

# B/T<sup>®</sup> RAPID-LOAD<sup>®</sup> PERISTALTIC PUMPS AND DRIVES

Operating Manual

Model Number

875-2611	945-1615	945-2615
875-2612	945-1620	945-3399
875-2613	945-1625	945-4399
875-2614	945-1815	
945-1610	945-2610	

A-1299-7058 First Edition



## SAFETY PRECAUTIONS



**DANGER:** High voltages exist and are accessible. Do not remove cover of Drive or Controller. Use extreme caution when servicing internal components.



**CAUTIONS:** Risk of electric shock – this pump is supplied with a grounding conductor and grounding-type attachment plug. To reduce risk of electric shock, be certain that it is connected only to a properly grounded, grounding-type receptacle.

Electrical connections and grounding (earthing) must conform to local wiring codes.



**WARNINGS:** Tubing breakage may result in fluid being sprayed from pump. Use appropriate measures to protect operator and equipment.

To reduce the risk of injury, use hose clamps on all tubing connections. All tubing connections, must be made outside of the pump.

To reduce risk of injury, power must be removed from pump before removing or installing tubing. Fingers or loose clothing could get caught in drive mechanism. Do not operate this pump without cover or interlock door properly closed and latched. Rotating parts can cause serious injury.

To reduce risk of injury, do not pump materials hotter than 150 degrees Fahrenheit, (65.5°C).

Before permanent installation, test the equipment with the chemicals and under the specific conditions of your application.

Verify tubing material chemical compatibility prior to use. It is the sole responsibility of the user to determine suitability of the product for the application

## Explanation of Symbols



**CAUTION:** Risk of Danger. Consult Operator's manual for nature of hazard and corrective actions.



**CAUTION:** Risk of crushing. Keep fingers away from rotor while pump is in operation. Stop pump before loading or unloading tubing.



**CAUTION:** Hot Surface. Do not touch.



**CAUTION:** Risk of electric shock. Consult Operator's manual for nature of hazard and corrective actions.

## WARNING: Product Use Limitation



This product is not designed for, nor intended for use in, patient-connected applications, including, but not limited to, medical and dental use, and, accordingly, has not been submitted for FDA approval. If drive is used in a manner not specified in this manual the protection provided by the equipment may be impaired.

Use only MASTERFLEX® PERFECTPOSITION® B/T® precision tubing with MASTERFLEX pumps to ensure optimum performance. Use of other tubing may void applicable warranties.

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## Section 1 Introduction

This manual provides information for installing, operating and servicing the following models of MASTERFLEX® B/T® RAPID-LOAD® Peristaltic Pumps and Drive.

<b>MODEL</b>	<b>TYPE</b>
875-2611	Controller Only 115VAC for 945-2610
875-2612	Drive Only 115VAC for 945-2610
875-2613	Controller Only 230VAC for 945-2615
875-2614	Drive Only 230VAC for 945-2615
945-1610	Modular Drive, Analog 115V AC system
945-1615	Modular Drive, Analog 230V AC system
945-1620	Air-Powered Variable Occlusion Peristaltic Pump and Drive.
945-1625	Fixed Speed w/TEFC, 115V AC @ 60 Hz
945-1815	Fixed Speed w/TEFC, 230V AC @ 50 Hz
945-2610	Modular Drive, Digital 115V AC system.
945-2615	Modular Drive, Digital 230V AC system.
945-3399	Drive Only NEMA56C mount less motor
945-4399	Drive Only IEC72 mount less motor

The unique design of these peristaltic pumps provides a greatly simplified means for rapid loading and changing of tubing. In addition, the following features are incorporated:

Pumps up to 10 GPM (37 LPM).

Uses continuous tubing to ensure a sanitary and non-contaminating system.

Fluid contacts only the tubing.

Handles wide range of viscosities.

Several different sizes and formulations of tubing can be used.

## Application Data

The gentle peristaltic action of these pumps is ideal for pumping highly viscous and shear-sensitive liquids. These pumps are also ideally suited for use where sterile conditions and purity are required. Toxic and hazardous fluids can be pumped with the proper selection of MASTERFLEX *PERFECTPOSITION* B/T tubing since the fluid contacts only the tubing and not the pump.

