MAGUIRE PRODUCTS, INC.
ELEVEN CROZERVILLE RD.
ASTON, PA. 610 459-4300

MODEL MPA-E-6

# SIX ROLLER
# LIQUID COLOR METERING PUMP
# with
# EXTRUSION FOLLOWING

OCTOBER 17, 2000

INSTRUCTION MANUAL

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M A G U I R E  P R O D U C T S ,  I N C .

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SET UP INSTRUCTIONS - EXTRUSION FOLLOWING CONTROLLERS

1. The power cord must be plugged into any 110 volt continuous power outlet.

2. The RPM tachometer feed line provided must be installed from the extruder to the controller. On the extruder, this line must be connected to the tachometer output (either AC or DC) which drives the RPM gauge.

   The other end is fitted with a twist-lock 2 conductor female receptacle. This receptacle locks into the recessed male plug on the rear of the controller.

3. CALIBRATION OF ELECTRONICS - (required one time only):
   Calibration is necessary to match feeder electronics to the particular voltage output of your extruder. In the upper right corner of the front of the controller, there is a small access hole. This provides access to a small trim pot. This Trim pot must be adjusted one time only for your extruder. To do this:

   1. Set the controller to 100.

   2. While your extruder is running, adjust the trim pot so that the display represents the percent (%) of full speed that the extruder is running. For example, if your extruder is capable of running 150 RPMs and is currently at 50 RPMs, adjust the trim pot until the display reads 33 (i.e., 33% of full speed).

   3. After this is done, your controller is calibrated and the formula provided will now be accurate for setting the digital counter for each particular job.

NOTE: The FOLLOW-OFF-MANUAL switch should be in the FOLLOW position for normal operation. The MANUAL position will allow you to force the controller to run even when the extruder is not running, or running very slowly. In this mode, controller speed will follow the setting of the digital counter and may be controlled accordingly. FLUCTUATION OF SPEED IS NORMAL IN THIS MODE.

NOTE: If your tach voltage is very low, you may not be able to reach a high enough motor speed even when the calibration knob turned to its maximum position. If this happens, do the following:

   1. Set calibration knob in its middle position 1/2 way between full left and full right.

   2. On the back of the controller, you will note an allen head screw. This screw serves to prevent access to another adjustment pot. Remove the screw and use this adjustment to obtain the proper display as required in Step 2 above. This is a course adjustment. Replace the screw and fine tune with the calibration pot in front.

If you have calibrated your unit properly, the following should occur:

$$\frac{\text{Display number}}{\text{Setting number}} = \frac{\text{Current extruder speed}}{\text{Maximum extruder speed}}$$

At FULL SPEED, number displayed will EQUAL Counter setting.
At HALF SPEED, number displayed will be HALF of setting.
Re-adjust calibration pot if necessary.

## START-UP PROCEDURE

1. Place color drum next to process machine.

2. Install pickup lance into liquid container for suction pickup of liquid, or attach tubing assembly in accordance with color manufacturer's recommendations.

3. There should be provision for attaching the poly-tubing to the process machine so as to allow color to be metered in directly over the feed section of the screw, or into a premixer if one is installed. Assuming provisions have been made, attach or install the poly-tubing to the process machine as required. (Best color mixing without color contamination of the feed throat of your machine is obtained when the color delivery tube is positioned approximately one half (1/2) inch over the screw at the forward edge of the feed throat toward the side of the screw that is turning downward.)

   NOTE: Adaptor plates are available from MAGUIRE PRODUCTS that mount between the hopper and feed throat. This will allow easy insertion and removal of the color delivery tube into the feed throat of the process machine.

4. Connect the power cords as explained above in SETUP of CONTROLLER.

5. Set Counter to 20 and switch pump to 'MANUAL'. Rollers should now be turning slowly.

   Lay the pump tube into the slot across the top of the pump head running front to back in a straight path across the top of the dowel pin rollers; positioning the brass tube-inlet fitting against the machined recess of the pump head. Draw the tube into position under the overhanging portion of the pump body and maintain tension while the turning of the rollers draws the tube into place.

   The tube, properly installed, will be in contact with only the uppermost two rollers. The inlet end of the tube will be resting against the small recess that is machined into the side of the pump head that faces front. The tube will pass through the pump body in a nearly straight line and reappear out the other side of the pump head.

