



**Trico Poly
Systems**

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MARK XV

TWO COMPONENT

OPERATION MANUAL

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**TRICO POLY SYSTEMS, LLC.
60 BROWN AVE. SPRINGFIELD, NEW JERSEY 07081 USA**

MARK XV Operation Manual

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GENERAL SAFETY

WARNING – HAZARD OF ELECTRIC SHOCK

Any installation involving electric heaters, mechanical equipment, motors, etc. must be effectively grounded in accordance with the national electrical code to eliminate shock hazard.

All electrical wiring to electrical equipment must be installed in accordance with the National Electrical Code, or local electrical codes by a qualified person. For maximum equipment protection, the **National Electrical Code** recommends ground fault protection be provided for the branch circuit supplying electrical equipment.

NOTE: It is required that the end user provide a fused disconnect in close proximity to each piece of electrical equipment supplied by Trico Poly Systems LLC.

WARNING – MECHANICAL, AND OR CHEMICAL HAZARD

Equipment involving heaters, motors, gears, pumps, hoses, powered by air and, or fluids, in or on equipment, provided by Trico Poly Systems LLC must be operated or serviced by authorized personal only. Proper personal safety equipment, energy lock-outs, and proper tools must be used at all times.

Proper handling, ventilation, and or, breathing apparatus may be required to operate, the Trico Poly Systems LLC equipment if toxic chemicals are used in the manufacture of products from this equipment.

MATERIAL SAFETY DATA SHEETS ARE TO BE OBSERVED AT ALL TIMES.

Machines are designed to make a person's work more rewarding and to make a better product. All satisfaction is lost when a person gets injured while operating machinery. Therefore, we urge you to observe the following safety precautions in addition to those outlined by your own company.

1. Follow all safety directions for each material being processed by the machine. If you don't know what these directions are, locate someone that does.
2. Avoid skin contact with cleaning solvents and materials.
3. At all times wear required protective clothing. Always have goggles and gloves on when dispensing materials, flushing the head or handling materials.

4. Avoid contact with vapors by wearing the proper breathing respirators as required. Fume removal systems must be in good working order.
5. Do not use flammable solvents for cleaning the head or any part of the machine. Keep flammable solvents away from the machine as sparks from DC motors, AC contactors, etc could ignite them.
6. When working on the machine shut off power. Voltages on this machine can cause death upon contact. Make sure only qualified electricians work on electrical circuits.

Warning:

Do not attempt to repair the machine alone. Have someone present to disconnect power in the event of an emergency.

IMPORTANT GUIDELINES

These are some of the basic practices followed by some of our most successful customers:

1. Make one or two individuals in your company responsible for the day-to-day operational integrity of the machine. This individual should direct the maintenance and cleaning as required. He/She should understand how the various systems and parts work on the machine. If there is a problem, they should be the first person alerted to the situation. They should be the coordinator of all activity associated with the machine to assure that it will run properly and make good parts.
2. Keep the machine clean! Remove every spill as it occurs and make sure everyone is held accountable around the machine to clean up his or her own spills. Always have the necessary spare parts on hand for preventative maintenance. Lock them up in a cabinet near the machine and limit access to the parts.
3. **Make sure that the machine operator reads this manual!** If unskilled personnel are to be utilized or if rapid employee turnover is a problem, consider developing a basic training program.
4. Contact our Technical Service Department if you have an unusual problem.

Proper and Improper Handling of the Machine

Proper

Improper

<ul style="list-style-type: none">• Perform routine maintenance• Start pumps slowly• Use adequate ventilation and a fume removal system• Keep the mix head clean• Keep/pour pressure balanced• Work Safely!!	<ul style="list-style-type: none">• Trying to pump or meter cold materials• Overheating materials• Never use torches to melt out lines or suspected blockages
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OPERATING SUPPLIES

Chemicals:

1. Solvent (DBE) or equivalent for mix head purge
2. Plasticizer for lubricating seals and bearings (Benzoflex)
3. Mold release
4. Process materials (prepolymer, curative, colors, etc.)
5. Vacuum pump oil
6. Dow Silicone grease for lubricating "O" Rings and seals

Tools and Equipment:

1. Face shield
2. Gloves: check manufacturer for appropriate gloves for handling chemicals
3. Waste catcher
4. Test molds (pie tins, cups, etc.) for ratio calibration
5. Spill protection for floor (plastic, cardboard, metal sheets)
6. Absorbent material for cleaning up spills (paper towels, rags)
7. Medium and large crescent wrench, pipe wrench, bung tool, Allen wrenches, nut drivers, screw driver, knife, tweezers, pliers, end wrenches, wire brushes
8. Fume removal (exhaust hood, suction hose)
9. Pour hoses of a chemical resistant, reinforced, flexible material
10. Electronic scale sized for your operating range. (If you are pouring 10lbs/minute, the scale should handle 10 lbs.)
Note: Scale error should be small compared to allowable process error.
11. Flashlight for looking into material tanks and machine recesses
12. Metal container for cleaning parts in solvent
13. Drum dolly
14. Oven or chamber for reheating drums
15. Clean dry air source for tanks, lube and color pressure operation. (80-100 PSI)
16. Nitrogen source for pressurizing tanks and blanketing drums. Normal PSI on machine tanks is 30-35 PSI.

UNCRATING, SETUP & INSTALLATION

MARK XV UNCRATING AND SETUP

The MARK XV Hydrosponder is shipped in a wooden crate and is bolted to the top, and base of the crate. The uncrating should start with the removal of the four bolts located on the top, and once these are removed, the balance of the Mark XV's crate can be disassembled. Remove the Hydrosponder from the base and place it in its position. Before leveling and bolting to the floor, all the auxiliary equipment must be in place with the material transfer lines. The color and purge tanks (if applicable) will be strapped to the crate base inside the Mark XV Hydrosponder.

POWER HOOK-UP

The Mark XV receives its main power from three-phase 240 volts 60 Hz (refer to each machine's nameplate for amperage and neutral requirements) service. The balanced power is distributed by circuit breakers mounted on the rear of the Hydrosponder. The qualified electrician may be required to make a hole in the upper right-side panel. A conduit connector should be mounted in this area. The 208 or 240-volt 3 phase service with ground is to be provided from a fused disconnect located close to the Mark XV, and without an obstruction in its path.

AIR HOOK-UP

The air inlet to the Mark XV is located on the rear left side when viewing from the rear, just under the pump shelf. A pressure switch senses incoming pressure and triggers if the pressure is below the switch's setpoint (see Main Air Low indicator light on page 12). Main air is required for the Mark XV's purge, color, and lubrication systems. The air source provided must be free of oil, and or water. 100 PSI is required. **NOTE:** Nitrogen can be used to minimize moisture contamination.

Warning:

The MKXV will not operate properly without a minimum 85 PSI main air.

MARK XV INSTALLATION

The start-up of a system must begin by a proper installation of the equipment. The machine has been fully tested prior to the arrival at your plant; however, it is possible that damage has occurred during shipping. Check all wiring, air tubing, and lubrication **prior to the start-up**. Tighten all screws, bolts, lines and heated material transfer hoses. They must be completely secure. This must be done prior to energizing the equipment, with any air, fluids, or power.

NOTE: It is TPS' intent to provide the very best equipment for your facility, which will provide the very best products for your customers.

MKXV FUNCTIONS AND FEATURES

FRONT PANEL CONTROLS & INDICATORS

A. Temperature Controllers

Located at the top of the front panel are the machine's temperature controllers. Display temperatures may be setup in °F or °C. If the respective temperature exceeds the setpoint or decreases after reaching setpoint, the alarm will activate. Under each controller is a maintained push button for powering the controller and for resetting alarm conditions.

B. HMI (Human Machine Interface) Screen

The touch screen displays all relevant information required to run the machine. All pump information (size, pressure, flow rate, speed) is displayed as well as mixer purge settings and machine alarms.

There are two operation modes:

1. Admin (administrator). When the admin is logged on, all screens and buttons are accessible.
2. Operator. When the operator is logged, only the Main and Alarm screens are accessible.

See page 29 for a complete description of the HMI screens.

C. Alarm Indicator Light

This is a tri-colored light. It gives the operator a visual indication of the alarm type. The display colors are:

1. Constant Green – no alarms
2. Flashing Yellow – non-critical alarms:
 - i. Resin inlet under pressure
 - ii. Curative inlet under pressure
 - iii. Resin outlet over pressure warning
 - iv. Curative outlet over pressure warning
 - v. Temperature
3. Flashing Red – critical alarms:
 - i. Resin outlet over pressure stop
 - ii. Curative outlet over pressure stop
 - iii. Pot Life expired
 - iv. Main Air low
 - v. Mixer motor fault. Fault with mixer motor or mixer VFD.

D. Alarm Silence Switch

This is a momentary switch that is used to silence the audible alarm.

E. Lubrication Switch

The purpose of the lubrication system is to lubricate the mixer shaft seals. By lubricating shaft seals, the seals will last longer, prevent material leakage and prevent air introduction.

The momentary Lubricator push button switch is used to initiate a “manual” lube cycle. This function is allowed when the machine is not in pour mode. The Operate/Off/Purge switch must be in the Operate position.

When the lubricator button is depressed and released, the PLC enables the lubricator solenoid valve for two seconds. This operates the small high-pressure pump, located inside the lube reservoir container (mounted on the right side outer panel), forcing lubricant into the mixer shaft seals.

When in pour mode, the lube function described above is automatically controlled by a timer in the PLC. The cycle is approximately 20 seconds.

F. Drive Motor Speed Control Potentiometer

This pot controls the speed of the drive motor. The drive motor runs all the machine’s metering pumps. The motor is located under the pump shelf and is driven by a motor controller located on the inner left side panel.

G. Mixer Speed Control Potentiometer

This pot controls the speed of the mixer motor. The motor is mounted above the mixer housing and is controlled by a VFD (variable frequency drive). The VFD controller is located on the inner right-side panel.

H. Emergency Stop Switch (E-STOP)

This is a maintained red normally closed switch. Pressing this switch will cut off power to all output components (drive motor, mixer motor, and solenoids) and stop all machine functions. Twisting the knob will reset the switch.

I. Operate/Off/Purge Switch

This switch controls two main functions for the machine; operate and purge.

OPERATE

- a. The operator can manually lubricate the pump and mixer seals by depressing the lube push-button.
- b. Machine ready to pour. The operator can either set the Pour switch to ON or step on the foot switch. This initiates a pour (the pump drive motor and mixer motor are enabled).
- c. All alarm and Pot Life functions are enabled.

1. OFF

- a. Except for temperature control, no functions possible.
- b. Inlet under and outlet over pressure alarms are disabled.

2. PURGE

- a. Initializes the mixer purge sequence. The PLC enables the air and solvent timers (which turn on air and solvent solenoid valves) in sequence to provide pressurized air and solvent to the mixer’s internal parts and passageways.

- b. Solvent flows to the mixer through a needle valve and three-way resin inlet valve
- c. Purge Sequence is air, solvent, air.
- d. Once the purge sequence is completed, return the switch to either the Off or Operate position. To terminate the purge function prematurely, set the switch to Off or Operate as desired.

J. Pour Switch

The pour switch initiates a pour. It enables all machine systems to operate and dispense mixed material. The ON position is to the right. **The pour switch is the final step in the operational procedure which should be reviewed thoroughly prior to “pouring”.**

The foot switch is wired in parallel to the Pour switch and therefore can also be used to put the Mark XV into pour mode. Unlike the Pour switch, the foot switch is momentary and thus once the operator lifts their foot from the switch, the machine will stop pouring unless preset pour is enabled.

K. Audible Alarm (located on the upper right-side panel)

The audible alarm is activated when any alarm condition exists. It can be silenced by pressing the “Alarm Silence” switch.

DAILY STARTUP

A typical daily start-up should include the following steps:

1. Verify the E-STOP switch is in the outward position.
2. Verify POUR switch is off (left position). Verify Off-Operate-Purge switch is off (center position).
3. Turn on the main power disconnect switch. Check to see that all appropriate temperature controllers (except MOCA line) are energized. If not, press the corresponding white on/off push buttons. Allow all heated components to rise to proper operating temperatures. During the warm-up period, ensure the digital temperature controllers have the correct set points. To do this, press and hold the asterisk button.
4. Verify the MOCA line temperature controller is switched off.
5. Power on all other tanks (Degasser, MOCA Melter, etc.).

Warning:

DO NOT START TO MELT MATERIAL UPON INITIAL START-UP WITH THE MOCA DELTA-P INSERTED IN THE MIXER.

Warning:

Be sure a waste container is underneath the mixer and the MOCA delta-p is pointed down towards the container.

Note:

If color is not being used, disengage the pump and vent the tank.

6. Apply clean dry main air (or nitrogen) to the system at 100PSI. This allows for proper function of the lubricator, color and delta-p valves. The lubrication system will not work properly below 80PSI. Should the pressure drop, the alarm will sound and the alarm screen will indicate the problem.
7. Check tank levels and add sufficient material to satisfy the planned production. Make sure there is sufficient solvent in the purge solvent tank to properly purge the mixer multiple times. **NOTE: LESS MATERIAL IN THE PURGE TANK WILL CAUSE A LONGER DELAY IN PURGE MATERIAL REACHING THE MIXER.**
8. Once the hardener tank, pump and delta-p are at setpoint, turn the manual air valve located at the delta-p valve to apply air pressure to the MOCA delta-p diaphragm.
9. On the hardener tank, open its discharge valve and on the Mark XV, switch on the MOCA line temperature controller. MOCA in the upper and lower hoses will begin to warm up and melt out. Any pressure build up from the melting process will be relieved via the tank or delta-p valve.
10. Turn Operate-Off-Purge selector switch to the Operate position. Press the lubricator button and release a minimum of 5 times to pump the lubricant into the mixer shaft seals. The mixer **MUST** be lubricated prior to running the pump drive. It is also

recommended to lubricate manually when stopping the pump drive for a length of time. Lubricant should be compatible with the customer's chemical process. (Benzoflex 9-88 SG is typical) The Mark XV is shipped with benzoflex in its lube reservoir

11. Test the mixer purge function. Turn the main function selector switch to the Purge position. Make sure a required amount of solvent and air passes through the whole mixer. Return the function selector to Off.
12. Inspect and insure that the heated material transfer line ends (both resin and hardener), are properly connected to their terminal ports and secured with lock pins. Open the degasser (or resin tank) output valve.
13. Adjust the tank pressure regulators and Delta-P regulators, so that 35 PSI is applied to the tanks. **CHECK FOR LEAKS.** The Delta-P and Tank (or Degasser) pressures should be the same.
14. Inlet and discharge pressures are displayed on the "Processed Material" screen (Admin logged on). Readings may not be accurate until the machine is at temperature and all materials have melted out.

