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Safety Information

Be alert when seeing this symbol in this manual.

There is the potential for personal injury

Follow recommended precautions and safe operating practices.

Personnel must be fully qualified to perform procedures in this manual.

Follow Safety Instructions

Learn how to operate the machine properly. Do not let anyone operate without instruction.

Keep your machine in proper working condition. Unauthorized modifications to the machine may impair the machine's function and/or safety features and may also affect machine life.

Prevent Bypass Starting

Avoid possible injury or death from engine runaway. Do not start machinery by bypassing normal engine circuitry. Not only is it extremely unsafe, it can also VOID your warranty.

Start engine ONLY from operator's platform.

Prepare for Emergencies

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher and emergency numbers handy.

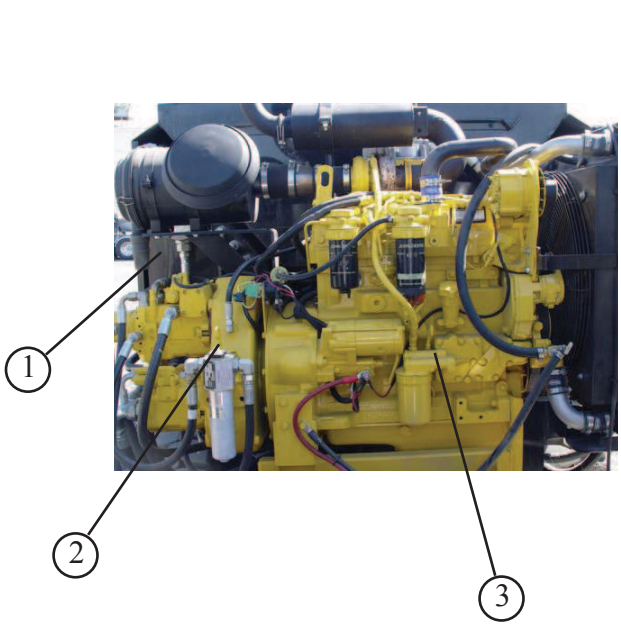
Stay Clear of Rotating Drivelines

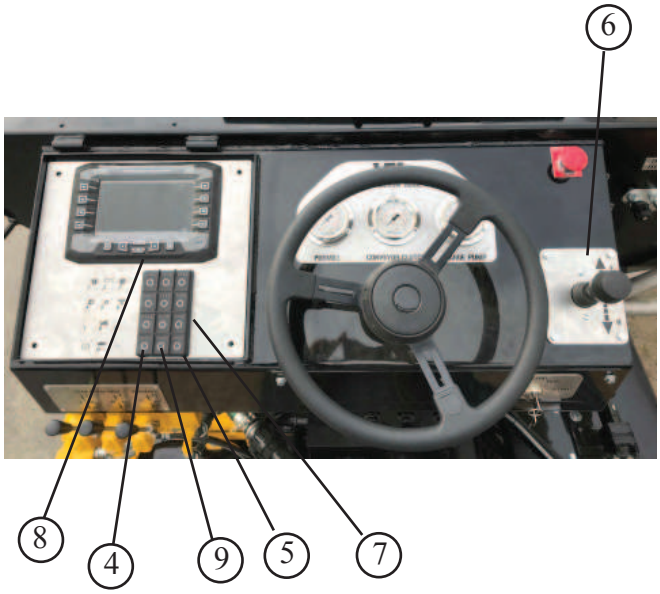
Entanglement in rotating driveline can cause serious injury or death.

Keep guards and covers in place at all times when operating machine.

Do not wear loose clothing. Stop engine and be sure drivelines are stopped before making adjustments or performing any type of service on equipment.

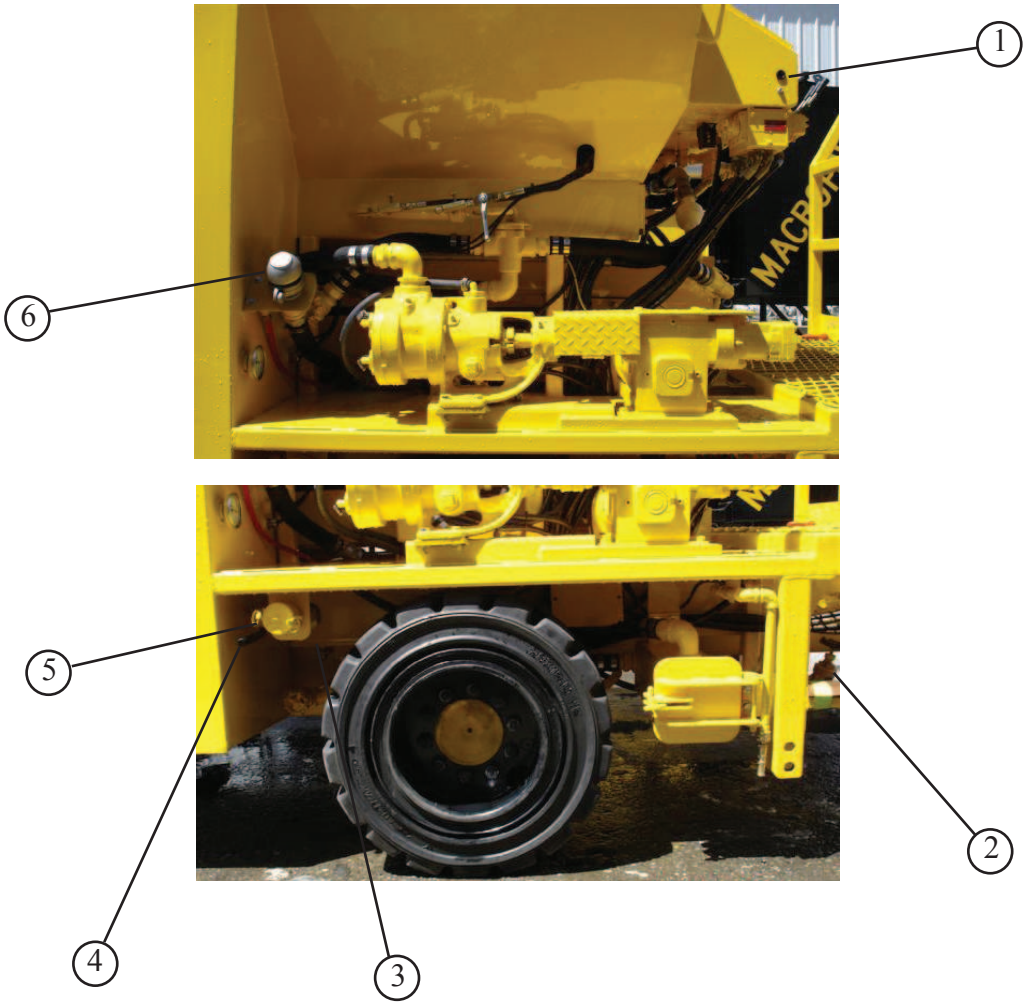
Getting To Know The Minimac





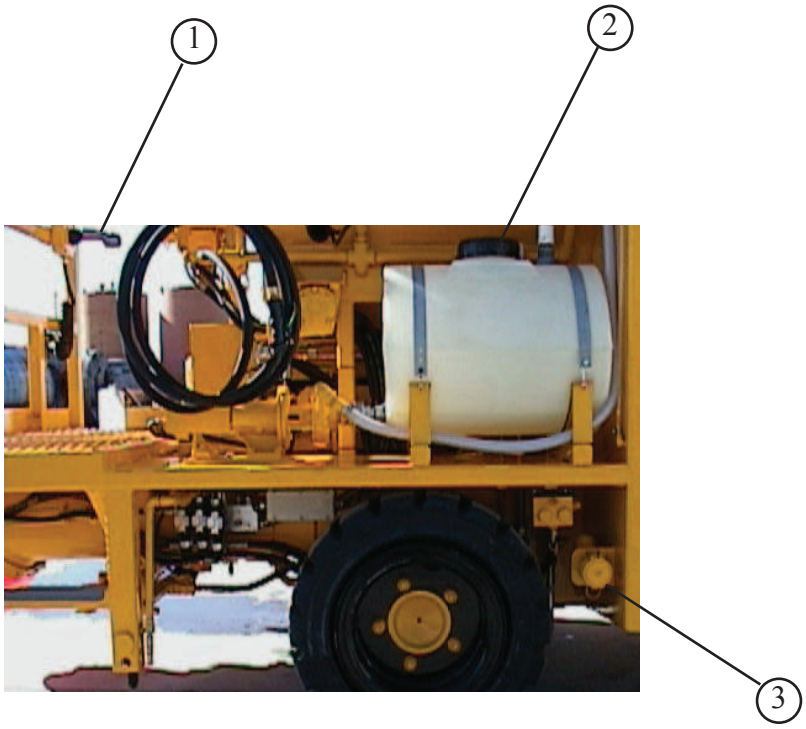
1. Hydraulic Oil Level (one each side)
2. Pump Drive Gearbox Oil Level
3. Engine Oil Level
4. Parking Brake Switch
5. Travel Speed Selector
6. Transmission Controller
7. Toggle Switches
8. Monitoring Panel
9. Engine Control Switches

Getting To Know The Minimac (cont'd)



1. Emulsion Tank Full Alarm
2. Emulsion Strainer Gate Valve
3. Emulsion Suction Valve
4. 1/4 Turn Valve Handle
5. Emulsion Tank Fill
6. Diesel Fill

Getting To Know The Minimac (cont'd)



1. Joystick Control Handle

2. Additive Tank Lid

3. Water Fill Camlock

Getting To Know The Minimac (cont'd)

Definitions

1. Slurry Seal - Slurry seal is a mixture of crushed aggregate, asphalt emulsion, water and other special purpose additives such as mineral fillers and/or liquid quick set control additives. Slurry seals are for repair of worn pavements caused by time, weather and traffic. Slurry seals extend the life of the pavement by sealing the surface and providing a new wearing surface.

2. Microsurfacing - Microsurfacing is a specialized form of slurry surfacing. It is also a mixture of crushed aggregate, asphalt emulsion, water and additives. But, the asphalt emulsion is polymer modified and the additives are specialized for fast setting and break control. The spreader box is also specialized in that it always uses augers for material distribution and it provides more control over depth, flatness and texture of the material.

3. Aggregate - Aggregate is hard, crushed stone; such as granite, slag, limestone or other high quality rock. It must be free of expansive clays and be uniformly graded. The size of the aggregate ranges in particle sizes from the thickness of the finished overlay (usually 1/4" or 6 mm) down to approximately #200 seive size.

4. Asphalt Emulsion - An asphalt emulsion is tiny globules of asphalt suspended in water by the use of a soap solution. Asphalt emulsions are liquid at normal ambient temperatures. They can be pumped by normal means. Once the emulsion is mixed with the aggregate and laid onto the pavement as slurry seal, the mixture will break in around 5 - 10 minutes and cure in about 3 - 4 hours, depending on conditions.

