial Number – _____
Sales Representative – _____
Customer Number – _____
Date of Installation – _____
Manual Number – MM193
Revision: 08
Published: 3-95

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ABOUT THIS MANUAL

The machine manual that you received with your TENNANT machine contains valuable information about the operation and maintenance, and numerous sections filled with TENNANT part numbers for the repair of the machine. Please read through this section titled *ABOUT THIS MANUAL* to become familiar with the contents of the machine manual, making the information you are looking for easier to find.

The machine manual consists of several sections of reference information, and the remainder contain part number information for ordering repair parts for the machine. Each section has a shaded bar at the top of the page with the name of that section. Just as this section has the title **ABOUT THIS MANUAL** on the top of each page. This way you can tell which section you are in at all times.

REFERENCE SECTIONS

The reference information sections of the manual are; General Information, Specifications, Operation, Maintenance, and Appendix.

GENERAL INFORMATION – The General Information section of the manual contains the safety precautions, the location of the safety labels on the machine, and a table of contents of the entire manual. The Safety Precautions are an overview of the safety measures to be observed when operating and maintaining your machine. The location of the safety labels show the mounting location of the safety labels for use in the replacement of the labels. The table of contents in this section is a list of all the table of contents that appear in the front of each section in the manual. This can be used for easy reference to locate information in a particular section of the manual.

SPECIFICATIONS – The Specifications section of the manual contains machine specification information useful in the operation and maintenance of the machine. This section gives you specification information on the engine, electric motors, brake system, hydraulics, fluid capacities, and machine weight to mention a few. The section also has a illustration of the top and side view of the machine with the height and width dimensions displayed.

OPERATION – The Operation section of the manual contains information needed to operate the machine. This section will list the controls and instruments on the machine, overview the machine operation, and tell you how to transport and store the machine.

MAINTENANCE – The Maintenance section contains information on the suggested maintenance procedures and adjustments to keep your machine in top operating condition. The section includes a Maintenance Chart listing the maintenance schedule and the areas of the machine to be addressed. Each subject of maintenance is covered in more detail in such areas as Lubrication, Hydraulics, Engine, and Electrical System.

APPENDIX – The Appendix contains hardware and hydraulic information. Standard hardware torques and identification information is included, plus hydraulic torques if your machine is hydraulically controlled.

PART SECTIONS

The remaining sections of the manual contain part number information for ordering repair parts for your machine. The manual contains part number information on every type of machine model available in the model size of your particular machine. Therefore there will be part number information in your manual you will not need to refer to when wanting to place an order.

The main thing you need to know about your machine is what type of model is it. Is the machine powered by an engine or batteries? If the machine has an engine, is it fueled from gasoline, LPG, or diesel? If it is a mid-sized or larger sweeper, is it multi-level or low dump? For the scrubbers, is it SRS® or standard. Determining this information about your machine will help guide you through the separate parts sections to find the repair part you need.

ABOUT THIS MANUAL

The smaller line of sweeper and scrubbers have less complicated part section arrangement, and are easier to find your way through the parts sections. The larger machines can have quite a variety of model types which significantly increases the size to the machine manual. Because of this, on the larger machine we made the first part section, Section 5, a part section which contains parts common to all type of the machine. If the machine has an engine, this section contains parts information on a gasoline powered machine.

The remaining sections contain only parts information which is unique to that particular machine type, such as unique diesel parts on the machine, or unique SRS® parts. Knowing the machine model type you have is important when searching for that part information you need for ordering repair parts. Start in that unique section first when looking for a part, then go to the first parts section, Section 5, if the part can't be found in the unique section.

MACHINE SERIAL NUMBERS

When a design change takes place to a machine, the changes are indicated in the parts sections with machine serial numbers. Know the serial number of your machine which can be found on the machine data plate mounted on the machine. Record this number on the inside front cover of your manual along with your customer number.

Machine number usage is recorded in the *Machine Serial Number* column of the parts lists in the parts sections of the manual. If the machine serial number column lists zeros on the left side of the dash, then this part is used on all machines; such as (000000–).

If the column lists zeros on the left of the dash and a number on the right of the dash, then the part is used on machines up to and including that machine serial number; such as (00000–002345).

For parts that are used on machines beginning at and continuing on from a certain serial number, the column would list a serial number on the left of the dash and have blank spaces on the right side of the dash; such as (002346–). This part would be used on machines starting with that machine serial number and greater.

Finally, parts can be used on machines with serial numbers in a certain block of numbers. In this situation there is a serial number on the left and right side of the dash. The part is then used on a machine with a serial number starting at the number on the left and up to and including the number on the right; such as (002346–008900).

PARTS ASSEMBLIES

A part assembly has parts within the assembly, such as a parking brake consisting of other smaller parts. What parts are contained in a part assembly can be determined by an indentation arrangement in the description column of the parts lists.

Here is an example of a part assembly, in this case we will use the parking brake mentioned previously:

Machine		Description	Qty.
Serial Number			
(000000– )	)	Parking Brake	1
(000000– )	)	Pin, Roll	1
(000000– )	)	Link	1
(000000– )	)	Spring, Compression	1
(000000– )	)	Pin, Roll	1
(000000– )	)	Support	1
(000000– )	)	Lever, Release	1
(000000– )	)	Rod, Parking Brake	1
(000000– )	)	Washer, 0.50"	3

In this example, the parts whose descriptions are indented under the parking brake are all parts of the parking brake. When you order the parking brake you will receive all the parts listed under it. You also can order any of the individual parts listed under the parking brake if it is the only part you need.

SUPPLIER COMPONENT BREAKDOWNS

TENNANT purchases certain components of the machine from suppliers. Some of these components are engines, hydraulic pumps and motors, electric motors, and solution pumps.


For those purchased components that are repairable, lists of parts for them appear in the later part of the parts sections. These are the supplier breakdowns. The engine breakdown contains both supplier and TENNANT parts numbers for repair parts. Breakdowns for hydraulic and electrical components have TENNANT part numbers for the parts TENNANT supplies. The serial numbers listed in any of the parts lists in these sections is a serial number the manufacturer uses to identify design changes in their particular component.

ORDERING REPAIR PARTS

Once you have located a part to order, there are several things you need to have to place the order. At the beginning of each parts section is an Ordering Repair Parts page which lists the information you will need to place your order. Review this list before placing the order.

SAFETY PRECAUTIONS






The following symbols are used throughout this manual as indicated in their descriptions:

 **WARNING:** To warn of hazards or unsafe practices which could result in severe personal injury or death.

FOR SAFETY: To identify actions which must be followed for safe operation of equipment.

The following information signals potentially dangerous conditions to the operator or equipment. Read this manual carefully. Know when these conditions can exist. Locate all safety devices on the machine. Then, take necessary steps to train machine operating personnel. Report machine damage or faulty operation immediately. Do not use the machine if it is not in proper operating condition.

FOR SAFETY:

1. **Do Not Operate Machine:**
 - Unless Trained And Authorized.
 - Unless Operation Manual Is Read And Understood.
 - In Flammable Or Explosive Areas Unless Designed For Use In Those Areas.
 - In Areas With Possible Falling Objects Unless Equipped With Overhead Guard.
 2. **Before Starting Machine:**
 - Check For Fuel Leaks.
 - Keep Sparks And Open Flame Away From Refueling Area.
 - Make Sure All Safety Devices Are In Place And Operate Properly.
 - Check Brakes And Steering For Proper Operation.
 3. **When Starting Machine:**
 - Keep Foot On Brake And Directional Pedal In Neutral.
 4. **When Using Machine:**
 - Use Brakes To Stop Machine.
 - Go Slow On Grades And Slippery Surfaces.
 - Use Care When Backing Machine.
 - Do Not Carry Riders On Machine.
 - Always Follow Safety And Traffic Rules.
 5. **Before Leaving Or Servicing Machine:**
 - Stop On Level Surface.
 - Set Parking Brake.
 - Turn Off Machine And Remove Key.
 6. **When Servicing Machine:**
 - Avoid Moving Parts. Do Not Wear Loose Jackets, Shirts, Or Sleeves When Working On Machine.
 - Block Machine Tires Before Jacking Machine Up.
 - Jack Machine Up At Designated Locations Only. Block Machine Up With Jack Stands.
 - Use Hoist Or Jack Of Adequate Capacity To Lift Machine.
 - Wear Eye And Ear Protection When Using Pressurized Air Or Water.
 - Disconnect Battery Connections Before Working On Machine.
 - Avoid Contact With Battery Acid.
 - Avoid Contact With Hot Engine Coolant.
 - Allow Engine To Cool.
 - Keep Flames And Sparks Away From Fuel System Service Area. Keep Area Well Ventilated.
 - Use Cardboard To Locate Leaking Hydraulic Fluid Under Pressure.
 - Use TENNANT Supplied Or Equivalent Replacement Parts.
-  **WARNING:** Engine Emits Toxic Gases. Severe Respiratory Damage Or Asphyxiation Can Result. Provide Adequate Ventilation. Consult With Your Regulatory Agency For Exposure Limits. Keep Engine Properly Tuned.
-  **WARNING:** Machine Can Emit Excessive Noise. Consult With Your Regulatory Agency For Exposure Limits. Hearing Loss Can Result. Wear Hearing Protection.
-  **WARNING:** Flammable Materials Can Cause An Explosion Or Fire. Do Not Use Flammable Materials In Tank(s).
-  **WARNING:** Flammable Materials Or Reactive Metals Can Cause Explosion Or Fire. Do Not Pick Up.
-  **WARNING:** Moving Fan Blades. Keep Away.

GENERAL INFORMATION



WARNING: Strong Vacuum. Keep Away From Fan Inlet When Fan Is Running.



WARNING: Heavy Bumper. Get Help to Handle.

The following safety labels are mounted on the machine in the locations indicated. If these or any label becomes damaged or illegible, install a new label in its place.

NO GASOLINE LABEL – LOCATED ON THE REAR DECK OF THE MACHINE.

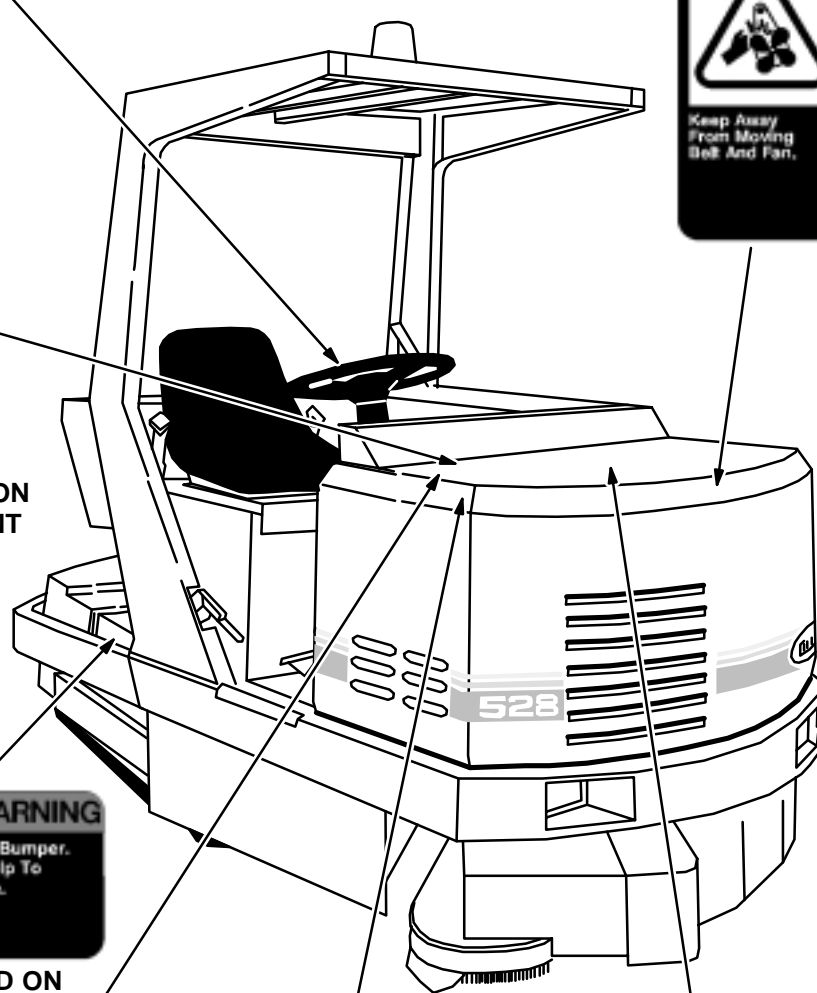


04760

ENGINE FAN LABEL – LOCATED ON ENGINE FAN SHROUD

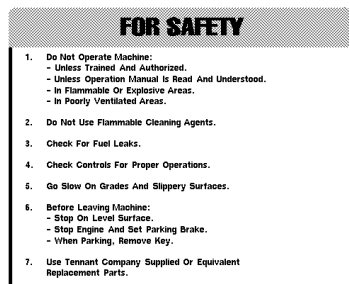


NOISE LABEL – LOCATED ON THE DRIVER COMPARTMENT PANEL.



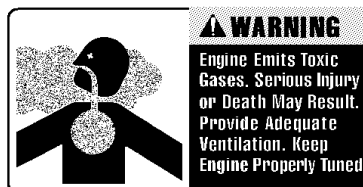
HEAVY BUMPER – LOCATED ON THE SCRUB HEAD COVER SIDES.

04750



04761

SAFETY LABEL – LOCATED ON THE DRIVER COMPARTMENT PANEL.



04412

EMISSIONS LABEL – LOCATED ON THE DRIVER COMPARTMENT PANEL.



VACUUM FAN LABEL – LOCATED ON THE VACUUM FAN HOUSING.

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MACHINE SPECIFICATIONS

POWER TYPE

Engine type – piston
 Ignition – breakerless–type spark
 Cycle – 4
 Aspiration – natural
 Cylinders – 4
 Bore – 2.91 in (74 mm)
 Stroke – 2.97 in (75 mm)
 Displacement – 79 cu in (1300 cc)
 Net power – 29 hp (21.6 kw) @ 2400 rpm governed
 Net power – 53.7 hp (40 kw) @ 4000 rpm maximum
 Fuel – gasoline, 87 octane minimum, unleaded or LPG
 Cooling system – water/ethylene glycol antifreeze
 Electrical system – 12 V nominal, 50 A alternator

Engine type – piston
 Ignition – diesel
 Cycle – 4
 Aspiration – natural
 Cylinders – 3
 Bore – 3.25 in (85 mm)
 Stroke – 3.23 in (82 mm)
 Displacement – 85 cu in (1395 cc)
 Net power – 27 hp (20 kw) @ 2200 rpm governed
 Net power – 31 hp (23 kw) @ 2650 rpm governed
 Net power – 32 hp (24 kw) @ 3600 rpm maximum
 Fuel – diesel, No. 1 or No. 2
 Cooling system – water/ethylene glycol antifreeze
 Electrical system – 12 V nominal, 37 A alternator

POWER TRAIN

Propelling – hydraulic drive motors (2)
 Scrub brush – hydraulic drive motors (2)
 Vacuum fan – hydraulic drive motor
 Side Brush – hydraulic drive motor

STEERING

Type – front wheel controlled, worm and sector gear
 Power source – manual

HYDRAULIC SYSTEM

Function – operates propelling, scrub head lift, squeegee lift, main brush drive, side brush operation, vacuum fan.

Control valve, vacuum fan drive – open center type, single spool, solenoid operated.

Control valve, side brush and vacuum fan drive – open center type, four spool, solenoid operated.

Control valve, squeegee lift, scrub brushes drive, scrub head lift – open center type, four spool, solenoid operated.

Pump, propelling – variable displacement piston type, 1.24 cu in (20 cc) maximum displacement per revolution, 11.4 gpm (43 L/min) @ 2400 rpm.

Propelling system relief pressure – 4000 psi (27,850 kPa)

Pump accessories – gear type, 0.84 cu in (14 cc) displacement, 8 gpm (30 L/min) @ 2400 rpm.

Scrub brush system relief pressure – 2200 psi (15,170 kPa).

Vacuum fan system relief pressure – 2000 psi (13,790 kPa).

Motor, propelling – internal gear type, 6.2 cu in (100 cc) displacement per revolution, 4500 psi (31,028 kPa) maximum rated pressure.

Motor, main brush – internal gear type, 4.5 cu in (75 cc) displacement per revolution, 2500 psi (17,240 kPa) maximum rated pressure.

Motor, side brush – internal gear type, 5.9 cu in (95 cc) displacement per revolution, 2500 psi (17,240 kPa) maximum rated pressure.

Cylinder, scrub head lift – single action type, 2 in (50 mm) bore x 4 in (100 mm) stroke, 1 in (25 mm) diameter rod, 2500 psi (17,240 kPa) maximum rated.

Cylinder, squeegee lift – single action type, 2 in (50 mm) bore x 4 in (100 mm) stroke, 1 in (25 mm) diameter rod, 2500 psi (17,240 kPa) maximum rated pressure.

SPECIFICATIONS

Cylinder, side brush lift – single action type,
2 in (50 mm) bore x 4 in (100 mm) stroke,
1 in (25 mm) diameter rod, 2500 psi
(17,240 kPa) maximum rated pressure.

Cylinder, side brush swing – single action type,
2 in (50 mm) bore x 4 in (100 mm) stroke,
1 in (25 mm) diameter rod, 2500 psi
(17,240 kPa) maximum rated pressure.

BRAKING SYSTEM

Service brakes – hydraulic drum brakes (2), one
each rear wheel, master cylinder foot brake
actuated.

Parking brake – utilizes service brakes, cable
actuated.

SUSPENSION SYSTEM

Front – one 12 in (305 mm) x 4 in (100 mm)
solid tire

Rear – two 12 in (305 mm) x 5 in (125 mm)
solid tires

SYSTEM FLUID CAPACITIES

Engine cooling system, gasoline, LPG radiator –
N/A qt (N/A L)

Engine cooling system, gasoline, LPG total –
N/A qt (N/A L)

Engine cooling system, diesel radiator – N/A qt
(N/A L)

Engine cooling system, diesel total – N/A qt
(N/A L)

Engine lubricating oil, gasoline, LPG – 3.5 qt
(3.3 L) with filter

Engine lubricating oil, diesel – 7 qt (6.7 L) with
filter

Fuel tank, gasoline, diesel – 8 gal (30 L)

Fuel tank, LPG – 33 lb (15 kg)

Hydraulic system – reservoir 10 gal (38 L)

Hydraulic system – total system N/A gal (N/A L)

Standard solution tank – 65 gal (245 L)

Standard recovery tank – 68 gal (260 L)

SRS® solution tank – 122 gal (465 L)

SRS® cleaning solution tank – 4.9 gal (18.5 L)

GENERAL MACHINE

DIMENSIONS/CAPACITIES

Length – 108.5 in (2755 mm)

Length with side brush – 114.5 in (2910 mm)

Width – 51.4 in (1305 mm)

Width with side brush – 56 in (1420 mm)

Height – 54.0 in (1370 mm)

Height with overhead guard – 84 in (2135 mm)

with overhead guard and warning lamp –
91.2 in (2315 mm)

Track – 40.5 in (1030 mm)

Wheelbase – 36.75 in (925 mm)

Main Scrub brush – diameter 11 in (280 mm)

Main Scrub brush – length 43 in (1090 mm)

Side Brush – diameter 13 in (330 mm)

Rear squeegee width – 45 in (115 mm)

Debris hopper capacity – 1.5 cu ft (43 L)

MACHINE WEIGHTS

Net GVWR – 4500 lb (2040 kg)

GENERAL MACHINE PERFORMANCE

Maximum forward speed – 7.5 mph (12 km/h)

Maximum reverse speed – 4 mph (6.4 km/h)

Turning radius – right, 64.5 in (1640 mm)

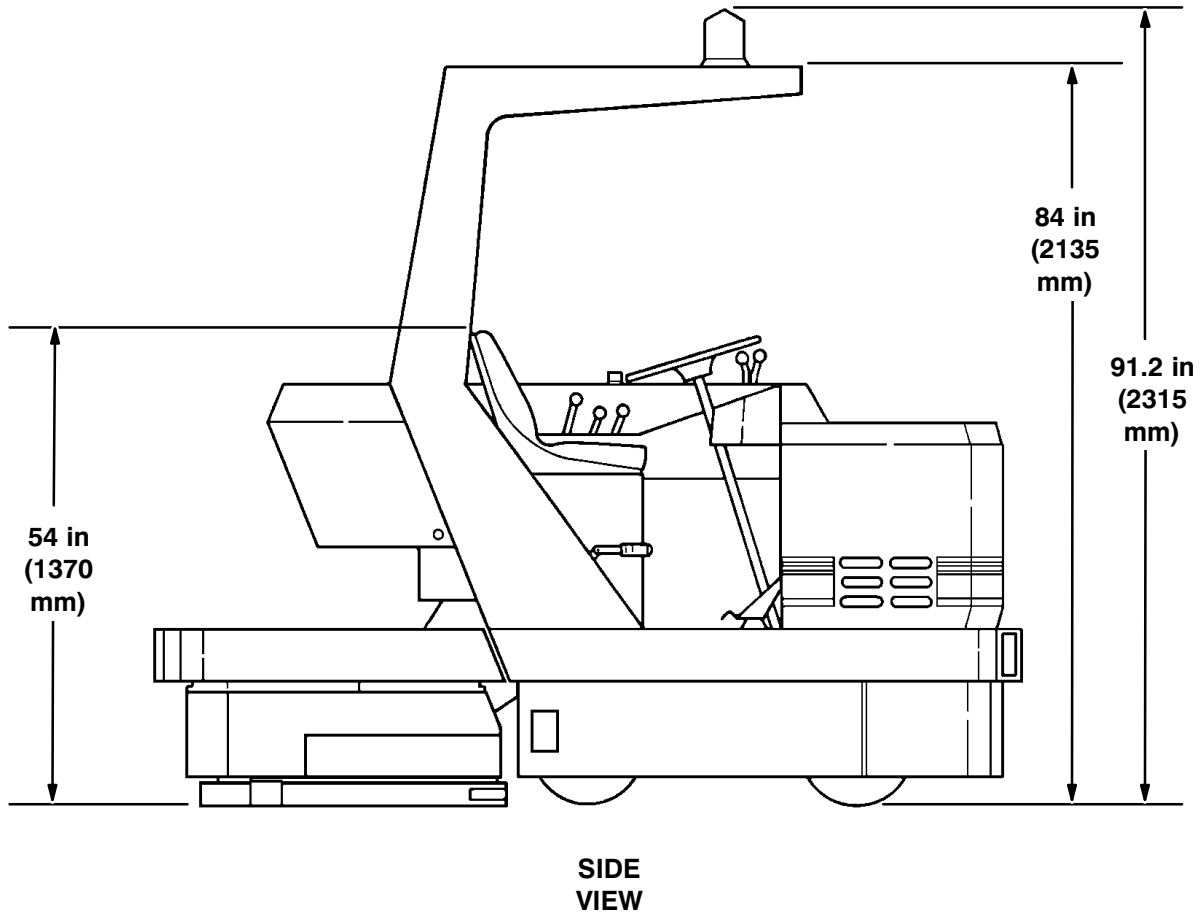
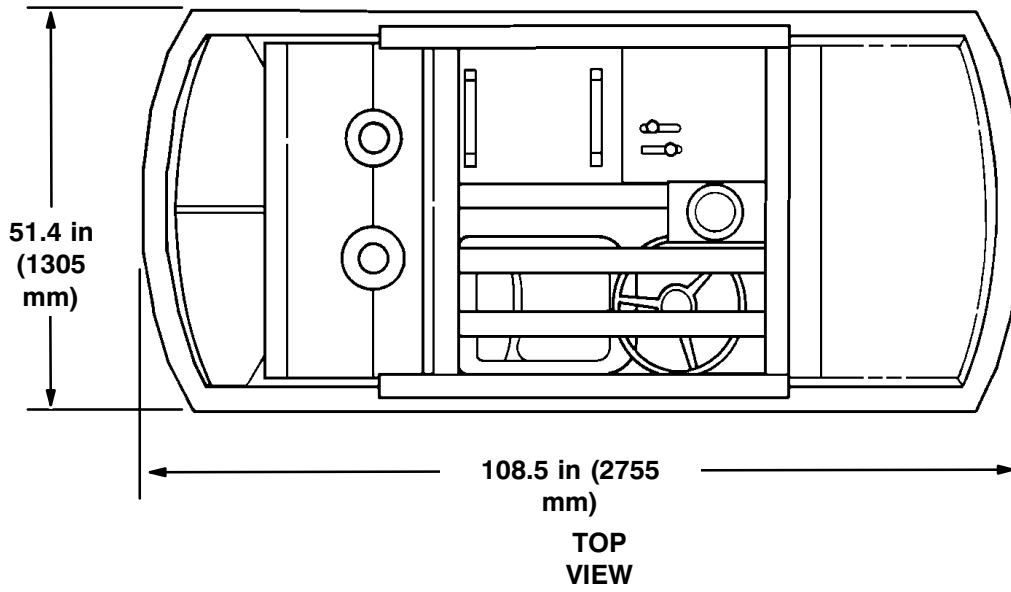
Turning radius – left, 66.3 in (1685 mm)

Turning radius with side brush – left,
71.75 in (1825 mm)

Minimum aisle turn width – 129 in (3275 mm)

Minimum aisle turn width with side brush –
143.5 in (3645 mm)

MACHINE DIMENSIONS



02417

SECTION 2

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PREPARATION FOR OPERATION**AFTER UNLOADING AND BEFORE OPERATING THE MACHINE:**

1. Check the machine for shipping damage.
2. Read this manual carefully before operating or servicing the machine.

FOR SAFETY: Do Not Operate The Machine Unless Operation Manual Is Read And Understood.

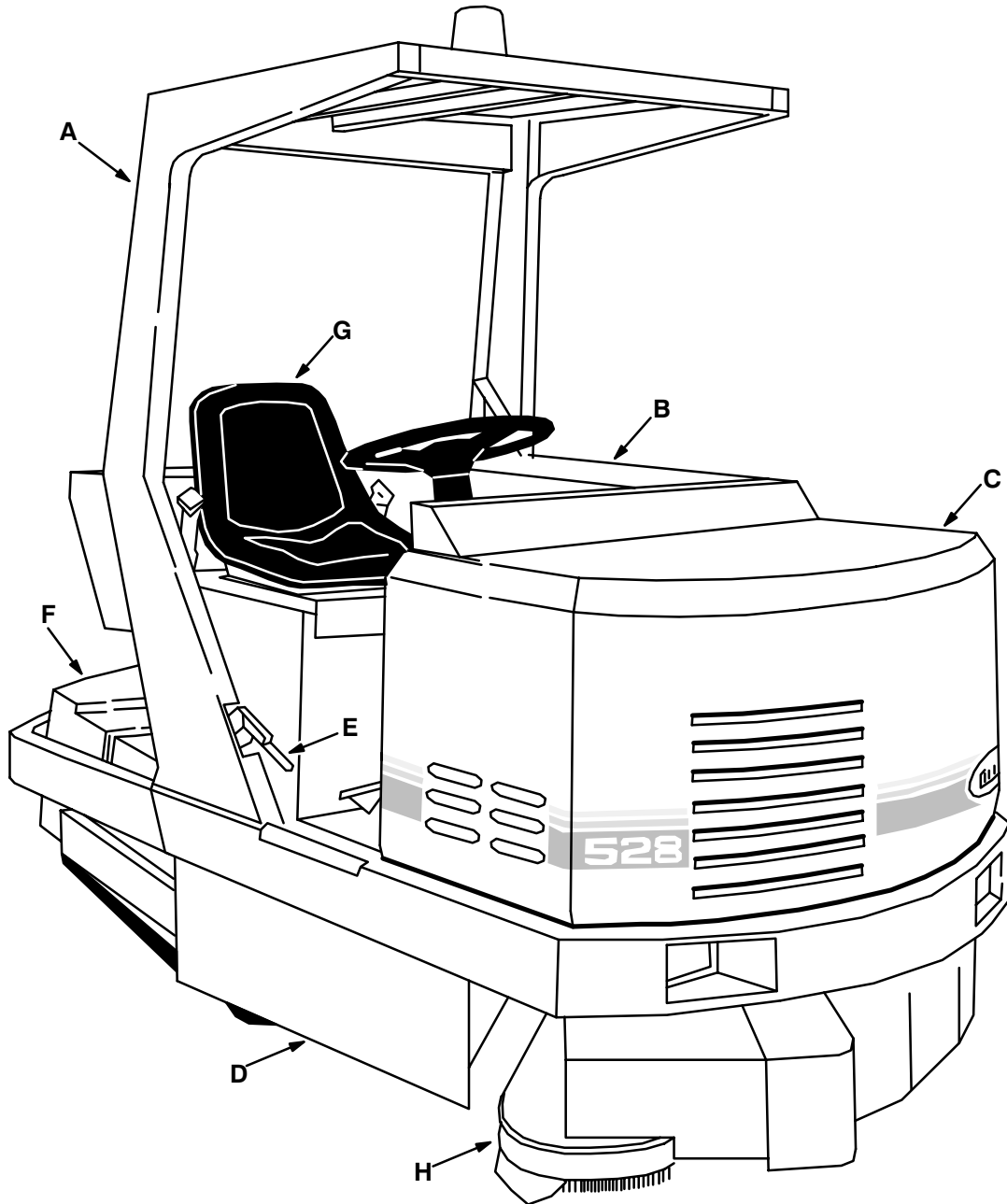
3. Check the hydraulic fluid level in the hydraulic fluid reservoir, using the dipstick provided. TENNANT hydraulic fluid is recommended. If TENNANT hydraulic fluid is not available, use only new, approved hydraulic fluid. See *HYDRAULICS* in the *MAINTENANCE* section.
4. Check the engine oil level.
5. Check the radiator coolant level.

FOR SAFETY: When Servicing Machine, Avoid Contact With Hot Engine Coolant. Allow Engine To Cool.

6. Check the scrub brush adjustment, as described in *SCRUB HEAD* in the *MAINTENANCE* section.
7. Check the squeegee adjustment as described in *SIDE SQUEEGEE* and *REAR SQUEEGEE* in the *MAINTENANCE* section.
8. Fill the fuel tank, or install an LPG fuel tank on the machine.

FOR SAFETY: Before Starting Machine, Keep Sparks And Open Flame Away From Refueling Area.