CAUTION:

The inlet shutoff valves at the mixer must be OPEN at all times when materials are being dispensed. Failure to open the valves and attempting to pump material into the mixer can cause extremely high backpressure. During this condition, the possibility for machine damage, leaks, and even personal injury is high.

15. When the temperature controllers indicate the proper operating temperature, turn the mixer resin 3-way valve to open position. At this point, the metering pumps can begin to turn. Place the machine in OPERATE and depress the foot switch (or set the Pour switch to On). Allow them to continue to turn for about 5 seconds to insure their free turning. If the pumps do not turn allow a few additional minutes of heating to melt down any solid material, and try again. (A sure manual check on proper pump operation would be to loosen the hardener pump clamp knobs, slide the assembly back far enough to disengage the gears and turn the pump by hand. If the pump will not turn, this is an indication of solid particles in the pump. This operation will enable you to determine whether the resin or hardener pump is not operating properly. Also, it will prevent the shear pin from breaking.) Resin should now pour from the bottom of the mixer and hardener from the end of the Delta-p.
16. Allow the resin and hardener to pour into scrap containers until the streams are free of air. At this point, provided all other related systems are functioning properly, test pours can begin with ratio checks.
17. Insert the MOCA delta-p valve into the mix-head and production can begin.

CAUTION:

For any machine processing urethane resin systems there are two main points to consider, namely:

1. The ambient air, or rather the moisture in it, will ACT as a curing agent to the resin. It becomes important, therefore, to **do everything possible to prevent any moisture / air from contacting the resin.** Previous experience indicates that this

means the resin should not be cleaned out after each run, but rather it should be left in to keep the air out of the system. Keep all “O” rings and gasket seals in good condition. Use a dehumidifier on the vent port of the supply drum (if a Degasser is utilized) and maintain the lubricator system in good working condition. These same conditions and recommendations apply when either a TDI or MDI system is used in the machine.

2. When using hot melt hardeners or resins, the basic issue is to maintain sufficient heat in the material to insure its proper liquid condition. The shear pin, through which the pumps are driven, is used to protect the gears and shafts of the pump from damage in the event that a solid particle or piece of foreign material gets in the gears of the pump. **In the event cold or hard material is attempted to be metered, and the pump shear pin snaps, it is the operator’s responsibility to notice either a reduction in flow or noticeable change in discharge pressures.**

TYPICAL SHUTDOWN

A typical shutdown of the Mark XV consists of purging the mix head and relieving pressure on the curative, resin, color tanks and transfer lines. Once production is finished, follow these steps to shut down the machine. A waste container is required.

1. Follow the mixer purge sequence as described on page 20.
2. Turn Operate-Off-Purge selector switch to the Operate position. Press the lubricator button and release a minimum of 5 times to pump the lubricant into the mixer shaft seals.
3. Remove the MOCA delta-p valve from the mixer and aim down towards the waste container. Plug the port.
4. Close the discharge output valve on the hardener tank. Turn the manual air valve at the MOCA delta-p to relieve the air pressure on the delta-p diaphragm; a small amount of MOCA will drip into the waste container. This will depressurize the lower and upper MOCA hoses. Turn off the MOCA line temperature controller. **Failure to do this operation can result in line failure or rupture as the next time the machine is switched ON, the MOCA heating process will cause excessive pressure to build up.**

NOTE:

DO NOT VENT PRESSURE FROM THE HARDENER TANK BY BACKING OUT THE REGULATOR, UNLESS THE DELTA-P IS REMOVED FROM THE MIXER AND THERE IS PROPER VENTILATION IN THE FACILITY.

5. Close the resin inlet valve at the mixer and supply tank discharge valve.
6. Turn the mixer and pump speed control back to the zero position.
7. Set Operate switch to Off.
8. Close off the main air and turn off the main electrical disconnect switch cutting all of the power from the machine.

PRESSURE SENSORS

The pressure sensor used on the MARK XV is composed of three sections (diaphragm, capillary, and electronics). The diaphragm section mounts to the pump block. The capillary is a liquid-filled pressure transmission system. The pressure applied to the diaphragm is transmitted via the liquid in the capillary to a strain gauge in the electronics. The electronics then generates an electrical signal proportional to the pressure. This signal is sent to the PLC and displayed on the HMI.

PRESSURE INDICATION

Pump pressures are displayed on the HMI in the “Processed Material” screen.

There are two pressure sensors for each pump (inlet and outlet). The inlet sensors are measuring the pressure of material entering the metering pump and the outlet sensors are measuring the pressure of material leaving the metering pump. When the OPERATE/OFF/PURGE switch is in the OPERATE mode and the foot pedal is depressed (or POUR switch set to on), the pump drive system operates. As the pumps begin to turn, the pressure sensors will indicate the inlet/discharge pressures of each pump. In Operate mode, the pressures are continually monitored. Should any pressure exceed its limits (set in the recipe or Setup screen), the alarm will activate. Deviation from these limits indicates an imbalance, which would result in the mix not being perfectly on ratio. **Under an alarm condition, the operator is responsible to investigate**

For example:

CURATIVE PUMP (MOCA)

1. The curative pump is engaged and the foot switch is depressed.
2. The supply tank is pressurized and the ball valve is open. The pressure on the tank should be the same as the inlet pressure on the inlet sensor. (If the upper material line were empty, the pressure displayed on the screen would match the pressure on the tank.) The discharge pressure controller would read zero.
3. As the foot switch remains depressed, the pumps will continue to turn filling the upper line with the same pressure. Once the pressure is the same across the pump, material will push past the delta-p diaphragm and begin to dispense into the mixing chamber.
4. If an alarm occurs, silence the audible alarm and investigate the cause.
5. As the pump is running continuously during a production pour, the discharge pressure will be constant; assuming the pour speed is not changed.
6. Troubleshooting will depend on the individual pressure display.
 1. A discharge pressure value higher than “**100**”, indicates a **backpressure** problem.
 2. An inlet pressure value lower than “**25**” indicates an **inlet pressure** problem.

PREPOLYMER PUMP (RESIN)

1. The resin pump is engaged and the foot switch is depressed.
2. The supply tank is pressurized and the ball valve is open. The pressure on the tank should be the same as the inlet pressure on the inlet sensor. If the inlet valve to the mixer was open, the resin inlet pressure would match the pressure on the tank. The outlet or discharge (backpressure) pressures controller would match the pressure set on the Delta-p regulator.
3. As the foot switch remains depressed, the pumps will continue to turn filling the upper line with some pressure depending on the flow rate. Once material begins to flow into and through the mixer, the discharge pressure will increase.

WARNING: Do not run the resin metering pump with the mixer inlet valve closed as machine damage and or personal injury can occur!

4. If an alarm occurs, silence the audible alarm and investigate the cause.
5. As the pump is running continuously during a production pour, the discharge pressure will be a constant pressure; assuming the pour speed is not changed and there is no curing of material in the mixer of pour line.
6. Troubleshooting will depend on the individual pressure display.
 1. A discharge pressure value higher than “**100**”, indicates a **backpressure** problem.
 2. An inlet pressure value lower than “**25**” indicates an **inlet pressure** problem.

If either resin or curative inlet pressure is below the minimum setpoint (in the setup screen), the alarm will sound and the drive motor will not run. For special pours or test pours, the operator can override this, see the setup screen (page 39).

PRESSURE PROBLEMS

Some potential problems associated with pressure are described below:

Delta-P valve is blocked (MOCA)

- insufficient heat / damaged heater
- mixed material has accumulated in the tip of the Delta-p
- frozen material
- foreign object or dirt blocking the diaphragm from functioning properly
- diaphragm requires replacement

Heated material transfer line is blocked

- insufficient heat due to broken insulation
- tripped circuit breaker
- heat controller not on or too low a setpoint

Inlet pressure is blocked

- ball valve is closed from the supply tank
- heated line is blocked with moisture cured material
- (RESIN) Inlet valve closed

Material transfer line (hose) is under sized

- replace smaller line Example: 6QD with 8QD

PRESSURE SENSOR O-RING

When maintenance is required on the pump, the pressure sensor's diaphragm may have to be removed from the pump block. Use caution when re-assembling the diaphragm on the block. As with all O-rings, do not install the diaphragm with its O-ring dry. Do not over-tighten the diaphragm to the pump block as this may sever the O-ring thus causing a leak.

PRESSURE SENSOR DRIFT

Over time, the pressure sensor can begin to drift or get a buildup of material and cause an offset. When this occurs, it will be necessary to re-calibrate the pressure sensors. If maintenance work is carried out on the pump, the sensors should be zeroed once the re-assembly is complete. See page for 40 for calibration procedure.

DELTA-P VALVES

The delta-p is a type of diaphragm valve. The delta-p is a regulator through which any remaining volumetric compressibility of the metering system is reduced to an absolute minimum. The valve assembly is composed of three parts: valve body, diaphragm and air cap. By function, the delta-p is defined as a constant backpressure regulator and in its present location at the mixer; it doubles as a shut-off valve and line end heater. The delta-p is a valuable tool in increasing metering accuracy.

The function of the delta-p is to maintain a state of constant pressure in the metering system, nullifying volumetric change. Air pressure is applied to the diaphragm via the air cap. Air pressure on the diaphragm has changed over the years. Initially the air pressure on the diaphragm was either set by a standard air regulator (resin side) or directly teed off the tank (curative side).

In newer dispensing machines, there are two different setups:

1. One setup involves a standard regulator and air solenoid. When not pouring, the air solenoid is off (de-energized) and main air (90-100 PSI) is routed via the solenoid to the diaphragm. This puts the delta-p valve in the closed position and no material can flow out of the valve. When pouring, the solenoid is on (energized) and air from the regulator is routed to the diaphragm. This puts the delta-p valve in the open position and provided the metering pump is running, material can flow out of the valve. The regulator is adjusted to try to maintain zero differential material pressure across the metering pump. When the material has very low viscosity (MOCA, HQEE, 1.4 BD,

- etc.), the diaphragm has the same pressure as the material tank (solenoid routes the same pressure feeding the material tank to the diaphragm).
2. The second setup involves the use of an electronic pressure regulator. When not pouring, the electronic regulator's output is maximum or at some higher pressure, ensuring the delta-p valve is closed and no material discharge. When pouring, the regulator's output is such that the differential material pressure at the metering pump is as close to zero as possible (air pressure on the diaphragm can be regulated down to zero).

NOTE:

The Delta-p diaphragm should be checked periodically for signs of wear. The diaphragm should be soft and flex freely. There should not be any permanent set in the diaphragm.

When checking the diaphragm, be sure that the through hole of the Delta-p valve body is free of obstruction. If material has started to build up in the passage, it is a sign of too low tank pressure. Material tank pressure to the Delta-p should be raised in order to prevent this buildup of material. Moisture in the air will also cause material buildup. Care should be taken to thoroughly clean the mixer and Delta-p valves periodically.

POT LIFE & PURGING

POT LIFE

As described previously, the Pot Life timer is used to provide a warning to the operator that the mix head contains reactive material and should be purged with appropriate solvent.

The timer is enabled by the PLC when the Pour mode ends. When the pot life time has expired, the following will result:

- a. The audible alarm will sound.
- b. The tri-colored alarm light will flash red
- c. "Pot Life Timer Expired" will be displayed on the alarm screen.

NOTE: Normal pot life for most mixed prepolymers is 1/4 of the gel time.

PURGING

Brought about by the customer's process, solvent or small chemical system pours for purging or cleaning the mixer may be required.

To prevent the buildup of reactive material in the mixer chamber, a purge should typically be made within 1/5 to 1/4 of the flowable pot life of the chemical system. If a small chemical pour is made, the chemical clock pot life is reset, and the 1/5 to 1/4 of the flowable pot life is reestablished. However, if the reactive material in the mixer was displaced by the purge material; typically DBE or safety solvent, this would not reestablish the chemical clock and no further purge of the mixer is required. However, startup of the mixer would require that the purge material is totally displaced as well as all air in the mixer.

WARNING

There is no universal purging material for all the chemicals in use today. The chemical make-up of the system you are using is known to you and your chemical supplier. We have general knowledge, but only your supplier and perhaps you have detail knowledge as to the best purging material for cleaning up spills, dissolving or flushing reactive material for the mixer. It is important that the equipment is operated in compliance with all applicable local and federal laws and regulations pertaining to the safe handling of chemicals. Consult your chemical supplier for details.

When purging the mix head, solvent (purge material) is routed from a pressurized tank through a check valve (at the mix head). The valve is connected to a ball valve (resin inlet valve) which is mounted to the mixer adapter block. The block is the area where the resin and curative components meet. The mixer chamber is mounted under the block. The solvent is introduced into the adapter block via the ball valve. It then travels down into the mix chamber. The pin mixer driven by the mixer motor is running during this process. To cleanse the mix chamber thoroughly, pressurized air is introduced before and after the solvent.