***Use only MASTERFLEX® PERFECTPOSITION® B/T® precision tubing with MASTERFLEX pumps to ensure optimum performance. Use of other tubing may void applicable warranties.***



***WARNING: Tubing breakage may result in fluid being sprayed from pump. Use appropriate measures to protect operator and equipment.***



***Verify tubing material chemical compatibility prior to use. It is the sole responsibility of the user to determine suitability of the product for the application.***

## General Description

The RAPID-LOAD® B/T peristaltic pump (see Figure 1) is mounted on a base and attached to a NEMA 56C frame motor or IEC-72 71-14F130 frame motor through a 5.45:1 gear head and adapter. Depending on the model, the motor is either supplied or customer furnished and is attached to the adapter by four bolts. A modular controller is furnished with some models. The modular controller can be wall mounted.



**Figure 1-1.** RAPID-LOAD Pump and Drive Family

Due to its unique design, different MASTERFLEX *PERFECTPOSITION* B/T tubing sizes can be accommodated by this RAPID-LOAD peristaltic pump.

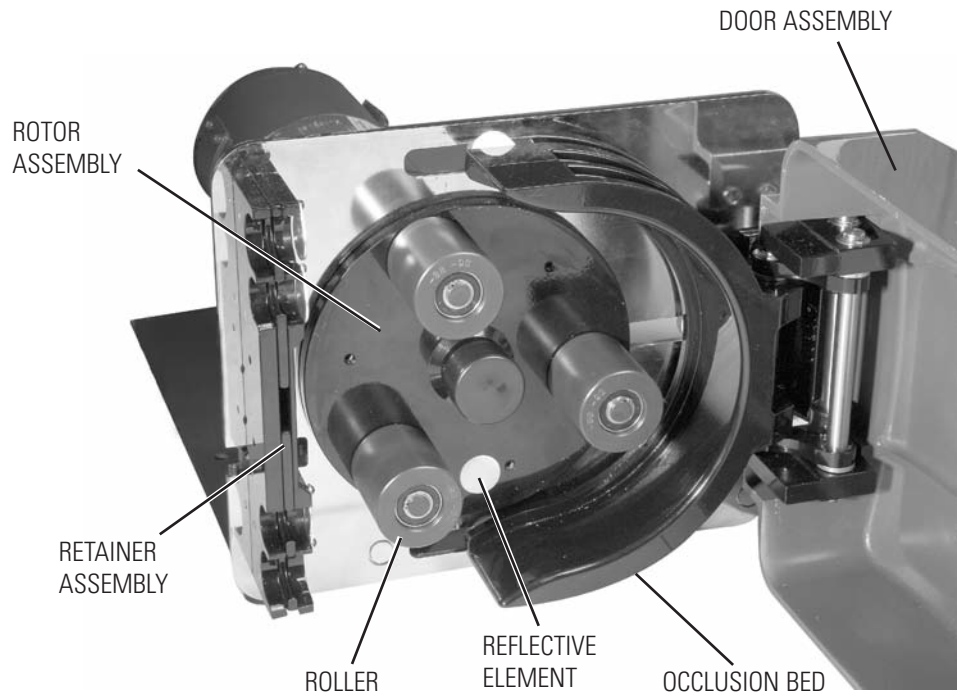
For an indirect estimate of flow rate, a reflective element attached to the rotor has been provided for use with an optical tachometer. Point tachometer beam through front cover window and target the reflective element.

To obtain flow rate in mL/min., multiply tachometer rpm reading times the nominal flow per revolution value provided in TABLE 1  
(**Note:** 3,785 mL = 1 U.S. liquid gallon).

The maximum recommended rotor speed is 321 rpm. The pump rotor can turn either clockwise or counterclockwise. When turning clockwise (FWD) the top connection is for suction and the bottom connection is for discharge. The 321 rpm speed is obtained from the standard 1725 rpm fractional horsepower motor through the 5.45:1 gear reduction. Faster speeds will increase flow, but will also considerably shorten average tubing life. (We cannot be responsible for pump performance when operated at speeds higher than 321 rpm.)

**⚠ WARNING:** *To reduce the risk of injury, use hose clamps on all tubing connections. All tubing connections, must be made outside of the Pump Head.*

Silicone or C-FLEX® tubing, because of their highly elastic natures, can expand very quickly if back-pressure is present and could create leakage at the fittings if not securely retained. It is this same elastic nature, however, that makes them such excellent materials for this peristaltic type pump. NORPRENE® tubing yields longer life, especially under pressure. Refer to Table 1 for tubing recommendations. Do not attempt to use other materials in lieu of these, as pump performance could be severely compromised with possible damage to the pump.



