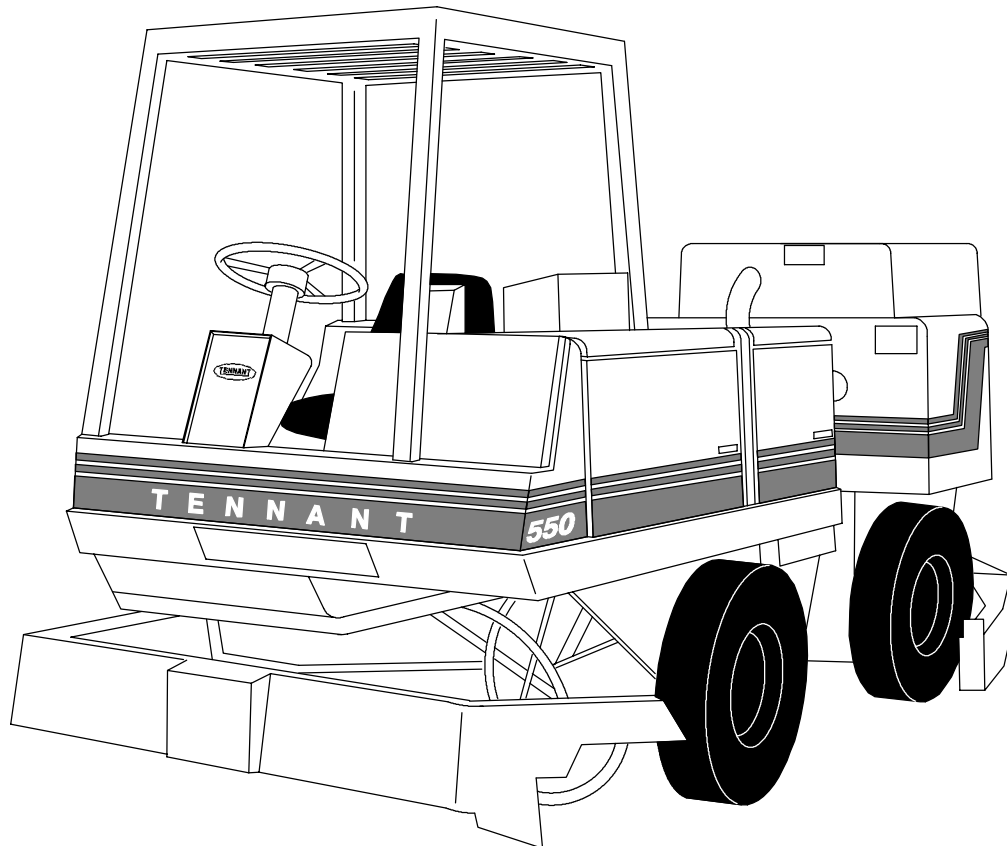




550

(Operator Manual)



MM148
Rev. 25 (9-99)



This manual is furnished with each new TENNANT Model 550. 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 How To Use This Manual; Standard Parts; LPG Parts; Diesel Parts, SRS® Parts; Options; Breakdowns; F163 Engine Parts, Gasoline, LPG; TM27 Engine Parts, Gasoline, LPG; Engine Parts, Diesel; 65951 Engine Parts, Diesel; and Cross Reference.

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 supplied or equivalent parts.

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 - MM148
Revision: 25
Published: 9-99
03952

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Acknowledgements: Technical information and/or illustrations supplied by Teledyne Continental Motors, Industrial Products Division; Sperry Vickers Corporation; Eaton Corporation, Hydraulics Division.



CALIFORNIA PROPOSITION 65 WARNING:

Engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

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.
 - Report Machine Damage of Faulty Operation Immediately.

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.
 - 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 Approved 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).

GENERAL INFORMATION



WARNING: Explosion or fire could occur:

- If machine is used to pick up flammable spills from floors.
- If machine picks up reactive metals, such as aluminum or magnesium. Reactive metals and some detergents form explosive hydrogen gas. Contact Tennant Company for appropriate detergent selection.



WARNING: Moving Belt. Keep Away.



WARNING: Moving Fan Blades. Keep Away.



WARNING: Raised Scrub Head May Fall. Block Scrub Head Up.



WARNING: Crush Hazard Between Front And Rear Halves Of Machine. Engage Pivot Lock.



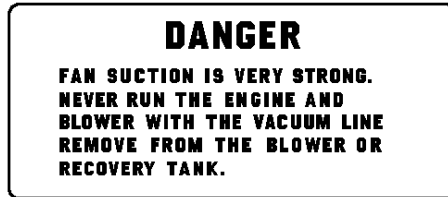
WARNING: Strong Vacuum. Keep Away From Fan Inlet When Fan Is Running.

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

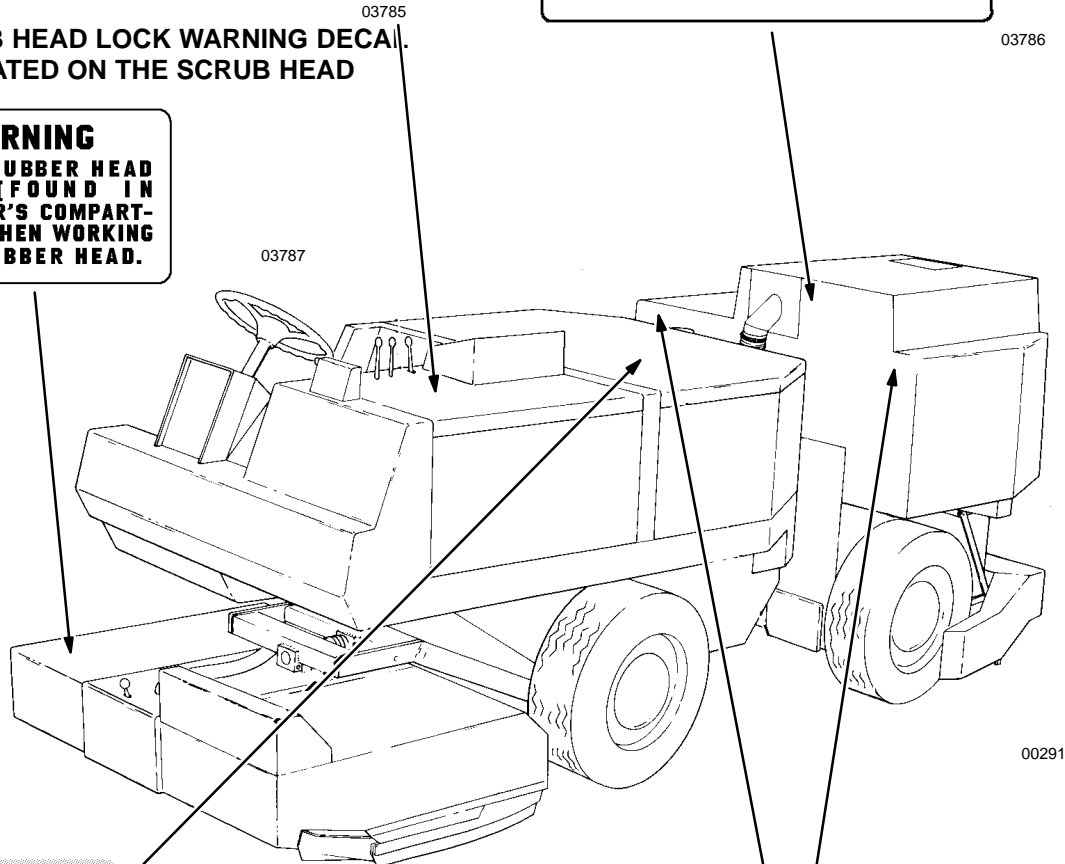
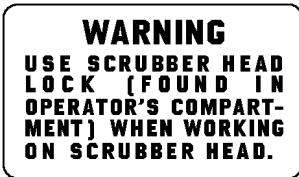
**TRAVEL SPEED CAUTION DECAL –
LOCATED ON THE SIDE OPERATOR
PANEL**



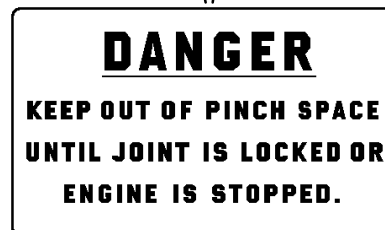
**FAN SUCTION DANGER DECAL –
LOCATED ON THE SOLUTION TANK**



**SCRUB HEAD LOCK WARNING DECAL –
LOCATED ON THE SCRUB HEAD**



**ENGINE FAN WARNING DECAL –
LOCATED ON THE FAN SHROUD**



**PINCH SPACE DANGER DECAL –
LOCATED ON THE SOLUTION TANK**

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MACHINE SPECIFICATIONS

POWER TYPE

Engine manufacturer/model – Continental F163
 Engine type – piston
 Ignition – breaker type spark
 Cycle – 4
 Aspiration – natural
 Cylinders – 4
 Bore – 3.44 (85 mm)
 Stroke – 4.38 (110 mm)
 Displacement – 162 cu in (2.7 L)
 Net power – 59 hp (45 kw) @ 2400 rpm
 governed 63 hp (50 kw) @ 2800 rpm
 maximum
 Fuels – gasoline, 86 octane, or LPG
 Cooling system – water
 Electrical system – 12 V nominal, 35 A alternator

Engine manufacturer/model – Continental TM27
 Engine type – piston
 Ignition – breaker-less type spark
 Cycle – 4
 Aspiration – natural
 Cylinders – 4
 Bore – 3.58 in (90 mm)
 Stroke – 4.06 in (105 mm)
 Displacement – 164 cu in (2.7 L)
 Net power – 58 hp (43 kw) @ 2400 rpm
 governed 70 hp (52 kw) @ 3000 rpm
 maximum
 Fuels – gasoline, 85 octane unleaded, or LPG
 Cooling system – water
 Electrical system – 12 V nominal, 42 A alternator

Engine manufacturer/model – Continental
 TMD27
 Engine type – piston
 Ignition – diesel
 Cycle – 4
 Aspiration – natural
 Cylinders – 4
 Bore – 3.58 in (90 mm)
 Stroke – 4.06 in (105 mm)
 Displacement – 164 cu in (2.7 L)
 Net power – 55 hp (40 kw) @ 2400 rpm
 governed 66 hp (50 kw) @ 3000 rpm
 maximum
 Fuels – #1 or #2 diesel fuel
 Cooling system – water
 Electrical system – 12 V nominal, 42 A alternator

POWER TRAIN

Propelling – hydraulic drive motors (2)
 Scrub brush – hydraulic drive motors (2)
 Vacuum fan – belt driven

STEERING

Type – articulated frame
 Power source – double action hydraulic cylinder
 Emergency steering – manual

HYDRAULIC SYSTEM

Function – operates propelling, steering, scrub
 brush drive, scrub head lift, rear squeegee
 lift.

Control valve, scrub brush drive, scrub head lift –
 open center, single spool.

Control valve, squeegee position – two position,
 electrical solenoid actuated.

Propelling pump – variable displacement piston
 type, 20.9 gpm (80 L/min) @ 2400 rpm

Propelling pump – variable displacement piston
 type, 22.7 gpm (86 L/min) @ 2200 rpm

Propelling system rated pressure – 4500 psi
 (31,030 kPa)

Scrub brush drive pump – vane type, 17.2 gpm
 (65 L/min) @ 2400 rpm

Scrub brush drive system rated pressure –
 2500 psi (17,240 kPa)

Accessories pump – vane type, 6.2 gpm
 (25 L/min) @ 2400 rpm

Accessories pump – gear type,
 front section: 15.8 gpm (60 L/min) @
 2400 rpm
 rear section: 4 gpm (15 L/min) @ 2400 rpm

Accessories system rated pressure – 2000 psi
 (13,790 kPa)

Propelling motor (2) internal gear type, 17 cu in
 (275 cc) per revolution, 1750 psi (12,065
 kPa) maximum rated pressure

Scrub brush drive motor (2) – internal gear type,
 9.9 cu in (160 cc) per revolution, 1200 psi
 (8275 kPa) maximum rated pressure

Scrub head lift cylinder – single action type, 2 in
 (50 mm) bore x 4 in (100 mm) stroke, 1 in
 (25 mm) diameter rod, 1500 psi
 (10,345 kPa) maximum rated pressure

SPECIFICATIONS

HYDRAULIC SYSTEM (Continued)

Rear squeegee lift cylinder – double action type, 2 in (50 mm) bore x 4 in (100 mm) stroke, 1 in (25 mm) diameter rod, 1500 psi (10,345 kPa) maximum rated pressure.

Steering cylinder – double action type, 2 in (50 mm) bore x 11 in (280 mm) stroke, 1 in (25 mm) diameter rod, 2000 psi (13,790 kPa) maximum rated pressure

BRAKING SYSTEM

Service brakes – hydraulic caliper disc brakes (2), (one per front wheel) foot brake master cylinder actuated.

Parking brakes – mechanical caliper disc brakes (2), (one per front wheel), cable actuated.

SUSPENSION SYSTEM

Front – two 8.00 x 16.5 6-ply rating tubeless tires
Rear – two 8.00 x 16.5 6-ply rating tubeless tires

SYSTEM FLUID CAPACITIES

Engine cooling system, radiator – 6.4 qt (6 L)
Engine cooling system, total system – 13.4 qt (13 L)

Fuel tank, gasoline, diesel – 15.3 gal (60 L)
Fuel tank, LPG – 33 lb (15 kg)

Engine lubricating oil, gasoline, LPG – 4.5 qt (4 L)
Engine lubricating oil, diesel – 7 qt (6.5 L)

Hydraulic system, reservoir – 11.5 gal (45 L)
Hydraulic system, total system – 13.8 gal (52 L)

Standard solution tank – 140 gal (530 L)

Standard recovery tank – 120 gal (455 L)

SRS® solution tank – 240 gal (905 L)

SRS® cleaning solution tank – 10 gal (40 L)

GENERAL MACHINE DIMENSIONS/CAPACITIES

Length – 156.5 in (3975 mm)

Width – 61.25 in (1555 mm)

Height – 60.87 in (1545 mm)
Height with overhead guard – 83.63 in (2125 mm)

Track, front – 46.7 in (1185 mm)
Track, rear – 45.3 in (1150 mm)

Wheel base – 58.75 in (1490 mm)

Scrub brush (2), path width – 50 in (1270 mm)
Scrub brush (2), diameter – 11 in (280 mm)

Rear squeegee path width – 56.5 in (1435 mm)

Debris hopper capacity – 2.6 cu ft (0.073 m³)

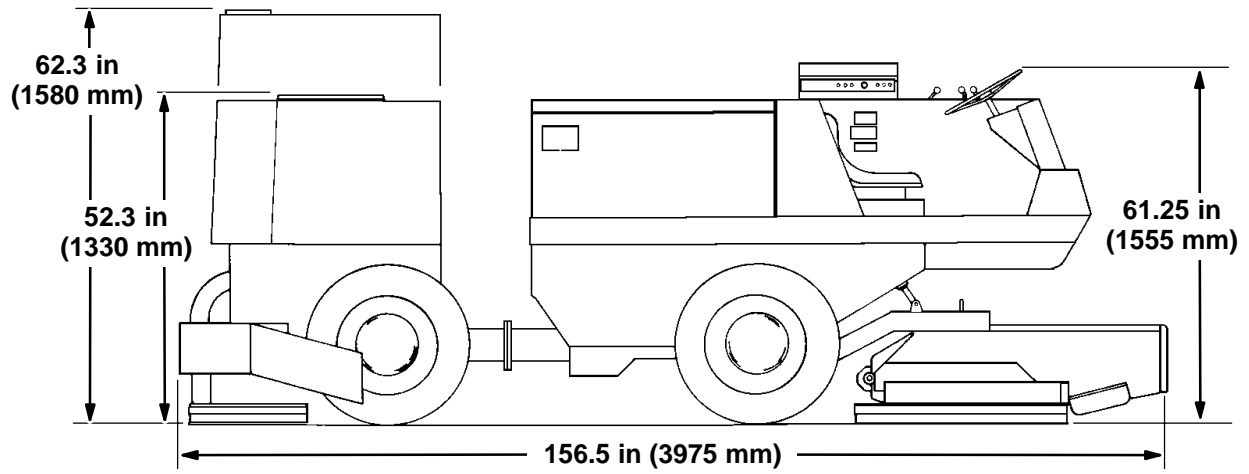
MACHINE WEIGHTS

GVWR – 7200 lb (3265 kg)

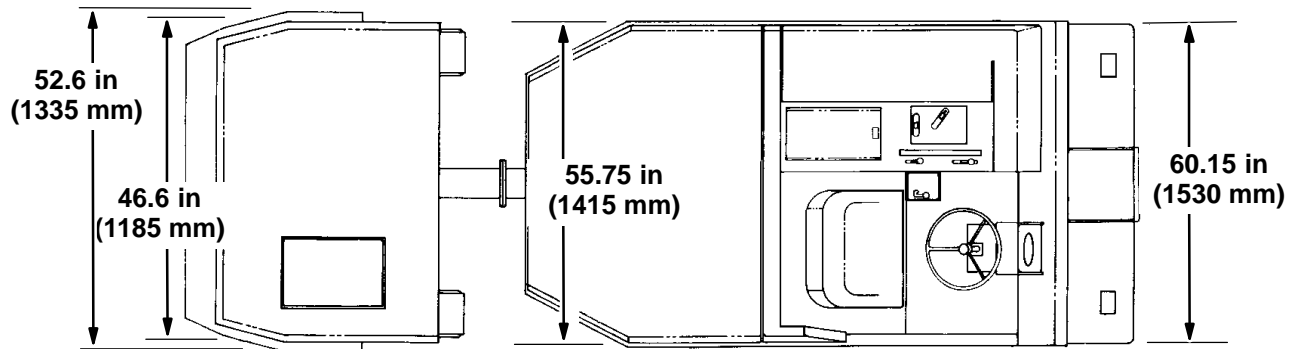
GENERAL MACHINE PERFORMANCE

Maximum forward speed – 9 mph (14.5 km/h)
Maximum reverse speed – 5 mph (8 km/h)
Turning radius, right – 98 in (2490 mm)
Turning radius, left – 95.25 in (2420 mm)
Maximum rated climb and descent angle – 10°
Maximum rated climb and ascent angle when tanks are full – 8°

MACHINE DIMENSIONS



SIDE VIEW



TOP VIEW

00362

SECTION 2

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PREPARATION FOR OPERATION

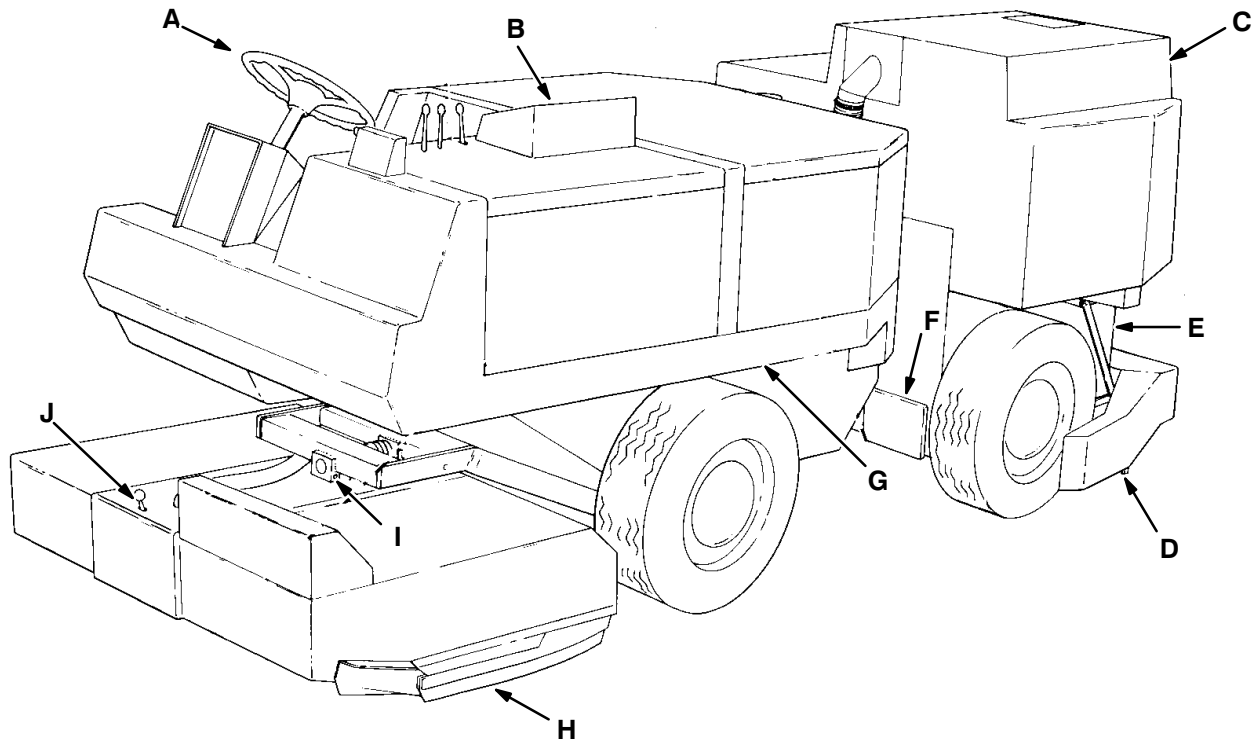
AFTER UNLOADING AND BEFORE OPERATING THE MACHINE:

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

FOR SAFETY: Do Not Operate 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 the *HYDRAULICS* in the *MAINTENANCE* section.
4. Check the engine oil level.
5. Check the radiator coolant level.
6. Check the brush adjustment, as described in *SCRUB HEAD* in the *MAINTENANCE* section.
7. Check the air pressure of the tires.
8. Fill the fuel tank, or install an LPG fuel tank on the machine per the instructions in this manual.

