

TUSKIN Equipment Corporation

TC-101 Liquid Color Metering System
Operation & Maintenance Manual

Warning: Read instructions carefully before attempting to install, operate or service the Tuskin Metering Pump. Retain instructions for future reference.

Introduction

The Tuskin TC-101 Liquid Metering System consists of a drive unit coupled to a peristaltic pump head. The 1/8 horsepower permanent magnet gearmotor within the drive unit is powered by control electronics that utilizes a 6800 family microprocessor. The pump features a brushed aluminum housing and a polyester touch pad for easy cleanup. An interference filter on the AC power input along with full optical isolation of all signal inputs and outputs make the TC-101 a truly rugged instrument capable of reliable operation in the most demanding of industrial environments. All setup information is retained through power cycles in a non-volatile EEPROM memory. Simple keystroke entry along with jog capability and presets for tube loading and priming make the TC-101 quick, easy, and convenient to use.

Specifications

3-roller Pump Head specifications

Maximum flow rates at 60 RPM:

1/8 ID tubing	35 cc/min
3/16 ID tubing	77 cc/min
1/4 ID tubing	141 cc/min

Drive Unit Specifications

Power Input: 120 VAC/240 VAC 50/60 Hz, selectable via internal switch

Power Output: 90 VDC 1A maximum, short circuit protected

Power Line Noise Immunity: passes NEMA ICS 2-230 showering arc test

Electrostatic Discharge Noise Immunity: Passes IEC 801-2 ESD test

Metered Mode Signal Input: 12 - 120 VAC 50/60 Hz

Proportional Signal Input: 2.0 VDC minimum, 500 VDC maximum, 70 to 500 VDC full scale, adjustable via front panel calibration control (1.4 VAC minimum, 353 VAC maximum, 50 to 353 VAC full scale, 50/60 Hz)

MotorType: DC permanent magnet

Motor Operating Speed Range: 106 to 3180 RPM

Output Shaft Gear Reduction Ratio: 53:1

Operating Temperature Range: 0 to 60 degrees

Operating Humidity Range: 0 to 95 % RH, non-condensing

General: 6301 microprocessor with EEPROM non-volatile set-up memory, 5 digit 1/2 inch high numeric red LED display, Red LED mode and unit indicators, Stop key with red status LED and Run key with green status LED, 18 key polyester membrane keypad, all signal inputs and outputs optically coupled.

Use and Operation

***** **Warning** *****
DO NOT operate this device on the secondary side of a step up/down transformer, Variac, or other line isolation or line voltage regulation transformer. Voltage spikes caused by chopping of the current in the transformer will result in catastrophic failure of the pump.

Connections:

The TC-101 is supplied with two cords. The black cord is a standard AC power cord for 110 VAC 50/60 Hz use. The gray cord is the signal cord. The wires are stripped and tinned to allow application of your connectors or terminal blocks. The signal connections are:

- White - signal common
- Black - metered mode cycle input
- Green - proportional mode input

The connections are insensitive to wiring polarity except if both signal are simultaneously connected and applied. For this case, both signals must be DC levels and both negative leads must be connected to the white, or signal common, wire.

Both inputs will separately accept DC or AC signals.

