1996 SEAGRAVE TRIPLE
DETROIT/ALLISON

Make SEAGRAVE TRIPLE Model TB-50CF Year 1996

Laden Weight Front Rear

Tire Size Front 385/65R-22.5 Rear 12R-22.5

Tire Pressure Front 110 Rear 70 psi

Make of Engine DETROIT DIESEL Model Series 60 DDEC III Horsepower 415 hp

No. of Cylinders 6 Cubic Inches 774

Capacity: Fuel	50	gal
Crankcase	38	qts SAE 15w-40
Transmission	37	qts SAE 15w-40
Pump Transmission	24	pts SAE Dextron II
Differential	47	pts SAE 90-140
Power Steering	*ar	pts SAE 10w
Water Tank	500	gal
Cooling Tank	64	qts.

Transmission ALLISON WORLD, HD4060, 5 SPEED

Main Pump WATEROUS CMUYCX Type 2-STAGE CENTRIFUGAL

Rated Capacity 1500 gpm @ 150 psi

Priming Pump WATEROUS, Type -ROTARY VANE- POSITIVE DISPLACEMENT

*As required

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ENGINE:

Model……..Detroit Series 60 DDEC III
Maximum Horsepower……415 hp
Peak Torque (1200 rpm)……1450 ft lbs.
Governed Speed…….. rpm
No. of Cylinders……6
Bore and Stroke……5.12" x 6.30"
Engine Displacement……..774 cubic inches
Compression Ratio..……15.0:1
Operating Cycles……..4
Oil System Capacity……38 qts. 15w -40
Oil Pressure……12 psi at idle
28 psi at 1800 rpm
2100 rpm
Operating Range……1200-1800 rpm
Engine Temperature Operating Range…….170^{o} – !95^{o} F warning light at 220^{o} F
Engine Heater……..120^{o} – 140^{o} F

SPECIFICATIONS:

Fuel Tank……..50 U.S. Gal
Starter Motor……..12 volts
Batteries……Lead acid 12 volt/6 batt
Cab Hydraulic Pump Reservoir……Low Motor Oil
Fire Pump……..1500 gpm at 150 psi
150 gpm at 600 psi
Relief/Dump Valve……Set at 250 psi
Alternator……240 amps
Rear Axle……..RS 23 180
Gear Ratio……..3.91:1
Transmission……Allison World Transmission

DIMENSIONS:

Length……329" = 27' 5"
Width……..96" = 8'
Height……114" = 9' 6"
Cab Tilt Height……..167" = 13' 11"

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ENGINE:

- Detroit, Series 60 DDEC III
- 5.½" bore and 6.30" stroke
- 774 cubic inch
- Compression ration – 15.0 to 1
- Highest torque – 1450 ft lbs between 1200-1500 rpm
- Highest horsepower 415 at 1500 rpm
- Operating range 1200 rpm to 1800 rpm
- Can run an additional 7% on high idle.

NOTE: This can be very harmful if engine is cold. Due to minimal lubrication.

- After engine starts, check oil psi and alternator output.

- The Series 60 is designed to run at lower rpm

- Driving at lower rpm:
  - delivers best performance
  - largest engine life
  - best fuel economy (1200 to 1800 rpm)

- Series 60 delivers greater torque and pulling power at low rpm.

SERIES 60 DDEC:

- An electronically controlled fuel injection system that optimizes fuel economy and reduces exhaust emission. It does this by controlling the torque and horsepower curve, air fuel control (AFC) function, engine high speed, low idle and road speed.

- The features include gear down protection, progressive shifting, automotive/variable speed governor, low idle adjustment, and engine protection shut down.

- Electronic Control Module (ECM). The Detroit Series 60 engine is electronically controlled. Many of its functions are controlled by sensors and switches. These switches and sensors feed information to a central point. This point is the electronic control module or ECM.

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- The DDEC ECM receives information from many different sensors. Some of these sensors include the electronic unit injector, air temperature sensor, coolant temperature sensor, oil pressure sensor, oil and fuel temperature sensor, SRS and TRS sensors, vehicle speed sensor, coolant level sensor, throttle position sensor and turbo boost sensor.

- The electronic unit injector incorporates a solenoid operated poppet valve which performs injection timing and metering functions. When the solenoid valve is closed, pressurization and fuel injection is initiated. Opening the solenoid valve releases injection pressure, ending injection. The duration of valve closure determines the quantity of fuel injected. The air temperature sensor, located in the air intake manifold, monitors the air temperature entering the engine. The ECM adjusts the engine timing to reduce white smoke, and improve cold starts. The coolant temperature sensor is located on the right side of the engine.