5. Fines - Fines are a dry additive or mineral filler used to adjust the workability of the slurry and/or modify the setting and curing characteristics. The most common mineral filler is Portland cement and the most common dry additive is aluminum sulfate crystals.

6. Liquid Additives - Liquid additives are also used to adjust the workability of the slurry and/or modify the setting and curing characteristics. The most common liquid additve is liquid aluminum sulfate.

7. Main Start - For proper mixing of the slurry seal, all of the above components must come to together at the same time, even though the slurry seal machine stores them separately and uses different means to move them from storage to mixing. This is where main start comes in - it is a means of starting and controlling the timing of the movement of all of the materials so they properly come together.

Getting To Know The Minimac (cont'd)

Definitions (cont'd)

8. Pugmill - The pugmill is where the materials come together. It is a mixing chamber, using paddles mounted on two hydraulically driven shafts. As the pugmill is mixing, it is also moving the material from the inlet end to the outlet end and then depositing it into the spreader box.

9. Spreader Box - The spreader box controls the actual laying of the slurry seal or microsurfacing onto the pavement. The spreader box defines the width of the pass by striking off the outside edges and the thickness of the pass by striking off the depth of the slurry. It controls texture of the surface of the slurry by use of a drag flap or texture flap. For wide passes or for thicker or faster setting mixes, the spreader box uses hydraulically powered augers to help spread the slurry mixture from the middle to the outer ends of the spreader box.

Getting To Know The Minimac (cont'd)

Materials Systems Descriptions

Aggregate

The aggregate for laying slurry is stored in the main hopper. It is brought out of the hopper by the aggregate conveyor, into the inlet hopper and then into the pugmill. There is a vibrator in the main hopper, mounted on a hanging beam, that prevents bridging of the aggrgate in the hopper. The conveyor and vibrator are hydraulically driven and are started when Main Start is engaged, the conveyor by the conveyor clutch and the vibrator by the vibrator on/off valve. The amount of output per revoluton of the conveyor is controlled by the adjustable aggregate gate at the back of the main hopper and the speed of the revolutions of the conveyor is controlled by the emulsion pump/aggregate conveyor speed control valve.

Emulsion

Emulsion for laying slurry is stored in the emulsion tank, which is located on the left side of the machine. It is brought out of the tank by the emulsion pump, into the inlet hopper and then into the pugmill. The emulsion pump on/off and speed is controlled by the emulsion pump/aggregate conveyor speed control valve. When the emulsion pump is operating it is normally recirculating the emulsion back to the emulsion tank through the three-way emulsion sequence valve. When Main Start is engaged, the sequence valve is shifted so that the emulsion stops flowing back to the tank and then flows to the inlet hopper.

Emulsion Pump, Clutch, Conveyor Gearbox

This assembly ties the emulsion pump and the conveyor mechanically together so that the speed of each is in a constant ratio to each other. This is necessary for proper slurry seal operation as the ratio of emulsion to aggregate is the most important factor in obtaining a good slurry seal application. A single hydraulic motor drives both systems. As described above, the emulsion pump is always rotating and when main start is engaged the conveyor clutch engages and the conveyor starts rotating. Adjusting the emulsion pump/aggregate conveyor speed control valve varies the speed of both systems simultaneously as required.

Water

Water for laying slurry, for the spray bars and spray hose(s) and for the pressure washer is stored in the water tank, which is located on the right side of the machine. It is brought out of the tank by the hydraulically driven water pump. Water for laying slurry flows to the water/additive sequence valve, into the inlet hopper and then into the pugmill. The sequence valve is shifted to the open position when Main Start is engaged. The flow of water for the slurry mixture is controlled by the water flow control valve and the amount is monitored by the water flow meter. Water for the spray bars, spray hoses and pressure washer is available whenever the water pump is operating.

Getting To Know The Minimac (cont'd)

Fines

Fines storage is in the fines feeder hopper. It is brought out of the fines hopper by a hydraulically driven auger built into the feeder, then into the inlet hopper and into the pugmill. The auger is started when Main Start is engaged, providing the fines feeder on/off switch is turned on. The rate at which the fines feeder delivers fines to the inlet hopper is controlled by the fines feeder speed control valve.

Liquid Additive

Liquid additive is stored in the additive tank and is brought out of the tank by the additive pump. It flows to the water/additive sequence valve, into the additive wye where it mixes with the water and then it flows into the inlet hopper and pugmill. The sequence valve is shifted to the open position when Main Start is engaged. The additive pump is a hydraulically driven pump and is controlled by the additive pump on/off switch. The amount of flow of additive is controlled by the additive flow control valve, and is monitored by the additive flow meter.

Monitoring System

The monitoring system provides information regarding the amounts of material used, the rate at which it is being applied and provides shut-downs when the material in the machine is used up. Monitoring systems can vary from machine to machine depending on customer requirements, but most have water and additive flow meters, aggregate and fines counters, a fines-to-aggregate ratio meter, an emulsion pump speed meter and a shutdown system. The aggregate and fines counters use an electronic sensor to count the total revolutions of the aggrgate conveyor head pulley or the fines feeder auger. Once the machine has been calibrated (see "Calibrating the Minimac" section of this manual), the operator can then calculate the total volume of material that has been used by the machine. The fines to aggregate ratio meter is utilized to be able to set the speed of the fines feeder to achieve the correct percentage of fines for the slurry seal mixture. The emulsion pump speed meter provides information as to the rate at which material is being applied. The usual shutdown system provided is for low aggregate, but a low emulsion shutdown system can also be supplied. Refer to the separate "Monitoring System" instruction manual for full details for the system supplied with this machine.

Getting To Know The Minimac (cont'd)

Machine Systems Descriptions

Engine and Hydraulics

All power for operating the Minimac is provided by the John Deere diesel engine. This engine powers hydraulic pumps which in turn provide flow and pressure for the various hydraulic systems. Fuel for the diesel engine is provided from the fuel tank mounted between the frame rails near the back of the machine.

The hydraulic system utilizes four hydraulic pumps. Two of these pumps are variable displacement piston pumps. They are pressure compensated pumps, which means that the maximum pressure the pumps can achieve is determined by a control valve built into the pumps. When the maximum pressure is reached, the pump will reduce its flow output to zero. One of these pumps is also a load sense pump, which means that the pump senses the hydraulic pressure required to operate the system. One of the pumps is the ground drive pump. It is a variable displacement piston pump that is electro-hydraulically controlled by the transmission controller. All three of these pumps are driven by the pump drive gearbox attached to the back of the engine. The fourth pump is a constant displacement gear pump driven by the ground drive pump.

The lower right hand pump, or main start pump, supplies oil flow to the hydraulic circuits for the main start, vibrator, emulsion pump/aggregate conveyor, additive pump, fines feeder and water pump. It has a maximum oil flow capacity of 27 GPM (102 LPM) @ 2400 RPM. The system pressure is set at 1750 psi (121 bar).

The lower left hand pump supplies oil flow to the pugmill / spreader box auger circuit. It has a maximum oil flow capacity of 27 GPM (102 LPM) @ 2400 RPM. The system pressure is set at 2500 psi (172 bar) and the stand-by pressure is set at 150 - 250 psi (10 - 17 bar). This system is monitored by the pressure gauge labeled "PUGMILL PRESSURE" on the dash panel of the machine. The load sense circuit on this pump senses the pressure required to run the pugmill or box augers through a line from the pugmill control valve. There is a shuttle valve in this valve which allows the pump to sense whichever pressure is higher. When the pugmill or auger valves are turned off, the flow of oil to the load sense compensator is blocked, putting the pump in stand-by mode.

The main upper pump supplies oil flow to the rear wheel hydraulic motors. This pump and motor circuit is a closed loop. The oil flows from the pump to the motors and back to the pump. Make up oil for this loop is drawn from the hydraulic reservoir by the charge pump built in to the main pump. Charge pump pressure is monitored by the pressure gauge labeled "CHARGE PUMP PRESSURE" on the dash panel of the machine. This pressure should be approximately 350 psi (24 bar) when the transmission controller is in neutral and 300 psi (20 bar) when the machine is moving forward or reverse. The rear wheel hydraulic motors offer two hydraulic speeds, which are selected by the "HI/LOW TRAVEL SPEED" switch on the dash panel of the machine.

Getting To Know The Minimac (cont'd)

Engine and Hydraulics (cont'd)

The main upper pump also supports and drives the steering / spreader box lift/diverter/sideshift pump. This pump has a maximum oil flow capacity of 10.5 GPM (40 LPM) @ 2400 RPM. The system pressures are set at 1200 psi (83 bar) for the steering circuit and 1500 psi (103 bar) for the box lift. Each circuit has its own relief valve. The steering circuit receives its oil from a priority flow divider, so the unit will always have steering function at lower engine speeds. The engine speed must be at least 1500 RPM for the box lift function to operate.

When starting and stopping the engine on the Minimac, it is preferred that all of the pumps be in stand-by mode. Do this by turning off all switches and the pugmill and box auger levers.

The oil for the hydraulic system is stored in two 35 gal. (130 liter) hydraulic reservoirs located on each side of the Minimac just in front of the aggregate hopper. The left side reservoir supplies oil for the main start pump and the ground drive charge pump. The right side reservoir supplies oil for the pugmill pump and the steering / box lift pump. Each pump draws its oil from the reservoir through separate suction hoses, each equipped with a suction strainer located inside the reservoir. Oil returned to the reservoir is filtered by 7 micron filter assemblies. The oil flow returning from the main start circuit is routed through an air-to-oil cooler mounted in front of the engine radiator. Also, the oil flow from the hot oil shuttle in the ground drive circuit is routed through a second air-to-oil cooler mounted in front of the radiator.

Main Hydraulic Circuit

Oil from the main pump flows from the pump outlet to the main start block, located behind the rear panel on the right side of the machine. If the machine is equipped with the optional high pressure washer, its oil flow will be teed into this circuit. (NOTE: Main start functions must be turned off for the high pressure washer to function.) As the pump is variable displacement, only the oil flow required by the various circuits in use is put out by the pump.

Main Start Valve Assembly:

- Water Pump Valves - These valves include a fixed flow control, set at 5 GPM (19 LPM), and an electrically operated on/off valve. The on/off valve is turned on by the "WATER" switch.

- Fines Feeder Valves - These valves include an adjustable flow control, adjustable from 0 - 6 GPM (0 - 23 LPM), and an electrically operated on/off valve. The "FINES FEEDER" knob controls the flow control and adjusts the speed of the fines feeder motor. The "FINES" switch enables the fines feeder circuit when Main Start is engaged.