6. Assuming pump is not already primed, set counter to 60 and run pump in the 'MANUAL' mode until color line is primed.

7. Using the formula provided in this manual, set the counter to the proper setting for the particular part you are molding.

8. The main switch should now be set on "FOLLOW". Your pump will now operate as explained in the SETUP OF CONTROLLER section.

## PRINCIPLE OF CONTROLLER OPERATION
## EXTRUSION FOLLOWING

Controllers equipped with our EXTRUSION FOLLOWING option differ from our standard controllers in several important ways.

1. A "CYCLE" power cord is not provided. Instead, an extruder speed signal cord is provided to carry the extruder RPM tachometer voltage to the controllers computer logic. The color controller then follows this signal exactly as extruder RPMs and related tachometer voltages change.

2. An additional calibration adjustment must be made to allow the controller to function properly for the particular voltage range and output characteristics of your extruder.

## PRINCIPLE OF OPERATION

A tachometer that currently exists on your extruder provides either an AC or DC voltage output which varies with extruder RPMs. This signal drives the RPM gauge of your extruder and, in some cases, provides sophisticated tach feedback to your Extruder Drive Controller.

When this signal (either AC or DC) is fed into the MAGUIRE extruder-voltage pre-processor, it is converted into a digital pulse-train whose frequency is linear with the incoming voltage. Through an optical coupler, this pulse train is passed on to the main processor. The Optical Coupler provides complete electrical isolation, ensuring that extruder circuits will not interfere with the controller circuitry and vice-versa.

A calibration pot allows each pre-processor to be exactly tuned for your particular extruder. The main computer is programed to expect a pulse-train of a given frequency at full extruder RPMs. At this frequency, the micro-processor will run the controller drive motor at the full 100% of the speed that is set on the digital counter. At any lower frequency, motor speed will be cut back proportionally. The calibration pot, then, is provided to tune your particular pre-processor to output the full-speed frequency at the full rated speed of your extruder.

Calibration is required only once. After calibration is complete, you need only set the digital counter for the proper controller metering rate for FULL extruder speed. Anything less than full speed will automatically be reflected in a correspondingly reduced metering rate.

# ADDITIONAL CONTROLLER INFORMATION

The MAGUIRE Digital Controller provides the precise speed regulation and metering control necessary to assure absolute accuracy over color usage.

Since metering rate is directly related to motor output shaft rotation, accuracy is obtained by controlling the exact degree of rotation of the drive motor. The unique Maguire Products Digital Controller is designed to do this with precision. Our standard Model divides each full motor rotation into 159 increments; each increment representing a small fraction of a gram of color being carefully measured out.

The digital counter located on the face of the controller provides the means for predetermining the exact degree of rotation per 1.1 seconds and, therefore, the precise amount of color that will be added in this time period. To determine the proper setting for the counter, a simple formula is used based on percent of color required and the pounds per hour of the extrusion process.

Motor speed is automatically controlled by the internal microprocessor to allow color metering to occur uniformly at a speed directly proportional to the speed of your extruder. The operator need not concern himself with color motor speed adjustment as the extruder speed changes. Changing extruder drive speed or fluctuations in plant voltage are automatically detected and compensated for and, therefore, will have no effect on metering accuracy.

The controller contains a 1/27 HP D.C. Permanent Magnet motor with variable speed control of from approximately 50 to 3000 RPMs. In the standard configuration, the motor is close coupled to a heavy duty gearbox with a reduction ratio of 53:1. Final output speed of the motor is, therefore, approximately 1 to 56 RPMs. As the motor turns, a "hall effect" pickup device on the motor sends 3 pulses per revolution to the microprocessor controlling it. The gearbox ratio of 53:1 means that 159 pulses (3x53) are received for every single revolution of the motor output shaft.

The purpose of the thumbwheel switch is to pre-set the exact number of pulses that the motor is going to run every 1.1 seconds. A setting of 159 will one turn every 1.1 seconds.

In addition to this precise control of color quantity being metered, the microprocessor also controls motor speed using the same pulses for digital tachometer feedback. This ensures that motor speed is precisely regulated regardless of changing torque requirements or variations in plant voltage.

# PRINCIPLE OF PUMP OPERATION

The MAGUIRE three and six roller peristaltic pumps are designed for years of rugged industrial service with little or no maintenance. Only the inexpensive pumping tube needs to be replaced from time to time to keep these units performing like new.