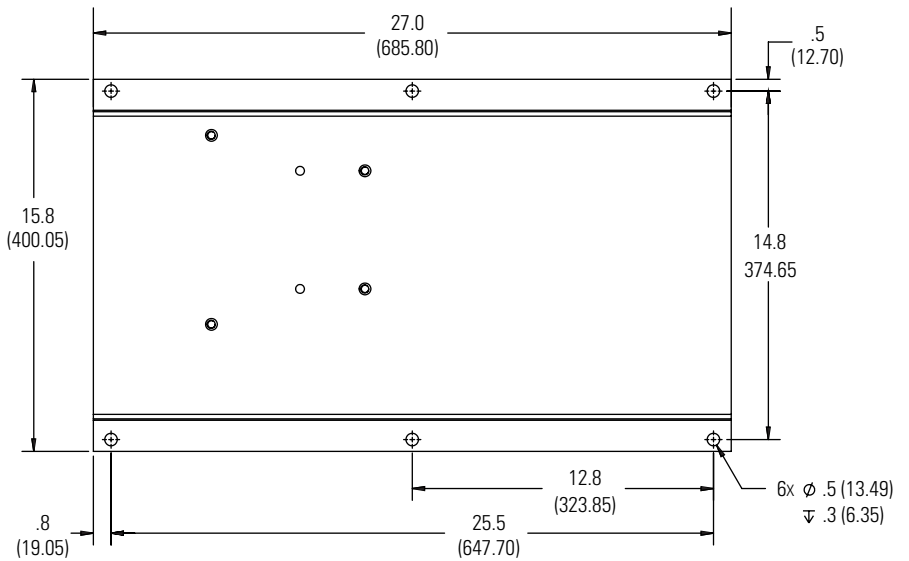
**Figure 1-2.** RAPID-LOAD Pump and Drive



## Section 2 Installation and Setup

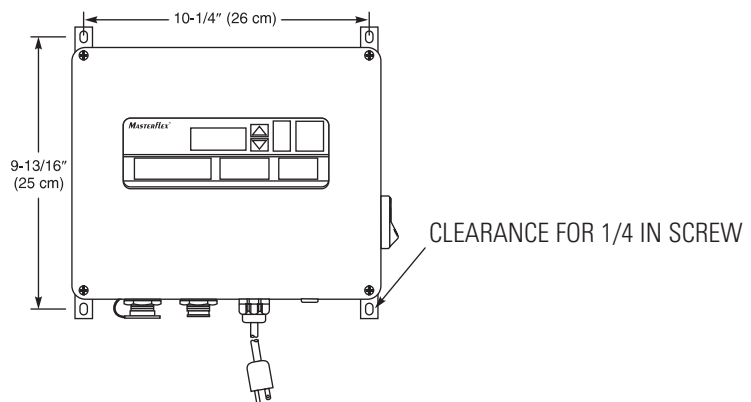
These units should be placed on a flat surface such as a floor, bench or table and should be near an electrical power source. Be sure to check data plate for proper voltage rating(s).

### PUMP MOUNTING DIMENSIONS (All Models)



**Figure 2-1.** Pump Mounting Dimensions, applies to all Pump Systems.

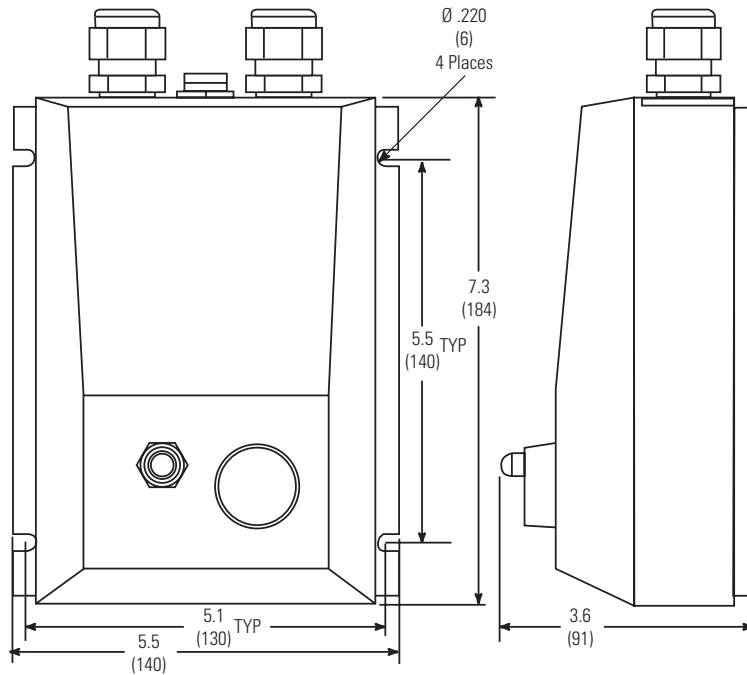
### CONTROL BOX MOUNTING DIMENSIONS (Digital Models Only)