Getting To Know The Minimac (cont'd)

Main Hydraulic Circuit (cont'd)

- Additive Pump Valves - These valves include a fixed flow control, set at 2 GPM (8 LPM), and an electrically operated on/off valve. The on/off valve is turned on by the "ADDITIVE" switch.

- Aggregate Conveyor / Emulsion Pump Valves - These valves include an adjustable flow control, adjustable from 0 - 12 GPM (0 - 45 LPM), and an electrically operated on/off valve. The "AGGREGATE CONVEYOR" knob controls the flow control and adjusts the speed of the emulsion pump / aggregate conveyor motor. The on/off valve is turned on by the "EMULSION" switch. The emulsion pump is always running when the flow control and on/off valves are on, but the conveyor only operates when Main Start is engaged.

- Vibrator Valves - These valves include a fixed flow control, set at 2 GPM (8 LPM); a pressure reducing valve, set at 350 psi (24 bar); and an electrically operated on/off valve. The on/off valve is turned on when Main Start is engaged.

- Main Start On/Off and Conveyor Clutch Valves - The on/off valve is an electrically operated valve. When this valve is turned on by engaging the Main Start switch, oil is directed to the conveyor clutch which engages and starts the conveyor. This oil flows through a pressure reducing valve where the pressure is reduced to 265 psi (18 bar). This pressure is monitored by the pressure gauge labeled "CONVEYOR CLUTCH PRESSURE" on the dash panel of the machine. The Main Start switch is also connected to the vibrator on/off valve and the fines feeder switch. The Main Start switch will simultaneously start or stop all of these functions when it is turned on or off.

- Water/Additive and Emulsion Sequence Cylinder Valves - The sequence cylinder vavles are elect rically operated valves. They supply oil to the cylinders that actuate the emulsion and water/additive valves. When these these valves are turned on by engagine the Main Start switch, oil is directed to the cylinders to open these valves.

  NOTE: The Water, Fines, Additive, Agg./Emulsion, Vibrator and Main Start On/Off valves have an override feature that will allow the valves to work in case of electrical failure. See "Manual Override and Sequencing Valves" section for more details.

Sequence Adjustment and Sequence Override Valves:

The sequence timing of the emulsion and water/additive valves is adjusted using the EZ-OP comput er in the MAIN->SETUP->SEQUENCE screen. See the "Mnitoring System Manual" for more de tails.

Getting To Know The Minimac (cont'd)

Main Hydraulic Circuit (cont'd)

High Pressure Washer (Optional):

The high pressure washer is powered by the main hydraulic circuit. Its oil is supplied through a tee at the main pump pressure line bulkhead. The high pressure washer circuit is turned on or off by turning the switch located on the left side of the dash, next to the emulsion tank full alarm. The high pressure washer circuit can only be operated when all of the other main circuit hydraulic functions are turned off (or turning very slowly). The main water pump must be operating for the high pressure washer to function. The high pressure washer switch will turn on the main water pump when it is turned on.

Steering / Spreader Box Lift/Diverter/Sideshift Circuit

Oil from the steering / box lift pump flows from the pump to the steering / box lift valve block located just behind the left rear tire of the Minimac.

Steering / Box Lift Valve:

- Steering Valves - These valves include a priority flow divider and a pressure relief valve. The flow divider directs 4 GPM (15 LPM) to the steering circuit and the balance of the flow goes to the box control circuit. The pressure for the steering circuit is controlled by the pressure relief valve, which is set at 1500 psi (100 bar). The oil then flows to the steering valve, which is controlled by the steering wheel. The steering valve directs oil to the steering cylinder located on the front axle.

- Box Lift/Diverter/Sideshift Valves - These valves include a pressure relief valve and three electrically operated directional control valves. The pressure relief valve is set at 1500 psi (100 bar). The directional valves are controlled by the joystick control handle located on the operator's platform. The direction that the joystick and thumb switch is moved will determine the output movement of the various functions.

Getting To Know The Minimac (cont'd)

Pugmill / Spreader Box Auger Circuit

Oil from the pugmill pump flows from the pump outlet to the pugmill / spreader box auger on/off/speed control valve assembly. This valve, located to the left of the dash panel, controls not only the on and off functions, but also the speed of these devices. It is a proportional valve, so the amount that the valve lever is moved will determine the flow output of the valve and the speed of rotation of the pugmill or augers.

Pugmill / Spreader Box Auger Control Valve:

- Pugmill Valve - The oil flows from the work ports of this valve to the pugmill motor and then back to the valve. It then returns to the right hand oil reservoir.

- Auger Control Valves - There are two auger valves, one for each side of the spreader box. The oil flows from the work ports of these valves, through the hydraulic quick-disconnects located at the rear of the machine, to the auger drive motors and then back to the valve.

Ground Drive Circuit

As described on page 10 of this manual, this circuit is a closed loop circuit. In addition to its pump and motors, this circuit includes three valves for providing the two speed function, brakes and system cooling. Control for the forward / reverse function of this circuit is provided by the transmission controller located on the dash panel of the machine.

Ground Drive Circuit Valves and Controls:

- Two Speed / Brake Valves - These valves are located behind the left rear tire of the Minimac. They are mounted in a single block. These valves are electrically controlled on/off valves. The two speed valve directs oil to the displacement contol ports of the rear wheel motors. When it is activated by switching the "TRAVEL SPEED" switch to the "HI" position the oil flow will cause the wheel motors to go into 1/2 displacement, which allows them to turn twice as fast as full displacement. When the switch is placed in the "LOW" position, power is taken away from the valve, which stops oil flow to the control ports of the motors. The motors will then go back to full displacement, which reduces to speed to 1/2 but provides twice the torque. The machine is usually run in "LOW" range during slurry seal operations and "HI" range for traveling. The brake valve directs oil flow to the brake ports of the rear wheel motors. The brakes are spring applied and hydraulically released. So, when the "PARKING BRAKE" switch is in the "OFF" positon the brake valve is activated to release the brakes. When the switch is in the "ON" position, power is taken away from the valve, which stops oil flow to the brake ports and allows the springs inside the motor to apply the brakes.

Getting To Know The Minimac (cont'd)

Ground Drive Circuit (cont'd)

- Hot Oil Shuttle Valve - This valve assembly is located just in front of the right rear tire of the Minimac. It includes a pilot operated directional control valve and a pressure relief valve. It directs flow of oil from the low pressure side of the ground drive closed loop to the small oil cooler located on the engine radiator. In operation, the directional valve will be shifted by the high pressure side of the loop so that it allows oil to flow out from the low pressure side of the loop. The pressure that it flows out of the loop at is controlled by the pressure relief valve. This valve is set at 300 psi (20 bar). When the ground drive is in neutral, both sides of the loop are at charge pump pressure (350 - 24 bar), and no oil flows out of the hot oil shuttle valve. It only functions when the machine is moving. This is whay the "CHARGE PUMP PRESSURE" gauge reads 350 pis in neutral and 300 psi when the machine is moving.

- Ground Drive Control - The transmission controller located on the dash panel of the machine controls the forward/neutral/reverse function of the Minimac by controlling the direction and amount of flow going from the ground drive pump to the ground drive motor. It does this by sending an electrical signal to the electro-hydraulic controller located on the ground drive pump. This controller then causes the pump to go from a neutral (zero flow) positon to a position that provides oil flow out of one port or the other on the pump. When oil is flowing out the 'B' port of the pump, the machine will move forward. When oil is flowing out the 'A' port, the machine will move in reverse. The transmission controller on the dash and the electro-hydraulic controller on the pump are both proportional devices, meaning that the further the controller is moved the faster the machine will travel.

Getting To Know The Minimac (cont'd)

Electrical System

The electrical system is 12 volt DC, negative ground. It is supplied from the engine's battery and charging system. The Minimac's electrical system is protected with two 30 amp fuses, located between the power input on the engine starter battery terminal and the ignition switch and main power relay. The ignition switch is a 4-position Accessory-Stop-Run-Start switch. The run terminal (IGN) powers all of the engine controls and engine electronics. The electronic control will stop the engine if a loss of oil pressure or a high engine coolant temperature condition exists. The accessory terminal (ACC) is utilized to power the voltmeter and fuel gauge and is used to switch the main power relay which powers the balance of the electrical ciruits and the fuel supply pump. The main power relay receives its power directly from the main fuse. The following is a brief description of each of the accessory electrical circuits:

- E-Stop (Emergency Stop) Circuit - This circuit is controlled by the E-Stop button. Pressing the button interrupts power, stopping the engine. The E-Stop button is a maintained style switch. The button must be pulled up to operate the Minimac.

- Main Start Circuit - This circuit is controlled by the Main Start Trigger on the Joystick Control Handle via an electronic PLC (programmable logic controller) located under the monitoring panel. When the trigger is pulled the first time, the PLC will actuate the main start relay, which will power the main start valve and the vibrator valve. It also supplies power to the fines feeder switch which, if it is turned on, will power the fines feeder valve. When the trigger is then pulled the second time, the PLC will switch off the main start relay, turning off power flow to all of the main start functions.

- 3 Second Shutdown Circuit - The main start circuit can be interrupted by the 3 second delay function of the ECU which is triggered by the low aggregate and low emulsion switches. If the aggregate flowing out of the main hopper on the aggregate conveyor or the emulsion level in the emulsion tank drops below a pre-set level, the respective switch will close. The switch closure will start the timer on the 3 second delay function and after 3 seconds it will turn off the main start circuit. When the switch closes, it will immediately trigger the aggregate alarm and the aggregate or emulsion alarm light on the EZ-OP display, alerting the operator that the system will shut down in 3 seconds. This circuit can be overridden in the MAIN->SETUP->ALARMS screen in the EZ-OP display.

- Monitoring Panel - The monitoring panel receives its power directly from the 40 amp relay. The EZ-OP monitoring system is described in detail in the separate "Monitoring System" instruction manual.

- Water Pump, Additive Pump & Emulsion Pump Circuits - These circuits are powered by their respective output pins on the EZ-OP ECU.

Daily Start Up

Before Starting

1. Check engine oil level.

2. Check engine radiator level.

3. Check pump gearbox oil level.

4. Check hydraulic oil reservoir level in both reservoirs.

After checking all components, the Minimac is ready to start.

Start Up

NOTE: Refer to John Deere operator's manual for complete operating guidelines.

1. Place engine speed control rocker switch in the idle (turtle) position - make sure all "ON/OFF" indicators are red on the keypad and the pugmill control handle and box auger handles are centered.

2. Turn the key switch clockwise to to crank engine.

NOTE: Do not operate starter for more than 30 seconds at a time. To do so may overheat the starter. If the engine does not start the first time, wait at least 2 minutes before trying again. If it does not start after four attempts, see troubleshooting section in John Deere Operator's Manual.