To purge the mix chamber, follow the steps:

1. Place an approved container for the solvent used below the mixer output.
2. Adjust the solvent and or air purge regulators so the pressure is between 40-60 PSI and results in sufficient flow into mixer.
3. Open the resin inlet valve.
4. Turn the function selector switch, (Operate/Off/Purge), to Purge. This starts the purge sequence. Purging material is now forced from the tank, up through the tubing, and into the mixer. It is usually wise to watch the purging material move through the tubing, just before it enters the mixer (a sure way to determine that the solvent is actually flowing). A “Purge” text display on the main screen will alert the operator that the purge function is being performed.
5. Once the sequence is complete, set the selector switch to Off or Operate.
6. Enough purging material should be put through the mixer to insure the removal of the mixed prepolymer and curative. The mixer speed is a pre-determined speed set on the mixer motor’s controller.

NOTE

To terminate the purge sequence prematurely, set the selector switch to Off or Operate when desired.

WARNING

This equipment is not designed nor intended to be used in any area containing a spark ignitable solvent, gas or chemicals. Any person operating this equipment should be aware of the potential hazards that exist with the total chemical system your company has selected and the mechanical environment that your company has selected to operate the equipment in. Check with your Chemical Supplier and Safety Department prior to operating this equipment.

Under no conditions should this equipment be used at elevated temperatures approaching or exceeding the auto ignition temperature of the material stored or contained in or being processed in the area selected by your company.

MIXER

MIXER NORMAL OPERATION

The resin enters the mixer through a valve, into the port block and passes straight ahead to the agitator shaft hole, through the center of the upper end of the block. From this point it passes completely around the agitator shaft, and rises to and completely fills that area just below the shaft seal. It is now pushed down along the agitator shaft into the mixer cavity area. For this reason, the resin is always fed into the mixer before the hardener to fill this entire cavity and prevent the hardener from penetrating this area and creating the possibility of catalyzed material forming around the shaft seal.

Hardener enters the mixer on the opposite side of the port block and slightly lower. It passes directly from the port into the mixer cavity area where it encounters the resin. It is at this point that the mix of both materials begins and continues as the two incoming streams drive through the mixer cavity.

As long as the metering pumps continue to turn, this process is taking place. At the end of a pour the pot life timer begins to count down. When it reaches zero the alarm sounds and a purge must be done. The pot life period is a constantly re-occurring condition and begins at the end of each pour. The time is dependent on the types of resin and hardener being processed, their ratios and temperature, the temperature of the mixer, and the volumetric holdup in the mixer. The potlife timer when exhausted, will cause the alarm to activate and be displayed on the Alarm screen.

MIXER SHAFT SEAL LUBRICATION

Shaft seal life has been increased through the utilization of mixer seal lubrication. The lubricating mechanism is a positive pressure type, metering approximately one to two drops, which is adjustable through a small range.

In the MARK XV HYDROSPENSER, the lubricator is activated only with the initiation of each shot, at which time the metered drops are introduced between the two sets of mixer shaft seals squeezing out equivalent drops beyond the lower seal face into the reactive mix. The actual volumetric quantity utilized on the mixer is approximately 0.1 cc. For small volumetric shots, where this would be appreciable, the lubricant can be reduced further. Conversely, if larger mixers are utilized, or a high ratio of filler is present, the lubricant can be increased to approximately twice the original volume.

The lubricants available at present can be material that will be compatible with the reactive mixed material, offer sufficient lubrication for the seals and at present be compatible with the elastomeric components within the lubricator. Some materials that have been successfully used as lubricant are Benzoflex, polyethylene glycol and mineral oil. The actual lubricant used

depends on the resin system and application. By lubricating the shaft seal interface, the coefficient of friction is reduced, permitting higher shaft speeds and lower heat generation. This is extremely important with the speed of the electric mixer. The lubricant also functions as a heat sink, absorbing some of the generated heat energy and passing it on through the seal area into the mixer cavity, resulting in a further reduction of heat and an increase in reliability.

The theory behind the origin of the lubricator was not merely to lubricate the shaft seal face, but no function as a wash past the lower seal face, flushing out reactive material which may tend to set-up from the generated heat, or removing filler particles if present, preventing them from becoming imbedded in the seal which would result in seal wear and grooving of the mixer shaft. To successfully accomplish this, the lubricant must flush the seal lip and eventually become part of the reactive mix. The material in the cavity below the seal is also continuously flushed, preventing stiffening of the seal lip chemically and possible set-up of the trapped material.

When a newly reassembled to be lubricated is put into operation, care must be taken to manually bring lubricant up and into the area to be lubricated before operating. **If this step is omitted and the shaft seal is run dry, the friction is sufficient to destroy the edge of the seal lip within the first few moments of operation, increasing friction and heat, resulting in a rapid degeneration of the seal.** If the fillers are utilized, they can imbed themselves into the seal permanently, resulting in a burned-out seal and a scarred agitator shaft. However, if the lubricator is properly utilized, seal life is vastly improved, greatly reducing replacement and most important eliminating unnecessary “down” time.

To manually lube, the push button switch must depressed and released slowly a sufficient number of times to bring air free lubricant through the points to be lubricated.

GUIDELINES FOR MIXER OPERATION

Only use clean smooth agitator shafts and be sure the collet is clean from any dirt prior to tightening. The slightest imbalance on the agitator will cause vibration, shaft whip and could possibly scar the inner wall of the mixing chamber.

- Purge speeds are preset to 8K rpm (130Hz or approximately 45% of full on the speed adjustment pot) from Trico. Please consult TPS to adjust this speed.
- **Never operate the motor at high speeds 12k (above 200Hz or 60%) with an empty chamber. The material inside the chamber helps stabilize the shaft and prevent whip.**
- Care should be taken by the operator when operating above 13k rpm, (230Hz or 70%) when pouring slow or with very thin easily mixed materials. Spindle motors are approximately 3 times more powerful than a typical router motor. Because of this they will not “bog down” when mixing viscous materials and NOT require an increase of the speed pot.
- Typical mixing rpm for 5 to 25 lbs. per minute is about 10 to 12k (200 to 230Hz or 50-60%). It is the operator’s responsibility to ensure well mixed product is being dispensed and adjust the speed manually on machines without recipe preset mixer speeds.
- **Do not block the air flow through the motor housing. The top of the motor and the collet access area in the motor housing must be open at all times.** Typical motor

temperatures while running can approach 50°C in a cool shop or as high as 100°C with continuous operation in hot ambient conditions.

- Spindle motors are very expensive. Care should be taken to keep them clean at all times. Should shaft seals fail and material begins to migrate into the collet area stop the machine as soon as possible.
- The spindle motor housing will bolt directly to the phenolic insulator that houses the upper shaft seal and or bearing.
- Wrench sizes are 1 1/16” and spanner 45 to 50mm.

MIX HEAD - MAINTENANCE

The mix head and its associated parts are of critical importance to the quality of the finished product. Failure to keep the mix head clean and well maintained may result in off ratio, contaminated or air-filled urethane. At all times, operators should be aware of normal operating pour pressures and maintenance of the mix head.

WARNING

Never start any maintenance on the mix head before verifying the machine’s main power or the mixer motor’s circuit breaker is turned off.

MIX CHAMBER AND AGITATOR

This area can become built up with urethane from not enough air/solvent cleaning or from extremely long continuous pours where some reaction occurs in the head.

Urethane build up in the mix head or pour hose could be caused by increased pour pressure, reduced delivery or increased mixer motor load. These problems could be influenced by machine throughput, material gel time, temperature, and external hose length. Operating experience will determine acceptable intervals for disassembly and cleaning of this area.

The method to use for cleaning the chamber and pin mixer is to soak them in solvent. To improve the reaction of the solvents they could be heated. If heated, precautions should be made with flammable or toxic material. After the pieces have been soaked, the urethane can then be blown or scraped off. Take care not to break or damage the mixer pins or mixer shaft or use abrasive materials or hand tools as this can damage metal sealing surfaces.

MIX HEAD SEALS

The mixer shaft seals not only keep the pin mixer in its proper location, they also prevent material from leaking out of the mix chamber.

The seals may leak material, solvent or lubrication oil. This results in urethane filled bearings or lubricant contamination of the product. Clean or replace seals at the first sign of a leak. Several factors can cause seal failure:

1. High back pressure in the chamber, can be caused by a dirty chamber, restricted pour spout, or restricted hose.
2. High pressure caused by trying to blow out semi jelled urethane with the flush system.
3. Seal distortion could be caused by high excess temperature of 300°F.
4. Insufficient or complete lack of lubricating oil.

MIXER ASSEMBLY

NOTE: There are many different combinations for assembling a mixer. The particular combination selected will be determined primarily by (1) the type of resin and harder to be mixed and their viscosity's, (2) the rate at which these materials are to be mixed and (3) the number of components. Because of this, it is not practical to write a specific set of instructions for each mixer combination available. Training and experience will determine the best procedure for TPS' various mixers. Assembly drawings should always be referenced.

MIXER / POUR ISSUES

Problem	Solutions
No resin or hardener flow	Ball valve on supply unit not open Delta-P clogged Resin pump not turning No discharge pressure from supply unit No material in supply unit Drive Motor Fault Blockage in material transfer line Shear Pin broken Frozen material
Poor Mix	Mixer motor not "ON" Mixer speed is too slow Mixer agitator not correctly fastened in collet Chemical dispersion problem
No Solvent	Purge switch not in "PURGE" position No air pressure on purge tank Inlet valve stuck closed No solvent in tank Slot in 3-way valve not facing the Mixer Chamber Needle valve not open on 3-way valve Handle not down on 3-way valve

MIXER MOTOR DRIVE SETTINGS

Listed below are the settings for the mixer motor’s variable frequency drive (VFD).

Note: The settings are for reference only, do not attempt to change these settings without first reviewing with the technical department of TPS.

1	B1-01	1	Frequency source analog input
2	B1-02	1	Run command from digital inputs
3	B1-03	0	Stop method – deceleration
4	C1-01	2	Acceleration time (sec)
5	C1-02	4	Deceleration time (sec)
6	C6-01	1	Duty mode - normal
7	C6-02	4	Carrier frequency – 10KHz
8	D1-02	130	Frequency reference, input S5 (Purge)
9	E1-01	230	Input voltage
10	E1-04	300	Max output frequency
11	E1-05	220	Max output voltage
12	E1-06	300	Base frequency
13	E1-07	150	Mid output frequency
14	E1-08	110	Voltage at Mid output frequency
15	E1-09	4.0	Min output frequency
16	E1-10	4.0	Voltage at Min output frequency
17	E2-01	7.0 (15)	Motor rated current (High Flow Mix-head)
18	E2-03	2.5 (5)	Motor no load current (High Flow Mix-head)
19	H1-05	3	Digital input selection – S5
20	H4-01	103	Analog output (0-10VDC) motor current
20	L1-01	1	Motor protection – on

Changing Parameter Settings

The following procedure explains the steps required to change the VFD’s parameter settings.

Verify the machine’s POUR and OPERATE switches are in the off position.

The example used below is the mixer speed setting during purge (parameter D1-02). All speed parameters including purge speed are entered in Hertz. The default D1-02 setting is 130Hz. To get the corresponding RPM value, multiply the setting by 60 (130Hz is equivalent to 7,800 RPM).

The mixer VFD is usually mounted on the left inside panel (as viewed from the rear). To change a setting, use the buttons under the display. Proceed as follows:

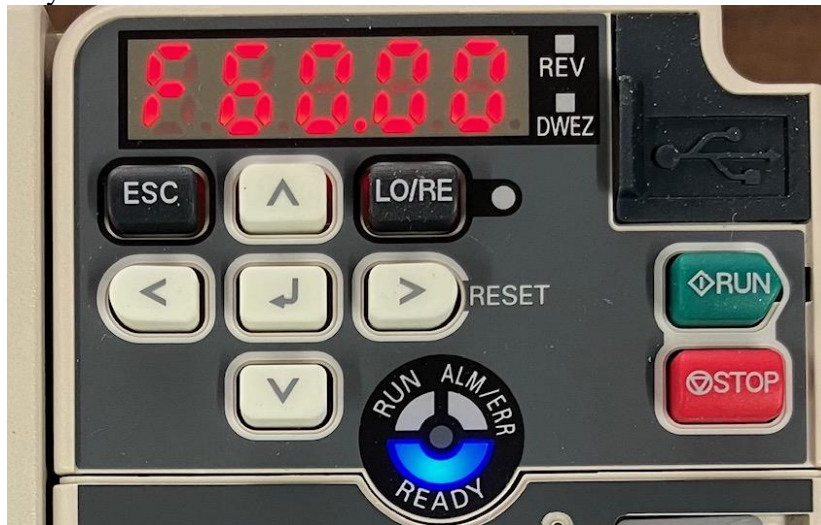
The following procedure explains the steps required to change the mixer motor's VFD parameter settings. For model GA500.

Verify the machine's POUR and OPERATE switches are in the off position.

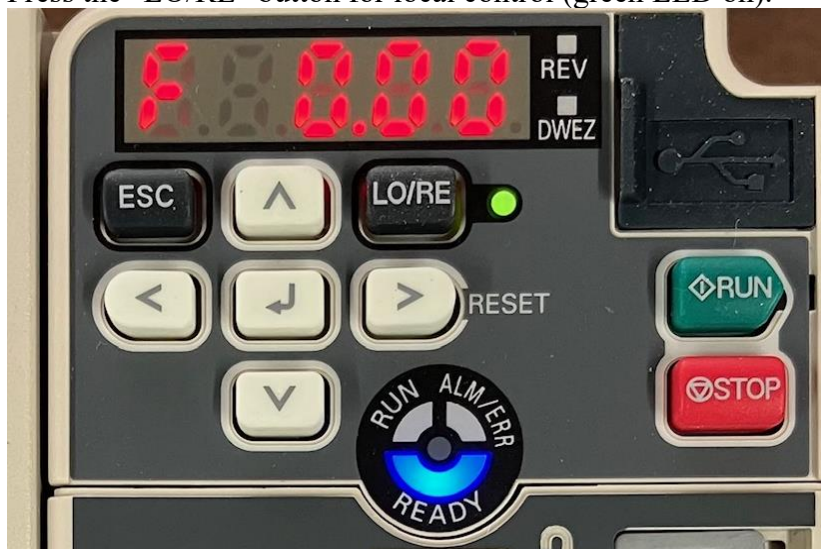
The example used below is the mixer speed setting during purge (parameter D1-02). All speed parameters including purge speed are entered in Hertz. The default D1-02 setting is 130Hz. To get the corresponding RPM value, multiply the setting by 60 (130Hz is equivalent to 7,800 RPM).