- Another sensor is the oil pressure sensor. Two other sensors are the oil and fuel temperature sensors. The oil temperature sensor optimizes idle speed and injection timing to improve cold startability and reduce white smoke. The fuel temperature sensor provides a signal to the ECM to calculate fuel consumption. The ECM utilizes the fuel temperature signal to adjust the fuel consumption for changes in the fuel density as a function of temperature to maintain horsepower. Other sensors control the timing of the engine. The SRS senior provides a “once per CAM revolution” signal. The SRS provides a “36 per crankshaft revolution” signal. Working together, these sensors tell the ECM which cylinder is at top dead center for cylinder firing. Precise monitoring of piston position allows for optimum injection timing, resulting in excellent fuel economy and performance with low emissions. The vehicle speed sensor provides the ECM with the vehicle road speed for use with vehicle speed limiting and progressive engine braking. The next to last sensor is the throttle position sensor. The electronic foot pedal assembly instantaneously converts the operators throttle input into a signal to the ECM. The throttle response is fast and accurate. This sensor is self-calibrated, and requires no maintenance turbocharger compressor discharge, this sensor provides air pressure data to the ECM for smoke control during engine acceleration.

- The ECM processes the information that it receives from the sensors, and controls opening and closing of the injector solenoid. This action controls the amount of fuel metered to each injector, and the precise time of injection for each injector. This will produce the correct horsepower and torque for the engine.

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- Another system that the ECM is connected to is the diagnostic system. This system is capable of reading any fault codes recorded in the ECM. The diagnostic switch is an on/off type switch located in the circuit breaker panel in front of the Captain's seat. This switch is turned on when a mechanic wants to read any fault codes. It must remain off at all other times.

- When shutting down engine, do not switch battery master switch to "off" while engine is still running. This can damage the voltage regulator and destroy the alternator diodes.

- During prolonged idling – maintain at least **900 –1100 rpm** to keep temperature from falling below normal temperature.

- The incomplete combustion in a COLD engine will cause: **plugged injectors**, **crankcase dilution, formation of laquer and/or gummy deposits** on rings, pistons and valves and sludge in the engine.

- **After heavy use – idle for 3 to 5 minutes** to cool engine prior to shutdown.

- With hot engine stopped suddenly, the turbocharger's temperature could rise as much as **100 degrees F.**

- If engine rotation increases by 200 to 300 rpm above rated speed may damage the engine. Valves may hit the pistons (valve float), increased oil consumption, injector plunger seizure, and other damage requiring major repairs.

FUEL SYSTEM:

- 50 gallon fuel tank.

- Shut-off is mounted forward of the fuel tank above the rear axle.

- Fuel pump is a positive displacement type pump.

- If ignition switch breaks solenoid wire or solenoid burns out or battery voltage drops below nine volts electricity to the fuel modulation valve will be cut off, causing the valve to close and the engine protection system to take over. Power and speed will gradually be reduced when this occurs, pull over and notify the shops. There is nothing in the field that can be done to restart engine.

- When ignition switch is turned on the ECM opens a modulation valve where it enters injectors or is bypassed. When electricity to ECM is turned off (ignition switch turned off) the valve closes shutting the flow of fuel to the injector.

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- Keep the fuel tank FULL. This minimizes condensation forming in the tank and also keeps the fuel at the proper temperatures.

- RAYCOR 490RP30 fuel filter/water separator, access to filter is gained by tilting cab (left side of engine).

- There is also two canister type fuel filters plumbed in the fuel system. Located behind the frame rail just below the Raycor 490RP30, changed at annual pump test.

- Frequency of water draining or filter replacement is dependent upon contaminants of fuel.

- Inspect/drain collection bowl for water weekly.

- To drain water:

    1. Open the drain and operate the priming pump to drain off contaminants. The priming pump is located at the top of the fuel filter housing.

    2. Tighten drain (clockwise), run engine, check for leaks.

- Filter replacement is done annually at pump test.

- In the event filter replacement is done in the field:
    1. Drain off some fuel by loosening the vent plug and opening the drain valve (the valve plug is located at the top right corner of the fuel filter/water separator housing.)

    2. Remove filter element from mounting head with bowl connected.

    3. Remove bowl from filter element. Clean bowl and O-ring gland.

    4. Lubricate o-ring with clean diesel fuel or motor oil and place in bowl gland.

    5. Spin bowl onto new filter element snugly by hand**. "CAUTION" Do not use tools to tighten**.

    6. Lubricate filter top seal with clean diesel fuel or motor oil.

    7. With the vent plug still loosened, operate the priming pump until fuel purges at the vent plug. Make sure filter is completely full of fuel, then close vent plug.

    8. Start engine and check that there are no leaks.

- When water and/or contaminants accumulate in separator bowl and reach a predetermined level:

  1. Warning light and
  2. Audible buzzer will sound.

  Drain bowl "as soon as possible." Engine could stall and serious damage done if water is not drained out of bowl.

ENGINE COOLING SYSTEM:

- Water pump mounted on front of engine.
  Water pump has packless seal and requires no lubrication.

- It is most important to visually inspect coolant. If rust or clear water condition is evident. Inform the shops immediately for cooling system inspection.