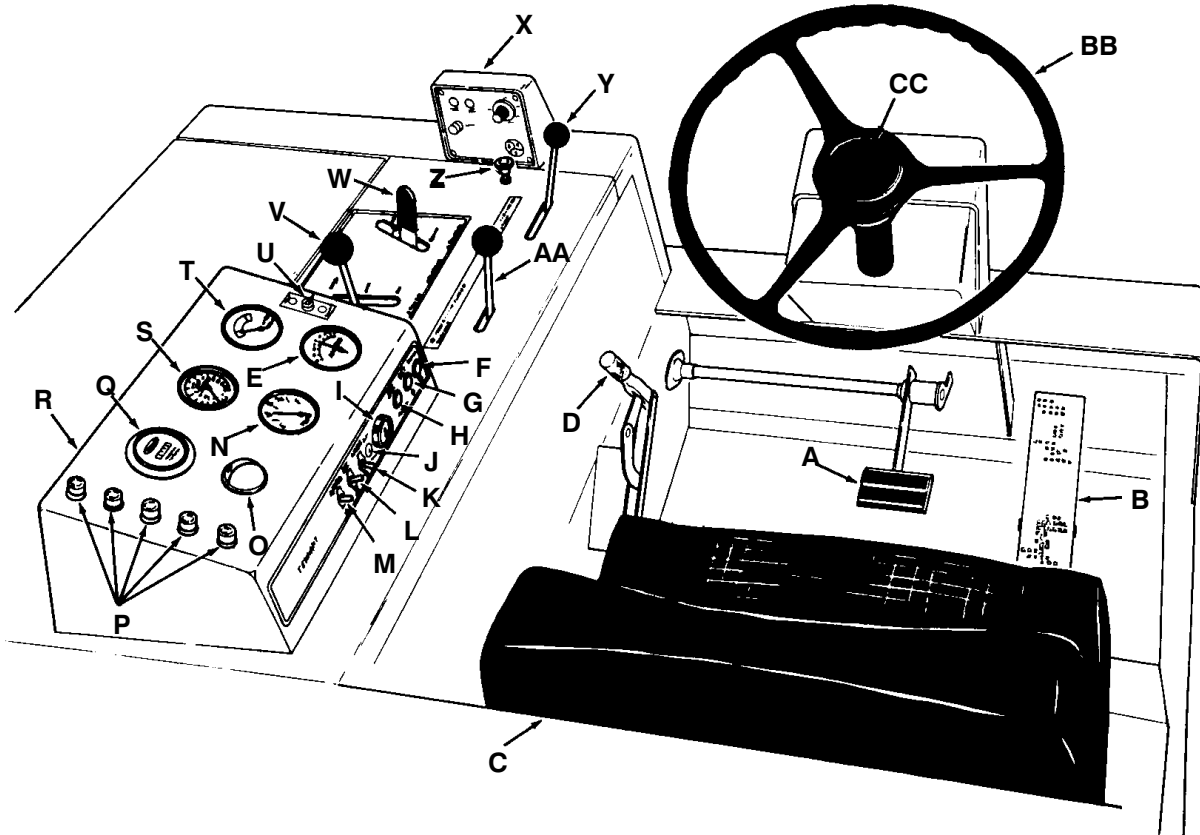
OPERATION OF CONTROLS



MACHINE COMPONENTS

00291

- | | |
|----------------------------|---------------------------------------|
| A. Steering Wheel | F. Clean-out Door |
| B. Instrument Panel | G. Articulated Joint |
| C. Solution Tank | H. Side Squeegee |
| D. Rear Squeegee | I. Head Pivot |
| E. Recovery Tank | J. Debris Trough Release Lever |



02353

INSTRUMENTS AND CONTROLS

- | | |
|------------------------------------|-------------------------------------|
| A. Brake Pedal | P. Fuses |
| B. Directional Pedal | Q. Engine Hour Meter |
| C. Operator Seat | R. Instrument Panel |
| D. Parking Brake Lever | S. Oil Pressure Gauge |
| E. Ammeter | T. Engine Coolant Temperature Gauge |
| F. Squeegee Position Lamp | U. Squeegee Switch |
| G. Tank Drain Lamp | V. Scrub Brush Lever |
| H. Scrub Brush Pressure Lamp | W. Scrub Head Position Lever |
| I. Ignition Switch | X. SRS® Panel |
| J. Diesel Pre-Heat Indicating Lamp | Y. Solution Lever |
| K. Operating Lights Switch | Z. Choke Knob |
| L. Rotating Light Switch | AA. Throttle Lever |
| M. Hazard Light Switch | BB. Steering Wheel |
| N. Fuel Level Gauge | CC. Horn Button |
| O. Panel Lamp | |

OPERATION

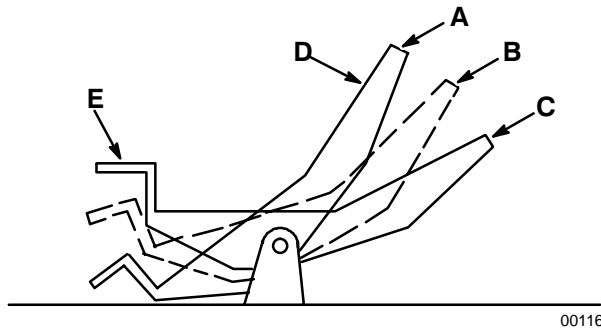
BRAKE PEDAL

The brake pedal operates the brakes on the two front 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 propelling drive. The foot pedal is used to select the direction of travel and the speed of the machine.



DIRECTIONAL PEDAL

00116

- A. "Reverse" Position
- B. "Neutral" Position
- C. "Forward" Position
- D. "Toe" Portion
- E. "Heel" Portion

Gradually press the "toe" portion of the pedal for forward travel or the "heel" portion of the pedal for reverse travel. Regulate the speed of the machine by varying the pressure on the pedal.

NOTE: Always use the brake pedal for normal stopping and controlling machine speed on down grades.

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.

SCRUB HEAD LOCK LEVER

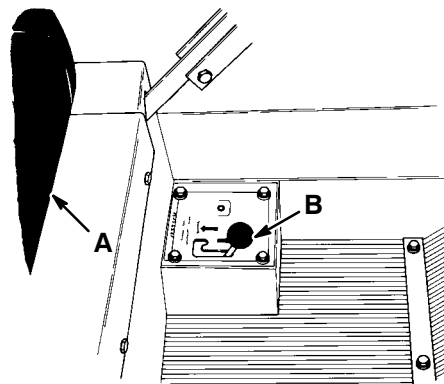
The scrub head lock lever controls the scrub head lock mechanism. This locks the scrub head, preventing it from lowering.

To set the scrub head lock, fully raise the scrub head. Then push the scrub head lock lever into the "LOCK" position.

To release the scrub head lock, fully raise the scrub head. Then pull the scrub head lock lever into the "UNLOCK" position.

Always set the scrub head lock before working under the scrub head. The scrub head lock must also be set whenever the machine will not be used for an extended period of time, overnight for example. Flat spots on the brushes will appear if the scrub head is left down for an extended period of time.

WARNING: Raised Scrub Head May Fall. Block Scrub Head Up.



SCRUB HEAD LOCK LEVER

01816

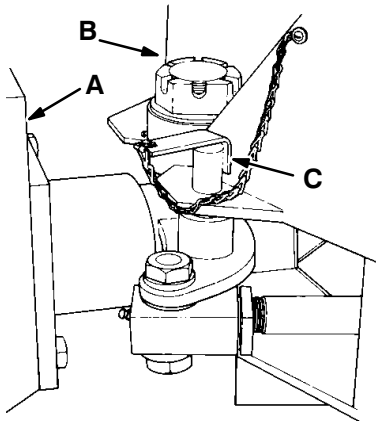
- A. Operator Seat
- B. Scrub Head Lock Lever

PIVOT LOCK PIN

The pivot lock pin is provided to lock the pivot joint between the front and rear machine sections. The pin is hung on the front section of the machine adjacent to the machine pivot.

To lock the sections, turn the machine so the pivot lock holes line up, then insert the pin in the lined up holes. The pin will prevent the machine from pivoting and creating a pinch area.

⚠ WARNING: Crush Hazard Between Front And Rear Halves Of Machine. Engage Pivot Lock.



PIVOT LOCK PIN IN USE

00251

- A. Machine Trailer Section**
- B. Machine Tractor Section**
- C. Pivot Lock Pin**

PARKING BRAKE LEVER

The parking brake lever controls the brakes on the two front wheels. To set the parking brake pull the brake handle up. To release the parking brake push the brake handle down. Always set the parking brake 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.

AMMETER

The ammeter registers the charging current which is being passed to the battery by the alternator. It also registers battery discharge used by the machine when the alternator is not charging.

SQUEEGEE POSITION LAMP

The squeegee position lamp lights when the squeegee is either fully raised or lowered. This can be helpful to the operator when the squeegee is not visible.

TANK DRAIN LAMP

The tank drain lamp lights when the recovery tank is nearly full. The machine operator can then plan to return to a draining location.

SCRUB BRUSH PRESSURE LAMP

The scrub brush pressure lamp option lights when scrub brush down pressure is excessive, which may cause the brushes to stall. The operator should then check the brush position adjustment.

NOTE: This information holds true only after the hydraulic fluid has warmed up (about 10 to 15 minutes). If the light comes on after the oil is warm, the cause may be operating on a rough floor-use "restricted" brush down pressure.

IGNITION SWITCH

The key-operated ignition switch has four positions. Those positions are "accessories," "off," "on," and "start." To operate any electrical option without operating the engine, turn the switch to the "accessories" position.

To start the engine, turn the key to the "start" position. Do not engage the starter for more than ten seconds at a time, or after the engine has started, as the starter may be damaged. To stop the engine, turn the key to the "off" position.

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

DIESEL PRE-HEAT INDICATING LAMP

The diesel pre-heat indicating lamp is present on diesel powered machines. The lamp lights when the diesel pre-heater is operating.

OPERATING LIGHTS SWITCH

The operating lights switch is present on machines with the operating lights option. It controls the headlights, taillights, and the brush spot light. Flip the switch toggle upward to turn the lights on. Flip the switch toggle down to turn the lights off.

ROTATING LIGHT SWITCH

The rotating light switch is present on machines with the rotating light switch option. Flip the switch toggle up to turn the light on. Flip the switch toggle down to turn light off.

HAZARD LIGHT SWITCH

The hazard light switch is present on machines with the hazard light option. Flip the switch toggle up to turn the light on. Flip the switch toggle down to turn the light off.

FUEL LEVEL GAUGE

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

PANEL LAMP

The panel lamp is present on machines with the operating lights option. The lamp lights whenever the operating lights switch toggle is flipped up to turn on the operating lights.

FUSES

Fuses are a one-time circuit protection device designed to stop the flow of current in the event of a circuit overload. Never substitute higher value fuses than those specified in this manual. The chart below shows the various fuses and the electrical components they protect.

PROTECTIVE-DEVICE	RATING	CIRCUIT PROTECTED
Fuse	15 A	Auto-Squeegee
Fuse	1 A	Recovery Tank Level Lamps
Fuse	1 A	SRS® Tank Level Lamps
Fuse	15 A	Brush Pressure Lamp, Squeegee Pressure Lamps
Fuse	20 A	Rotating, Hazard Lights
Fuse	10 A	SRS® Solution Pump

ENGINE 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.

ENGINE OIL PRESSURE GAUGE

The engine oil pressure gauge registers the engine oil pressure. Normal engine oil pressure ranges from 7 psi (50 kPa) at idle, to 35 psi (240 kPa) 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 severe engine damage.

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. Over-heating may occur due to a low coolant level, a clogged radiator, a loose fan belt, a defective thermostat, or other engine malfunctions. Engine overheating will always cause a coolant loss. If coolant loss does not occur, check for malfunction of the temperature sending unit.

SQUEEGEE SWITCH

The squeegee switch, in conjunction with a hydraulic flow sensing device, and the scrub brush lever, controls the position of the rear squeegee.

To raise the squeegee, flip the switch toggle forward into the "Squeegee Up" position. This position cannot be overridden by the hydraulic flow sensing device.

To lower the squeegee, flip the switch toggle back into the "Down" position. The squeegee will lower when the machine starts moving in the forward direction. When traveling in the reverse direction, the hydraulic flow sensing device overrides the squeegee switch and raises the rear squeegee. This prevents the rear squeegees from being damaged when traveling in reverse. The squeegee switch should always be in the "Down" position when scrubbing.

SCRUB BRUSH LEVER

The scrub brush lever controls the scrub brush motors. To start the scrub brushes rotating in their normal direction, pull the lever into the “ON” position. To stop brush rotation, move the lever into the “OFF” position.

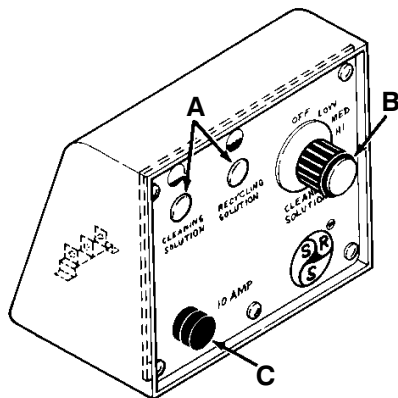
To start the scrub brushes rotating opposite their normal direction for double scrubbing, push the lever into the “REVERSE” position.

SCRUB HEAD POSITION LEVER

The scrub head position lever controls the position of the scrub head. To raise the scrub head, pull the lever back into the “RAISE” position. To stop scrub head movement move the lever to the “HOLD” position. To lower the scrub head, push the lever into the “LOWER” position.

SRS® LIQUID LOW LEVEL LAMPS

The SRS® liquid low level lamps option includes two indicating lamps. The cleaning solution lamp lights when the cleaning solution level is low. The recycling solution lamp lights when the recycling solution is low.



SRS® CONTROL PANEL

00351

- A. Liquid Low Level Indicator Lamps**
- B. Cleaning Solution Flow Knob**
- C. SRS® Pump System Fuse**

SRS® CLEANING SOLUTION FLOW KNOB

The SRS® cleaning solution flow knob controls the pumping of cleaning solution into the solution flow to the floor. The “LOW”, “MED”, and “HI” levels indicate the rate of cleaning solution flow.

The “LOW” level causes the pump to deliver one-fourth flow capacity, “MED” level one-half capacity, and “HI” level full pump capacity of cleaning solution into the solution flow to the floor. The “OFF” position shuts off the cleaning solution flow.

SOLUTION LEVER

The solution lever controls the solution control valve. To stop solution flow to the floor, push the lever into the “CLOSED” position. To start solution flow, pull the lever into the “OPEN” position.

ENGINE CHOKE KNOB

The engine choke knob is present on gasoline powered machines. The knob controls the engine choke. To aid the starting of a cold engine, close the engine choke by pulling the knob out. After the engine has warmed up, push the knob in to open the engine choke, allowing the engine to run normally at its operating temperature and speed. Using the choke on a warm engine is not necessary.

THROTTLE LEVER

The throttle lever controls the engine governed speed on a gasoline and LPG powered machine. The throttle lever controls the engine governed speed and stops the engine on a diesel powered machine. To speed the engine to the maximum governed speed, move the lever into the “FULL” position. To slow the engine to idle speed, move the lever to the “IDLE” position. To stop the engine on a diesel powered machine, move the lever to the “STOP” position.

STEERING WHEEL

The steering wheel controls a steering cylinder which is mounted between the two halves of the machine. Do not turn the steering wheel excessively when the engine is not running. An articulated trunnion connects the front and rear sections of the machine so that the rear section always follows the path of the front section. A horn button is located in the center of the steering wheel.

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.

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.

Check the engine lubricating oil level.

Check the engine air filter restriction indicator.

Check the fuel level.

Check for LPG odor indicating a leak.

Check for frosting on the LPG hoses and components.

Check to make sure a liquid withdrawal LPG tank is to be used.

Check the brakes and controls for proper operation.

Check the service records to determine service requirements.

TO START MACHINE

NOTE: Before starting machine, perform the pre-start checks.

1. LPG machines: Check the LPG fuel tank gauge to see if there is an adequate fuel supply.
2. LPG 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 service valve, wait a few seconds, and slowly open the service valve once again.

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

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

4. Cold gasoline engines: Pull out the choke button about three-fourths of the way. Push choke in after the engine has started and is running smoothly.

Cold diesel engines: Turn the ignition key to the "on" position to start the diesel pre-heater. Wait until the pre-heater lamp goes off, then proceed to start the engine.

ATTENTION! Do not use a cold engine starting aid such as ether unless directed to by a representative of the engine manufacturer.

5. Move the throttle control lever to the "IDLE" position.

- Turn the ignition switch key to the “start” position until the engine starts. Do not operate the starter for more than ten seconds at a time or after the engine has started.

NOTE: Do not operate the starter motor for more than ten 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.

- Allow the engine and hydraulic system to warm up three to five minutes.
- Release the machine parking brake.
- Drive the machine to the solution filling site.

TO FILL SOLUTION TANK

- Stop the engine and set the parking brake.

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

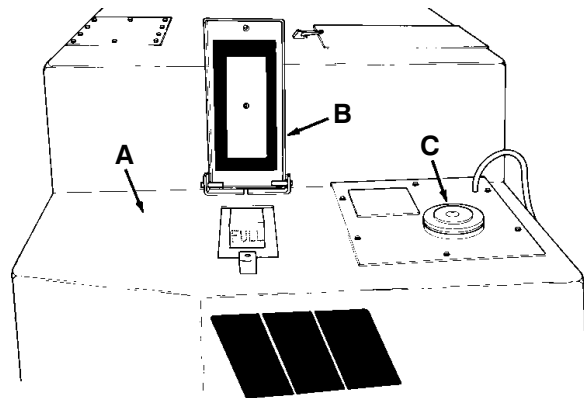
- Open the solution tank fill door or cap.
- Pour the required amount of detergent into the tank. Fill the tank with water to 1 in (25 mm) below the tank opening. The water must not be hotter than 130°F (54°C) or tank damage may occur.

NOTE: If standing water is to be picked up in addition to the solution put down by machine, do not fill tank all of the way. This will allow more water to be picked up before the ball float shutoff is actuated.

SRS® machines: Pour liquid detergent into the cleaning solution tank – not the solution tank. Do not use powdered detergent or any other detergent not designed for the SRS® application. Replace the cleaning solution tank fill cap.

NOTE: Floor conditions, water condition, amount of soilage, type of soilage, brush action, and squeegee action all play an important role in determining the type and the concentration of detergent to be used. For specific recommendations, contact the local TENNANT representative.

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



SRS® TANK

00348

- A. Solution Tank**
- B. Solution Fill Door**
- C. Cleaning Solution Fill Cap**

- Close the solution fill door.

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.

- Drive the machine to the area to be scrubbed.
- Move the scrub head position lever to the “RAISE” position to release the scrub head lock.

OPERATION

3. Move the scrub head lock lever to the "UNLOCK" position.
4. Place the squeegee switch in the "Down" position.
5. Move the solution lever back to start the solution flow.

For SRS® machines: Turn the cleaning solution knob to the desired cleaning solution flow.

6. Move the scrub brush lever to the "ON" position.
7. Scrub as required.



WARNING: Explosion or fire could occur:

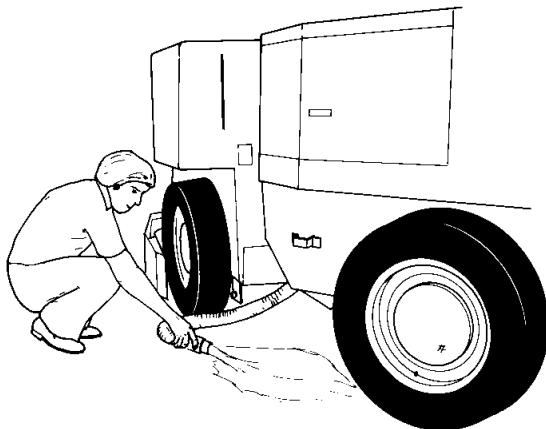
- If machine is used to pick up flammable spills from floors.
- If machine picks up reactive metals, such as aluminum or magnesium. Reactive metals and some detergents form explosive hydrogen gas. Contact Tennant Company for appropriate detergent selection.