Metering is accomplished by the compression and release of a flexible pumping tube. These peristaltic pumps are true positive displacement pumps. Unlike other positive displacement pumps such as piston, gear, diaphragm, and rotary screw pumps, a peristaltic pump has no seals, check valves or clearances to allow even the slightest internal leakage. Liquid is retained within a flexible tube at all times and never comes into contact with any surfaces of the pumping mechanism. There are no check valves used at all.

Where tubing passes through the pump head, rollers alternately close off a portion of the tube and squeeze the liquid inside the tube forward by rolling over the tube in the forward direction. As the tube behind the roller springs back to its original round shape, the expanding inside cavity creates a vacuum that draws liquid into the tube. At least one roller is always in the position of closing off the tube completely, thereby assuring that no liquid can "leak" backwards.

Pumping is so complete that this type of pump can pump air as effectively as liquid and can develop a near full vacuum of 30 inches of mercury. These pumps are self-priming and will pass any entraped air bubbles in the liquid through the pump without loss of prime.

Six hardened dowel pins retained by a plastic cage are held firmly out against the inside surface of the pump head housing by a flexible polyurethane center drive roller. A tube compression slot is machined into the pump head housing and tube compression tolerances will not change over time. In this design there are no bearings and the dowel pins will not wear out.

The rollers are driven by a variable speed motor and, as they move over the tube, they cause the liquid inside the tube to be squeezed forward in small uniform increments. The accuracy of these pumps for metering small amounts of viscous liquids is unmatched.

## PUMP TUBING

The pump tube that is continually compressed by the rotating rollers is the heart of the pump. Many materials are available for this tube; resiliency and chemical compatibility being the primary considerations in selection of this material. Virtually all liquid color applications use polyurethane tubing.

Conditions that affect tube life are resiliency of the tube material selected--urethane being the best, chemical compatibility, and tubing diameter--smaller diameters having a longer life than larger diameters.

Three different diameter pump tubes are available for use in the Maguire Six Roller Pump; 1/8", 3/16", and 1/4" I.D. tubes. Theoretical maximum pumping rates of the pump are as follows:

Using 1/8" I.D. pump tube -- 33 CCs/minute @ 56 RPMs.
Using 3/16" I.D. pump tube -- 72 CCs/minute @ 56 RPMs.
Using 1/4" I.D. pump tube -- 132 CCs/minute @ 56 RPMs.

These maximum pumping rates are achievable only for liquids having viscosities similar to, or lower than, latex paint or easy pouring syrup. Viscosities so high that they do not readily pour can also be pumped, but at considerably reduced maximum rates.

While the pump is a positive displacement pump and can produce a full vacuum, the liquid flowing to the pump is pushed only by atmospheric pressure, about 15 PSI. Since high viscosity liquids flow poorly through small diameter tubes, these two conditions should be observed:

1. Always use as large a diameter supply tube to the inlet side of the pump as is practical and do not reduce this diameter except upon entering the pump head.

2. Keep the distance to the liquid supply as short as possible.

In selecting tube sizes, keep these factors in mind:

Larger diameter tubes offer higher pumping rates and are generally recommended when coloring very large parts. They are also better suited for pumping thicker materials.

Smaller diameter tubes always last longer and also pump more accurately for a longer period of time.

Generally, presses with less than a 500-ton capacity use 1/8" I.D. green tube. Nearly all larger presses use 3/16" I.D. red tube. Only large extrusion applications use 1/4" I.D. tube.

## DESCRIPTION OF CONTROLS

1. FOLLOW-OFF-MANUAL SWITCH

EXTRUSION FOLLOW: The controller will follow the speed of the extruder based on the voltage signal that it receives from the extruder into the special receptacle located on the back of the controller.

OFF: Will prevent the controller from running and will remove power to the computer controls. If a voltage spike or transient power surge should cause the processor to become "confused", switching to OFF may be necessary to re-start the processor.

MANUAL: The controller will run continuously as long as 110 volt power is present at the controller power cord. Speed is controlled by and directly follows the setting of the thumbwheel switch.

The FOLLOW-OFF-MANUAL switch should be in the FOLLOW position for normal operation. The MANUAL position will allow you to force the controller to run even when the extruder is not running, or running very slowly. In this mode, controller speed will follow the setting of the digital counter and may be controlled accordingly. SOME FLUCTUATION OF PUMP SPEED IS NORMAL IN THIS MODE.