To change a setting, use the buttons under the display. Proceed as follows:

1. The initial screen should be as shown in the picture below. The frequency speed number may be different.



2. Press the "LO/RE" button for local control (green LED on).



3. Press the down arrow twice and PAR will display.



4. Press the ENTER button and the first "A" parameter is selected.



5. Press the up arrow three times and the first "D" parameter is selected (d1-01).

- To get to d1-02, press the right arrow (Reset) two times to select the “01” and the up arrow once to change to “02”.



- Press the enter button and the display will show the current setting for d1-02. The default value is 130.



- Use the up/down and or right arrow (reset) buttons to change the value. Use the right arrow (reset) to change the position of the selected digit and the up/down arrows to change the number.
- Once the value is set, press the enter button. The screen briefly displays the word “END”. This saves the value and returns the display to “d1-02”.
- Press the ESC button four times to return to the normal display.
- Press the “LO/RE” button once to switch to remote control (green LED off). This concludes changing the setting.

MIXER MOTOR

The motor used to run the pin mixer is a spindle motor capable of reaching very high speeds (>15K RPM). The rotor is dynamically balanced and depending on type, each motor contains 3 or 4 bearings.

The motor is forced air cooled by a fan located on the spindle shaft underneath the cooling fan cover. Do not obstruct or cover the fan cover in any way.

WARNING

Never start any maintenance on the mix head before verifying the machine’s main power or the mixer motor’s circuit breaker is turned off.

Maintenance

On a weekly basis, check the following:

- Always keep the area above the mix head (nut and collect area) clean and free of dust, grease, urethane, metal shavings, etc.
- Clean the grill of the cooling fan and remove any objects blocking the airways.
- Check motor securing screws (screws that secure motor to motor housing).

Motor Troubleshooting

Problem	Probable Cause	Corrective Action
Excessive vibration during pour	<ul style="list-style-type: none"> • Incorrect pin mixer • Incorrectly assembled pin mixer or other mix head parts • Motor not secured properly to housing • Incorrect VFD settings • DO NOT “BOTTOM” OUT” THE AGITATOR IN THE COLLET! 	<ul style="list-style-type: none"> • Use proper balanced pin mixer • Check that pin mixer and or other mix head components are properly assembled together • Check screws that secure motor to housing • Review VFD settings • Leave a 1/8” gap
Motor does not run	<ul style="list-style-type: none"> • VFD circuit breaker off • VFD malfunctioned 	<ul style="list-style-type: none"> • Check circuit breaker • Check condition of motor drive, check VFD error codes
Motor alarm fault	<ul style="list-style-type: none"> • Over current • Motor connector is disconnected 	<ul style="list-style-type: none"> • Motor overloaded – urethane too viscous at running speed; mix chamber contains hardened urethane (check VFD error code) • Check motor connector

MARK XV PNEUMATIC CONTROLS

Located on the lower front panel are the pneumatic controls for the following:

1. Purge system
2. Color System
3. Batch Tank (optional)
4. Melter (optional)

The Purge System and Color System consist of the following:

1. Regulator
2. Pressure gauge
3. Manual Valve or Solenoid

OPERATION

By turning the regulator's adjustable knob, clockwise to increase pressure and counter clockwise to decrease pressure, the operator can set the required air pressure to the supply tank. The purge supply tank will only be pressurized when the Operate/Off/Purge switch is in the "Purge" position. The regulator can remain at the desired pressure setting. The Color System pressure can be set by adjusting the air regulator. The pressure will only be applied to the color supply tank when the color pump is engaged. By engaging the color pump, the push-button switch is released on the valve which is mounted behind the pump.

Batch Tank System consists of the following:

1. Regulator
2. Vacuum/Pressure Gauge
3. Four-way valve
 - a. Pressure
 - b. Vent
 - c. Vacuum
 - d. Common port to tank

The four-way valve allows the operator to apply preset air or nitrogen pressure, vacuum or vent to the Batch Tank. By turning the selector handle on the valve each function can be applied.

A Melter System consists of the following:

1. Regulator
2. Pressure Gauge
3. Shut-Off Valve

The Melter System has air pressure from the air regulator supplying the Melter Tank and the Delta-P valve. Both the Tank and Delta-P valve must have the same air pressure. The Tank supply line goes from the regulator to the shut off valve, then to the Tank. The shut off valve is used to allow the Melter Tank to maintain pressure while the regulator is opened to relieve pressure to the Delta-P valve i.e. change diaphragm or bleed the line for shut down.

NOTE: It is recommended to use Nitrogen to pressurize the MOCA Melter, Nitrogen eliminates the discoloration caused by oxidation of the MOCA by atmospheric air.

PLC LCD LED DISPLAY

CIO-0

Input/0	Prox. Switch (shaft counter)
Input/1	24V
Input/2	Operate
Input/3	Purge
Input/4	Pour
Input/5	Manual lube
Input/6	Alarm silence
Input/7	Mixer motor fault
Input/8	Temperature alarm
Input/9	Main air low
Input/10	Master output relay (24V – Normal) (0V – E-Stop)
Input/11	

CIO-100

Output/0	
Output/1	
Output/2	Lube solenoid
Output/3	Air purge solenoid
Output/4	Solvent purge solenoid
Output/5	Mixer run (pour mode)
Output/6	Mixer purge speed (purge mode)
Output/7	Drive motor relay

CIO 101

Output/0	Audible alarm
Output/1	Visual alarm (BLK)
Output/2	Visual alarm (WHT)
Output/3	Visual alarm (BRN)
Output/4	Resin Press Sensor Cal
Output/5	Curative Press Sensor Cal
Output/6	Resin delta-p solenoid
Output/7	Curative delta-p solenoid

HEATED MATERIAL TRANSFER LINES

Each component on the MARK XV has a heated material transfer hose (line). The lines are divided between an upper line and a lower line. Material transfer lines come in various lengths and diameters. Lengths are measured in inches and diameters are 4 QD, 6 QD and 8 QD 12 QD and 16 QD. (Each QD number is the approximate inner diameter of the hose in mm) At each end of the hose is a special fitting called a “QD” or “quick disconnect”. The hose is held in place by a lock pin. This design allows quick change of hoses and eliminates cold spots and the need for wrenches in tight spaces.

All hoses are manufactured by TPS and designed for specific reasons. The hose itself is a Teflon hose with stainless steel over braid for reinforcement. The hose is heated by supplying voltage to the stainless-steel braid. Voltage will vary due to hose size and length. When the heated line temperature controller “calls” for heat, power is supplied to the hose and the hose will gradually heat up to operating temperature.

Power is supplied by a transformer mounted on the UPPER SHELF of the MARK XV. The power supplied will be determined by the number of secondary wraps on the transformer.

At each end of a heated material transfer hose are “power leads”. The power leads are soldered to the end socket on the hose. This socket is isolated from the QD fitting. If the socket should touch the fitting or any part of the machine with power on, the line will short out. Connected to the power leads are colored, insulated connectors. These connectors will be black, white, red or green. The transformer lead will have a female connector. The lower line at the supply vessel will have a male connector. The lower line at the metering pump will have a female connector. The lower line female will connect with the upper line male and the upper line connector at the mixer will have a female connector. This female connector will connect to a Ground connector mounted on the MARK XV front panel.

UPPER LINE

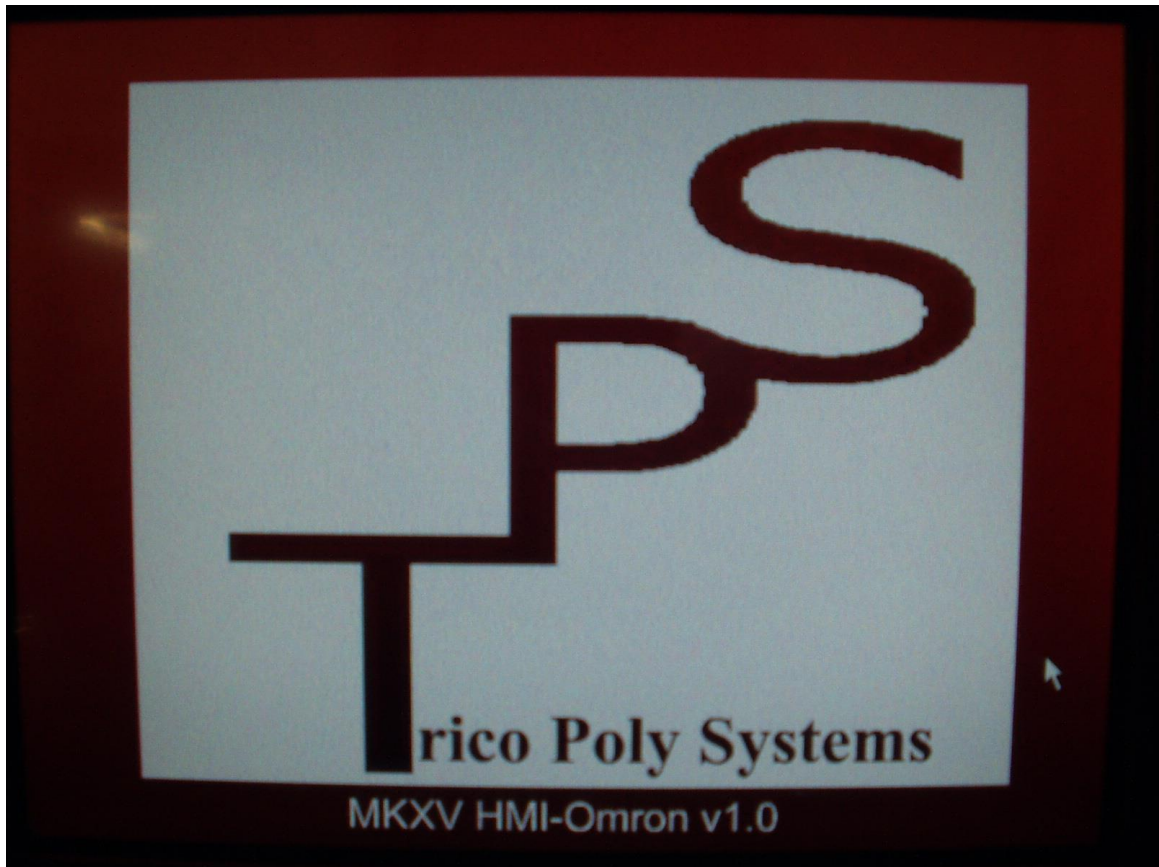
The upper line starts at the metering pump and connects to the Mixer Assembly. The upper line on the resin side will insert into the three-way valve mounted on the mix chamber. The upper line on the curative side will connect with the Delta-P valve.

LOWER LINE

The lower line originates at the supply vessel. The supply vessel can be one of the following: Slinger Degasser, Grid Melter or Batch Tank. The lower line will plug into a female adapter and be held in place by a lock pin. The other end of the lower line will plug into the metering pump. The lower line also contains a precision RTD sensor with connector for temperature indication and control.

HMI Interface Screens

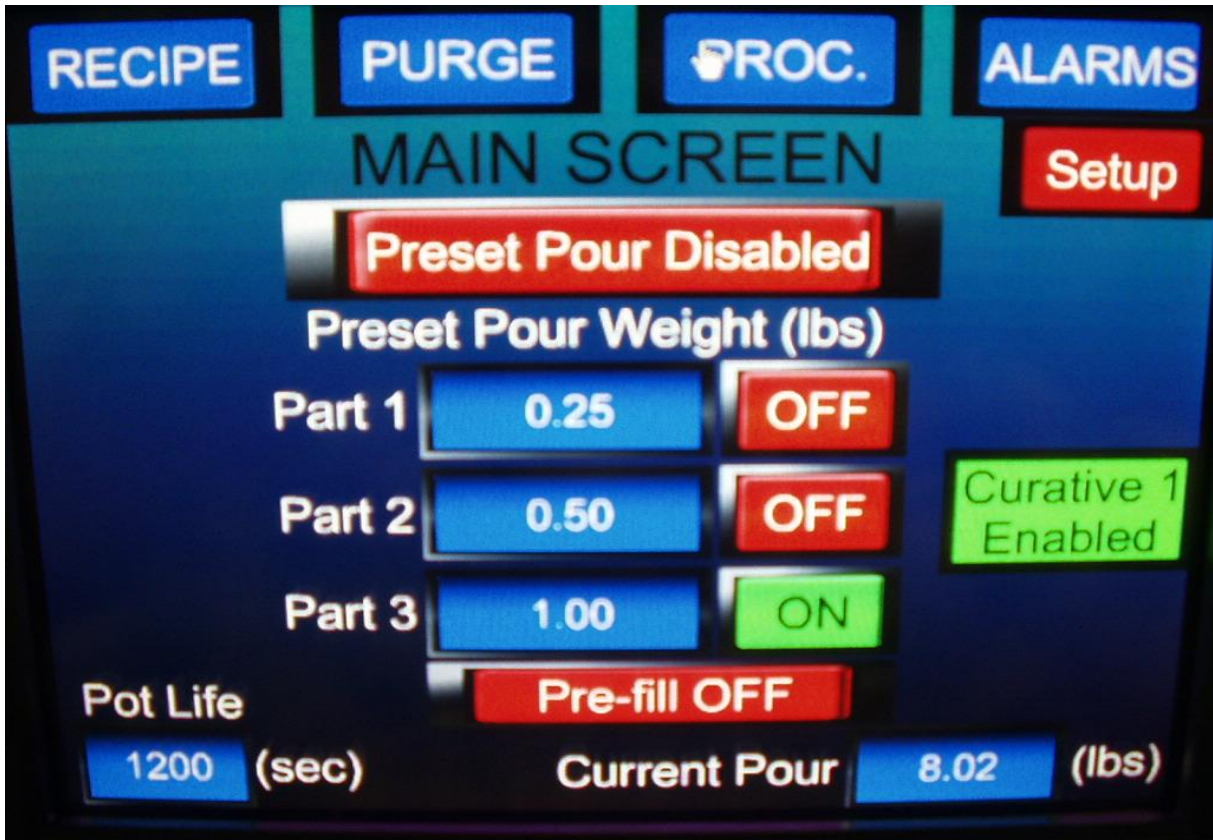
Title Screen



1. This is the main screen. Shown above is a typical start-up screen. Press anywhere in the TPS logo to enter into the MKXV operation screens.