OPERATION OF CONTROLS



MACHINE COMPONENTS

04750

- | | |
|------------------------|------------------------|
| A. Overhead Guard | E. Parking Brake Lever |
| B. Recovery Tank Cover | F. Scrub Head Cover |
| C. Engine Hood | G. Operator Seat |
| D. Lower Access Door | H. Side Brush |

INSTRUMENT PANEL SYMBOLS

The symbols are used to identify controls and displays on the machine:



Recovery Tank Full



Solution Tank Low



Operational Lights



Side Brush Down and On



Side Brush Up and Off



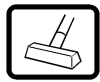
Scrub Head Up and Brushes Off



Scrub Head Down and Brushes On



Squeegee down



Vacuum Wand



Squeegee Up



Fast



Idle



Engine Start



Cleaning Solution Flow



Key Start



Circuit Breaker No. 1



Circuit Breaker No. 2



Circuit Breaker No. 3



Circuit Breaker No. 4



Circuit Breaker No. 5



Circuit Breaker No. 6



SRS®



Main Brushes



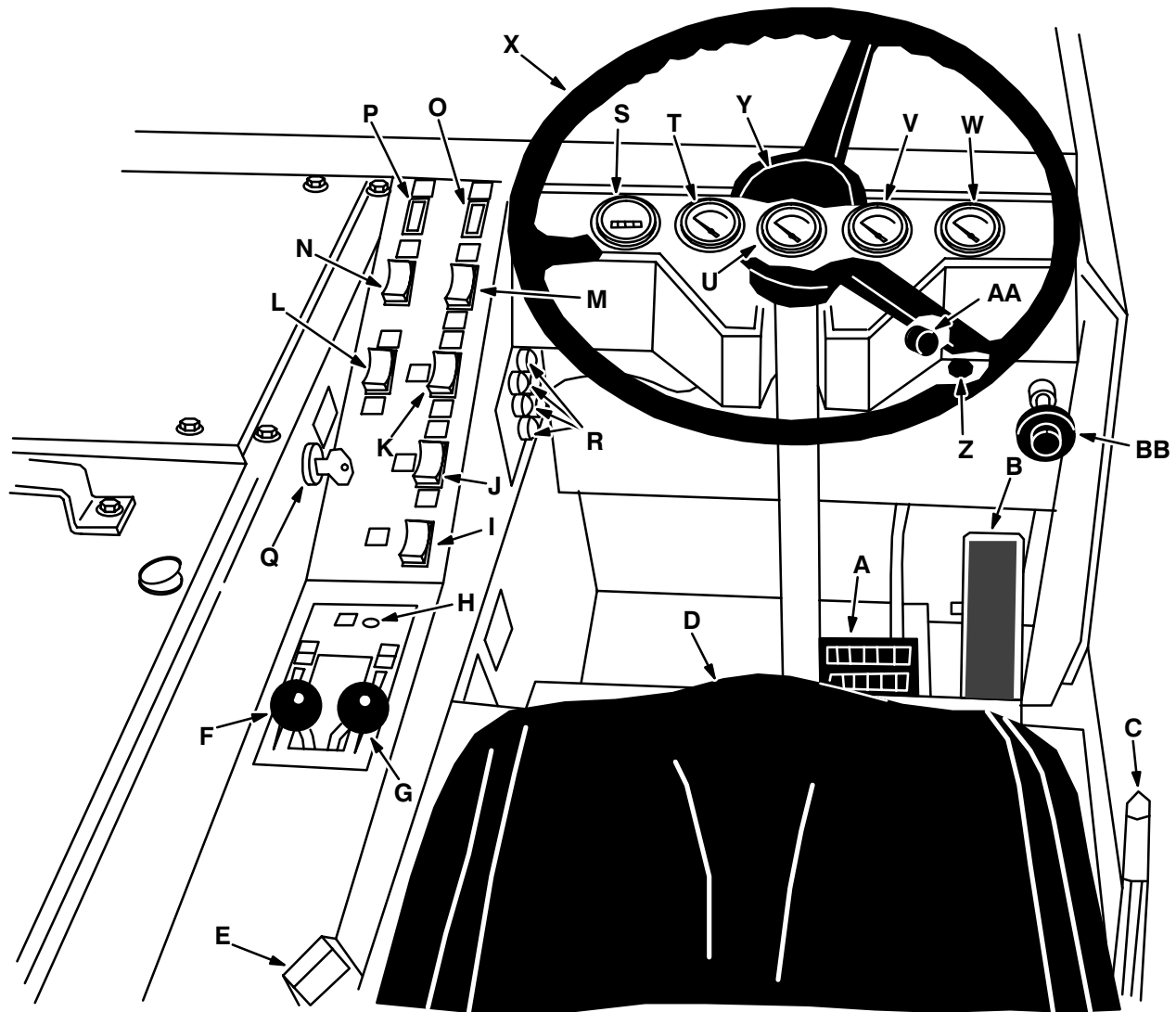
Side Brushes



Solution Flow On



Variable Rate



04751

INSTRUMENTS AND CONTROLS

- | | |
|---------------------------------------|-------------------------------------|
| A. Brake Pedal | O. Solution Tank Low Lamp |
| B. Directional Pedal | P. Recovery Tank Full Lamp |
| C. Parking Brake Lever | Q. Ignition Switch |
| D. Operator Seat | R. Circuit Breakers |
| E. Seat Belt | S. Hour Meter |
| F. Solution Flow Lever – Side Brush | T. Voltage Gauge |
| G. Solution Flow Lever – Main Brushes | U. Fuel Level Gauge |
| H. SRS® Lamp | V. Engine Coolant Temperature Gauge |
| I. Cleaning Solution Flow Switch | W. Engine Oil Pressure Gauge |
| J. Throttle Control Switch | X. Steering Wheel |
| K. Cleaning Switch | Y. Horn Button |
| L. Scrub Head Switch | Z. Engine Choke Knob |
| M. Side Scrub Brush Switch | AA. Diesel Preheat Push Button |
| N. Operational Lamps Switch | BB. Diesel Throttle Knob |

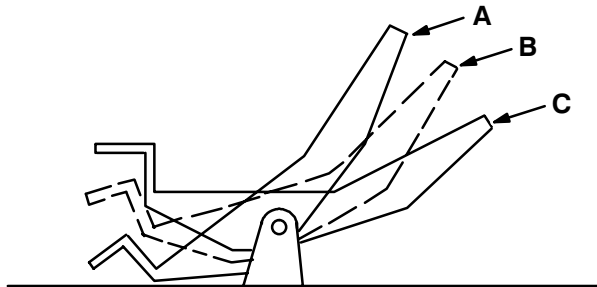
BRAKE PEDAL

The brake pedal operates the hydraulic drum brakes on the two rear wheels.

To stop the machine, return the directional control pedal to neutral; then apply pressure to the brake pedal.

DIRECTIONAL PEDAL

A single foot pedal controls the hydraulic propelling drive. The foot pedal is used to select the direction of travel and the propelling speed of the machine.



00116

DIRECTIONAL PEDAL

- A. "Reverse" Position**
- B. "Neutral" Position**
- C. "Forward" Position**

To travel forward, press the "toe" portion of the pedal; to travel backward, press the "heel" portion of the pedal. The propelling speed of the machine is regulated by varying the pressure on the pedal.

PARKING BRAKE LEVER

The parking brake lever operates the rear wheel brakes. To engage the parking brake, pull the parking brake handle up. To disengage the parking brake, push the handle down. Always park on a level surface, engage the parking brake, and stop the engine before leaving the machine unattended and before working on the machine.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.


OPERATOR SEAT

The operator seat is of a fixed-back style with a forward-backward adjustment. To adjust the seat, loosen the seat mounting bolts, slide the seat to the position desired, and tighten the bolts. The seat tilts forward to allow access to the solution tank.


SEAT BELT

An automotive-type seat belt option is provided to secure the machine operator in the operator's seat. To lock the seat belt, insert the belt tongue into the belt buckle. To adjust seat belt, pull on the belt tail until the seat belt is snug. To release the seat belt, pull the seat belt buckle up.

SOLUTION FLOW LEVER – MAIN BRUSHES

The solution flow lever – main brushes  controls the solution flow to the main brushes in the scrub head. The lever also controls the solution pumps on the SRS®. The flow of solution to the floor is variable. To start solution flow, push the solution flow lever slightly forward. To increase to full flow, push the lever all the way forward. To stop solution flow, pull the lever all the way back.

SOLUTION FLOW LEVER – SIDE BRUSH


The solution flow lever – side brush  controls the solution flow to the side brush option. The flow of solution to the floor is variable. To start solution flow, push the solution flow lever slightly forward. To increase to full flow, push the lever all the way forward. To stop solution flow, pull the lever all the way back.

NOTE: The solution flow to the side brush will not operate if the scrub solution flow control lever – main brushes is not on.

SRS® LAMP

The SRS® lamp  lights when the SRS® pump is working.




CLEANING SOLUTION FLOW SWITCH

The cleaning solution flow switch  meters cleaning solution into the scrub solution on the SRS® machine. The switch has three settings. The middle (0) position is no cleaning solution flow; the top (1) position is low cleaning solution flow for normal scrubbing operation; and the bottom (2) position in high solution flow for heavy duty scrubbing operation.

THROTTLE SWITCH

The throttle switch controls the gasoline and LPG engine speed. To start the engine, place the





switch in the bottom  (Engine Start) position. To slow the engine before stopping it, place the switch in the middle  (Idle) position. To speed up the engine to operating speed, place the switch in the top  (Fast) position.


CLEANING SWITCH

The cleaning switch controls the position of the squeegee and turns on the main scrub brushes during scrubbing operation. The cleaning switch has three positions: squeegee down and brushes on; squeegee up and brushes on; and vacuum wand with brushes off.

The squeegee down position is for normal scrubbing operation. The squeegee up position allows cleaning solution to soak on the surface. The vacuum wand position is operational on machines with a vacuum wand option.



To clean, place the switch in the top  (Squeegee Down) position.

To soak, place switch the in the bottom  (Squeegee Up) position.



To use the vacuum wand, place the switch in the middle  (Vacuum Wand) position.

NOTE: The main scrub brushes will not operate if the cleaning switch is in the middle (Vacuum Wand) position. When normal scrubbing or during soak operation, make sure the cleaning switch is not in the middle (Vacuum Wand) position.

SCRUB HEAD SWITCH


The scrub head switch controls the position of the scrub head. To lower the scrub head, place the switch in the top  (Scrub Head Down and Brushes On) position. To raise and lock the scrub head up; press the bottom  (Scrub Head Up and Brushes Off) position of the switch and hold for 3 to 4 seconds to raise the head fully, then let go of the switch.

SIDE BRUSH SWITCH


The side brush switch controls the side brush option position and operation. To lower and start the the side brush, place the switch in the top  (Side Brush Down And On) position. To raise and turn off the side brush, place the switch in the bottom  (Side Brush Up and Off) position.

NOTE: The side brush will not operate if the scrub head is in the raised position.


OPERATIONAL LAMPS SWITCH

The operational lamps switch controls the hazard lamp, headlight, and taillight options. To turn on the operational lamps, place the switch in the top  (Operational Lights) position. To turn the operational lamps off, place the switch in the bottom position.


SOLUTION TANK LOW LAMP

The solution tank low lamp  lights when the solution tank is nearly empty. Depending on the scrubbing conditions, there may be 10 to 20 minutes of scrubbing time remaining before the solution tank is empty. Plan to return to the machine filling/dumping site when the solution tank low lamp lights.

RECOVERY TANK FULL LAMP

The recovery tank full lamp  lights when the recovery tank is nearly full. Depending on the scrubbing conditions, there may be 10 to 15 minutes of scrubbing time left before the vacuum shut-off ball float stops the water vacuum.

IGNITION SWITCH

The key-operated ignition switch  starts the engine. To start the engine, turn the key clockwise. To turn the ignition off, turn the key counter-clockwise.

NOTE: Do not operate the starter motor for more 10 seconds at a time or after the engine has started. Allow the starter to cool between starting attempts. The starter motor may be damaged if it is operated incorrectly.

FOR SAFETY: Before Starting Machine, Make Sure All Safety Devices Are In Place And Operate Properly.

HOUR METER

The hour meter records the number of hours the machine has been operated. This information is useful in determining when to service the machine.

VOLTAGE GAUGE

The voltage gauge indicates the present voltage potential of the battery when the engine is not operating. Normal battery voltage is 10 to 14 volts. When the engine is operating, the gauge registers alternator output voltage. If the voltage exceeds 14 volts, it may be overcharging. If the voltage falls below 10 volts, it may not be accepting or getting a charge from the alternator. Overcharging and undercharging are indications that one or more electrical components are in need of repair.

ENGINE COOLANT TEMPERATURE GAUGE

The engine coolant temperature gauge registers the engine coolant temperature. Normal engine coolant temperatures range up to 200° F (93° C). Temperatures above this level indicate an over-heating engine. This condition may arise due to a low coolant level, a clogged radiator, a loose fan belt, a defective thermostat, or other engine malfunctions. Engine over-heating will always cause a coolant loss. If coolant loss does not occur, check for malfunction of the temperature sending unit.

ENGINE OIL PRESSURE GAUGE

The engine oil pressure gauge registers the engine oil pressure. Normal engine oil pressure ranges from 20 to 35 psi (140 to 240 kPa) on gasoline and LPG powered machines, and 30 to 65 psi (205 to 450 kPa) on diesel powered machines at full engine throttle. If the gauge registers an oil pressure reading below 7 psi (50 kPa), stop the engine immediately and determine the cause. Failure to stop the engine will result in engine damage.







NOTE: The engine is equipped with an oil pressure switch that will stop the engine if oil pressure drops below 5 psi (35 kPa).

CIRCUIT BREAKERS

Circuit breakers are resetable circuit protection devices designed to stop the flow of current in the event of a circuit overload. Once tripped, circuit breakers must be manually reset by pushing the overload button in. If the overload which caused the circuit breaker to trip is still present in the circuit, the circuit breaker will continue to stop current flow until the overload is corrected.

The circuit breakers are located below the steering console.

The following chart shows the various circuit breakers and the electrical components they protect.

PROTECTIVE DEVICE	RATING	CIRCUIT PROTECTED
CB-1 	15 A	Horn
CB-2 	15 A	Gauges, Engine
CB-3 	15 A	Squeegee, Side Brush
CB-4 	15 A	Scrub Head
CB-5 	15 A	Solution System
CB-6 	15 A	Operational Lights

STEERING WHEEL

The steering wheel operates a steering gear assembly which controls the front caster wheel through an arm and tie rod. The machine is very responsive to steering wheel movements. Use care until you become more experienced in guiding the machine. A horn button is located in the center of the steering wheel.

FUEL LEVEL GAUGE

The fuel level gauge is present on gasoline and diesel powered machines. The gauge indicates how much fuel is left in the fuel tank.

ENGINE CHOKE KNOB

The engine choke knob controls the gasoline engine choke. To close the choke for cold starting, pull the choke knob out. To open the choke, push the knob in. It is not necessary to choke a warm engine.

DIESEL PREHEAT PUSH BUTTON

The diesel preheat push button is present on diesel powered machines. The push button controls the engine preheaters.

To use the engine preheaters, push and hold in the preheat push button for 15 to 20 seconds. Start the engine. If the engine doesn't start in 10 seconds, push and hold in the preheat button for 10 seconds more and try to start the engine again.

DIESEL THROTTLE KNOB

The diesel throttle is present on diesel powered machines. The throttle knob controls the engine speed.

Before starting the engine, push the throttle knob in half way. Once the engine is warm, push the throttle knob all the way in for operating speed of the engine. To stop the engine, pull the throttle all the way out.

MACHINE OPERATION

NORMAL SCRUBBING OPERATION

A normal scrubbing operation consists of eight typical operations: pre-start checklist, starting machine, filling solution tank, scrubbing, draining recovery tank and emptying hopper, post operation checklist – engine operating, stopping machine, and post operation checklist – engine stopped.

PRE-START CHECKLIST lists things to check before starting the machine.

TO START MACHINE lists the steps required to start the machine.

TO FILL SOLUTION TANK lists the steps required to fill the solution tank and the cleaning solution tank on the SRS® model machines.

TO SCRUB lists things to keep in mind before and during the scrubbing operation.

TO DRAIN RECOVERY TANK AND EMPTY HOPPER lists the steps required to empty the debris hopper and the recovery tank.

POST OPERATION CHECKLIST – ENGINE OPERATING lists things to check before stopping the machine engine.

TO STOP MACHINE lists the steps required to stop the machine.

POST OPERATION CHECKLIST – ENGINE STOPPED lists things to check after stopping the machine engine.

PRE-START CHECKLIST

Check under the machine for leak spots.

Empty the engine air filter dust cap and check the air filter restriction indicator.

Check the engine radiator for debris and clean if needed.

Check the engine lubricating oil level.

Check the fuel level.

Check for LPG odor or frosting on hoses or components indicating LPG fuel leak.

Check the brakes and controls for proper operation.

Check service records to determine service requirements.

TO START MACHINE

1. LPG powered machines: Slowly open the liquid service valve.

NOTE: Opening the service valve too quickly may cause the service valve check valve to stop the flow of LPG fuel. If the check valve stops the flow of fuel, close the valve, wait a few seconds, and slowly open the valve once again.

2. The machine operator must be in the operator's seat with the directional control pedal in the "neutral" position and with a foot on the brake pedal or with the parking brake engaged.

FOR SAFETY: Before Starting Machine Make Sure All Safety Devices Are In Place And Operate Properly.

3. Gasoline powered machines: When the engine is cold, pull out the choke button about three-fourths of the way. Push choke in after the engine has started and is running smoothly.

LPG powered machines: When the engine is cold and exposed to cold temperatures, open the engine hood, press the primer button on the LPG vaporizer, close the engine hood.

Diesel powered machines: Hold in the engine preheat push button for 15 to 20 seconds.

4. Gasoline and LPG powered machines: Press the throttle control switch to the start position.

Diesel powered machines: Push the throttle knob in half way.

OPERATION

5. Turn the ignition switch key on until the engine starts. Do not operate the starter for more than a few seconds at a time or after the engine has started.

NOTE: Do not operate the starter motor for more than 10 seconds at a time or after the engine has started. Allow the starter to cool between starting attempts. The starter motor may be damaged if it is operated incorrectly.

6. Allow the engine and hydraulic system to warm up three to five minutes.
7. Gasoline and LPG powered machines:
Place the throttle switch in the top (Fast) position.

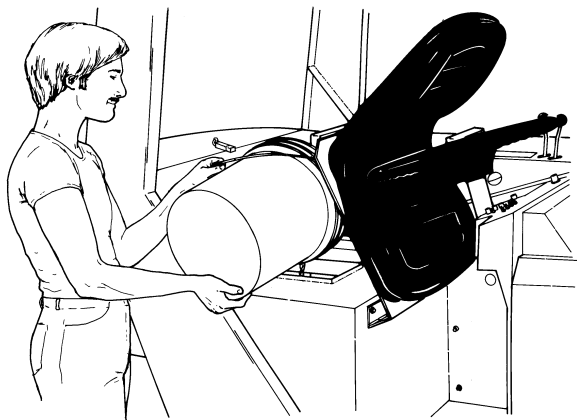
Diesel powered machines: Push the throttle knob all the way in.
8. Disengage the machine parking brake.
9. Drive the machine to the solution filling site.

TO FILL SOLUTION TANK

1. Stop the engine and engage the parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

2. Lift the operator seat forward.
3. Standard model machines: Pour the required amount of detergent into the tank. Fill the tank with water to 1 in (25 mm) below the tank opening.



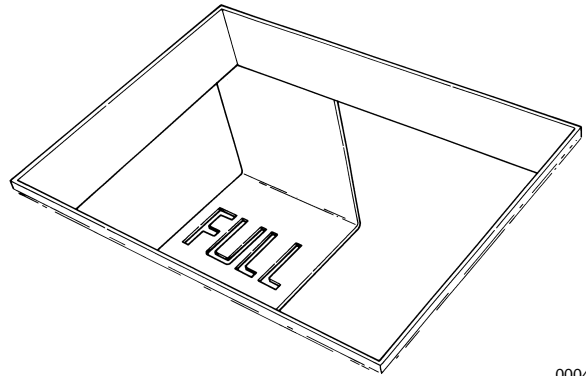
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ADDING DETERGENT TO SOLUTION TANK

SRS® model machines: Fill the tank with water up to the "full" mark. Fill the cleaning solution tank with cleaning solution. The water must not be hotter than 130° F (54° C) or solution system damage may occur.

NOTE: Do not use bleach in solution tank or tank damage will result.

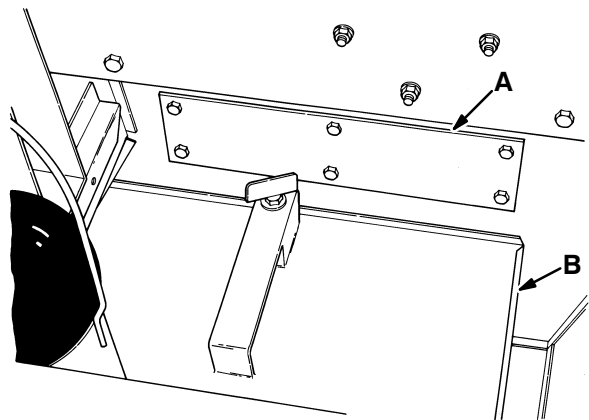
! WARNING: Flammable Materials Can Cause An Explosion Or Fire. Do Not Use Flammable Materials In Tank(s).



00040

SOLUTION TANK FULL INDICATOR

SRS® model machines: When operating the machine with the cross-over door removed, the solution tank must not be filled with water above the two cross-over tubes located under the cross-over door.



00057

FOAM CROSS-OVER DOOR

**A. Foam Cross-Over Door
B. Laminar Filter Cover**

4. Lower the seat.

TO SCRUB

Plan the scrubbing in advance. Try to arrange long runs with minimum stopping and starting. Do an entire floor or section at one time.

Pick up oversize debris before scrubbing. Remove bulky debris from aisles before scrubbing. Pick up pieces of wire, twine, string, etc., which could become entangled in brush or brush plugs.

Allow a few inches overlap of brush paths.

Do not turn steering wheel too sharply when the machine is in motion. It is very responsive to the movement of the steering wheel. Avoid sudden turns, except in emergencies.

Try to scrub as straight a path as possible. Avoid bumping into posts or scraping the sides of the machine.

1. Drive the machine to the area to be scrubbed.
3. Place the scrub head switch in the top (Scrub Head Down and Brushes On) position.
4. Place the cleaning switch in the top (Squeegee Down) position.

NOTE: The main scrub brushes will not operate if the cleaning switch is in the middle (Vacuum Wand) position. When scrubbing make sure the cleaning switch is not in the middle (Vacuum Wand) position. The scrub head will not lower to the ground if the switch is in the middle (Vacuum Wand) position.

5. Place the side brush switch, if present on the machine, in the top (Side Brush Down and On) position.
6. Move the solution flow lever(s) to the desired position. For SRS® machines: place the cleaning solution flow switch to the desired flow rate position.
7. Scrub as required. When the ball float shuts off machine vacuum, or the solution tank low lamp lights, return to the solution dump/filling site. Drain the recovery tank, empty the hopper, and refill the solution tank.

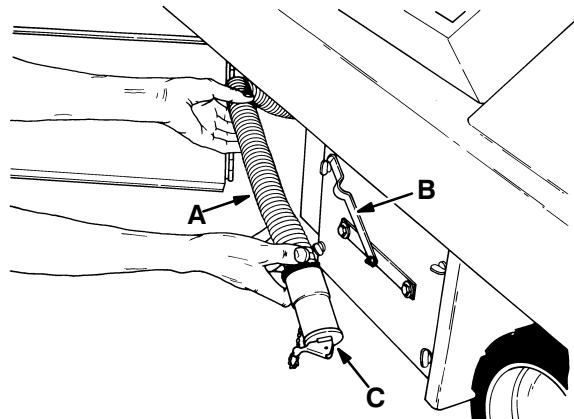
⚠ WARNING: Flammable Materials Or Reactive Metals Can Cause Explosion Or Fire. Do Not Pick Up.

TO DRAIN RECOVERY TANK AND EMPTY HOPPER

1. Stop the engine, and engage the parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

2. Open the lower left access door, both lower access doors on SRS® model machines.
3. Remove and unplug the drain hose(s) next to a floor drain.

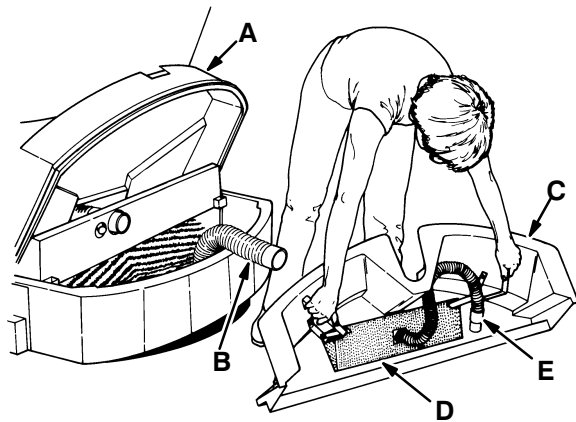


00067

DRAINING RECOVERY TANK

- A. Drain Hose
- B. Hose Retaining Clip
- C. Hose Plug

4. Open the scrub head cover.
5. Disconnect the squeegee and debris screen vacuum hoses.
6. Lift the hopper out of the machine.

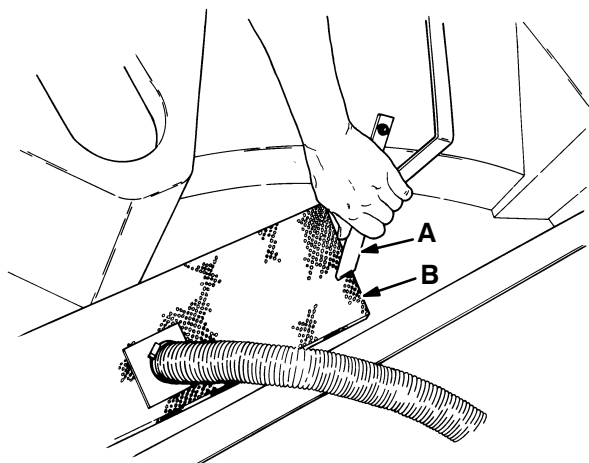


REMOVING DEBRIS HOPPER

02424

- A. Scrub Head Cover
- B. Squeegee Suction Hose
- C. Debris Hopper
- D. Debris Screen
- E. Screen Suction Hose

7. Remove and clean the debris screen.



REMOVING DEBRIS SCREEN

00027

- A. Debris Screen Retainer
- B. Debris Screen

8. Reinstall the debris screen in the hopper.
9. Reinstall the hopper in the scrub head. Close the scrub head cover.
10. Plug and secure the drain hose(s) to the machine.
11. Close the access door(s).

12. SRS® model machines: Flush the solution tank outlet screens. Then fill the solution tank with enough clean water to cover the solution outlet screens. Run the SRS® pump for a few minutes to flush the system.

POST OPERATION CHECKLIST – ENGINE OPERATING

Check scrub brush pattern for width and evenness. See *MAINTENANCE* section.

Check squeegees for proper deflection.

TO STOP MACHINE

1. Return the directional control pedal to the “neutral” position. Apply the brake.
2. Move the solution flow lever(s) all the way back to the off position.
3. Hold the scrub head switch in the bottom (Scrub Head Up) position for 3 to 4 seconds to raise the scrub head all the way up.
4. Place the side brush switch, if present on the machine, in the bottom (Side Brush Up and Off) position.
5. Turn the operating lamps off if used.
6. Gasoline and LPG powered machines: Place the throttle switch in the middle (Idle) position.

Diesel powered machines: Pull the throttle knob all the way out.
7. Engage the machine parking brake.
8. Turn the ignition key switch off. Remove the key from the ignition switch.
9. LPG powered machines: Close the LPG tank liquid service valve.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

POST OPERATION CHECKLIST – ENGINE STOPPED

Check for wire or string tangled on the scrub brushes.

Check the squeegees for wear or damage.

Empty and clean debris hopper.

Drain and clean the recovery tank.

Check the vacuum hoses for debris or obstructions.

Check to make sure the LPG tank service valve is closed.

Check for LPG odor indicating a fuel leak.

Fill the fuel tank.

Check under the machine for leaks spots.

DOUBLE SCRUBBING OPERATION

Double scrubbing is a method of removing heavy accumulations of soilage, dirt, wax, or spills. It involves making two passes over the area to be cleaned. To double scrub, make a single pass over the surface being cleaned with the cleaning switch in the bottom (Squeegee Up) position. This dispenses solution and allows both brushes to rotate with the rear squeegee up. Allow the solution to soak on the floor for 15 to 20 minutes. Then make a second scrubbing pass in the normal manner with the clean switch in the top (Squeegee Down) position.

NOTE: The main scrub brushes will not operate if the cleaning switch is in the middle (Vacuum Wand) position. When normal scrubbing or during soak operation, make sure the cleaning switch is not in the middle (Vacuum Wand) position.

FOR SAFETY: When Using Machine, Go Slow On Grades And Slippery Surfaces.

OPERATION ON GRADES

Drive the machine slowly on grades. Use the brake to control machine speed.

FOR SAFETY: When Using Machine, Go Slow On Grades And Slippery Surfaces.

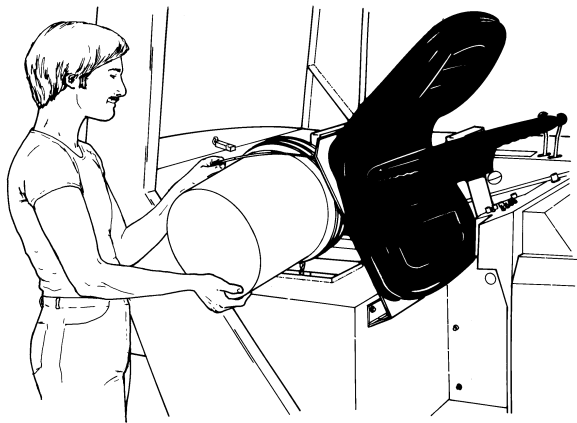
The maximum rated ramp climb and descent angle is 10° with empty solution and recovery tanks, and 8° with full solution and recovery tanks.

OPERATION

SOLUTION TANK

The machine solution tank supplies the scrub brushes with a water and detergent solution. The solution tank on standard machines is located on the right side of the machine under the operator seat.

Access to the solution tank is through the opening in the top of the tank under the operator seat. To fill the tank, lift the operator seat forward, pour in the required amount of detergent and fill the tank with water to 1 in (25 mm) below the tank opening.



00025

ADDING DETERGENT TO SOLUTION TANK

DETERGENT RECOMMENDATIONS

Floor conditions, amount of soilage, type of soilage, brush action, and squeegee action all play an important role in determining the type and concentration of detergent to be used. For specific recommendations, consult the local Tennant Company Representative.

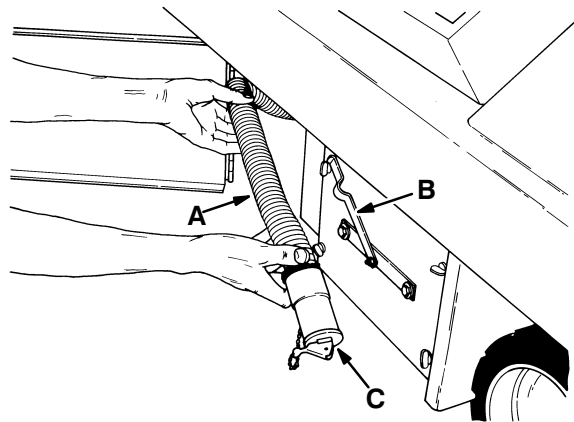
⚠ WARNING: Flammable Materials Can Cause An Explosion Or Fire. Do Not Use Flammable Materials InTank(s).

RECOVERY TANK

The machine recovery tank stores the water solution picked up by the machine squeegee and vacuum fan. The recovery tank on standard machines is located to the left of the operator seat.

The recovery tank should be drained after the solution tank is empty or whenever the ball float rises and stops water vacuum. The recovery tank may fill before the solution tank empties if standing water is picked up in addition to the solution put down by the machine.

To drain the recovery tank, stop the engine, engage the parking brake, open the lower access door, and remove and unplug the drain hose next to a floor drain. The tank will not empty with the vacuum fan operating. Shut off the vacuum fan by placing the cleaning switch in the bottom (Squeegee Up) position. Clean the recovery tank after every work shift.



00067

DRAINING RECOVERY TANK

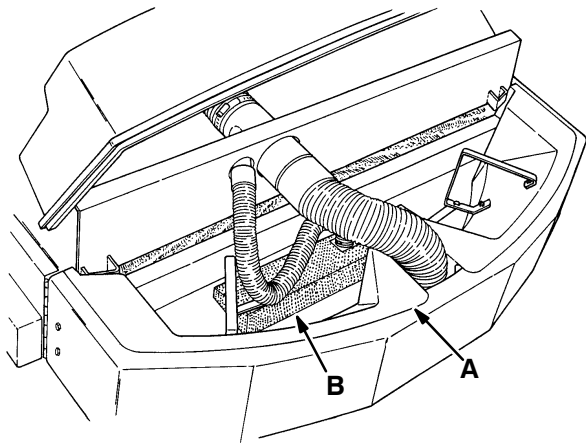
- A. Drain Hose
- B. Hose Retaining Clip
- C. Hose Plug

DEBRIS HOPPER

The debris hopper collects debris picked up by the scrub brushes. It is located behind the scrub brushes.

A vacuumized debris screen is located on the bottom of the debris hopper to draw water solution out of the debris collected in the hopper.

The debris hopper should be emptied and cleaned whenever the recovery tank is drained. To empty and clean the debris hopper, stop the engine, engage the parking brake, open the scrub head cover, disconnect the vacuum hoses, and lift the hopper out of the machine. Remove and clean the debris screen from the hopper. Reinstall the debris screen, debris hopper, and vacuum hoses when finished.



DEBRIS HOPPER

02473

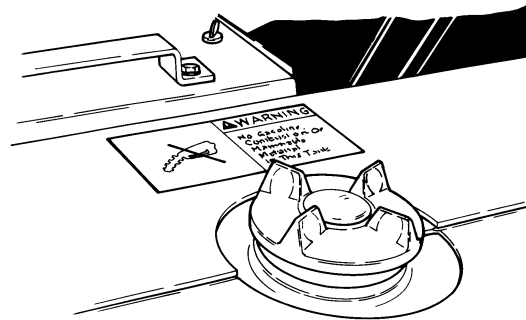
- A. Debris Hopper**
- B. Debris Screen**

SRS® CLEANING SOLUTION TANK

The SRS® cleaning solution tank supplies the scrub brushes with cleaning solution. The tank is mounted behind and to the left of the operator seat.

To fill the tank, open the tank cap, pour the liquid cleaning solution in and replace the cap. Do not use powdered detergent or any other detergent not designed for the SRS® application.

! WARNING: Flammable Materials Can Cause An Explosion Or Fire. Do Not Use Flammable Materials In Tank(s).



CLEANING SOLUTION TANK CAP

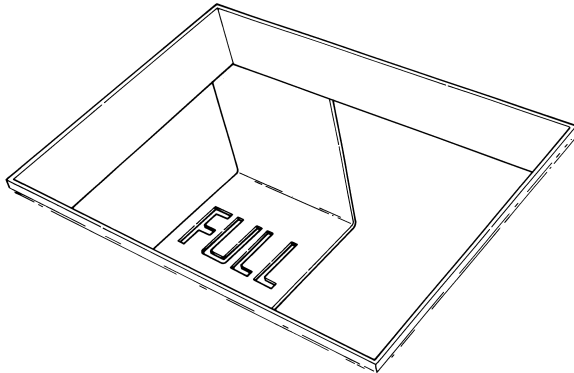
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OPERATION

SRS® SOLUTION TANK

The SRS® machine solution tank supplies the scrub brushes with a water and cleaning solution mixture. It also stores water picked up by the machine squeegees and vacuum fan.