- Equipped with a system conditioner to filter, provide electrolytic protection and to act as a rust inhibitor. A portion of the coolant is circulated through the conditioner any time that the engine is running, located on the right side of engine block next to oil filter.

- The importance of a properly conditioned or inhibited coolant liquid cannot be overstressed. An improperly inhibited coolant can:

  1. Become corrosive enough to "eat away" coolant passages and seal ring grooves and cause coolant leaks to develop
  2. Cause liner scuffing.
  3. Scoring
  4. Piston seizure
  5. Cylinder head cracking

  An engine effected in the manner overheats gradually over a period of weeks or months.

- A coolant, which has insufficient inhibitors, invites the formation of rust and scale within the cooling system.

  - Rust, scale and mineral deposits can coat walls of the cylinder block, water jackets and outside of cylinder liners. As deposits build up they insulate the metal and reduce rate of heat transfer.

  - Improperly inhibited coolant can also contribute to cavitation erosion, caused by collapse of bubbles, formed at the coolant side of an engine component (pressure differential in liquid cause by vibration of the engine part).

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- Check Coolant level

  - Most important to visually check condition of the coolant. Rust? Clear water? Inform Shops.

  - Check water pump weep hole. If leaking seal has worn out.

- Coolant recovery tank located outside of cab under Captains seat. Can be maintained full without tilting cab.

  *Hot and cold marks on recovery tank (actually on diamond plate).

- Engine heater maintains coolant's temperature at 120 to 140 degrees, it is a 110 v AC, 1000 watt, direct immersion type. It shall be connected when in quarters.

- Radiator Cap is pressure relief type with 7 lbs. rating. This allows the coolants temperature to rise to 233 degrees before boiling.

- **Deaeration tank** purges air, which could become trapped in the cooling system from circulating through the system.

- If possible, do not permit engine water temperature to exceed 200 degrees.

- Thermostat – modulating type, 170^0 F

Cooling Fan:

- The fan is bolted directly to the hub and continuously turns while the engine is running.

- Driven by two vee belts.

ENGINE LUBRICATION SYSTEM:

- 28 psi at 1800 rpm
- 12 psi at idle
- Force-feed wet sump system integral with lower case of engine.
- Lower case holds 32 quarts of oil, six in filter or other related engine lubricating oil system.

- An oil cooler of the heat exchanger type is located on the right side of engine block.

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- Series 60 two oil filters.

- Check engine oil, wait at least 20 minutes often shut down. After first four minutes can check level, if oil level is at the "low" mark, the engine maximum may be run safely. When practical wait the full 20 minutes to get an accurate readings.

ELECTRICAL SYSTEM:

- **REFER TO TRAINING BULLETIN #65**

- Lead acid 12-volt batteries, 6 of them.

- Valid at 950 CCA at 0^{o} degrees F each

- A 1996 Detroit Diesel with 744 cubic inches @ 1550 amps to start.

- Batteries connected in parallel to rest of electrical system. This allows alternator on board charger to change all batteries simultaneously.

- Use of 800 MHz radio and MDT Unit create a constant eight amperes per hour draw on battery system.

  - Thus a 45-amp battery charger has been installed on each rig.

- Heavy apparatus must be plugged in when vehicle is in quarters.

- Opening and closing of circuit breaker will produce a "clicking" sound. Will continue until short or the switch controlling that circuit is found. Notify the shops.

- Battery Charger:
  1. Connect 110 volts into apparatus electrical receptacle.
  2. Turn charger switch to "ON" position at receptacle.
  3. Can leave radios on.

- Battery charger is self-regulated will decrease amperage as batteries charge.

- When apparatus is placed out of service (over ten hours) radio "cut-off" switch must be turned off (located between Captains seat and firefighter jump seat).

- Low voltage warning system:
  - Audible device activates when batteries fall below 11.2. (Drivers side under dash).

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- Battery Cable – the battery master switch must be in the OFF POSITION. Before moving the battery cables, this will present a spark from happening at the terminal and igniting the hydrogen and oxygen gases being omitted from the battery. It is not necessary to turn off the radio when charging.

- 12 volt starting motor – Do not crank over 30 seconds. Hesitate about 30 seconds before retrying.

- Running engine slightly above idle speed will be enough to supply the entire electrical system with adequate voltage. Raise RPM above idle speed ONCE.

- If a "full charge" cannot be maintained or if battery overcharges and liquid has been boiling …. Notify shops.

CHARGING SYSTEM QUICK CHECK:

ENGINE MODE	VOLTMETER READING	CONDITION
Battery switch on ignition switch on engine not running no electrical load	12.2 – 12.8	Batteries ok
Same condition as above	Below 12	Recharge battery
Engine running (1 min. or more) approximately 1000 rpm – no load	13.8 – 14.2	Check alternator ok
Same as above	Below 13.8	Check alternator - belt tension – alternator b.o.
Engine running (1 min. or more) approximately 1000 rpm - full load (all lights on)	13.5 – 14.2	Charging System ok
Same as above	Below 13.5	Check alternator - belt tension – check battery – condition – alternator b.o.