3. After engine starts, release the key.

NOTE: If key switch is released before the engine starts, wait until the starter and the engine stop turning before trying again. This will prevent possible damage to the starter and/or flywheel.

Daily Start Up (cont'd)

4. Check all gauges for normal engine operation. If operation is not normal, stop engine and determine the cause. Otherwise, bring engine RPM up to 2400 RPM.

NOTE: Should the engine die when operating under load, shut off all controls and restart the engine to prevent overheating of turbocharger parts caused when the flow of oil for cooling and lubrication is stopped.

5. Engine Control Rocker Switch Operation:

a. Engine Speed. There are three switches to control engine speed.
   1. Rabbit / Turtle: Full speed / idle speed either from the MAIN->OPERATE->ENGINE screen.
   2. ▲&▼: From the ENGINE screen to adjust speed between full speed and idle speed.

b. Idledown Override: If the sequence valves or the clutch are inactive for an opertar set time delay (MAIN->OPERATE->ENGINE->IDLE DOWN) the engine will automatically go to low idle. This feature can be overridden by pressing the override button in the IDLE DOWN screen on the EZ-OP display.

Warming Engine

1. Check oil pressure gauge as soon as engine starts. If gauge needle does not rise above minimum pressure within 5 seconds, stop the engine and determine the cause. Normal engine oil pressure is 55 PSI at rated full load speed (2400 RPM).

2. Watch coolant temperature gauge. Do not place engine under full load until engine reaches normal temperature. The normal engine coolant temperature range is 82° - 94° C (180° - 202° F). Maximum continuous coolant temperature is 105° C (221° F). If temperature exceeds this level, reduce load on engine and determine cause of high temperature operation. The high coolant temperature shutdown switch is set at 110° C (230° F).

NOTE: To assure proper lubrication, during start-up, operate engine at or below 1200 RPM with no load for 1-2 minutes. Extend this period when operating at temperatures below freezing.

Driving The Minimac

To Drive The Minimac

1. Release the parking brake by turning the parking brake switch to the "OFF" position.

2. Select the travel speed - "HI" or "LOW".

3. Pull up on the neutral lock of the tranmission controller and gently move the controller lever to the desired direction of travel - "F" for forward or "R" for reverse. The further the controller is moved from the neutral "N" position the faster the Minimac will travel.

NOTE: Be sure not to force the controller lever at the end of the stroke or damage will result to the stop pin!

NOTE: The Minimac brakes dynamically! This means that when the transmission controller is moved toward the neutral position, the Minimac will slow down, then completely stop when the neutral position is reached. The faster the controller lever is pulled to neutral the faster the machine will slow down.

CAUTION: DO NOT SHIFT TO NEUTRAL WHEN TRAVELING AT HIGH SPEED! INJURY TO YOURSELF OR DAMAGE TO THE MACHINE MAY RESULT.

Loading Procedures

Filling Water Tank

NOTE: This inlet fills at the bottom of the tank and it includes a check valve to help prevent siphoning of water back to the source.

1. Remove plug from the cam lock fitting located at the rear of the Minimac water tank (see page 5 for location).

2. Insert male hose fitting and lock down the fitting cam locks.

3. Fill tank to desired level.

4. After closing valve from water source, unlock cam lock fitting and remove supply hose. The check valve behind the cam lock fitting will close automatically when the fill flow stops.

Filling Additive Tank

1. Open tank lid by rotating counterclockwise.

2. Lift off tank lid.

3. Fill tank with additive to be used.

4. After filling tank, install tank lid and turn clockwise to lock.

CAUTION: CHECK MATERIAL SAFETY DATA SHEETS (MSDS) BEFORE HANDLING AND LOADING CHEMICALS. ALWAYS WEAR PROPER SAFETY GEAR!

Loading Procedures (cont'd)

Loading Emulsion From Stockpile Tanker

NOTE: This procedure uses a pump located on the tanker.

1. Remove fill plug cam lock fitting located next to 1/4 turn emulsion valve (see page 4 for location).

2. Hook up the female cam lock coupler to valve fitting.

NOTE: 1/4 turn emulsion valve has teflon insert. DO NOT use torch or flame to heat the valve or this insert will be damaged!

3. Switch on the emulsion tank filling alarm. Switch is located on the side of the dash panel on the emulsion tank side. The ignition key must be in the "RUN" position for the alarm to function.

4. Open the 1/4 turn emulsion valve to allow emulsion to flow directly into emulsion tank.

NOTE: When the emulsion tank FULL alarm sounds, there will be approximately 6" (15 cm) usable space left before the tank is full. This will allow time to stop the flow of emulsion before the tank overflows.

5. Close the 1/4 turn emulsion valve.

6. Close emulsion valve on supply tanker.

7. Release cam lock fitting from Minimac.

Loading Procedures (cont'd)

Self Loading The Minimac With Emulsion

1. Start the Minimac engine and run at 1000 - 1400 RPM to warm up the emulsion pump. The emulsion pump center section must be hot (approximately 80° C - 180° F) before starting the pump.

2. Remove fill plug cam lock fitting located near the fill valve on the back side of the emulsion strainer (see page 4 for location).

3. Hook up the female cam lock coupler to valve fitting.

4. Open the emulsion fill gate valve to allow emulsion to be pumped into emulsion tank through emulsion strainer and pump.

5. Close the Minimac emulsion tank suction gate valve located below the equipment deck on the emulsion tank and leave emulsion tank circulating gate valve open.

6. With the Minimac now warmed up, start emulsion pump by adjusting the "AGGREGATE CONVEY OR" control to about 400 RPM on the "EMULSION PUMP" speed indicator on the EZ-OP screen. Pump speed can be adjusted to fit the desired filling speed. Faster speed will not damage pump. If emulsion has lumps, the pump can become noisy and stall, so run the pump at more than 350 RPM if this occurs.

NOTE: If, while loading material, emulsion pump starts making excessive noise and still runs, but does not seem to be pumping, reduce pump RPM immediately. DO NOT run emulsion pump over 350 RPM under these conditions, as pump is probably cavitating.

6. Turn on emulsion tank full alarm (see page 21) and fill tank until alarm sounds.

7. Stop emulsion pump by closing the "AGGREGATE CONVEYOR" speed control and close the emul sion loading gate valve on the emulsion strainer before disconnecting the emulsion loading hose.

8. Close emulsion valve on supply tanker.

9. Release cam lock fitting from Minimac.

NOTE: Remember to open the emulsion tank suction line BEFORE restarting the emulsion pump. Failure to do so will damage the emulsion pump.

Unloading Procedures

Follow these procedures to unload individual materials from the Minimac when other materials are loaded. These instructions assume the Minimac engine is running, has been warmed up and is at operating speed of 2400 RPM.

Unloading Aggregate Only

1. Open the "AGGREGATE CONVEYOR" control to set the emulsion pump speed to approximately 400 RPM.

2. Turn on the pugmill to full speed forward direction by pushing the lever inward toward the dash panel.

3. From the EZ-OP display go to MAIN->DIAGNOSTIC->OUTPUTS screen. Press the CONVEYOR CLUTCH button to start the conveyor.

4. Lower the box lift and center the diverter chute using the Joystick Control Handle.

5. Aggregate will start unloading and coming out of the pugmill. It may be necessary to move the Minimac forward depending on the amount of aggregate to be unloaded. If the aggregate piles up to the pugmill discharge opeing it can block the opening and plug up the pugmill.

Unloading Emulsion Only

1. Disconnect the emulsion hose from the inlet hopper camlock fitting,

2. Connect this hose to a hose going to the tank where the emulsion will be pumped.

3. Open the "AGGREGATE CONVEYOR" control to set the pump speed to approximately 400 RPM.

4. From the EZ-OP display go to MAIN->DIAGNOSTIC->OUTPUTS screen. Press the EMULSION VALVE button to open the emulsion valve.

5. Emulsion will now be pumped from the emulsion tank on the Minimac to the storage tank.

Unloading Procedures (cont'd)

Unloading Water Only

1.Turn the "EMULSION" pump switch off.

2. Turn "WATER PUMP" switch on the keyppad on (green).

3. From the EZ-OP display go to MAIN->DIAGNOSTIC->OUTPUTS screen. Press the WATER/ADDI TIVE VALVE button to open the water/additive valve.

4. Water will flow through the pugmill and out the diverter chute. Amount of water flow can be adjusted with the water valve located next to the water flow meter on the left side of the dash.

Unloading Fines Only

1. Turn "FINES" keypad switch on (green).

2. Turn the "FINES FEEDER" control about half open.

3. Turn on the pugmill to full speed forward direction by pushing the lever inward toward the dash panel.

4. Lower the box lift and center the diverter chute using the Joystick Control Handle.

5. From the EZ-OP display go to MAIN->DIAGNOSTIC->OUTPUTS screen. Press the FINES button to start the fines feeder.

6. Pull the Main Start Trigger on the Joystick Control Handle.

7. Fines will start unloading and coming out of the pugmill. The unloading speed can be adjusted by changing the "FINES FEEDER" valve setting.

Calibrating the Minimac

To produce a Slurry Seal mixture to laboratory specifications the Minimac must be calibrated to work with the specific materials being used on a job. The Minimac mixing system is built around the aggregate conveyor head pulley. The emulsion pump is a positive displacement pump and is driven from the conveyor head shaft with a fixed ratio. This allows the emulsion to aggregate ratio to be adjusted by changing the aggregate gate opening. The fines filler to aggregate ratio is controlled by changing the speed ratio between the fines feeder and aggregate conveyor. The ratio of fines feeder speed to aggregate conveyor speed is displayed on the Fines / Agg. Ratio Meter. Both water and liquid additive flow rates are controlled by adjusting the corresponding gate valves. A truck scale will be required to weigh the Minimac for aggregate and emulsion calibration and a portable scale will be necessary for weighing the fines.

Aggregate Calibration

Aggregate is generally the first material to be calibrated. **(Minimac MUST have emulsion in emulsion tank as emulsion pump will be operating during this calibration procedure.)** This calibration will develop a graph for the Aggregate Gate Setting versus Emulsion to Agg Ratio. (The aggregate used for calibration must be representative of the aggregate to be used on the job. Aggregate density can vary greatly.) A sheet is provided to record the calibration data. Fill it out as shown below. We recommend 50 head shaft revolutions for each gate setting.

Proceed as in the example that follows:

1. Load the Minimac with aggregate.

2. Weigh the Minimac and record this weight as the Heavy Weight for Trail #1.

3. Set the aggregate gate opening height and record as the aggregate gate setting. (Start with a small opening and proceed to larger openings.)

4. Drive the Minimac to a location where the aggregate can be unloaded onto the ground.

5. Start the emulsion pump by pening the "AGGREGATE CONVEYOR"speed control knob. Set the pump to about 350-400 RPM to start - faster speeds are okay.