Access to the SRS® solution tank is through the opening in the top of the tank under the operator's seat. To fill the tank, lift the operator seat forward and fill the tank with water up to the "full" mark.



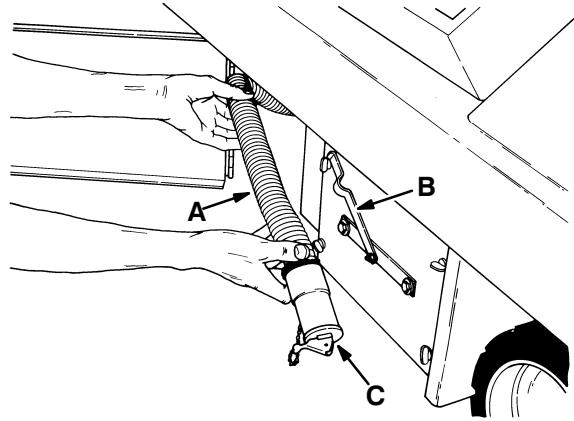
SOLUTION TANK FULL INDICATOR

00040

NOTE: If standing water is to be picked up in addition to the solution put down by the machine, do not fill the tank up to the "full" mark. This will allow more water to be picked up before the ball float shut-off is actuated.

Do not put detergent or cleaning solution directly into the SRS® solution tank. The cleaning solution should be put in the cleaning solution tank.

The SRS® solution tank should be drained and cleaned after every work shift. To drain the tank, stop the engine, engage the parking brake, open the lower access doors, and unplug the drain hoses next to a floor drain. The tank will not empty with the vacuum fan operating. Shut off the vacuum fan by placing the cleaning switch in the bottom (Squeegee Up) position.



DRAINING TANK

00067

- A. Drain Hose
- B. Hose Retaining Clip
- C. Hose Plug

MACHINE TROUBLESHOOTING

Problem	Cause	Remedy
Trailing water – poor no water pickup	Worn rear squeegee	Rotate or replace rear squeegee or blade
	Rear squeegee out of adjustment	Adjust rear squeegee
	Worn side squeegee	Replace side squeegee blade
	Side squeegee out of adjustment	Adjust side squeegee
	Vacuum hose clogged	Flush vacuum hoses
	Recovery tank full	Drain tank
	Ball float stuck shutting off vacuum	Clean ball float and float guide
	Engine not operating at governed speed	Speed up engine to “full” speed and readjust governor
	Debris caught on squeegee	Remove debris
	Debris hopper full	Empty hopper
	Foam filling recovery tank	Empty recovery tank; change detergent
	Vacuum hose to rear squeegee hose disconnected or damaged	Reconnect or replace vacuum
	Vacuum fan to recovery tank hose damaged	Replace hose
	SRS® models: Operator seat tank seal not sealing	Remove obstruction or replace seal
Little or no solution flow to floor	Solution tank empty	Fill solution tank
	Solution control cable broken or out of adjustment	Replace and/or adjust cable
	Solution supply lines, spreader tube or spray nozzle clogged	Flush solution supply lines, spreader tube, or spray nozzle
	SRS® models: Solution outlet screen clogged	Spray screens clean
	SRS® models: Solution pump clogged, broken, or lost prime	Flush, inspect, and prime pump
	SRS® models: Electrical problem preventing solution pump from operating	Trace electrical circuits for open contacts or broken components
	Side scrub brush models: Solution pump clogged, broken, or lost prime	Flush, inspect, and prime pump
	Side scrub brush models: Electrical problem preventing solution pump from operating	Trace electrical circuits for open contacts or broken components

OPERATION

Problem	Cause	Remedy
Poor scrubbing performance	Debris caught on scrub brushes	Remove debris
	Improper detergent or brushes used	Check with TENNANT representative for advice
	Worn scrub brushes	Replace scrub brushes
	Scrub brushes out of adjustment	Adjust scrub brushes
	Scrub head out of adjustment	Adjust scrub head
	SRS® models: Cleaning solution pump failure	Repair or replace cleaning solution pump
	SRS® models: Electrical problem preventing solution pump from operating	Trace electrical circuits for open contacts or broken components
	Side scrub brush models: Cleaning solution pump failure	Repair or replace cleaning solution pump
	Side scrub brush models: Electrical problem preventing solution pump from operating	Trace electrical circuits for open contacts or broken components
	Debris hopper full	Empty hopper
	Cleaning switch in Vacuum Wand position	Place cleaning switch in Squeegee Up or Squeegee Down position

OPTIONS OPERATION

VACUUM WAND

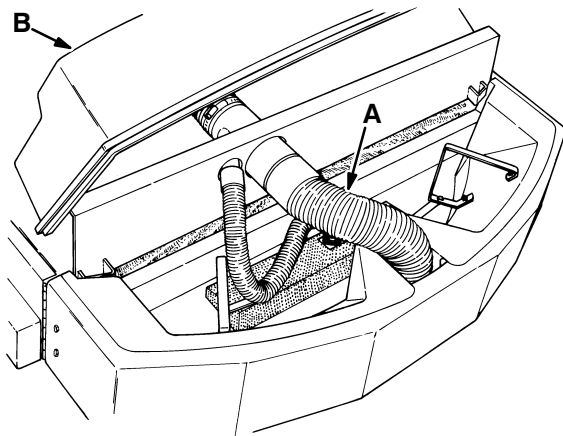
The vacuum wand option gives the machine the added flexibility of picking up spills not accessible by the machine. An 84 in (2140 mm) long hose utilizes the machine vacuum system.

TO OPERATE VACUUM WAND

1. Stop the engine and engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

2. Remove the vacuum wand equipment from the machine.
3. Open the scrub head cover.
4. Remove the large diameter squeegee suction hose from its hose connector.

**SQUEEGEE SUCTION HOSE**

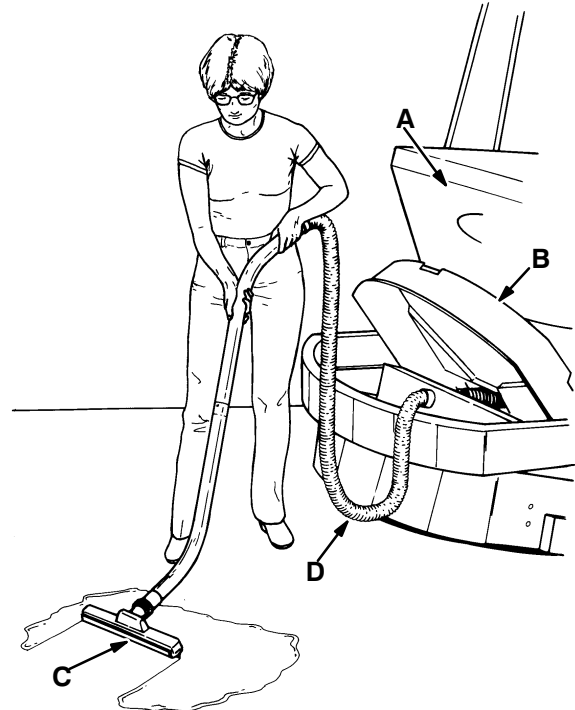
02473

- A. Suction Hose
- B. Scrub Head Cover

5. Push the vacuum wand hose into the hose connector.
6. Assemble the wand and hose.
7. Start the engine.
8. Gasoline and LPG powered machines:
Place the throttle switch in the top (Fast) position.

Diesel powered machines: Push the throttle knob all the way in.

9. Place the cleaning switch in the middle (Vacuum Wand) position.
10. Vacuum as required.

**OPERATING VACUUM WAND**

02425

- A. Rear Storage Door
- B. Scrub Head Cover
- C. Wand
- D. Hose

11. When finished, place the cleaning switch in the bottom (Squeegee Up) position and shut off the engine.
12. Remove the vacuum wand hose from the hose connector.
13. Reconnect the squeegee suction hose.
14. Close the scrub head cover.
15. Clean and rinse off the squeegee wand and equipment as required.
16. Store the squeegee wand equipment in the proper locations.

TRANSPORTING MACHINE

PUSHING OR TOWING MACHINE

The machine may be pushed or towed from the front or the rear, using the bumpers provided, over short distances up to 1 mph (2 km/h).

Place a dolly under the rear wheels to travel distances greater than 1 mile (1 km) or speeds over 1 mph (2 km/h).

MACHINE JACKING

The machine may be jacked up for service at the designated locations. Use a jack of adequate capacity and good working condition. Always stop the machine on a flat, level surface and block the tires before jacking the machine up. The front jacking location is in the middle of the flat bottom edge of the machine frame.

The rear jacking locations are next to the rear wheels. Open the access doors to allow the jack to contact the bottom of the bumper.

TO JACK UP MACHINE

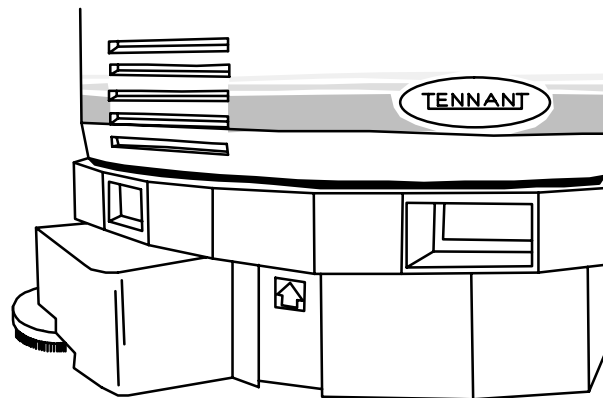
1. Drain the solution and recovery tanks.
2. Stop the engine and engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

3. Block the tires, which are not being jacked up, in order to secure the machine position.

FOR SAFETY: When Servicing Machine, Block Machine Tires Before Jacking Machine Up.

4. Use a jack of adequate capacity to raise the machine. Jack up the machine only at the designated locations.



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FRONT JACKING LOCATION

5. Block machine up with jack stands or similar devices near the designated jacking locations to secure the machine.

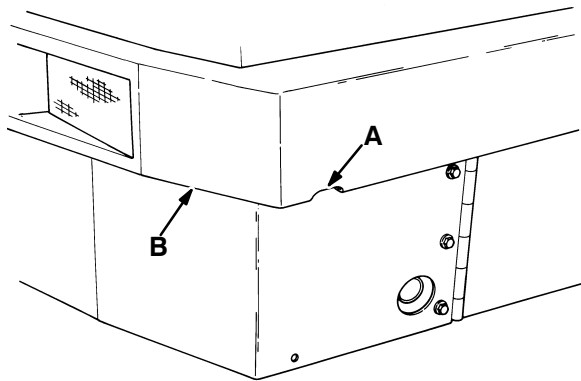
FOR SAFETY: When Servicing Machine, Jack Machine Up At Designated Locations Only. Block Machine Up With Jack Stands. Use Hoist Or Jack Of Adequate Capacity To Lift Machine.

6. Lower the machine onto the jack stands.
7. Check to make sure the machine is secure.
8. Service the machine as required.
9. When finished servicing the machine, raise the machine off the jack stands.
10. Remove the jack stands from under the machine.
11. Lower the machine.
12. Remove the blocks from the tires.

MACHINE TIE-DOWNS

The machine may be tied down at each of the four corners of the machine at the locations specified.

To tie the front of the machine down, use the tie-down slots provided. The front tie-down slots are located in the front corner of the machine frame.



FRONT LEFT TIE-DOWN SLOT

04759

- A. Tie-Down Slot**
- B. Machine Bumper**

To tie the rear of the machine down, wrap chains around each corner of the rear bumper. Then secure the other end of the chain to the trailer or truck bed tie-downs.

When transporting the machine on a trailer or in a truck, be sure to engage the machine parking brake and block the machine tires to prevent the machine from rolling.

MACHINE STORAGE**STORING MACHINE**

When storing the machine for extended periods of time, these procedures must be followed to lessen the chance of rust, sludge, and other undesirable deposits from forming:

1. Drain and clean the solution and recovery tanks.
2. Change engine oil.
3. Place the scrub head switch in the bottom (Scrub Head Up) position.
4. Park the machine in a cool and dry area.
5. Stop the engine and engage parking brake.
6. Block scrub head up.
7. Fill the hydraulic reservoir with hydraulic fluid to the full mark to prevent excessive condensation from forming in the reservoir.

8A. Gasoline and LPG powered machines: To store the machine 30 to 90 days:

1. Remove the spark plugs.
2. Pour 3 oz (90 cc) of clean engine oil into each spark plug hole.
3. Remove the ignition coil high tension wire on machines below serial number 031000. Operate the engine starter motor for at least a dozen revolutions. This distributes the oil over the cylinder walls.

NOTE: Before preparing the engine for storage, allow it to cool down to the surrounding temperature. Oil adheres to cold metal surfaces much better than hot surfaces.

4. Replace the high tension coil wire, on machines below serial number 031000, and spark plugs.
5. Drain the gasoline from the carburetor.
6. LPG powered machines: Close the liquid service valve.

8B. Gasoline and LPG powered machines: To store the machine over 90 days:

1. Remove the spark plugs.
2. Pour 3 oz (90 cc) of clean engine oil into each spark plug hole.
3. Remove the ignition coil high tension wire on machines below serial number 031000. Operate the engine starter motor for at least a dozen revolutions. This distributes the oil over the cylinder walls.

NOTE: Before preparing the engine for storage, allow it to cool down to the surrounding temperature. Oil adheres to cold metal surfaces much better than hot surfaces.

4. Replace the high tension coil wire, on machines below serial number 031000, and spark plugs.
5. Drain the engine oil from the engine oil pan.
6. Drain the coolant from the radiator and engine block.
7. Close the engine cooling system drain cocks.
8. Drain gasoline from the carburetor, fuel tank, and the fuel lines.
9. Seal the air cleaner inlet and the exhaust outlet with weatherproof masking tape.
10. Tighten the engine oil filler cap, the fuel tank cap, and the radiator cap to make certain they are securely in place.
11. LPG powered machines: Close the liquid service valve.

8C. Diesel powered machines: To store machine:

1. Drain the coolant from the radiator and engine block.
2. Close the engine cooling system drain cocks.

SECTION 3

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MAINTENANCE

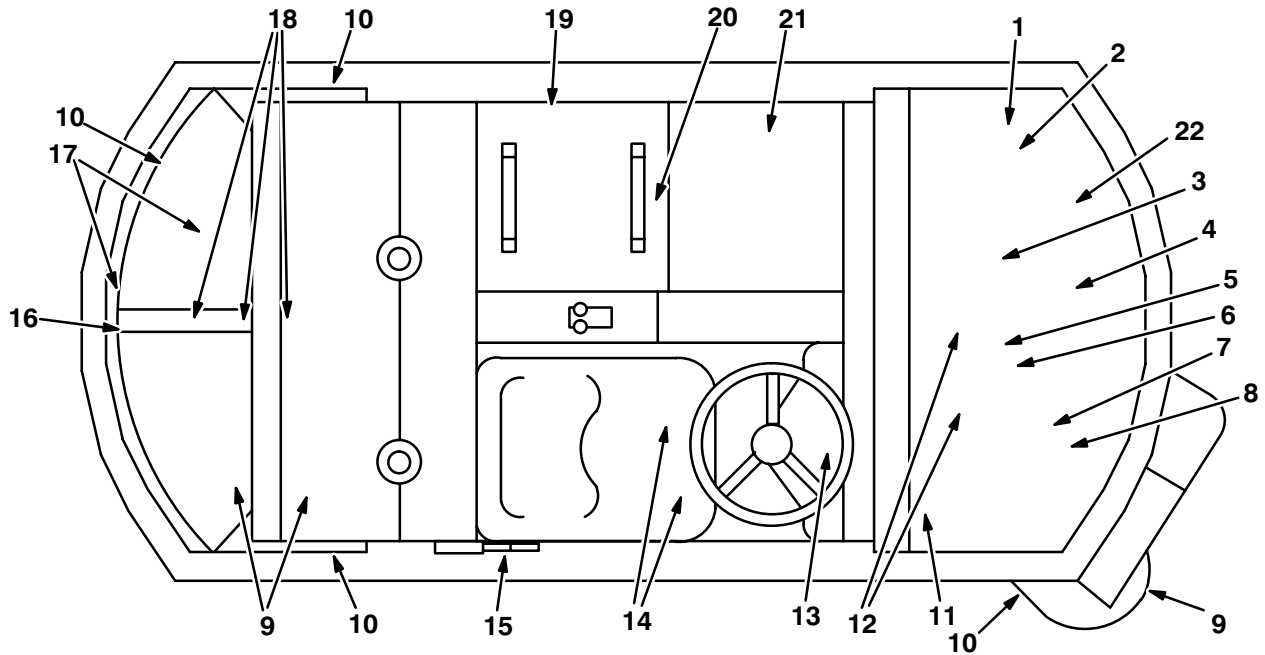
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RECOMMENDED FIRST 50-HOUR MACHINE INSPECTION

After the first 50 hours of operation, the following procedures are recommended:

1. Perform the brush pattern test to check for correct brush adjustment.
2. Check the scrub head side squeegee blades for wear or damage.
3. Check the rear squeegee for worn or damaged blades or for incorrect adjustment.
4. Check the vacuum hoses for damage or loose connections.
5. Gasoline and LPG powered machines below serial number 031000: Check engine ignition timing.
6. Gasoline and LPG powered machines below serial number 031000: Torque cylinder head bolts to the proper specification.
7. Replace the hydraulic fluid filter element.
8. Gasoline powered machines: Replace the fuel filter element.
9. Perform all remaining 50-hour lubrication and maintenance procedures listed in the *MAINTENANCE CHART*.

MAINTENANCE CHART



04752

Interval	Key	Description	Procedure	Lubricant	No. of Service Points
Daily	3	Engine crankcase	Check oil level	EO	1
	9	Brushes	Check for damage, wear and adjustment	-	2
	10	Squeegees	Check for damage, wear, and adjustment	-	4
	19	Recovery tank	Clean out	-	1
	17	Vacuum hoses	Clean out	-	3
	20	Laminar tube set	Flush	-	1
	14	SRS® tank screen filters	Clean	-	2
	1	Radiator core exterior	Check for debris and clean	-	1
	7	Engine air filter	Check restriction indicator	-	1
	22	Fuel water trap filter, diesel	Empty dust cap Drain water	-	1
50 Hours	3	Engine crankcase, diesel	Change oil and filter element	EO	1
	18	Scrub head pivots	Lubricate	SPL	3
	16	Rear squeegee roller	Lubricate	SPL	1
	12	Steering arm rod ends	Lubricate	SPL	2
	5	Front caster	Lubricate	SPL	1
	6	Front wheel bearing	Lubricate	SPL	1
100 Hours	3	Engine crankcase, gasoline, LPG	Change oil and filter element	EO	1
	1	Radiator	Check coolant level	WG	1
	21	Hydraulic fluid reservoir	Check fluid level	HYDO	1
	2	Engine fan belt	Check tension	-	1
	15	Parking brake	Check adjustment	-	1

Interval	Key	Description	Procedure	Lubricant	No. of Service Points	
400 Hours	11 4	Brake master cylinder Engine, gasoline, LPG, for machines below serial number 031000	Check brake fluid level	BF	1	
			Check and adjust valve clearances	–	8	
			Check and adjust idle speed	–	1	
			Check and adjust idle mixture	–	1	
			Clean or replace and adjust spark plugs	–	4	
			Clean or replace and adjust distributor points	–	1	
			Clean and inspect distributor cap and rotor	–	1	
			Check and adjust ignition timing	–	1	
			Replace PCV valve	–	–	
			Clean PCV hoses, tubes and fittings			
		4	Engine, gasoline, LPG, for machines serial number 031000 and above	Check and adjust valve clearances	–	8
				Check and adjust idle speed	–	1
				Check and adjust idle mixture	–	1
				Clean or replace and adjust spark plugs	–	4
				Replace PCV valve	–	–
			Clean PCV hoses, tubes and fittings			
		21	Hydraulic fluid reservoir	Change hydraulic fluid	HYDO	1
	8	Hydraulic fluid filter	Change filter element	–	1	
	13	Steering gear	Check grease level	MPG	1	
	22	Fuel filter, diesel	Replace element	–	1	
800 Hours	4 1	Engine Cooling system	Torque intake manifold bolts	–	4	
			Flush	WG	1	
	21	Hydraulic reservoir breather	Replace	–	1	
	21	Hydraulic reservoir strainer	Replace	–	1	

BF – Brake fluid

EO – Engine oil

HYDO – Tennant Company or approved hydraulic fluid

MPG – Multi-purpose calcium soap base grease

SPL – Special lubricant, Lubriplate EMB grease (TENNANT Part No. 01433-1)

WG – Water and permanent-type ethylene glycol anti-freeze, one-to-one ratio

NOTE: More frequent intervals may be required in extremely dusty conditions.

LUBRICATION

ENGINE

Check the engine oil level daily.

GASOLINE AND LPG POWERED ENGINES

Gasoline and LPG powered engines should be lubricated with SAE–SG/SH rated engine oil. Change the engine oil and oil filter after every 100 hours of operation.

The following oil grades are recommended for engines operating in the ambient temperatures listed.

MULTI-VISCOSITY OILS

Below 32°F (Below 0°C) 5W 30	–10° to 90°F (–23° to 32°C) 10W 30	–10° to above 90°F (–23 to above 32°C) 10W 40	Above 10°F (Above –12°C) 20W 40
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SINGLE VISCOSITY OILS

–10° to 32°F (–23° to 0°C) 10W	10° to 60°F (–12° to 16°C) 20W 20	32° to 90°F (0° to 32°C) 30	Above 60°F (Above 16°C) 40
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The engine oil capacity is 3.5 qt (3.3 L) including the oil filter.

DIESEL POWERED ENGINES

Diesel powered engines should be lubricated with SAE–CC/CD rated engine oil. Change the engine oil and oil filter after every 50 hours of operation.

The following oil grades are recommended for engines operating in the ambient temperatures listed.

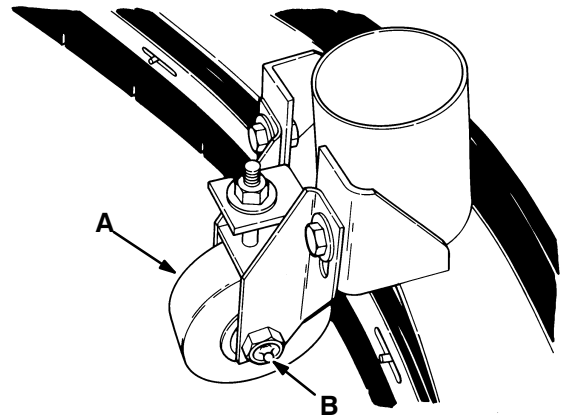
SINGLE AND MULTI-VISCOSITY OILS

Below 32°F (Below 0°C) 10W 10W 30	32° to 77° F (0° to 25° C) 20	Above 77° F (Above 25° C) 30
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The engine oil capacity is 7 qt (6.7 L) including the oil filter.

REAR SQUEEGEE ROLLER (For machines below serial number 033056)

The rear squeegee roller supports the rear squeegee assembly. A grease fitting has been provided on the roller shaft for lubrication purposes. Lubricate the roller bearing with Lubriplate EMB grease (TENNANT Part No. 01433–1) after every 50 hours of operation. Spin the roller to distribute the grease.



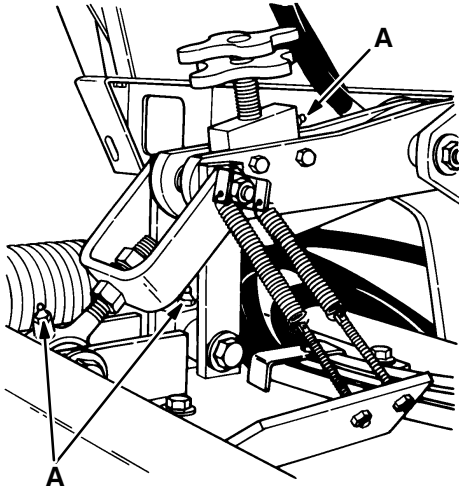
REAR SQUEEGEE ROLLER

00022

- A. Caster
- B. Caster Grease Fitting

SCRUB HEAD PIVOTS

The scrub head pivots when it is raised and lowered. Three grease fittings have been provided to lubricate the pivot points. Lubricate the pivots with Lubriplate EMB grease (TENNANT Part No. 01433-1) after every 50 hours of operation.



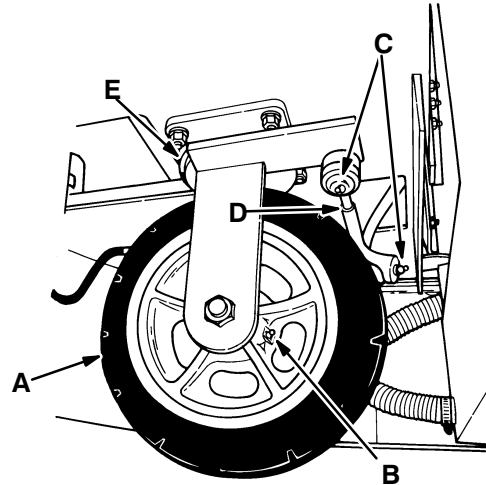
SCRUB HEAD PIVOT

A. Grease Fittings

00089

FRONT CASTER AND WHEEL BEARING

The front caster wheel supports the weight of the front of the machine. A grease fitting has been provided on the wheel to lubricate the wheel bearings and on the front of the caster for its lubrication. Lubricate the front wheel bearings and caster with Lubriplate EMB grease (TENNANT Part No. 01433-1) after every 50 hours of operation.



FRONT CASTER AND STEERING ARM

- A. Front Wheel**
- B. Wheel Bearing Grease Fitting**
- C. Steering Arm Grease Fitting**
- D. Steering Arm**
- E. Caster Grease Fitting**

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MAINTENANCE

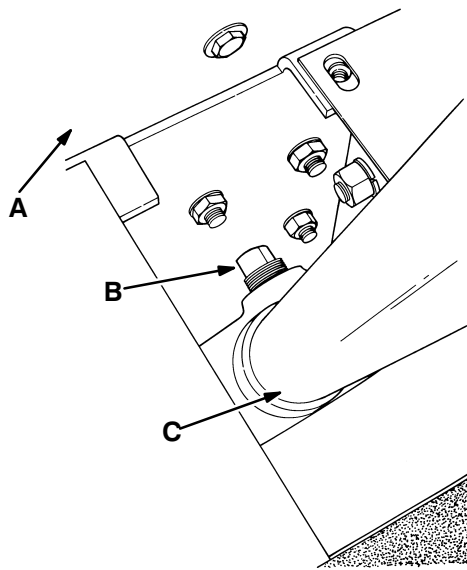
STEERING ARM ROD ENDS

The steering arm steers the front caster. Each rod end is equipped with a grease fitting for lubrication purposes. Lubricate each steering arm rod end with Lubriplate EMB grease (TENNANT Part No. 01433-1) after every 50 hours of operation.

STEERING GEAR

The steering gear controls the steering arm. A square head plug has been provided on the left side of the gear box to check the grease level and to allow filling.

Check the steering gear grease level after every 400 hours of operation. Fill the unit with multipurpose, calcium soap base grease.



00013

STEERING GEAR

- A. Firewall**
- B. Plug**
- C. Steering Column**

HYDRAULICS

HYDRAULIC FLUID

The quality and condition of the hydraulic fluid plays a very important role in how well the machine operates. TENNANT's hydraulic fluid is designed to meet the special needs of its machines.

TENNANT's hydraulic fluids provide longer life of the hydraulic components. There are two fluids available for two different temperature ranges:

TENNANT part no.	Ambient Temperatures
65869	above 45° F (7° C)
65870	below 45° F (7° C)

The higher temperature fluid is designed with a higher viscosity and should not be used at the lower temperatures. Possible damage to the hydraulic pumps may occur because of improper lubrication.

The lower temperature fluid is a thinner fluid designed for colder temperatures.

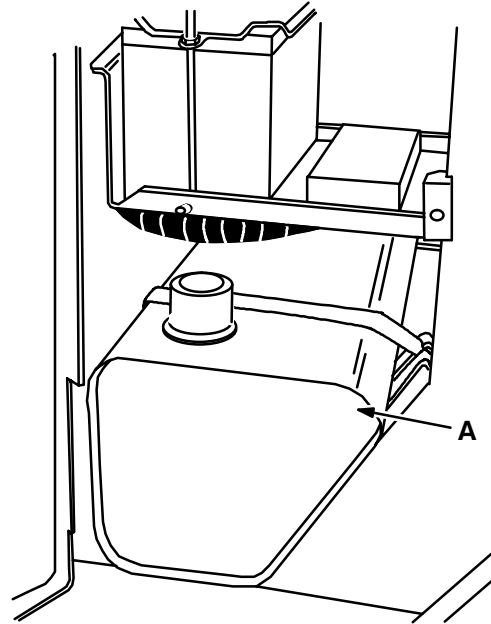
If a locally-available hydraulic fluid is preferred, or if products of only one oil company are used, contact TENNANT Technical Customer Service to check the specifications of the substitute fluid. Using substitute fluids can cause premature failure of hydraulic components.

ATTENTION! Hydraulic components depend on system hydraulic fluid for internal lubrication. If dirt or other contaminants are allowed to enter the hydraulic system, malfunctions, accelerated wear, and damage will result.

HYDRAULIC FLUID RESERVOIR

Hydraulic fluid is stored in the hydraulic fluid reservoir. The reservoir holds 10 gal (38 L) of hydraulic fluid. The reservoir is located under the battery.

The reservoir is equipped with a breather–filler cap and fluid level dipstick mounted on the reservoir. See *HYDRAULIC FLUID RESERVOIR BREATHER* for breather service information.



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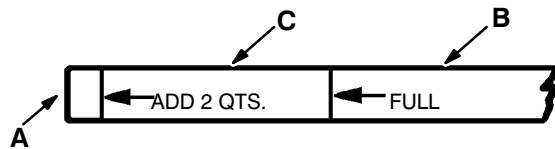
HYDRAULIC FLUID RESERVOIR

A. Hydraulic Reservoir

The hydraulic fluid level dipstick is built into the breather–filler cap. The end of the dipstick is marked with “full” and “add” levels. This indicates the level of hydraulic fluid in the reservoir.

MAINTENANCE

Check the hydraulic fluid level after every 100 hours of operation. It should be above the “add” marks on the dipstick, but not above the “full” mark when the hydraulic fluid is warm.



HYDRAULIC FLUID LEVEL DIPSTICK ⁰²⁴³⁰

- A. Dipstick
- B. Full Range
- C. Add Range

Do not overfill the hydraulic fluid reservoir. Hydraulic fluid expands as it heats to its normal operating temperature. Always allow for expansion when filling the reservoir.

ATTENTION! Do not overfill the hydraulic fluid reservoir or operate the machine with a low level of hydraulic fluid in the reservoir. Damage to the machine hydraulic system may result.

Drain, flush, and refill the hydraulic fluid reservoir with hydraulic fluid after every 400 hours of operation.

TO DRAIN THE HYDRAULIC FLUID RESERVOIR

1. Stop the engine and engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

2. Allow the hydraulic fluid to cool.
3. Open the side door.
4. Loosen the breather-filler cap. Remove the reservoir drain plug at the end of the drain hose located on the bottom of the reservoir to drain the hydraulic fluid. Discard the used hydraulic fluid.

NOTE: Always change the hydraulic fluid filter when draining the hydraulic fluid reservoir.

5. Flush the reservoir with clean hydraulic fluid or suitable solvent. Do not use gasoline, kerosene, or diesel fuel.
6. Reinstall the reservoir drain plug.
7. Close the side door.

TO FILL THE HYDRAULIC FLUID RESERVOIR

1. Open the side door.
2. Remove the reservoir breather–filler cap.
3. Pour 10 gal (38 L) of new, approved hydraulic fluid through a 200 mesh screened funnel and into the reservoir filler neck.

ATTENTION! Use only new, approved hydraulic fluid to fill the hydraulic fluid reservoir.

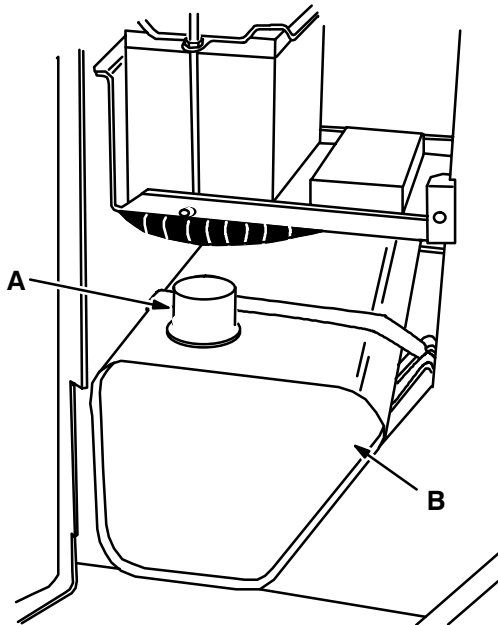
4. Check the hydraulic fluid level in the reservoir with the reservoir dipstick.
5. Add hydraulic fluid until the level in the reservoir is between the “add” and the “full” range. Do not overfill.