The above information does not supersede the standard battery maintenance program as recommended in the F-377, but is intended to be followed only as a quick daily check to make sure the charging system is functioning in a normal manner. Keep the batteries at full charge at all times.

AIR CONDITIONING UNIT:

- Two A/C Units each ahs a drip pan for condensation. When drip pan fills water will overflow into the overflow tank. The overflow tank has a pump to automatically drain it.

- Drain hose for overflow tank terminates behind left front tire. During normal operation water will drain from this hose.

- If drain hose get clogged, water will begin to leak from bottom of A/C Unit. Notify shops if this is excessive.

- Driving over rough terrain can cause water to splash over drip pan and leak out of A/C Unit.

- When in use it is normal for some water to leak into cab. Due to sweat from evaporator.

- Each unit has one air filter to keep dirt out of evaporator. Made of a nylon material.

- Periodically check both filters for dirt. A dirty filer will cause WARM air to come from A/C unit. Shops clean and service filters.

ALTERNATOR SYSTEM:

- Rectifier is located OUTSIDE of alternator on left frame rail next to the transmission.
- Rectifier changes AC to DC – current then goes to the battery.
- Produces a maximum of 240 amps @ 14.2 volts @ low engine RPM's
- Alternator bearings are lubed/sealed at factory.
- If voltmeter fails to show a charge, when it should, CHECK ALL CONNECTIONS FOR TIGHTNESS and wiring for breaks. If this fails to remedy the situation, notify the SHOPS.

Circuit Breakers protect the electrical system.

If a short occurs, the breakers heat up, and click open. When they cool they close, making another clicking sound. Unless the short has been fixed, the breakers will open again. This "clicking" sound will continue until faulty circuit has been found.

NOTE: Even if the short has been fixed OR isolated, the Shops should be notified.

DUAL BRAKE SYSTEM: (also called split brake system)

- Brakes are by ROCKWELL Dura Master Disc Brake System.
  E-8 BENDIX – WESTINGHOUSE – E8 brake application valve is heart of system.

- TWO separate supply and delivery systems – Service and Emergency.

- Air pressure is lost in secondary system – braking goes on in a normal manner.

- Air pressure is lost in priming system, the E-8 brake application valve will allow the air pressure from the secondary system to come into the primary system, to equal the amount of mechanical pressure being applied at the pedal.

SPRING BRAKES:

Spring brakes effect the rear wheels only brake is applied by ABSENCE of air, by spring pressure.

To apply the brakes: Pull yellow button, located on the console.

To release the brakes: Push the yellow button until there is enough air in the system to hold the brakes off.

Three Primary Uses of the Spring Brake:

1. Emergency brake
2. Parking brake
3. "Low pressure starting" protective device

If spring brakes cannot be released and the apparatus must be towed:
1. Remove release bolt (stored outside of the service chamber)
2. Remove two self-tapping screws holding top washer behind the stop washer is a rubber snap plug.
3. Remove snap plug and reinstall the stopwasher.
4. Insert release bolt, tighten enough to mechanically release compression spring.

TOWING:

1. Remove release bolt (stored outside of the service chamber)
2. Remove two self-tapping screws holding stop washer, behind stopwasher is a rubber snap plug.
3. Remove snap plug and reinstall stop washer, insert release bolt, tighten bolt enough to mechanically release compression spring.
4. Apparatus can now be moved or towed.

REMEMBER TO CHOCK THE WHEELS FIRST!!

SELF-ADJUSTING BRAKES:

Periodic adjustments of brakes have been eliminated. Regular inspection of lining water, lubrication and slack adjust travel must still be checked.

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Adjusting procedure:

1. Start engine and achieve full system pressure (120 psi)
2. Depress brake pedal fully and hold for one second.
3. Repeat four or more times.
4. Shut off engine
5. Recheck slack adjuster travel

- New pads are different thickness

Rear	Front
Outer pad - 9/16"	Pads are identical to rear
Inner pad - 7/8"	

- Maximum brake arm travel – Front and rear in 2½”

WEEKLY:

1. Check outboard and inboard pad for wear. ¼” call shops for inspection by mechanic.
2. At least 1/8" of slide pin should show.
3. Check rotors for checks and cracks
4. Check inner pad with mirror and flashlight.

- **Rotor Inspection**
  1. Chock front and rear of a tire not jacked up
  2. Jack vehicle up
  3. With brake off, rotate wheel, look for checks and cracks. Also check lateral run outs of the disc.

- LIGHT HEAT CRACKING is normal. – (very fine hairline cracks across the surface of the rotor.) If cracks go completely through the rotor, it must be replaced.

- During braking operation, the apparatus can develop a steering wheel side to side motion of chatter, this may indicate a warped or cracked rotor.

CAUTION: Over use can glaze the pads and crack rotors from excessive heat.