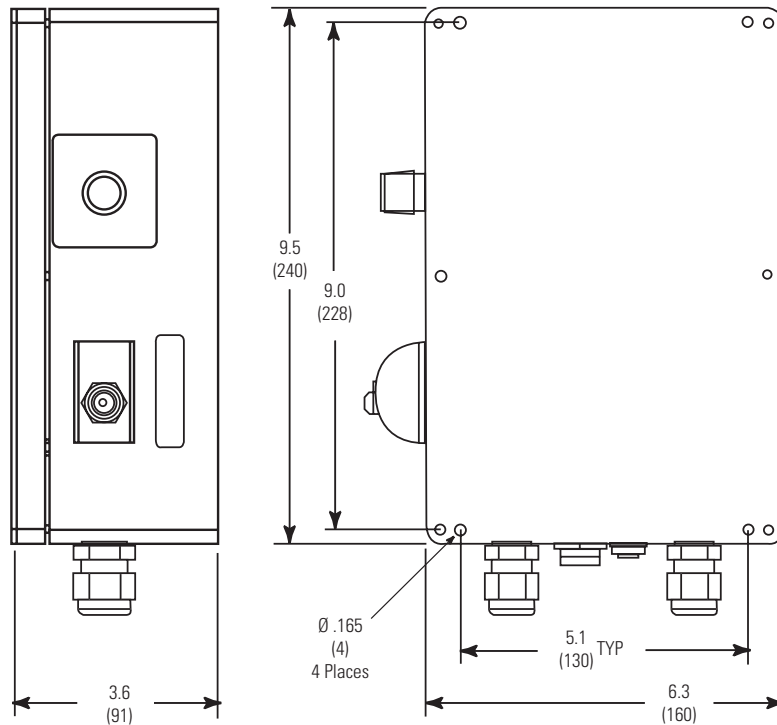
**Figure 2-2.** Control Box Mounting Dimensions 875-2611, 875-2613, 945-2610 and 945-2615.

# CONTROL BOX MOUNTING DIMENSIONS (Analog Models 945-1610 and 945-1615 Only)

**NOTE:** The controller and bracket can be removed and located up to 10 feet away.



**Figure 2-3.** Control Box Mounting Dimensions 945-1610 (115V).



**Figure 2-4.** Control Box Mounting Dimensions 945-1615 (230V).

## Model 945-1620

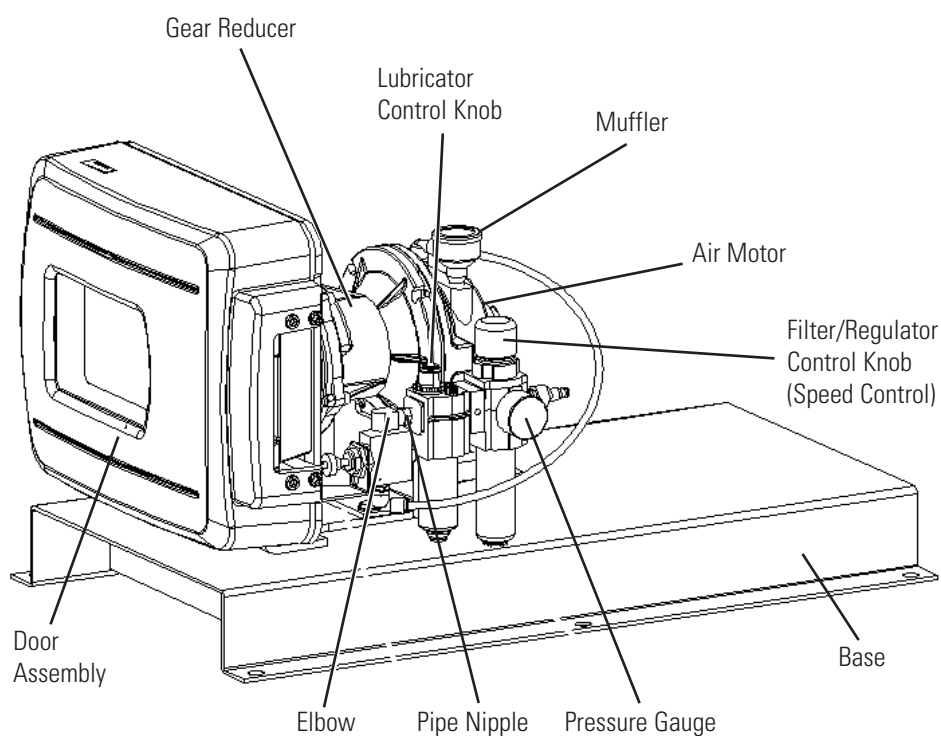
This unit should be placed on a flat surface such as a floor, bench, or table and should be near a compressed air source.