NOTE: Do not overfill the hydraulic fluid reservoir. As hydraulic fluid heats to its normal operating temperature, it expands. Always allow for this expansion when filling the hydraulic fluid reservoir.

6. Lubricate the reservoir breather filler cap with a film of hydraulic fluid.
7. Place the reservoir breather–filler cap securely on the reservoir.
8. Close the side door.
9. Start engine and operate all of the hydraulic components. Then recheck the hydraulic fluid level.

HYDRAULIC FLUID RESERVOIR BREATHER

The hydraulic fluid reservoir is equipped with a breather. The breather relieves excess pressure in the reservoir. The breather is mounted on the hydraulic fluid reservoir. The breather should be replaced after every 800 hours of operation.



RESERVOIR BREATHER-FILLER CAP

- A. Breather-Filler Cap**
- B. Hydraulic Reservoir**

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HYDRAULIC FLUID FILTER

The machine hydraulic system is kept clean to a level of 10 microns by a hydraulic fluid filter. The hydraulic fluid filter is located under the engine air filter.

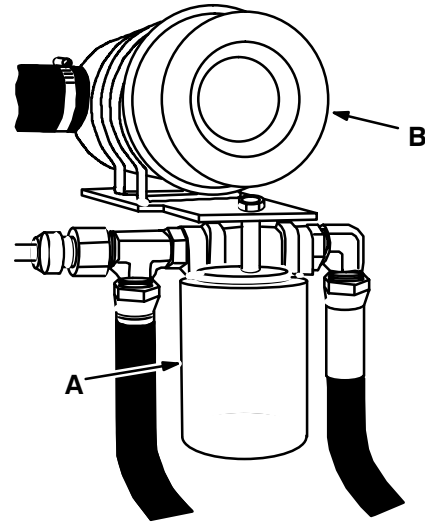
Replace the hydraulic fluid filter element after the first 50 hours of operation and then after every 400 hours of operation.

TO REPLACE HYDRAULIC FLUID FILTER ELEMENT

1. Stop the engine and engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

2. Open the engine hood.



HYDRAULIC FLUID FILTER

04748

- A. Hydraulic Fluid Filter Element**
- B. Air Filter**

3. Unthread and discard the hydraulic fluid filter element.

NOTE: Be aware the hydraulic filter is below the top of the hydraulic fluid reservoir. Some hydraulic fluid will drain from the reservoir. Discard all hydraulic fluid drained from the system. Drained hydraulic fluid may contain foreign material harmful to the hydraulic system.

4. Apply a thin coat of hydraulic fluid to the seal of the new hydraulic fluid filter element.
5. Thread and hand tighten the new hydraulic fluid filter element on the filter head.
6. Operate the machine and check for leaks. Correct any leaks found.
7. Check the hydraulic fluid reservoir level and fill as required.
8. Close the engine hood.

MAINTENANCE

HYDRAULIC PUMPS

The machine propelling pump is a variable displacement hydraulic piston pump. It is driven by the engine via a splined coupling.

The machine accessories pump is a hydraulic gear pump. It is tandem mounted to the hydraulic piston pump.

After repairing or replacing a hydraulic pump, or when system contamination is likely, change the hydraulic fluid in the reservoir and the hydraulic fluid filter. Then the proper start and break-in procedure must be followed to prevent possible damage to the pump. *TO START AND BREAK-IN HYDRAULIC PUMP* outlines the procedure.

TO START AND BREAK-IN HYDRAULIC PUMP

1. Engage the machine parking brake and block the front tire of the machine.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key. Block Machine Tires Before Jacking Machine Up.

2. Jack up the rear of the machine at the designated locations.

FOR SAFETY: When Servicing Machine, Jack Machine Up At Designated Locations Only. Block Machine Up With Jack Stands.

3. Block up the machine with jack stands in the designated locations. Make sure the rear tires clear the floor by 2 in (50 mm) and the floor is cleared of all obstacles within a 24 in (610 mm) radius.

FOR SAFETY: When Servicing Machine, Use Hoist Or Jack Of Adequate Capacity To Lift Machine.

4. Fill the hydraulic fluid reservoir with 10 gal (38 L) of new, approved hydraulic fluid.
5. Fill the hydraulic pump through the case drain port with hydraulic fluid.
6. Remove the engine coil wire from the engine distributor.
7. Operate the engine starter motor for three 10 second periods.

8. Replace the engine coil wire.
9. Start the engine and operate it at a low idle for two minutes.
10. Press the directional control pedal one-half of its travel in the "forward" direction while also operating the scrub brushes for one minute.
11. Stop the engine.
12. Raise the rear of the machine, remove the jack stands, and lower the machine.
13. Fill the hydraulic fluid reservoir with new, approved hydraulic fluid.
14. Check the hose routings to be sure the hoses do not contact any moving, hot, or sharp surfaces.
15. Replace the hydraulic fluid filter after the first hour of operation.

DIRECTIONAL PEDAL

The directional pedal controls the flow of hydraulic fluid to the hydraulic drive motors. The pedal has three positions – "forward," "neutral," and "reverse." The "forward" and "reverse" positions send hydraulic fluid to the drive motors to propel the machine.

The "neutral" position is the position in which the propelling pump sends no hydraulic fluid to the propelling motors. The machine should not creep when the "neutral" position is correctly adjusted. Adjust the control pedal linkages whenever the machine creeps or after replacing the hydraulic propelling pump or pump linkages.

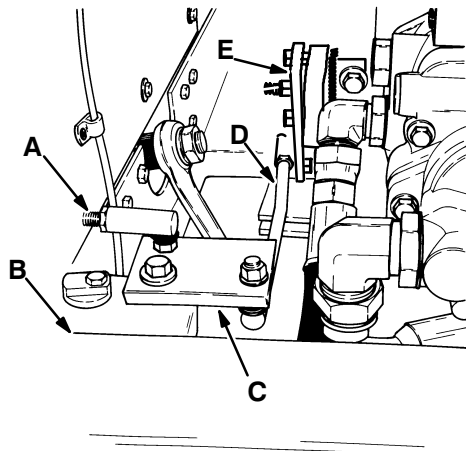
FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

TO ADJUST DIRECTIONAL CONTROL PEDAL LINKAGE

1. Stop the engine and engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

2. Hold the directional control pedal in the "reverse" position. Adjust the pedal rod between the pedal and the bell crank so there is 0.38 in (10 mm) between the bell crank and the side of the machine frame.



PUMP LINKAGE

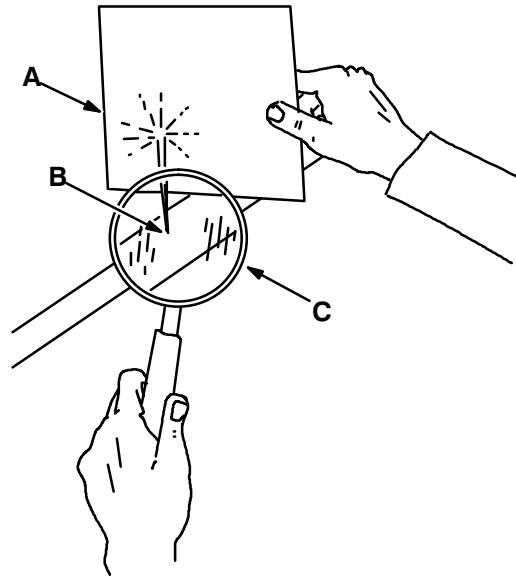
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- A. Pedal Rod**
- B. Machine Frame**
- C. Bell Crank**
- D. Pump Rod**
- E. Pintle Arm**

3. Adjust the pump rod and rod ball joints so the machine travels 4 mph (6.4 km/h) in "reverse." Make sure the adjustment also gives a full stroke in the forward speed.
4. Adjust the pump pintle arm centering springs so the machine will not creep when the pedal is in the "neutral" position.

HYDRAULIC FLUID LEAKS

Fluid escaping from a very small hole can be almost invisible. Use a piece of cardboard or wood, rather than hands, to search for suspected leaks.



HYDRAULIC PINHOLE LEAK

00002

- A. Cardboard**
- B. Pinhole Leak**
- C. Magnifying Glass**

If injured by escaping hydraulic fluid, see a doctor at once. Serious infection or reaction can develop if proper medical treatment is not administered immediately.

FOR SAFETY: When Servicing Machine, Use Cardboard To Locate Leaking Hydraulic Fluid Under Pressure.

MAINTENANCE

HYDRAULIC SYSTEM TROUBLESHOOTING

SYMPTOM	CAUSE	REMEDY
Side brush won't turn, or turns slowly. Everything else works fine.	Bad coil at "SV4".	Replace coil.
	Cartridge stuck open at "SV4".	Clean or replace cartridge.
	Bad seal at "SV4".	Replace seal.
	Bad motor.	Service or replace motor.
	Bad rocker switch S7.	Replace switch.
	Bad rocker switch S8.	Replace switch.
	Bad relay M3.	Replace relay.
	Bad electrical connections.	Remake connection.
Vacuum fan won't turn, or turns too slowly. Everything else works fine.	Bad coil at "SV5".	Replace coil.
	Cartridge stuck open at "SV5".	Clean or replace cartridge.
	Bad seal at "SV5".	Replace seal.
	Bad motor.	Service or replace motor.
	Bad rocker switch S8.	Replace switch.
	Bad electrical connection at rocker switch or solenoid valve.	Remake connection.
Side brush and vacuum fan won't turn or turns slowly.	Relief valve is stuck open.	Clean or replace relief valve.
	Bad accessory pump.	Service or replace pump.
Side brush won't retract in reverse.	Bad coil at "SV6".	Replace coil.
	Cartridge valve spool stuck closed at "SV6".	Clean or replace cartridge.
	Bad relay M3.	Replace relay.
	Bad electrical connection at relay or solenoid valve.	Remake connection.
	Flow switch not working properly.	Service or replace flow switch.
Side brush stays retracted.	Cartridge valve spool stuck open at "SV6".	Clean or replace cartridge.
	Bad relay M3.	Replace relay.
	Flow switch stuck closed.	Service or replace flow switch.
Side brush won't go down.	Bad coil at "SV7".	Replace coil.
	Cartridge valve spool stuck closed at "SV7".	Clean or replace cartridge.
	Fixed pressure reducing valve stuck open.	Clean or replace cartridge.
	Adjustable pressure reducing valve stuck closed.	Clean or replace cartridge.
	Bad rocker switch S-7 or S-8.	Replace rocker switch.
	Bad electrical connection at rocker switch or solenoid valve.	Remake connection.
Side brush stays down, won't come up.	Cartridge valve spool is stuck in shifted position at "SV7".	Clean or replace cartridge.
	Bad rocker switch at S7.	Replace switch.

SYMPTOM	CAUSE	REMEDY
Too much down force on side brush.	Pressure setting of adjustable pressure reducing valve is too high.	Turn adjustment knob counter-clockwise and lock in place with lock knob.
	Fixed pressure reducing valve malfunctioning, spool stuck in relieving mode.	Replace cartridge.
	Adjustable pressure reducing valve malfunctioning, spool stuck in spring held position.	Replace cartridge.
Not enough down force on side brush.	Pressure setting of adjustable pressure reducing valve is too low.	Turn adjustment knob clockwise and lock in place with lock knob.
	Fixed pressure reducing valve malfunctioning.	Replace cartridge.
	Adjustable pressure reducing valve malfunctioning.	Replace cartridge.
Main brush motors won't turn either direction.	Bad coil at "SV1".	Replace coil.
	Cartridge stuck open at "SV1".	Clean or replace cartridge.
	Relief valve stuck open.	Clean or replace relief valve.
	Bad seal on SV1.	Replace seal.
	Bad electrical connection at rocker switch or solenoid valve.	Remake connection.
	Bad rocker switch at S8 or S9.	Replace switch.
	Circuit breaker CB4 tripped.	Reset circuit breaker CB4. Look for short circuit.
Main brush motors won't turn in clean mode.	*Bad coil at "SV9".	Replace coil.
	*Valve spool stuck at 4-way, 3-position valve.	Manually shift valve with manual override to free binding spool. Clean or replace if necessary.
	Bad rocker switch S9.	Replace switch.
	*Blown diode assembly at 45A/BRN wire.	Replace diode assembly.
Main brush motors won't turn in soak mode.	*Bad coil at "SV8".	Replace coil.
	*Valve spool stuck at 4-way, 3-position valve.	Manually shift valve with manual overrides to free binding spool, clean or replace if necessary.
	Bad rocker switch S9.	Replace switch.
	*Blown diode assembly at 43A/GRN wire.	Replace diode assembly.

* Applies to machines below serial number 030366.

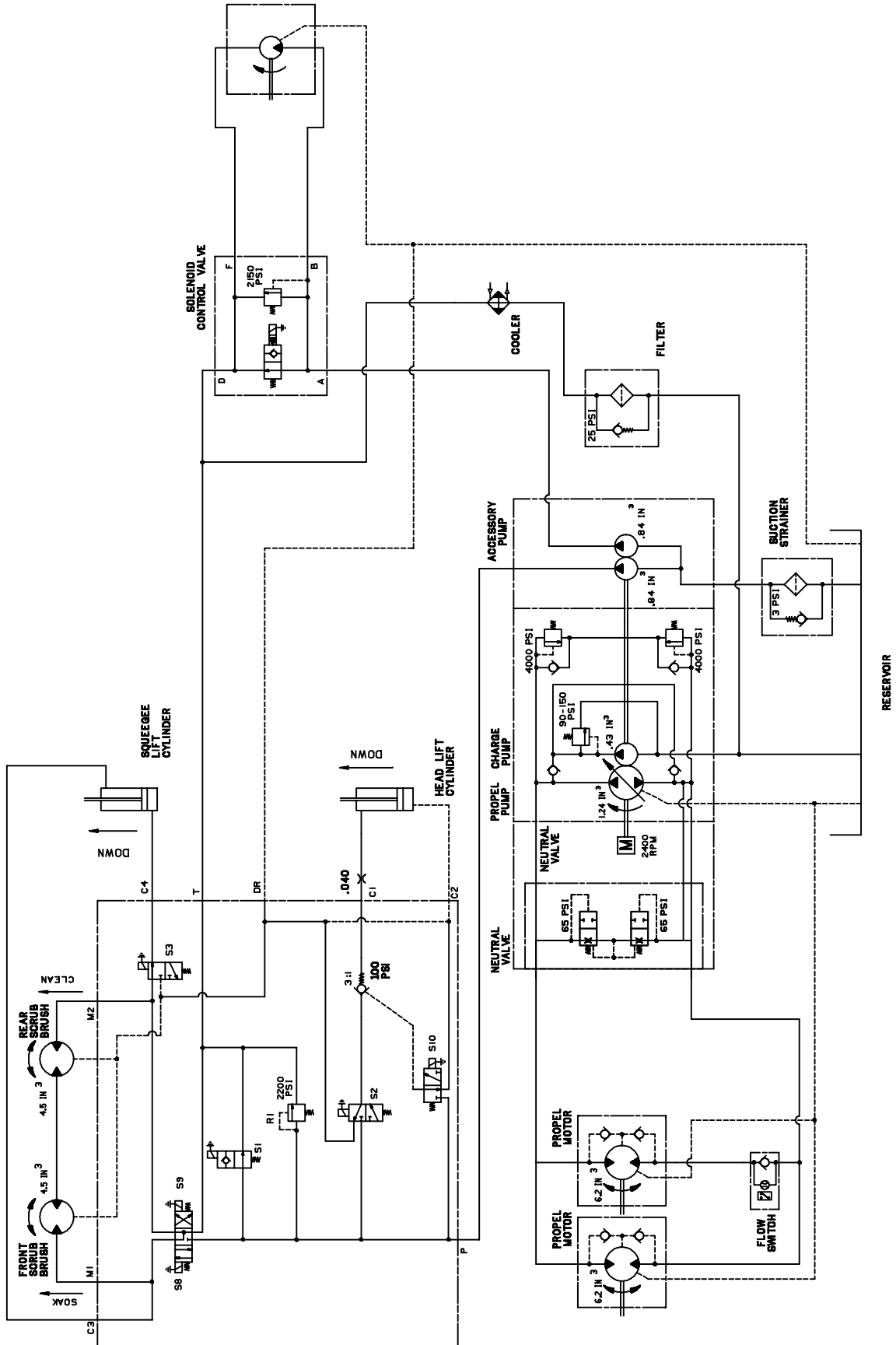
MAINTENANCE

SYMPTOM	CAUSE	REMEDY
Squeegee won't go up.	Bad coil at "SV3".	Replace coil.
	Cartridge valve spool stuck at "SV3".	Clean or replace cartridge.
	Bad electrical connection at SV3.	Remake connection.
	Bad relay M3.	Replace relay M3.
	Circuit breaker CB3 tripped.	Reset circuit breaker CB-3. Look for short circuit.
	Flow switch S6 not working properly.	Service or replace flow switch.
Scrub head won't go down.	Bad coil at "SV10".	Replace coil.
	Cartridge valve spool stuck at "SV10".	Clean or replace cartridge.
	Cartridge valve spool stuck in shifted position at "SV2".	Clean or replace cartridge.
	Bad rocker switch S8.	Replace switch.
	Bad electrical connection at rocker switch or solenoid valve SV10.	Remake Connection
Scrub head won't go up.	Bad coil at "SV2".	Replace coil.
	Cartridge valve spool stuck at "SV2".	Clean or replace cartridge.
	Check valve stuck.	Clean or replace check valve.
	Relief valve stuck open.	Clean or replace relief valve.
	Bad rocker switch S-8.	Replace switch.
	Bad coil at SV1.	Replace coil.
	Cartridge valve spool stuck at SV1.	Clean or replace cartridge.
	Blown diode assembly at 44/BLU.	Replace diode assembly.
Bad electrical connection.	Remake connection.	
Scrub head lowers slowly with machine turned off.	Pilot check valve seat damaged, allowing leakage.	Replace pilot check valve.
Main brush motors turn too slowly.	Bad seal at "SV1".	Replace seal.
	Bad seal at "SV2".	Replace seal.
	Bad seal at "SV10".	Replace seal.
	Bad seal at "SV3".	Replace seal.
	*Spool not shifting fully on 4-way, 3 position directional valve.	Manually shift valve with manual overrides to free binding spool. Clean or replace if necessary.
	Relief valve stuck partially open.	Clean or replace cartridge.
	Cartridge at "SV1" stuck partially open when shifted.	Clean or replace cartridge.
	Pump flow is low.	Service or replace gear pump.
	Bad motors.	Service or replace motors.

* Applies to machines below serial number 030366.

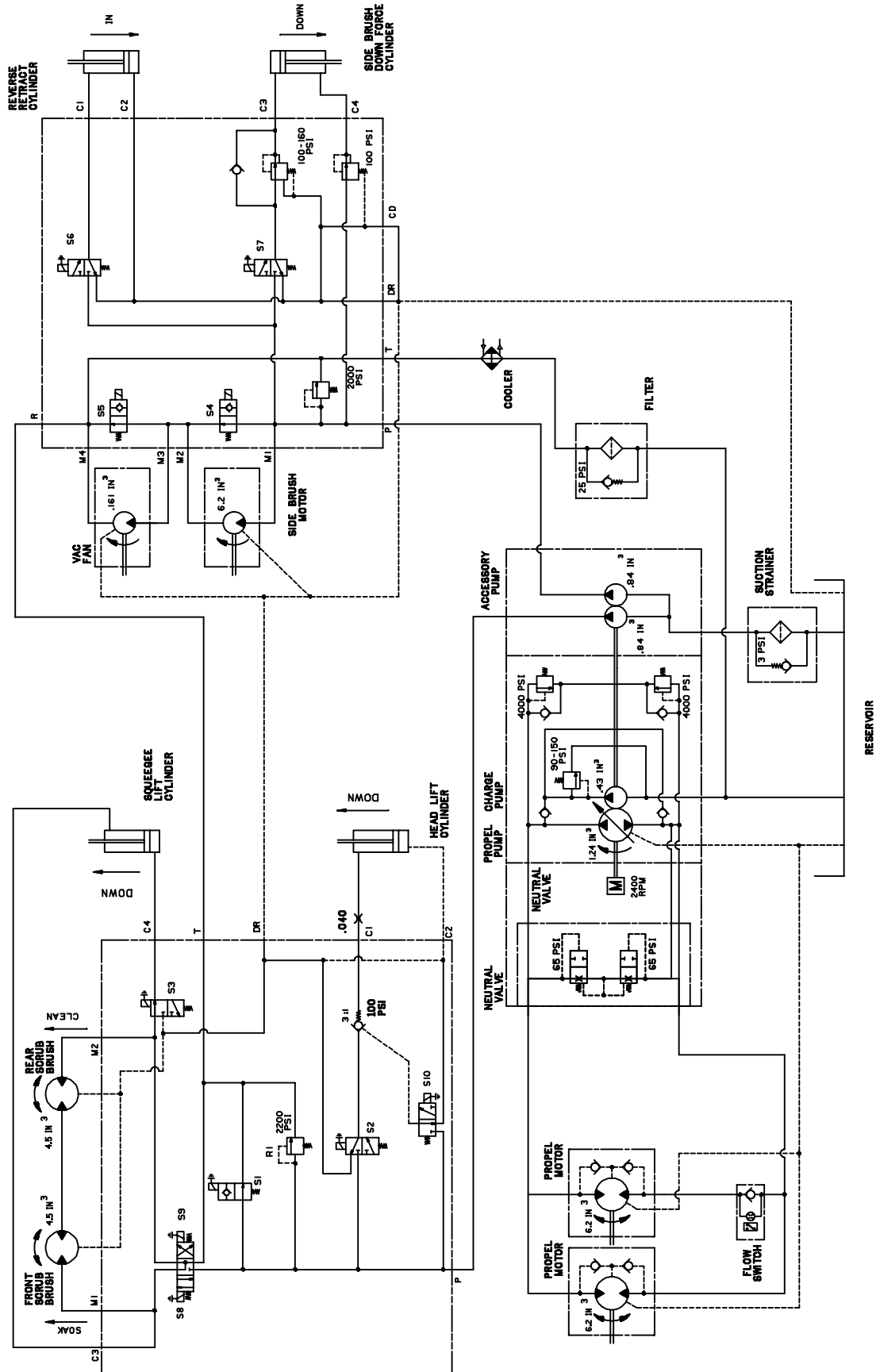
HYDRAULIC COMPONENTS TROUBLESHOOTING

Problem	Cause	Remedy
Hydraulic cylinder failure.	Piston seals leaking.	Replace cylinder.
	Barrel worn or rod bent.	Replace cylinder.
Hydraulic control valve failure.	Valve seals leaking.	Install seal kit.
	Check valve sticking.	Replace check valve.
	Relief valve stuck open (leaking).	Clean or replace relief valve.
Hydraulic solenoid valve failure.	Valve seals leaking.	Install seal kit.
	Solenoid coil failure.	Replace solenoid coil or valve.
	Solenoid spool sticking.	Replace valve.
	Flow sensing switch failure.	Repair or replace flow sensing switch.
Hydraulic motor failure.	Motor leaking.	Install seal kit.
	Drive link failure.	Replace drive link.
	Gerotor worn.	Replace gerotor set.
	Output shaft failure.	Replace output shaft and bearings.
Hydraulic gear pump failure.	Pump leaking.	Install seal kit.
	Gear set failure.	Replace gear set.
	Relief valve stuck.	Replace back plate assembly.
	Engine-to-pump coupling failure.	Replace coupling.
Hydraulic piston pump.	Pump leaking.	Install seal kit.
	Relief valve stuck.	Clean or replace relief valve.
	Integral charge pump failure.	Replace charge pump.
	Rotating group worn.	Replace rotating group.
	Shaft failure.	Replace shaft.
	Backplate worn.	Replace backplate.
	Engine-to-pump coupling failure.	Replace coupling.



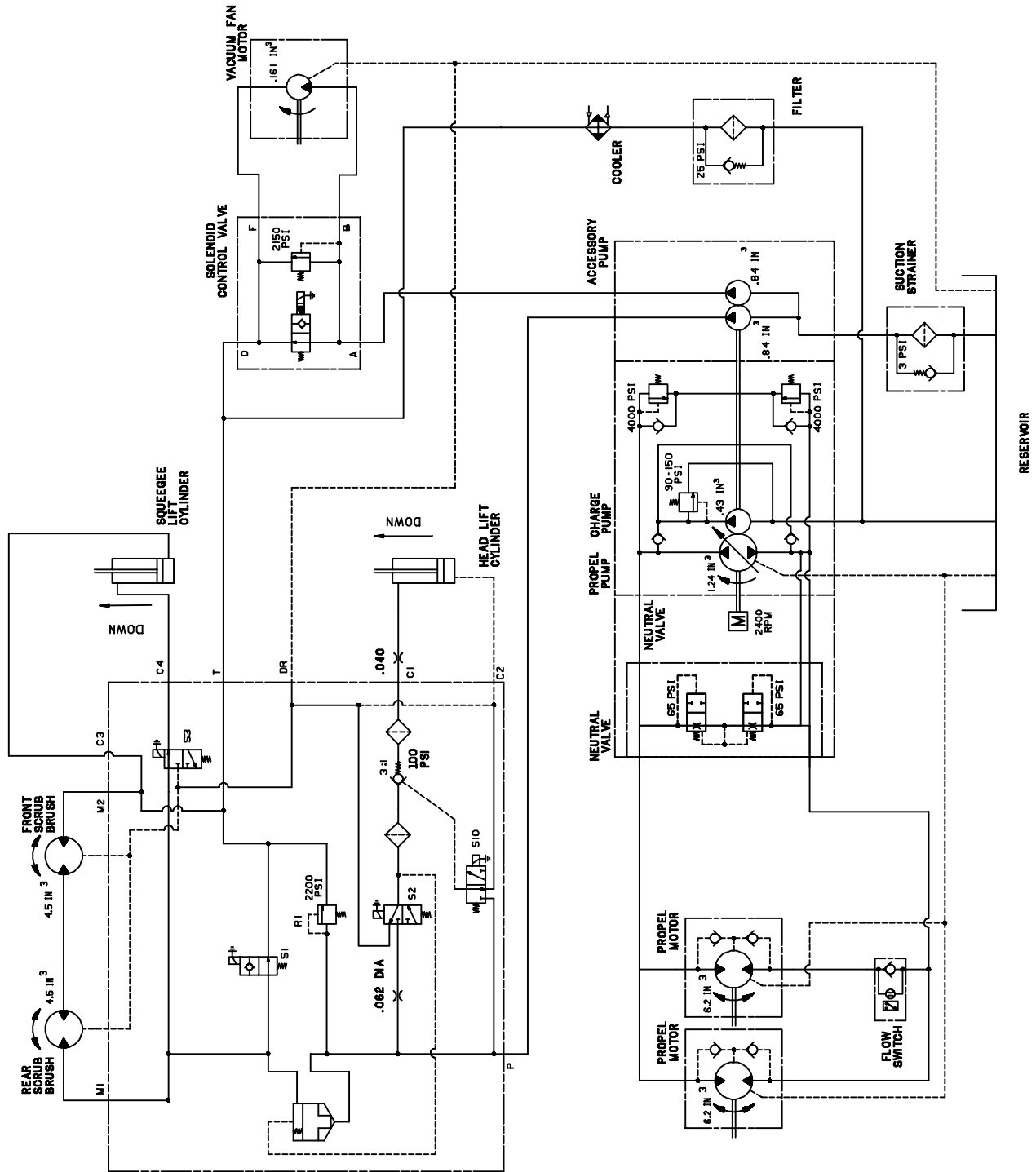
HYDRAULIC SCHEMATIC
 (For machines below serial number 030366)

04754



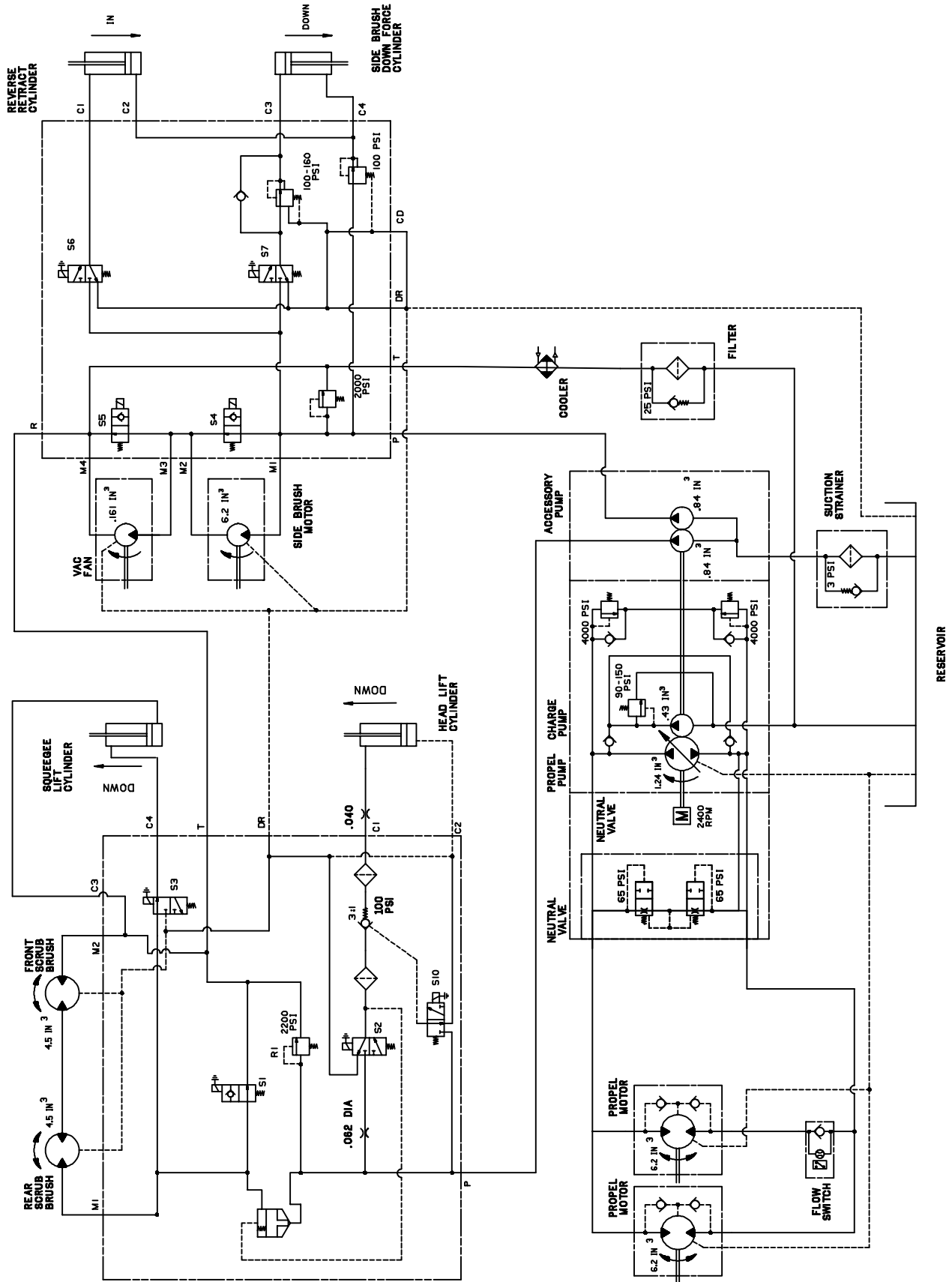
HYDRAULIC SCHEMATIC, WITH SIDE BRUSH OPTION
 (For machines below serial number 030366)

04753



HYDRAULIC SCHEMATIC
 (For machines serial number 030366 and above)

04754



HYDRAULIC SCHEMATIC, WITH SIDE BRUSH OPTION
 (For machines serial number 030366 and above)

04753

ENGINE

ENGINE LUBRICATION

Check the engine oil level daily.

GASOLINE AND LPG POWERED ENGINES

Gasoline and LPG powered engines should be lubricated with SAE-SG/SH rated engine oil. Change the engine oil and oil filter after every 100 hours of operation.

The following oil grades are recommended for engines operating in the ambient temperatures listed.

MULTI-VISCOSITY OILS

Below 32°F (Below 0°C) 5W 30	-10° to 90°F (-23° to 32°C) 10W 30	-10° to above 90°F (-23 to above 32°C) 10W 40	Above 10°F (Above -12°C) 20W 40
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SINGLE VISCOSITY OILS

-10° to 32°F (-23° to 0°C) 10W	10° to 60°F (-12° to 16°C) 20W 20	32° to 90°F (0° to 32°C) 30	Above 60°F (Above 16°C) 40
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The engine oil capacity is 3.5 qt (3.3 L) including the oil filter.

DIESEL POWERED ENGINES

Diesel powered engines should be lubricated with SAE-CC/CD rated engine oil. Change the engine oil and oil filter after every 50 hours of operation.

The following oil grades are recommended for engines operating in the ambient temperatures listed.