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AIR RESERVOIR SYSTEM:
Components:
Brake chamber at each wheel, check valves, switch, compressor, dryer, indicator switch, quick release valves, reservoir tanks, safety valves.

- Air storage tanks:
  1 primary @ 90 psi, the secondary tanks begin to fill.
  5 secondary

- Apparatus may be moved when primary reaches 90 psi, however, only rear brakes have full braking power prior to secondary tanks reaching 90 psi.

- Steering column hand will not function unless secondary air system has reached 90 psi.

- Two air gauges on dash, left gauge on dash indicates pressure in primary tank.

- Red lights and buzzer on dash will operate when pressure falls below 60 psi and ignition switch is on.

- Moisture Ejection System - Desiccant type; WABCO System Saver 1000 air dryer.

  Removes both liquid and water vapor from the compressor discharge before it reaches air brake reservoir.

  Spin on cartridge serviced yearly in shops. Operates on same priniciple as previous systems.

Automatic Bleeders Valve – located on primary tank operate this "schrader" valve weekly to ensure functioning correctly.

AIR OUTLET:

- Mounted on the left side, midship of apparatus to fill tires on extinguishers only.
- DO NOT use a spray gun to paint with it.
- DO NOT connect air bottle to it.
- Shut-off valve shall be closed when not in use.
- A one-way check valve is fitted to the air outlet, this will make it impossible to keep the system charged up with a portable compressor connected to it.

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AIR CLEANER:

- Location: Directly behind the engine access is gained by tilting the cab.
- Has an exterior "filter" intake screen located in front of jumpseat door on the left side.
- Dry type, replaced or serviced yearly at shops.
- Maximum inlet restriction for a clean air filters is 10" of H_20.
- If the dash gage reads 25" of H_20 check for restrictions at screen, such as leaves, ashes, paper, etc. If screen is clear call shops for service.
- When washing apparatus avoid direct water into filter intake.
- If DUST or DIRT enters the engine rapid wear of the piston rings, cylinder liners, piston and exhaust valve mechanisms. There will be a POWER LOSS and high lubricating OIL CONSUMPTION.
- If dirt is allowed to build up in the filer, air supply will be restricted, resulting in HEAVY CARBON deposits on pistons and valves. This is due to incomplete combustion.
- Never direct a stream of water into the intake.
- Never mount or hang a tool to any part of the housing or tubing.
- Cleaning the filter is not recommended , serviced at annual pump test or sooner if necessary

TURBOCHARGER:

- Consists of a turbine wheel and a centrifugal blower, or compressor wheel, separately encased but mounted on and rotating with a common shaft.
- Forces additional air into engine so it can:
  1. Burn more fuel
  2. Develop more horsepower
  3. Maintain engine's efficiency
- The power to drive the turbine wheel, which in turn drives the compressor is obtained from energy of engine exhaust gases, can turn up to 60,000 rpm.

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- Is cooled and lubricated by engine lubricating oil.

- Oil lag or oil starvation to the turbo will cause premature wear on the bearings.

- A periodic check of air cleaner is essential. A clogged filter results in high exhaust temperature, which will damage turbine, bearings, and shaft. Also will cause engine to run over-rich. This will cause engine to smoke excessively.

- **Do not over rev the engine on cold starts. (oil lag to turbo bearings)**

- Diesel runaway – See your handout. The information in your handout is taken from this 93 logbook.

- Don't shut down engine while hot. May cause temperature or turbocharger to rise 100^{o} above engine temperature and damage bearings.

- Bi-Monthly inspect the connections, clamps, and couplings, between the air cleaner and the turbocharger. Unfiltered air can cause excessive wear and damage to the compressor section of the turbocharger.

- Idle 3 to 5 minutes before shutting down…for the same reason you've been reading about in the past six logbooks.

CHARGED AIR SYSTEM:

- An air to air radiator located in front of engine coolant radiator.
- Connected between the compressor side of turbo and intake side of engine.
- Approximately same size as the engine coolant radiator.
- Works the same way as a standard radiator, turbo sends hot compressed air through air to air radiator then into intake manifold.
- Provides dense and cooler air – more efficient maintenance of charge air system. Bi-monthly check for cracks, leaks and loose connections.

TRANSMISSION:

- Allison World HD4060P, 5 speed, automatic transmission.

- WT electronic control system – controls the electrical portion of the world transmission.

- Two-countershaft design allows engine torque to be equally divided between the two countershafts. This provides a high ratio of torque capacity to the weight of the transmission.

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- All gears are constant mesh, through spur teeth.

Maximum speed in each gear:

Gear	Max. Speed	Ratio
1st -	13.7 mph	3.51
2nd -	25.2 mph	1.91
3rd -	33.7 mph	1.43
4th -	48.2 mph	1.00
5th -	65.1 mph	1.00
6th -	mph	
7th -	mph	
Rev. -	10.0 mph	04.80

- This apparatus is equipped with a TELMA MAGNETIC Focal Retarder (see handout on operation).