6. Turn the pugmill on to full speed in the forward direction.

7. From the EZ-OP display go to MAIN->CALIBRATE->AGGREGATE screen. The above instructions will be repeated in the EZ-OP calibration instructions.

Calibrating the Minimac (cont'd)

8. Press the Main Start Trigger on the Joystick Control Handle. Watch the aggregate coming out of the pugmill. It will be necessary to move the Minimac forward to keep aggregate from building up at the back of the machine and plugging the pugmill..

10. The aggregate flow will automatically shut off when the pre-set nuber of Aggregate Conveyor Head Shaft revolutions has been reached. Record this number in space marked "Head Shaft Revolutions:". Stop the pugmill AFTER it has emptied of aggregate.

11. Weigh the Minimac and record this number as Light Weight under Trial #1.

12. Repeat this procedure at the same gate setting for trails 2 and 3.

Figure #1: Example of Aggregate Calibration with Trial Data and Calculations

Aggregate Calibration

Aggregate Gate Setting	in(cm)	4"					
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)		23480	22660	20280		
Light Weight	lbs (Kg)		21140	20280	17900		
Aggregate Unloaded	lbs (Kg)		2340	2380	2380		
Head Shaft Revolutions	Rev counts		50.1	50	50.1	SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)		46.71	47.60	47.50	141.81	47.27

Aggregate Gate Setting	in(cm)	5"					
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)		21140	24860	21580		
Light Weight	lbs (Kg)		18140	21580	18460		
Aggregate Unloaded	lbs (Kg)		3000	3280	3120		
Head Shaft Revolutions	Rev counts		49.9	50.1	50	SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)		60.12	65.47	62.40	187.99	62.66

Aggregate Gate Setting	in(cm)	6"					
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)		25320	21560	21920		
Light Weight	lbs (Kg)		21560	17580	18180		
Aggregate Unloaded	lbs (Kg)		3760	3980	3740		
Head Shaft Revolutions	Rev counts		50	49.5	50	SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)		75.20	80.40	74.80	230.40	76.80

Equations used in above tables:

Aggregate unloaded = Heavy Weight - Light Weight

Sum = (Agg. Weight / Rev Trial #1) + (Agg. Weight / Rev Trial #2) + (Agg. Weight / Rev Trail #3)

Average = Sum / 3

Calibrating the Minimac (cont'd)

Emulsion Calibration

The emulsion is calibrated to determine the weight of emulsion pumped per revolution of the Aggregate Conveyor Head Shaft. To calibrate the emulsion proceed as follows:

1. Unload any aggregate left in aggregate hopper from the aggregate calibration.

2. Load the Minimac emulsion tank with emulsion using the procedures detailed on page 21-22 of this manual.

3. Weigh the Minimac and record this weight as the Heavy Weight for Trial #1.

4. Disconnect the emulsion line from the pugmill inlet hopper and connect it to a line returning to an emulsion storage tank.

5. Move emulsion sequence cylinder on/off valve that was closed to calibrate the aggregate to it's normal on position. (Leave water/additive sequence cylinder valve in off position.)

6. Start the emulsion pump by opening the "AGGREGATE CONVEYOR" speed control knob. Set the pump to about 350-400 RPM.

7. From the EZ-OP display go to MAIN->CALIBRATE->EMULSION screen. The above instructions will be repeated in the EZ-OP calibration instructions.

9. The EZ-OP ECU will automatically close the emulsion valve when the desired number of Aggregate Conveyor Head Shaft revolutions has been reached. Record this number as Head Shaft Revolutions under Trial #1.

10. Weigh the Minimac and record this number as Light Weight under Trial #1.

11. Repeat this procedure for trials 2 and 3.

Calibrating the Minimac (cont'd)

Figure #2. Example of Emulsion Calibration with Trial Data and Calculations

Emulsion Calibration

	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)		16310	16040	15700		
Light Weight	lbs (Kg)		16040	15700	15360		
Emulsion Pumped	lbs (Kg)		270	340	340		
Head Shaft Revolutions	Rev counts		40.2	50	50.1	SUM	Average
Emulsion / Rev	lbs/Rev (Kg/Rev)		6.72	6.80	6.79	20.30	6.77

Equations used in above table:

Emulsion Pumped = Heavy Weight - Light Weight

Emulsion / Rev = Emulsion Pumped / Head Shaft Revolutions

Sum = (Emulsion / Rev trial #1) + (Emulsion / Rev trial #2) + (Emulsion / Rev trial #3)

Average = Sum / 3

Emulsion to Aggregate Graph

Figure #3: Example of Percent Emulsion to Aggregate Ratio

% Emulsion to Aggregate Ratio

	UNITS	Gate Setting		
Agg. Gate Setting	in. (cm)	4	5	6
Ave. Emulsion / Rev	lbs/Rev (Kg/Rev)	6.77	6.77	6.77
Ave Agg. / Rev	lbs/Rev (Kg/Rev)	47.27	62.66	76.8
Emulsion to Agg.		0.1432	0.1080	0.0882
% Emulsion to Agg Ratio	%	14.32	10.80	8.82

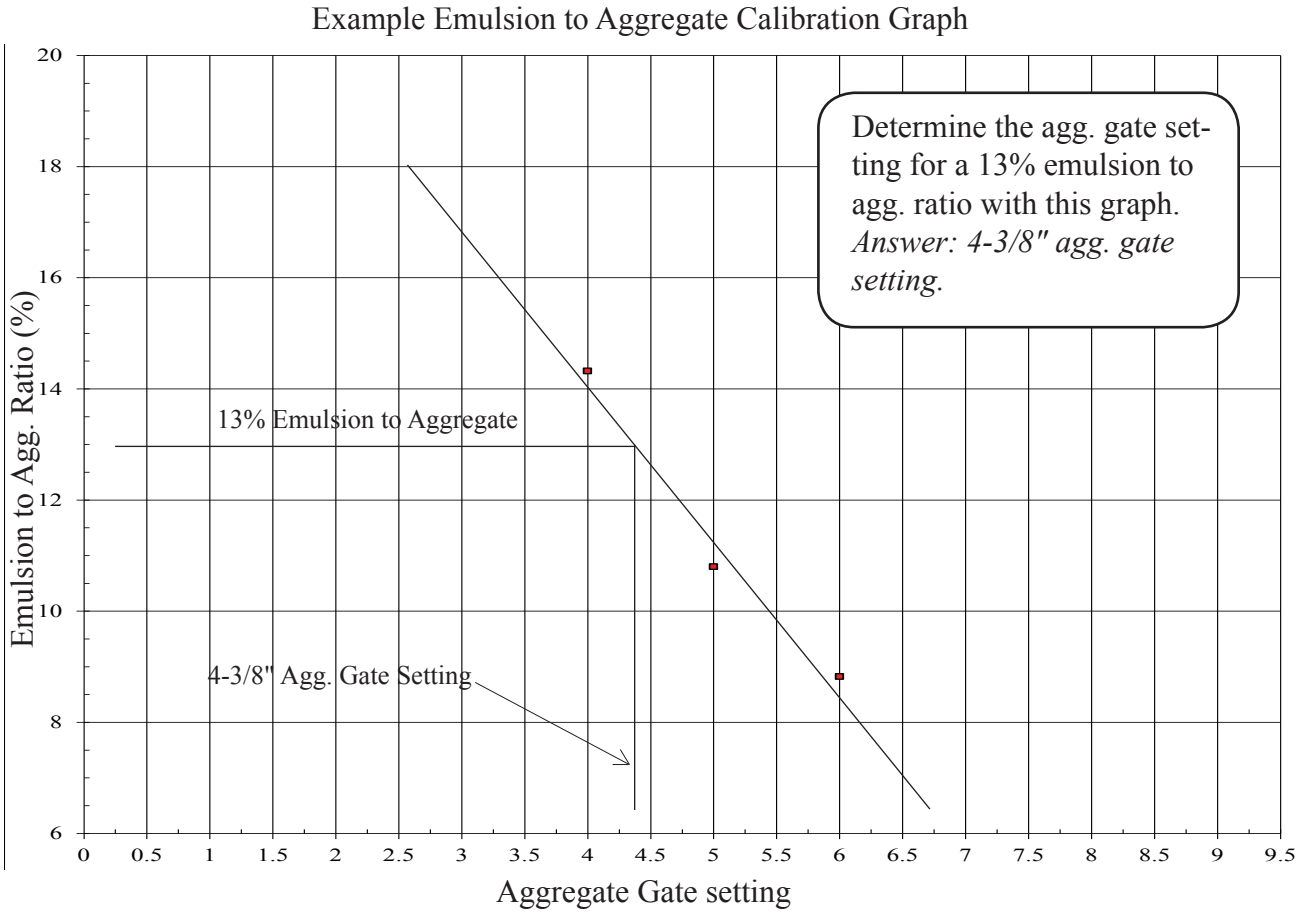
Equations used in above table:

Emulsion to Agg = (Ave. Emulsion Weight / Rev) / (Ave. Aggregate Weight / Rev)

% Emulsion to Aggregate Ratio = Emulsion to Agg x 100

Plot the values of percent emulsion to aggregate versus aggregate gate setting on a graph as shown on the following page. This is used to determine the aggregate gate setting to achieve a given percent emulsion to agg ratio. Enter the graph at the desired percent emulsion to agg ratio. Draw a horizontal line to the right until it intersects the calibration line. Then draw a vertical line down from that point to determine the aggrgate gate setting.

Calibrating the Minimac (cont'd)



Fines Filler Calibration

The fines to aggregate ratio displays the ratio of fines flow as a percentage of the aggregate flow.

Display Value = (Fines flow lbs. or kgs.) / (Aggregate flow lbs. or kgs.)

So, with numbers:

Display Value = 0.65 lbs. / 65 lbs. = 1.0%

Calibrating the Minimac (cont'd)

The Minimac must be calibrated before this becomes useful information to the operator. In other words, we must determine the weight of the product per shaft revolution for both the fines and the aggregate. The aggregate calibration shown previously should have been completed at this point. The fines feeder must be calibrated to determine the weight of fines discharged per auger revolution. This procedure is similar to the emulsion and aggregate calibration measurements as shown in the following example.

1. With the Minimac engine off, remove the pugmill inlet hopper and find a suitable container to place under the fines feeder discharge.

2. Weigh the empty container on a suitable scale that will weigh up to approximately 100 lbs (50 Kg). Enter this weight as Empty Weight under Trial #1.

3. Load the fines feeder hopper with cement representative of that to be used on the job.

4. Press the "FINES" on/off keypad switch to the on position (green). Set the "FINES FEEDER" speed control knob to a middle range.