SINGLE AND MULTI-VISCOSITY OILS

Below 32°F (Below 0°C) 10W 10W 30	32° to 77° F (0° to 25° C) 20	Above 77° F (Above 25° C) 30
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The engine oil capacity is 7 qt (6.7 L) including the oil filter.

COOLING SYSTEM

Maintaining cooling system efficiency is important. Engine temperatures must be brought up to and maintained within the satisfactory range for efficient operation. However, the engine must be kept from overheating in order to prevent damage to the valves, pistons, and bearings. Check the radiator coolant level after every 100 hours of operation.

Use soft, clean water mixed with permanent-type, ethylene glycol antifreeze in a one-to-one ratio to fill the cooling system. Deposits of sludge, scale, and rust prevent normal heat transfer. Flush the radiator and the cooling system after every 800 hours of operation, using a dependable cleaning compound. Follow the mixing procedure recommended by the compound manufacturer. This is important because of the difference in concentration and composition of the cleaning compounds. After cleaning, flush the system with clean water.

Whenever a cooling system is badly rust-clogged, as indicated by overflow loss or abnormally high operating temperatures, corrective cleaning by reverse flow flushing will most effectively remove the heavy deposits of sludge, rust, and scale. The reverse flow flushing should be performed immediately after draining the cleaning solution. Flush the radiator first, then the engine, to allow the engine to cool as much as possible.

Engine overheating may also be caused by dirty radiator fins. The exterior fins of the radiator can be cleaned with an air or water hose. Check the radiator core exterior daily for debris.

FOR SAFETY: When Servicing Machine, Wear Eye And Ear Protection When Using Pressurized Air Or Water.

Blow or rinse all dust, which may have collected on the radiator, in through the grill and radiator fins, opposite the direction of normal air flow. The grill and hydraulic cooler may be tilted back for easier cleaning. Use care not to bend the cooling fins when cleaning. Clean thoroughly to prevent caking dust. Clean the radiator and cooler only after the radiator has cooled to avoid cracking.

The engine is equipped with a 180° F (82° C) thermostat. Normal engine temperature is 200° F (93° C). Temperatures up to 220° F (104° C) are allowable. Temperatures over 220° F (104° C) indicate a problem exists.

NOTE: Overheating is always accompanied by loss of coolant water. If in doubt, check.

A pressure cap is used on the radiator to prevent overflow loss of water during normal operation. The spring-loaded valve in the cap closes the outlet to the overflow pipe of the radiator and thus seals the system. Pressure developing within the system raises the boiling point of the coolant and allows higher temperatures without overflow loss from boiling. The pressure valve opens at 15 psi (100 kPa), allowing steam and water to pass out the overflow pipe.

FOR SAFETY: When Servicing Machine, Avoid Contact With Hot Engine Coolant. Allow Engine To Cool.

ATTENTION! Never pour cold water or cold antifreeze into the radiator of an overheated engine. Allow the engine to cool and avoid the danger of cracking the cylinder head or block. Keep the engine running while adding water.

AIR INTAKE SYSTEM

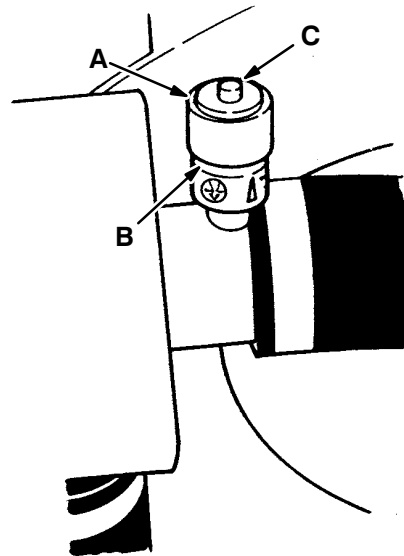
The importance of maintaining an air filter cannot be overemphasized. Dirt ingested through improperly installed, improperly serviced, or inadequate air filter elements wears out more engines than long hours of operation. Even a small amount of dirt will wear out a set of piston rings in just a few hours. Operating with a clogged air filter element also causes the fuel mixture to be richer, which can lead to formation of harmful sludge deposits in the engine. Always cover the air intake when the air filter is removed for servicing. Do not neglect servicing the air filter. Use only correct parts for replacement. Keep all other air intake components such as hoses and clamps secure and in good condition to prevent entrance of unfiltered air.

Overmaintenance can cause more damage than good. Removing the air filter element more often than is needed allows contaminants to enter the engine unnecessarily. Clean or replace the air filter element only when the restriction indicator indicates excessive restriction in the system.

AIR FILTER RESTRICTION INDICATOR

The air filter restriction indicator signals when to clean or replace the air filter element. Check the restriction indicator daily. The indicator's red line will move as the air filter element fills with dirt. Do not clean or replace the air filter element until the red line reaches 5 kPa and the "SERVICE WHEN RED" window is filled with red. The service indicator red line may return to a lower reading on the scale when the engine is shut off. The red line will return to a correct reading when the engine is started.

Clean or replace the filter element when the service indicator reads 5 kPa. After cleaning or servicing the air filter element, reset the service indicator by pushing the reset button on the end of the indicator.



AIR FILTER RESTRICTION INDICATOR

02172

- A. Restriction Indicator**
- B. Indicator Window**
- C. Indicator Reset Button**

AIR FILTER

The engine air filter housing includes a dust cap and a dry cartridge-type air filter element. The dust cap must be emptied of dirt daily. The air filter element must be cleaned and inspected or replaced whenever the yellow indicator of the air filter restriction indicator reads 20 in (500 mm). The filter element must be replaced if it is damaged or has been cleaned three times.

MAINTENANCE

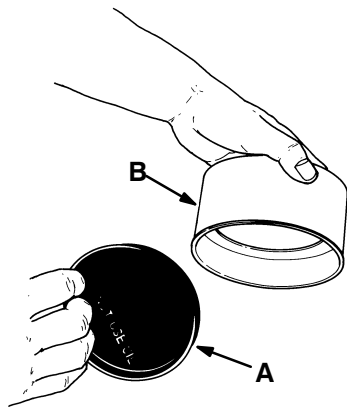
Service the air filter element only when the restriction indicator indicates excessive restriction in the system. Do not remove the air filter element unless it is restricting air flow.

TO REPLACE AIR FILTER ELEMENT

1. Stop the engine and engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

2. Open the engine hood.
3. Unscrew the clamp ring on the filter.
4. Remove the dust cap.
5. Empty the dust cap by removing the rubber insert.

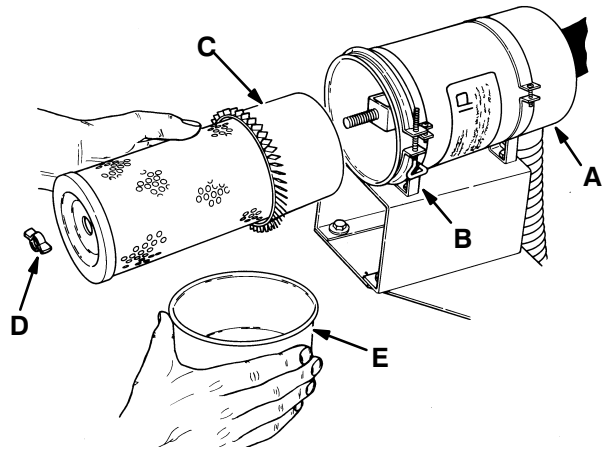


EMPTYING DUST CAP

02491

- A. Rubber Insert
- B. Dust Cap

6. Remove the filter wing nut.
7. Gently pull the filter element out of the filter housing.



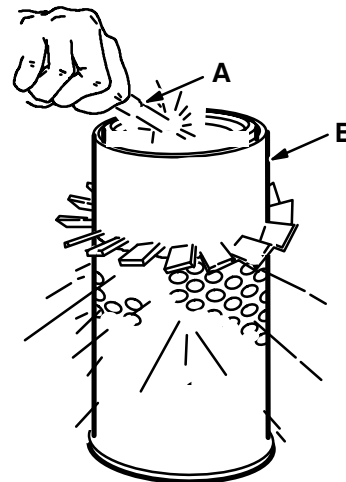
REMOVING AIR FILTER ELEMENT

00044

- A. Filter Housing
- B. Clamp Ring
- C. Filter Element
- D. Wing Nut
- E. Dust Cap

8. Clean the interior of the air cleaner housing with a damp cloth. Clean the element housing sealing surfaces.
9. Using an air hose, direct dry, clean air maximum 30 psi (205 kPa) up and down pleats on the inside of the filter. Do not rap, tap, or pound dust out of the element.

FOR SAFETY: When Servicing Machine, Wear Eye And Ear Protection When Using Pressurized Air Or Water.

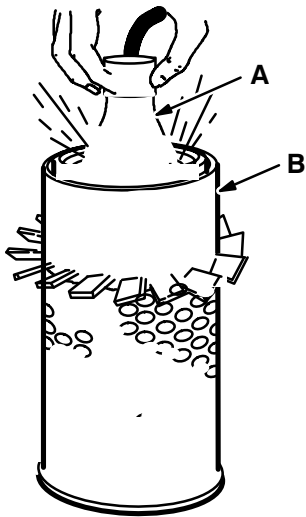


CLEANING AIR FILTER ELEMENT

00051

- A. Air Hose
- B. Filter Element

- After cleaning the air filter element, inspect it for damage by placing a bright light inside. The slightest rupture requires replacement of the filter. Clean and inspect the seals on the ends of the element. They should be unbroken and flexible. Remember, the element must be replaced after it has been cleaned three times.

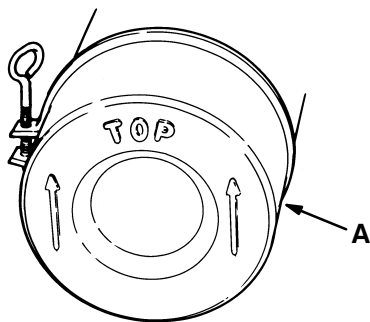


INSPECTING AIR FILTER ELEMENT

03500

- A. Bright Light**
- B. Filter Element**

- Install the new or cleaned filter element so that the fins on the element are at the intake end of the air cleaner. Use care so that the fins are not damaged. Make sure the element is seated evenly. Tighten the element wing nut.
- Install the dust cap with the arrows pointing up. Tighten the clamp ring to hold it in place. Check all intake hose connections for leaks or abrasion.



DUST CAP

02492

- A. Dust Cap**

- Reset the air filter restriction indicator.
- Close the engine hood.

FUEL SYSTEM – GASOLINE

FUEL FILTER

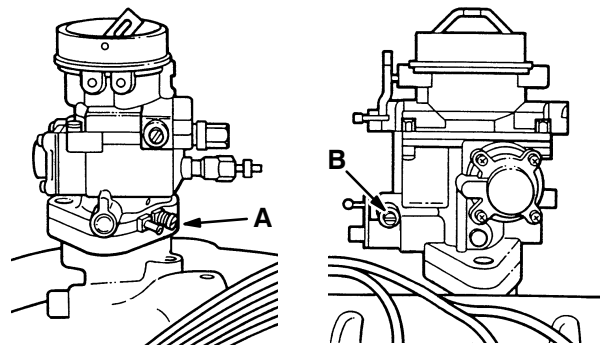
The fuel filters trap fuel impurities. One is located under the fuel tank, the other is located on the carburetor. Replace the filter elements after the first 50 hours of operation and then as required.

CARBURETOR

The carburetor has two basic adjustments. Those adjustments are idle fuel mixture and idle speed. Check and adjust idle fuel mixture and idle speed after every 400 hours of operation. The idle fuel mixture is controlled by a screw located on the front of the carburetor. Turning the screw clockwise, leans the fuel mixture. Turning the screw counterclockwise, richens the fuel mixture.

FOR SAFETY: When Servicing Machine, Avoid Moving Parts. Do Not Wear Loose Jackets, Shirts, Or Sleeves When Working On Machine.

The idle speed is controlled by a screw located on the side of the carburetor next to the throttle linkage. Turning the screw clockwise increases engine speed. Turning the screw counterclockwise, decreases engine speed. Proper idle speed is 950 ± 50 rpm with all options in the "off" position.



CARBURETOR ADJUSTING SCREWS

05509

- A. Idle Fuel Mixture Adjusting Screw**
- B. Idle Speed Adjusting Screw**

FOR SAFETY: When Servicing Machine, Keep Flames And Sparks Away From Fuel System Service Area. Keep Area Well Ventilated.

FUEL SYSTEM – LPG

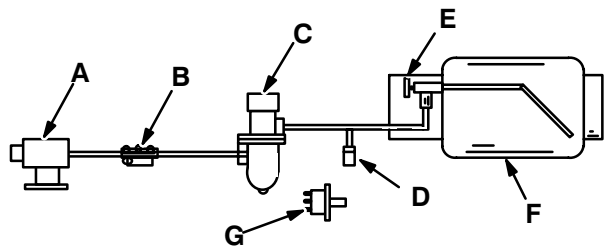
LPG FUEL SYSTEM

The liquid withdrawal LPG fuel system is made up of five components which are: the LPG fuel tank, pressure relief valve, fuel filter lock, vaporizer–regulator, and the carburetor.

Liquid LPG fuel flows from the LPG tank, under its own pressure, to the pressure relief valve. This valve is normally closed, preventing LPG fuel from escaping into the atmosphere. The valve opens to relieve pressure if the fuel pressure exceeds system limits. From the pressure relief valve, the liquid LPG fuel is piped to the fuel filter lock.

The fuel filter lock filters unwanted tank scale and deposits out of the LPG fuel. The fuel filter lock also stops the flow of LPG fuel when the engine is not operating. The oil pressure switch controls the fuel filter lock. When the engine oil pressure is 4 psi (30 kPa) or greater, the oil pressure switch permits an electrical current to open the fuel filter lock which allows LPG fuel to flow on to the vaporizer–regulator. The oil pressure switch is bypassed when the engine is being started, allowing LPG fuel to flow.

The vaporizer section of the vaporizer–regulator converts the liquid LPG fuel into a gaseous LPG fuel. From the vaporizer section, the gaseous LPG fuel is sent to the primary regulator section of the vaporizer–regulator. The primary regulator section reduces the pressure of the LPG fuel. From the primary regulator section, the gaseous LPG fuel is sent to the secondary regulator section. The secondary regulator section reduces the LPG fuel pressure to the level required by the carburetor. From the vaporizer–regulator, the LPG fuel is sent to the carburetor where it is finally metered into the air flow which is sent to the engine combustion chamber.



03511

LPG FUEL SYSTEM

- A. Carburetor**
- B. Vaporizer–Regulator**
- C. Fuel Filter Lock**
- D. Pressure Relief Valve**
- E. Tank Service Valve**
- F. LPG Fuel Tank**
- G. Oil Pressure Switch**

Never operate an LPG powered machine if the LPG fuel system is leaking, or if any component in the fuel system is malfunctioning. Operating the machine under either of these conditions may cause a fire or explosion.

Check for frosting. If frosting occurs on or near any LPG component, there is a possibility of an LPG fuel leak or a malfunctioning component. To locate the leak, apply a soapy water solution to the suspected area. Watch for bubbles forming in a confined area. This area may have an LPG fuel leak. Repair or replace the part. Use Loctite brand Stainless Steel PST thread sealant when reassembling. This epoxy–type sealant is not affected by aging or high humidity. Be sure to follow application directions and apply proper torque when reconnecting fittings. Never bypass safety components except to test. If they are defective, replace them before operating the machine.

Check routings of all LPG hoses. Keep them away from sharp edges, exhaust manifolds, or other hot surfaces. Check for signs of abrasion or deterioration. Replace hoses found to be worn or damaged.

FUEL TANKS

The LPG fuel tanks should be inspected for sharp dents, gouges, leaks, and broken protecting rings whenever the tanks are refilled. All tank valves must be inspected for leaks using a soap solution. Valves must also be checked for dirt, paint, or other debris in the valve openings. The following specific checks must also be made:

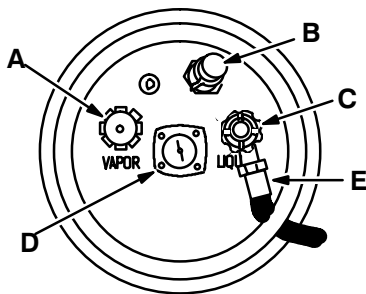
Filler Valve – Check for proper functioning and the presence of the handwheel. Valve must be closed except during filling.

Vapor and Liquid Service Valves – Check for proper functioning and presence of the handwheel. The valve must be closed except when in service.

Tank Service Valve Coupling – Check for proper functioning, thread condition, and damaged or missing washers or o-rings.

Safety Relief Valve – Check for damage. Check for the presence of the relief valve elbow and the proper direction of the elbow. If the rain cap is missing, check for foreign matter and replace cap. Do not tamper with the relief valve setting.

Magnetic Liquid Level Gauge – Check operation against the maximum filling point as determined by weight.



TYPICAL LPG LIQUID WITHDRAWAL FUEL TANK

03485

- A. Filler Valve**
- B. Safety Relief Valve**
- C. Liquid Service Valve**
- D. Magnetic Liquid Level Gauge**
- E. Tank Service Valve Coupling**

An LPG fuel tank with any of the stated defects must be removed from service and be repaired or destroyed accordingly.

If an LPG fuel tank is damaged or leaking, it should be removed to a designated safe area, and the proper personnel should be notified. Do not attempt to make repairs to the tank, regardless of condition. Repairs or disposal must only be made by qualified personnel.

The care an LPG fuel tank receives has a direct bearing on how long that tank can be used safely. LPG fuel tanks must not be dropped or dragged across any surface. To move LPG fuel tanks, use a hand truck or roll the tank on its foot ring while it is being held in a position slightly off vertical.

Whether the storage is inside or outside, fuel tanks should not be stored in the vicinity of combustible materials or high temperature sources such as ovens and furnaces, since the heat may raise the pressure of the fuel to a point where the safety relief valves would function. Care should be taken to insure that the tanks are stored in such a manner that if the safety relief valves do function, they will relieve vapor, rather than liquid.

Valves on empty tanks must be closed during storage and transportation.

Similar precautions should be taken in storing machines fitted with LPG fuel tanks. They may be stored or serviced inside buildings, provided there are no leaks in the fuel system and the tanks are not overfilled. While machines are being repaired inside a building, the shut-off valve on the tank must be closed, except when the engine must be operated.

The tank changing operation presents an opportunity for the machine operator to carefully observe the tank, fittings, and fuel lines. If abnormal wear is detected, the operator should report the findings to the appropriate personnel for action.

TO CHANGE AN LPG FUEL TANK

1. Park the machine in a designated safe area.

FOR SAFETY: When Servicing Machine, Keep Flames And Sparks Away From Fuel System Service Area. Keep Area Well Ventilated.

2. Close the tank service valve.

MAINTENANCE

3. Operate the engine until it stops from lack of fuel, then engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

4. Put on gloves and remove the quick–disconnect tank coupling.
5. Inspect the LPG fuel lines for wear or damage.
6. Disconnect the tank hold–down clamp and remove the empty LPG fuel tank from the machine.
7. Check the tank for damage or wear.
8. Store the tank in a designated safe area.
9. Select a filled LPG fuel tank and inspect it for damage or leaks.

NOTE: Make sure the LPG fuel tank matches the fuel system (liquid tank with liquid system).

10. Carefully place the LPG tank in the machine so that the tank centering pin enters the aligning hole in the tank collar.

NOTE: If the pin cannot be engaged, make sure you have the correct LPG fuel tank and then adjust the pin locator in or out.

11. Fasten the tank hold–down clamp to lock the tank in position.
12. Connect the LPG fuel line to the tank service coupling. Make sure the service coupling is clean and free of damage. Also make sure it matches the machine service coupling.
13. Open the tank service valve slowly and check for leaks. If an LPG leak is found, close the service valve immediately and notify the appropriate personnel.
14. If no leaks are found, the engine is ready to start.

FUEL FILTER LOCK

The fuel filter lock filters the LPG fuel. It also stops the flow of LPG fuel to the engine when the engine is not operating or when the engine oil pressure is less than 4 psi (30 kPa).

Replace the filter pack with the filter pack replacement kit if diminished gas flow indicates the filter is clogged. A drain plug is provided for purging the filter bowl. Clean out the bowl when replacing the filter pack.

VAPORIZER–REGULATOR

If any malfunction is noted, completely disassemble the vaporizer–regulator. Clean all of the parts in alcohol. Inspect all of the parts and replace where needed. Carefully reassemble the vaporizer–regulator with the seal repair kit. Check for proper operation.

CARBURETOR

If any malfunction is noted, completely disassemble the carburetor. Clean all of the parts in alcohol.

Inspect all of the parts and replace when needed. Carefully reassemble the carburetor with the seal repair kit.

FOR SAFETY: When Servicing Machine, Keep Flames And Sparks Away From Fuel System Service Area. Keep Area Well Ventilated.

OIL PRESSURE SWITCH

The engine oil pressure switch requires no regular maintenance. Never bypass the oil pressure switch as this is a safety feature which prevents LPG fuel from flowing when the engine is not operating properly.

LPG FUEL TROUBLESHOOTING

Problem	Cause	Remedy
Engine will not start	Out of fuel	Replace fuel tank with full one
	Service valve opened too quickly - engaging safety valve	Close valve and reopen slowly
	Plugged fuel filter	Replace filter
	Kinked or restricted fuel line	Straighten or replace fuel line
	Engine out of tune	Tune-up engine
	Oil pressure switch failure	Replace oil pressure switch
	Fuel lock valve failure	Repair or replace fuel filter lock
	Vaporizer-regulator failure	Repair or replace vaporize - regulator
Engine runs unevenly or lacks power	Wrong type of fuel tank - vapor withdrawal tank	Replace vapor withdrawal tank with liquid withdrawal tank
	Plugged fuel filter	Replace filter
	Kinked or restricted fuel line	Straighten or replace fuel line
	Engine out of tune	Tune-up engine
	Restricted air filter	Clean or replace air filter element
	Vaporizer - regulator maladjusted	Adjust vaporizer - regulator

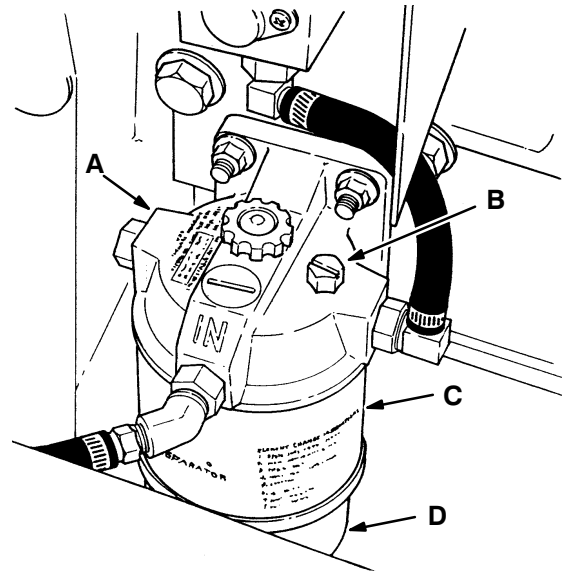
MAINTENANCE

FUEL SYSTEM – DIESEL

DIESEL FUEL SYSTEM

The diesel fuel system is made up of five basic components which are: fuel tank, fuel water trap filter, fuel pump, injection pump, and injectors.

Fuel flows from the fuel tank through the fuel water trap filter. The water trap filter separates water and impurities from the fuel. From the fuel water trap filter, fuel is drawn through the electric fuel pump and pumped to the injection pump. The injection pump pressurizes and sends fuel to the injectors. The injectors atomize and inject proper amounts of fuel into the combustion chamber at the proper times. Excess fuel is returned to the fuel tank through an overflow pipe.



02765

FUEL WATER TRAP FILTER

The fuel water trap filter separates water and impurities from the fuel. It is located next to the engine bellhousing. The bottom portion of the unit is the water trap. The middle portion is the filter element.

Drain the water trap of water daily. To drain the water trap, loosen the drain knob on the bottom of the unit. First water, then diesel fuel will drain. Tighten the drain knob when diesel fuel appears.

Replace the fuel filter element and clean the water trap after every 400 hours of operation.

TO REPLACE FUEL FILTER ELEMENT

1. Stop the engine and engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

2. Open the side and top engine access doors.
3. Loosen the vent plug and open the water trap drain to drain diesel fuel.

FOR SAFETY: When Servicing Machine, Keep Flames And Sparks Away From Fuel System Service Area. Keep Area Well Ventilated.

FUEL WATER TRAP FILTER

- A. Filter Head
- B. Vent Plug
- C. Filter Element
- D. Water Trap Bowl

4. Remove the filter element and the water trap from the filter head.
5. Remove the water trap bowl from the filter element.
6. Clean the water trap bowl.
7. Lubricate the o-ring and spin the water trap bowl onto the new filter element.
8. Lubricate the o-ring and spin the filter element and water trap onto the filter head and tighten the vent plug.
9. Bleed the fuel lines of air as described in *TO PRIME FUEL SYSTEM*.
10. Close the side and top engine access doors.

PRIMING FUEL SYSTEM

Priming the fuel system removes pockets of air in the fuel lines and fuel components. Air in the fuel system will prevent smooth engine operation.

Prime the fuel system after running out of fuel, changing fuel filter elements or repairing a fuel system component.

TO PRIME FUEL SYSTEM

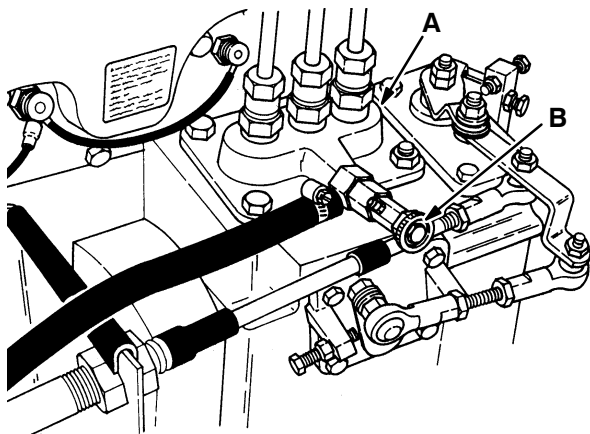
1. Stop the engine and engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

2. Fill the fuel tank.

FOR SAFETY: When Servicing Machine, Keep Flames And Sparks Away From Fuel System Service Area. Keep Area Well Ventilated.

3. Open the side and top engine access doors.
4. Open the air vent on top of the fuel injection pump.



02766

FUEL INJECTION PUMP

- A. Injection Pump**
- B. Air Vent**

5. Start the engine, operate it for one minute, then stop it; or operate the starter motor in ten-second intervals until a steady stream of fuel flows from the vent.
6. Close the air vent.
7. Close the access doors.

GOVERNOR – GASOLINE, LPG

The electronic governor controls engine speed. It consists of a control box located behind the battery, and an actuator mounted on the engine. The control box regulates the actuator, which in turn controls the throttle.

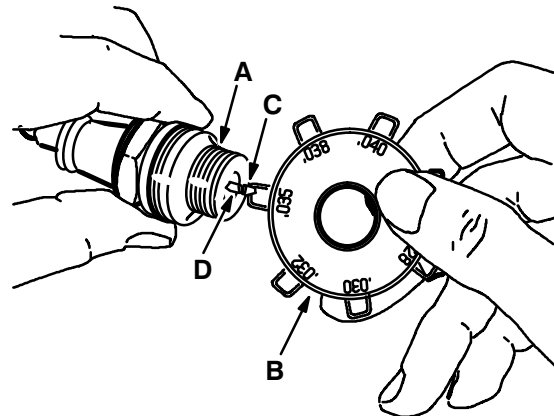
The electronic governor is factory set and is not user serviceable.

IGNITION SYSTEM – GASOLINE, LPG

SPARK PLUGS

Clean or replace and adjust spark plugs after every 400 hours of operation. Spark plug gaps are best checked with a wire gauge unless the plug is dressed to obtain a correct reading with a flat gauge. The adjustment should always be made on the side electrode and never on the center electrode, which may cause a broken porcelain.

“Gapping” the electrode tip is more easily done with the proper tools.



01471

GAPPING SPARK PLUG

- A. Spark Plug**
- B. Gapping Tool**
- C. Side Electrode**
- D. Center Electrode**

The proper spark plug gap is 0.035 in (0.9 mm) for machines below serial number 031000. The proper spark plug gap is 0.039 in (1 mm) for machines serial number 031000 and above.

MAINTENANCE

Spark plugs must be correctly installed in order to obtain good performance. It is a simple but important matter to follow these procedures when installing plugs:

1. Clean the spark plug seat in the cylinder head.
2. Use a new seat gasket and screw the plug in by hand.
3. Tighten the spark plugs to 22 to 28 ft lb (30 to 40 Nm) with a socket wrench of the correct size.

DISTRIBUTOR (For machines below serial number 031000)

The distributor operation is vital to the operation of the engine. The following items should be carefully inspected after every 400 hours of normal operation; however, dirt, dust, water, and high speed operation may cause more rapid wear and necessitate more frequent inspections:

1. Remove the distributor cap. Clean the cap and examine for cracks, carbon runners, or corroded terminals. If the vertical faces of the inserts are burned, install a new cap. If the horizontal faces of the inserts are burned, replace the cap and the rotor as this condition is caused by the rotor being too short. Inspect cap to distributor seal and the distributor housing breather.
2. Check the centrifugal advance mechanism for "freeness" by turning the breaker cam in the direction of rotation and then releasing it. The advance springs should return the cam to its original position.

ENGINE IGNITION TIMING (For machines below serial number 031000)

The engine ignition timing must be checked with a timing light, using the timing points located on the front of the engine and the timing marks located on the crankshaft pulley. Distributor ignition timing should be checked after the first 50 hours of operation and after every 400 hours of operation thereafter.

To check and adjust the ignition timing with a scope, refer to the scope manufacturer's instructions. To check and adjust the timing with a timing light, see *TO CHECK AND ADJUST IGNITION TIMING*.

TO CHECK AND ADJUST IGNITION TIMING
(For machines below serial number 031000)

NOTE: Dwell angle must be correct or timing will not be accurate.

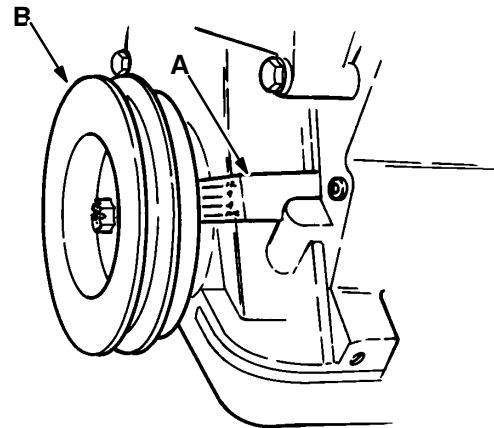
1. Stop the engine and engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

2. Clean and mark the timing marks.

NOTE: Painting a white line on the front pulley timing marks will make them more visible under the timing light.

3. Disconnect and plug the vacuum hose from the distributor.



00696

ENGINE TIMING MARKS

- A. Timing Pointer
- B. Crankshaft Pulley

4. Connect the timing light to the No. 1 cylinder spark plug wire. Connect a tachometer to the engine.

FOR SAFETY: When Servicing Machine, Avoid Moving Parts. Do Not Wear Loose Jackets, Shirts, Or Sleeves When Working On Machine.

5. Start the engine and reduce the idle speed to 600 rpm to be sure that the centrifugal advance is not operating. Adjust the initial ignition timing to 6° BTDC on gasoline engines, and 10° BTDC on LPG engines.

To advance the timing, turn the distributor body clockwise. To retard the timing, turn the distributor body counterclockwise.

6. Check the centrifugal advance for proper operation by starting the engine and accelerating it to approximately 2000 rpm. If the ignition timing advances, the centrifugal advance mechanism is functioning properly. Note the engine speed when the advance begins and the amount of total advance. Stop the engine.
7. Unplug the vacuum line and connect it to the distributor vacuum advance unit. Start the engine and accelerate it to approximately 2000 rpm. Note the engine speed when the advance begins and the total amount of advance. Advance of the ignition timing should begin sooner and advance farther than when checking the centrifugal advance alone. Stop the engine.
8. If the vacuum advance is not functioning properly, remove the distributor and check it on a distributor tester.
9. After adjusting timing, be sure to increase the engine idle speed to its normal setting.

ENGINE IGNITION TIMING (For machines serial number 031000 and above)

The ignition system does not require any mechanical external adjustments, however the spark plug high tension leads must be inserted correctly, if ever removed, at each numbered coil position to the corresponding spark plug number in the cylinder (front to rear #1, 2, 3, and 4).

The ESC module controls the timing position in the start mode at 10° BTDC until the rpm reaches 250 rpm, thereafter the sensors are processed and timing is set to be compatible with engine speed, crankshaft position, engine load, engine coolant temperature and overspeed by the module.