TO DRAIN AND CLEAN RECOVERY TANK AND EMPTY HOPPER

1. Stop the engine and set the parking brake.

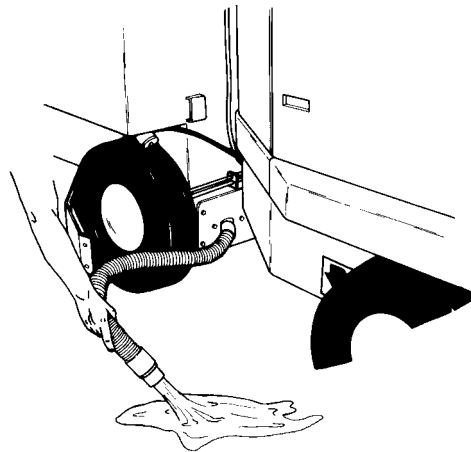
FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, And Turn Off Machine.

2. Remove and unplug the tank drain hose next to a floor drain.



DRAINING RECOVERY TANK

00288

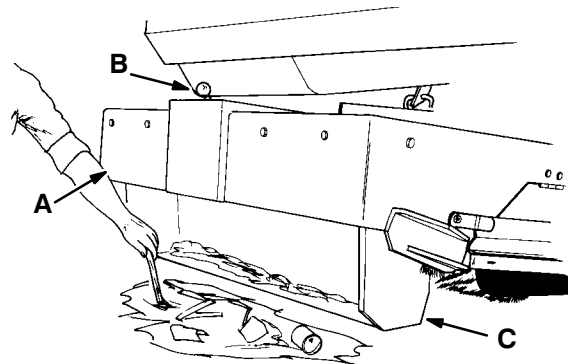


DRAINING SRS® TANK

00343

3. Pull the debris trough lever to dump the debris trough.

NOTE: If a more gentle dumping action is desired, the trough can be dumped with the scrub head lowered; then the head can be raised hydraulically to slowly tip the trough.



DUMPING DEBRIS TROUGH

00283

- A. Scrub Head**
- B. Debris Trough Lever**
- C. Debris Trough**

4. Clean the trough screen.
5. Clean the channel above the debris trough. If debris builds up in this area, the trough will not swing all the way up and latch properly. Remove any debris which has accumulated on top of the rail.

6. Close the debris trough.
7. Plug and secure the drain hose to the machine after tank is drained.
8. SRS® machines: Partially fill the solution tank with clean water. Run the SRS® pump for a few minutes to flush the solution hoses.

POST OPERATION CHECKLIST – ENGINE OPERATING

Check the scrub brush pattern for width and evenness.

Check the squeegees for proper deflection.

TO STOP MACHINE

1. Return the directional pedal to the “neutral” position. Apply the brake.
2. Move the solution lever to the “OFF” position.
3. Move the scrub head position lever to the “RAISE” position to set the scrub head lock.
4. Move the scrub head lock lever to the “LOCK” position.
5. Move the scrub brush lever to the “OFF” position.
6. Place the squeegee switch in the “Squeegee Up” position.
7. Turn off the operating lights if used.
8. Place the throttle lever in the “IDLE” position.
9. Set the machine parking brake.

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

10. Turn the ignition key switch to the “off” position. Remove the ignition key from the ignition switch.
11. Diesel powered machines: Hold the throttle lever in the “STOP” position to stop the engine.
12. LPG powered machines: Close the LPG tank liquid service valve.

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 the debris hopper.

Drain and clean the recovery tank.

Check the vacuum hoses for debris or obstructions.

Fill the fuel tank.

Check for leaks.

DOUBLE SCRUBBING OPERATION

Double pass scrubbing should be necessary only for heavy soilage and build-up of dirt, wax, etc. Operate the machine as desired for normal scrubbing but keep the rear squeegee up while making the first scrubbing pass. Allow the solution to soak on the floor for 15 to 20 minutes. Then make a second pass in the normal manner with the rear squeegee down.

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

OPERATION ON GRADES

Drive the machine slowly on grades. Some loss of rear wheel steering traction could occur when braking with empty solution tanks.

The maximum rated ramp climb angle is 10°.

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

OPERATION

MACHINE TROUBLESHOOTING

Problem	Cause	Remedy
Trailing water – poor or no water pickup	Worn rear squeegee	Rotate or replace rear squeegee 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
	Float stuck shutting off vacuum	Clean float
	Vacuum fan drive belt loose or broken	Adjust, or replace and adjust belt
	Debris caught on squeegee	Remove debris
	Foam filling recovery tank	Empty recovery tank; use less or change detergent
	Vacuum hose to rear squeegee disconnected or damaged	Reconnect or replace vacuum hose
	Vacuum fan to recovery tank hose damaged	Replace hose
	Little or no solution flow to floor	Solution tank empty
Solution control linkage broken or out of adjustment		Replace and/or adjust linkage
Solution supply lines plugged		Flush solution supply lines
Solution spreader holes plugged		Flush spreader holes
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
	Debris hopper full	Empty hopper
	Brushes have rotation set	Rotate brushes end-for-end
	Scrub brush drive failure	See <i>HYDRAULIC COMPONENTS TROUBLESHOOTING – Hydraulic Motor Failure</i> , in the <i>MAINTENANCE</i> section

OPTIONS OPERATION

HIGH PRESSURE SPRAYER

The high pressure sprayer option gives the machine the ability to spray wash grease, oil, and other dirt from trucks, racks, walls, etc. The water and detergent solution is taken from the solution supply line located under the operator seat. The solution is directed first to the spray pump which is driven off the machine hydraulic system. The spray pump has a 4 gpm (15 L/min) capacity up to 800 psi (5515 kPa). From the pump, the water flows through the hand-held sprayer.

NOTE: Pump only approved machine detergents and solutions through the high pressure sprayer. Acids and abrasive fluids may damage the unit.

The engine idle must be set between 700 and 850 rpm to allow the pump to operate at normal speed.

TO OPERATE HIGH PRESSURE SPRAYER

1. Set the machine parking brake.

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

2. Start engine. Place the throttle lever in the "IDLE" position.

ATTENTION! Do not operate the high pressure sprayer at full engine throttle or the water pump will fail.

3. Open the shutoff valve on the scrub head.
4. Adjust water pressure to 800 psi (5515 kPa) using red pressure adjustment knob on regulator.

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

5. Spray as required.

NOTE: Check the water spray pressure. It is to be 600 to 800 psi (4140 to 5515 kPa) when operating the sprayer. The maximum pressure when not spraying is 1200 psi (8275 kPa). To change the water pressure, adjust the red pressure adjustment knob on the regulator, or adjust the engine idle.

6. When finished, close the shutoff valve and relieve water pressure in the high pressure spray hose. Place all equipment in its proper storage location.

VACUUM WAND

The vacuum wand option gives the machine the added flexibility of picking up spills not accessible by the machine. A 20 ft (6095 mm) hose and wand utilizes the machine vacuum system.

TO OPERATE VACUUM WAND

1. Set the machine parking brake.

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

2. Remove the vacuum wand and hose from storage on the machine.
3. Remove the rear squeegee vacuum hose plate from the rear of the tank.
4. Attach the vacuum wand hose plate to the rear of the tank using the toggle clamps provided.
5. Start the engine.
6. Move the throttle lever to the "FULL" position.
7. Operate the vacuum wand as required.
8. When finished, stop the engine, and remove the vacuum wand hose plate from the rear of the tank.
9. Reconnect the rear squeegee vacuum hose plate to the rear of the tank using the toggle clamps provided.
10. Clean and rinse off the vacuum wand, hose, and related equipment as required.
11. Store the vacuum wand equipment in the proper locations.

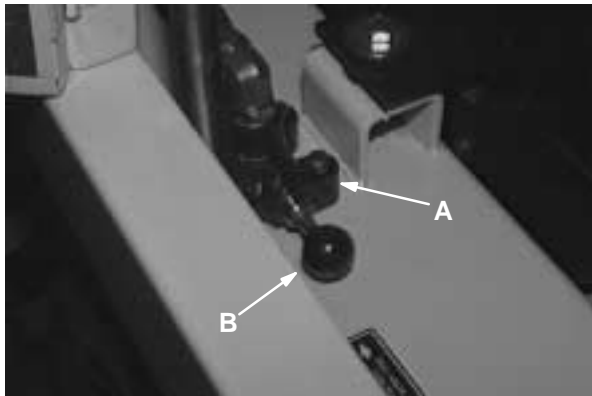
TRANSPORTING MACHINE

PUSHING OR TOWING MACHINE

The machine may be pushed or towed up to a distance of 1 mile (1.6 km) at speeds up to, but not exceeding, 5 mph (8 km/h). Distances and speeds over these may damage the hydraulic motors.

ATTENTION! Do not push or tow machine for more than 1 mile (1.6 km) at speeds exceeding 5 mph (8 km/h). Distances and speeds greater than these may damage the hydraulic motors.

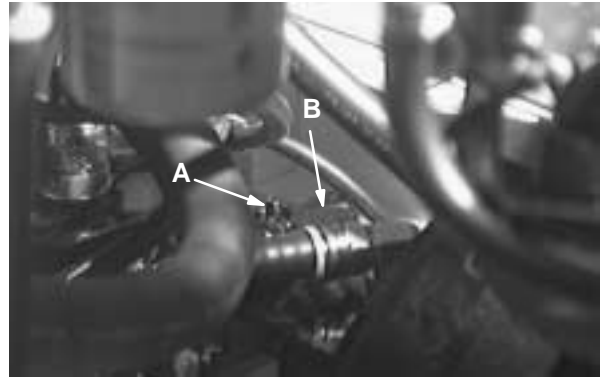
Machines serial number 005101 to 005268 have a tow bypass valve to prevent damage to the hydraulic system when the machine is being towed. Pull the handle out to tow the machine.



TOW BYPASS VALVE

- A. Tow Bypass Valve
- B. Handle

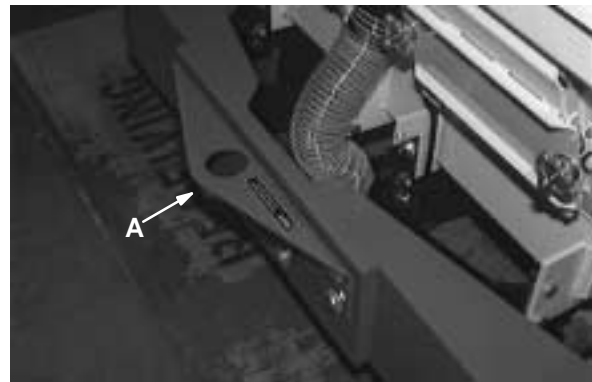
Machines serial number 005269 and above have a towing valve on the propelling pump to prevent damage to the hydraulic system when the machine is being towed. Turn the valve 90° clockwise before towing the machine.



TOWING VALVE

- A. Towing Valve
- B. Propelling Pump

You can tow the machine from the front or rear using the towing and tie-down brackets, located at the front or rear of the machine.



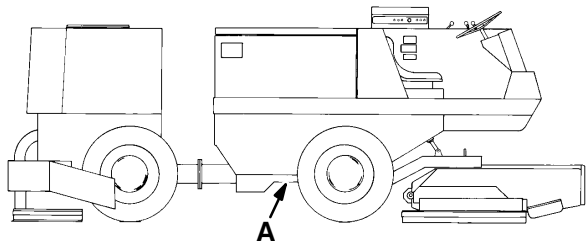
TOWING BRACKET

- A. Towing Bracket

MACHINE JACKING LOCATIONS

The machine jacking locations are labeled with a label. The tractor jacking locations are behind each of the front wheels, and the tank jacking locations are in front of the rear wheels.

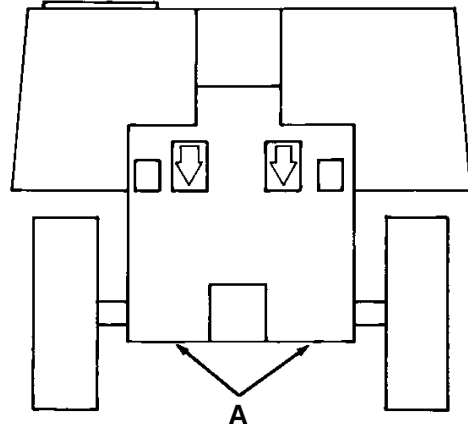
FOR SAFETY: When Servicing Machine, Block Machine Tires Before Jacking Machine Up. Jack Machine Up At Designated Locations Only. Block Machine Up With Jack Stands. Use Hoist Or Jack Of Adequate Capacity To Lift Machine.



TRACTOR JACKING LOCATION

00362

A. Jacking Location



TANK JACKING LOCATION

01820

A. Jacking Location

MACHINE STORAGE

STORING MACHINE

When storing the machine for extended periods of time, the following procedures must be followed to reduce the chance of rust, sludge, and other undesirable deposits to form:

1. Drain and clean out the solution recovery and cleaning solution tanks.
2. Park the machine in a cool and dry area.
3. Stop the engine and set the machine parking brake.

LPG powered machines: Close the LPG tank liquid service valve.

4. Raise and lock the scrub head.
5. Fill the hydraulic reservoir with hydraulic fluid to the full mark on the dipstick, to prevent excessive condensation from forming in the reservoir.

GASOLINE POWERED MACHINES

To store the machine 30 to 90 days:

1. Change engine oil and oil filter.
2. Remove the spark plugs.
3. Pour 3 oz (90 cc) of clean engine oil into each spark plug hole.
4. Remove the ignition coil high tension wire. 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.

5. Replace the high tension coil wire and spark plugs.
6. Drain the gasoline from the carburetor.

7. Seal the air cleaner inlet, the exhaust outlet, and the crankcase breather tube with weatherproof masking tape.
8. Tighten the engine oil filler cap, the fuel tank cap, and the radiator cap to make certain they are securely in place.

To store the machine 90 days to 6 months:

1. Remove the spark plugs.
2. Pour 3 oz (90 ml) of clean engine oil into each spark plug hole.
3. Remove the ignition coil high tension wire. 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 and spark plugs.
5. Drain the engine oil.
6. Drain the engine coolant from the radiator, and the engine block.
7. Close the drain cocks.
8. Drain gasoline from the carburetor, fuel tank, and the fuel lines.
9. Seal the air cleaner inlet, the exhaust outlet, and the crankcase breather tube 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.

DIESEL POWERED MACHINES

To store the machine for 30 days or more:

1. Change the engine oil and filter.
2. Drain all fuel from the fuel tank and the fuel filters. Pour 1 gal (4 L) of new, clean #1 diesel fuel in tank.
3. Prime the fuel system.
4. Seal the air vent in the fuel tank or filler cap with waterproof tape.
5. Drain engine coolant.
6. Remove the injectors and pour a small amount of pure castor oil into the cylinder bores.
7. Replace the injectors (using new copper sealing washers) and slowly rotate the crankshaft one complete revolution to evenly distribute the lubricant. Do not rotate crankshaft further so as not to destroy protective film on bore walls.
8. Remove the engine air filter and carefully seal the intake orifice with waterproof tape or some other suitable medium.
9. Remove the exhaust pipe and seal the manifold outlet.
10. Remove valve rocker cover. Lubricate the rocker gear with engine oil and replace the cover. Be sure that the gasket is correctly fitted.
11. Clean the engine breather pipe. Seal the end with waterproof tape or a cork.
12. Remove all of the belts from the engine and save for future use. Attach them to the engine to prevent loss.

SECTION 3

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MAINTENANCE

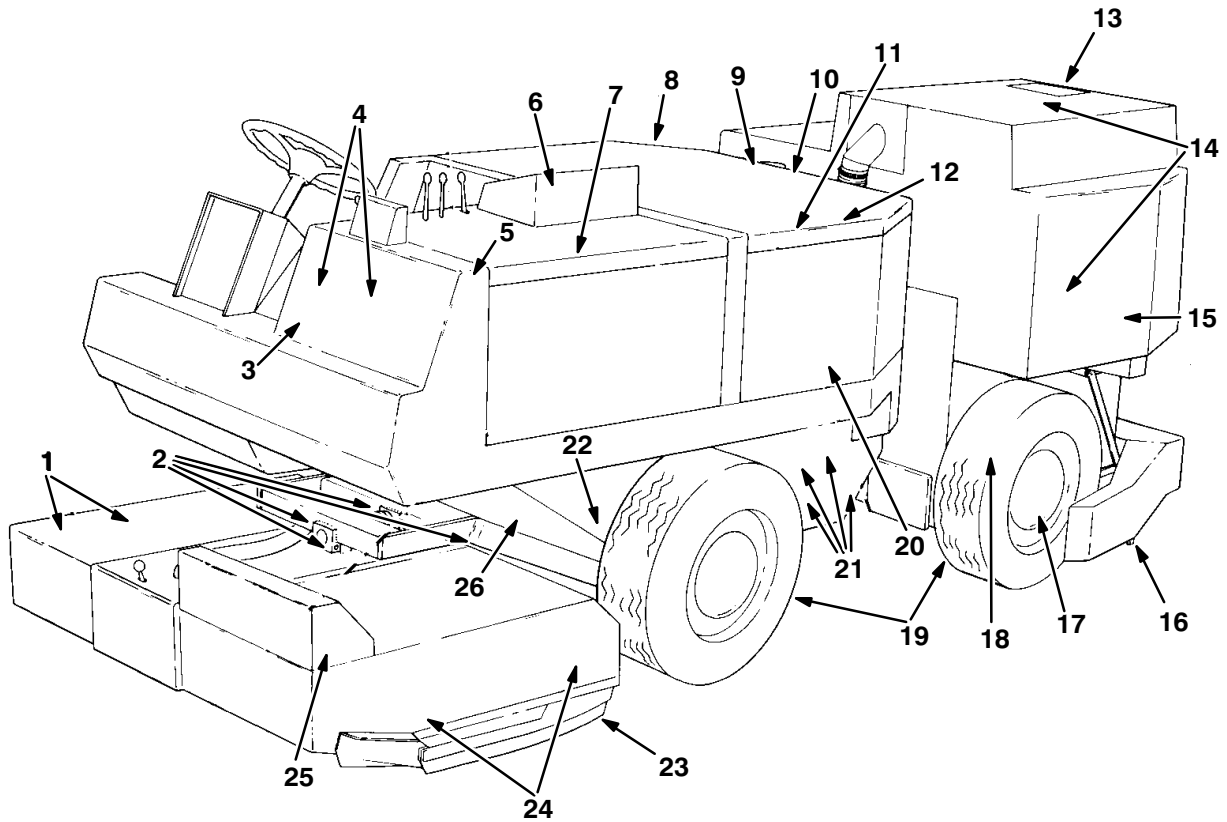
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RECOMMENDED FIRST 50-HOUR MACHINE INSPECTION

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

1. Check the air filter element. Tighten all connections on intake hose, air filter, etc.
2. Change engine oil and filter.
3. Check for the correct alternator and vacuum fan belt tension.
4. Check the scrub brush pattern.
5. Check the scrub head side squeegee blades for wear or damage.
6. Check the rear squeegee for worn or damaged blades or for incorrect adjustment.
7. Check vacuum hoses for damage or loose connections.
8. Check engine valve tappet clearance.
9. Diesel powered machines: Remove the rocker assembly and tighten the cylinder head nuts in the correct sequence and to the correct torque.
10. Torque the cylinder head bolts to the proper specification.
11. Perform all remaining 50-hour lubrication and maintenance procedures listed in the *MAINTENANCE CHART*.

MAINTENANCE CHART



00291

Interval	Key	Description	Procedure	Lubricant/ Fluid	No. of Service Points
Daily	7	Engine air filter	Check service indicator	–	1
	11	Engine crankcase	Check oil level	EO	1
	16	Rear squeegee	Check for damage, wear, and adjustment	–	1
	23	Side squeegees	Check for damage, wear, and adjustment	–	2
	24	Scrub brushes	Check for damage, wear, and adjustment	–	2
	19	Tires	Check air pressure	–	4
	13	SRS® Solution tank and metering pump	Empty and clean Flush laminar tubes	–	1
50 Hours	11	Engine crankcase	Change oil and oil filter element	EO	1
	24	Scrub brushes	Rotate brushes	–	2
	21	Machine pivot	Lubricate	SPC	4
	2	Scrub head pivot	Lubricate	SPC	4
	22	Scrub head hinges	Lubricate	SPC	2
	18	Rear squeegee casters	Lubricate	SPC	3
	1	Scrub brush idler plugs	Lubricate	SPC	2
	6	Vacuum fan shaft	Lubricate	SPC	1
	10	Radiator	Clean exterior	–	1
9	SRS® cleaning solution filter on machines below serial number 003790	Clean	–	1	

Interval	Key	Description	Procedure	Lubricant/ Fluid	No. of Service Points
50 Hours	25	Solution dispensing tube	Flush	–	1
	8	Vacuum fan drive belt	Check tension	–	1
100 Hours	11	Water trap, diesel	Clean	–	1
	8	Intermediate drive belt	Check tension	–	1
	12	Alternator belt	Check tension	–	1
	5	Hydraulic fluid reservoir	Check fluid level	HYDO	1
	10	Radiator	Check coolant level	WG	1
200 Hours	11	Engine, gasoline, LPG	Clean or replace and adjust spark plugs	–	4
			Clean or replace and adjust distributor points (F163 only)	–	1
			Clean PCV hoses, tubes, and fittings	–	1
			Lubricate distributor felt	EO	1
	26	Parking brake	Check adjustment	–	1
	14	Spray deflectors	Check for wear	–	2
	19	Wheels	Tighten lug nuts	–	4
400 Hours	5	Hydraulic fluid reservoir	Change hydraulic fluid	HYDO	1
	4	Hydraulic fluid filters	Change filter element	–	2
	3	Brake master cylinder	Check fluid level	BF	1
	11	Engine, gasoline, LPG	Adjust valve tappets	–	8
			Torque cylinder head bolts	–	15
	11	Engine, diesel	Adjust valve tappets	–	8
	11	Fuel filter, diesel	Replace filter elements	–	2
	11	Water trap filter, diesel	Replace filter element	–	1
800 Hours	5	Hydraulic reservoir breather	Replace	–	1
	10	Cooling system	Flush	–	1
2000 Hours	17	Rear wheel bearings	Repack with lubricant	WBG	2

BF – Brake fluid

EO – Engine oil

HYDO – TENNANT or approved hydraulic fluid

SPC – Special lubricant, Lubriplate EMB grease, TENNANT Part No. 01433–1

WBG – Wheel bearing grease

WG – Water and permanent-type ethylene glycol antifreeze, 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 50 hours of operation. Change the engine oil more frequently if the environment is extremely dusty.