NOTE: Some versions may require a user to log on before gaining permission to navigate to the other screens.

Main Screen – Admin Mode

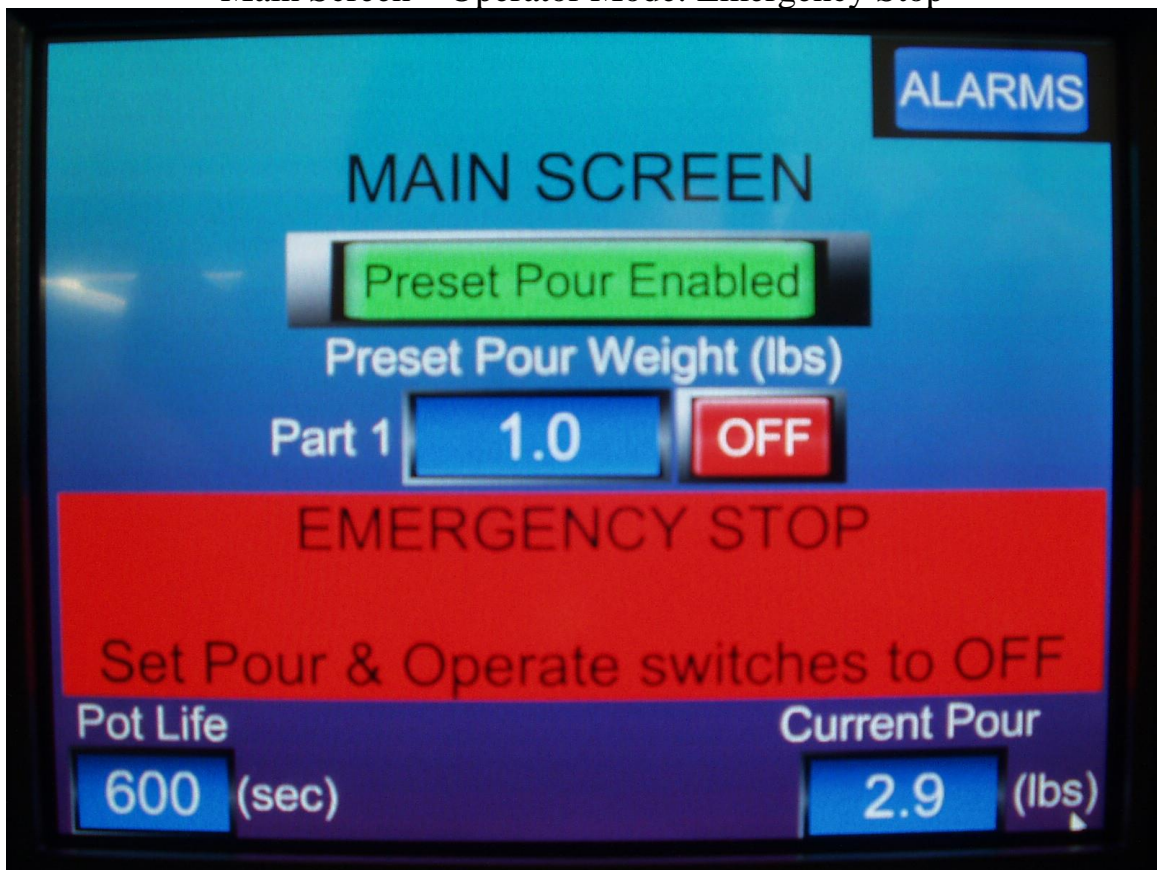


The main screen contains all necessary buttons to run the machine. As shown above, this screen is in admin (administrator) mode. All buttons are accessible. The other mode is known as the operator mode; this mode has a simplified view where less buttons are available to the operator.

1. The buttons at the top navigate to the appropriate screen. In operator mode, only the Alarm button is displayed.
2. SETUP button – Once pressed, this takes the user to the Machine Setup screen. This button is not visible under normal operation. The administrator must login to activate this button.
3. LOG OFF button – This button is used to log off the administrator and log on the operator. This button is not visible (accessible) under normal operation.
4. PRESET POUR – When the Preset Pour pushbutton is pressed and displays Preset Pour Enabled, the machine is setup for a preset pour. With the Pour and Operate switches set to on, the machine will run until the pour counter reaches the part weight that is enabled (see below). To stop the pour before reaching the preset amount, simply set the Operate switch to off. If the button is set to Preset Pour Disabled, the machine will run continuously until the pour switch is set to off.

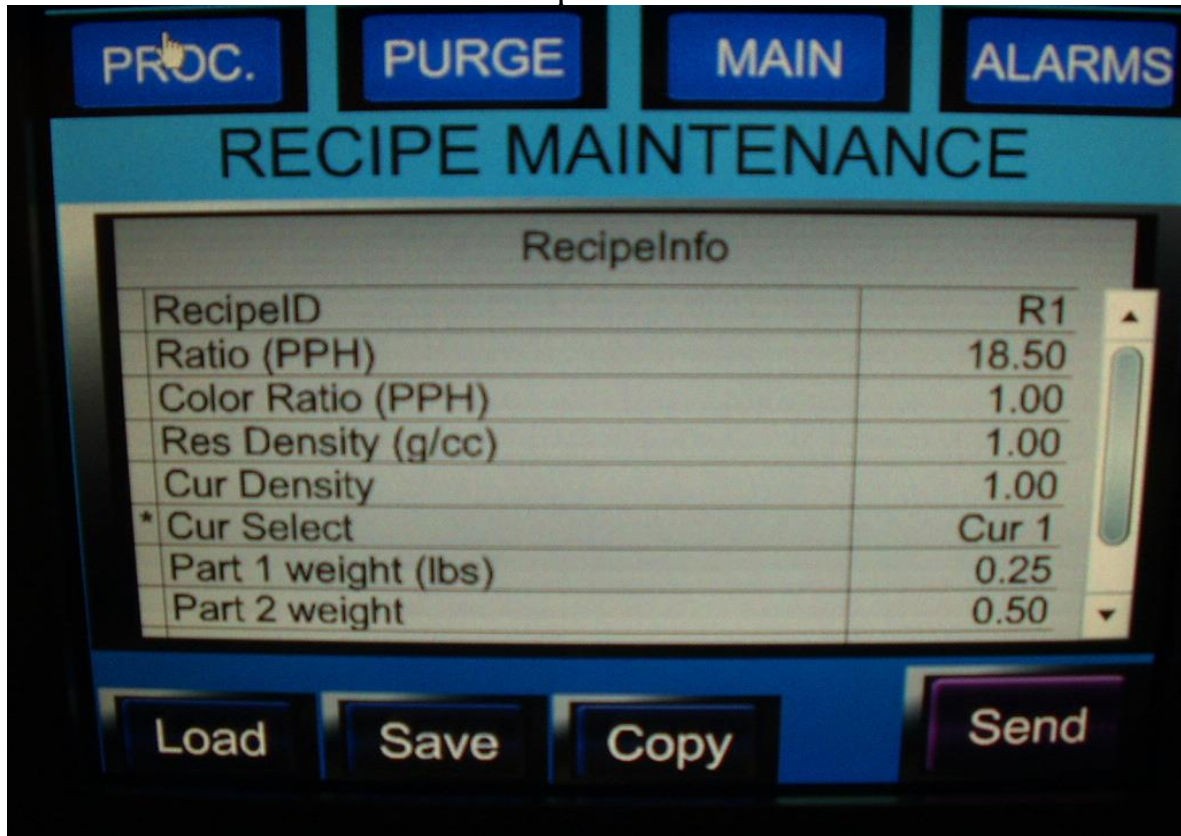
5. **PRESET POUR WEIGHT** – Three entry buttons exist for entering three separate weights (lbs.). Each entry has an enable/disable button labeled ON or OFF. To enter a weight, simply press on the part weight shown in blue and a keypad will be displayed. Enable the proper part by pressing its respective enable button.
6. **POT LIFE**. This is a countdown timer that is displayed at the end of the pour. At the end of the count, the machine will alarm for pot life. It appears at the lower left of the screen.
7. **CURRENT POUR (lbs.)** – Displays the machine’s current pour in pounds.
8. **CURATIVE ENABLED** – It is imperative that the correct tank is pressurized and valves open to match the recipe being run.

Main Screen – Operator Mode: Emergency Stop



Should the emergency stop button be pressed, this is the display on the main screen. The operator must set both Pour and Operate switches to off.

Recipe Screen



This screen contains the machine's formulation or recipe. This information is used by the Mark XV's controller to properly display the machine's flow rate, pump speeds and totalizers.

1. Use "LOAD" button to bring up a list of recipes.
2. Use "COPY" button to create a new recipe from an existing recipe.
3. Use "SAVE" button to save the recipe as required.
4. The "SEND" button must be pressed after a recipe is loaded. It sends all information to the controller.
5. The recipe consists of the following:
 - i. Recipe ID – This can contain letters and is used for the customer's own internal recipe identification.
 - ii. Ratio – (PPH). This is the curative ratio referenced to 100 parts of resin.
 - iii. Resin Density – (g/cm³) Set the resin's material density (or specific gravity) at the process temperature.
 - iv. Curative Density – (g/cm³) Set the curative material density.
 - v. Part 1 weight – (lbs.) Preset pour for part one in pounds.
 - vi. Part 2 weight – (lbs.)
 - vii. Part 3 weight – (lbs.)

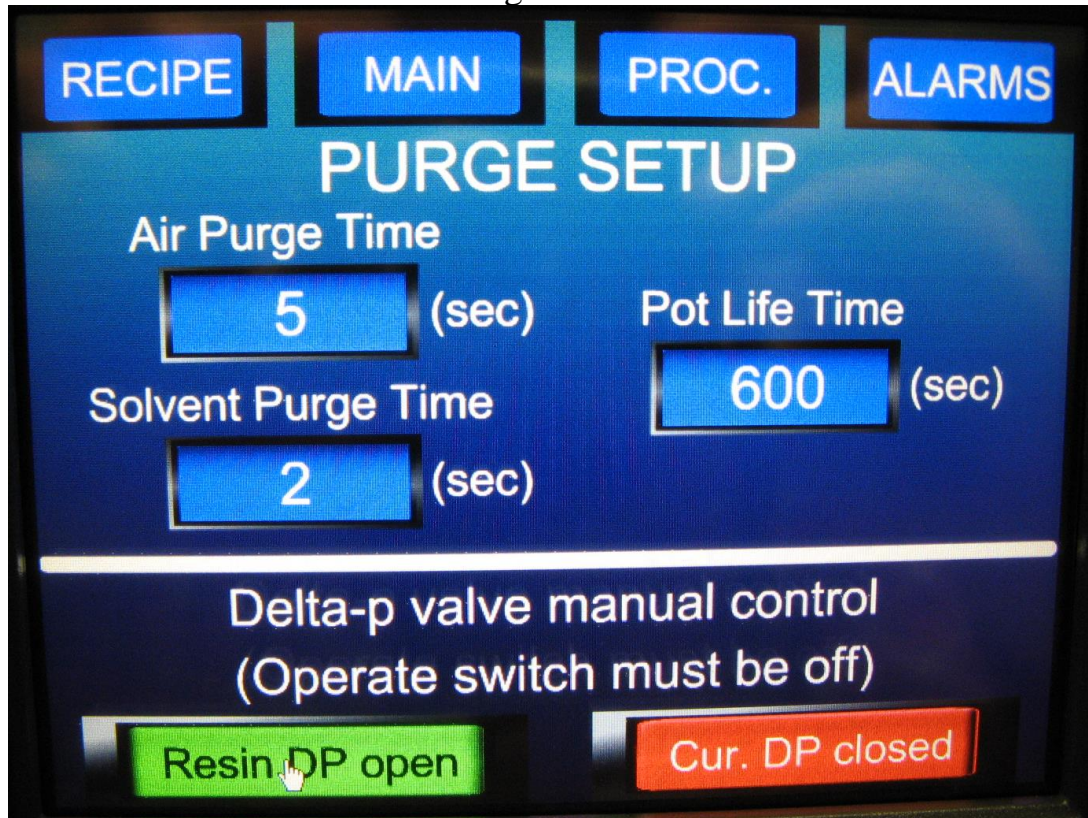
Recipe Screen – Creating a Recipe



Once one recipe is created, others can be created by simply renaming the new recipe and going in and changing the parameters.

1. To rename (create) a recipe, simply load (use “Load” button) any recipe. Press the “Copy” button and the recipe list pops up. Press inside the blue rectangle above the first recipe. This brings up the keyboard. Type in the new name for the recipe (must begin with a letter) and press “Enter”. Once “Enter” is pressed, the keyboard disappears and the new recipe is created. Now you must go into each parameter in the recipe and change the value.
2. To change a parameter value, press on the appropriate description (i.e. Recipe ID) and a keypad pops up. Enter the new value. An asterisk is displayed on the left. Once all parameters are changed, press the “Save” button and the recipe is now saved. Be aware that these actions do not send the recipe to the controller. You must press “Send” to send the recipe to the controller.

Purge Screen



This screen sets up the machine parameters for purging the mix-head and pot life alarm time and allows control of the air solenoids for the delta-p valves.

