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INSTRUMENT OPERATING PROCEDURE

INSTRUMENT:

Peristaltic (Masterflex) Pumps

MODEL:

Masterflex 12 volt high speed drive
Masterflex 12 volt low speed drive
Masterflex 110 volt variable speed drive
Masterflex 110 volt I/P drive
Masterflex 110 volt digital
Masterflex 110 volt model LS delivery pump
Watson-Marlow H.R.S.V. 110 volt
Watson-Marlow High Flow 110 volt

MANUFACTURER:

Masterflex
Watson-Marlow

PRECAUTIONS:

POTENTIAL INTERFERENCES:

Any equipment operating nearby which produces a strong electromagnetic field may cause erratic pump operation. e.g.: two-way radios, some generators, or other motors

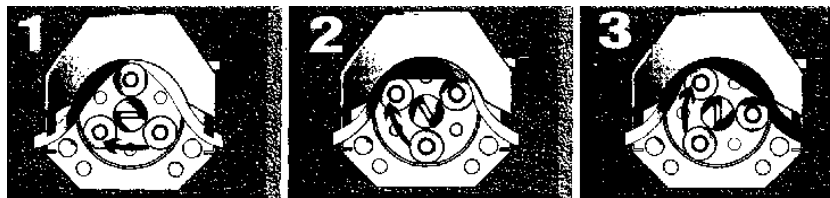
SAFETY:

Personnel are required to wear protective equipment when handling lampricides. This equipment is listed on applicable restricted use pesticide labels. Under no circumstances is the public allowed near operating application equipment.

PROCEDURES:

I. Principle

- A. Pump head consists of two parts: the rotor and the housing. The tubing is placed in the tubing bed, between the rotor and housing, where it is occluded (squeezed).
- B. The rollers on the rotor move across the tubing, pushing the fluid. The tubing behind the rollers recovers its shape, creates a vacuum, and draws fluid in behind it.
- C. A “pillow” of fluid is formed between the rollers. This is specific to the ID of the tubing and the geometry of the rotor. This pillow remains fairly constant except with very viscous fluids.



II. Mounting two heads per drive:

- A. The pumps listed above with the exception of the High Speed 12 volt and both models of the Watson-Marlow may be operated with two attached heads by using long head mounting screws. This essentially doubles the output of a single pump. “Y” connectors may be used on the input/output side to simplify the setup. This procedure is referred to as “stacking heads”.

III. Equipment Selection:

- A. Selection of the proper pump and head tubing is dependent upon the expected feed rate and availability of a suitable 110 volt power source. The following tables contain approximate feed rates attainable with various pump and tubing combinations. The tables represent pump capabilities when pumping water under ideal conditions. Actual performance with TFM is considerably less, especially during cold weather.

IV. Pump operation procedures:

- A. Once the pump model and tubing selection has been made for a given site, setup and operation proceeds as follows: (Note moisture and lampricide must not enter pump drive)
 - 1. The selected silicone head tubing is connected between 3/8" vinyl intake/output hose of sufficient length to reach the TFM tub or can (intake) and the stream to be treated (output).

2. The silicone head tubing is placed in the pump head. This is accomplished by moving the lever on top to the right to open the head. The tubing is then set in place over the center of the rollers and the lever moved to the left to close the head. The plastic retainer clips on the sides are then tightened to prevent the tubing from “creeping” when the pump is turned on. Care is taken not to crimp or crush the silicone tubing.
3. Plug the power cord of 12-volt models into the rear of the pump before attaching the cord to the battery. The power cord is permanently attached to the drive unit on 110-volt models, so this is not a concern.
4. Place the weighted intake hose in the TFM container and attach the output hose to the butterfly valve (if used).
5. Switch the pump drive ON to begin pumping.
6. The pump will produce a steady flow after all air bubbles have cleared the lines. Check the delivery rate with a stopwatch and a graduated cylinder of the appropriate size.
7. To adjust the feed rate turn the black knob on the face of the pump clockwise to increase and counterclockwise to reduce the flow. After each adjustment the delivery rate is checked with the graduated cylinder and stopwatch until the desired flow is attained.