**Unpack the drive** and save packaging material until proper product operation has been verified.

**Install the following components:** pressure gauge, pressure filter/regulator and lubricator assembly, pipe nipple, elbow, and muffler. See Figure 2-5 for proper orientation, (all items and fittings included except as noted). Use a thread seal such as PTFE tape for all connections to reduce the possibility of air leakage.

Connect compressed air line to the 1/4 NPT connection on the regulator (fitting not supplied). Turn on compressed air line to start pumping. (Maximum 100 psig inlet.)

**NOTE:** Pump will not run unless Door Assembly is closed.



**Figure 2-5.** Air-Powered Rapid-Load Pump and Drive

## MODEL 945-3399

Install customer-supplied motors in accordance with the following procedure.



**CAUTION:** This product is intended for use with a motor that has a maximum speed of 1800 rpm, @ 0.5 HP (0.67 KW). Do not use a motor with a higher speed capacity.



**WARNING:** Electrical connections and grounding (earthing), must conform to local codes. (See motor wiring diagram for motor wiring instructions.)

Tools required: 5/16 inch Hex Key.

Model 945-3399 is designed to be installed to a customer-supplied NEMA Type 56C frame motor. To install the unit, refer to Figure 2-6 and follow these steps:

1. Using a 5/16 inch Hex Key, and the supplied hardware, bolt the motor to the gear reducer by installing the four flat washers on the bolts and inserting the bolts through the gear head adapter into the motor. Torque bolts from 17 to 19 foot pounds.
2. Cutoff connector from end of interlock cable and strip outer jacket.
3. Strip individual conductors and wire in series with the power to the motor turned off. Failure to do so will result in defeating the door interlock, creating a potential crushing hazard.



**CAUTION:** Risk of crushing. Keep fingers away from rotor while pump is in operation. Stop pump before loading or unloading tubing.

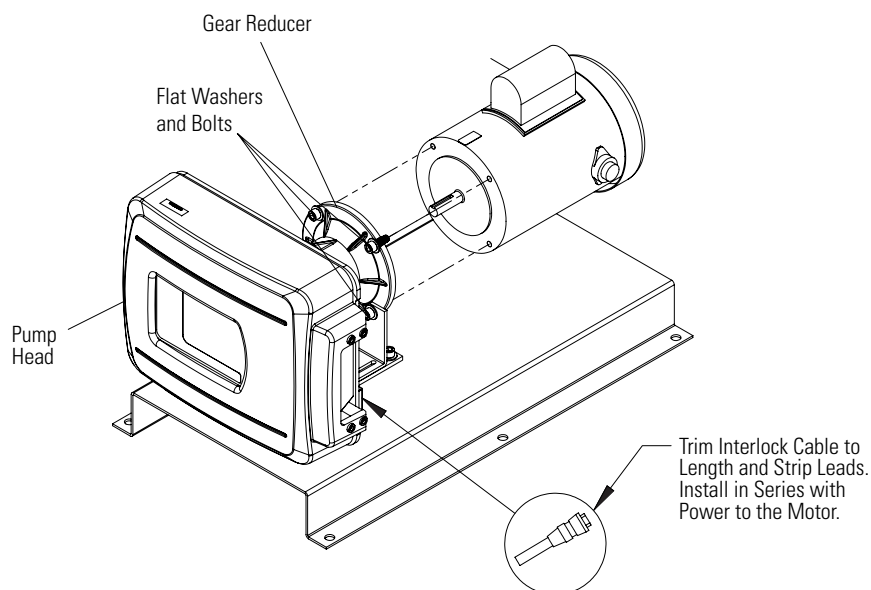


Figure 2-6. Motor Mounting NEMA TYPE 56C Motor Frame

## MODEL 945-4399

Install customer-supplied motors in accordance with the following procedure.