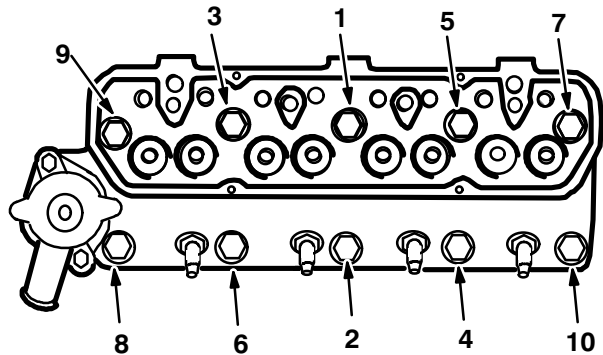
CYLINDER HEAD – GASOLINE, LPG

CYLINDER HEAD

A three-stage torque procedure should be used when reassembling the cylinder head. The cylinder head bolts must be tightened after the first 50 hours of operation, for machines below serial 031000, and seasonally thereafter for all gasoline and LPG machines.

Snug down cylinder head bolts in the proper sequence; first to 7 to 11 ft lb (10 to 15 Nm), then to 30 to 37 ft lb (40 to 50 Nm), then to 60 to 66 ft lb (80 to 90 Nm), and then after ten to fifteen minutes torque to 74 to 81 ft lb (100 to 110 Nm).

Tighten the intake manifold bolts to 15 to 18 ft lb (20 to 24 Nm) after every 800 hours of operation.



CYLINDER HEAD BOLT TIGHTENING SEQUENCE 03532

The cylinder head bolts must be retorqued after the engine is put into operation and brought up to proper operating temperatures. To retorque head bolts, follow the correct sequence. Loosen one head bolt at a time one-quarter turn, 90 degrees; then retorque it to the correct value.

NOTE: Power wrench torque limit must be held at least 10 ft lb (14 Nm) below hand torque specification; then hand torque to the specifications.

MAINTENANCE

VALVE TAPPET CLEARANCE

The valve tappet clearance must be checked and adjusted if necessary after every 400 hours of operation.

To set the valve clearance without the engine operating, rotate the crankshaft until No. 1 cylinder is at the top of the compression stroke. Check the timing marks. It should read 0 or TDC. Both valves on No. 1 cylinder are now closed. Set the valve clearance on both valves. Next, rotate the crankshaft 180°, and set the valve lash on both valves on No. 2 cylinder. Again rotate the crankshaft 180°, and set the valve lash on both valves on No. 4 cylinder. Rotate the crankshaft another 180°, and set the valve lash on both valves on No. 3 cylinder.

Check and adjust, for machines below serial number 031000, the intake valve clearance from 0.009 in (0.22 mm), and the exhaust valve clearance from 0.023 in (0.59 mm) while the engine is cold.

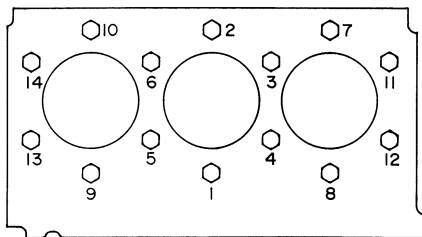
Check and adjust, for machines serial number 031000 and above, the intake valve clearance from 0.009 in (0.22 mm), and the exhaust valve clearance from 0.013 in (0.32 mm) while the engine is cold.

CYLINDER HEAD – DIESEL

CYLINDER HEAD

The cylinder head must be properly torqued after servicing to ensure proper operation. A three-stage torque procedure should be used. Snug down the cylinder head bolts and nuts in the proper sequence; first to one-third, then two-thirds, and then to the full torque specification of 55 to 60 ft lb (75 to 80 Nm). Retighten the bolts and nuts after the first 30 minutes of operating the engine.

NOTE: Power wrench torque limit must be held at least 10 ft lb (15 Nm) below torque specification. Hand tighten to specification.



CYLINDER HEAD BOLT TIGHTENING SEQUENCE

02767

VALVE CLEARANCE

The valve clearance must be properly adjusted after servicing or retorquing the cylinder head bolts to ensure proper operation. Measure valve clearance with a feeler gauge after aligning each cylinder on the compression top dead center stroke.

Adjust them with the engine cool to 0.0071 to 0.0087 in (0.18 to 0.22 mm) in the firing order 1–2–3.

CRANKCASE VENTILATION SYSTEM

Clean the crankcase ventilation hoses, tubes, and fittings and replace the PCV valve after every 400 hours of operation.

TUNE-UP CHART – GASOLINE, LPG

Idle speed, no load	950 ± 50 rpm
Maximum governed speed, under load	2400 ± 50 rpm
Spark plug gap (for machines below serial number 031000)	0.035 in (0.9 mm)
Spark plug gap (for machines serial number 031000 and above)	0.039 in (1 mm)
Timing (for machines below serial number 031000)	6° BTDC @ 600 rpm, gasoline
	10° BTDC @ 600 rpm, LPG
Firing order	1–2–4–3, counterclockwise rotation
Valve clearance, cold (for machines below serial number 031000)	0.009 in (0.22 mm) intake
	0.023 in (0.59 mm) exhaust
Valve clearance, cold (for machines serial number 031000 and above)	0.009 in (0.22 mm) intake
	0.013 in (0.32 mm) exhaust

ELECTRICAL SYSTEM

BATTERY

The battery used in the machine is a low maintenance battery. It has been constructed with special materials and has extra electrolyte to reduce or eliminate maintenance. Its design reduces electrolyte loss and contamination. Do not add water, remove the battery vent plugs, or check the battery specific gravity.

The battery is rated at 12 V, 475 ccA. It is located under the battery cover. When removing battery cables, remove the negative (-) cable before the positive (+) cable.

Do not allow the battery to remain in discharged condition for any length of time.

Do not operate the machine if the battery is in poor condition or with only 25% of the charge left.

Clean the top surface and the terminals of the battery periodically. Use a strong solution of baking soda and water. Brush the solution sparingly over the battery top, terminals, and cable clamps. Do not allow any baking soda solution to enter the battery. Use a wire brush to clean the terminal posts and the cable connectors. After cleaning, apply a coating of clear petroleum jelly to the terminals and the cable connectors. Keep the top of the battery clean and dry.

Keep all metallic objects off the top of the battery, as they may cause a short circuit. Replace worn or damaged wires.

The electrolyte level in regular non-sealed batteries can be checked. It must always be above the battery plates. Add distilled water to maintain solution at the correct level above the plates, but do not overfill. Never add acid to batteries, only distilled water. Keep vent plugs firmly in place at all times, except when adding water or taking hydrometer readings.

FOR SAFETY: When Servicing Machine, Avoid Contact With Battery Acid.

If when checking battery specific gravity, one or more battery cells tests lower than the other battery cells, (0.050 or more) the cell is damaged, shorted, or is about to fail.

NOTE: Do not take readings immediately after adding water—if the water and acid are not thoroughly mixed, the readings may not be accurate. Check the hydrometer readings against this chart:

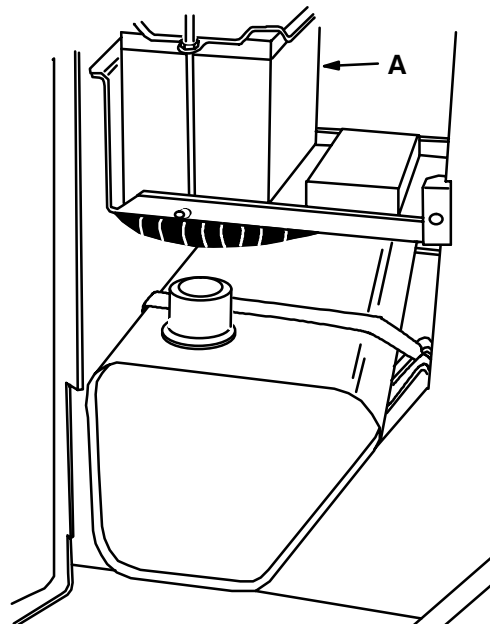
SPECIFIC GRAVITY at 80° F (27° C)	BATTERY CONDITION
1.260 – 1.280	100% charged
1.230 – 1.250	75% charged
1.200 – 1.220	50% charged
1.170 – 1.190	25% charged
1.110 – 1.160	Discharged

NOTE: If the readings are taken when the battery electrolyte is any temperature other than 80° F (26.6° C), the reading must be temperature corrected.

To determine the corrected specific gravity reading when the temperature of the battery electrolyte is other than 80° F (26.6° C):

Add to the specific gravity reading 0.004 (4 points) for each 10° F (5.5° C) above 80° F (26.6° C).

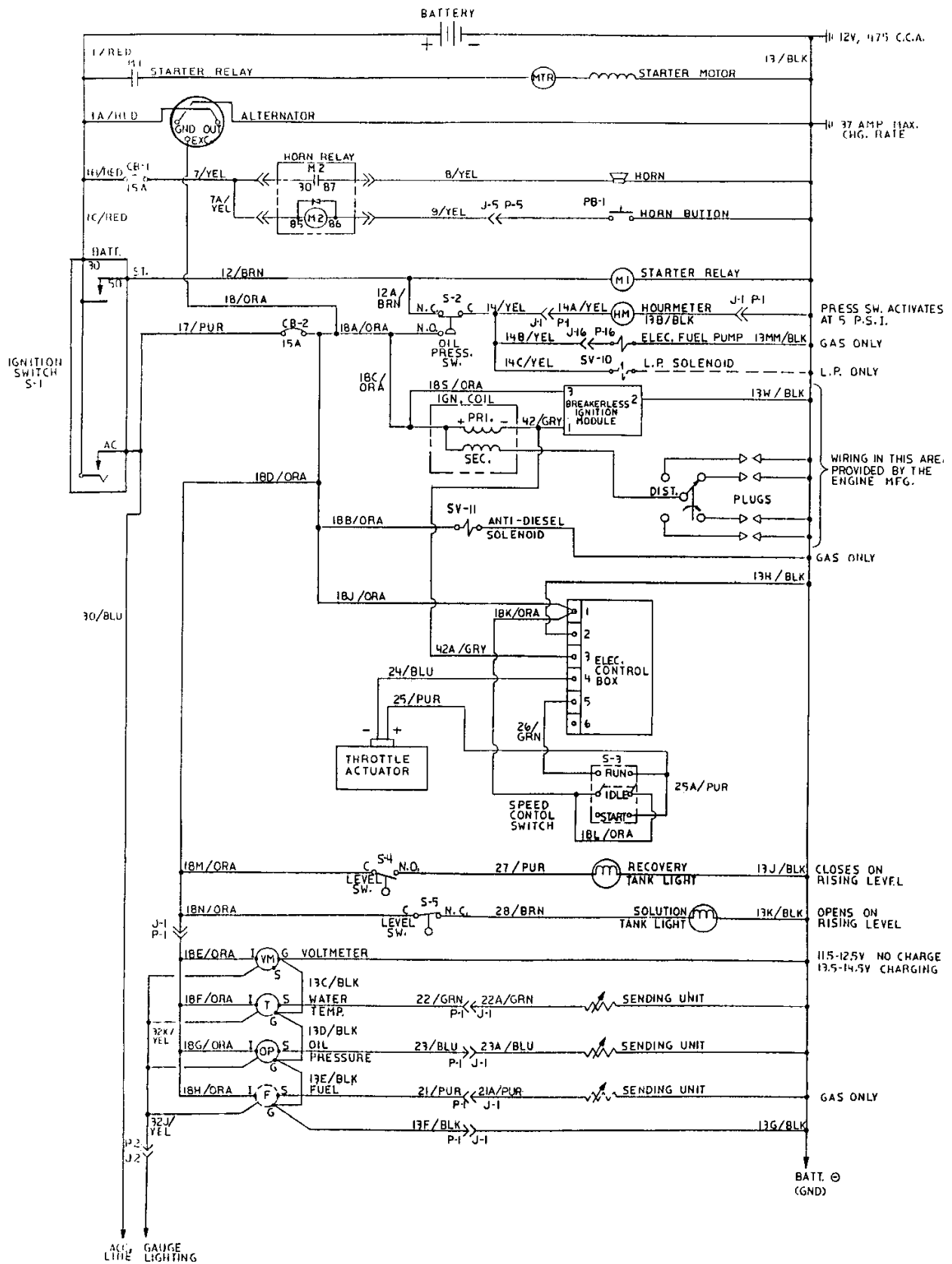
Subtract from the specific gravity reading 0.004 (4 points) for each 10° F (5.5° C) below 80° F (26.6° C).



BATTERY

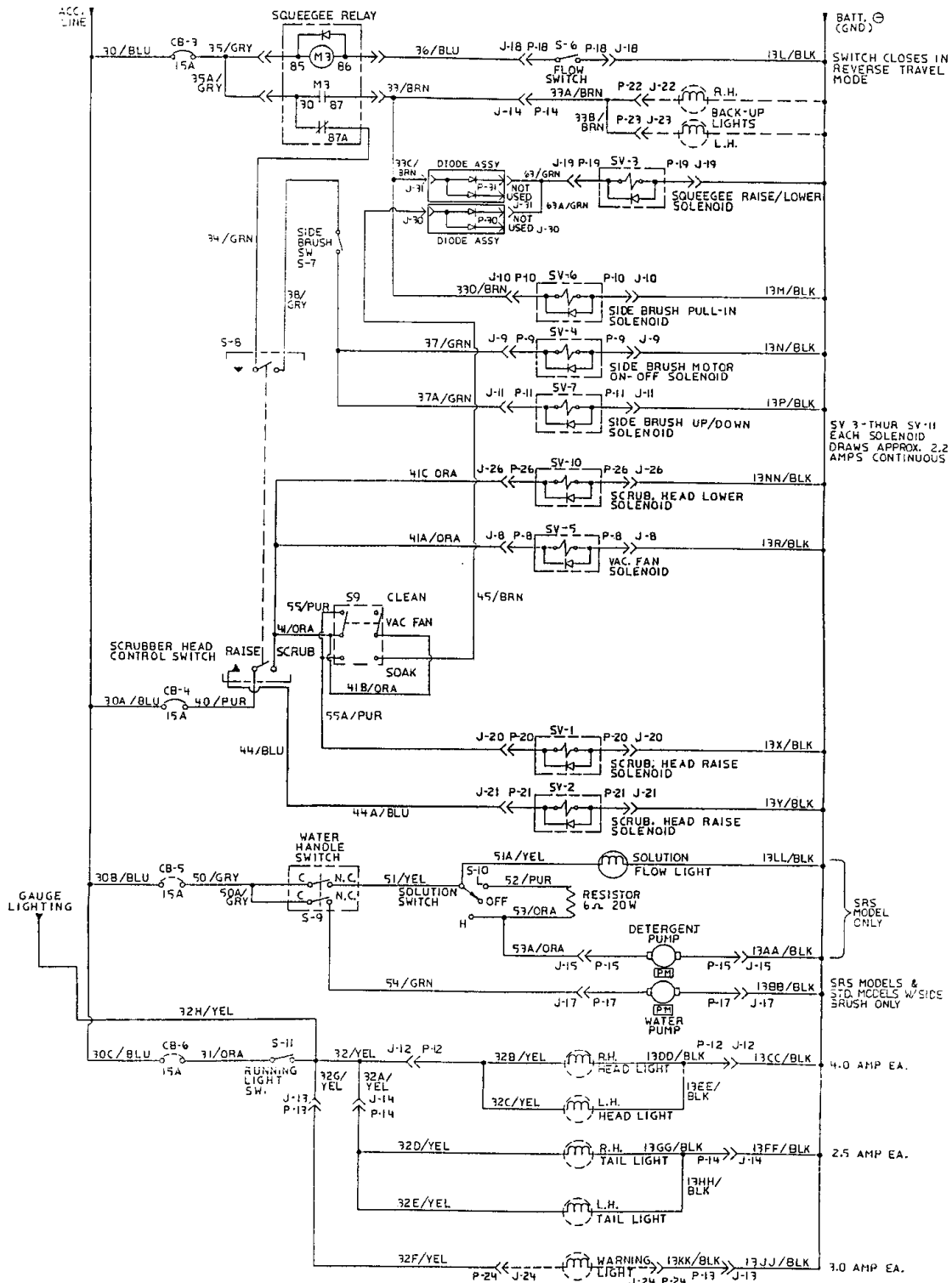
A. Battery

04747



ELECTRICAL SCHEMATIC, GASOLINE, LPG
(For machines below serial number 031000)

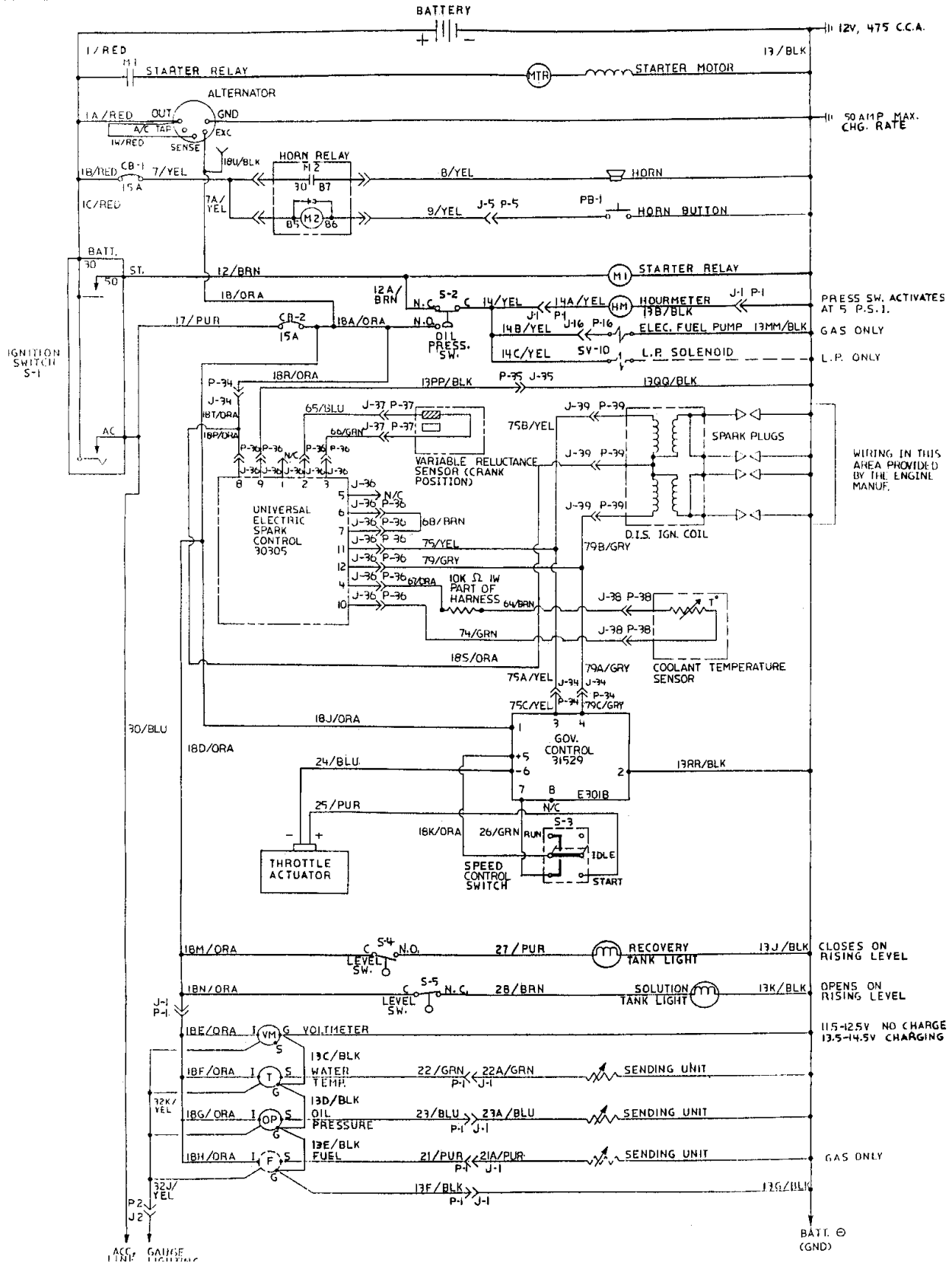
04756



LEGEND			
M	POWER RELAY	HM	HOURLY METER
HR	MOTOR	L	LOW
CB	CIRCUIT BREAKER	H	HIGH
PM	PERMANENT MAGNET	BATT	BATTERY
S	SWITCH	ST	START
PB	PUSHBUTTON	GND	GROUND
J	JACK	ACC	ACCESSORY
P	PLUG	IGN	IGNITION
C	COMMON	V	VOLTMETER
N.O.	NORMALLY OPEN	T	TEMPERATURE GAUGE
N.C.	NORMALLY CLOSED	OP	PRESSURE GAUGE
SV	SOLENOID VALVE	F	FUEL GAUGE

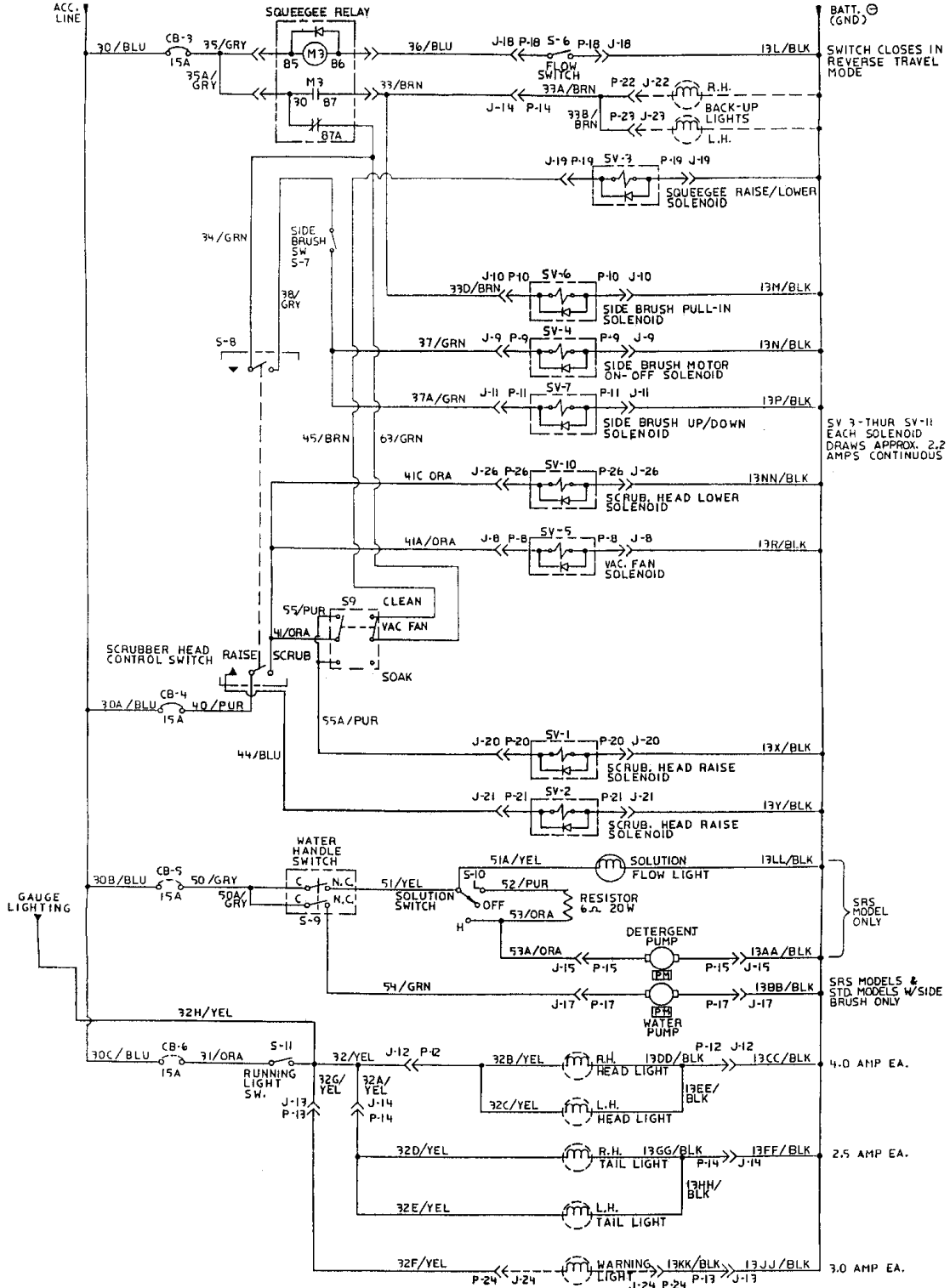
ELECTRICAL SCHEMATIC, GASOLINE, LPG
(For machines below serial number 031000)

04756



ELECTRICAL SCHEMATIC, GASOLINE, LPG
 (For machines serial number 031000 and above)

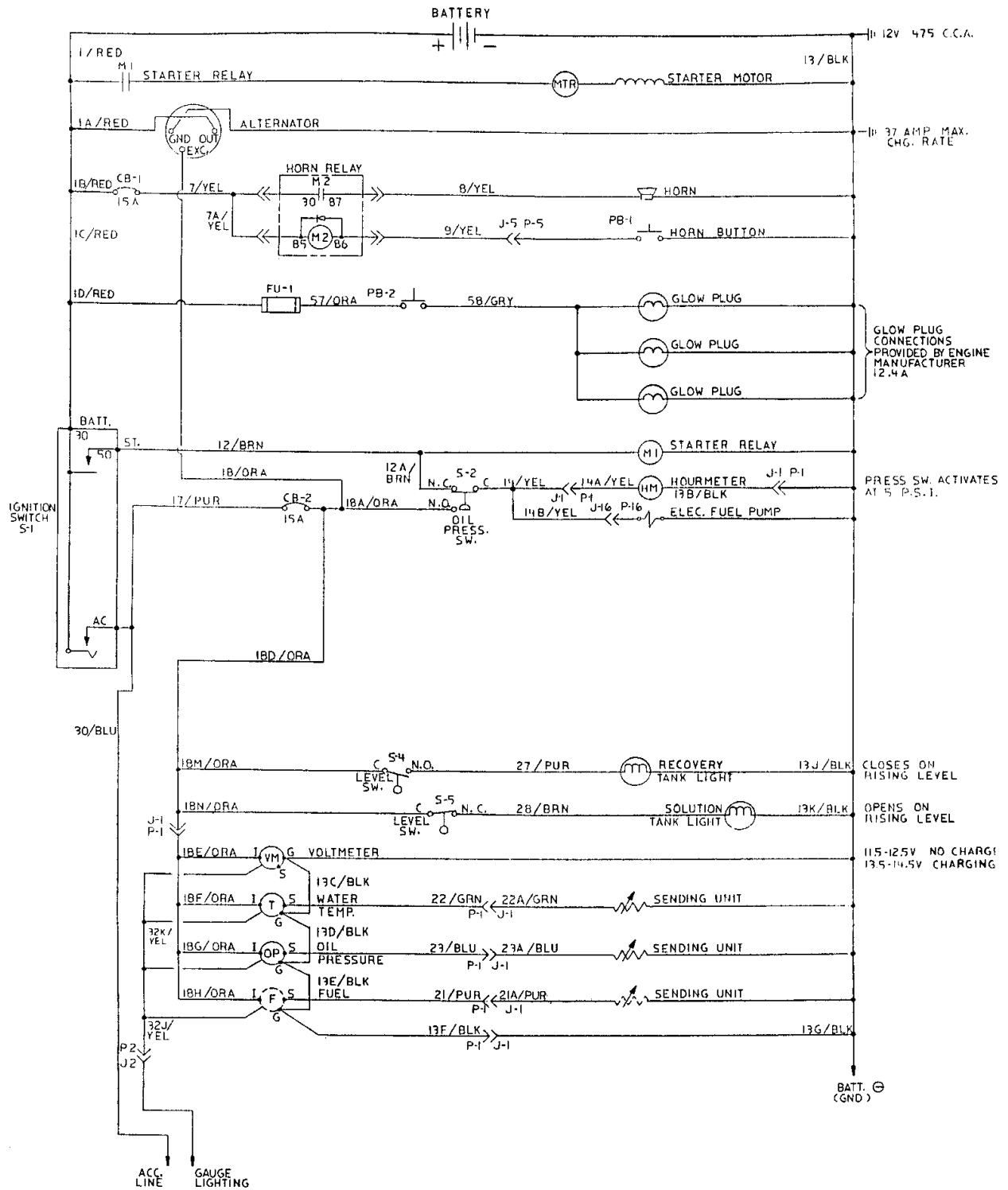
04756



LEGEND			
H	POWER RELAY	HM	HOURLMETER
HM	MOTOR	IL	LOW
CB	CIRCUIT BREAKER	IH	HIGH
PM	PERMANENT MAGNET	BATT	BATTERY
S	SWITCH	ST	START
PB	PUSHBUTTON	GND	GROUND
J	JACK	ACC	ACCESSORY
P	PLUG	IGN	IGNITION
C	COMMON	VM	VOLTMETER
N.O.	NORMALLY OPEN	TM	TEMPERATURE GAUGE
N.C.	NORMALLY CLOSED	OP	PRESSURE GAUGE
SV	SOLENOID VALVE	F	FUEL GAUGE

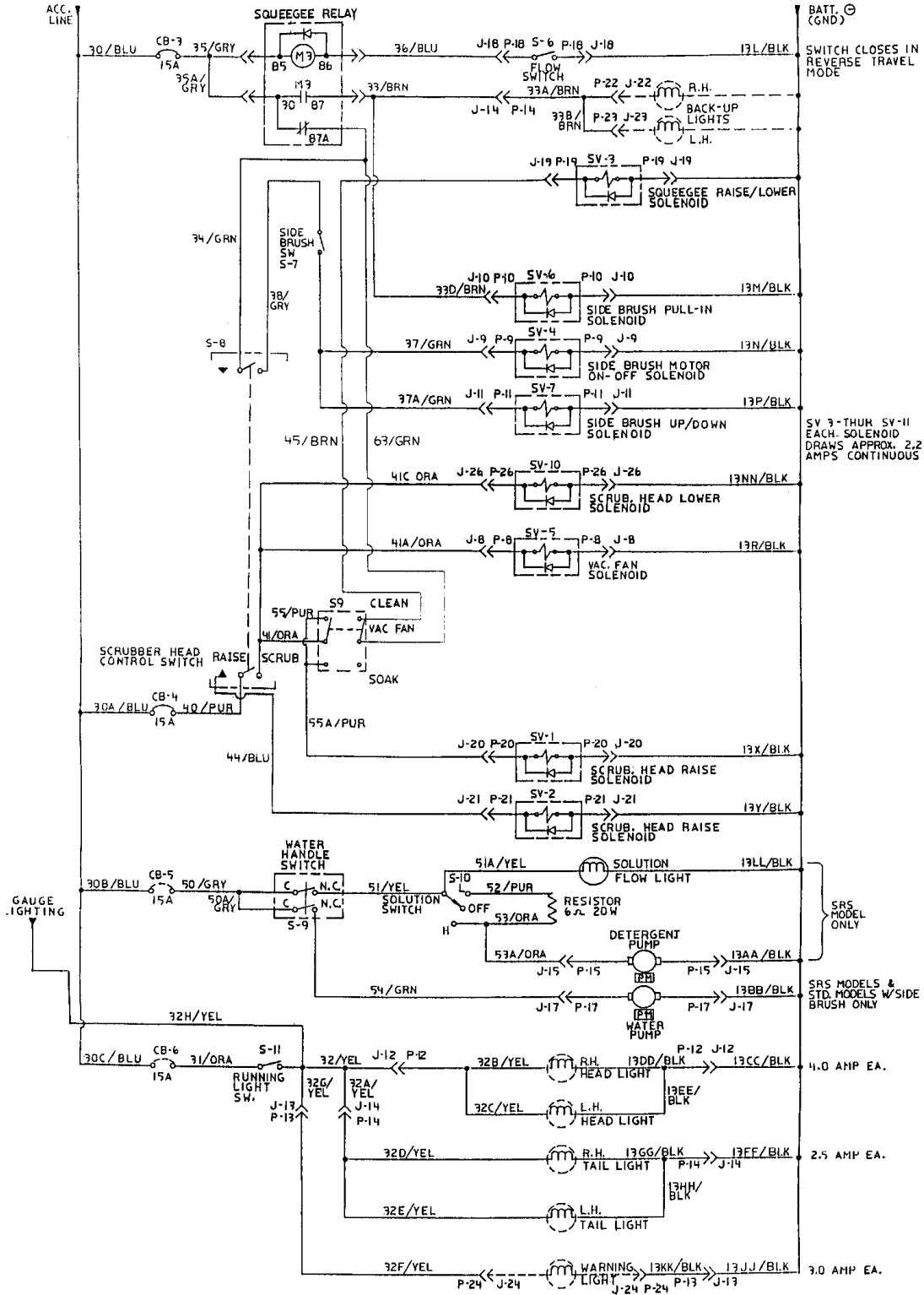
ELECTRICAL SCHEMATIC, GASOLINE, LPG
 (For machines serial number 031000 and above)

04756



ELECTRICAL SCHEMATIC, DIESEL

05173



LEGEND			
M	POWER RELAY	HM	HOURLY METER
MR	MOTOR	L	LOW
CB	CIRCUIT BREAKER	H	HIGH
PM	PERMANENT MAGNET	BATT	BATTERY
S	SWITCH	ST	START
PB	PUSHBUTTON	GND	GROUND
J	JACK	ACC	ACCESSORY
P	PLUG	IGN	IGNITION
C	COMMON	VM	VOLTMETER
N.O.	NORMALLY OPEN	T	TEMPERATURE GAUGE
N.C.	NORMALLY CLOSED	OP	PRESSURE GAUGE
SV	SOLENOID VALVE	F	FUEL GAUGE

ELECTRICAL SCHEMATIC, DIESEL

05173

BELTS AND CHAINS

ENGINE FAN BELT

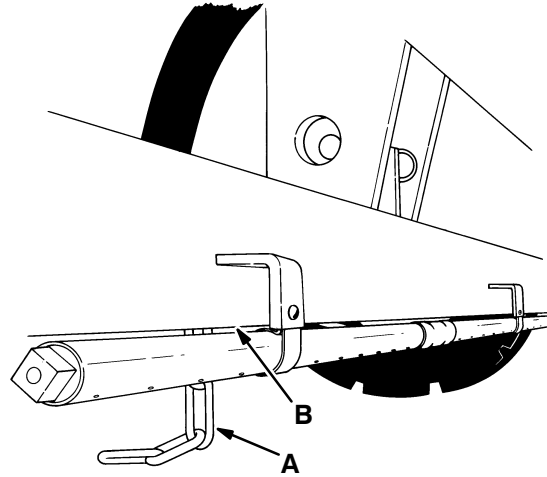
The engine fan belt is driven by the engine crankshaft sheave and drives the engine fan and alternator. Check and adjust belt tension after every 100 hours of operation.