- When descending grades hold rpm to max. 1800-1900 rpm or less.

- Governor WILL NOT control engine when descending hill. Back wheels are driving engine. 200-300 RPM above maximum range will **cause valves to float** .

REAR AXLE:

- Rockwell, Model RS-23-180
- Ratio 5.38 to 1

STEERING:

- **Ross hydrapower** integral power steering gear.

PUMP:

- Waterous Centrifugal (CMUYCX 1500)
- Two stage pump
- Series/parallel type.
- Chain driven
- Capacity - 1500 gpm @ 150 psi.
- High-pressure 150 gpm at 600 psi.
- Pump is hydrostatically tested at 600 psi.
- Manifold drain – don't drain under pressure.
- Pressure gauges are liquid filled with damper valves
- Zinc anodes mounted in pump cavity to prevent pump corrosion.
- Compound gauge is liquid filled with damper valves – reads positive psi and vacuum in inches of mercury.

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PUMP TRANSMISSION:

- Lubrication is supplied by two methods:
  1. Externally mounted oil pump to pump impeller shaft. This supplies lubrication to upper part of pump transmission when pump is in gear only.

  2. Lubrication to lower section is via the "splash system." This system operates at all times.

- Expect to see approximately 2 to 5 psi on pump transmission oil pressure gauge on pump panel.

PUMP PACKING:

- Mechanical type - no adjustment, no leakage. – Notify shops if condition exist.

PRIMING PUMP:

- Electric driven rotary vane priming pump.

TRANSFER VALVE:

- Two position controlled by a push/pull handle.
- Normally changing the transfer valve position, regardless of pressure will not damage pump, however, the operator should always follow procedure developed by their Fire Department.

PANEL THROTTLE:

- Many components of the Detroit engine are electronically controlled. One of these components is the pump panel throttle. Since there is no mechanical fuel pump on the Series 60 engine, a cable throttle can no longer be used. Instead, an electronic vernier type throttle has taken its place. Included with the electronic panel throttle is a throttle interface module. This module receives information from the panel throttle and transfers it to the ECM on the engine. The throttle interface module is located in the compartment just behind the pump panel main pressure and suction gauges.

- When the throttle interface module is powered up by the safety system (maxi brake and pump engaged safety switches) the throttle module will perform a self check and the led on the module will light for approximately four seconds and then turn off.

- After the self-check, the throttle interface module will verify that the panel throttle control knob is at its full inward position (less than ¼ turn). If the panel throttle is not all the way in, the throttle interface module flashes error #1 on the led until panel throttle zero position is detected.

IMPORTANT: THE THROTTLE INTERFACE MODULE WILL NOT CONTROL THE ENGINE UNTIL ZERO PANEL THROTTLE POSITION IS DETECTED. THIS FEATURE IS PRESENT TO AVOID UNINTENTIONAL INCREASE IN ENGINE SPEED SHOULD THE PANEL THROTTLE KNOB BE LEFT IN THE OPEN POSITION.

- After the interface module has performed self-check and detected the zero throttle position, it is ready to control the engine.

- After the panel throttle control knob has been turned out approximately ¼ turn, the interface module will begin to control the engine. At this time, the panel throttle knob will over-ride the foot throttle in the cab. There will be a 1-2 seconds delay when the control is first transferred from the foot throttle to the pump panel throttle. Once control is established at the panel throttle, the throttle response will be immediate and very precise. The panel throttle will now electronically control the engine between 800 rpm and full engine speed.

- When finished operating the pump panel throttle, turn the control knob to its full inward position. When the throttle interface module detects this position and th engine rpm is at or less than 800 rpm, it will release control back to the foot throttle. This transfer will take approximately 3-4 seconds. If the panel throttle is turned out again, panel throttle control will be re-established with the engine ECM and engine speed will increase.

RADIATOR FILL VALVE:

- No damage to the radiator can occur when filling it this way. The increase pressure when the radiator is full will raise the CAP and the coolant will flow out the overflow. Pump water will contaminate radiator water system will need to be flushed. Notify shops for service and flushing.

- Overfilling the radiator will dilute the coolant.

AUXILARY COOLER:

- Assist in keeping engine cool while pumping.
- Water from pump does not mix with engine coolant.
- If engine temperature is unusually high, first step, is to open the auxiliary cooler

NOTE: Maintain engine coolant temperature at 180^{o} for maximum efficiency.

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RELIEF VALVE:

- Waterous relief valve.
- A spring loaded, pressure actuated unit that is installed between the discharge and suction sides of the pump.
- WATEROUS relief valve system consists of two units:

    1. Relief valve proper
    2. Pilot valve (This unit controls the relief valves operation)

- Controls discharge of 75 psi to 300 psi.
- Can't control discharge pressure to an amount lower than suction pressure plus 50 psi.
- When operating from draft or tank no less than 75 psi.