**CAUTION:** This product is intended for use with a motor that has a maximum speed of 1800 rpm, @ 0.5 HP (0.67 KW). Do not use a motor with a higher speed capacity.

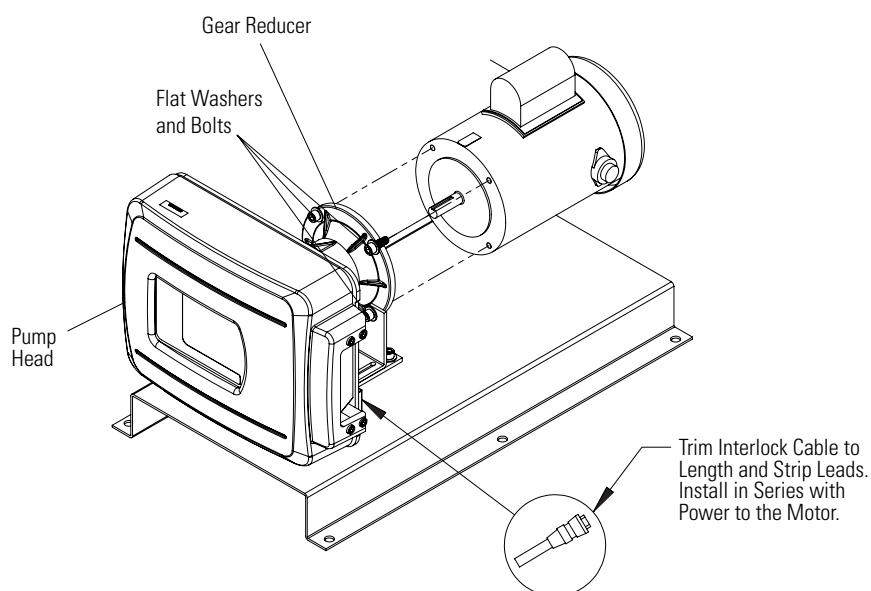
**WARNING:** Electrical connections and grounding (earthing), must conform to local codes. (See motor wiring diagram for motor wiring instructions.)

Tools required: 13 mm Wrench.

Model 945-4399 is designed to be installed to a customer-supplied IEC-72-71-14F130 frame motor with foot mountings. To install the unit, refer to Figure 2-7 and follow these steps:

1. Using a 13 mm wrench, and the supplied hardware, bolt the motor to the gear reducer by installing the four flat washers on the bolts and inserting the bolts through the gear head adapter into the motor. Torque bolts from 1.73 to 2.00 kilogram-meters (12.5 to 14.5 foot pounds.)
2. Cutoff connector from end of interlock cable and strip outer jacket.
3. Strip individual conductors and wire in series with the power to the motor turned off. Failure to do so will result in defeating the door interlock, creating a potential crushing hazard.

**CAUTION:** Risk of crushing. Keep fingers away from rotor while pump is in operation. Stop pump before loading or unloading tubing.



**Figure 2-7.** Motor Mounting IEC-72 71-14F130 Motor Frame

## TUBING TYPES

Use only **MASTERFLEX PERFECTPOSITION B/T** precision tubing with **MASTERFLEX** pumps to ensure optimum performance.

**Use of other tubing may void applicable warranties.**

**NOTE** Use **MASTERFLEX PERFECTPOSITION B/T** tubing. These pumps are designed to use **PERFECTPOSITION B/T** tubing sizes 87 and 91 only. The tubing sizes refer to the last two digits of the **MASTERFLEX PERFECTPOSITION B/T** tubing model number.

**Table 1.** Tubing Types

Characteristics	Tubing Size	
	B/T 87	B/T 91
Inside Dia. in (mm)	0.5 (12.7)	0.75 (19.05)
Hose barb size in (mm)	1/2" (12.7)	3/4" (19.0)
Flow Range (with 321 rpm drive)	0.17-5.0 GPM (0.010-18.9 L/m)	0.37-10 GPM (1.40-37.85 L/m)
Nominal Flow Per Revolution	70.46 mL	141 mL
Maximum Vacuum	28.5 in Hg	28.5 in Hg
Maximum Pressure	35 PSI	30 PSI

All **MASTERFLEX PERFECTPOSITION B/T** tubing formulations in sizes B/T 87 and B/T 91 can be used with this pump. Be sure tubing material matches application.