5. From the EZ-OP display go to MAIN->CALIBRATE->FINES screen. The above instructions will be repeated in the EZ-OP calibration instructions.

6. The EZ-OP ECU will automatically shut off the flow of fines when the desired number of fines auger shaft revolutions has been reached. Record this as Fines Auger Revolutions under Trial #1.

7. Weigh the full container and record this number as Full Weight under Trial #1.

8. Repeat this procedure for trials 2 and 3.

Figure 4. Example of Fines Calibration Data and Calculations

Fines Calibration

	UNITS	Trial #1	Trial #2	Trial #3		
Full Weight	lbs (Kg)	26	26	26		
Empty Weight	lbs (Kg)	3	3	3		
Fines Unloaded	lbs (Kg)	23	23	23		
Auger Shaft Revolutions	Rev counts	50.1	50	50.1	SUM	Average
Fines / Rev	lbs/Rev (Kg/Rev)	0.46	0.46	0.46	1.38	0.46

Calibrating the Minimac (cont'd)

Equations used in previous table:

Fines Unloaded = Full Weight - Empty Weight

Fines / Rev = Fines Unloaded / Auger Shaft Revolutions

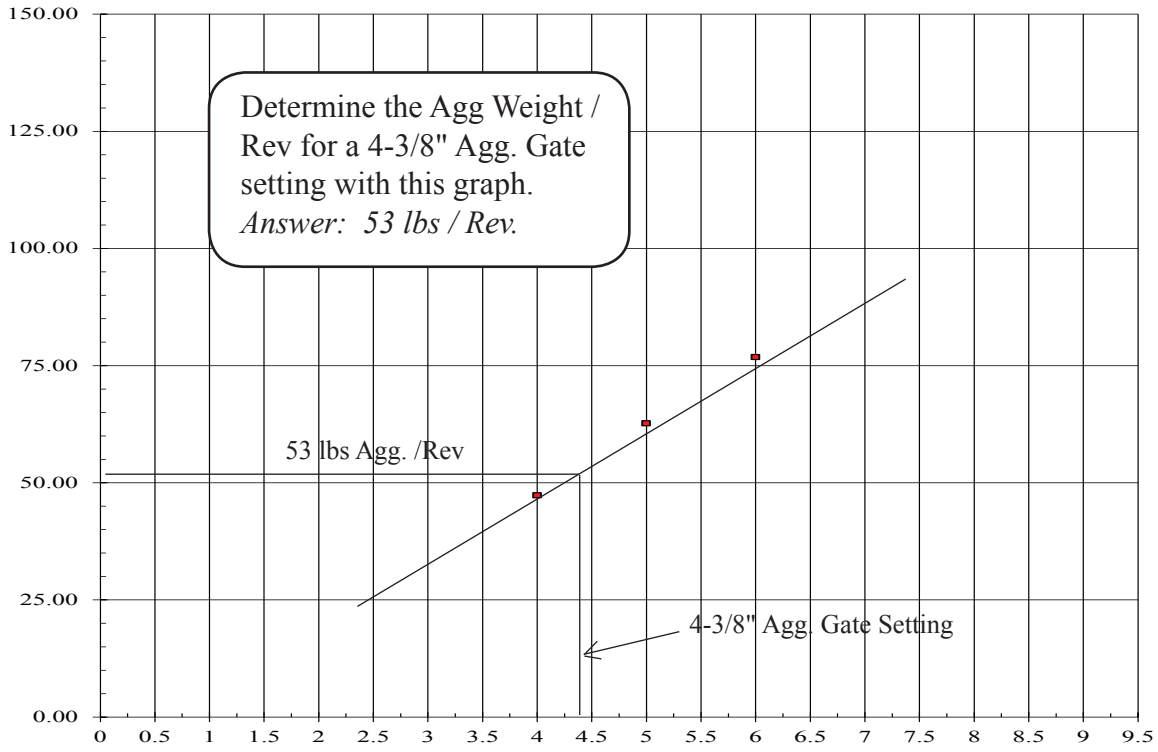
Sum = (Emulsion / Rev Trial #1) + (Emulsion / Rev Trial #2) + (Emulsion / Rev Trial #3)

Average = Sum / 3

Fines to Agg Speed Ratio Calculation

Plot the values of aggregate weight per conveyor head shaft revolution versus aggregate gate setting found in figure 1 on a graph as shown below. Enter the graph at the aggregate gate setting determined from the emulsion and aggregate calibration, draw a vertical line up until it intersects the calibration line. Then draw a line to the left from that point to determine the weight of aggregate per revolution. This will be used to calculate the fines to aggregate speed ratio to match the laboratory design mix.

Example Aggregate Gate Setting versus Weight of Aggregate per Revolution Calibration Graph



Calibrating the Minimac (cont'd)

Liquid Additive Flow Calculation

If liquid additive is required, the mix design will specify the amount by a percentage of the dry aggregate. This percentage can be converted into a flow rate based upon the aggregate conveyor RPM. The aggregate conveyor speed is indicated by the Ratio Meter display on the monitoring panel when channel 'B' is selected. See "Monitoring Manual" for instructions. So, for a known aggregate conveyor speed and aggregate gate setting, we can determine the pounds (or kg.) of aggregate / minute the machine is producing. From this aggregate output rate, we can calculate the additive flow reguired:

At emulsion pump speed of about 400 RPM, the conveyor will be turning about 53 RPM.

At a gate setting of 4.375", the aggregate output is 53 lbs./ rev. x 53 RPM = 2809 lbs./min.

With an additive requirement of 1%, the flow rate required is 28.09 lbs./min. Assuming the additive specific gravity is 1.335 (or approx. 11.15 lbs./gal.), then the flow rate is 28.09 ÷ 11.15 = 2.5 GPM.

If the mix design recommends an approximate water flow rate, this can be calculated using the same method (using 8.34 lbs./gal.). But, usually water is determined while the slurry is being layed, using a visual evaluation of the slurry as it is being mixed and laid.

Aggregate Calibration Charts

Job: ______________________________ Date: ______________________________

Machine No: ______________________________ Measured By: ______________________________

Aggregate Type: ____

Aggregate Moisture%: ____________________

Aggregate Calibration

Aggregate Gate Setting	in(cm)						
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)						
Light Weight	lbs (Kg)						
Aggregate Unloaded	lbs (Kg)						
Head Shaft Revolutions	Rev counts					SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)						

Aggregate Gate Setting	in(cm)						
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)						
Light Weight	lbs (Kg)						
Aggregate Unloaded	lbs (Kg)						
Head Shaft Revolutions	Rev counts					SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)						

Aggregate Gate Setting	in(cm)						
	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)						
Light Weight	lbs (Kg)						
Aggregate Unloaded	lbs (Kg)						
Head Shaft Revolutions	Rev counts					SUM	Average
Agg. Weight / Rev	lbs/Rev (Kg/Rev)						

Emulsion Calibration Charts

Job:_____ Date:_____

Machine No:_____ Measured By:_____

Emulsion Type: _____

Emulsion Temperature:_____

Emulsion Calibration

	UNITS		Trial #1	Trial #2	Trial #3		
Heavy Weight	lbs (Kg)						
Light Weight	lbs (Kg)						
Emulsion Pumped	lbs (Kg)						
Head Shaft Revolutions	Rev counts					SUM	Average
Emulsion / Rev	lbs/Rev (Kg/Rev)						

% Emulsion to Aggregate Ratio

	UNITS	Gate Setting		
Agg. Gate Setting	in. (cm)			
Ave. Emulsion / Rev	lbs/Rev (Kg/Rev)			
Ave Agg. / Rev	lbs/Rev (Kg/Rev)			
Emulsion to Agg.				
% Emulsion to Agg Ratio	%			

Fines Calibration Charts

Job: _____ Date: _____

Machine No: _____ Measured By: _____

Fines Type: _____

Fines Calibration

	UNITS	Trial #1	Trial #2	Trial #3		
Full Weight	lbs (Kg)					
Empty Weight	lbs (Kg)					
Fines Unloaded	lbs (Kg)					
Auger Shaft Revolutions	Rev counts				SUM	Average
Fines / Rev	lbs/Rev (Kg/Rev)					

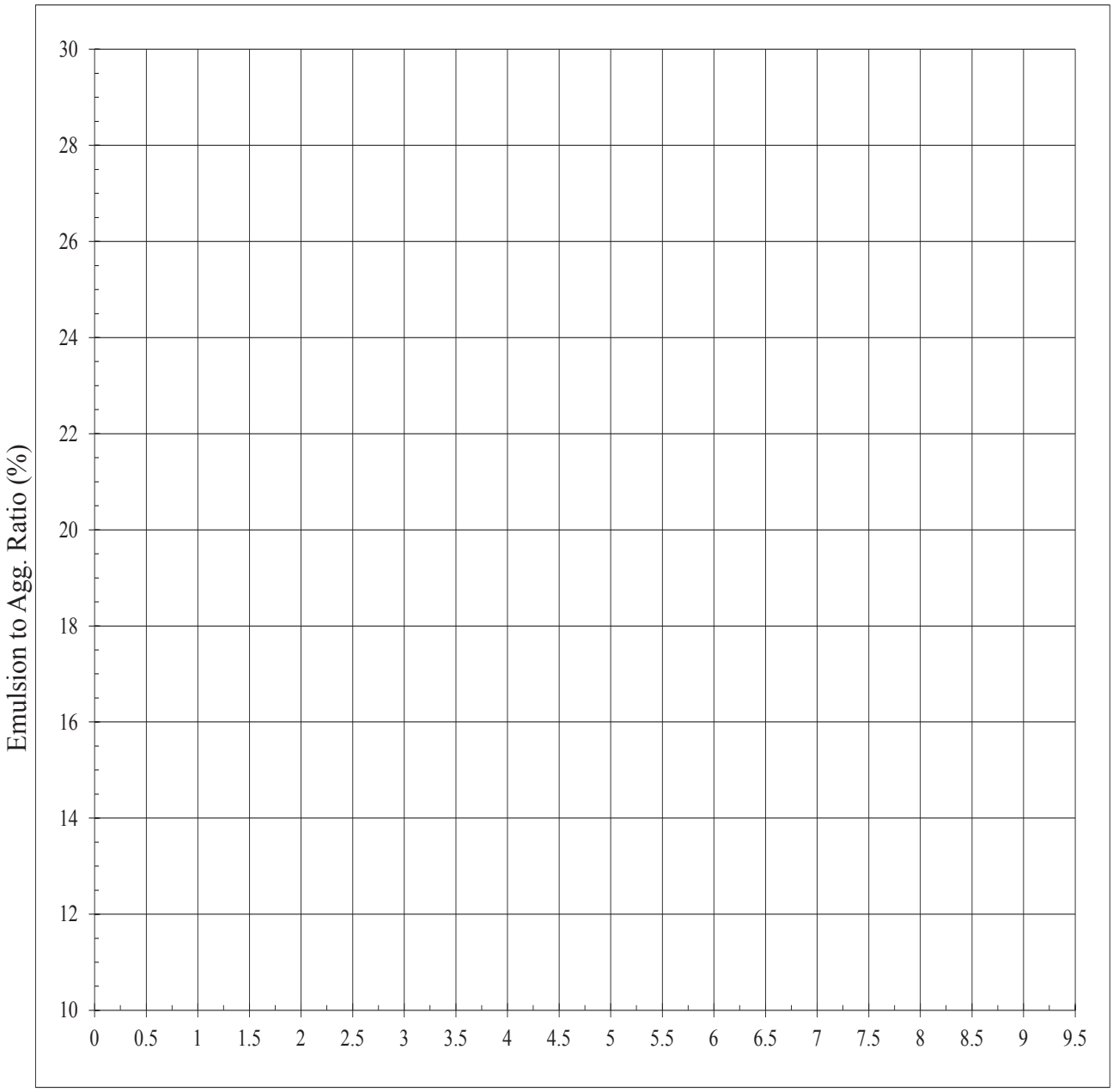
% Fines to Aggregate Ratio

	UNITS	
Desired Fines to Agg. Ratio	%	
Aggregate / Rev	lbs/Rev (Kg/Rev)	
Ave. Fines / Rev	lbs/Rev (Kg/Rev)	
Fines / Agg.	lbs/Rev (Kg/Rev)	
Speed Ratio		