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

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

SINGLE VISCOSITY OILS			
-10° to 32°F (-23° to 0°C)	10° to 60°F (-12° to 16°C)	32° to 90°F (0° to 32°C)	Above 60°F (Above 16°C)
10W	20W 20	30	40

The engine oil capacity for machines with the F163 engine is 4.5 qt (4.2 L) with filter.

The engine oil capacity for machines with the TM27 engine is 7 qt (6.6 L) with 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. Change the engine oil more frequently if the environment is extremely dusty.

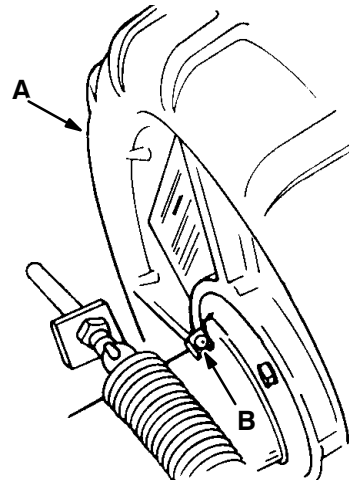
The following oil grades are recommended for engines operating in the ambient temperatures listed.

SINGLE AND MULTI-VISCOSITY OILS		
Below 32°F (Below 0°C)	32° to 77° F (0° to 25° C)	Above 77° F (Above 25° C)
10W 10W 30	20	30

The engine oil capacity is 7 qt (6.6 L) with filter.

VACUUM FAN SHAFT

There is one grease fitting which is used to lubricate the vacuum fan shaft. Grease the vacuum fan bearings after every 50 hours of operation. The vacuum fan grease fitting is covered with a plastic cap. Snap the cap open and apply Lubriplate EMB grease (TENNANT Part No. 01433-1) to the vacuum fan grease fitting. Wipe off all excess grease and replace the grease fitting cap.



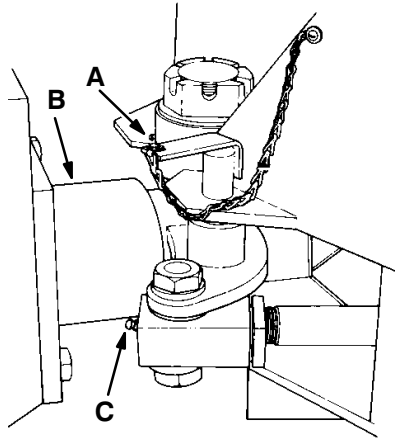
VACUUM FAN

03789

- A. Vacuum Fan
- B. Grease Fitting

MACHINE PIVOT

There are four grease fittings which are used to lubricate the machine pivot assembly. There is an upper bearing grease fitting, a lower bearing grease fitting, and a grease fitting on each rod end of the steering cylinder. Apply grease to these fittings after every 50 hours of operation. Use a Lubriplate EMB grease (TENNANT Part No. 01433-1).



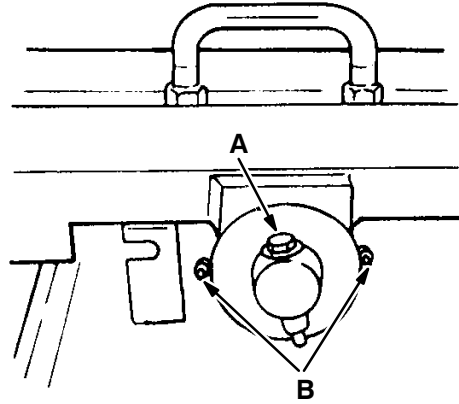
MACHINE PIVOT

00251

- A. Upper Bearing Grease Fitting
- B. Machine Pivot
- C. Steering Cylinder Rod End Grease Fitting

SCRUB HEAD PIVOT

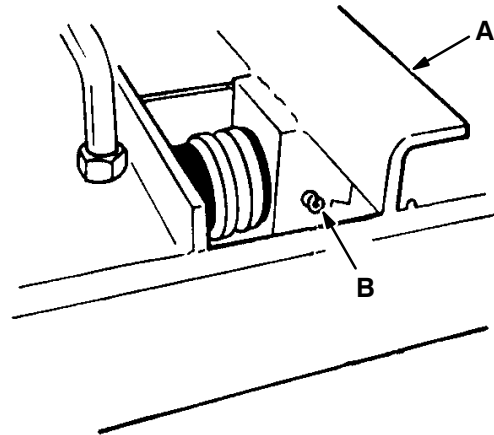
There are four grease fittings which are used to lubricate the scrub head pivot assembly—one on each of the four scrub head pivot blocks. Apply grease to these fittings after every 50 hours of operation. Use a Lubriplate EMB grease (TENNANT Part No. 01433-1).



SCRUB HEAD PIVOT

03790

- A. Pivot
- B. Grease Fitting



SCRUB HEAD PIVOT

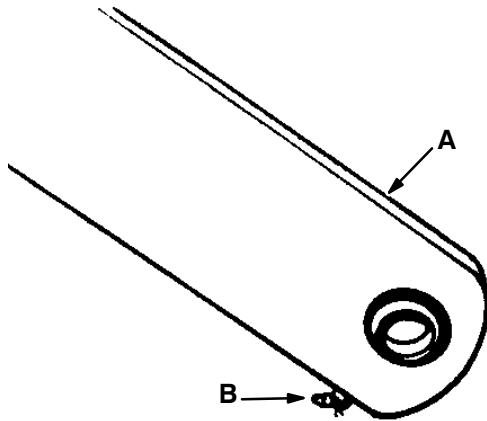
03791

- A. Scrub Head
- B. Grease Fitting

MAINTENANCE

SCRUB HEAD HINGES

There are two grease fittings which are used to lubricate the scrub head hinges. One grease fitting is located on the underside of each of the hinges. Apply grease to these fittings after every 50 hours of operation. Use a Lubriplate EMB grease (TENNANT Part No. 01433-1).



SCRUB HEAD HINGE

03792

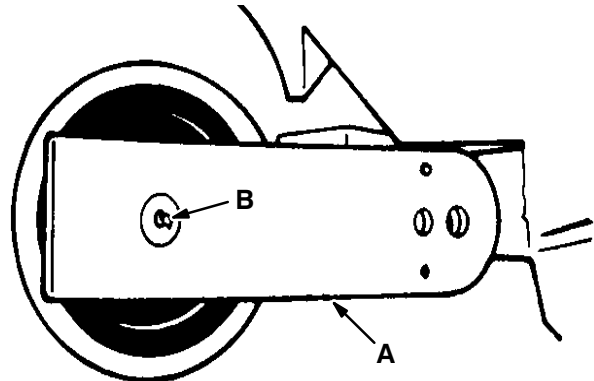
- A. Scrub Head
- B. Grease Fitting

REAR SQUEEGEE CASTERS

Lubricate the rear squeegee casters after every 50 hours of operation. Use Lubriplate EMB grease (TENNANT Part No. 01433-1).

SCRUB BRUSH IDLER PLUGS

There are two grease fittings which are used to lubricate the brush idler plugs. They are located in the center of each idler plug and are covered with plastic caps. Snap the caps open to apply grease to the fittings. Use a Lubriplate EMB grease (TENNANT Part No. 01433-1). Wipe off all excess grease and replace the plastic cap. Apply grease to the fittings after every 50 hours of operation.



BRUSH IDLER PLUG

03793

- A. Idler Arm
- B. Grease Fitting

REAR WHEELS

The rear wheels have automotive-type bearings. Repack the bearings with automotive-type wheel bearing grease after every 2000 hours of operation.

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.

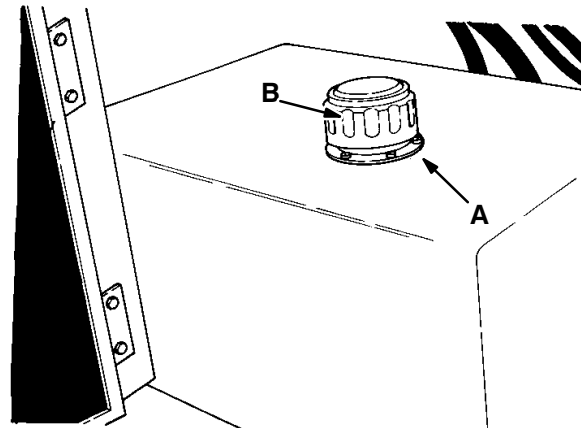
If a locally-available hydraulic fluid is preferred, or if products of only one oil company are used, contact TENNANT Technical Customer Service to check the specifications of the substitute fluid. Using substitute fluids can cause premature failure of hydraulic components.

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 up to 11.5 gal (44 L) of hydraulic fluid. The reservoir is located in the front left corner of the machine.

The reservoir is equipped with a breather-filler cap and fluid level dipstick mounted on the filler neck. See Hydraulic Fluid Reservoir Breather for breather service information.



02354

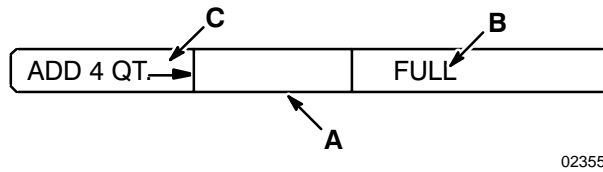
HYDRAULIC FLUID RESERVOIR
BREATH-FILLER CAP

- A. Filler Neck
- B. Breather-Filler Cap

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” mark on the dipstick, but not above the “full” mark when the hydraulic fluid is at operating temperature.



HYDRAULIC FLUID LEVEL DIPSTICK

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

Lubricate the filler cap gasket with a film of hydraulic fluid before putting the cap back on the reservoir.

Do not overfill the hydraulic fluid reservoir. The 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 set the machine parking brake.

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

2. Allow the hydraulic fluid to cool.
3. Open the left side access door.

4. Loosen the breather-filler cap. Remove the reservoir drain plug 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 and breather-filler cap.
7. Close the left side access door.

TO FILL THE HYDRAULIC FLUID RESERVOIR

1. Open the left side access doors.
2. Remove the breather-filler cap.
3. Pour the new hydraulic fluid into the hydraulic fluid reservoir through a 200 mesh screened funnel. Watch the hydraulic fluid level on the sight gauge. Do not overfill the reservoir.

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. Place the reservoir breather-filler cap securely on the reservoir.
7. Close the access doors.

HYDRAULIC FLUID RESERVOIR BREATHER

The hydraulic fluid reservoir is equipped with a breather. The breather is built into the filler cap on top of the reservoir. It maintains atmospheric pressure in the reservoir. The breather should be replaced after every 800 hours of operation.

HYDRAULIC FLUID FILTER

The hydraulic system is kept clean to a level of 10 microns by two hydraulic fluid filters. They are located in the engine compartment and should be changed after every 400 hours of operation.

TO REPLACE THE HYDRAULIC FLUID FILTER ELEMENT

1. Park the machine on a flat surface, stop the engine, and set the machine parking brake.

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

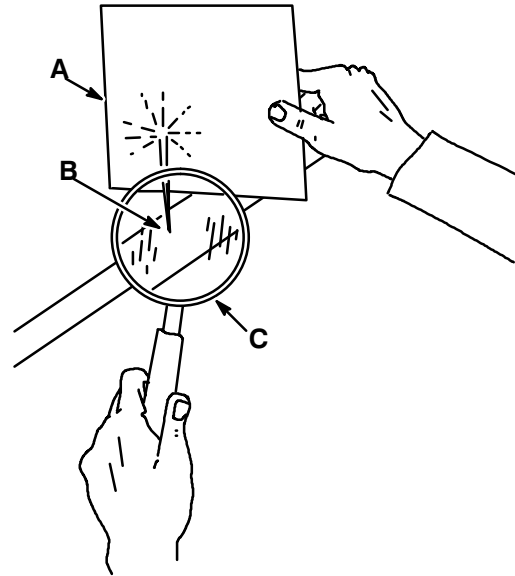
2. Open the left side access doors.
3. Unthread and discard the hydraulic fluid filter elements.

NOTE: 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 elements on the filter heads.
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 access doors.

HYDRAULIC FLUID LEAKS

Hydraulic fluid escaping at high pressure from a very small hole can be almost invisible and can cause serious injuries. Use a piece of cardboard or wood, rather than hands, to search for suspected leaks.



HYDRAULIC PIN HOLE LEAK

00002

- A. Cardboard**
- B. Pin Hole 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 COMPONENTS TROUBLESHOOTING

Problem	Cause	Remedy
Hydraulic cylinder failure	Piston seals leaking	Install seal kit
	Barrel worn or rod bent	Replace cylinder
Hydraulic control valve failure	Valve seals leaking	Install seal kit
	Solenoid failure	Replace solenoid
	Solenoid spool sticking	Replace valve section
	Check valve sticking	Replace valve
	Relief valve stuck open (leaking)	Clean or replace relief valve
Hydraulic steering valve failure	Valve leaking	Install seal kit
	Drive link failure	Replace drive link
	Thrust bearing worn	Replace thrust bearing
	Gerotor worn	Replace gerotor set
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 vane pump failure	Pump leaking	Install seal kit
	Vane set failure	Replace vane set
	Relief valve stuck	Replace relief valve
	Engine-to-pump coupling failure	Replace coupling
Hydraulic piston pump failure	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

ENGINE

LUBRICATION

Check the engine oil level daily.

GASOLINE AND LPG POWERED ENGINES

Gasoline and LPG powered engines should be lubricated with SAE–SE/SF rated engine oil. Change the engine oil and oil filter after every 50 hours of operation. Change the engine oil more frequently if the environment is extremely dusty.

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

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

The engine oil capacity for machines with the F163 engine is 4.5 qt (4.2 L) with filter.

The engine oil capacity for machines with the TM27 engine is 7 qt (6.6 L) with 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. Change the engine oil more frequently if the environment is extremely dusty.

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

The engine oil capacity is 7 qt (6.6 L) with 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 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. 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 hose. Clean the radiator exterior after every 50 hours of operation.

Blow all dust, which may have collected on the radiator, in through the grill and radiator fins, opposite the direction of normal air flow. This should be done only after the radiator has cooled, to avoid cracking.

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

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.

MAINTENANCE

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.

AIR INTAKE SYSTEM

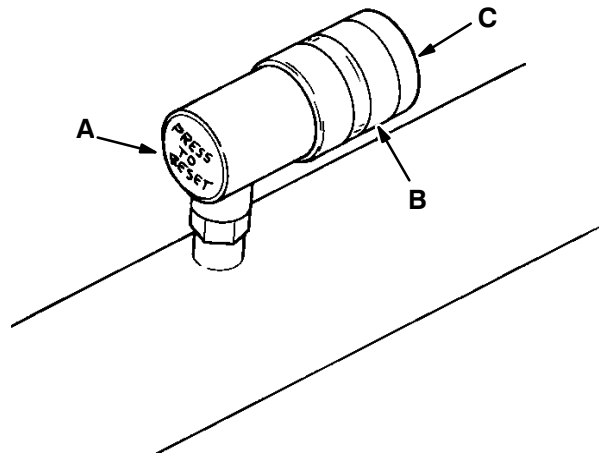
The importance of maintaining an air filter cannot be overemphasized. Dirt ingested through improperly installed, improperly serviced, or inadequate air filter elements wears out more engines than long hours of operation. Even a small amount of dirt will wear out a set of piston rings in just a few hours. 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 approved replacement parts. Keep all other air intake components such as hoses and clamps secure and in good condition to prevent entrance of unfiltered air.

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

AIR FILTER SERVICE INDICATOR

The air filter service indicator signals when to replace the air filter element. Check the service indicator daily. The red line will move on the scale as the air filter element fills with dirt. Do not replace the air filter element until the red line reaches 20 in H₂O (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.

Replace the filter element when the service indicator reads 20 in H₂O (5 kPa). After replacing the air filter element, reset the service indicator by pushing the reset button on the end of the indicator.



AIR FILTER RESTRICTION INDICATOR

00212

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

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 inspected or replaced whenever the air filter service indicator reads 20 in H₂O (5 kPa). The filter element must be replaced if it is damaged.

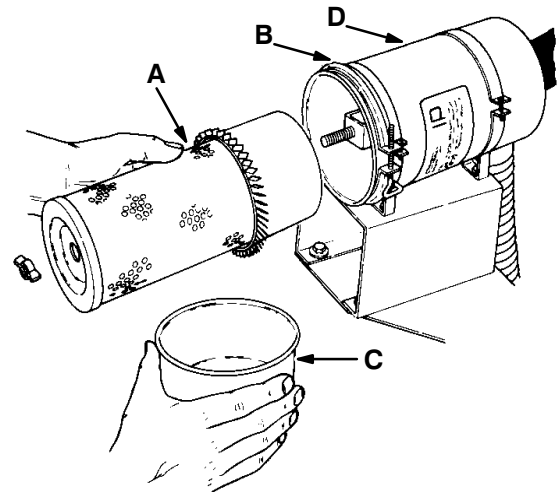
Service the air filter element only when the air filter service indicator shows excessive restriction in the system. Do not remove the air filter element unless it is restricting air flow.

TO REPLACE AIR FILTER ELEMENT

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

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

2. Open the left side and top engine access doors.
3. Unscrew the clamp ring on the filter.
4. Remove the dust cap.
5. Empty the dust cap.
6. Remove the filter wing nut.
7. Gently pull the filter element out of the filter housing.



REMOVING AIR FILTER ELEMENT

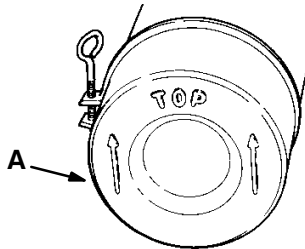
00044

- A. Filter Element**
- B. Clamp Ring**
- C. Dust Cap**
- D. Filter Housing**

8. Clean the interior of the air cleaner housing with a damp cloth. Clean the element housing sealing surfaces.

MAINTENANCE

9. Install the new filter element so the fins on the element are at the intake end of the air cleaner. Use care so the fins are not damaged. Tighten the wing nut attaching the element.
10. 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

A. Dust Cap

11. Reset the air filter service indicator.
12. Close the access doors.

02492

FUEL SYSTEM – GASOLINE

FUEL FILTER

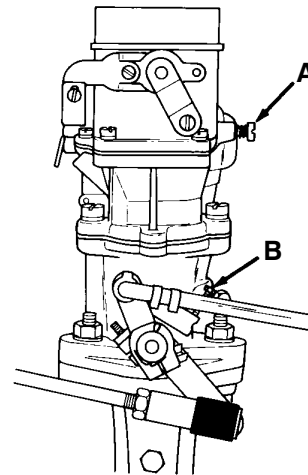
The in-line fuel filter is located under the fuel tank. Clean the fuel filter as required.

CARBURETOR

The carburetor has three basic adjustments. They are idle fuel mixture, fixed high speed jet, and idle speed adjustment.

The idle fuel-air adjusting needle controls the idle mixture. Turning the idle adjusting needle clockwise results in a leaner mixture. Turning the idle adjusting needle counterclockwise results in a richer mixture.

The high speed jet is not adjustable. For high altitude it may be exchanged for reduction in size to lean the fuel to compensate for the lighter, thin air. The size must be carefully determined first by testing a smaller jet with 0.001 to 0.002 in (0.025 to 0.050 mm) smaller passage, depending on the elevation.



CARBURETOR ADJUSTMENTS

00052

- A. Idle Mixture Adjustment Needle
- B. Idle Speed Adjustment

The idle speed is adjusted by turning the screw clockwise to increase speed or counterclockwise to lower the speed.



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.

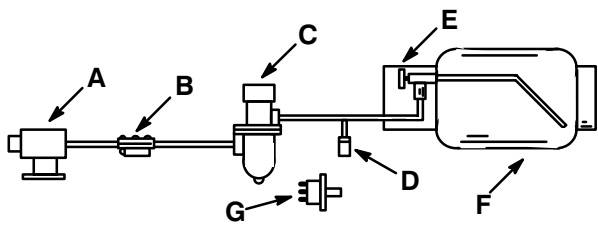
FUEL SYSTEM – LPG

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. 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.



LPG FUEL SYSTEM

03511

- 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 the suspected 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 the safety components 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.