PURGE

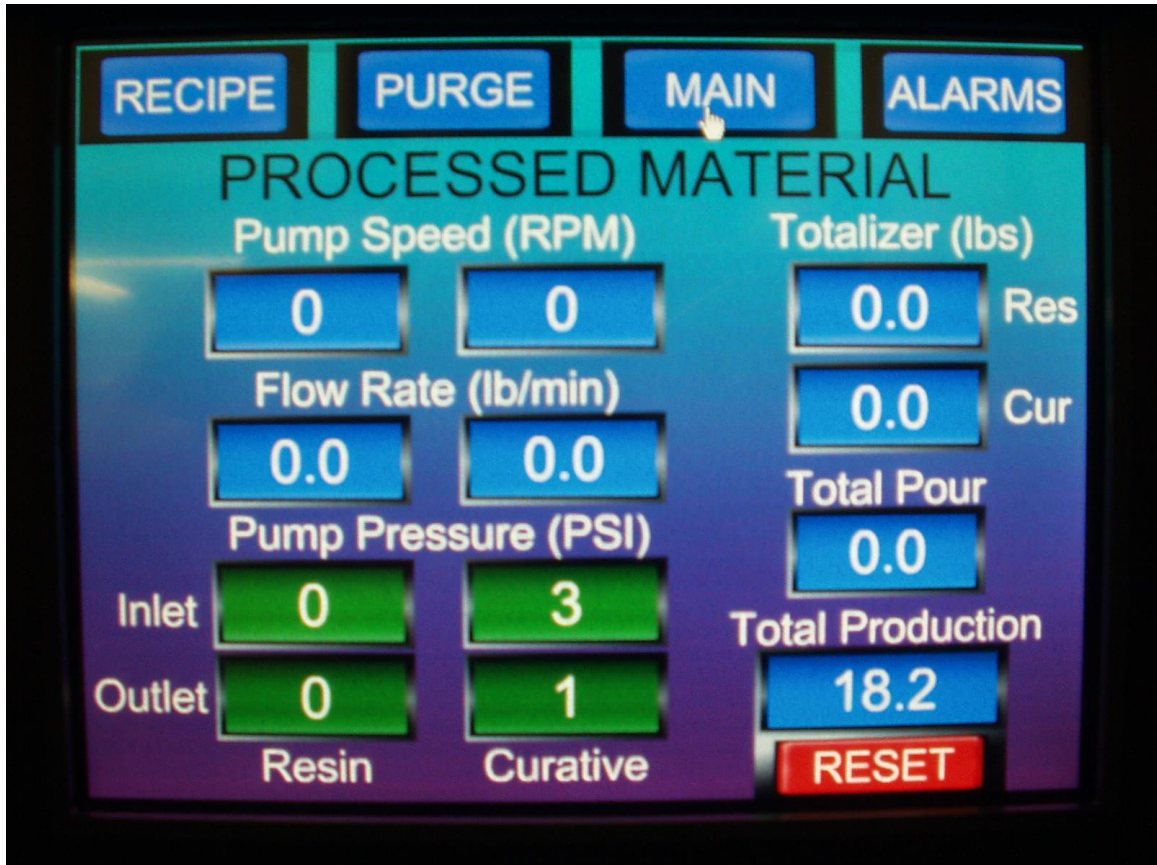
1. AIR PURGE CYCLE TIME – This specifies the amount of time in seconds that the air solenoid is ON for purging the mix-head with air
2. SOLVENT PURGE CYCLE TIME – This specifies the time that the solvent solenoid is ON. Solvent is then run from the solvent tank to the mix-head. The purge sequence is as follows (the lube system is on during purge):
 - a. Mixer on - Air purge
 - b. Solvent purge
 - c. Air purge – mixer off
3. POT LIFE TIME – This sets the count down time for the pot life. This setting can only be changed when the machine is not pouring and the pot life is not counting down.

DELTA-P VALVE MANUAL CONTROL

During normal machine operation, the air pressure on the Delta-p valves is automatically controlled. Manual control is possible if both POUR and OPERATE switches are in the off position. This is useful for diaphragm inspection. To open the delta-p valve (solenoid energized)

press the respective delta-p button. The button will change color from red (closed) to green (open). Once the solenoid is energized, the respective regulator can be set to zero (zero pressure on diaphragm) and the air cap can be removed and the diaphragm inspected. Note, once finished do not forget to set the regulator to its original setting.

Process Material Screen



This screen contains information on the processed material of the machine. It also displays the pump speeds, pump pressures and a total production counter. Note: It is important to keep in mind that this information is all based on the recipe and proper operation of the proximity switch (located on the main shaft).

1. PUMP SPEEDS (RPM) - Displays each pump speed.
2. FLOW RATES (lb./min) – Displays each pump’s flow rate.
3. TOTALIZER - Displays totalizers for each component. These numbers are displayed until the next time the pour switch is set to on; at which point they are reset to zero.
4. TOTAL PRODUCTION - Displays the total production of material weight (lbs.). This counter does not reset and so should be reset to zero at the operator’s discretion.

5. PUMP PRESSURE (PSI) – There are two pressure sensors for each pump (inlet and outlet). The inlet sensors are measuring the pressure of material entering the metering pump and the outlet sensors are measuring the pressure of material leaving the metering pump. In Operate mode, the pressures are continually monitored. Should any pressure exceed its limits (set in the recipe or Setup screen), the alarm will activate. Deviation from these limits indicates an imbalance, which would result in the mix not being perfectly on ratio. **Under an alarm condition, the operator is responsible to investigate**

Alarm Screen



This screen shows all alarms. It puts a time stamp on the alarm for later review.

- Current CPU Date and time.
- Scrolls up/down through the current alarm list.
- Via the “USER” button at lower right, the proper user can login and get access to several additional functions. When pressed, a log on screen is displayed. Enter the user name and password. The operator’s user name is “User1”. No password is required.
- Acknowledges an alarm and time stamps it.
- Clears non-active alarms. This button is only visible if the administrator is logged on.

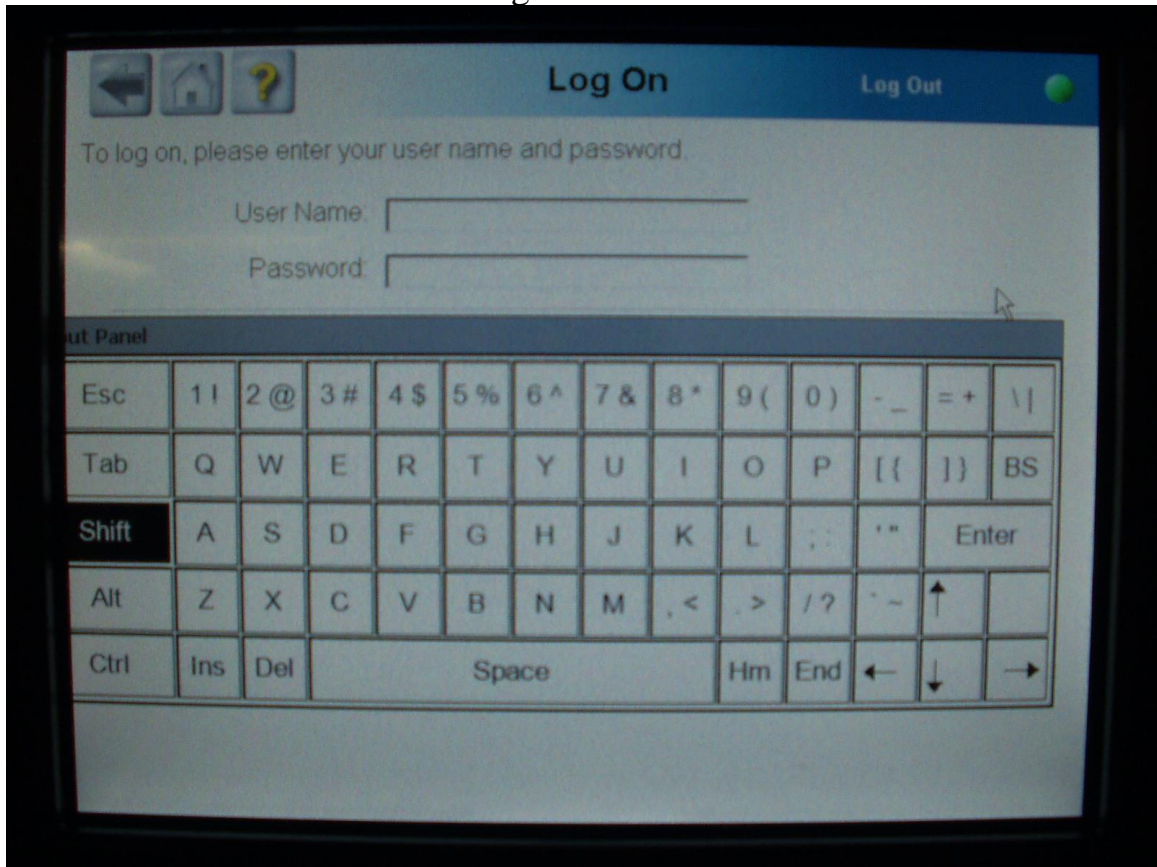
Machine Alarms

1. Inlet under pressure – one for each component. An under-pressure alarm occurs when the inlet pressure is below the “minimum inlet” pressure. This is set in the recipe or Machine Setup screen.
2. Warning outlet pressure – one for each component. A warning outlet alarm occurs when the outlet pressure is above the “warning outlet” pressure (set in the recipe or Machine Setup screen).
3. Outlet over pressure – one for each component. An over pressure alarm occurs when the outlet pressure is above the “shut down outlet” pressure (set in the recipe or the Machine Setup screen). This condition will stop a pour and shut down all pumps.
4. Pot life timer expired.
5. Mixer Motor fault. A mixer motor or mixer motor drive problem will enable this fault.
6. Temperature alarm. This is a general temperature alarm and encompasses all the temperature controllers on the machine (line, pump, delta-p, mixer).
7. Main air low. This alarm activates if incoming air pressure is below approximately 80 PSI. This is the minimum operating pressure for the lube system.
8. Inlet and or Outlet pressure ignored

NOTES:

1. **Should the machine ever stop a pour due to an overpressure, or mixer motor fault condition; set both the Pour and Operate switches to OFF.**
2. **If the machine stops a pour due to an overpressure condition, control will not be given back to the operator until the overpressure condition has been corrected (pressure relieved).**

Log On Screen

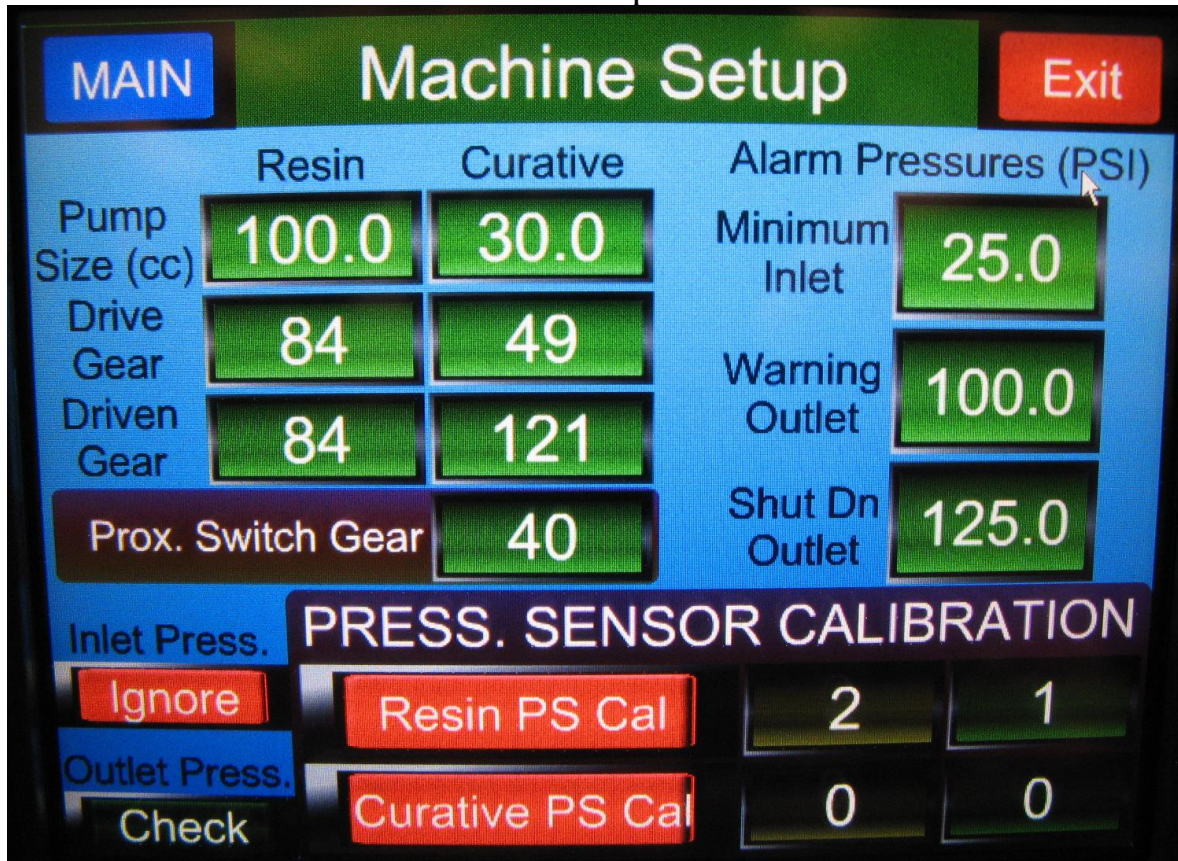


When the User button is pressed from the Alarm screen (or the Log Off button from the Main screen), the screen above is displayed.

To get all access, login as the administrator (User Name is "Admin"). After entering the user name, press the tab key to go down to the password entry and enter the password.

To get limited access, login as the operator (User Name is "User1"). No password is required.