110/240 VAC Selection

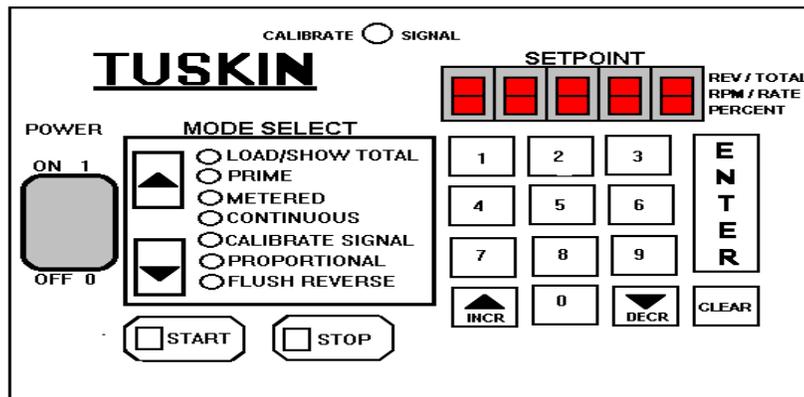
The TC-101 is configured for 120 VAC operation at the factory. To convert the pump for 240 VAC, first unplug the signal and power cords. Remove the four phillips screws that hold the control panel to the housing and pull the control panel forward and out of the box. Locate the red power select switch near the power transformer and set it to the "240" position. Reassemble the control panel into the housing and reconnect the pump.

Loss of Power

If power is lost while the unit is operating, the pump will be stopped when power is restored. Setpoints are saved in non-volatile memory and are recalled automatically at power-up. If the non-volatile memory is corrupted, the unit will recall default values for all setpoints.

Touch Pad Operation

The front panel of the TC-101 features a 5 digit LED display, ON/OFF switch and touch keys as shown in the figure below.



Mode Select Keys

The arrows are used to advance the pump through the seven operating modes as shown by the LED indicators. The operating mode can be changed only when the pump is stopped and the display is not flashing.

Numeric Keys

The Numeric Keys, 0 through 9, are used to enter a new RPM, Count, or Percent setpoint depending on the selected mode. The unit of the number being displayed is always shown by the indicators to the immediate right of the display. Depressing any entry key except the Enter Key causes the pump to begin accepting new setpoint information. The display will begin flashing to indicate this. If the Enter Key is not pressed within 20 seconds to lock in the new value, the display will return to the original non-flashing setpoint. Pressing the Clear Key will always restore the previous setpoint and leave the pump ready to accept a new value.

Enter Key

The Enter Key is used to lock the new setpoint into memory. When this key is pressed, the new value will be checked for validity. If the new value is out of range, the previous setpoint will be restored and the display will continue to flash. If the value is acceptable, the displayed value will become the new setpoint and the flashing will stop

In Proportional Mode, pressing the Enter Key will cause the display to toggle between the "Percent" and "RPM" displays. In Metered Mode, the Enter Key activates the "Preload Multiplier" as explained in the detailed description of the Metered Mode.

INCR and DECR Keys

These keys cause the display to count up or down from the current displayed value. If the unit is running in Continuous or Proportional mode and the INCR or DECR Keys are pressed, a "J" will appear in the left-most digit of the display to show that the pump is running in "jog". Setpoint changes due to the INCR or DECR Keys will occur immediately as long as the "J" indication is on. Pressing the Enter Key or any of the Numeric Keys will terminate jogging.

Start Key

The Start Key causes the pump to run in the selected mode. When the Start Key is pressed while the pump is running, the current RPM, percent, or count will show in the LED display.

Stop Key

When the Stop Key is pressed, the pump will stop operating immediately regardless of the state of the pump (run, data entry, jog).

Summary of Operating Modes

Load/Install Tube

The pump runs at a fixed, low speed to facilitate loading and removing the tube in the pump head. When in this mode, total will be displayed. If the Start Key is pressed, the unit will continue to turn. Reset total by pressing "0" and the Enter Key.

In "load tube" the display reads "LOAD". When the Start Key is pressed, the pump runs in the forward direction at a constant 10 RPM to facilitate threading the tube past the rollers. All other keys except the Stop Key are disabled. The pump will run until the Stop key is pressed.

Prime

When this mode is selected, the display reads "Prime". When the Start Key is pressed, the pump runs in the forward direction at a constant 10 RPM to pull fluid from the reservoir through to the outlet of the tubing. All other keys except the Stop Key are disabled. The pump will run until the Stop Key is pressed.