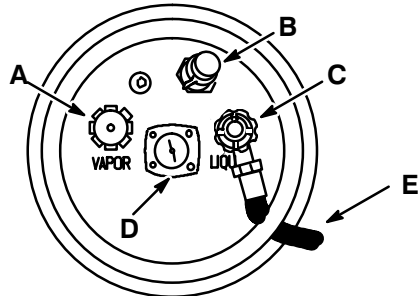
Safety Relief Valve – Check for damage. Check for the presence of the relief valve elbow and the proper direction of the elbow. If the rain cap is missing, check for foreign matter and replace the rain cap. Do not tamper with the relief valve setting.

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

MAINTENANCE

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

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



03485
TYPICAL LPG LIQUID WITHDRAWAL FUEL TANK

- 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. Take care to insure that the tanks are stored in such a way 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. The machines 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.

Changing the tank is a chance for the machine operator to carefully check the tank, fittings, and the fuel lines and fittings. If abnormal wear is detected, the operator should report the findings to the appropriate personnel.

TO CHANGE AN LPG FUEL TANK

1. Park the machine in a designated safe area. Set the machine parking brake.

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

2. Close the tank service valve.
3. Operate the engine until it stops from lack of fuel.



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.

4. Put on gloves and remove the quick-disconnect tank coupling.
5. Inspect the LPG fuel lines for wear or damage.
6. 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 mounting bracket up or down.

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. The fuel filter lock 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 fuel filter lock 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.

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.

MAINTENANCE

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 vaporizer – regulator
Engine runs unevenly lacks power	Wrong type of fuel tank – vapor withdrawal tank	Replace vapor withdrawal tank or 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	Replace air filter element
	Vaporizer – regulator maladjusted	Adjust vaporizer – regulator

FUEL SYSTEM – DIESEL

FUEL WATER TRAP

The fuel water trap is located next to the fuel tank. The water trap should be drained of water daily. To drain the water trap, unscrew the spigot on the bottom of the water trap. Drain the water trap of water. As fuel appears, tighten the spigot to stop the flow. It may be necessary to bleed the fuel system of air after draining the water trap.

After every 100 hours of operation, the water trap must be cleaned as described in *TO CLEAN THE WATER TRAP*. Replace the water trap filter element after every 400 hours of operation.

TO CLEAN WATER TRAP

1. Thoroughly clean the exterior of the water trap.
2. Unscrew the bowl retaining bolt in the center of the water trap head.
3. Lower the bowl from the water trap head. Replace the filter element if it is due to be replaced.
4. Thoroughly clean the water trap bowl in cleaning fluid.

NOTE: Do not use gasoline to clean the bowl.

5. After cleaning the water trap bowl, fill the bowl with clean fuel. Hold the water trap bowl in position under the water trap head.
6. Secure the bowl retaining bolt.
7. Prime the fuel system as described in *PRIMING THE FUEL SYSTEM*.

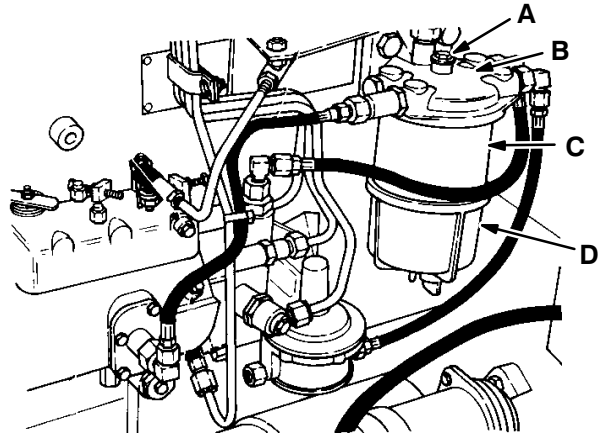
FUEL FILTER

The fuel filter is mounted on the top right side of the engine. The fuel filter should be replaced after every 400 hours of operation.

TO REPLACE FUEL FILTER (For machines below serial number 005002)

1. Thoroughly clean the exterior of the fuel filter assembly.

2. Unscrew the filter bolt in the center of the head.



FUEL FILTER

- A. Filter Bolt**
- B. Filter Head**
- C. Filter Element**
- D. Filter Bowl**

3. Lower the filter bowl and element and discard the fuel, together with the old element.
4. Thoroughly clean the filter bowl in cleaning fluid.

NOTE: Do not use gasoline as a cleaning fluid.

5. Place the new element and sealing rings in position, fill with clean fuel, and push the filter bowl up firmly and squarely so that the top rim of the filter element locates centrally against the sealing ring in the filter head.
6. Hold in this position while the filter bolt is located and tightened. If the bowl is located correctly, no excessive tightening will be required to obtain a leak-proof seal.

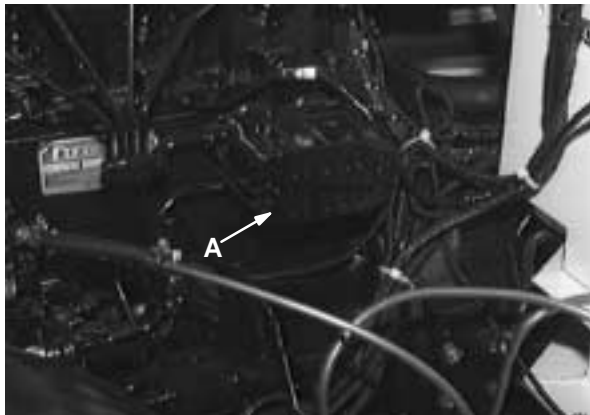
After the fuel filter has been reassembled, it is necessary to remove air from the fuel system. See *PRIMING THE FUEL SYSTEM*.

TO REPLACE FUEL FILTER (For machines serial number 005002 and above)

1. Thoroughly clean the exterior of the fuel filter assembly.

MAINTENANCE

2. Release the two spring claps on either side of the metal canister element and pull the element off the filter bracket.



FUEL FILTER

A. Fuel Filter Element

3. Lubricate the new element grommets with clean diesel fuel, and push the element into place. Snap the spring clamps into position.

After the fuel filter element has been changed, it is necessary to remove air from the fuel system. See *PRIMING THE FUEL SYSTEM*.

FUEL INJECTION PUMP

The fuel injection pump controls the engine speed. The maximum speed screw is set and sealed by the manufacturer and must not be altered in any way unless factory authority is first obtained. Any adjustments should be carried out by experienced fuel pump technicians. The unauthorized removal of any seals on the pump may void the warranty.

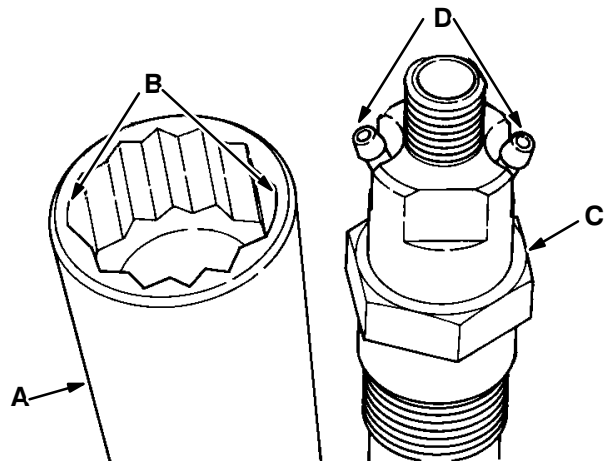
NOTE: Unless proper test equipment and trained technicians are available, adjustment or maintenance of the fuel injection pump should not be attempted.

FUEL INJECTORS

When replacing injectors in the cylinder head, it is essential that a new, correct-type heat shield washer be fitted between the nozzle cap and the cylinder head.

Use care when replacing the fuel injectors to prevent loosening the injector leak-off nipples.

Be sure to cut a relief in the inside of your socket for clearance. This will prevent an interference between the socket and the leak-off nipple.



SOCKET RELIEF CLEARANCE

01477

- A. Socket
- B. Relief
- C. Injector
- D. Leak-Off Nipple

Tighten injectors evenly to 52 ft lb (70 Nm).

Injectors should be taken out only if engine is malfunctioning as outlined below:

- Misfiring
- Knocking in one (or more) cylinders
- Engine overheating
- Loss of power
- Smoky exhaust (black or white)
- Increased fuel consumption

The faulty injector or injectors may be located by loosening the line fitting nut on each, in turn, with the engine running at a fast idle. This allows the fuel to escape and not enter the cylinder. The injector least affecting the engine performance should be removed from the cylinder head and reconditioned or replaced.

NOTE: No attempt should be made to adjust the injection pressure without a proper testing pump and pressure gauge. It is impossible to adjust the setting of the injector with any degree of accuracy without proper equipment.

PRIMING THE FUEL SYSTEM

Priming is necessary on initial installation of the fuel injection system, after any subsequent removal, or if the system was drained by running out of fuel.

Before priming and venting, ensure that the outside of the vent screws and surrounding area is thoroughly clean to prevent dirt and foreign matter entering the system.

NOTE: Electrical equipment such as starters should be shielded during priming to prevent fuel entry.

Carry out steps 1 and 2 while operating the fuel lift pump priming lever.

1. Operate the fuel lift pump priming lever and loosen the filter outlet connection until fuel flows free of air.
2. Continue operating the fuel lift pump priming lever while loosening the top vent valve and the vent screw on the governor housing. When fuel flows free of air, tighten the connections. Stop operating the priming lever and place it in the vertical position.

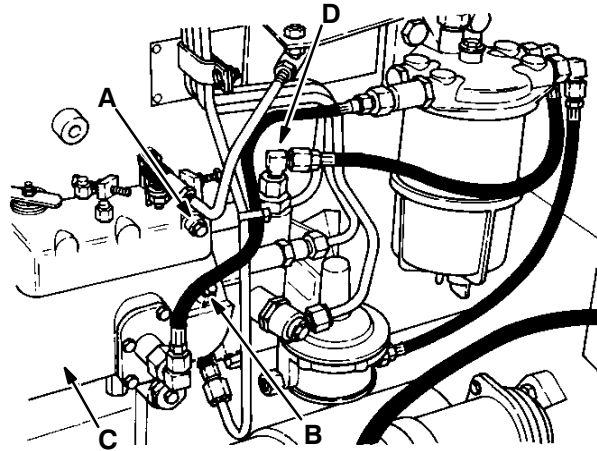
NOTE: Leaving the priming lever in the horizontal position will lock the pump action stopping the fuel supply.

3. Loosen any two injector high pressure pipe nuts at the injector end. Set the accelerator to the fully "open" position and ensure that the stop control is in the "run" position. Crank engine until fuel is free of air bubbles. Tighten nuts.

NOTE: The bleeding operation may take a considerable amount of cranking with the starter to purge all air. It is important that the battery be in good operating condition when bleeding.

If the engine will not start after bleeding, or any other time, it may be an indication of a low battery charge. If the voltage to the fuel shutoff solenoid falls below 8 volts, the valve will shut off fuel to the engine. This may happen during cranking if the battery charge is low. The condition may not be readily apparent since cranking speed might still be good.

4. Start the engine.



INJECTION PUMP VENTS

- A. Top Vent Valve**
- B. Governor Housing Vent Valve**
- C. Injection Pump**
- D. Fuel Pump Inlet Connection**

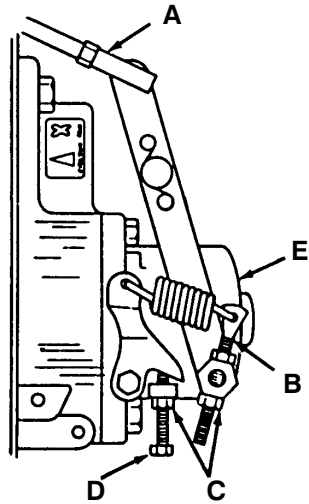
01475

GOVERNOR, F163 – GASOLINE, LPG

The F163 engine speed is governed by a governor located at the front of the engine. The governor makes the engine operate at a constant speed. It is factory set and should not be adjusted unless the engine exceeds 2400 ± 50 rpm under load, 2700 ± 100 rpm no-load, or if the engine surges.

With the engine stopped and spring tension about normal, the governor should hold the throttle in the open position. The governor to carburetor control rod should be adjusted in length so the throttle stop lever is 0.01 to 0.03 in (0.2 to 0.8 mm) off the pin.

Make certain that all linkage is movable with the governor spring attached at operating tension. Disconnect the governor spring and check movement of levers and rods.



01821

F163 MECHANICAL GOVERNOR LINKAGE

- A. Carburetor to Governor Rod
- B. Sensitivity Screw
- C. Lock Nut
- D. Speed Adjustment Screw
- E. Governor

TO ADJUST GOVERNOR, F163

1. Set the machine parking brake.

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

2. Start the engine and allow it to warm up.

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

3. With the engine warmed up, adjust the idle speed approximately 150 rpm higher than the required speed under load, by turning the speed screw in or out, thus either increasing or decreasing pull on the spring.
4. Apply the desired load and readjust the speed screw in order to obtain the required speed under load.

Release load and note rpm at which the engine settles out. Again apply load and observe the drop in rpm before the governor opens throttle to compensate.

5. The range of a governor's action is indicated by the differential between rpm under load and that under no load. This can be varied and the sensitivity of the governor is changed by changing the length of the sensitivity screw.

To broaden the range of the governor and produce a more stable action, lengthen the sensitivity screw and compensate for this change by turning the speed screw in to restore the speed.

To narrow the range and increase the sensitivity of the governor, reverse the procedure outlined in step 5. (Changing the length of the sensitivity screw has the same effect as using a stronger or weaker spring.)

6. With the governor adjusted for desired performance, release the load and allow the engine to run at governed speed with no load. If a surge is noted, lengthen the sensitivity screw at spring anchor and readjust the speed screw to obtain desired no load rpm

7. When governor adjustment is completed, make sure that all lock nuts are tight in order to maintain the adjustment.

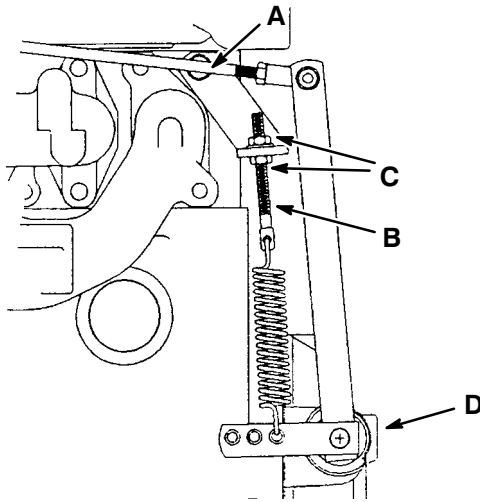
GOVERNOR, TM27 – GASOLINE, LPG

The TM27 cam gear governor differs from a conventional centrifugal governor, mainly in the round steel balls used as the actuating force producer instead of pivoting masses of weight. When the governor is driven at increasing speeds by the engine, the hardened steel balls move outward forcing the conical upper race and lever assembly toward a closed throttle position.

The lever assembly is pulled towards the open position by an externally mounted spring. As the speed increases, the centrifugal force created by the balls will increase until a balanced condition between the governor force and the spring force exists, and the governing lever remains stationary — holding constant engine RPM.

This built-in cam-gear governor is sealed, dust proof, engine lubricated, compact and easily adjusted. The control shaft floats on two needle bearings to remove friction for closer and more accurate control through the whole power range.

The idle surge adjusting screw, if supplied, should be adjusted "in" just far enough to eliminate any tendency of the engine to surge.



11123

TM27 GOVERNOR LINKAGE

- A. Carburetor to Governor Rod**
- B. Speed Adjustment Screw**
- C. Lock Nut**
- D. Governor**

TO ADJUST GOVERNOR, TM27

1. Set the machine parking brake.

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

2. Linkage adjustment: With the engine stopped and the spring tension about normal, the governor should hold the throttle, (butterfly) in the wide open position.

The governor to carburetor control rod should be adjusted in length so that the throttle stop lever is 0.4 to 0.8 mm (0.02 to 0.03 in) off the stop pin. Be sure that the bumper screw, if supplied, is backed out so it doesn't interfere.

Make sure that all the linkage at the governor and carburetor operate freely — without binding.

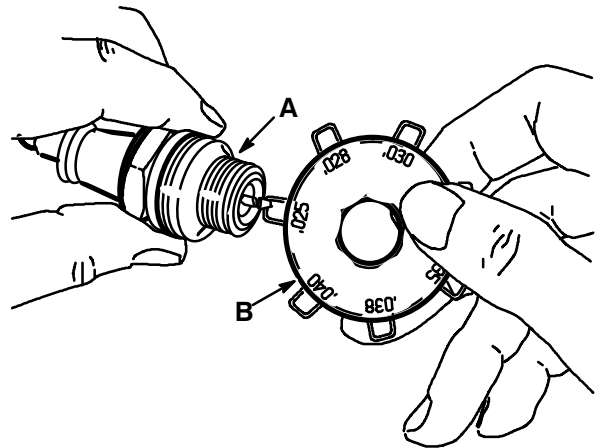
3. Speed adjustment: To increase the speed, increase the spring tension using the adjusting screw. To decrease the speed, decrease the spring tension using the adjusting screw.

4. Idle surge adjustment: (When the surge screw is supplied) Turn the governor idle surge adjusting screw "in" or to the right until corrected.
5. Continue surging: This may indicate an excessive looseness or binding of the governor linkage, and sometimes too lean a fuel mixture.

ELECTRICAL SYSTEM

SPARK PLUGS

Clean or replace and adjust spark plugs after every 200 hours of operation. A wire gauge is best for checking the spark plug gap. A flat gauge should not be used unless the electrode surfaces have been dressed with a small file to get parallel surfaces between the center and side electrodes. Set the spark plug gap by bending the side electrode. All spark plugs, new or used, should have the gaps checked and reset if necessary.



00054

GAPPING THE SPARK PLUG

- A. Spark Plug**
- B. Gapping Tool**

The proper spark plug gap for F163 engines is 0.025 in (0.6 mm). The proper spark plug gap for TM27 engines is 0.035 in (0.9 mm).

To get good performance from the spark plugs, follow these steps when installing the plugs:

1. Clean the spark plug seat in the cylinder head.
2. Use a new seat gasket and screw the plug in by hand.

MAINTENANCE

3. Tighten the spark plugs to 22 to 28 ft lb (30 to 38 Nm) with a socket wrench of the correct size.

DISTRIBUTOR

The distributor operation is vital to the operation of the engine and the following items should be carefully inspected every 200 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.
2. Check the centrifugal advance mechanism for "freeness" by turning the distributor shaft in the direction of rotation and then releasing it. The advance springs should return the shaft to its original position.
3. F163 engines: Inspect the breaker points and gap. If the points are pitted, burned or worn, install a new set of points. Badly pitted points may be caused by a defective or improper condenser capacity.

When replacing points, make sure they are aligned and that they make full contact. Bend the stationary arm to obtain proper alignment; do not bend the breaker arm.

4. F163 engines: Lubrication is required at the shaft, advance mechanism, breaker cam, and pivot. The shaft may be either oil or grease cup lubricated. Make sure the breaker arm moves freely on its hinge. Apply a drop of light oil or a trace of ball bearing lubricant to the breaker arm hinge.

Special grease (with Moly) should be used sparingly on the breaker cam unless the breaker cam is lubricated by a felt wick, which is lubricated with a couple drops of oil.

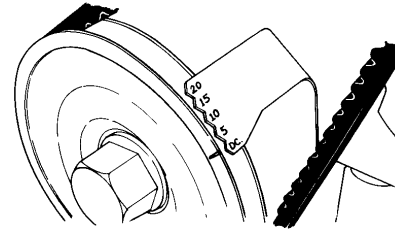
NOTE: Avoid excessive lubrication. Excess lubricant may get on the contact points and cause burning.

DISTRIBUTOR IGNITION TIMING

There are two methods of checking ignition timing: with or without a timing light.

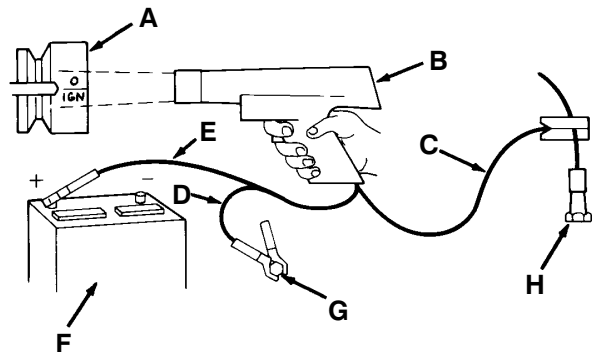
The preferred method is to use a timing light in the following sequence:

NOTE: Painting a line on the front pulley will make the timing mark more legible under the timing light.



CRANKSHAFT PULLEY TIMING MARK

1. Clip the blue secondary lead of light to the #1 spark plug. Leave the spark plug wire on the plug.
2. Connect the primary red positive lead to the positive terminal of the battery.