Emulsion to Aggregate Calibration Graph

Job:_____ Date:_____

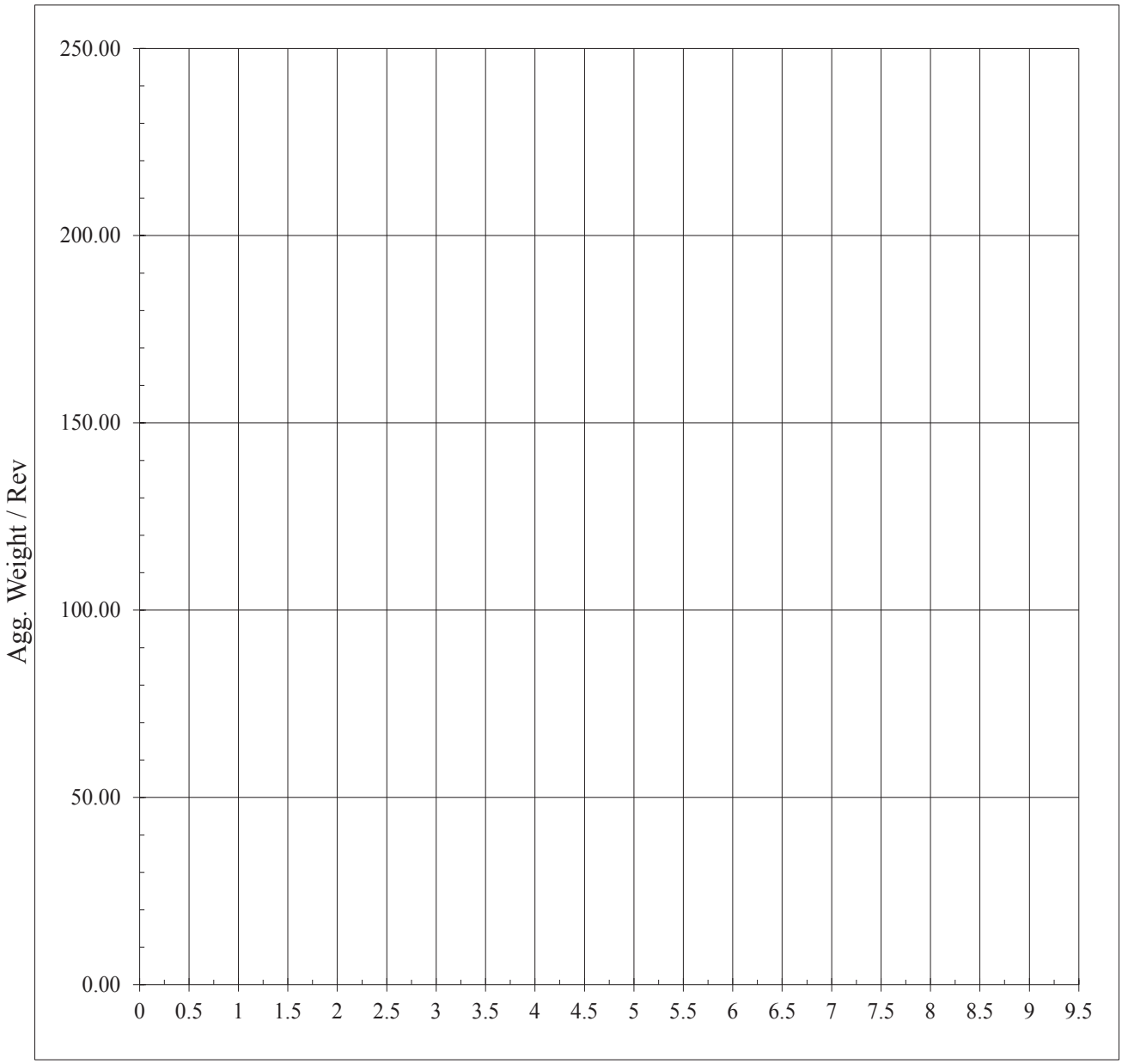
Machine No:_____ Measured By:_____



Aggregate Weight per Revolution Calibration Graph

Job:_____ Date:_____

Machine No:_____ Measured By:_____

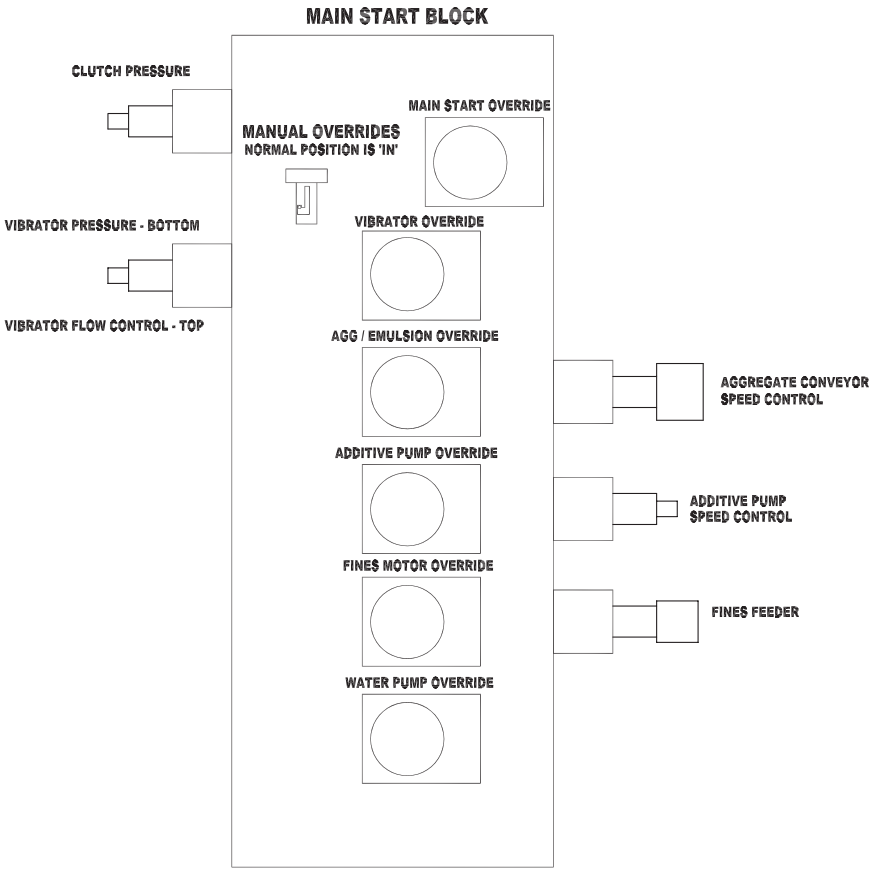


Manual Override And Sequencing Valves

The Minimac's hydraulic and electrical system provides for manual over-rides of most functions, as well as manual adjustment of the main start sequence control. The valve over-rides shown below are mounted in the main start hydraulic block located underneath the inspection cover just behind the right rear corner of the aggregate hopper. Sequence controls will be described in detail on page 39.

The valve override controls shown below can be used to activate their respective function in the case of electrical failure. To override the functions, depress the knurled knob, turn it counterclockwise and release it so that it pops up to the override position.

The box lift / diverter / sideshift valves also have an override feature. To manually activate, or override, these valves, use a 9 mm open-end wrench on the hexagonal shaped handle base on the opposite side of the valve from the coil.

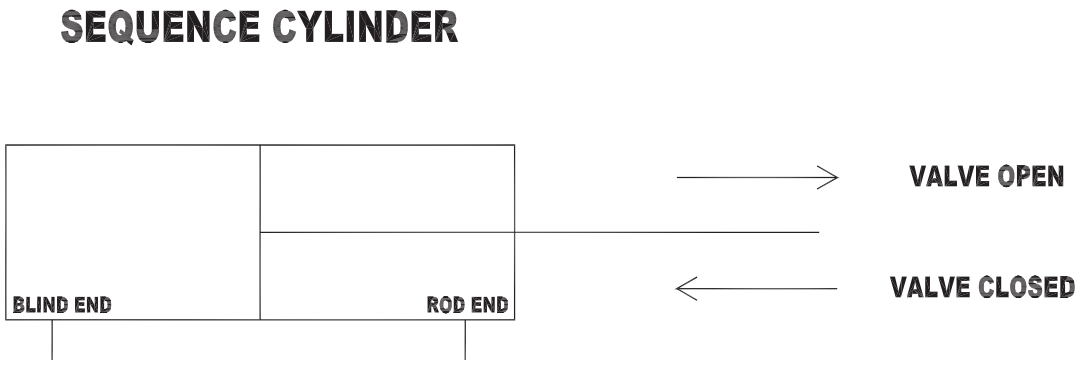


WARNING: IF THE BRAKE CONTROL VALVE MANUAL OVERRIDE IS ENGAGED THE MINIMAC PARKING BRAKES WILL NOT FUNCTION. PERSONAL INJURY OR DAMAGE TO THE MACHINE MAY RESULT.

Adjustment Of Automatic Sequencing

The Minimac is equipped with an adjustable automatic sequencing system. This system controls the timing of material delivery to the pugmill assuring consistent quality through the entire paving operation. This is accomplished with valves operated by hydraulic cylinders. The emulsion valve is a three way valve that recirculates emulsion back to the tank during standby or sends emulsion to the pugmill during mixing. The water and additive valves are two way shut-off valves controlled by the second cylinder.