**Verify tubing material chemical compatibility prior to use. It is the sole responsibility of the user to determine suitability of the product for the application.**

<b>PERFECTPOSITION Pump Tubing</b>	<b>B/T 87</b>	<b>B/T 91</b>
Silicone - 10 ft. (3.0 m), Platinum cured	96510-87	96510-91
Silicone - 10 ft. (3.0 m), Peroxide cured	96400-87	96400-91
BioPharm silicone - 10 ft. (3.0 m), Platinum cured	96421-87	96421-91
BioPharm silicone - 3 ft. (0.9 m)	96424-87	96424-91
BioPharm Plus silicone - 10 ft. (3.0 m), Platinum cured	96441-87	96441-91
BioPharm Plus silicone - 3 ft. (0.9 m)	96444-87	96444-91
C-FLEX - 10 ft. (3.0 m)	6424-87	6424-91
Chem-Durance® 25 ft. (7.6 m)	6432-87	6432-91
Chem-Durance® BIO 25 ft. (7.6 m)	6442-87	6442-91
PharMed® BPT - 25 ft. (7.6 m)	6508-87	6508-91
PharMed® BPT - 3 ft. (0.9 m)	95668-87	95668-91
PharmaPure® - 25 ft. (7.6 m)	6435-87	6435-91
NORPRENE® food - 25 ft. (7.6 m)	6402-87	6402-91
NORPRENE® food - 3 ft. (0.9 m)	6403-87	6403-91
TYGON® LFL - 25 ft. (7.6 m)	6429-87	6429-91
TYGON® LFL - 3 ft. (0.9 m)	6430-87	6430-91



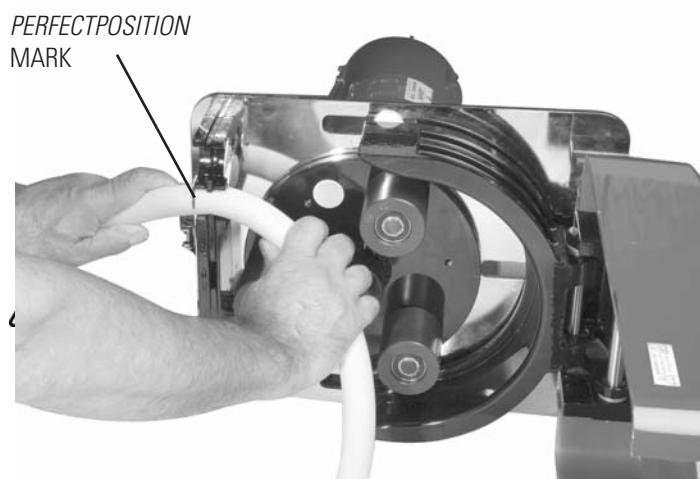
**WARNING: Before permanent installation, test the equipment with the chemicals and under the specific conditions of your application.**

## INSTALLING THE PUMP TUBING (All Pump Models)

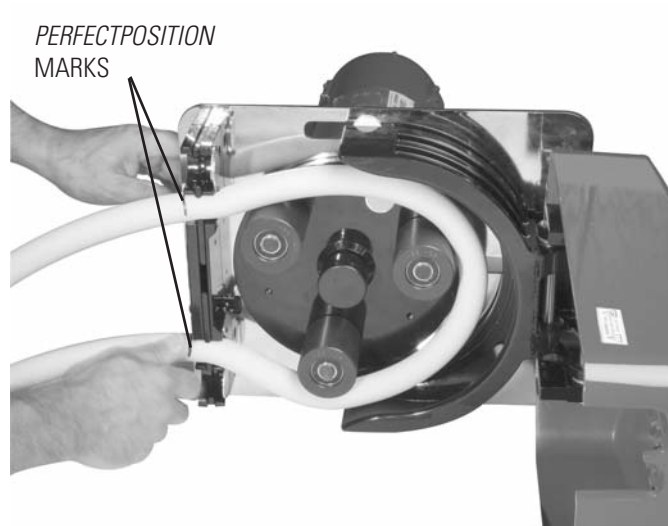


**WARNING:** Power must be removed from pump before removing or installing tubing. Fingers or loose clothing could get caught in drive mechanism. Do not operate this pump without cover or interlock door properly closed and latched. Rotating parts can cause serious injury.