2. MOTOR FORWARD/REVERSE SWITCH

This switch should be in the FORWARD position for all normal operation. Holding the switch down in the REVERSE position will cause he controller motor to run backwards. This will cause the liquid color to be returned to its source.

3. THUMBWHEEL SWITCHES

In the FOLLOW mode, the thumbwheel switch setting determines the MAXIMUM rate of speed of the controller. This is the rate of speed you would expect when your extruder is running at 100% of full rated speed. In the MANUAL mode, the setting directly determines the RPMs of the motor output shaft regardless of extruder speed.

4. DISPLAY WINDOW

The window will display motor RPMs. Flashing of this display at half second intervals indicates that the motor is not running at the full speed that is necessary to deliver the quantity of color requested by the counter setting. (See TROUBLESHOOTING section for more information.)

5. SIGNAL AND MOTOR LIGHTS

The Signal Light indicates power is present at the signal cord; in other words, the process machine screw is turning. The Motor Light indicates the computer processor is outputting a D.C. voltage to the controller motor; in other words, the motor is turning.

## FORMULA FOR SETTING THE COUNTER
## EXTRUSION FOLLOWING CONTROLLERS

1. Determine the MAXIMUM extruder output in pounds per hour,
   (at 100% of full rated RPM), (max lbs/hr).
2. Determine the POUNDS per 100 of color required (lbs/100).
3. Determine the color METERING RATE; GRAMS / MIN @ display of 40;
   (gr/min@40), see below.
4. Set the digital counter using the following formula:

(max lbs/hr) x (lbs/100) x 3 / (gr/min@40) = Setting

Example: Extruder output = 900 pounds per hour
lbs/100 required = 4.5
METERING RATE = 130 gr/min@40

900 x 4.5 x 3 / 130 = 93.46 -- Set Counter on 93

## METERING RATE - EXTRUSION FOLLOWING MODELS

METERING RATE equals the GRAMS of material metered in ONE MINUTE when the display is "40".

To determine METERING RATE for a given material:

1. Switch the controller to the MANUAL SPEED position.
   Set the counter to "040".
   The display should also read 40. If necessary, adjust
   the counter up or down until the DISPLAY reads 40.

2. Carefully collect and weigh the output over 1 minute (60 seconds).
   This weight in grams will equal the METERING RATE for this material
   (gr/min@40)

Example: Your controller is running and the display shows 40.
Over a 60 second period you meter 32 grams of material.

Your METERING RATE for this material is 32 (grams/min@40).

## ALTERNATE FORMULA METHOD
## EXTRUSION FOLLOWING 3 AND 6 ROLLER PUMP

This method does not require calibration, but instead relies on an accurate knowledge of the weight of the liquid (lbs./gal.) and accurate tube sizes.

1. Determine the MAXIMUM extruder output in pounds per hour, (at 100% of full rated RPM), (max lbs/hr).
2. Determine the POUNDS per 100 of color required (lbs/100).
3. Determine the weight of the liquid color in pounds per gallon.
4. Set the digital counter using the following formula:

(lbs/hr) x (% let-down) x ('F' factor) / (lbs/gal) = Setting

Example: Extruder output = 900 pounds per hour
% let-down of color = 2%
Weight of liquid color = 16 lbs. per gallon
Model 34-R; 'F' factor = 1.25

900 x 2 x 1.25 / 16 = 140.625 -- Set Counter on 141

CHART OF 'F' FACTORS

| Model # | (Tube) | RPM @ 90v | 'F' factor |
|---|---|---|---|
| 18-G | (green) | 18 | 4.65 |
| 34-G | (green) | 34 | 2.44 |
| 34-R | (red) | 34 | 1.25 |
| 34-C | (clear) | 34 | .74 |
| 51-R | (red) | 51 | .83 |
| 51-C | (clear) | 51 | .49 |

NOTE: On standard 3 and 6 roller liquid color pump controllers, the number of magnets that are attached to the motor armature is varied (1, 2, or 3) according to the gearbox ratio of the drive motor. This is done so that regardless of which gearbox ratio is selected for your application, the formula that is provided for setting the counter will not vary. In other words, there are only three formulas; one for green tubing, one for red tubing, and one for clear tubing. Different gearbox ratios do not result in different formulas.