Machine Setup Screen



This screen is used to display machine setup parameters that normally do not change. It is not accessible under normal conditions. To enter this screen, the administrator must be logged on. From the Main screen, locate the “Setup” button in the upper right side. Currently, the machine parameters include:

1. Component pump sizes, gear sizes – These settings should match what is currently installed on the machine, otherwise the displayed information on the Process screen (flow rates, speeds and totalizers) will be incorrect.
2. Gear sizes
3. Minimum Inlet pressure – Alarm is activated when the inlet pressure falls below the setting.
4. Warning Outlet pressure – Alarm is activated when the discharge pressure reaches the setting.
5. Shutdown Outlet pressure – Alarm is activated and the machine stops pouring when the discharge pressure reaches the setting.
6. Inlet/Outlet pressure check – Under normal conditions, the machine will not run if either the inlet or outlet pump pressures are outside their limits. For special tests, this “check” can be ignored. To ignore either condition, press the respective button. The button will change from “check” to “ignore”. Note, these functions are not retentive and will reset to “check” if machine power is cycled.

7. Zero Cal for Press Sensors – These buttons are used to calibrate the zero point of the pressure transducers. This should only be done with the machine at process temperature (of each component) AND NO inlet pressure from the supply tanks AND NO pressure upstream (at the delta-p valves). With both the POUR and OPERATE switches set to OFF, press the respective “Zero Cal” button. This initiates the calibration process which takes approximately 10 seconds. The respective inlet and outlet pressures should then display 0 +/- 5 PSI.
8. Main Screen – Sends HMI to the main screen without logging off the administrator.
9. Exit – Sends HMI to the “Shell” environment. This is the underlying software that the screens run in. Other functions are permitted such as calibrating the touch screen, importing/exporting recipes, etc. Contact TPS.

TEMPERATURE CONTROL SETTINGS 3300

Only for Pump/Delta-P Valves/Mixer

LEVEL 1		LEVEL 2		LEVEL 3	
Tune	OFF	SP1.P	--	SP1.d	SSd
BAnd	10 (18)	bAnd	OFF	SP2.d	rLY
int.t	5	PL.1	100	Burn	uP.SC
dEr.t	25	PL.2	100	rEU.d	1r.2r
dAC	1.5	SP2.A	bAnd	rEU.L	1n.2n
CYC.t	5	SP2.b	Lt.ho	SPAn	-56 (-101)
oFSt	0	diSP	1	Zero	15 (27)
SP.Lk	OFF	hi.SC	150 (302)	ChEK	Off
SPrr	0	Lo.SC	0 (32)	rEAD	--
SPrn	OFF	inPt	RTD	tECh	CTA
SoAk	--	Unit	°C (°F)	Ver	(factory set)
Set.2	8 (14)			rESET	(see below)
Bnd.2	0.1 (0.2)				
CYC.2	ON.OFF				

Only for Heated Hoses

LEVEL 1		LEVEL 2		LEVEL 3	
Tune	OFF	SP1.P	--	SP1.d	SSd
bAnd	10 (18)	bAnd	OFF	SP2.d	rLY
int.t	5	PL.1	100	Burn	uP.SC
dEr.t	25	PL.2	100	rEU.d	1r.2r
dAC	1.5	SP2.A	bAnd	rEU.L	1n.2n
CYC.t	5	SP2.b	Lt.ho	SPAn	0
oFSt	0	diSP	1	Zero	0
SP.Lk	OFF	hi.SC	150 (302)	ChEK	Off
SPrr	0	Lo.SC	0 (32)	rEAD	--
SPrn	OFF	inPt	RTD	tECh	CTA
SoAk	--	Unit	°C (°F)	Ver	(factory set)
Set.2	8 (14)			rESET	(see below)
Bnd.2	0.1 (0.2)				
CYC.2	ON.OFF				

LEVEL 4

DO NOT ALTER: USE DEFAULT SETTINGS ONLY

NOTE: For line sensors LEVEL 3 Span and ZERO must be set to 0.

GENERAL INFORMATION

- 1) These settings, when entered on all new units will configure both outputs

properly and calibrate the unit for the special RTD temperature control. There should be no need to make any additional adjustments.

- 2) Set.2 represents the upper/lower band for alarm purposes. This input can be adjusted by the operator for individual applications. The factory hysteresis is 8.0°C.
- 3) After setting all initial parameters and entering a setpoint, then *tune at setpoint* should run, this will tune the heating and pick the new P.I.D settings for SP1.
- 4) For the rESET setting, “all” should only be used to completely reset the controller in the event that a total reprogram is needed.
- 5) All temperature controllers have the same program and are interchangeable.

To silence Alarm and reset, depress white button below Controller. Depress once to turn Controller OFF and depress again to turn Controller ON.

ENTERING ADJUSTMENTS

1. To enter new setpoint, depress the * button. The unit of measure will appear first, then the present setpoint. While depressing the * button, depress the up or down scroll button to desired setpoint temperature.
2. To enter the program (Level 1, Level 2, Level 3), depress both scroll buttons simultaneously for three seconds. The word " tune " will appear on the display. This is the first entry on Level 1. To scroll to each input, depress either the up or down scroll button. To change an input, depress the * button and scroll up/down with the scroll buttons.

CONTROLLER TROUBLESHOOTING

Display	Cause	Solution
Input Fail	<ul style="list-style-type: none"> ● Sensor not connected ● Poor wire connection ● Controller defective ● Controller not programmed ● Faulty sensor 	<ul style="list-style-type: none"> ● Check connection ● Check connection ● Replace ● Re-Enter program ● Replace
False Temp. Display	<ul style="list-style-type: none"> ● Loose connection ● Lead is shorted to ground 	<ul style="list-style-type: none"> ● Check connection ● Check connection
No Display	<ul style="list-style-type: none"> ● No 24vdc 	<ul style="list-style-type: none"> ● Push-button faulty ● Replace Controller ● Power Supply issue

REMOVAL OF PRINTED CIRCUIT BOARD (CAL 3300)

1. Turn power off to the Controller by depressing the white pushbutton. Insert a screwdriver between the gasket and faceplate. There is a parting line between the faceplate and outer case. Do not remove the gasket. Gently pry the faceplate forward.
2. Once the printed circuit board has been slid forward, gently slide the remaining portion of the circuit forward with your fingers. The faceplate is attached to the printed circuit board.
3. Clean printed circuit board with air and examine contacts. The contacts are located on the rear topside of the circuit board. If the contacts are dirty, clean carefully with alcohol.
4. Re-insert the printed circuit board into the housing by aligning the board. Gently slide the circuit board into the housing until the board is completely pushed in.
5. Turn on power to Controller.

METERING PUMPS

CAUTION:

Do not drive against any finished surface. The pump should come apart easily. Do not use extreme force.

The metering pump has been designed and built to very precise and rigidly controlled tolerances and will provide very good metering accuracy on all of the popular formulations available at this time. In order to maintain and operate your metering pumps properly, the following instructions listed should be followed.

A. REPLACEMENT OF THE SHEAR PIN

Remove the four Allen bolts from the shear pin guide and lock. Remove the shear pin guide and gear lock along with the broken shear pin. Insert the new shear pin in the pump and lock the whole system up with the four Allen bolts. Loosen the Slide Mount Screws and disengage the gears. The pump gear should be free to rotate before power is applied to the pump again.

B. INSERTION OF THE SHAFT SEALS

Insert spring first (refer to Drawing 21029- or 21040-). Insert shaft seal retainer into housing and make sure that the groove in retainer is toward the spring. Insert seals one at a time, lips should face the spring. Insert outer seal retainer with flat end toward outside of the block. Insert the bearing retainer, bearing hub and seal retainer and "O" rings as a unit and fasten with the three Allen bolts.

C. CHANGING THE PUMP GEAR

Remove the four Allen bolts, which secure the shear pin guide and gear lock in place. A light tap on the gear should break the taper fit and the gear should come free. Set the new gear on the taper of the bearing retainer. Align the shear pin with respect to

the drive shaft, as well as the four Allen bolts which secure the drive. The two pins located in the gear lock should line up with the two holes provided for in the cast gear.

D. OPTIONAL FRONT PUMP ENGAGEMENT

The color and curative pumps are mounted on individual linear slides. On the lower front shelf, two pull knobs with lock collars are attached to a shaft that runs to each pump. Simply pull the collar toward you to unlock it, and push the knob inward to disengage each pump from its drive gear. Pull the knob towards you until the gears mesh to re-engage. Then slide the collar against the shaft support and it will re-lock. **Be absolutely sure the gears are mated properly or the risk of pouring with out color or curative is possible.** There is an additional manual lock on the curative pump left side of the slide. Also, with the color pump disengaged it will be pushed against a valve that can be used to vent the color tank.

MATERIAL RATIO AND GEAR SELECTION

GENERAL

Both resin and hardener pumps are mounted (either left handed or right handed) and are driven by direct coupled gears. The driving gear is made of steel and slides to the key-way of the motor / reducer drive shaft. The driven gear is normally made of urethane and attached to the shaft of the metering pump by a bearing retainer. The ratio of material can be set by selection of proper gears. Each ratio requires a set of gears.

RATIO CALCULATIONS

1. Obtain specific gravity of both resin and hardener at operating temperature.
2. Convert ratio by weight to ratio by volume or vice versa.
3. Based on calculated revolutions of both resin and hardener pumps to get the ratio in 6-digit decimal numbers.
4. Refer to the ratio chart, locate the nearest 6-digit decimal number and find the number of teeth of driving and driven gears.
5. Limitation of the ratio chart.
 - The total number of teeth of driving and driven gears should not be more than 172, or less than 164.
 - The smallest metal driving gear is 34 teeth.
 - The smallest urethane driven gear is 84 teeth

RATIO CHECK

To check material ratio, the Delta-P is removed from the mixer and the 3-way mixer ball valve is set to the open position. Insert a plug into the Delta-P port. Depress the foot switch and set the speed control for a uniform flow of hardener from the Delta-P. This should occur somewhere close to the desired production pour speed.

With a uniform flow coming from the mixer and Delta-P, insert a separate container under each stream. When the containers have enough material in them for a ratio check withdraw both at the same time. Release the foot switch and weigh both materials to determine the ratio.

EXAMPLES

CASE 1 GEAR SELECTION

CONDITION: SP GR of Resin = 1.17 grams/cc
SP GR of Moca = 1.26 grams/cc
N1 = N2 (84 Driving / 84 Driven) on resin pump
Desired ratio 12.5 / 100 (H / R by weight)
Resin pump 30cc / rev
Moca pump 10cc / rev

- Step 1. Calculate the amount of resin pumped per revolution.
When the resin pump makes one revolution, the resin pump pushes out 30cc or $(1.17 \times 30) = 35.1$ grams of material.
- Step 2. Calculate the amount of Moca needed during one revolution from the resin pump.
Desired ratio is 12.5 / 100 by weight.
Moca pump should push out $(35.1 \times 0.125) = 4.3875$ grams or $(4.3875 / 1.26) = 3.48214$ cc of Moca.
- Step 3. Determine the gear ratio by dividing the required volume of moca by the Moca Pump.

Moca pump needs to rotate $3.48214 / 10 = 0.348214$ revolutions;
Therefore, $N1 / N2 = 0.348214$.

- Step 4. Select the gears from the chart.

From the chart, 0.349206 ratio gives 44 / 126 teeth for the moca pump (which is the nearest number to 0.348214).

The gear selection will be:

N1 = 84 (metal, resin driving)
N2 = 84 (urethane, resin driven)
n1 = 44 (metal, moca driving)
n2 = 126(urethane, moca driven)

CASE 2 GEAR SELECTION

With the same material, a ratio of 18.5 / 100 by weight is needed instead of 12.5 / 100.

- Step 1. Determine the existing gear ratio for the moca.
The existing set of gears on the moca pump are presently 44 and 126;
Therefore, existing gear ratio is $(44 / 126) = 0.349206$.
- Step 2. Calculate the MULTIPLIER from the new ratio and the existing ratio.
Existing ratio is 12.5 / 100.

New ratio is $18.5 / 100$.

The FACTOR is $(18.5 / 12.5) = 1.48$

Step 3. Calculate the new gear ratio from the existing gear ratio and the MULTIPLIER.

The new gear ratio is $(0.349206 \times 1.48) = 0.516824$

Step 4. Select the gears from the chart.

From the chart, 0.517857 ratio gives 58 / 112 teeth for the moca pump (which is the nearest number to 0.516824).

The gear selection will be:

$n1 = 58$	$N1 = 84$
$n2 = 112$	$N2 = 84$

CASE 3 GEAR SELECTION

When color agent is to be added using a saddle mount pump. The desired ratio is 400 grams of color agent per 100 lbs. of resin.

CONDITIONS: SP GR of color agent = 1.29 grams / cc
 SP GR of Resin = 1.17 grams / cc
 Saddle mount color pump is 0.297 cc / rev.
 1 Lb. = 454 grams.

Step 1. Convert the resin from Lbs. to cc. and the Color agent from grams to cc.

100 pounds of resin is $(100 \times 454 / 1.17) = 38803$ cc

400 grams of color agent is $(400 / 1.29) = 310$ cc

Step 2. Calculate the volumetric ratio of color to resin.

The ratio is $(310 / 38803) = 0.007989$ or 0.8 parts / 100 parts (by volume)

Step 3. Calculate the amount of color agent needed during one revolution from the Resin pump.

Desired ratio is $0.8 / 100$

Resin pump makes one revolution, pushing out 30 cc.

Color pump should push out $(30 \times 0.008) = 0.24$ cc color agent

Step 4. Determine the gear ratio by dividing the required volume of color agent by the Color pump.

The gear ratio is $(0.24 / 0.297) = 0.8080$ revolutions; therefore, $C1 / C2 = 0.8080$

Step 5. Calculate the gears.

The saddle mount pump is typically driven by a standard 42 teeth metal gear;
Therefore, $C2 = 42$ teeth.

$C1$ is $(0.8080 \times 42) = 33.936$ teeth.