PILOT VALVE MAINTENANCE:

After prolonged pumping - use of dirty water – or in any case, clean the valve….Call shops to disassemble and clean pilot valve.

WATER TANK:

- 500 gallons, ½" polypropylene "pro tank"
- Flow capacity from tank to pump of 600 gpm.
- Overflow capacity is rated at 600 gpm.
- Fill only through inlets with strainers.

SUCTION INLETS:

- Two 6" inlets, one on each side, reduced to 4" with 4" keystones attached, no friction loss
- 4" front suction 5 psi friction loss, 15-30 gpm loss.
- 3½" right auxiliary inlet 50 – 110 FL and also supplies 155-350 gpm less than 4" suction.
- 3½" left auxiliary inlet 10-40 psi FL and supplies 35-140 gpm less than 4" suction.
- The above numbers were calculated by flowing between 630-1270 gpm through the 4" main inlet and 4" front inlet.

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- The data for the 3½" auxiliary suction inlets was determined by flowing 630-1090 gpm through each inlet.

  (Main purpose of this test was to determine gpm and friction loss in plumbing for all five suction inlets.)

- Data for maximum gpm at draft was calculated by drafting through each individual suction inlet

4" main inlets	970 gpm
4" front	770 gpm
3½" right aux. Inlets	390 gpm
3½" left aux. Inlet	575 gpm

AUXILIARY TANK FILL:

- The left side auxiliary suction inlet also supplies water to the auxiliary tank valve. This valve allows you to fill your rank without going through the pump. Thus you are able to keep tank full without affecting pump pressure.

- There is no check valve in the auxiliary tank fill line. If left open with no incoming pressure you will drain your tank.

RELIEF/DUMP VALVE:

- Located on suction side of pump. When incoming pressure greater than 250 psi the valve will bypass excessive pressure and water to pavement via a 2½" male outlet.

- Do not cap this outlet.

- A shut-off valve located before the relief/dump valve is to be left open at all times however it can be shut-off if suction pressure is greater than 250 psi is desired.

- The actual dump valve is located on right side of the pump next to the priming reservoir.

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DISCHARGE OUTLETS:

- Four 3½" discharge outlets, two aside, panel side are reduced to 2½".
- Manifold (each side) connected to three 1½" discharge gates for a total of six 1½". Each manifold has a shut-off valve and pressure gauge.
- 3" ball valve to turret.
- 1½" tank fill between main pump and water tank.
- 3" ball valve tank to pump dump valve.
- Slo cloz – controls opening/closing speed of 3" or larger valves "suction or discharge" by use of hydraulics.

  - Bolts to top of valve above the existing handle of the four main discharge gates, two auxiliary suction inlets and wagon battery.

  - Closing time is @ 3 seconds.

- Has an adjustments plug. When turned clockwise reduces the orifice causing resistance. Shops only can adjust.
- Principle of Operation – A circular race filled with silicone grease, When open/closing valve, grease is forced through orifice which creates resistance, causes assembly to turn slower.

PRIMING PUMP SYSTEM:

- Electric driven rotary vane pump mounted on pump transmission.
- A priming type valve mounted on pump the body has a switch on one end enclosed in a housing. This valve is manually opened, a plunger closes the switch to start the priming pump. Releasing the valve control opens the switch to stop the priming pump.
- Priming control valve –mounted on top of main pump opens/closes passage to pump.

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CAB TILTING PROCEDURES:

TO RAISE CAB:

1. Set the parking brake and shift transmission to neutral before tilting the cab.

2. Make sure all loose equipment inside the cab is either removed or secured.

3. Plug in remote electric control cable.

WARNING! NEVER STAND IN THE PATH OF THE CAB.

4. Turn on battery master switch and ignition.

5. Remove cab tilt cylinder safety locks from behind front cab doorposts.

6. Close all cab doors before tilting cab.

7. Battery tray must be locked in place before tilting cab.

8. Press the up control button on the remote cable to tilt the cab to full tilt.

9. Make sure that once the cab is tilted to its maximum height, that you "immediately" insert both of the mechanical cab locking devices. (NOTE: see photo 10 item 5).

10. Turn off the ignition switch. NOTE: If the ignition switch is not turned off the engine hour meter will continue to run.

TO LOWER CAB:

1. Before lowering the cab remove the cylinders safety lock assembly from both sides or serious damage may result to the cab structure.

2. Make sure all persons, tools, or other obstructions are clear of pinch points. Position yourself so that you can be certain no personnel are within arms reach of the cab during lowering.

3. Press the down control to lower the cab. When the cab is lowered completely, the spring loaded lock will secure the cab.

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WARNING!