Injection/Metered (for detailed instructions see page 8)

In Metered Mode the TC-101 dispenses a programmed amount of material in response to a trigger. While the pump is dispensing, it measures the duration of the input signal. On the next cycle the pump will adjust its speed to dispense the desired amount of fluid evenly over the duration of the input signal. The unit is triggered applying voltage (12 – 120 VAC) momentarily to the metered signal input lines (Grey Cord). Pressing the Stop Key will abort any cycle that is in progress and take the unit out of run.

Fixed Extrusion/Continuous (for detailed instructions see page 9)

The pump runs at the programmed setpoint speed without regard to the condition of the input signals. The display shows the RPM setpoint when the pump is stopped and the actual instantaneous speed when the pump is running. When the Start Key is pressed, the pump runs at the setpoint speed. The speed is completely independent of any external input signals. The pump will accept any value between 2 and 60 RPM as a valid setpoint. All keys are active in the Continuous Mode.

Calibrate/Extruder

While in this mode, all keys except the mode select arrows are disabled. The display shows the value of the signal at the proportional mode input expressed in percent of full scale. This mode is intended to allow you to conveniently adjust the input circuitry to match the full scale output from your equipment. To perform the calibration, set up your equipment to generate the full scale signal level. For example, in the case of a plastics extruder, you would run the extruder at full screw speed. Turn the screwdriver adjustment located in the top center of the pump face until the percent display reads "100" without flashing. Values of 100.5 percent and up will cause the display to flash.

An alternative method is to set up the external equipment to run at some known speed and then calculate that speed as a percentage of its maximum. For example, an extruder capable of 10 RPM is operated at 7 RPM or 70 percent of its maximum. Adjust the calibrate control for a display of 70. The most accurate calibration will be obtained when the external equipment running as close as possible to full speed. Do not calibrate at low percentages (0 to 20). The unit will accept rate values from 1 to 999. To change the rate, select the Calibrate/Enter Rate Mode. Hitting the Enter Key will cause the display to toggle between the calibrate percent display and the rate display. With the display showing "rate", key in a

valid entry and hit the Enter Key to lock the value into memory. Changing the rate will reset the totalizer to zero.

Tracking/Proportional (for detailed instructions see pages 10)

The display will toggle between setpoint percent and setpoint RPM when the Enter Key is pressed with the pump stopped. Similarly, the display will toggle between actual percent and actual RPM when the pump is running. Setpoint entry will affect whichever setpoint is displayed when a key in the entry group is pressed. The proportional mode input should be calibrated prior to using the proportional mode. All keys are active in this mode.

When running the proportional input is monitored and the motor speed is continuously adjusted to reflect the current value of the input signal. The speed is calculated using the following formula: **Operating RPM = Setpoint RPM * (Actual Percent divided by Setpoint Percent).**

As in the other modes, results that fall outside of the 2 to 60 RPM range will force the operating speed to the appropriate limit. If the actual percent value drops below 6%, the pump will stop until the signal again exceeds 6%.

Flush/Reverse

When the Start Key is pressed and held, the pump runs in reverse direction at 60 RPM to pull fluid out of the line and return it to the reservoir. All other keys are disabled as long as the Start Key is held. There is a delay upon entering and exiting "Flush" during which the internal microprocessor waits for the motor to fully stop before it trips the reversing relay.

Operation of TC-101 in Injection Mode (INJECTION / METERED)

1. ELECTRICAL INSTALLATION:
Connect line marked "CYCLE" (gray wire) into 110 VAC outlet, powered during screw operation.

(Metered mode signal input: 12-120 VAC 50/60 Hz)

2. Calculate setting for metering counter using the formula:

$$\frac{\text{Shot weight (Grams)} \times \text{Let Down Ratio (LDR)} \times \text{Factor (see below)}}{\text{(Lbs. Per Gallon Liquid)}}$$

Factor:

Peristaltic Pump:

Green tube (1/8" ID) – 1.35

Red tube (3/16" ID) – 0.60

Clear tube (1/4" ID) – 0.34

Progressive Cavity Pump:

Size 1 – 0.416

Size 2 – 0.089

3. Use the Mode Select keys to select METERED. The Count Status LED will appear.
4. Enter COUNT input and press the ENTER key. The display will read the COUNT entry in a non-flashing format. For "Normal" operation (without Preload) press START, then proceed to #5. For "Preload" operation, Press ENTER a second time (a "P..0" will appear). Then enter a two-digit preload multiplier and press ENTER. Then press START. At this point, a quantity of color will be injected into the machine, regardless of any injection signal. After delivering this Preload Count, the control will follow the external injection signal to deliver the setpoint COUNTS per cycle.
5. Start injection molding machine. After several colored parts have been molded, to approved standard. If a change in setting is required, wait until color adjustment has gone through the length of screw before rechecking to standard.
6. To adjust color, either of two methods may be used:
 - A. Press "INCR" or "DECR" to the desired setpoint.
 - B. Press the numeric keypad to select the desired setpoint (which will flash), then press ENTER.
7. Color should be checked periodically to avoid color drifting from target color.
8. If regrind material is being introduced, the amount of color should be adjusted to reflect only the amount of natural resin introduced.

Operation of TC-101 in Fixed Extrusion (FIXED EXTRUSION / CONTINUOUS)

1. ELECTRICAL INSTALLATION:

Connect black power cord into 110V outlet. The gray cycle wire is not utilized for Fixed Extrusion applications.

2. Calculate setting for metering RPM/counter using the formula:

$$\frac{\text{Resin Output (Lb./Hr.)} \times \text{Parts per Hundred (Color)} \times \text{Factor (see below)}}{\text{(Lbs. Per Gallon Liquid)}}$$

Factor:

Peristaltic Pump:

Green tube (1/8" ID) – 0.90

Red tube (3/16" ID) – 0.40

Clear tube (1/4" ID) – 0.23

Progressive Cavity Pump:

Size 1 – 0.297

Size 2 – 0.064

3. Use the Mode Select keys to select Extrusion. The RPM Display will appear.

4. Enter RPM input and press the ENTER key. The display will read the RPM entry in a non-flashing format.

5. Start extruder. After several minutes when the color appears uniform, check color to approved standard. If a change in setting is required, wait until color adjustment has gone through the length of screw before rechecking to standard.

6. To adjust color, either of two methods may be used:

A. Press "INCR" or "DECR" to the desired setpoint.

B. Press the numeric keypad to select the desired setpoint (which will flash), then press ENTER.

7. Color should be checked periodically to avoid color drifting from target color.

8. If regrind material is being introduced, the amount of color should be adjusted to reflect only the amount of natural resin introduced.

Operation of TC-101 in Proportional Mode (TRACKING EXTRUDER / PROPORTIONAL)

1. CALIBRATE PUMP TO EXTRUDER (Initial Set-up only):
 - A. The % Display Status LED will appear. All keys will be disabled except the Mode Select keys.
 - B. The display will read a number from 0 to 100 representing the percentage of maximum Extruder speed.
 - C. The control should then be calibrated to the Extruder by using a small screwdriver to adjust the “Calibrate Signal” pot so that the display % matches the operating speed of the Extruder.
 - D. Press the Mode Select key to exit the calibrate mode.

NOTE: If calibrating at 100%, a flashing display of 100% is not an acceptable calibration. The display must read a non-flashing 100% to be in calibration. Do not calibrate at 0%. Recalibration is necessary if pump is moved to a different extruder.