TIMING LIGHT HOOKUP

- A. Crankshaft Pulley
- B. Timing Light
- C. Blue Lead
- D. Black Lead
- E. Red Lead
- F. Battery
- G. Head Bolt
- H. Spark Plug

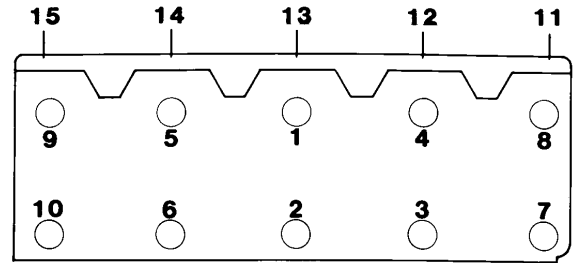
3. Connect the black primary negative lead to the cylinder head cap screw or the alternator bracket. Disconnect the vacuum line from the distributor to the manifold, and clamp the end of the line leading to the manifold.

4. Start the engine and run it at idle speed, 400 rpm or lower, so the automatic advance of the distributor is completely retarded.

NOTE: The engine must be operating at or below 400 rpm to obtain the correct engine timing.

5. Direct the timing light on the crankshaft pulley and note the timing marks as the light flashes.
6. Timing is TDC at engine idle for F163 engines, 2° for gasoline TM27 engines, and 5° for LPG TM27 engines.
7. To advance the timing, turn the distributor body clockwise. To retard the timing, turn the distributor body counterclockwise.
8. When the timing is correct, tighten the distributor clamp screw securely. Then recheck timing again with the light.
9. This operation is best performed in a shaded area so the timing light is visible.
10. After setting the timing, remove the clamp and reconnect the rubber tube to the vacuum advance unit on the distributor.

TM27 engines: Hand torque cold M10 bolts to 50 to 55 ft lb (68 to 75 Nm) and M12 bolts to 80 to 85 ft lb (108 to 115 Nm) in the correct order.



TM27 CYLINDER HEAD BOLT TIGHTENING SEQUENCE

The cylinder head cap screws and risers must be re-torqued after the engine is put into operation and brought up to proper operating temperatures. To re-torque cap screws, follow the correct sequence. Loosen one head cap screw or riser at a time one quarter turn (90 degrees); then re-torque 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.

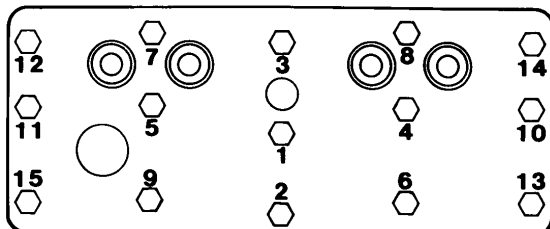
CYLINDER HEAD – GASOLINE, LPG

CYLINDER HEAD BOLT TIGHTENING

A three-stage torque procedure should be used when reassembling the cylinder head. The cylinder head cap screws and risers must be tightened in the proper sequence after the first 50 hours of operation and after every 400 hours of operation.

Snug down cap screws and risers in the proper sequence. Tighten the cap screws and risers to one-half of the specified value.

F163 engines: Torque to 45 to 48 ft lb (61 to 65 Nm).



F163 CYLINDER HEAD BOLT TIGHTENING SEQUENCE

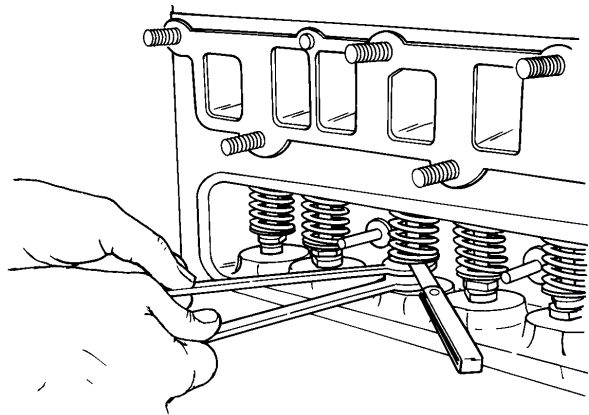
MAINTENANCE

VALVE TAPPET CLEARANCE

The valve tappet clearance must be checked after the first 50 hours of operation and after every 400 hours of operation.

F163 engines: Check and adjust the intake valve tappets to 0.012 in (0.3 mm) clearance and the exhaust valve tappets to 0.020 in (0.5 mm) clearance when the engine is warm.

TM27 engines: Check and adjust the intake tappets to 0.014 in (0.36 mm) clearance and the exhaust valve tappets to 0.018 in (0.46 mm) clearance when the engine is warm and is operating at idle speed.



ADJUSTING F163 VALVE TAPPET CLEARANCE

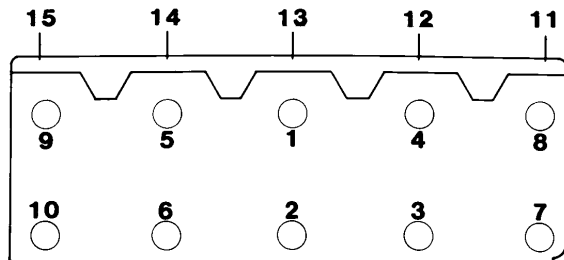
00061

CYLINDER HEAD – DIESEL

CYLINDER HEAD BOLT TIGHTENING

The proper sequence and torque values should be used when reassembling the cylinder head. The cylinder head bolts must be tightened in the proper sequence after the first 50 hours of operation.

Hand torque cold M10 bolts to 50 to 55 ft lb (70 to 75 Nm) and M12 bolts to 90 to 95 ft lb (120 to 130 Nm) in the correct order.



CYLINDER HEAD BOLT TIGHTENING SEQUENCE

01472

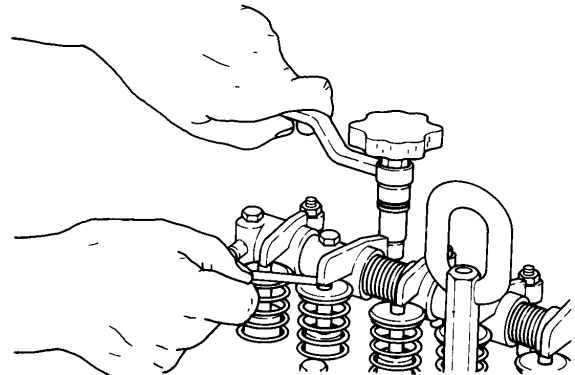
The cylinder head cap screws and risers must be retorqued after the engine is put into operation and brought up to proper operating temperatures. To retorque cap screws, follow the correct sequence. Loosen one head cap screw or riser at a time one quarter turn (90 degrees); then retorque it to the correct value. Check the valve tappet clearance.

NOTE: Power wrench torque limit must be held at least 10 ft lb (15 Nm) below hand torque specification; then hand torque to the specifications.

VALVE TAPPET CLEARANCE

The valve tappet clearance must be checked after the first 50 hours of operation and after every 400 hours of operation.

Check and adjust the intake valve tappets to 0.014 in (0.35 mm) clearance and the exhaust valve tappets to 0.018 in (0.45 mm) clearance when the engine is warm and is operating at idle speed.



ADJUSTING VALVE TAPPET CLEARANCE

01473

PCV SYSTEM

Check the PCV system after every 200 hours of operation. Check all connections. They are to be airtight. To service the system, clean the PCV valve and the air inlet. Check all hoses for wear or plugging.

TUNE-UP CHART – GASOLINE, LPG

Idle speed, no load	600 ± 50 rpm
Maximum governed speed	2400 ± 50 rpm
Spark plug gap, F163	0.025 in (0.6 mm)
Spark plug gap, TM27	0.035 in (0.9 mm)
Ignition point gap, F163	0.020 in (0.5 mm)
Timing, F163	TDC @ 400 rpm
Timing, TM27 gasoline	15° BTDC @ 1850 rpm
Timing, TM27 LPG	18° BTDC @ 1850 rpm
Firing order	1–3–4–2
Valve clearances, F163 warm	intake 0.012 in (0.3 mm)
	exhaust 0.020 in (0.5 mm)
Valve clearances, TM27 warm	intake 0.014 in (0.36 mm)
	exhaust 0.018 in (0.46 mm)

ELECTRICAL SYSTEM**BATTERY**

The battery on gasoline and LPG powered machines is rated at 12 V, 540 ccA. The battery on diesel powered machines is rated at 12 V, 625 ccA. The battery is located in the engine compartment. 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 only 25% of the charge is 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. The level 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 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 (27° 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 (27° C):

Add to the specific gravity reading 0.004, 4 points, for each 10° F (5.5° C) above 80° F (27° C).

Subtract from the specific gravity reading 0.004, 4 points, for each 10° F (5.5° C) below 80° F (27° C).

BELTS AND CHAINS

VACUUM FAN DRIVE BELT

The vacuum fan drive belt tension should be checked after every 50 hours of operation. The proper belt tension is obtained when the midpoint of the belt deflects 0.25 in (6 mm) from a force of 3 lb (1.4 kg) on all machines below serial number 004111. The proper belt tension for gasoline and LPG machines is obtained when the midpoint of the belt deflects 0.34 in (9 mm) from a force of 7 to 8 lb (3.2 to 3.6 kg) on machines serial number 004111 and above. The proper belt tension for diesel machines is obtained when the midpoint of the belt deflects 8 to 9 lb (3.6 to 4.0 kg) on machines serial number 004111 and above.

TO ADJUST VACUUM FAN DRIVE BELT

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

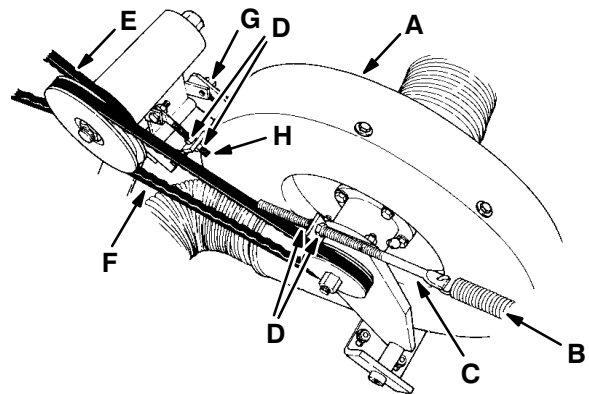
FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, And Turn Off Machine.

2. Raise the engine cover.

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

3. Loosen the jam nuts on the tension spring eyebolt.
4. Thread the tension spring eyebolt in to tighten the vacuum fan drive belt or out to loosen the vacuum fan drive belt to get the desired belt tension.
5. Tighten the tension spring eyebolt jam nuts.

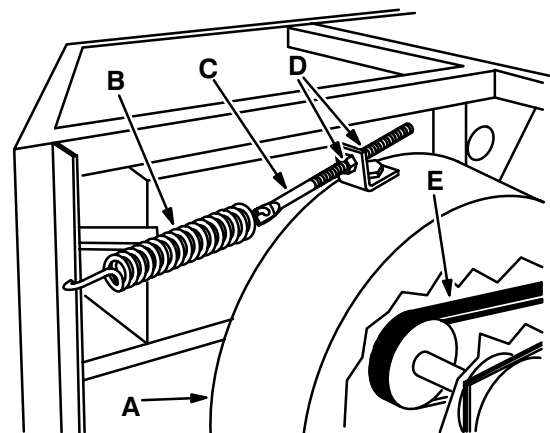
6. Lower the engine cover.



02359

ADJUSTING VACUUM FAN BELT
(For machines below serial number 004111)

- A. Vacuum Fan Housing
- B. Tension Spring
- C. Tension Spring Eyebolt.
- D. Jam Nut
- E. Intermediate Drive Belt
- F. Vacuum Fan Drive Belt
- G. Belt Tension Bolt
- H. Belt Tension Adjusting Eye Bolt



06973

ADJUSTING VACUUM FAN BELT
(For machines serial number 004111 and above)

- A. Vacuum Fan Housing
- B. Tension Spring
- C. Tension Spring Eyebolt.
- D. Jam Nut
- E. Vacuum Fan Drive Belt

MAINTENANCE

INTERMEDIATE DRIVE BELT

The intermediate belt is used on machines serial number below 004111. The intermediate drive belt tension should be checked after every 100 hours of operation. The proper belt tension is obtained when the midpoint of the belt deflects 0.12 in (3 mm) from a force of 5 lb (2.3 kg).

TO ADJUST INTERMEDIATE DRIVE BELT

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

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

2. Raise the engine cover.
3. Loosen the belt idler tension bolt.
4. Thread the belt tension adjusting eye bolt in to tighten the belt tension or thread the belt tension adjusting eye bolt out to loosen the belt tension.
5. Tighten the belt idler tension bolt.
6. Lower the engine cover.

ALTERNATOR AND RADIATOR FAN BELT

The alternator and radiator fan belt tension should be checked after every 100 hours of operation. The proper belt tension is obtained when the midpoint of the belt's longest span deflects 0.50 in (13 mm) from a force of 10 to 12 lb (5 to 6 kg).

TO ADJUST ALTERNATOR AND RADIATOR FAN BELT

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

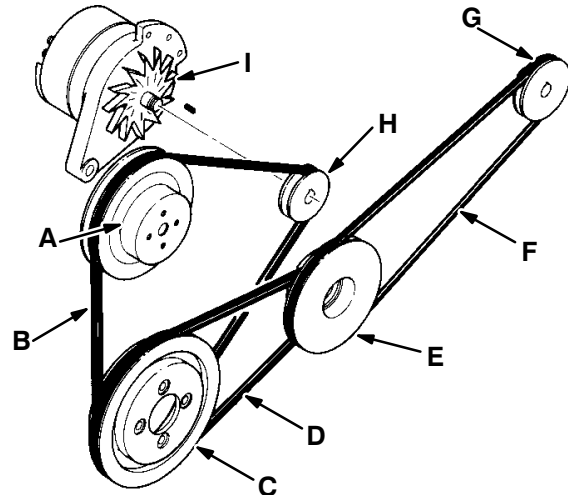
FOR SAFETY: Before Leaving Or Servicing Machine; Stop On Level Surface, Set Parking Brake, And Turn Off Machine.

2. Open the left rear engine access door.
3. Loosen the alternator clamp bolt.

4. Push the alternator out to tighten the belt.

ATTENTION! Do not use a pry bar against the alternator to tighten the belt. Using a pry bar may damage the alternator.

5. Tighten the alternator clamp bolt.
6. Check the belt deflection; adjust if necessary.
7. Close the left rear engine access door.



00796

DRIVE BELT SYSTEM
(For machines below serial number 004111)

- A. Engine Water Pump Sheave
- B. Alternator and Radiator Fan Belt
- C. Engine Crankshaft Sheave
- D. Intermediate Drive Belt
- E. Idler Sheave
- F. Vacuum Fan Drive Belt
- G. Vacuum Fan Drive Sheave
- H. Alternator Sheave
- I. Alternator

SCRUB HEAD

SCRUB HEAD

The scrub head houses the two scrub brushes and the brush drive mechanisms. The scrub head has two adjustments; scrub head height, and scrub brush pattern.

The scrub head height adjustment sets the minimum scrub head height. The height adjustment should not be changed unless, due to a major parts replacement or collision, the head adjustment may have been altered. If the head height is too low, excessive brush wear, engine overheating, brush bounce, or excessive brush drive plug and bearing wear may occur.

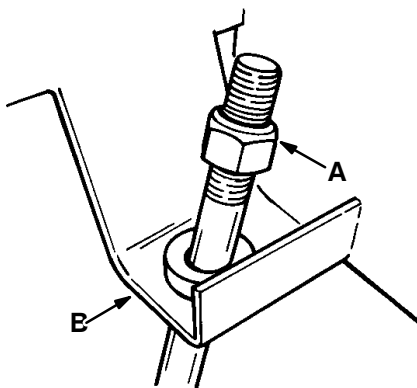
The scrub brush pattern adjustment determines the amount of contact the brush has with the floor. The brush pattern should be checked daily.

TO ADJUST SCRUB HEAD HEIGHT

1. The head height adjustment must be made with a full solution tank and tires correctly inflated; 55 psi (380 kPa) front, 35 psi (240 kPa) rear.

NOTE: Using a different sized tire on the machine, other than standard, will affect the head height adjustment.

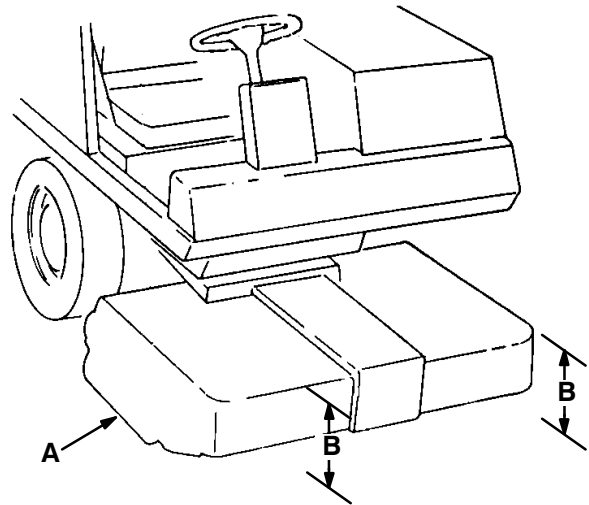
2. The head height adjusting nut is located under the operator's seat. The nut is accessible by lifting up the seat. Hold the seat up by attaching its chain to the steering wheel.



ADJUSTMENT NUT

- A. Nut**
- B. Scrub Head Link**

3. Adjust the nut so that the top front of the head is 13.62 in to 13.75 in (345 to 350 mm) from the floor.



SCRUB HEAD ADJUSTMENT

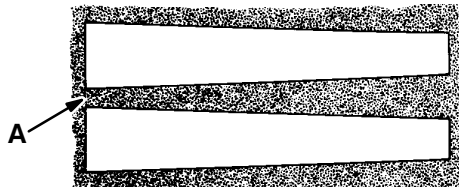
- A. Scrub Head**
- B. 13.62 to 13.75 in (345 to 350 mm)**

4. If the scrub head is lower than 13.62 in (345 mm), washers should be added below the adjusting nut.

TO ADJUST SCRUB BRUSH PATTERN

1. The machine must have correct tire pressures, full solution tank, and correct scrub head height adjustment.
2. On a smooth, level floor, apply chalk or some other material that won't blow away easily.
3. With the scrub head raised, move the machine over the test area. Start the brush rotation, apply the foot brakes, and lower the scrubber head, allowing the brushes to spin in one spot for 15 to 20 seconds. With no chalk or other material on the floor, allow the brushes to spin approximately two minutes.
4. Polish marks made by both brushes should be visible. They should be about 1.5 in (40 mm) wide the full length of the brush. With a soft brush the polish mark should not exceed 3 in (75 mm) wide, evenly, the full length of the brush.

5. The rear brush polish mark is the most critical and should be adjusted first. If the polish mark is uneven or cone shaped from one end to the other, the brush leveling spring located at the operator side of the head lift, should be adjusted. The spring compensates for the weight of the brush drive motors. Loosen the top nut first to make the adjustment.

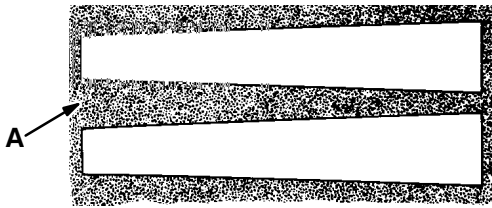


00082

TAPERED BRUSH PATTERN

A. Operator Side

Lower the brush leveling adjusting nut if the polish mark is too wide on the operator's side.

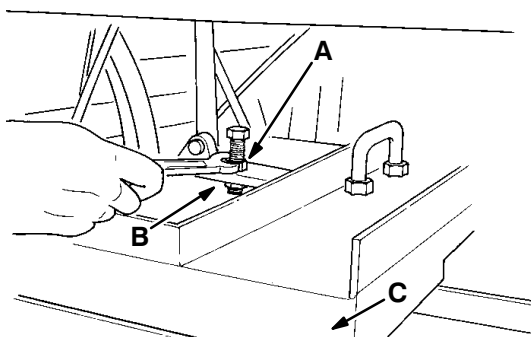


00082

TAPERED BRUSH PATTERN

A. Operator Side

Raise the brush leveling adjusting nut if the polish mark is too narrow on the operator's side. Retighten the top nut after making adjustments.

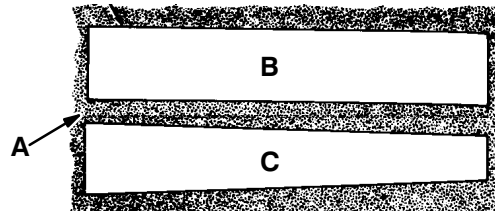


00285

LEVELING BRUSH

A. Top Nut
B. Brush Leveling Adjusting Nut
C. Operator Side of Scrub Head

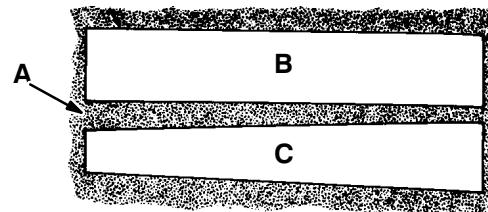
6. The polish mark of the front brush should match the polish mark of the rear brush. If the front brush polish mark is uneven, the narrow side should be shimmed. Add shims to the shaft bearing mount located on the underside of the scrub head. Remove the debris trough, loosen the bolts holding the bearing protector, and loosen the flat socket head bolts that hold the bearing mounting bracket before installing shims. One 0.12 in (3 mm) thick shim will add about 0.50 in (13 mm) width to the polish mark.