- **NEVER STAND IN THE PATH OF THE CAB.**
- **NEVER WORK BENEATH THE CAB IN A PARTLY RAISED POSITION. ALWAYS TILT THE CAB TO THE FULL UP POSITION AND USE BOTH CYLINDER SAFETY LOCK ASSEMBLIES BEFORE WORKING UNDER THE CAB.**
- **KEEP ALL PERSONS AND LIMBS CLEAR OF PINCH POINTS WHEN LOWERING THE CAB TO PREVENT INJURY.**
- **DO NOT MOVE THE VEHICLE UNLESS THE CAB IS IN THE FULLY LOWERED AND LOCKED POSITION.**

- Keep valve in center position except when pumping with hand pump.
- Once over center, cab lowers automatically when using hand pump.

CAB HYDRAULIC PUMP RESERVOIR:

Holds low motor oil. If the reservoir is not completely full the cab will not raise to full tilt. When adding or checking fluid level the cab must be in the lowered position. If fluid (ATF) is added check for leaks, notify the Department Shops. If a leak or other cab tilting problems occur.

CAB MICRO-SWITCHES:

- There are two micro-switches located in the engine compartment. One of the micro-switches is next to the cab locked on the right side of the engine compartment.

- This switch activates a red light on the dash when the cab is unlocked. The red light is labeled (cab not locked). Note: see photo 15 item 8).

- The other micro-switch is located on the transmission. This switch stops the cab from raising or lowering if the manual shift is not in neutral.

PUMPING PROCEDURES:

ROAD TO PUMP:

1. Stop/spot apparatus
2. Shift to neutral
3. Set parking brake (brake must be set or pump will not engage)
4. Throw pump shift lever rearward.
5. Engage road transmission (7^{th} gear) Note: One green lights will turn on - pump engaged

PUMP TO ROAD:

1. Shift transmission to neutral
2. Throw pump shift lever forward
3. Release parking brake, apply service brake
4. Engage road transmission

PNEUMATIC SHIFT MANUAL OVERRIDE:

- Used when system has exhausted its air supply.

ANYTIME THE PUMP WILL NOT SHIFT FROM ROAD TO PUMP, SHIFTING MANUALLY IS DONE AS FOLLOWS:

NOTE: IT IS RECOMMENDED THAT THIS PROCEDURE BE PERFORMED USING TWO PEOPLE; ONE PERSON IN THE CAB, AND ONE PERSON AT THE OVERRIDE CONTROL POSITION.

SHIFT TO PUMP AS FOLLOW:

1. Bring apparatus to a complete stop.
2. Reduce engine to idle speed, put road transmission in neutral.
3. Set parking brake.
4. Move in cab pump shift control into pump position.

WARNING! THE IN CAB PUMP SHIFT CONTROL MUST BE IN THE PUMP POSITION. IF NOT, AIR PRESSURE MAY PREVENT MANUALLY SHIFTING TO PUMP AND RISING PRESSURE MAY ATTEMPT TO SHIFT BACK TO ROAD.

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5. Push manual shift control rod in, for pump position. Pump engaged light must be on.

6. Wait at least four seconds.

7. Shift road transmission into pumping gear. Pump engaged light must be on.

SHIFT TO ROAD AS FOLLOWS:

1. With engine at idle speed, put road transmission into neutral.
2. Move in cab pump shift lever into road position.
3. Pull manual shift rod out for road position.
4. Wait at least four seconds before engaging road transmission.

MISCELLANEOUS INEORMATION:

- If drafting, strainer should be at least TWO FEET from the surface of water. Whirlpools forming above suction strainer indicated strainer is too close to surface of water.

- Cleaning of BUDD CADGARD wheels, water not to exceed 170^{o} degrees F,

  DO NOT USE ABRASIVE CLEANERS. Products at higher concentration than .20 percent acid or .04 percent caustic can cause permanent damage to chemical shield.

- Flush entire pump system clean with fresh water for several minutes after handling chemicals, salt water or dirty water.

- Keep pump either completely full or completely drained, never partially full.

- Transfer valve should be checked for use of operation on a daily basis.

- Excessive idling creates two problems:
  1. Burning gas about 1/2 gal per hour.
  2. Causes engine to operate at dangerously low temperatures and this causes a build up of carbon deposits around injectors, valves, pistons and valve seats.

CUMMINS ENGINE BRAKE:

"C" brake with three positions (operation is same as Jake brake, see your handout)

1. Minimum - opens exhaust valves on two cylinders
2. Moderate - opens exhaust valves on four cylinders
3. Maximum - opens exhaust valves on six cylinders

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The ECM receives signals from C-brake switches, then electronically enables or disables the C-brake through the “brake enable” relay.

NOTE: C-Brake cannot be enabled:
- ♦ When engine rpm goes below 850 rpm.
- ♦ When an electronic problem is diagnosed.

- ♦ Electrical windshield wiper system.

- ♦ IMRON PAINT (polyurethane enamel) on the body – no abrasive cleaners use “K.S. Custom Body Jelly” Storeroom stock number = 932 5408.

Audible warning devices:
1. Low voltage
2. Low oil pressure – dash – engineer panel
3. Low air
4. Fuel filter/water separator gage located just forward of the shift tower.