Gear selection will be:

$C1 = 34$ (metal driving)

$C2 = 42$ (metal driven)

RATIO SELECTION CHART

RATIO	DRIVER	DRIVEN	RATIO	DRIVER	DRIVEN
1.428571	120	84	1.010101	100	99
1.392857	117	84	1.010000	101	100
1.372093	118	86	1.009900	102	101
1.357142	114	84	1.000000	84	84
1.348837	116	86			
1.337209	115	86			
1.318181	116	88			
1.294117	110	85			
1.280898	114	89			
1.273809	107	84			
1.269662	113	89			
1.250000	110	88			
1.239583	119	96			
1.229885	107	87			
1.220930	105	86			
1.209302	104	86			
1.190476	100	84			
1.181818	104	88			
1.174418	101	86			
1.162790	100	86			
1.149425	100	87			
1.136363	100	88			
1.123595	100	89			
1.111111	100	90			
1.101123	98	89			
1.090909	96	88			
1.080459	94	87			
1.071428	90	84			
1.068965	93	87			
1.065934	97	91			
1.057471	92	87			
1.040511	90	86			
1.034883	89	86			
1.023255	88	86			
1.022222	92	90			
1.021276	96	94			
1.020408	100	98			
1.013333	76	75			
1.012987	78	77			
1.012658	80	79			
1.012345	82	81			
1.012048	84	83			
1.011764	86	85			
1.011494	88	87			

1.011235	90	89	.886363	78	88
1.010989	92	91	.879120	80	91
1.010752	94	93	.877777	79	90
1.010526	96	95	.875000	77	88
1.010309	98	97	.868131	79	81
1.000000	84	84	.866666	78	90
.988235	84	85	.865168	77	89
.988095	83	84	.863636	76	88
.987951	82	83	.858695	79	92
.976744	84	86	.857142	78	91
.976470	83	85	.855555	77	90
.976190	82	84	.853932	76	89
.975904	81	83	.849462	79	93
.965517	84	87	.847826	78	92
.965116	83	86	.846153	77	91
.964706	82	85	.844444	76	90
.964205	81	84	.842696	75	89
.954545	84	88	.838709	78	93
.954023	83	87	.836956	77	92
.953488	82	86	.835164	76	91
.952941	81	85	.833333	75	90
.952380	80	84	.829787	78	94
.943182	83	88	.827956	77	93
.942529	82	87	.826086	76	92
.941860	81	86	.824175	75	91
.941176	80	85	.822222	74	90
.932584	83	89	.819148	77	94
.931818	82	88	.817203	76	93
.931034	81	87	.815217	75	92
.930232	80	86	.813186	74	91
.929411	79	85	.810526	77	95
.921348	82	89	.808510	76	94
.920454	81	88	.806451	75	93
.919540	80	87	.804347	74	92
.918604	79	86	.802197	73	91
.911111	82	90	.800000	76	95
.910112	81	89	.797872	75	94
.909090	80	88	.795698	74	93
.908450	79	87	.793478	73	92
.906760	78	86	.791666	76	96
.900000	81	90	.789473	75	95
.898876	80	89	.787234	74	94
.897727	79	88	.784946	73	93
.896551	78	87	.781250	75	96
.890109	81	91	.782608	72	92
.888888	80	90	.778947	74	95

.887640	79	89	.776595	73	94
.886363	78	88	.774193	72	93
.885057	77	87	.773195	75	97
.879120	80	91	.770833	74	96
.877777	79	90	.768421	73	95
.876404	78	89	.765957	72	94
.875000	77	88	.763440	71	93
.869650	80	92	.762886	74	97
.868131	79	91	.760416	73	96

RATIO	DRIVER	DRIVEN	RATIO	DRIVER	DRIVEN
.757894	72	95	.669902	69	103
.755319	71	94	.666667	68	102
.755102	74	98	.666666	66	99
.752577	73	97	.663366	67	101
.750000	72	96	.660194	68	103
.747368	71	95	.660000	66	100
.744897	73	98	.656863	67	102
.744680	70	94	.656565	65	99
.742268	72	97	.653846	68	104
.739583	71	96	.653465	66	101
.737373	73	99	.650485	67	103
.736842	70	95	.650000	65	100
.734692	72	98	.647058	66	102
.731958	71	97	.644231	67	104
.729166	70	96	.643564	65	101
.727272	72	99	.640776	66	102
.726315	69	95	.640000	64	100
.724489	71	98	.638095	67	105
.721649	70	97	.637254	65	102
.720000	72	100	.634615	66	104
.718750	69	96	.633663	64	101
.717171	71	99	.631067	65	103
.714285	70	98	.628571	66	105
.711340	69	97	.627450	64	102
.710000	71	100	.625000	65	104
.708333	68	96	.623762	63	101
.707070	70	99	.622641	66	106
.704081	69	98	.621359	64	103
.702970	71	101	.619047	65	105
.701031	68	97	.617647	63	102

.700000	70	100	.615384	64	104
.696969	69	99	.613207	65	106
.693878	68	98	.611650	63	103
.693069	70	101	.609523	64	105
.690722	67	97	.607843	62	102
.690000	69	100	.607476	65	107
.686869	68	99	.605769	63	104
.686274	70	102	.603773	64	106
.683673	67	98	.601942	62	103
.683168	69	101	.600000	63	105
.680000	68	100	.598103	64	107
.676768	67	99	.596154	62	104
.676470	69	102	.594339	63	106
.673546	66	98	.592592	64	108
.673267	69	101	.592233	61	103
.670000	69	100	.590476	62	105

RATIO	DRIVER	DRIVEN	RATIO	DRIVER	DRIVEN
.588785	63	107	.518182	57	110
.586538	61	104	.517857	58	112
.584905	62	106	.513513	57	111
.583333	63	108	.513274	58	113
.580952	61	105	.509091	56	110
.579439	62	107	.508928	57	112
.577981	63	109	.508772	58	114
.576923	60	104	.504587	55	109
.575472	61	106	.504504	56	111
.574074	62	108	.504424	57	113
.571428	60	105	.500000	57	114
.570093	61	107	.500000	56	112
.568807	62	109	.500000	55	110
.566038	60	107	.495652	57	114
.564815	61	108	.495572	56	113
.563636	62	110	.495495	55	111
.561902	59	105	.491228	56	114
.560748	60	107	.491071	55	112
.559633	61	109	.490909	54	110
.556604	59	106	.486956	56	115
.555555	60	108	.486725	55	113
.554545	61	110	.486386	54	111
.551402	59	107	.482758	56	116
.550459	60	109	.482456	55	114

.549549	61	111	.482143	54	112
.547160	58	106	.478261	55	115
.546296	59	108	.477876	54	113
.545454	60	110	.477477	53	111
.542056	58	107	.474138	55	116
.541285	59	109	.473684	54	114
.540540	60	111	.473214	53	112
.537037	58	108	.470085	55	117
.536363	59	110	.469565	54	115
.535714	60	112	.469026	53	113
.532710	57	107	.465517	54	116
.532110	58	109	.464912	53	114
.531531	59	111	.464286	52	114
.527778	57	108	.461538	54	117
.527273	58	110	.460869	53	115
.526786	59	112	.460177	52	113
.522936	57	109	.457627	54	118
.522522	58	111	.456896	53	116
.522124	59	113	.456140	52	114
.518518	56	108	.452991	53	117

RATIO	DRIVER	DRIVEN	RATIO	DRIVER	DRIVEN
.452173	52	115	.388429	47	121
.451327	51	113	.387096	48	124
.449152	53	118	.386555	46	119
.448276	52	116	.385246	47	122
.447368	51	114	.383333	46	120
.445378	53	119	.382114	47	123
.444444	52	117	.380165	46	121
.443478	51	115	.379032	47	124
.440678	52	118	.378151	45	119
.439655	51	116	.377049	46	122
.438596	50	114	.376000	47	125
.436974	52	119	.375000	45	120
.435897	51	117	.373984	46	123
.434782	50	115	.371900	45	121
.433333	52	120	.369775	46	124
.432203	51	118	.368852	45	122
.431034	50	116	.368000	46	125
.428571	51	119	.366666	44	120
.427350	50	117	.365854	45	125
.426086	49	115	.365079	46	126
.425000	51	120	.363636	44	121

.423729	50	118	.362903	45	124
.422414	49	116	.360565	44	122
.421483	51	121	.360000	45	125
.418803	49	117	.357724	44	123
.420168	50	119	.357143	45	126
.416666	50	120	.355372	43	121
.415254	49	118	.354839	44	124
.413793	48	116	.354331	45	127
.413223	50	121	.352459	43	122
.411765	49	119	.352000	44	125
.410256	48	117	.349593	43	123
.409836	50	122	.349206	44	126
.408333	49	120	.346774	43	124
.406779	48	118	.346457	44	127
.404959	49	121	.344262	42	122
.403361	48	119	.344000	43	125
.401709	47	117	.343750	44	128
.401639	49	122	.341463	42	123
.400000	48	120	.341270	43	126
.398374	49	123	.338709	42	124
.398305	47	118	.338583	43	127
.396694	48	121	.336000	42	125
.394958	47	119	.335937	43	128
.393443	48	122	.333333	43	129
.391666	47	120	.333333	42	126
.390244	48	123	.333333	41	123
.389830	46	118	.330708	42	127

RATIO	DRIVER	DRIVEN	RATIO	DRIVER	DRIVEN
.330645	41	124	.281250	36	128
.328125	42	128	.280303	37	132
.328000	41	125	.279070	36	129
.325581	42	129	.278195	37	133
.325397	41	126	.276923	36	130
.323077	42	130	.276119	37	134
.322835	41	127	.274809	36	131
.322581	40	124	.272727	36	132
.320312	41	128	.217318	35	129
.320000	40	125	.270676	36	133
.317829	41	129	.269231	35	130
.317460	40	126	.268657	36	134
.315384	41	130	.267176	35	131
.314961	40	127	.265152	35	132

.312977	41	131	.263158	35	133
.312500	40	128	.265138	34	130
.310078	40	129	.261194	35	134
.309524	39	126	.259541	34	131
.307692	40	130	.257576	34	132
.305344	40	131	.255639	34	133
.304687	39	128	.253731	34	134
.303030	40	132			
.302325	39	129			
.301587	38	126			
.300000	39	130			
.299312	38	127			
.297710	39	131			
.296875	38	128			
.295454	39	132			
.294574	38	129			
.293233	39	133			
.292308	38	120			
.291338	37	127			
.290076	38	131			
.289062	37	128			
.287879	38	132			
.286822	37	129			
.285174	38	133			
.284615	37	130			
.283582	38	134			
.282443	37	131			

LOWER THAN .253 RATIO

RATIO	DRIVER	DRIVEN	RATIO INCREMENT
.251980	33	131	.001908
.250000	33	132	.001539
.248120	33	133	.000341
.246268	33	134	.001852
.246153	32	130	.000115
.244274	32	131	.001879
.242424	32	132	.001850
.240601	32	133	.001823
.238805	32	134	.001796
.236641	31	131	.002164
.234848	31	132	.001793
.233082	31	133	.001766
.231343	31	134	.001739
.230769	30	130	.000574
.229007	30	131	.001762
.227272	30	132	.001735
.225563	30	133	.001709
.223880	30	134	.001683
.223076	29	130	.000804
.223174	29	131	.001702
.219696	29	132	.001678
.218045	29	133	.001651
.216417	29	134	.001628
.215384	28	130	.001033
.213740	28	131	.001644
.212121	28	132	.001619
.210526	28	133	.001595
.208955	28	134	.001571

SPARE PARTS

HMB Pumps – Curative pumps (3.5, 5.5, 10cc). Replace at six months or at first sign of leak.

Note: all o-rings are silicone, unless stated

Quantity	Part No.	Description
1	45989	o-ring, 16mm, viton, drive shaft (pump to block)
1	41584	o-ring #224, (bearing hub to block)
1	42161	o-ring #016, inlet
1	42159	o-ring # 013, outlet
2	42008	o-ring #018, mounting block (pressure sensor) to pump block
2	41741	o-ring #010, pressure sensor
1	42032	o-ring #119, pump lube cap
3	41037	Shaft seals, 5/8”
1	31453	Seal retainer, spring to seals
1	31454	Seal retainer, seals to bearing hub
1	31455	spring
1	31105	Shear pin

BLB Pumps – Resin pumps (10, 20, 30, 50, 100cc). Replace at six months or at first sign of leak.

Note: all o-rings are silicone, unless stated

Quantity	Part No.	Description
1	42015	o-ring #019, shaft (pump to block)
1	42141	o-ring #226, (bearing hub to block)
1	42137	o-ring #122, inlet
1	41010	o-ring # 118, outlet
2	42008	o-ring #018, mounting block (pressure sensor) to pump block
2	41741	o-ring #010, pressure sensor
1	42139	o-ring #216, pump lube cap
1	32405	Gasket, Teflon, pump lube cap (old design, not used on new pumps)
3	41004	Shaft seals, 3/4”
1	31073	Seal retainer, spring to seals
1	31072	Seal retainer, seals to bearing hub
1	31074	spring
1	31106	Shear pin

Mixer Assembly (clean and breakdown every 2-4 weeks)

Quantity	Part No.	Description
2	42401	Shaft seal, pin mixer
1	41196	Gasket, nozzle
1	41010	o-ring #118, insulator
1	41741	o-ring # 010, curative delta-p valve
3	42008	o-ring #018, various (adapter blocks, 12Qd fittings)
1	46589	o-ring #121, chamber to insulator
1	32293	Diaphragm, red, 2"
1	31317-1	Diaphragm, red, 1.75"
1	31385	Insulator, delta-p to chamber
2	21346	Check valve, ¼ NPT, w/ Kalrez o-ring
2	41032	Seal, ball valve, Teflon (ball)
2	41026	Seal, ball valve, Teflon

Rev. Changes

G: 24-Aug-2023

- Change mixer VFD model and accel/decel settings
- Change HMB pump drive shaft o-ring p/n from 44152 to 45989

H: 18-Jul-2024

- Update mixer VFD GA500 settings