00082

TAPERED BRUSH PATTERN

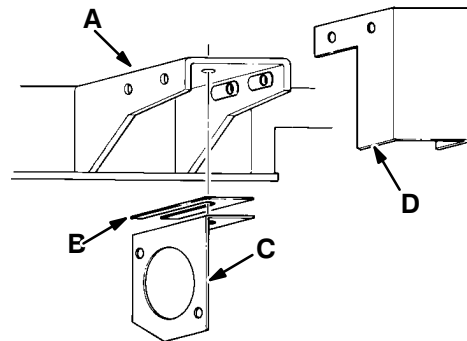
A. Operator Side
B. Rear Brush Marks
C. Front Brush Marks



00082

TAPERED BRUSH PATTERN

A. Operator Side
B. Rear Brush Marks
C. Front Brush Marks

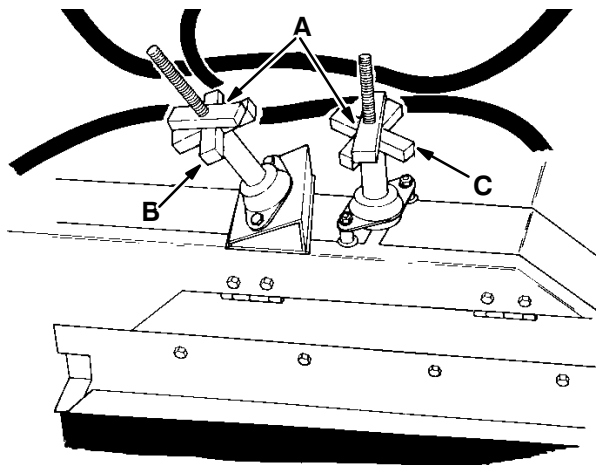


00284

BRUSH SHAFT MOUNTING

A. Scrub Head
B. Shim
C. Bearing Mounting Bracket
D. Bearing Protector

7. Recheck the brush polish marks to see if the front and rear match, and are even across the full length of the brush.
8. The width of the rear brush polish mark can vary more than the desired 2 to 3 in (50 to 75 mm). There are adjusting knobs located on the drive side of the scrub head. Turn the knob clockwise to decrease the width of the polish mark and counterclockwise to increase the width of the polish mark. The polish mark should not exceed 3 in (75 mm). Use the locking strips to keep the adjusting knobs in place.



BRUSH ADJUSTMENT KNOBS

- A. Locking Strips**
- B. Front Brush Adjusting Knob**
- C. Rear Brush Adjusting Knob**

9. For maximum brush life, rotate the brushes from front-to-rear after every 50 hours of operation.

SCRUB BRUSHES

The scrub brushes are tubular and run 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.

Rotate the scrub brushes from front-to-rear after every 50 hours of operation for maximum brush life and best scrubbing performance.

The scrub brush patterns should be checked daily. The width of the patterns should be 2 to 3 in (50 to 75 mm). The scrub brush pattern is adjusted by turning the adjustment knobs on top of the scrub head. See *TO ADJUST SCRUB BRUSH PATTERN*.

TO REPLACE SCRUB BRUSHES

1. Raise scrub head and set scrub head lock.

! WARNING: Raised Scrub Head May Fall. Block Scrub Head Up.

2. Stop engine and set parking brake.

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

3. Open right side door on scrub head and use the chain to hold the door in the raised position.
4. Use wrench to remove hex head bolt attaching the brush arm.

NOTE: If arm does not come off easily, insert bolt in the adjacent threaded hole and screw in until arm comes off.

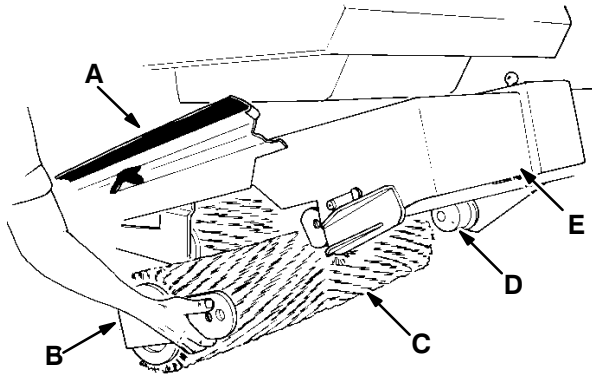
5. The brush arm and brush can then be pulled out.

MAINTENANCE

- Repeat steps 4 and 5 to remove other brush.
- Insert one end of brush through access door and push the brush in until it touches the drive plug.

It is helpful to have a second person guide the other brush end onto the drive plug while you are pushing and turning the brush until it engages the drive keyway on the plug.

- Install the brush arm with the hex head bolt.



00287

REPLACING BRUSH

- A. Door
- B. Brush Arm
- C. Brush
- D. Brush Drive Plug
- E. Raised Scrubber Head

- Repeat the steps 7 and 8 for the other brush.
- Unhook the chain and lower the access door.
- Release the scrub head lock before lowering the scrub head.

SOLUTION SYSTEM

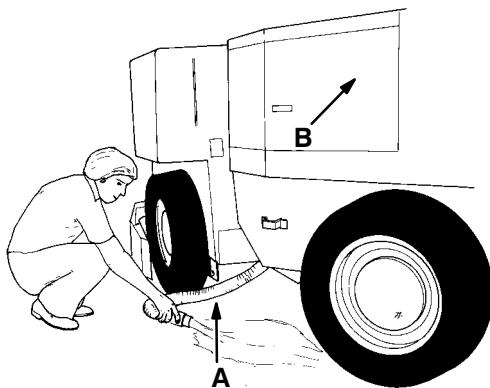
RECOVERY TANK

The recovery tank has a capacity of 120 gal (455 L). When the tank is full, a ball float will rise and shut off the vacuum to the tank. A 48 in (220 mm) long drain hose for the recovery tank is located on the front of the tank.

You can determine the water level in the recovery tank by lowering the hose end until water appears – this will then be the water level in the tank, (engine must be off; this stops vacuum).

To drain the tank, lower the hose and place it near a suitable floor drain.

NOTE: The hose will not drain until the engine is off, stopping vacuum.



00288

DRAINING RECOVERY TANK

- A. Drain hose**
- B. Operator Side of Machine**

Three clean-out doors are provided for the recovery tank; two at the front and one at the rear of the tank.

Flush all sand, sludge, debris, etc., out of the tank. Also, check the return hoses and connections for clogging or damage.

NOTE: The clean-out door seal will leak if small particles of debris are caught between the door edge and rubber seal.

NOTE: When replacing the clean-out doors, the thumbscrews should be tightened to 20 – 50 in lb (2.26 – 5.65 Nm). Do not over-tighten. Too much torque on the thumbscrews will cause the clean-out doors to bow and cut the door seals.

Empty and clean the recovery tank after every shift. The ball float screen retainer at the top of the tank should also be cleaned when draining the tank.

NOTE: The water must not be hotter than 130° F (54° C) or tank damage may occur.

WATER SPRAY DEFLECTOR

The water spray deflector is located on the rear squeegee discharge tube inside of the recovery tank. The spray deflector deflects the spray of water and small debris picked up by the rear squeegee away from the walls of the recovery tank. The deflector should be checked for wear after every 200 hours of operation.

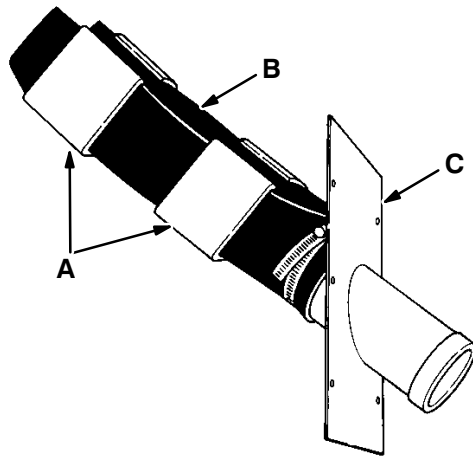
To check the water spray deflector for wear, the rear squeegee discharge tube must be removed. Be sure to save and reuse the rubber-backed washers which are located on the inside of the recovery tank. Inspect or replace the spray deflector. Reinstall discharge tube, using a new gasket if the existing one was damaged.

MAINTENANCE

SRS® WATER SPRAY DEFLECTOR

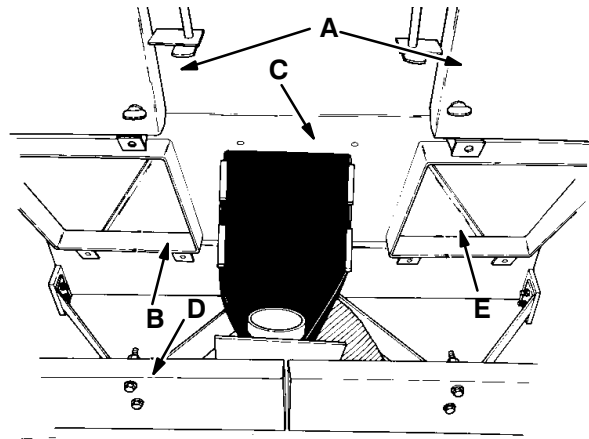
The SRS® solution tank has two spray deflectors; a lower spray deflector located on the rear squeegee discharge tube inside the tank, and a top spray deflector located in the top rear of the tank. The spray deflectors deflect the spray of water and small debris away from the walls of the solution tank. The deflectors should be checked for wear after every 200 hours of operations.

To check the lower spray deflector for wear, the rear squeegee discharge tube must be removed from the rear of the tank. Be sure to save the rubber seal washers which are located on the inside of the tank. Inspect the spray deflector for wear. If replacement is necessary, install a new deflector into the spray deflector frames, and mount the deflector to the rear squeegee discharge tube. Reinstall the discharge tube into the rear of the tank. Use a new discharge tube gasket if the existing one is damaged.



00339
CORRECT POSITIONING OF LOWER SPRAY DEFLECTOR

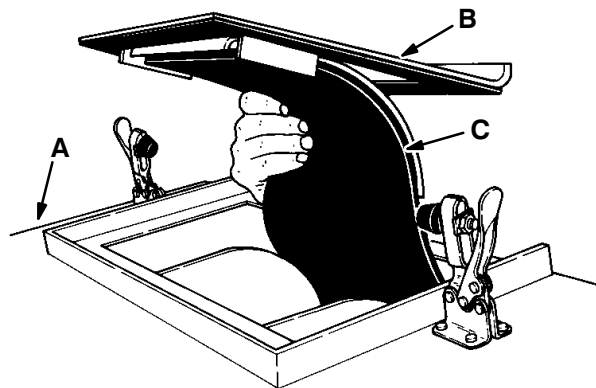
- A. Spray Deflector Frames
- B. Spray Deflector
- C. Rear Squeegee Discharge Tube



00353
INSTALLING LOWER SPRAY DEFLECTOR

- A. Top Rear Clean-Out Doors
- B. Bottom Clean-Out Door
- C. Spray Deflector
- D. Rear Bumper
- E. Bottom Clean-Out Door

To check the top spray deflector for wear, remove the top access cover at the top rear of the solution tank. Inspect the deflector for wear. Remove the deflector if replacement is necessary. Replace the top access cover gasket if the gasket is damaged. To install the spray deflector back into the tank, slide the bottom of the deflector down the back of the tank. Then, with the top cover gasket in place on the solution tank, position the deflector to follow the curvature of the bottom of the access cover. Clamp the top access cover in place.



00346
INSTALLING TOP SPRAY DEFLECTOR

- A. Solution Tank
- B. Top Access Cover
- C. Spray Deflector

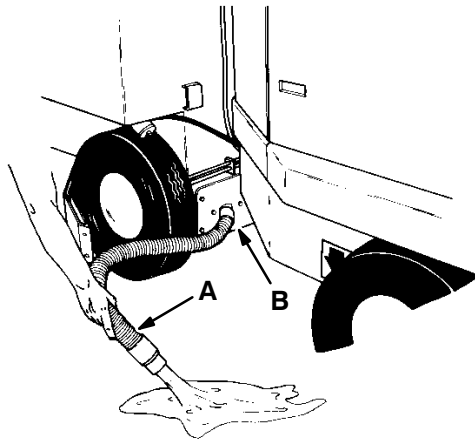
SRS® SOLUTION TANK

The tank has a capacity of 265 gal (1000 L). When the tank is full, a ball float will rise and shut off the vacuum to the tank. A 72 in (1830 mm) long drain hose for the recovery tank is located on the front of the tank. You can determine the water level in the tank by lowering the hose end until water appears—this will then be the water level in the tank, (engine must be off; this stops vacuum). To drain the tank, lower the hose and place in suitable floor drain.

Empty and clean the solution tank and flush the laminar tubes after every shift.

Partially fill the solution tank with clean water. Run the SRS® pump for a few minutes to flush the solution hoses.

NOTE: The water must not be hotter than 130° F (54° C) or tank damage may occur.



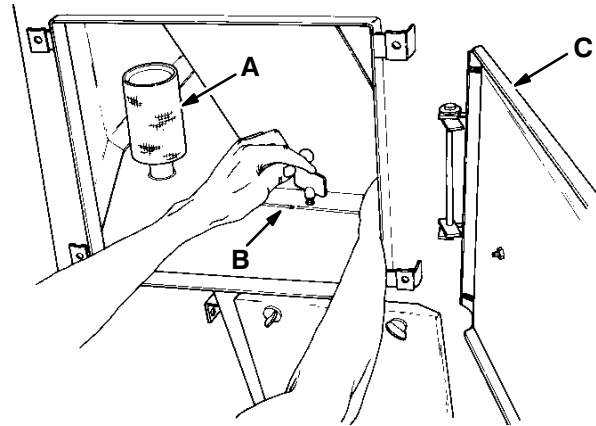
DRAINING SOLUTION TANK

- A. Drain Hose
- B. Clean-out Door

00343

Six clean-out doors are provided on the tank: two at the front, two at the upper rear, and two at the lower rear of the tank. Using the sludge removal tool, remove all sand, sludge, debris, etc., from the tank. Remove the two large plugs above the tank tires near the upper front of the tank. Flush the sediment from all compartments of the tank and the wire mesh filters. Check for dirt buildup in the laminar flow tubes. To clean tubes, remove and flush. Also, check the return hoses and connections for clogging or damage.

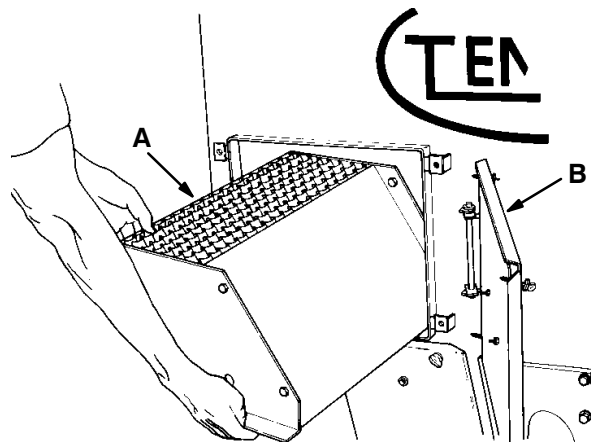
NOTE: For machines below serial number 004934, when replacing the clean-out doors, the thumbscrews should be tightened to 20 – 50 in lb (2.26 – 5.65 Nm). Do not over-tighten. Too much torque on the thumbscrews will cause the clean-out doors to bow and cut the door seals.



REMOVING LAMINAR TUBES

- A. Solution Outlet Filter
- B. Laminar Tube Set Fastener
- C. Upper Rear Clean-Out Door

00345



REMOVING LAMINAR TUBES

- A. Laminar Tube Set
- B. Upper Rear Clean-Out Door

00342

NOTE: Keep laminar tube sections facing the outside of the machine.

SOLUTION DISPENSING TUBE

The solution dispensing tube has a flushing connection built in. The flushing connection is the tee fitting next to the solution control valve. This allows a garden hose to be threaded into the dispensing system to flush the system. Flush the system after every 50 hours of operation.

SRS® CLEANING SOLUTION FILTER

Machines below serial number 003790 have a cleaning solution filter provided to filter cleaning solution before it enters the main supply hoses or pump. The filter is mounted on the top front right side of the solution tank. Clean the filter after every 50 hours of operation.

SRS® METERING SOLUTION PUMP

A bellows pump meters cleaning solution into the recycling solution at rates of one-quarter, one-half and one percent. The cleaning solution is introduced to the recycling solution at a point just before the spray nozzle. Clean the metering pump daily when cleaning the solution tank.

TROUBLESHOOTING

Low Flow

1. Poppet valves dirty, dried cleaning solution residue on valves.
2. Restriction in cleaning solution lines.
3. Air leak at pump intake.
4. Defective wiring or motor.

Motor Fails to Turn On

1. Loose wiring connection.
2. Defective motor.

Motor Operates, But No Pump Discharge

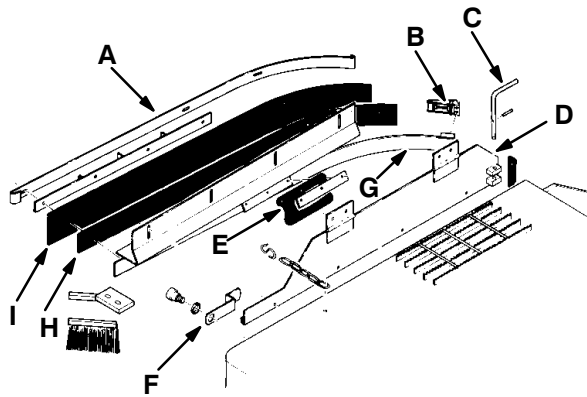
1. Damaged bellows.
2. Restriction in cleaning solution lines.
3. Air leak in intake line.
4. Unprimed pump.
 - a. Remove pump inlet hose.
 - b. Fill pump chamber with approximately one ounce SRS® solution.
 - c. Reinstall pump inlet hose.
 - d. Pump should start metering tank solution after 3 to 4 minutes run time.

SQUEEGEES

SIDE SQUEEGEES

The side squeegees control scrub brush water spray. They consist of a squeegee blade, backup strip, band, and clamp. Check the side squeegee blades for damage or wear daily. Replace squeegee blade by opening the quick-release latch and removing the band. Remove the bracket, old blade, and backup strip. Replace the squeegee blade and backup strip if the blade is worn.

Adjust the squeegee clamp so that there is adequate pressure to hold the squeegee blade in place. The squeegee blade should be held so that it cannot be pulled from between the locating pins.

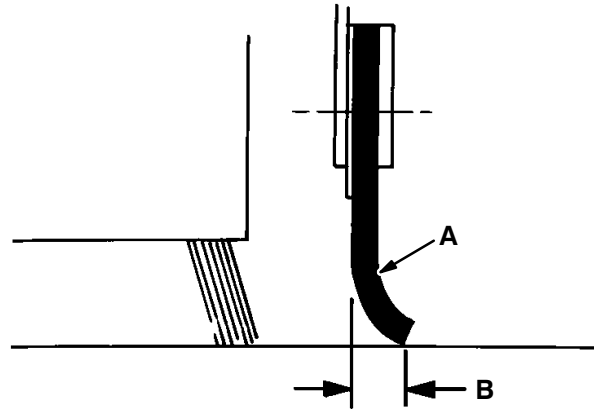


SIDE SQUEEGEE ASSEMBLY

- A. Retaining Band**
- B. Latch**
- C. Door Locking Pin**
- D. Door**
- E. Flap**
- F. Door Latch**
- G. Squeegee Frame**
- H. Backup Strip**
- I. Squeegee Blade**

The side squeegee frame is attached to the squeegee door with four screws. The screw mounting holes are slotted, allowing vertical adjustment of the squeegee blade by simply loosening the screws and moving the squeegee up or down. Check the side squeegee blades adjustment daily.

Lower the head and adjust the squeegee so that the blade deflects 0.50 in (13 mm). The squeegee should deflect evenly across its entire length.



SIDE SQUEEGEE BLADE DEFLECTION

- A. Side Squeegee Blade**
- B. 0.50 in (13 mm) Deflection**

REAR SQUEEGEE

The rear squeegee assembly channels water into the vacuum fan suction. When properly maintained, the squeegee should leave floors nearly dry. The assembly consists of a front and rear blade held in place by bands and clamps. Two back-up strips are used with the rear blade. Check the rear squeegee for damage or wear and adjustment daily.

The rear squeegee has been factory adjusted. The factory adjustments need to be done only after replacing a major component of the rear squeegee assembly. Regular squeegee adjustments are covered in *TO ADJUST REAR SQUEEGEE*.