However, in EXTRUSION FOLLOWING controllers, we have found that better motor control and accuracy at slow speeds is obtained by always providing a full three magnets on the motor armature. Therefore, different gearbox ratios require different formulas. The formulas given above are for three different gearbox ratios using different tube sizes.

Model 6-18-G: Gearbox ratio is 101:1; speed is 18 RPMs.
Models 6-34-G & 6-34-R: Gearbox ratio is 53:1; speed is 34 RPMs.
Models 6-51-R & 6-51-C: Gearbox ratio is 35-1/3:1; speed is 51 RPMs.

These RPM ratings are taken at 90 volts, not at full speed which occurs at full line voltage of about 130 volts.

If you are uncertain which model you have, set the counter on 200 and hold switch on 'MANUAL'. This will force the controller to run at full speed. Now count the number of turns the motor output shaft makes in one minute.

#18 motors run at about 30 RPMs, or 1 turn every two seconds.
#34 motors run at 56 RPMs, or about 1 turn per second.
#51 motors run at about 90 RPMs, or about 1.5 turns per second.

In all cases, three magnets will produce a digital readout of about 180 at full speed regardless of the gearbox ratio of the drive motor. If your controller only produces a full speed reading of about 120, then your unit is equipped with two magnets instead of three. If this is the case, then the "F" constants in the above formulas will be too high and should be reduced by 1/3 (or multiplied by .66).

## CHANGING COLORS

1. Run the pump in REVERSE to empty the tube of color.

2. Remove pump tube from pump head.

3. Remove poly-tubing from process machine and coil entire tube onto top of drum. Do not disconnect any other fittings. Tape up the open end of the poly-tubing to prevent dripping of color.

4. Bring in next color drum and repeat Steps 5 through 8 of "Start Up Procedure".

## PICKUP ASSEMBLY

An inexpensive pickup assembly is fitted to the drum of color to be used. If one pump is going to run more than one color, each color drum should be equipped with its own pickup assembly. Each pickup assembly consists of several components. All a re connected together and should never be disassembled except in the case of a tube blockage caused by contaminants in the liquid color. The lance and threaded adaptor are installed directly into the lid of the drum. The other end of the tubing assembly is connected to the feed throat of the process machine.

A common source of problems comes from contaminants, such as plastic pellets entering the liquid. When opening a new drum or replacing an empty one, be certain that no openings are left uncovered where contaminants could accidentally enter the liquid.

Tubing assemblies for 30-gallon drums are fitted with a High Capacity Filter that reduces the possibility of plastic pellets clogging the pump tube. It is easily cleaned by back flushing with water.

If a pickup assembly is available for every color, operators should never need to come in contact with the liquid color except when replacing an empty drum. The REVERSE switch allows the operator to momentarily run the pump in reverse to drain liquid from the tube assembly back into the liquid container. Since there is no cleanup required for a color change and no color is discarded or lost, a considerable amount of coloring is saved over a period of time.

## DISASSEMBLY AND CLEANING

### CLEANING THE PICK-UP ASSEMBLY

If a pickup tube assembly must be used for a different color or if, for some other reason, it becomes necessary to clean the coloring from the inside of a pickup assembly, the following steps will make this potentially messy job easier.

1. Disconnect tubing from the process machine.

2. With the pump tube still installed in the pump head, run the pump in reverse until no more color flows from the tubing assembly.

3. Once this is done and you are assured of a continuous air passage through the tubing, the tubing assembly should be removed from the pump head and color container and placed in a large utility sink. Place one end of the tubing assembly into the spigot opening and turn on the hot water SLOWLY. Once you can see water flowing from the other end of the tubing assembly, leave the water running for about 10 minutes. This should be sufficient time to clean all remaining traces of liquid color from the tube. BE PATIENT. HOT WATER AND TIME WILL DO THE JOB FOR YOU.

4. A copper pickup lance can be cleaned in the same manner.

### SIX (6) ROLLER PUMP HEAD

1. Remove the clear cover disk.

2. Using an allen wrench, remove the two recessed screws holding the pump head to the control housing. The pump head may now be removed by simply pulling it away from the motor shaft.