High Speed 12 volt		
Tubing Size	Minimum Output mL/min	Maximum Output mL/min
#16	80	400
#25	170	850
#15	200	1000
#24	340	1700
#18	380	1900
#35	460	2300

Low speed 12 volt		
Tubing Size	Minimum Output mL/min	Maximum Output mL/min
#16	16	72
#25	34	150
#18	76	340

110 volt Digital Readout		
Tubing Size	Minimum Output mL/min	Maximum Output mL/min
#16	4.8	480
#25	10	1000
#18	23	2300

I/P Drive		
Tubing Size	Minimum Output mL/min	Maximum Output mL/min
#26	0.1	1.1
#82	1	13

Watson-Marlow H.R.S.V. 110 volt		
Tubing Size	Minimum Output mL/min	Maximum Output mL/min
1/8 inch	60	300
1/4 inch	100	1200
3/8 inch	400	3000
1/2 inch	600	6000
3/4 inch	900	13000
1 inch	1000	19000

Watson-Marlow High flow 110 volt		
Tubing Size	Minimum Output mL/min	Maximum Output mL/min
1/4 inch	200	1500
1/2 inch	600	13000
3/4 inch	2000	25000
1 inch	4000	33000

Compact Masterflex 12 volt		
Tubing size	Minimum Output mL/min	Maximum Output mL/min
LS/14	5	35
LS/16	20	120
LS/17	70	390
Output rates are approximate		

B. Changing pump configuration during an application:

1. An applicator may be required to attain a feed rate outside the range of capability of the equipment being used. This requires changing the head tubing and/or pump drive which causes an interruption of the flow of lampricide. This interruption is kept to a minimum.
2. Changing head tubing:
 - a. The lines are purged before any connections are broken. This can be done in the following ways:
 - (1) Lift the intake out of the chemical and allow the pump to run.
 - (2) Switch the pump to reverse and pump the lampricide in the lines back into the tub.
 - b. Open the head and raise the silicone tubing above the system, allowing residual lampricide to drain from the connectors.
 - c. After freeing the connectors, the hoses are drained to avoid siphoning from the tub.
 - d. Free the connectors over a bucket of water for easy cleanup.
 - e. Install head tubing of a new size and adjust feed rate.
3. Changing pump drive:
 - a. When changing a pump drive all connectors can be left intact and

placed into a new pump head. Tubing is inspected for signs of wear before installation of a new pump drive.

V. Operation of Model LS toxicant delivery pump; toxicity test application

A. Lampricide stock solutions

1. TFM

- a. Concentration of stock solution is approximately 9.05 g (A.I.)/L deionized water.
- b. Pre-weighed bottles of TFM stock contain approximately 18.1 g TFM (A.I.). Dilute one bottle to two liters with deionized water to provide diluter stock. Example: 52.6 g of 34.4% A.I. TFM diluted to 2.0 L with deionized water will provide appropriate stock solution.

2. Niclosamide

- a. Concentration of stock solution is approximately .094 g (A.I.)/L methanol
- b. Pre-weighed tubes of niclosamide contain about .375 g of niclosamide (A.I.). Example: 0.61g of 61.5% A.I. niclosamide = 0.375 g A.I..
- c. The following dilution scheme is used with the 0.61 g niclosamide stock:
 - (1) Dilute 0.61 g niclosamide with 1.0 L methanol (A stock)
 - (2) Dilute 250 mL of stock A to 1.0 L with methanol (B stock; diluter stock solution)
- d. Alternate stock:
 - (1) Pre-weigh 0.153 g of 61.5% A.I. niclosamide
 - (2) Dilute to 1.0 L with methanol (diluter stock solution)

B. Pump set-up

1. Tubing

- a. TFM (for head and delivery tubes)
 - (1) Tygon tubing
 - (2) Size 13
- b. Niclosamide
 - (1) Silicon tubing (head)
 - (2) Size 13
 - (3) Teflon delivery tubes

2. Operating parameters

- a. **DIR:** clockwise
- b. **MODE:** INT
- c. **SIZE:** 13
- d. Delivery setting (mL/min)
 - (1) TFM:
 - (a) Adjust delivery setting to 0.4 mL for each

- mg/L TFM desired.
- (b) Example: a setting of 1.20 mL/min will provide a TFM concentration of 3.0 mg/L in container number 1.