⚠ WARNING: Moving Fan Blades. Keep Away.

To adjust belt tension, loosen the alternator mounting bolts and pull the alternator away from the engine until the belt is snug; then tighten the bolts. Do not use a pry bar on the alternator as it will damage the alternator. Proper belt tension is obtained when the belt deflects 0.5 in (13 mm) from a force of 8 to 10 lb (4 to 5 kg) applied at midpoint of the longest span.

STATIC DRAG CHAIN

A static drag chain is provided to prevent the buildup of static electricity in the machine. The chain is attached on the rear of the machine frame and drags on the floor. Make sure that it is making contact with the floor at all times.



STATIC DRAG CHAIN

00033

- A. Static Drag Chain**
- B. Machine Frame**

SCRUB HEAD

SCRUB HEAD

The scrub head houses the two scrub brushes, their drive mechanisms, and the side and rear squeegee assemblies. The scrub head has one adjustment—scrub head leveling. The scrub head leveling adjustment levels the scrub head. It is factory set and should not be changed unless, due to a major parts replacement or machine damage, the head adjustment may have been altered. If the scrub head is not level, the brushes will bounce. There will also be excessive wear on the brush drive plugs and bearings.

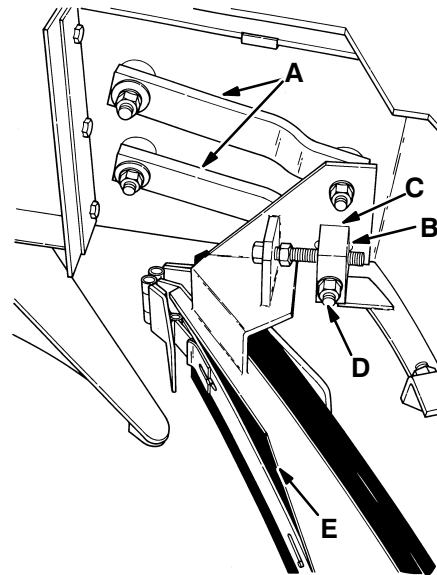
TO LEVEL SCRUB HEAD

1. Park the machine on a smooth level floor.
2. Lower the scrub head.
3. Stop the engine and engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

NOTE: The scrub head must be adjusted with new side and rear squeegees, and new scrub brushes.

4. Center the rear squeegee tip adjusting block bolts in their slots.



ADJUSTING BLOCK BOLTS

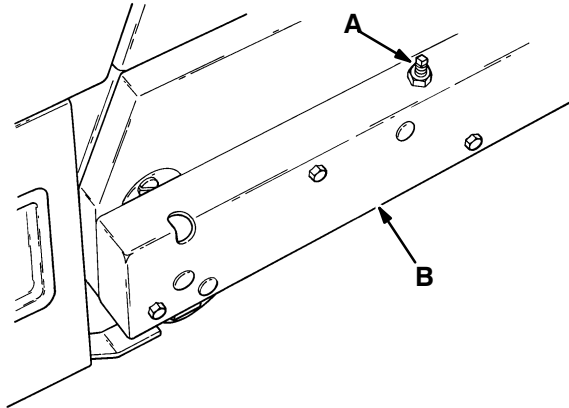
00011

- A. Parallel Arms**
- B. Slot**
- C. Tip Adjusting Block**
- D. Block Bolt**
- E. Squeegee**

5. Check to make sure the rear squeegee link pivots and lift pivot rotate freely.
6. Loosen the rear squeegee frame lift stud ball joint jam nuts.
7. Thread the two ball joints onto the stud as far as possible.

MAINTENANCE

8. The front blade of the rear squeegee should be 0.25 ± 0.06 in (6 ± 2 mm) off the floor when the rear blade is resting on the floor uncurled.
9. Adjust the side squeegee adjusting bolts so that the dimensions from the top of the bolt to the top of the squeegee frame is 1.5 ± 0.06 in (38 ± 2 mm).

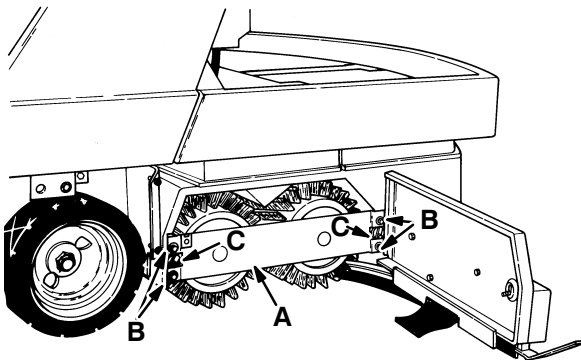


SQUEEGEE ADJUSTING BOLT

00084

- A. Adjusting Bolt
- B. Side Squeegee Frame

10. Adjust the spray deflector upward until it contacts the scrub head.
11. Loosen the four brush idler plate mounting bolts.



BRUSH IDLER PLATE

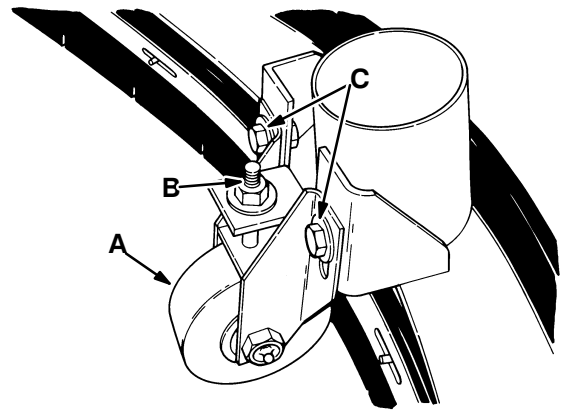
00049

- A. Brush Idler Plate
- B. Mounting Bolts
- C. Adjusting Cams

12. Set both of the brush adjusting cams to the center position (rectangular portion of cam horizontal).
13. Tighten the four brush idler plate bolts.
14. Start the engine.
15. Raise and then lower the scrub head to the floor so the rear squeegee rests on the floor but is not curled.
16. Stop the engine.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

17. Adjust the rear squeegee caster down to the floor with the caster adjustment screw. Make sure it is squarely positioned on the floor, then tighten the locking screws.



REAR SQUEEGEE CASTER

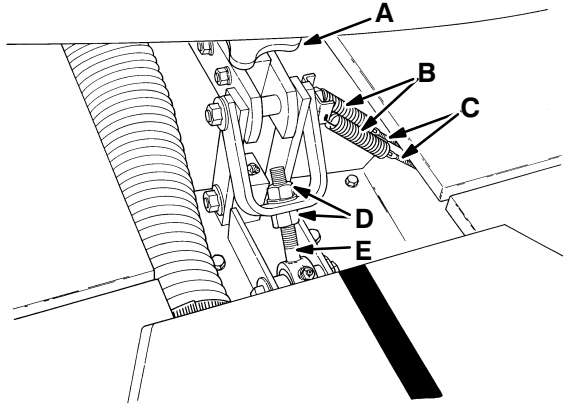
00022

- A. Caster Wheel
- B. Caster Adjustment Screw
- C. Locking Screw

18. Start the engine, release the parking brake, and move the machine forward to deflect the squeegee blades.
19. Stop the engine and engage the parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

20. The scrub head should be parallel to the floor from side to side within 0.12 in (3 mm). If the head is too high on the left side, evenly increase the tension on the head leveling springs. If the scrub head is too high on the right side, evenly decrease the tension on the head leveling springs.



00070

SCRUB HEAD ADJUSTMENTS

- A. Head Adjustment Knob**
- B. Leveling Spring**
- C. Spring Adjuster**
- D. Jam Nut**
- E. Adjustable Yoke**

21. The scrub head should be parallel to the floor from the front to the rear within 0.25 in (6 mm). If the head is too high in the front, shorten the adjustable yoke. If the head is too low in the front, lengthen the adjustable yoke. Retighten the yoke jam nut.
22. Check the scrub brush width and squeegee adjustments.

BRUSHES

MAIN BRUSHES

The main brushes are tubular and span the width of the scrub head, sweeping debris into the debris trough while they scrub the floor. The brushes should be inspected daily for damage or wear. Remove any string or wire found tangled on the scrub brushes, drive, or idler hubs.

The main brushes may be rotated front-to-rear to increase brush life. Replace the main brushes when there is 0.5 in (13 mm) of brush bristle left.

The main brush patterns should be checked daily. They should be 2 to 3 in (50 to 75 mm) wide. The main brush pattern is adjusted by turning the adjustment knob on top of the scrub head or the adjustment cams on the brush idler plate. See *TO CHECK AND ADJUST MAIN BRUSH PATTERN*.

TO REPLACE MAIN BRUSHES

1. Raise scrub head.
2. Stop engine and engage parking brake.

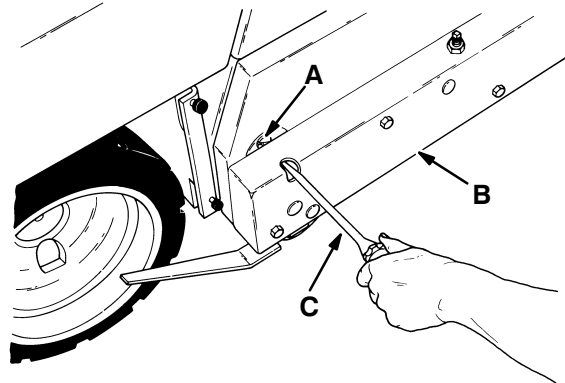
FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

3. Block scrub head up.
4. Raise and chain up the rear bumper.



WARNING: Heavy Bumper. Get Help To Handle.

5. Open the lower left access door and the left scrub head access door with a Allen wrench. The door fastener has a socket head.

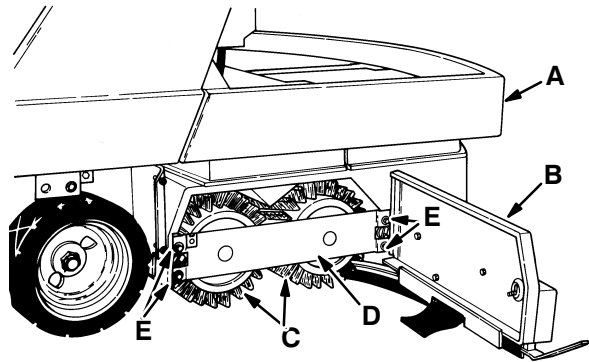


00048

OPENING LEFT SCRUB HEAD ACCESS DOOR

- A. Door Fastener
- B. Side Squeegee Cover
- C. Allen Wrench

6. Remove the four brush idler plate bolts.

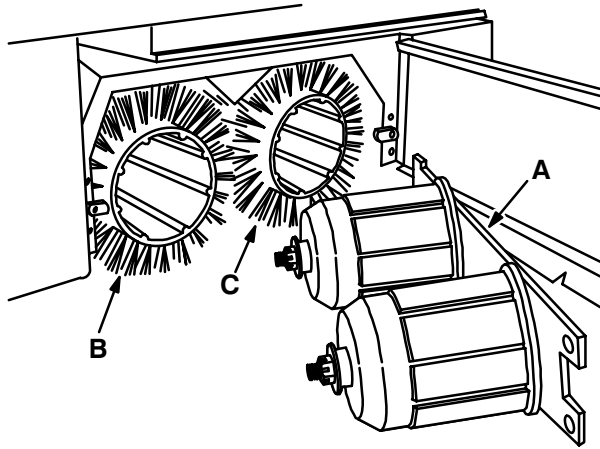


00049

BRUSH IDLER PLATE

- A. Rear Bumper
- B. Left Side Access Door
- C. Brush
- D. Brush Idler Plate
- E. Plate Bolts

7. Remove the brush idler plate.



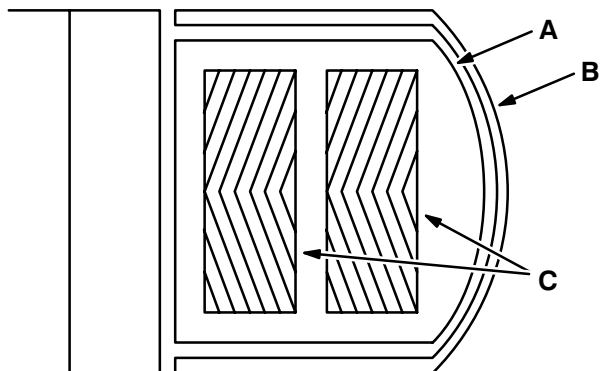
BRUSH IDLER PLATE

00055

- A. Brush Idler Plate**
- B. Front Brush**
- C. Rear Brush**

8. Pull out the front brush and then the rear brush.

9. Line up the drive end of the new brush with the rear brush drive plug. Make sure the V – pattern points toward the front of the machine when viewed from the top. Slide the main brush onto the rear brush drive plug.



TOP VIEW OF BRUSH PATTERN

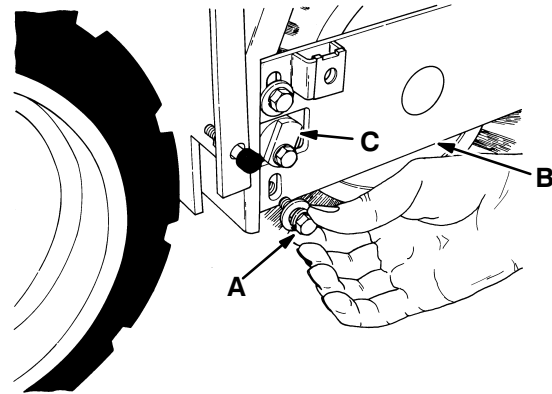
04772

- A. Scrub Head**
- B. Rear Bumper**
- C. Scrub Brush Pattern**

10. Line up the drive end of the brush with the front brush drive plug. Slide the main brush onto the front brush drive plug.

11. After the two brushes have engaged the drive plugs, slide the brush idler plate into position.

12. Install the four idler plate mounting bolts.



INSTALLING BRUSH IDLER PLATE MOUNTING BOLTS

00056

- A. Mounting Bolt**
- B. Brush Idler Plate**
- C. Adjusting Cam**

13. Close the access door, lower the rear bumper, and remove scrub head blocks.

14. Adjust the brush pattern as described in *TO CHECK AND ADJUST MAIN BRUSH PATTERN*.

MAINTENANCE

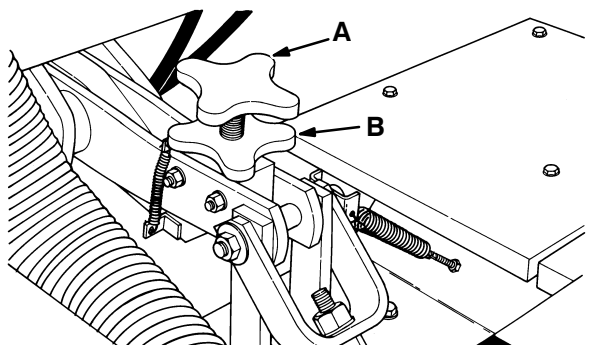
TO CHECK AND ADJUST MAIN BRUSH PATTERN

1. Apply chalk, or some other material that will not blow away easily, on a smooth, level floor.
2. With the scrub head up, position the machine scrub head over the test area.
3. Place the cleaning switch in the top (Squeegee Down) position, while keeping a foot on the brakes.
4. Lower the scrub head, allowing the brushes to spin on the floor in one spot for 15 to 20 seconds.

NOTE: If no chalk or other material is available, allow the brushes to spin approximately two minutes.

5. Raise the scrub head and remove the machine from the test area.
6. The main brush pattern should be 2 in (50 mm) across the full length of the brush. To adjust the width of the pattern, first loosen the lock knob. Turn the adjustment knob counterclockwise to increase the width of pattern. Turn the knob clockwise to decrease the width of pattern. Tighten the lock knob after adjusting the brush pattern.

NOTE: If either brush pattern is tapered, adjust the brush adjusting cams before attempting to get a full length brush pattern, to avoid damaging the brushes.



HEAD ADJUSTMENT KNOB

00018

- A. Head Adjustment Knob
- B. Lock Knob

7. If one or both of the brush patterns are tapered, the brush adjusting cam positions must be adjusted.

Turning the cam lobe up raises the idler side of the brushes. Turning the cam lobe down lowers the idler side of the brushes. Adjust the brushes to give an even brush pattern over the length of each of the brushes.

NOTE: Each cam has more of an influence on the closest brush. However, it does have some influence on the other brush. Take this into consideration when adjusting the cams. Make an adjustment with the engine off and the parking brake engaged. Tighten the adjustment and run a test pattern. Check the test pattern and readjust the cam(s) if necessary, with the engine off and the parking brake engaged.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

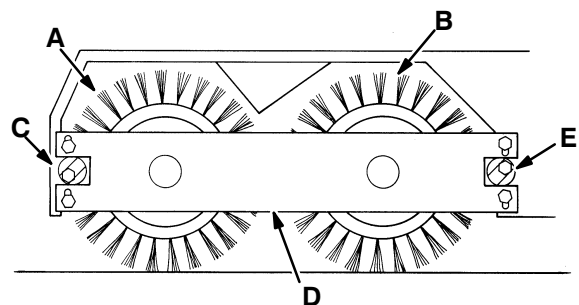


00082

TAPERED REAR BRUSH PATTERN

- A. Front Brush Pattern
- B. Rear

To correct this condition: Adjust the front cam lobe up; adjust the rear cam lobe down.



00069

CORRECTING TAPERED REAR BRUSH PATTERN

- A. Front Brush
- B. Rear Brush
- C. Front Cam
- D. Idler Plate
- E. Rear Cam

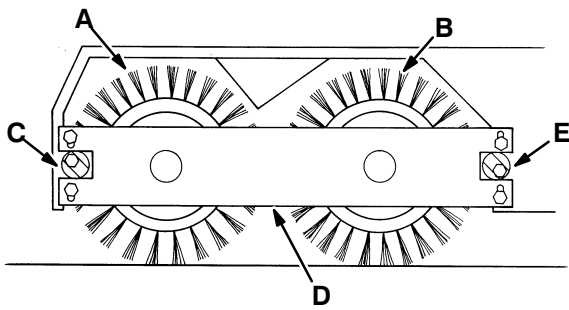


00082

TAPERED FRONT BRUSH PATTERN

- A. Front Brush Pattern**
- B. Rear Brush Pattern**

To correct this condition: Adjust the front cam lobe down; adjust the rear cam lobe up.



00069

CORRECTING TAPERED FRONT BRUSH PATTERN

- A. Front Brush**
- B. Rear Brush**
- C. Front Cam**
- D. Idler Plate**
- E. Rear Cam**

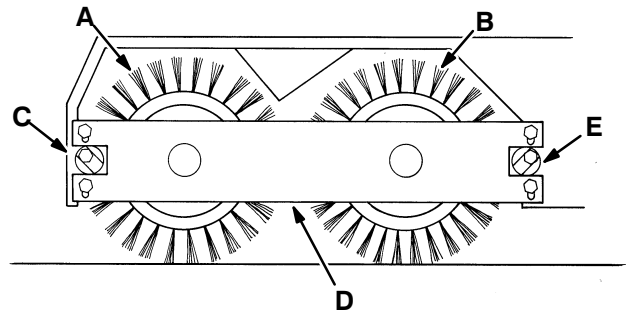


00082

TAPERED BRUSH PATTERNS

- A. Front Brush Pattern**
- B. Rear Brush Pattern**

To correct this condition: Adjust both brush cam lobes down.



00069

CORRECTING TAPERED BRUSH PATTERNS

- A. Front Brush**
- B. Rear Brush**
- C. Front Cam**
- D. Idler Plate**
- E. Rear Cam**

MAINTENANCE

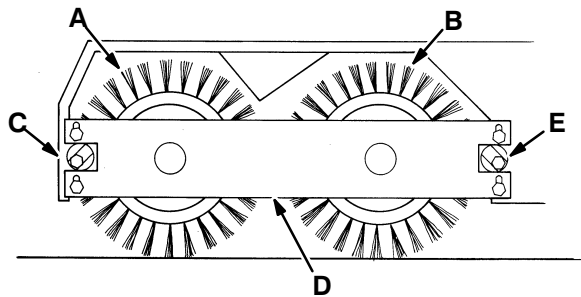


00082

TAPERED BRUSH PATTERNS

- A. Front Brush Pattern
- B. Rear Brush Pattern

To correct this condition: Adjust both cam lobes up.



00068

CORRECTING TAPERED BRUSH PATTERNS

- A. Front Brush
- B. Rear Brush
- C. Front Cam
- D. Idler Plate
- E. Rear Cam

NOTE: If the front and rear brush patterns are not equal in width, the head must be readjusted as described in To Level Scrub Head.

SIDE BRUSH

The side brush option scrubs debris from edges into the path of the main brushes. It should be inspected daily for wear or damage. Remove any string or wire found tangled on the side brush or side brush drive hub.

The side brush should be replaced when the remaining brush bristle measures 0.5 in (15 mm) in length.

The down pressure of the side brush option is adjustable. The brush pressure can be adjusted to increase cleaning performance of the side brush.

TO REMOVE SIDE BRUSH

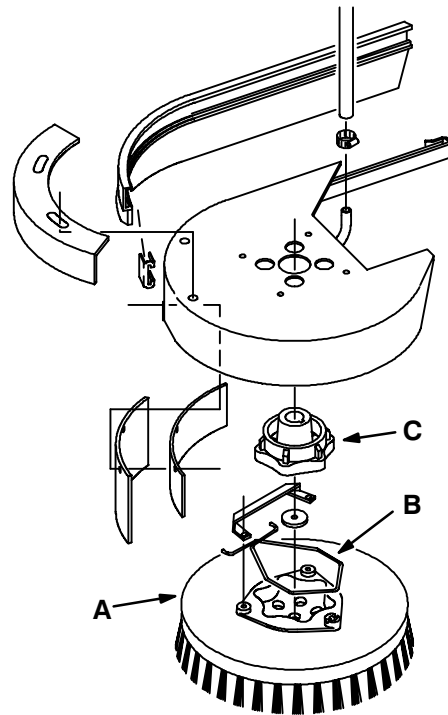
1. Place the side brush switch in the bottom (Side Brush Up) position.
2. Stop engine and engage parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

3. Press the brush spring clip together with a thumb and index finger, and apply downward pressure to the scrub brush to release it from the brush drive hub.

TO INSTALL SIDE BRUSH

1. Slide the side brush under the drive hub.
2. Line up the hex socket of the scrub brush with the hex on the drive hub.
3. Press the brush spring clip together and lift the scrub brush into place over the brush drive hub. Release the spring clip when the brush is in place.



04755

SIDE BRUSH

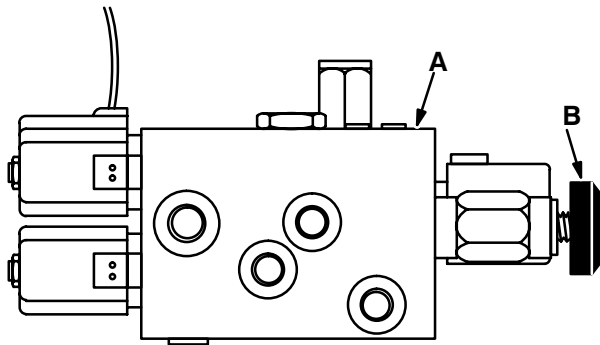
- A. Side Brush
- B. Spring Clip
- C. Drive Hub

TO ADJUST DOWN PRESSURE

1. Stop engine and engage parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

2. Open the engine hood.
3. Locate the hydraulic valve mounted on the firewall.
4. To decrease the down pressure of the side brush, turn the adjustment knob counter-clockwise on the hydraulic valve. Turn the adjustment knob clockwise to increase the down pressure of the side brush.



04757

**SIDE BRUSH DOWN PRESSURE
ADJUSTMENT**

- A. Hydraulic Valve**
- B. Down Pressure Adjustment Knob**

5. Close the engine hood.
6. Scrub with the side brush and readjust down pressure if necessary.

SQUEEGEES

SIDE SQUEEGEES

The side squeegees control water spray and channel water into the path of the rear squeegee. Check the side squeegees for damage, wear, and adjustment daily. Replace the side squeegee blades and back-up strips whenever they become damaged or lose their shape or resiliency.

TO REPLACE SIDE SQUEEGEE BLADES

1. Raise the scrub head.
2. Place the squeegee switch in the "up" position.
3. Stop the engine and engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

4. Block scrub head up.
5. Open the side squeegee latch and remove the side squeegee band, bridge, back-up strip, and blade.
6. Place the back-up strip over the pins of the squeegee frame.
7. Place the new side squeegee blade on the pins over the back-up strip.
8. Position the blade bridge on the squeegee frame pins. Be sure the tapered edge is facing the front of the machine.
9. Clip the rear of the retaining band over the rear of the squeegee and the blade bridge.
10. Latch the side squeegee latch.

NOTE: Make sure the band is snug to the squeegee, the back-up strip, and the blade bridge—adjust if necessary.

11. Adjust the side squeegee as described in *TO ADJUST SIDE SQUEEGEES.*

TO ADJUST SIDE SQUEEGEES

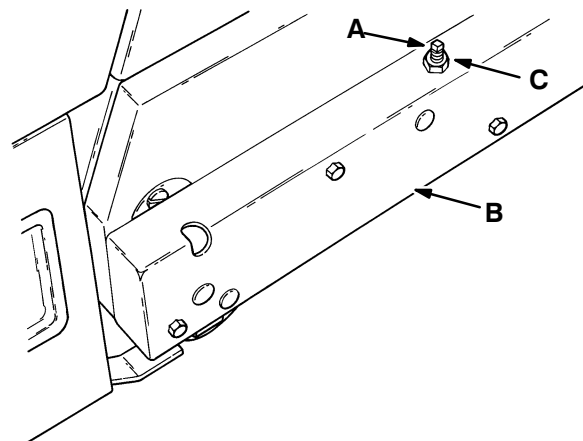
1. Lower the scrub head and move the machine forward.
2. Stop the engine and engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

3. Check the squeegee blade deflection. It should deflect 0.5 in (13 mm). Adjust the squeegees as needed.
4. To adjust squeegee blade deflection, first loosen the lock nut. To increase squeegee blade deflection, thread the down pressure adjustment screw into the assembly.

To decrease squeegee blade deflection, unthread the down pressure adjustment screw from the assembly.

Tighten lock nut to set the adjustment.



SIDE SQUEEGEE BLADE ADJUSTMENT SCREW

00084

- A. Adjustment Screw**
- B. Side Squeegee Frame**
- C. Lock Nut**

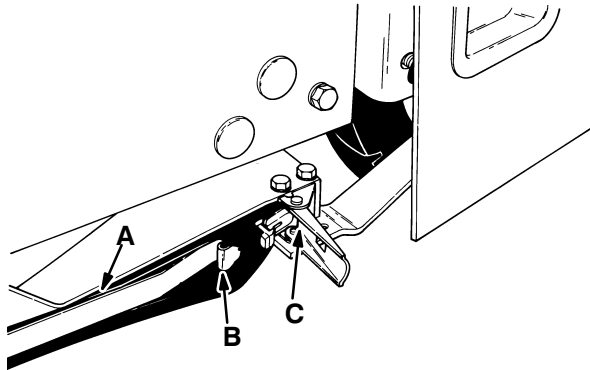
NOTE: A side squeegee benchmark adjustment is as follows: Adjust the down pressure adjustment screw so that the distance from the top of the screw to the top of the side squeegee frame is 1.5 ± 0.06 in (38 ± 2 mm). The side squeegees can be adjusted as required after the initial setting.

SIDE SQUEEGEE LATCHES

The side squeegee latches hold the side squeegee blade assembly in place. Adjust the latches when the squeegee band does not hold the squeegee blade assembly snug or if the latch will not latch completely.

To tighten the side squeegee band, thread the latch hook into the latch pivot.

To loosen the side squeegee band, unthread the latch hook out of the latch pivot.



SIDE SQUEEGEE LATCH

00065

- A. Squeegee Band**
- B. Latch Hook**
- C. Latch Pivot**

REAR SQUEEGEE

The rear squeegee assembly channels water into the vacuum fan suction. The front squeegee blade channels the water, and the rear blade wipes the floor. Check the rear squeegee assembly for damage, wear, and adjustment daily.

Replace the front blade of the rear squeegee whenever the blade has become damaged or when the blade no longer contacts the floor.

Rotate or replace the rear blade of the rear squeegee if its leading edge is worn half-way through the thickness of the blade.

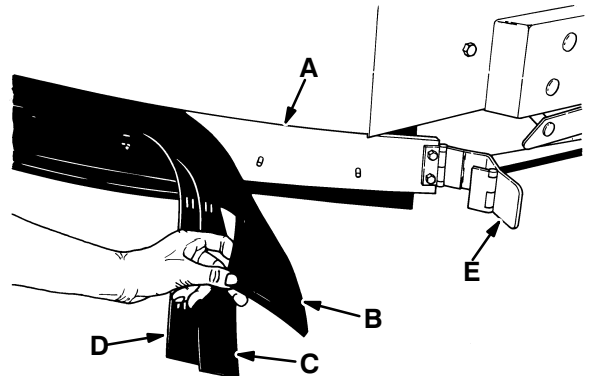
Each rear blade has four wiping edges. To use them all, start with one wiping edge. To use the next wiping edge, rotate the squeegee end-for-end. To use the next wiping edge, rotate the top edges down, bottom edges up. To use the last edge, rotate the squeegee end-for-end. Replace the back-up strips if they become damaged or if they lose their resiliency.

TO REPLACE OR ROTATE REAR BLADE

1. Lower the rear squeegee.
2. Raise the scrub head.
3. Stop the engine and engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

4. Block scrub head up.
5. Open the rear band clamp and remove the two squeegee back-up strips and the squeegee blade.
6. Replace or rotate the rear blade to allow a new edge of the blade to face the front of the machine.
7. Place the squeegee blade over the pins of the squeegee frame.
8. Place the squeegee back-up strips on the pins; inner strip using top holes, outer strip using lower holes.



INSTALLING REAR SQUEEGEE BLADE

00020

- A. Squeegee Frame**
- B. Rear Squeegee Blade**
- C. Inner Back-up Strip**
- D. Outer Back-up Strip**
- E. Retaining Band Clamp**

9. Position the squeegee retaining band over the outer back-up strip.

MAINTENANCE

10. Latch the retaining band clamp.

NOTE: Make sure the band is snug to the squeegee and the back-up strips-adjust if necessary.

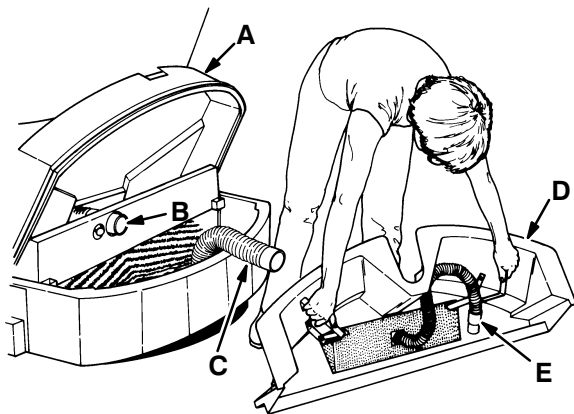
11. Adjust the rear squeegee as described in *TO ADJUST REAR SQUEEGEE.*

TO REPLACE FRONT BLADE

1. Lower the rear squeegee.
2. Lower the scrub head so the rear squeegee is just off the floor.
3. Stop the engine and engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

4. Disconnect the rear squeegee and debris screen suction hoses from the scrub head frame vacuum connections.
5. Remove the debris hopper.