3. To remove the roller set, simply push it out of the outer pump head housing.

4. Once disassembled, clean all parts if necessary with soap and water. Reassemble and re-install in reverse order.

   NOTE: DO NOT LUBRICATE ANY PUMP HEAD PARTS. The pump works best when totally DRY with NO lubrication. Since the center drive roller relies on friction to drive the 6 tube compression rollers, any lubrication such as Liquid Color contamination will interfere with proper operation.

# TROUBLESHOOTING CONTROLLER PROBLEMS

IF YOUR MAGUIRE PRODUCTS CONTROLLER DOES NOT WORK PROPERLY:

1. READ below about NORMAL OPERATION and compare to your problem.
2. The QUESTIONS that follow may assist you in solving your problem.
3. If you are unable to remedy the problem:
   a. ANSWER in writing as many of the QUESTIONS that apply.
   b. DESCRIBE the PROBLEM in your own words as carefully as you can.
   c. RETURN this information with the unit for repair.

## ========== NORMAL OPERATION ==========

With MAIN POWER cord plugged in, NO voltage to the signal following cord, Switch on FOLLOW:

The display should read zero ( 0)
The motor light and signal lights are OFF
The motor is NOT running.

IN FOLLOW:
AT NO TIME will the display be COMPLETELY BLANK.
BLINKING of the display is a WARNING that the actual motor speed is not up to "target" speed.
If the motor FORWARD - REVERSE switch is switched to OFF, the motor will stop.
Switching to OFF and then to FORWARD again will cause a momentary increase in motor speed as the unit tries to 'catch up'.

IN MANUAL:
The motor runs at a speed equal to the counter setting.
If the setting is above the maximum speed possible, then the motor just runs at full speed and the display BLINKS.
Full speed will display about '180'.
BLINKING of the display is NOT NORMAL except during speed changes.
If the FORWARD - REVERSE switch is turned OFF, a display of one ( 1) will result and the motor will not run.

ALL UNITS:
If at any time should the processor become confused and fail to run the motor properly or display the proper numbers, the unit will 'restart' itself after a delay of about 4 seconds.
BLINKING of the display means that actual motor speed is not up to "target" speed. This occurs normally when the motor is "ramping up" to speed or when you set too high a number on the counter resulting in a demand for a speed that the motor cannot achieve.

## ========== ANSWER QUESTIONS as they apply ==========

YOUR COMPANY NAME:_____ DATE:_____

NAME of PERSON who saw or knows the problem:_____

CONTROLLER SERIAL NUMBER: _____
Time in service: (new, 1 hour, 1 week, years, etc.) _____

========== IF PROBLEM IS WITH OUTPUT ==========

SPECIFICATIONS as they apply:

Extrusion, lbs/hour: _____
Desired color output (%): _____

========== IF PROBLEM IS ELECTRONIC FAILURE ==========

CIRCUMSTANCES of failure:

During storm: _____
On Monday morning start up: _____
Same time as another malfunction in plant such as a fuse blowing on a nearby piece of equipment: _____
Possibility of incorrect voltage (220): _____
Possibility of low voltage condition (below 100): _____
On power-up: _____
OR after running for how many hours: _____
Is problem intermittent: _____
How often: _____

TESTING results:

Do other controllers fail under same circumstances: _____
Does controller work when tested in another location: _____
Does problem come and go: _____
After how much time: _____

========== IF PROBLEM IS ERRATIC OR INCORRECT OPERATION ==========

What is the COUNTER SETTING: _____
Is the problem only at certain settings: _____
Does the display BLINK: _____
Does display ever go completely blank (it shouldn't): _____
(it should always show a number or a zero except when blinking)
What is the actual motor output RPMs: _____
EXTRUSION RATE: _____
Does the display show the full counter setting: _____
What count is displayed when it runs: _____
Does the display drift: _____
Over what range: _____
Is the SIGNAL light lit: _____
Is the MOTOR light lit: _____
Is motor speed erratic: _____

==========  DESCRIBE the PROBLEM  ==========

Most problems are apparent and easy to fix. However, the more information we have about what caused the problem, the more we can do to improve our product so that these problems do not occur in the future.

In some cases we may NOT be able to duplicate YOUR particular problem in OUR testing facility. Describing the problem as CAREFULLY and as completely as possible will help us locate and correct any design weakness that might be responsible for the problems you are having.

## IN HOUSE REPAIRS

1. If a controller fails to respond properly to counter settings, cycle input signal, or on/off signals properly, you may make an inspection of the internal electronics.