The open and close delay for each cylinder can be adjusted from the EZ-OP Screen MAIN->SETUP->SEQUENCE screen.



Spreader Box

Hooking Up The Spreader Box

1. Locate and securely clamp the operator's Joystick Control Handle box to a position along the square tubing on the rear of the Minimac that will be comfortable and easy to use while operating the machine.

1. Using the Joystick Control Handle, center the material diverter by tilting the control handle left or right.

2. Slowly backup the Minimac, centering the material diverter rubber with the center of the spreader box.

3. Stop the Minimac when the material diverter rubber is centered over the front section of the spreader box.

4. Connect the two box lift chains to the chain hooks that are mounted on the end of the Minimac's box lift.

5. Connect the spreader box pull chains to the hooks that are pinned in the bottom of the square tube behind the rear tire of the Minimac.

NOTE: Mark chains with wire, cloth or paint at desired hook-up location for easy re-connection.

6. Connect the side shift bar from the spreader box to the side shift cylinder arm on the Minimac. Use Thumb Switch on Joystick Control Handle to shift cylinder arm left or right to align with side shift bar.

NOTE: Be sure material diverter bar is in the horizontal position before lifting box lift mechanism.

CAUTION: BE SURE ALL GROUND PERSONNEL ARE CLEARED FROM THE AREA WHEN BACKING THE MINIMAC TOWARDS THE SPREADER BOX.

Laying Slurry Seal

Once the Minimac has been calibrated, all settings made, and sequencing set you are ready to lay slurry seal. Move the Minimac to the work location and open the throttle until the engine on the Minimac reaches 2400 RPM. Operating engine at slower speeds can lead to a lack of power and possible engine overheating.

Proceed as follows:

1. Lower the spreader box where the slurry seal is to be placed.

2. Turn on the "WATER" keypad switch. If required for the application, turn on "ADDITIVE" and "FINES" keypad switches. Also place the toggles switches for the spray bars being used to the "AUTO" position. With switches set to "AUTO", the spray bar functions will start automatically when the transmission controller is moved in the "F" or forward direction. Should manual control of the spray bar functions be desired, move the toggle switches to the 'ON' position.

3. Set the emulsion pump to about 400 RPM.

4. Shift the Pugmill Control Handle to the full forward position.

NOTE: The center position of the pugmill control handle has a small stop. The further the handle is moved away from the center detent, the faster the pugmill drive will go. Up is forward and down is backward.

5. If you are using an augered box, shift the "SPREADER BOX" "LEFT" & "RIGHT" auger control levers to the desired direction you require the augers to move the slurry seal mix. Speed of the augers is controlled by the how far the levers are moved.

6. To start mixing material, press Main Start Trigger on the Joystick Control Handle. If you are using water spray bars, turn appropriate switches on now.

    A. The slurry seal mixture will flow down the material diverter rubber into the spreader box.

    B. Observe the fines ratio meter, water and additive flow meters and the mix as it leaves the pugmill.

Laying Slurry Seal (cont'd)

C. Adjust mix as required. Observe the rate at which material is produced. Adjust "AGGREGATE CONVEYOR" speed control to increase or decrease material flow rate as desired. Settings for water and additive may have to be adjusted for the new mixing rate. Fines ratio will also have to be adjusted. Observe fines ratio meter and adjust "FINES FEEDER" control knob as required.

D. As mixed material flows out of the pugmill, the material diverter can be used to direct the mixture to either side of the box as required. This is done by tilting the Joystick Control Handle to the left or right.

E. To side shift the spreader box, place your thumb on the black Thumb Switch on the top end of the Joystick Control Handle. Move the switch with your thumb in the direction you want the spreader box to move side to side.

F. When you are within approximately 10 yards (10 meters) of the end of the where the slurry seal is to stop and the spreader box is full, press and quickly release the Main Start Trigger in order to stop the material mixing. Continue to drag out the remainder of the material in the box to where that pass should end. Stop the Minimac. Turn off water spray bars. If you have excess slurry in the box, lift up the box and hand squeegee it back onto the pass that was just laid, spreading it evenly and uniformly.

Hints:

A. Pull outside or curb passes first, then run center passes.

b. Be sure to use left and right seam sprayers to eliminate joints when laying inside passes. The spray bar water will also help the squeegee man smooth out the joint overlap from previous passes.

c. When the slurry seal dries, the surface texture should be uniform.

CAUTION: THE OPERATOR MUST BE AWARE OF TREE BRANCHES AND OTHER LOW OVERHEAD OBSTRUCTIONS AS THEY CAN CAUSE SERIOUS INJURY TO THE OPERATOR.

High Pressure Washer - Optional Equipment

WARNING: NEVER POINT OR AIM THE HIGH PRESSURE WAND AT ANYONE AT ANYTIME. IT CAN CAUSE SERIOUS INJURY OR EVEN DEATH. ALWAYS WEAR EYE PROTECTION WHEN USING THE HIGH PRESSURE WASHER.

The high pressure washer system is powered by the Macropaver's main hydraulic system. Use the following procedure for operating the washing system.

1. Start up the Minimac and bring the engine to up to at least 1400 RPM.

2. Go to the washer water supply plumbing on the right rear and turn the water ball valve to the on position.

3. Turn on the "HIGH PRESSURE WASHER" switch,located on left side of dash, next to the emulsion full alarm.
   (Note: This switch will also turn on the main water pump.)

4. Remove the wand and pull out the amount of hose needed. Pull the trigger. The washer will start and stop when the trigger is pulled or released.

5. The pressure wand has high and low settings. To change, PUSH IN on the nozzle to go to HIGH pressure or PULL OUT on the nozzle to go to LOW pressure.

NOTE: Be careful to avoid spraying water on exposed electrical components when cleaning unit. Be especially careful behind the dashboard.

Hydraulic System Troubleshooting

Before getting into specifics of trouble shooting, it is important to have a basic understanding of hydraulics and the Minimac's hydraulic system. Hydraulic oil flow is developed by three direct drive axial piston pumps and one gear pump driven by the John Deere Turbodiesel. Each pump powers certain parts of the hydraulic system and are basically separate systems with two common reservoirs. Refer to the "Getting To Know The Macropaver" section and the enclosed hydraulic schematics for more information on the system.

TROUBLE	POSSIBLE CAUSE
No system function (0 PSI), or	1. Pump pressure compensator stuck
system hydraulic pressure low	2. More oil being used than pump can supply
High hydraulic oil temperature	1. Hydraulic pressure set higher than required.
	2. Hydraulic pump or motor failing.
	3. Restriction in hydraulic hose or fitting.
	4. Excessive time spent idling.
Pump noisy, operation of systems erratic	1. Hydraulic pump suction ball valve closed.
	2. Oil level in reservoir low.
	3. Suction strainer clogged.
Ground drive system slow or erratic	1. Charge pump relief valve or hot oil shuttle relief valve set to low
	2. Charge pump filter clogged.
	3. Electrical malfunction in ground drive control circuit

Material Systems Troubleshooting

TROUBLE	POSSIBLE CAUSE
Emulsion pump does not pump or shaft not turning	1. Emulsion pump water jackets not hot enough 2. Emulsion pump flow control not 'on'
Emulsion pump shaft turning but not delivering emulsion to pugmill	1. Three way emulsion fill valve not at 0° position 2. Emulsion strainer plugged 3. Emulsion pump input shaft key sheared 4. Emulsion sequence valve not being actuated 5. Emulsion pump relief valve held open by contamination or build-up of emulsion.
Emulsion pump and hoses vibrating or surging, pump making rattling noise	1. Pump is sucking air causing cavitation 2. Relief valve chatter - inspect relief valve for broken parts 3. Emulsion has lumps or chunks - check emulsion 4. Worn or damaged pump gears, bearings or shafts - disassemble and check
Aggregate conveyor does not deliver aggregate to pugmill	1. Emulsion pump flow control not 'on' 2. No or low hydraulic pressure to clutch

Sensor And Monitoring Panel Troubleshooting - Standard Panel

TROUBLE	POSSIBLE CAUSE
All Sensors	1. Check all connections from the sensor to the meter 2. Check the air gap between sensor and target wheel
Emulsion Pump Speed Meter does not display a speed	1. Check the emulsion pump to be sure it is turning
Aggregate Totalizing Meter display number does not increase during operation	1. Be sure conveyor turns and clutch engages
Fines Totalizing Meter display number does not increase during operation	1. Be sure fines auger is turning

Each sensor has an air gap between the head of the sensor and the target wheel it is monitoring that must be maintained. If the air gap is too large, the sensor will either give intermittent response or none at all. If the air gap is too small, the sensor head could come into contact with the target wheel and damage or destroy the sensor or wheel. Listed below are the air gap specifications and junction box connector number for each sensor.

Sensor Air Gap

Sensor	Location	Air Gap
Emulsion Pump	Aggregate/Emulsion Motor	Pre-set
Head Shaft	Aggregate/Emulsion Motor	Pre-set
Fines Motor	Left Side Inspection Cover	Pre-set

Sensor And Monitoring Panel Troubleshooting - CalTrans Panel

TROUBLE	POSSIBLE CAUSE
All Sensors	1. Check all connections from the sensor to the meter 2. Check the air gap between sensor and target wheel
Emulsion Pump Speed Meter does not display a speed	1. Check the emulsion pump to be sure it is turning
Emulsion Totalizing Meter display does not increase during operation	1. Check the emulsion pump to be sure it is turning
Aggregate Totalizing Meter display number does not increase during operation	1. Be sure conveyor turns and clutch engages
Fines Totalizing Meter display number does not increase during operation	1. Be sure fines auger is turning

Each sensor has an air gap between the head of the sensor and the target wheel it is monitoring that must be maintained. If the air gap is too large, the sensor will either give intermittent response or none at all. If the air gap is too small, the sensor head could come into contact with the target wheel and damage or destroy the sensor or wheel. Listed below are the air gap specifications and junction box connector number for each sensor.

Sensor Air Gap

Sensor	Location	Air Gap
Emulsion Pump	Aggregate/Emulsion Motor	Pre-set
Head Shaft	Aggregate/Emulsion Motor	Pre-set
Tail Shaft	Front End of Conveyor	0.157"(4mm)
Fines Motor	Left Side Inspection Cover	Pre-set

Appendix

1. John Deere Diesel Engine Operation and Maintenance Manual

2. Emulsion Pump Installation, Operation and Maintenance Manual

3. Water Pump Installation, Operation, Maintenance and Parts Bulletin

4. Additive Pump Operating, Maintenance and Parts Bulletin (Optional Equipment)

5. High Pressure Washer Operating, Maintenance and Parts Bulletin (Optional Equipment)