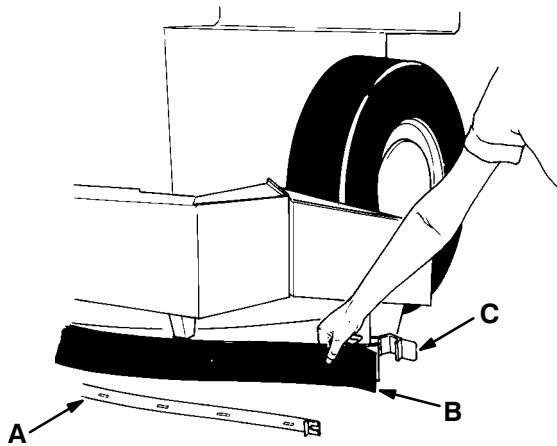
MAINTENANCE

TO REPLACE REAR SQUEEGEE BLADES

1. Stop the engine and set the parking brake.

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

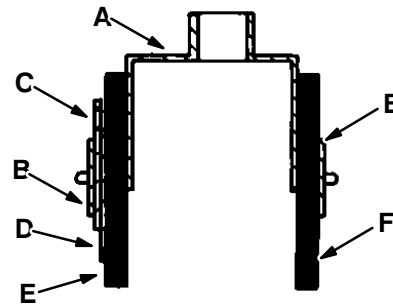
2. Open the band clamp and remove all parts.
3. Place the new squeegee blade over the pins on the frame.
4. Next, fit the two back-up strips on the pins. Inner strip down, outer strip up.
5. Position the retaining band in place and engage the clamp.
6. The front blade is replaced in the same manner, except that backup strips are not used.
7. Adjust the squeegee clamp so that there is adequate pressure to hold the squeegees in place. The squeegee blades should be held so they cannot be pulled from between the locating pins. After proper adjustment is made, lock each adjusting screw with a jam nut.



REAR SQUEEGEE

00290

- A. Band
- B. Blade and Back-Up Strips on Pins
- C. Clamp



REAR SQUEEGEE CROSS-SECTION

00151

- A. Squeegee Frame
- B. Band
- C. Outer Back-Up Strip
- D. Inner Back-Up Strip
- E. Rear Blade
- F. Front Blade

NOTE: Install back-up strips with outer strip up, inner strip down.

TO FACTORY ADJUST REAR SQUEEGEE

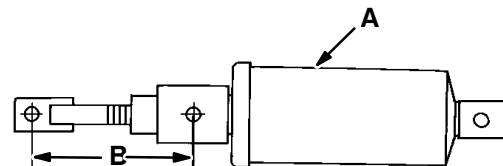
NOTE: The solution tank must be full, and the tires must be correctly inflated to properly adjust the rear squeegee.

1. LINKAGE PIVOTS

Check the squeegee linkage pivot points and, if necessary, tighten the locknuts on each bearing joint in the linkage. Tighten each locknut until the joint is just short of locking up. The linkage must be snug, but still free enough to rotate the linkage by hand.

2. SQUEEGEE LIFT CYLINDER

The squeegee lift cylinder rod end should be adjusted so there is 5.50 ± 0.12 in (140 ± 3 mm) between the cylinder rod hole and the rod end hole for machines below serial number 004506. For machines serial number 004507 and above, the adjustment should be 6.00 ± 0.12 in (150 ± 3 mm).



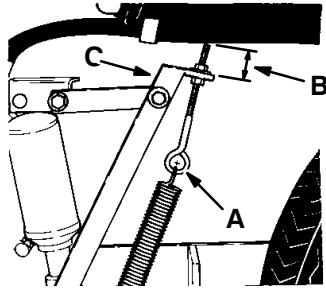
SQUEEGEE LIFT CYLINDER

01725

- A. Cylinder
- B. Adjustment Length

3. EYEBOLTS

The eyebolts should be adjusted so there is 1.38 ± 0.12 in (35 ± 3 mm) between the end of the eyebolt and the top of the arm on each side of the squeegee.



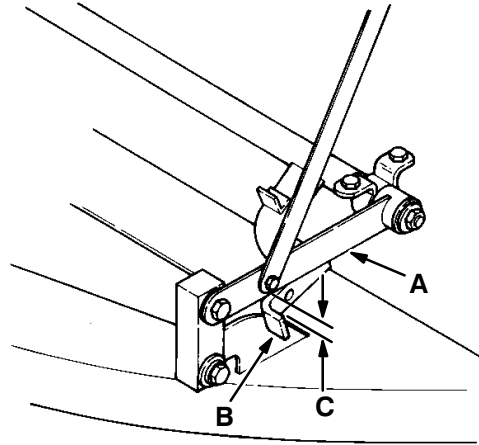
EYEBOLT

- A. Eyebolt**
- B. 1.38 ± 0.12 in (35 ± 3 mm)**
- C. Arm**

01726

5. ARM CLEARANCE

The distance between the arm assembly and the squeegee lift shaft arm should be 1 to 1.25 in (25 to 30 mm) with the squeegee blade down and perpendicular to the floor.



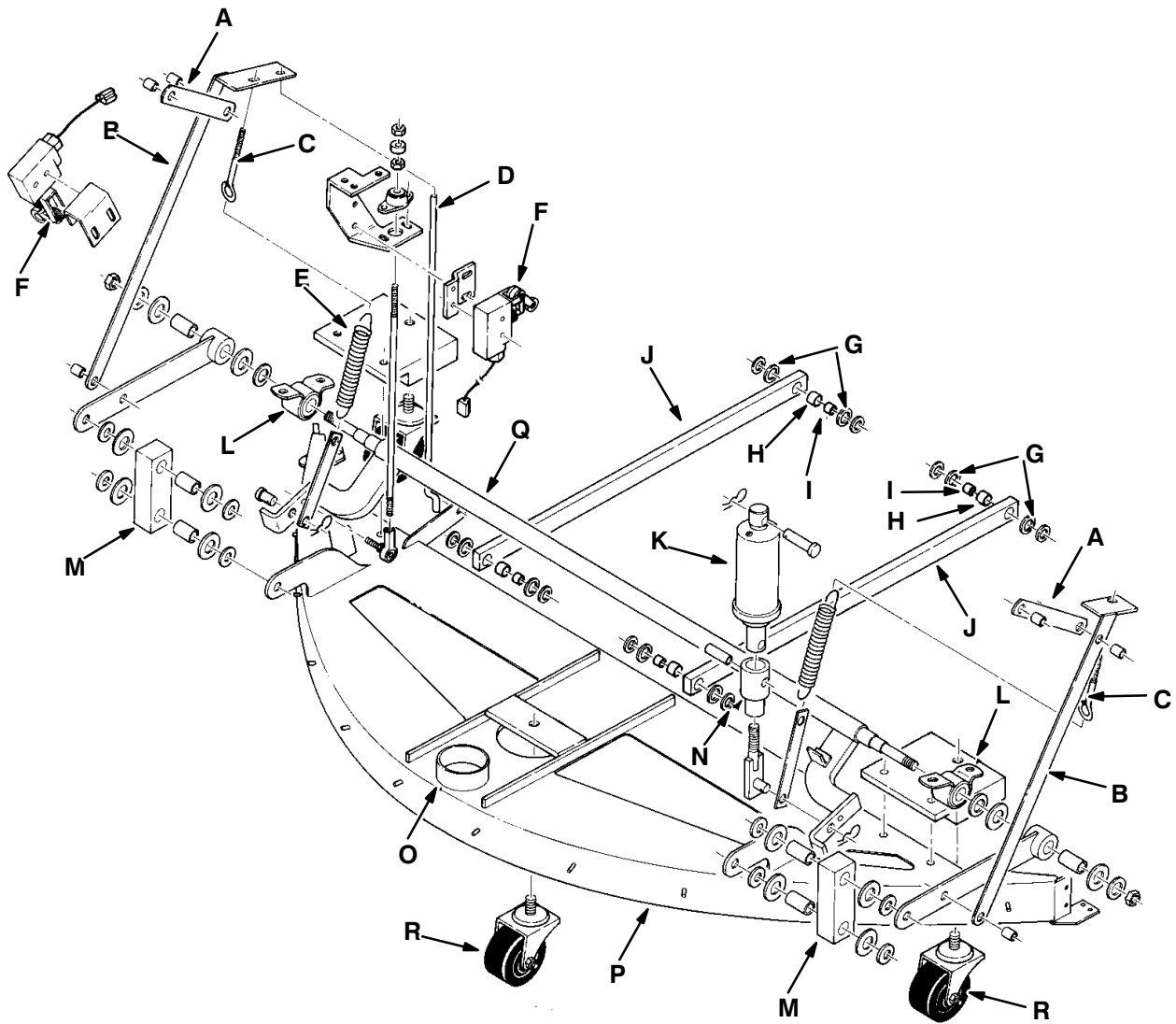
ARM CLEARANCE

- A. Arm Assembly**
- B. Squeegee Lift Shaft Arm**
- C. 1 to 1.25 in (25 to 30 mm)**

01728

4. CASTERS

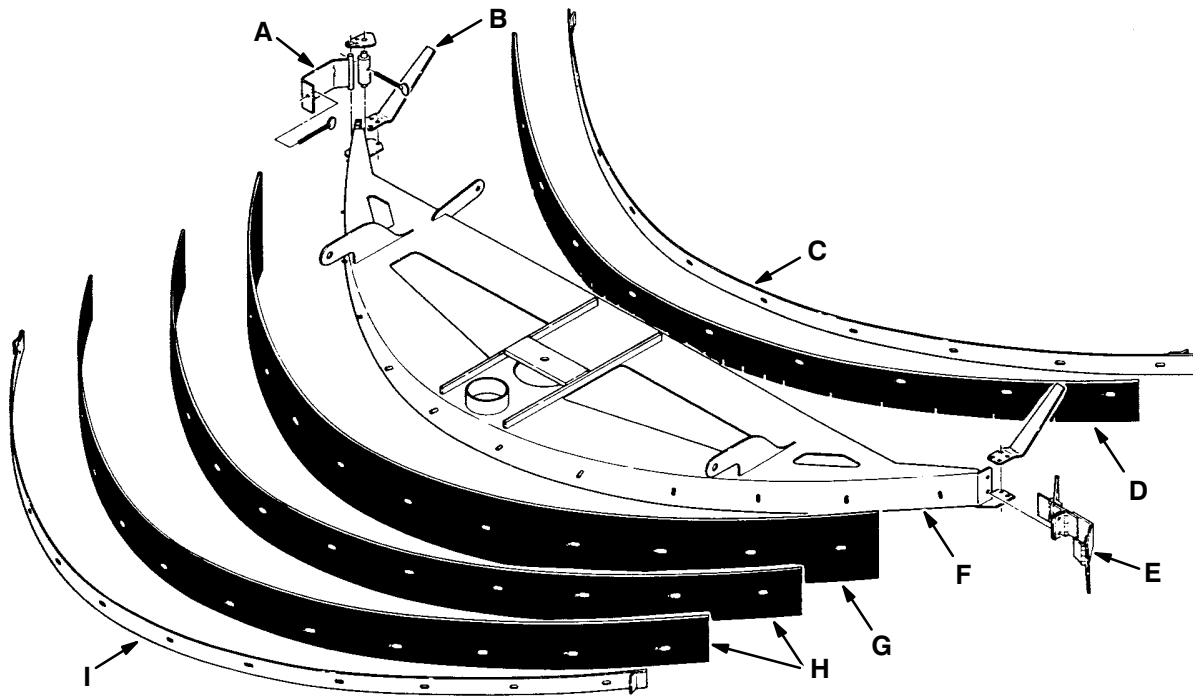
The caster should be in good condition and be free to spin. The center caster should be 0.25 ± 0.06 in (6 ± 2 mm) off the floor with the squeegee blade perpendicular to the floor. The tip casters should touch the floor with the squeegee blade perpendicular to the floor.



REAR SQUEEGEE LINKAGE

00191

- | | |
|--------------------------|---------------------------|
| A. Link | J. Front Drag Link |
| B. Arm | K. Squeegee Lift Cylinder |
| C. Eyebolt | L. Bearing |
| D. Squeegee Tip Lift Rod | M. Block Link |
| E. Down Pressure Spring | N. Cylinder Rod End |
| F. Roller Switch | O. Vacuum Hose Connection |
| G. Fibreglide Washer | P. Squeegee Frame |
| H. Bearing | Q. Lift Shaft |
| I. Sleeve | R. Caster |



REAR SQUEEGEE

00196

- | | |
|-----------------|------------------|
| A. Adjuster | F. Frame |
| B. Spring Guide | G. Rear Blade |
| C. Front Band | H. Back-Up Strip |
| D. Front Blade | I. Band |
| E. Band Clamp | |

TO ADJUST REAR SQUEEGEE

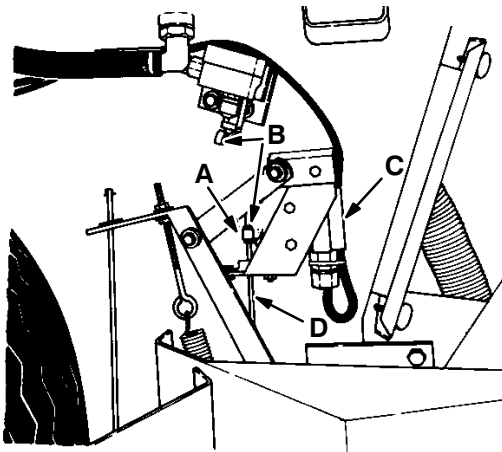
1. Lower the rear squeegee and drive the machine slowly forward to observe the squeegee roll-out. Adjust the squeegee roller height adjustment stud or add or remove washers from the caster to get an even roll-out. The top nut acts as a locknut. The nut just under the squeegee frame is the adjusting nut. Loosen the locking nut and turn the adjusting nut clockwise to increase down pressure, or counterclockwise to decrease pressure. Tighten the locknut after adjusting the adjusting nut.
2. Lower the rear squeegee and drive the machine slowly forward to observe the tips of the squeegee.
 - a. If both tips are too low, tighten both eyebolts which increases the down pressure on the back side of the squeegee frame to lift both tips.

- b. If both tips are too high, loosen both eyebolts which decreases the down pressure on the back side of the squeegee frame to lower both tips.
- c. If just one tip is too low, loosen the eyebolt on the side that is too low. If the tip is still too low, tighten the eyebolt on the opposite side.
- d. If just one tip is too high, tighten the eyebolt on the side that is too high. If the tip is still too high, loosen the eyebolt on the opposite side.

NOTE: The number of washers on the squeegee tip casters may need to be changed to properly adjust the squeegee tips.

MAINTENANCE

3. After the tips are adjusted, make sure the eyebolt adjustments are locked in place. The center of the squeegee may have to be readjusted to get an even roll-out across the squeegee. If the squeegee roll-out is set too small, the squeegee will skip when traveling on a uneven floor.
4. Lower the rear squeegee. The lower squeegee switch roller should be in line and tripped by the top of the trip barrel. Adjust the trip barrel position on the threaded rod to adjust.

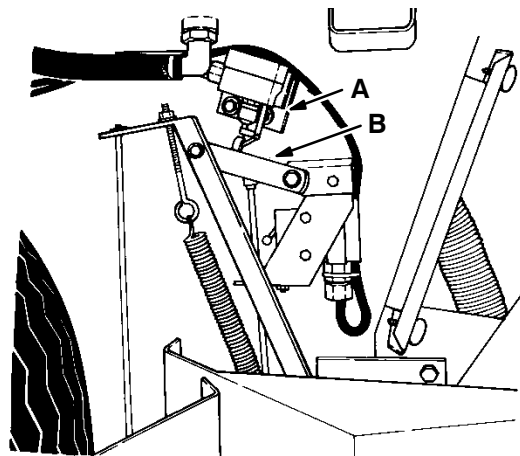


LOWERED SQUEEGEE

02357

- A. Trip Barrel
- B. Switch Roller
- C. Lower Switch
- D. Threaded Rod

Raise the rear squeegee. The upper squeegee switch roller should be tripped by the squeegee link. The lower squeegee switch roller should be free standing.



RAISED SQUEEGEE

02358

- A. Upper Switch
- B. Link

After both switches are properly adjusted with the engine operating, put the instrument panel squeegee switch in the "Down" position. The squeegee should lower. Press the directional pedal into the "reverse" direction. The squeegee should rise as soon as the machine moves backward. Press the directional pedal into the "forward" direction. The squeegee should lower.

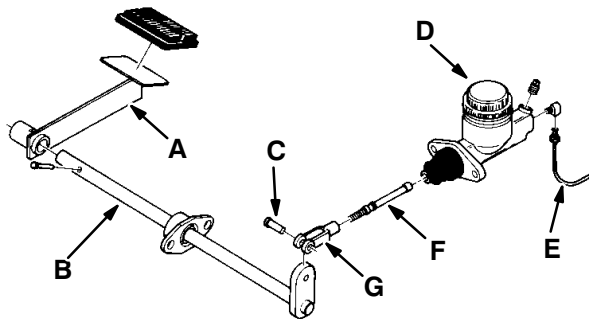
BRAKES AND TIRES

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 at the front of the machine. Open the front compartment door for access to the master cylinder.

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



00105

BRAKE SYSTEM COMPONENTS

- A. Brake Pedal**
- B. Shaft**
- C. Pin**
- D. Master Brake Cylinder**
- E. Brake Line**
- F. Push Rod**
- G. Clevis**

Brakes require bleeding whenever air enters the system, lowering the effective braking pressure. 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.

Whenever handling brake fluid, do not get any on the brake pads, brake discs, calipers, or body paint. Brake pads will be permanently damaged, requiring replacement. Body paint can be damaged also unless you wipe the area with a clean cloth and wash it with a soapy solution immediately.

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 front 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.
3. Open the bleeder valve and plug on the left front 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 with no air bubbles exits from the tube.
4. Bleed the right front 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. Top up the brake fluid reservoir with clean fluid.

PARKING BRAKES

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

The parking brake cables should be adjusted after every 200 hours of operation or whenever the machine rolls after setting the parking brake or when it becomes very easy to set the parking brake. To adjust the brake cables, turn the knurled knob on the end of the parking brake clockwise. Tighten the brake cable enough to make the parking brake slightly resist being set.

TIRES

The machine is equipped with four pneumatic tires. The air pressure in these tires is critical to machine performance. Check the tire pressure daily. The correct tire pressures are: 55 psi (380 kPa) front, 35 psi (240 kPa) rear.

Tighten the wheel lug nuts in a star pattern after every 200 hours of operation. Tighten lug nuts 85 to 95 ft lb (115 to 130 Nm).

OPTIONS

HIGH PRESSURE SPRAYER

The high pressure sprayer option requires some periodic maintenance to keep it operating properly.

Fill the crankcase and oil wicks according to the following instructions. Operate and maintain the pump only as directed.

The pump must not be run dry and must be drained of water prior to exposure to freezing temperatures.

NOTE: Do not pump acids, abrasive, or flammable fluids with this unit.

Crankcase – Fill crankcase to the dot on the oil gauge window with 1.25 pt (0.6 L) of genuine Cat Pump Crankcase Oil.

Change the oil after a 50 hour run-in period. Then change the oil every three months or at 500 hour intervals when using genuine Cat Pump Crankcase Oil. If other approved oil is used, change oil every month or at 200 hour intervals.

Piston Rod Wicks – Prior to initial operation, saturate the piston rod wicks and fill the reservoir (approximately 60 drops of oil – two pumps of a push-type oil can in each of the three lubricator housing holes). Add 30 drops of oil to each hole every week or 100 hours of operation.

Filter – The in-line solution filter must be cleaned or replaced after the 50 hour run-in period and every three months or 500 hours of service.

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	SAE Grade 5 Torque ft lb (Nm)	SAE Grade 8 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:

Nut to hold front wheel hub on propelling motor axle shaft: 200 to 250 ft lb (270 to 340 Nm)

Rear and front wheel nuts: 85 to 95 ft lb (115 to 130 Nm)

Rear wheel axle nuts: Tighten nuts until resistance is felt. Back off nut to first slot,

but no more than one-twelfth of a turn.

Allen head cap screw on o-ring tube assemblies of hydraulic drive motor: 15 to 20 ft lb (20 to 27 Nm)

Allen head cap screws on porting block of brush motor: 18 to 20 ft lb (25 to 27 Nm)

Brush drive motor plug: Torque slotted nut to 25 to 60 ft lb (35 to 80 Nm). Insert cotter pin through slot nearest the pin hole.

Pump drive coupling to flywheel: 35 to 40 ft lb (45 to 55 Nm)

Steering cylinder rod bolt: 240 to 250 ft lb (325 to 340 Nm)

Articulated joint horizontal shaft: Torque slotted nut to 15 to 20 in lb (1.7 to 2.3 Nm). Insert cotter pin through slot nearest pin hole. The snap ring should be tight against the bottom bearing, and joint should pivot freely.

Articulated pivot bolts (Connecting tractor to tank): torque to 125 to 135 ft lb (170 to 185 Nm)

Steering cylinder block flat head bolt 80 to 95 ft lb (110 to 130 Nm)

Main brush drive plug nut – 30 ft lb (40 Nm) then tighten to next slot.

Brake unit to hub sockethead screw – 9 to 12 ft lb (12 to 16 Nm) with Loctite 242 blue.

Front wheel nut – 10 to 12 ft lb (14 to 16 Nm) while turning wheel, tighten to spec, then backoff, retighten by hand till snug, then turn to next slot.

Damper solenoid nut – 20 to 23 in lb (2.5 to 3 Nm).





Pitman arm to steering column nut – 160 ft lb (215 Nm).

Propelling motor shaft thin nylon lock nut – 7 to 10 ft lb (9 to 14 Nm).

Propelling motor adapter bolts – 16 to 21 ft lb (21 to 28 Nm) with Loctite 242 blue on threads. Use loctite 515 sealant on the pilot fillet of the motor and the adapter.

APPENDIX

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