   Work only in a relatively clean environment. Inspect all cable connections to be sure each is tight and that proper connection is being made by each individual wire and clip within each connector; individual wire clips can sometimes pull loose from the connector. Inspect all solder connections for broken wires or improper solder connections.

   Inspect the magnet holding cup on the rear of the motor. If this assembly should loosen, this will adversely affect motor control. Take care not to disturb or damage the electronic hall effect device that is attached to the rear of the motor. Repairs to printed circuit boards should not be attempted. Generally, if a component fails it indicates a condition that may have caused other components to fail as well. Boards should be returned to the factory for repair.

   A blown fuse on a circuit board usually indicates that other problems are present. A new fuse of similar size and rating may be substituted but if it blows again, the board should be returned to our factory for service. DO NOT EXCEED 5 AMPS on the board.

2. Flashing of the number display indicates that the motor is unable to run at the proper calculated speed. One reason for this may be that the counter setting is too high and the cycle time too short for the motor to complete the metering even at full rated speed. The other cause for the flashing display is that an obstruction is slowing the output shaft and the automatic torque limiting feature is slowing the motor intentionally.

3. NO DISPLAY NUMBER at any time is usually a failed power supply. Be sure there is power to the unit. Check the fuse. There is a fuse on the circuit board; however, this fuse usually will not blow unless some other component on the board has failed. Replace only with a fuse of the same amp rating.

4. DISPLAY of ONE ( 1) indicates that the processor is attempting to run the motor but is not picking up any RPM feedback from the armature. Check (a),(b),(c) and (d) below if the motor does not run. Check (e) if it does run .

   (a) Components may be blown out on the circuit board. A reading of zero (0) VOLTS at the motor FORWARD - REVERSE switch would indicate this.

   (b) The FORWARD-REVERSE switch may be turned off or may be faulty.

   (c) Brushes on the motor may not be making proper contact with the armature. Sometimes brushes stick in their holders. A DC voltage at the motor leads without corresponding motor rotation would indicate this may be the problem. Removal of the brushes and light sanding of the brush sides will fix this.

(d) The armature may be burned out. This will occur only with continuous overloading and subsequent overheating. Circuit boards are designed to prevent this through a torque limiting feature. Armatures that burn up leave a distinct odor in the control box.

(e) If the motor is running but the display is still one ( 1), check the magnet holding disk on the motor armature shaft. It should be secure and there should be about 1/16 inch space between the magnet holder and the electronic "hall effect" device on the back of the motor housing. Also check this electronic device for proper location. It must be positioned under the magnet cup and have no broken wire leads.

## TROUBLESHOOTING LOSS OF COLOR

1. Check that color supply is adequate by tipping drum of color slightly or observing level of color. Consider that if color level is nearing the bottom of the drum, air may have been sucked in momentarily and a considerable length of time would have passed before the loss of color would be evident at the process machine.

2. Check that the controller output shaft is rotating the proper number of revolutions per cycle. On MPA-E-6 models: a display of 120 equals about 1 turn/second of the motor shaft. However, the roller set turns more slowly. If the motor shaft is not visible, the roller set can be checked for rate. The roller set will turn about 35 turns per second when the display reads 120. An incorrect relationship between counts and revolutions indicates an internal electronic problem.

3. In six (6) roller pumps, contamination of the roller set from liquid color will most probably result in slipping of the drive roller and a corresponding lack of color output. If you suspect slippage is the problem, disassemble and clean the pump head and rollers with soap and water. DO NOT LUBRICATE ANY PUMP HEAD PARTS. Reassemble and recheck for proper pump rotation.

4. Check that pump tube is not permanently flattened. Replace if necessary. Very short tube life may indicate a chemical compatibility problem.

5. Check for vacuum leaks on the inlet side of the pump head. Be sure that TEFLON TAPE was used on all pipe thread connections on the suction side of the pickup assembly. A vacuum leak is indicated if the pump pumps air out of the outlet without sucking liquid into the inlet. Place a moist finger over the outlet end of the pump tube to feel for escaping air. Bubbles in the liquid color output may also indicate an air leak. If an air leak is indicated, re-tape and re-tighten all threaded connect ions. Check for obstructions at the inlet end of the pump tube. Disconnect brass fittings and check for blockage at this point. Alternating suction and pressure, or pulsating, at the output end indicates a blocked tube. Check for blockage and reprime pump if necessary.