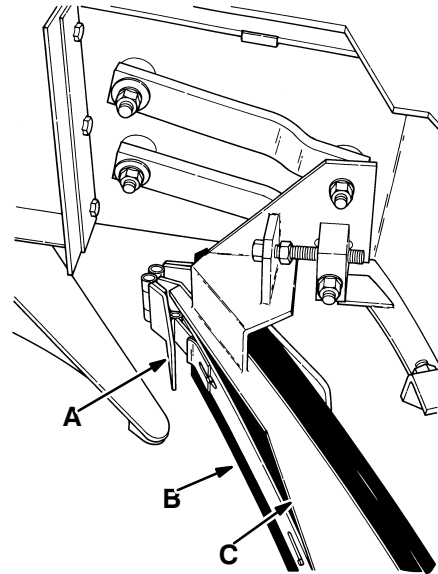


REMOVING DEBRIS HOPPER

02424

- A. Scrub Head Cover
- B. Vacuum Connection
- C. Squeegee Suction Hose
- D. Debris Hopper
- E. Debris Screen Suction Hose

6. Open the front band clamp and remove the front squeegee band and blade.

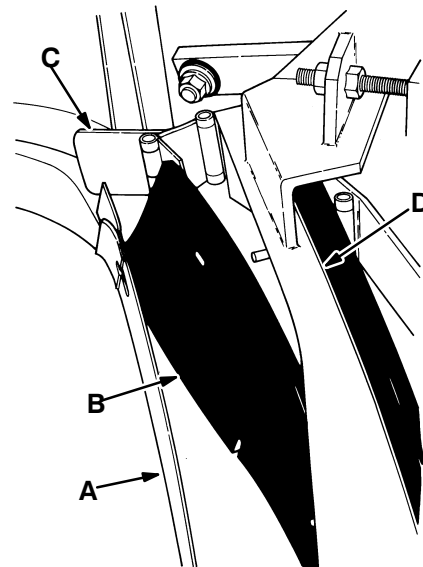


FRONT BAND CLAMP

00011

- A. Band Clamp
- B. Front Blade
- C. Squeegee Frame

7. Place the new squeegee blade over the pins of the squeegee frame.
8. Position the squeegee retaining band over the squeegee on the pins of the squeegee frame.



INSTALLING FRONT SQUEEGEE BLADE

00017

- A. Retaining Band
- B. Front Blade
- C. Band Clamp
- D. Squeegee Frame

- Engage the retaining band clamp.

NOTE: Make sure the band is snug to the squeegee—adjust if necessary.

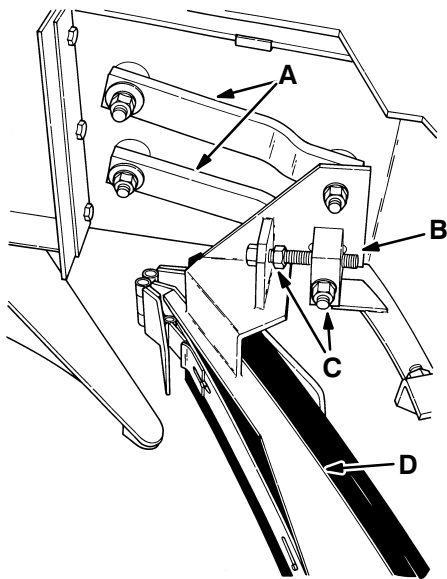
- Adjust the rear squeegee as described in **TO ADJUST REAR SQUEEGEE**.

TO ADJUST REAR SQUEEGEE

- Lower the scrub head and the rear squeegee.
- Stop the engine and engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

- Loosen the four squeegee tip adjuster lock nuts and the squeegee caster adjustment screws.

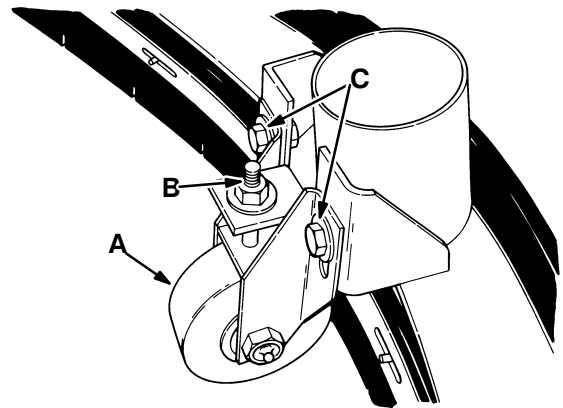


REAR SQUEEGEE LINKAGE

- A. Parallel Arms**
- B. Tip Adjusting Screw**
- C. Tip Adjuster Lock Nut**
- D. Squeegee Frame**

00011

- Position the squeegee so the blade just touches the floor from end to end. To do this, adjust the squeegee tip adjusting screws to raise or lower the squeegee tips; tightening the screws brings the tips down, loosening the screws brings the tips up.
- Tighten the four squeegee tip adjusting locknuts.
- Slide a 0.50 in (13 mm) thick block under the squeegee caster.
- Position the squeegee so the rear blade just touches the floor. Tighten the squeegee caster locking screws.



REAR SQUEEGEE CASTER

00022

- A. Caster Wheel**
- B. Caster Adjustment Screw**
- C. Locking Screw**

- Remove the block from under the squeegee caster.
- Start the engine and disengage the parking brake.
- Move the machine forward with the rear squeegee down, the brushes on, and the scrub head down.
- Stop the engine with the scrub head down.
- Engage the machine parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

- Inspect the rear squeegee blade deflection. The squeegee blade should be evenly deflected 0.62 ± 0.12 in (16 ± 3 mm). The squeegee ends should have a gap of 0.12 ± 0.06 in (3 ± 2 mm) between the front blade and the rear blade.

If the squeegee blade is deflected too much at the center, lower the caster accordingly. If the center is deflected too little, raise the caster accordingly.

If the squeegee blade tips are too high or too low, loosen the squeegee tip locknuts and adjust the squeegee tips, adjusting screws accordingly.

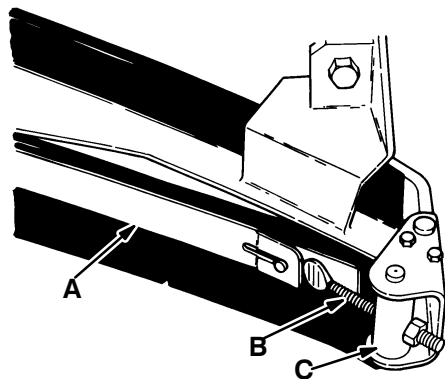
- Check the scrub brush pattern after making adjustments.

REAR SQUEEGEE RETAINING BAND CLAMPS

The retaining band clamps on the front and rear blades of the rear squeegee hold the squeegee bands and squeegees in place. The clamps may have to be adjusted periodically to keep the bands snug.

To tighten the retaining band, unthread the thumbscrew out of the adjuster bracket.

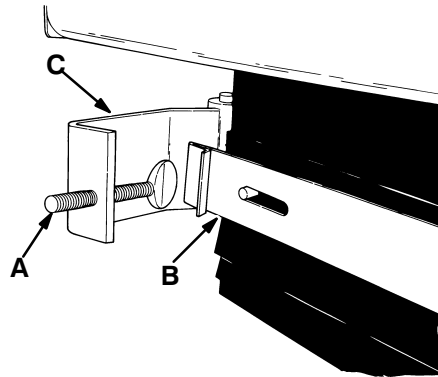
To loosen the retaining band, thread the thumbscrew into the adjuster bracket.



FRONT BLADE RETAINING BAND THUMBSCREW

00016

- A. Retaining Band
- B. Thumbscrew
- C. Adjuster Bracket



REAR BLADE RETAINING BAND THUMBSCREW

00021

- A. Thumbscrew
- B. Retaining Band
- C. Adjuster Bracket

SIDE BRUSH SQUEEGEE

The side brush squeegee is part of the side brush option. It controls water spray and channels water into the path of the scrub brushes. Check the squeegee and spray deflector for damage and wear daily. Replace the side squeegee blade and spray deflectors whenever they become damaged or lose their shape.

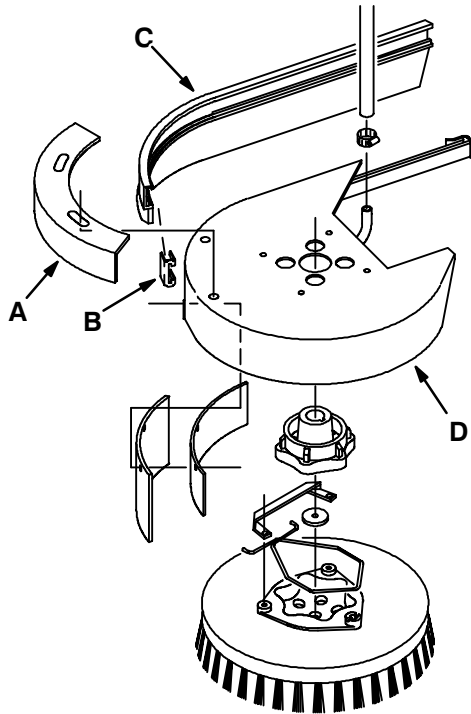
TO REPLACE SIDE BRUSH SQUEEGEE

- Place the side brush switch in the bottom (Side Brush Up) position.
- Stop engine and engage parking brake.

FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, Turn Off Machine And Remove Key.

- Remove the side brush guard.
- Remove the squeegee retainer.
- Pull the squeegee blade assembly off the front of the side brush frame.

6. Slide the new squeegee blade assembly onto the side brush frame.



SIDE BRUSH SQUEEGEE

04755

- A. Side Brush Guard**
- B. Squeegee Retainer**
- C. Squeegee Blade Assembly**
- D. Side Brush Frame**

NOTE: Lubricating the side brush frame where the squeegee makes contact will make it easier to install the squeegee blade assembly.

7. Replace the squeegee retainer.
8. Remount the side brush guard.

SOLUTION AND RECOVERY TANKS

SOLUTION TANK

The machine solution tank supplies the scrub brushes with a water and detergent solution. The solution tank on standard machines is located on the right side of the machine under the operator seat.

Access to the solution tank is through the opening in the top of the tank, under the operator seat.

The solution tank requires no regular maintenance. If detergent cakes on the bottom of the tank, remove the deposits with a strong blast of water.

SOLUTION VALVE(S)

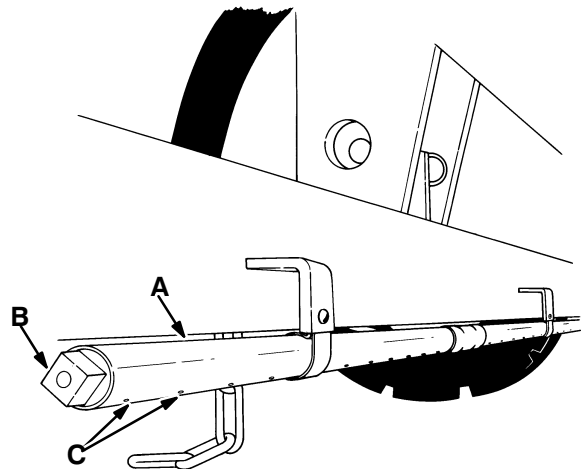
The solution valve(s) control the flow of solution to the scrub brushes. The valve linkage should be adjusted to provide full flow and no flow to the scrub brushes.

SOLUTION SPREADER TUBE

The solution spreader tubes distribute scrub solution to the scrub brushes. They may be flushed out if they become clogged with soap or other debris. A drain plug is located on each end of the spreader tube.

Before cleaning the solution spreader tube, make sure that the solution valve is opening fully when the scrub solution flow lever is moved all the way forward.

A brush and hot water may be needed to remove stubborn clogs. A sharp instrument may be used to clear the small distribution holes in the spreader tube.



00033

SOLUTION SPREADER TUBE

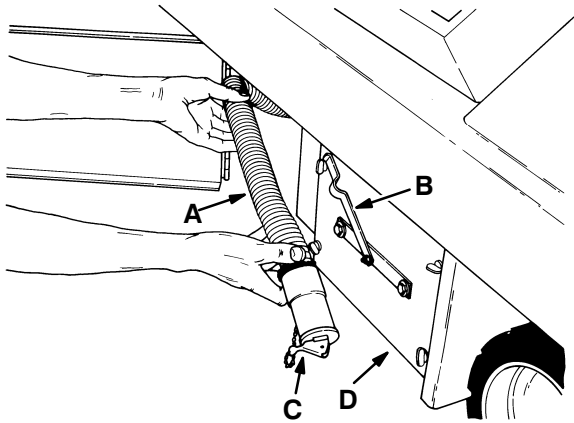
- A. Spreader Tube
- B. Tube Plug
- C. Distribution Holes

RECOVERY TANK

The machine recovery tank stores the water solution picked up by the machine squeegee and vacuum fan. The recovery tank on standard machines is located to the left of the operator seat.

The recovery tank should be drained after the solution tank is empty or whenever the ball float rises and stops the water vacuum.

To drain the recovery tank, stop the engine, engage the parking brake, open the lower access door, and unplug the drain hose next to a floor drain. The tank will not empty with the vacuum fan operating. Shut off the vacuum fan by placing the cleaning switch in the bottom (Squeegee Up) position. Clean the recovery tank after every work shift.



DRAINING RECOVERY TANK

00067

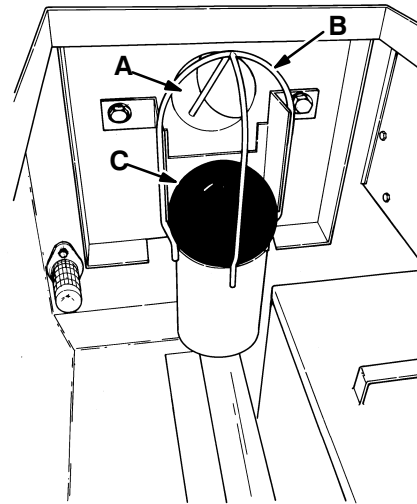
- A. Drain Hose**
- B. Hose Retaining Clip**
- C. Hose Plug**
- D. Cleanout Door**

Two doors have been provided to make the tank cleaning job easier. One door is located on top of the recovery tank. The other door is located behind the lower left side access door.

Spray the inside of the tank with clean water. Remove all sludge and debris from the bottom of the tank, out the lower cleanout door.

FOR SAFETY: When Servicing Machine, Wear Eye And Ear Protection When Using Pressurized Air Or Water.

Spray the ball float. Make sure the float guides are free of dirt and debris which may cause the float to stick.



RECOVERY TANK BALLFLOAT

02476

- A. Vacuum Fan Inlet**
- B. Ball Float Guide**
- C. Ball Float**

Keep vacuum hoses and nozzles clean. Clogged hoses are a common cause of poor water pickup.

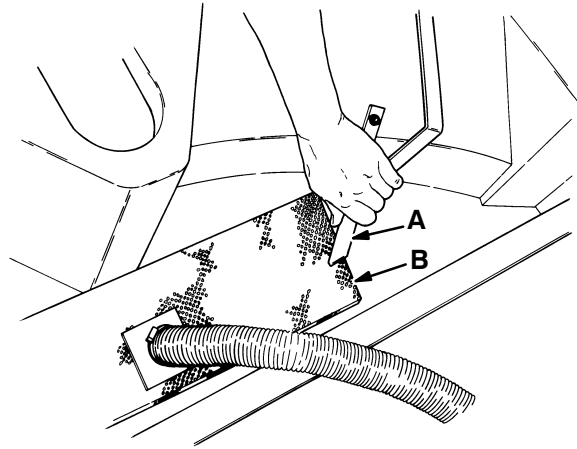
MAINTENANCE

DEBRIS HOPPER

The debris hopper collects debris picked up by the scrub brushes. It is located behind the scrub brushes.

A vacuumized debris screen is located on the bottom of the debris hopper to draw water solution out of the debris collected in the hopper.

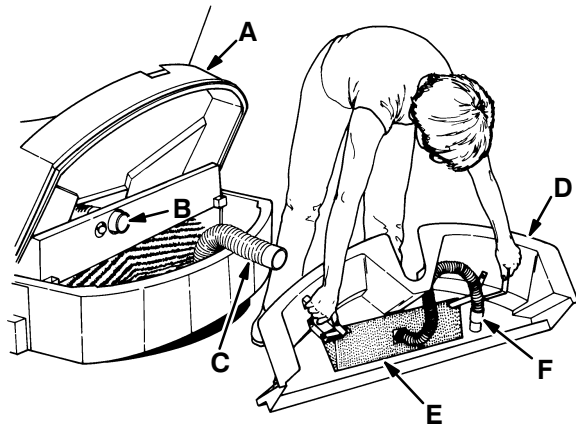
The debris hopper should be emptied and cleaned whenever the recovery tank is drained. To empty and clean the debris hopper, stop the engine, engage the parking brake, open the scrub head cover, disconnect the vacuum hoses, and lift the hopper out of the machine. Remove and clean the debris screen from the hopper. Reinstall the debris screen, debris hopper, and vacuum hoses when finished.



REMOVING DEBRIS SCREEN

00027

- A. Debris Screen Retainer
- B. Debris Screen



REMOVING DEBRIS HOPPER

02424

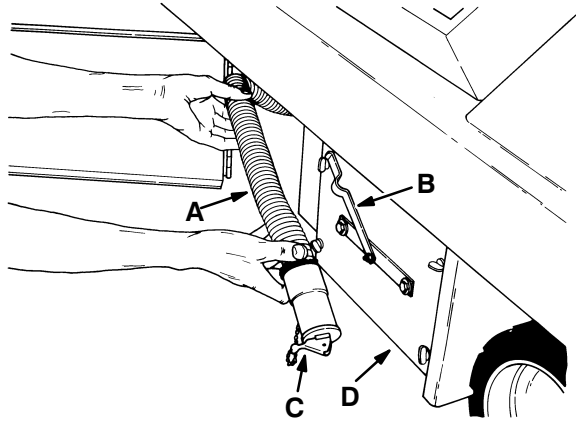
- A. Scrub Head Cover
- B. Suction Tube
- C. Squeegee Suction Hose
- D. Debris Hopper
- E. Debris Screen
- F. Debris Screen Suction Hose

SRS® SOLUTION TANK

The SRS® machine solution tank supplies the scrub brushes with a water and cleaning solution mixture. It also stores water picked up by the machine squeegees and vacuum fan.

Access to the SRS® solution tank is through the opening in the top of the tank, under the operator's seat.

The SRS® solution tank should be drained and cleaned after every work shift. To drain the tank, stop the engine, engage the parking brake, open the lower access doors, and unplug the drain hoses next to a floor drain. The tank will not empty with the vacuum fan operating. Shut off the vacuum fan by placing the cleaning switch in the bottom (Squeegee Up) position.



DRAINING TANK

00067

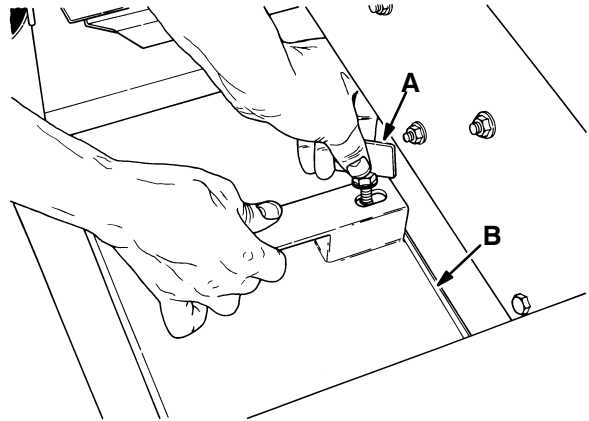
- A. Drain Hose
- B. Hose Retaining Clip
- C. Hose Plug
- D. Cleanout Door

Four doors have been provided to make the cleaning job easier. One door is located under the seat; this is also the water fill door. The second door is located on top of the tank next to the machine operator. The third door is located behind the bottom left side access door. The fourth door is located behind the bottom right side access door.

FOR SAFETY: When Servicing Machine, Wear Eye And Ear Protection When Using Pressurized Air Or Water.

Spray the inside of the tank with clean water. Remove all sludge and debris from the bottom of the tank. Remove the laminar filter cover and spray the screen and filters clean.

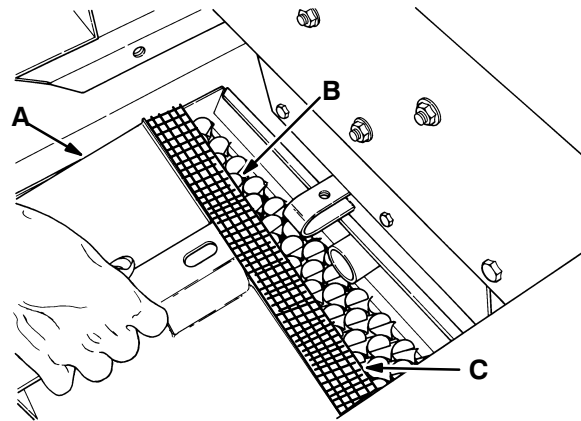
NOTE: The laminar filter may be removed from the tank by removing the thumbscrew holding the filter cover in place. Then lift the filter straight up.



00066

REMOVING LAMINAR FILTER COVER THUMBSCREW

- A. Thumbscrew
- B. Laminar Filter Cover



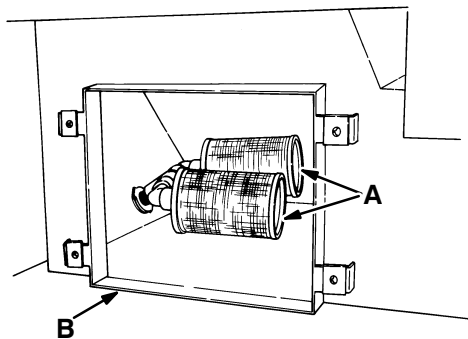
00031

REMOVING LAMINAR FILTER COVER

- A. Laminar Filter Cover
- B. Laminar Filter Tubes
- C. Screen

MAINTENANCE

Spray the solution outlet screens with clean water to remove all dirt and debris. Then fill the solution tank with enough clean water to cover the solution outlet screens. Run the SRS® pump for a few minutes to flush the system.



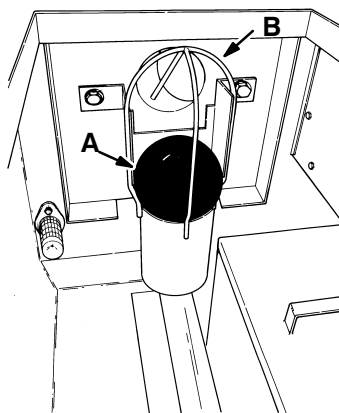
SOLUTION OUTLET SCREENS

00001

- A. Outlet Screens
- B. Lower Right Access Door Opening

FOR SAFETY: When Servicing Machine, Wear Eye And Ear Protection When Using Pressurized Air Or Water.

Spray the ball float clean. Make sure the float guides are free of dirt and debris which may cause the float to stick. Check the vacuum hoses for clogging or damage.



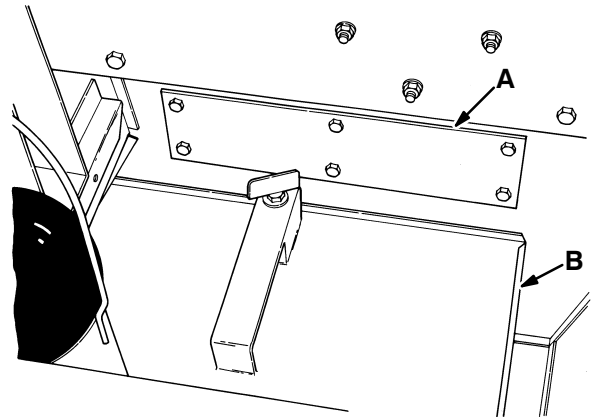
RECOVERY TANK BALL FLOAT

02476

- A. Ball Float
- B. Ball Float Guide

The SRS® solution tank has also been equipped with a foam cross-over door. It has been provided in case a large amount of foaming regularly occurs, and flows out of the vacuum fan. With the foam cross-over door removed, this foam will dissipate into the tank.

When operating the machine with the cross-over door removed, the solution tank must not be filled with water above the two cross-over tubes located under the cross-over door.



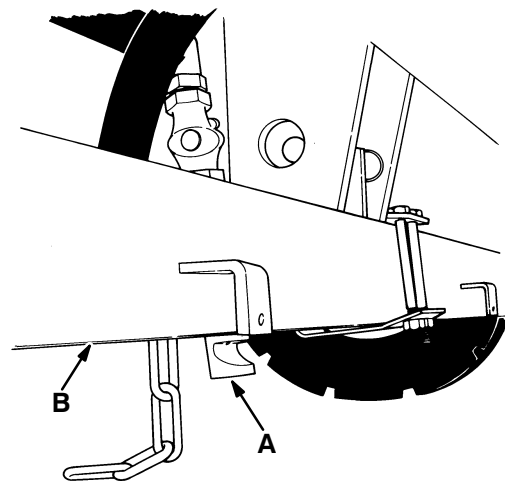
FOAM CROSS-OVER DOOR

00057

- A. Foam Cross-Over Door
- B. Laminar Filter Cover

SRS® SOLUTION SPRAY NOZZLE

The SRS® solution spray nozzle distributes scrub solution to the scrub brushes. It requires no regular maintenance. The spray nozzle should be adjusted so that the spray is centered across the front brush.



SOLUTION SPRAY NOZZLE

00012

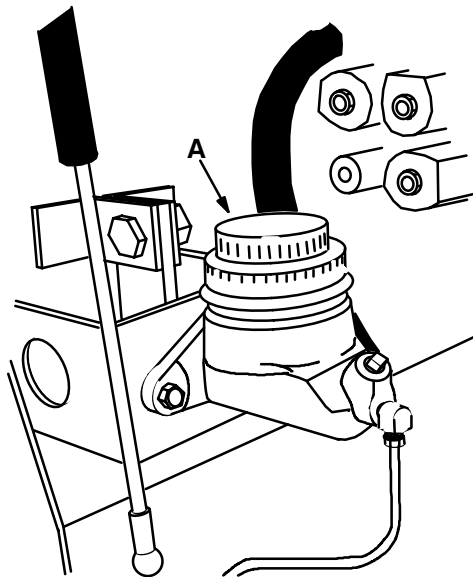
- A. Solution Spray Nozzle
- B. Machine Frame

BRAKES AND TIRES

SERVICE BRAKES

The service brakes are hydraulically activated by a master brake cylinder. Check the master brake cylinder fluid level after every 400 hours of operation and add brake fluid as needed. The master brake cylinder is located in front of the operator in the engine compartment.

If necessary, adjust the brake clevis on the master cylinder push rod so that the brake pedal is in a horizontal position when the cylinder push rod starts to engage the master cylinder piston.



MASTER CYLINDER

A. Master Cylinder

Brakes require bleeding whenever air enters the system. Air can enter when the master cylinder or wheel cylinders are serviced or if the fluid in the reservoir runs dry. Air can also enter through a leaky brake line or hose. Find the leaking line and replace it before bleeding the system.

Whenever handling brake fluid, do not get any on the brake shoes, drums, or body paint. Brake pads will be permanently damaged, requiring replacement. Body paint can also be damaged unless the area is wiped with a clean cloth and washed with a soapy solution immediately.

TO BLEED BRAKES

1. Make sure that the brake fluid reservoir is full and that the vent in the cap is open.
2. Connect a plastic or rubber tube to the bleeder valve on the left rear wheel. Suspend the other end of the tube in a jar or bottle filled with a few inches of brake fluid. During the remaining steps, keep this end submerged at all times and never let the level in the brake fluid reservoir drop below one half full. This is to keep air from being drawn into the system.
3. Open the bleeder valve on the left rear wheel about one turn. Have an assistant press the brake pedal slowly to the floor. As soon as the pedal is all the way down, close the bleeder valve and let the pedal up. Repeat this step as many times as necessary, until fluid free of air bubbles flows from the tube.
4. Bleed the right rear wheel in the same manner as described in the steps above. Keep checking the brake fluid reservoir to be sure it doesn't run out of fluid.
5. When all wheels are bled, discard the brake fluid in the jar or bottle; never reuse such fluid.
6. Fill the brake fluid reservoir with clean fluid.
7. Check the brakes for proper operation.

PARKING BRAKES

The parking brakes are mechanically activated by the parking brake lever and two cables.

The parking brakes should be adjusted whenever it becomes very easy to engage the parking brake, when the machine rolls after engaging the parking brake, and after every 100 hours of operation. The parking brake may be tightened by turning the knurled knob on the end of the parking brake clockwise.

TIRES

The machine tires are solid. Periodically, wash off the tires to remove built-up detergent and floor grime.

SECTION 4

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HARDWARE INFORMATION

The following charts state standard plated hardware tightening ranges for normal assembly applications. Decrease the specified torque by 20% when using a thread lubricant. Do not substitute lower grade hardware for higher grade hardware. If higher grade hardware than specified is substituted, tighten only to the specified hardware torque value to avoid damaging the threads of the part being threaded into, as when threading into speed nuts or weldments.

STANDARD BOLT TORQUE CHART

Thread Size	SAE Grade 5 Torque ft lb (Nm)	SAE Grade 8 Torque ft lb (Nm)
0.25 in	7–10 (9–14)	10–13 (14–38)
0.31 in	15–20 (20–27)	20–26 (27–35)
0.38 in	27–35 (37–47)	36–47 (49–64)
0.44 in	43–56 (58–76)	53–76 (72–103)
0.50 in	65–85 (88–115)	89–116 (121–157)
0.62 in	130–170 (176–231)	117–265 (159–359)
0.75 in	215–280 (291–380)	313–407 (424–552)
1.00 in	500–650 (678–881)	757–984 (1026–1334)

NOTE: Decrease torque by 20% when using a thread lubricant.

METRIC BOLT TORQUE CHART





Thread Size	Class 8.8 Torque ft lb (Nm)	Class 10.9 Torque ft lb (Nm)
M4	2 (3)	3 (4)
M5	4 (5)	6 (8)
M6	7 (9)	10 (14)
M8	18 (24)	25 (34)
M10	32 (43)	47 (64)
M12	58 (79)	83 (112)
M14	94 (127)	133 (180)
M16	144 (195)	196 (265)
M20	260 (352)	336 (455)
M24	470 (637)	664 (900)

NOTE: Decrease torque by 20% when using a thread lubricant.

Exceptions to the above chart:

Rear wheel hub nut – 175 ft lb (240 Nm)

BOLT IDENTIFICATION

Identification Grade Marking	Specification and Grade
	SAE–Grade 5
	SAE–Grade 8
	ISO–Grade 8.8
	ISO–Grade 10.9

01395

THREAD SEALANT AND LOCKING COMPOUNDS

Thread sealants and locking compounds may be used on this machine. They include the following:

Loctite 515 sealant – gasket forming material. TENNANT Part No. 75567, 15 oz (440 ml) cartridge.

Loctite 242 blue – medium strength thread locking compound. TENNANT Part No. 32676, 0.5 ml tube.

Loctite 271 red – high strength thread locking compound. TENNANT Part No. 19857, 0.5 ml tube.

HYDRAULIC FITTING INFORMATION

**HYDRAULIC TAPERED PIPE FITTING (NPT)
TORQUE CHART**

NOTE: Ratings listed are when using teflon thread seal.

Size	Minimum Torque	Maximum Torque
1/4 NPT	10 ft lb (14 Nm)	30 ft lb (41 Nm)
1/2 NPT	25 ft lb (34 Nm)	50 ft lb (68 Nm)
3/4 NPT	50 ft lb (68 Nm)	100 ft lb (136 Nm)

**HYDRAULIC TAPERED SEAT FITTING (JIC)
TORQUE CHART**

Tube O.D. (in)	Thread Size	Maximum Torque
0.25	0.44–20	9 ft lb (12 Nm)
0.38	0.56–18	20 ft lb (27 Nm)
0.50	0.75–16	30 ft lb (41 Nm)
0.62	0.88–14	40 ft lb (54 Nm)
0.75	1.12–12	70 ft lb (95 Nm)
1.0	1.31–12	90 ft lb (122 Nm)

**HYDRAULIC O-RING FITTING TORQUE
CHART**

Tube O.D.(in)	Thread Size	Minimum Torque	Maximum Torque
0.25	0.44–20	6 ft lb (8 Nm)	9 ft lb (12 Nm)
0.38	0.56–18	13 ft lb (18 Nm)	20 ft lb (27 Nm)
		*10 ft lb (14 Nm)	12 ft lb (16 Nm)
0.50	0.75–16	20 ft lb (27 Nm)	30 ft lb (41 Nm)
		*21 ft lb (28 Nm)	24 ft lb (33 Nm)
0.62	0.88–14	25 ft lb (34 Nm)	40 ft lb (54 Nm)
0.75	1.12–12	45 ft lb (61 Nm)	70 ft lb (95 Nm)
1.0	1.31–12	60 ft lb (81 Nm)	90 ft lb (122 Nm)

NOTE: Do not use sealant on o-ring threads.

*Aluminum bodied components