2. Select Proportional Mode (each time color and/or resin is changed): When the operator selects the Proportional Mode, the % Display Status LED will appear. The display will read the current Extruder % setpoint as a percent of the Extruder’s maximum speed. The operator may change this setpoint (when changing colors or resins) by entering a new value and pressing ENTER. If the operator chooses not to change this setpoint, just press ENTER. When Enter is pressed, the RPM status LED will appear and the display will read the pump RPM setpoint (in whole numbers). This value is the speed that the pump will operate when the Extruder is running at its % setpoint speed. The pump speed is dependent on the Extruder speed and will track it on a proportional basis. The pump will shut off if the Extruder speed drops below 6%. The operator may change the % or RPM setpoint by entering a new value with the Numeric Keys. The display will read the new entry in a flashing format. If the Enter key is pressed within 15 seconds, the control will accept the new entry as the new setpoint. If not, the display will read the original setpoint in a non-flashing format. Pressing the INCR or DECR keys will jog the setpoint up or down immediately. The operator may review the Extruder % setpoint and Pump RPM setpoint by pressing the ENTER key. Press the START key to start the pump. When the unit is operating, the operator may review the Extruder % speed and the actual Pump RPM by pressing the ENTER key. Setpoint changes may also be made while the pump is operating by using the Numeric, INCR and DECR keys.
3. Calculate setting for metering RPM/counter using the formula:

$$\frac{\text{Resin Output (Lb./Hr.)} \times \text{Parts per Hundred (Color)} \times \text{Factor (see below)}}{\text{(Lbs. Per Gallon Liquid)}}$$

Factor:

Peristaltic Pump:

Green tube (1/8” ID) – 0.90

Red tube (3/16” ID) – 0.40

Clear tube (1/4” ID) – 0.23

Progressive Cavity Pump:

Size 1 – 0.297

Size 2 – 0.064

4. Use the Mode Select keys to select Proportional Mode. The RPM Display will appear.
5. Enter RPM input and press the ENTER key. The display will read the RPM entry in a non-flashing format.

Routine Cleaning

Under normal use the TC-101 requires a minimal amount of routine care. The touchpad may be cleaned with a damp cloth and a mild detergent. The pump head may be removed for cleaning by out loosening the two set screws that secure the roller collar to the drive shaft. The set screws are accessible through a hole in the bottom of the pump head. Use Flush/Reverse to jog the collar until the set screws are visible. After the set screws have been loosened, remove the collar. Remove the two Phillips screws that hold the delrin pump head to the side of the box.

Troubleshooting

General

Pump runs fast whenever the unit is powered regardless of the signals and front panel settings:

*Motor output transistor has failed catastrophically.

Injection/Metered Mode

Pump doesn't run:

*Is the cycle signal present? Check your wiring and hookups.

*Is the cycle signal of sufficient magnitude? Use a voltmeter to measure the voltage with the pump connected.

Counts display runs out long before the cycle has ended:

*Speed calculation result is under 2 RPM. Change to a smaller feed tube and/or adjust the number of counts.

Counts display has undispensed counts remaining at the end of the cycle:

*Speed calculation result is over 60 RPM. Change to a larger feed tube and/or adjust the number of counts.

Tracking Extruder/Proportional Mode

Pump doesn't run:

*Is the proportional mode signal present? Check your wiring and hookups.

*Use a voltmeter to check for signal with the pump connected.

*Is the input calibrated? Perform the calibration adjustment.

*Is the signal over 6% of the expected full scale value? Use a voltmeter to check.

Pump doesn't follow the input. Always runs at full speed:

*Check your percent and speed setpoint values. If necessary use a smaller feed tube to allow adjusting the setpoints to reasonable values.

Pump doesn't follow the input. Always runs at minimum speed:

*Check your percent and speed setpoint values. If necessary use a larger feed tube to allow adjusting the setpoints to reasonable values.

Warranty and Factory Service

Tuskin Equipment Corporation warrants its products against defects in materials and workmanship. If a failure results from such defects within 5 year of Customer delivery, Tuskin will, at its option, repair or replace the defective unit free of all charges except for special shipping charges (UPS ground is standard).

All in-warranty and service returns must be accompanied with a Tuskin Return Authorization. For questions or to obtain a Return Authorization, contact:

Tuskin Equipment Corp.
1-800-887-5461