6. Pump speed may exceed the flow characteristics of the liquid being pumped. Pump suction alone is used to draw liquid into the pumping unit and only normal atmospheric pressure of 15 PSI is available to push liquid into the inlet end of the pump tubing assembly. Higher viscosity liquids do not flow as fast as lower viscosity liquids and may not be capable of flowing through pump tubing as rapidly as pumping speed would dictate. To determine if the maximum possible flow rate is being exceeded, reduce counter setting by 50%. If output does not drop proportionally, viscosity is a problem. To solve this, you may:

   (1) Locate color closer to the pump head using larger diameter supply lines to reduce flow restrictions where possible.
   (2) Use a larger diameter pump tube.
   (3) Specify a larger capacity pump.
   (4) Reformulate liquid color for lower viscosity.

THREE AND SIX ROLLER PUMP - MAXIMUM OUTPUT SPECIFICATIONS

| Model MPA | Tubing I.D. | Max RPMs Motor Shaft | Flow/hour @ 10#/gal Min.(grams) | Max.(lbs) | Min Dispense (one cycle |
|---|---|---|---|---|---|
| 18-G | 1/8" (green) | 30 | 36 | 2.9 | .006 grams |
| 34-G | 1/8" (green) | 56 | 36 | 5.4 | .006 grams |
| 34-R | 3/16" (red) | 56 | 81 | 11.6 | .013 grams |
| 51-G | 1/8" (green) | 90 | 36 | 8.6 | .006 grams |
| 51-R | 3/16" (red) | 90 | 81 | 18.0 | .013 grams |
| 51-C | 1/4" (clear) | 90 | 138 | 30.0 | .022 grams |

(Model 34-G is supplied unless otherwise specified)

To select proper pump size:

1. Determine maximum extrusion rate in pounds per hour. For injection molding, extrusion rate is approximately equal to tons of clamping pressure; i.e., a 500-ton press extrudes material at about 500 lbs/hour. A more accurate estimate may be made using shot weight and screw return time for any molded part:

   (Shot wt in grams) / (Screw return time in seconds) x 8 = (lbs/hr)

2. Determine maximum expected letdown ratio and multiply this times extrusion rate for maximum expected lbs/hour of color required.

3. From the above chart, select the pump with the lowest pumping rate that meets these maximum requirements.

Examples:

250 lbs/hr x .2% = .5 lbs/hr max. color -- Select Model 18-G
320 lbs/hr x 1.2% = 3.8 lbs/hr max. color -- Select Model 34-G
700 lbs/hr x 2% = 14 lbs/hr max. color -- Select Model 51-R

# WARRANTY

MAGUIRE PRODUCTS offers one of the MOST COMPREHENSIVE WARRANTIES in the plastics equipment industry. We warrant each Liquid Color Pump manufactured by us to be free from defects in material and workmanship under normal use and service; excluding only those items listed below as 'excluded items'; our obligation under this warranty being limited to making good at our factory any Liquid Color Pump which shall within FIVE (5) YEARS after delivery to the original purchaser be returned intact to us, transportation charges PREPAID, and which our examination shall disclose to our satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on our part, and MAGUIRE PRODUCTS neither assumes nor authorizes any other persons to assume for it any other liability in connection with the sale of its products.

This warranty shall not apply to any Liquid Color Pump which shall have been repaired or altered outside MAGUIRE PRODUCTS factory, unless such repair or alteration was, in our judgment, not responsible for the failure; nor which has been subject to misuse, negligence or accident, incorrect wiring by others, or installation or use not in accord with instructions furnished by Maguire Products.

Our liability under this warranty will extend only to Liquid Color Pumps that are returned to our factory in Aston, Pennsylvania PREPAID.

It should be noted, however, that we strive to satisfy our customers in whatever manner is deemed most expedient to overcome any problems they may have in connection with our equipment.

## EXCLUDED ITEMS:

Tubing used in our peristaltic pumps is warranted for thirty (30) days. This tubing has a limited service life, generally from one to six months, depending on diameter of tubing, hours of use, and chemical compatibility to the liquid being pumped.

Pump roller bearings in our three (3) roller design liquid color pump are warranted for a period of one (1) year. Color contamination can shorten their life to several months. (NOTE: Our six roller pumps do not contain any bearings and, therefore, have a full five (5) year warranty).