- (2) Niclosamide:
- (a) Adjust delivery setting to 0.04 mL/min for each ug/L niclosamide desired.
- (b) Example: a setting of 0.6 mL/min will provide a niclosamide concentration of 15 ug/L in container number 1.

3. Calibration

a. Check calibration

- (1) Press the **DISP** key once and the previous dispense volume will be displayed.
- (2) If 9 mL is not displayed set the pump to 9 mL with the UP/DOWN arrow keys.
- (3) Place the delivery tube in a 10.0 mL graduated cylinder.
- (4) Press the STOP/START key. This will initiate delivery of 9.0 mL at the rate of 1.0 mL/min (pre-set; see step II.C.2.c.).
- (5) The pump will shut off automatically when the volume is dispensed.
- (6) Read the volume in the graduated cylinder. It should be within 2% of 9.0 mL. If not, re-calibrate and check again.

b. Calibrate

- (1) If CAL LED is lit a previous calibration has been made. To clear the previous calibration press and hold the CAL switch until the CAL light goes out (requires about 3 seconds).
- (2) Place the delivery tube in a 5.0 mL graduated cylinder.
- (3) Adjust the flow rate to 1.00 mL/min with the UP/DOWN arrow keys.
- (4) Press CAL; a calibration volume of 4.00 mL/min will be displayed.
- (5) Press STOP/START. The pump will automatically dispense 4.00 (estimate; only if properly calibrated) mL and stop.
- (6) Read the volume and adjust the flashing 4.00 mL/min setting with the UP/DOWN arrow keys to the volume that was dispensed.
- (7) Press **SIZE** to exit.
- (8) Check the calibration; See step II.C.1.

C. Pump operation

1. Turn power switch ON.

2. Press **FLOW** to determine flow rate setting.
3. Adjust flow if necessary with the UP/DOWN arrows.
4. Press **STOP/START** key.

MAINTENANCE:

I. Potential problems and solutions:

A. Feed rate consistently low or erratic

1. On 12 volt models check battery voltage, if less than 12v replace battery.
2. Make sure hoses and tubing are not crimped.
3. Head tubing may be fatigued; this is indicated by tubing which does not resume a round shape when released from the head. Replace tubing or slide it through the head until a new section contacts the rollers.
4. Lampricide level in the tub may be low, refill tub.
5. The air temperature may be turning colder which causes the chemical to thicken. Change to a setup that delivers more volume.
6. Too much hydraulic head. Lower the pump below the level of lampricide in the tub.
7. Intake clogged. Clean intake screen.

B. Feed rate consistently high

1. Feed checks must be taken **after** refilling tub. Adding lampricide to the tub usually increases the feed rate.
2. Pump may be defective. Replace the pump and tag as defective.

C. Pump stops operating or speed adjustment is not possible

1. Check power connections.
2. Check circuit breaker on back of pump (12v models).
3. Check fuses (110v models).
4. Check battery voltage. Replace battery if needed.
5. Pump could be defective. Replace pump and tag as defective.

II. Clean up:

- A. Empty cans are rinsed during the shift only with permission from the analysis person. On smaller streams rinsing cans during the feed may result in excessive concentrations of lampricide and unreliable analysis. Pumps and other equipment used at application sites are thoroughly cleaned before storage. Run fresh water through pump until effluent is clear, then disassemble the system and drain hoses. The outside of hoses and tubing are rinsed. Pump housings are washed taking care not to get water on internal components. Dry before storage. Lampricide left in the tub is poured or pumped back into cans which are weighed and labeled. Volume of TFM remaining, location used, and operator's initials are recorded on the label. The site is cleaned and equipment is transported to camp and properly stored.

REFERENCES:

Equipment selection: Masterflex Tubing Pump Systems Reference Book, Barnant Co.

This procedure has been reviewed and approved by the undersigned representatives of the U.S. Fish and Wildlife Service and Fisheries and Oceans Canada.

REVIEWED/APPROVED _____ DATE _____
Field Supervisor (U.S.)

REVIEWED/APPROVED Mike Spivak DATE 05 MAR 2020
Program Manager (Canada)