1. Cut off power to the pump by disconnecting line cord or, if wired permanently, by removing the fuse. Do not assume that turning off the switch at the motor (or controller) is "safe enough."
2. Unlatch the door latch and open the cover.
3. Insert the tube in the appropriate upper tube retaining pocket (see Figure 2-10). Line up the "PERFECTPOSITION" placement marks printed on the tube with the outside edge of the retainer assembly (see Figure 2-8).



**Figure 2-8.** Tubing Retaining Pockets




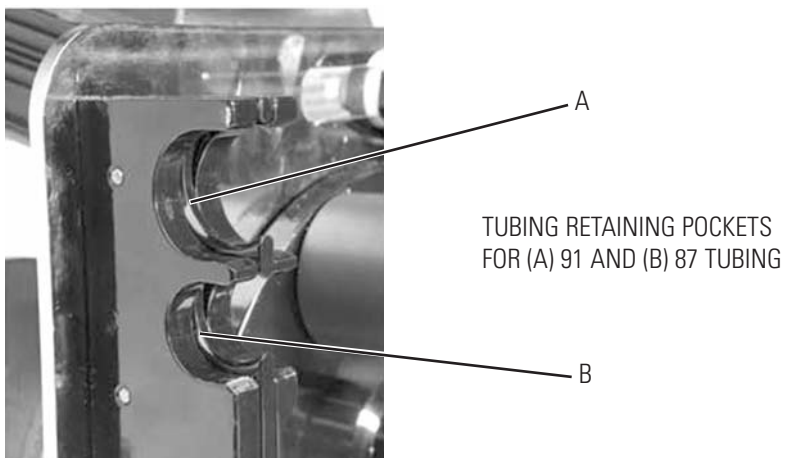
**Figure 2-9.** PERFECTPOSITION Marks

4. If the new tube must be cut from a length of approved replacement tubing, a minimum of 32 inches will be required for a new tube.
5. Going with the natural lay or curvature of the tubing, wrap the tubing around the assembly and insert the tubing in the lower retaining pocket.
6. Close the door and insure that door latch is engaged and locked.

 **WARNING: Do not operate this pump without cover or interlock door properly closed and latched. Rotating parts can cause serious injury.**

7. Restore power to the pump.

 **WARNING: To reduce the risk of injury, use hose clamps on all tubing connections.**  
**All tubing connections must be made outside of the pump.**

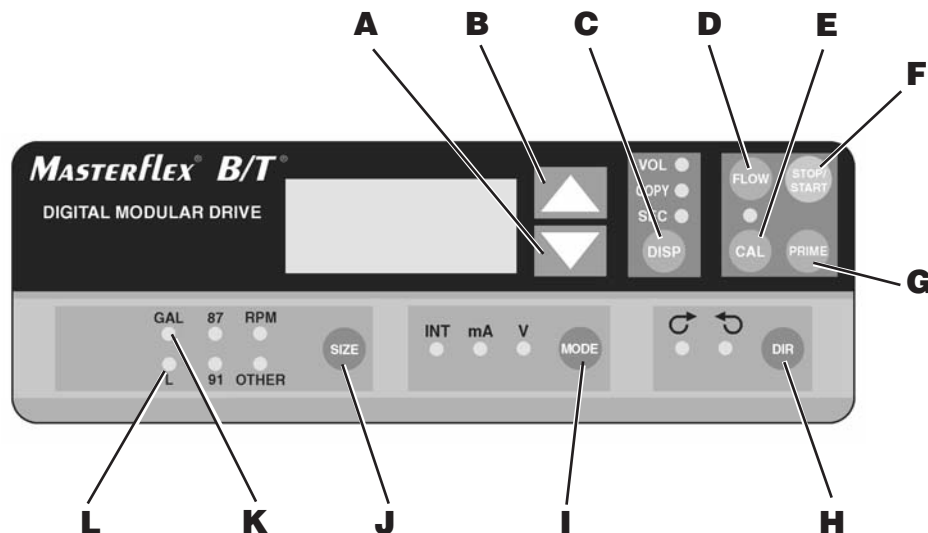


**Figure 2-10.** Tubing Retaining Pockets



## Section 3 Operation

### Control Display Functions Models 875-2611 875-2613 945-2610 945-2615



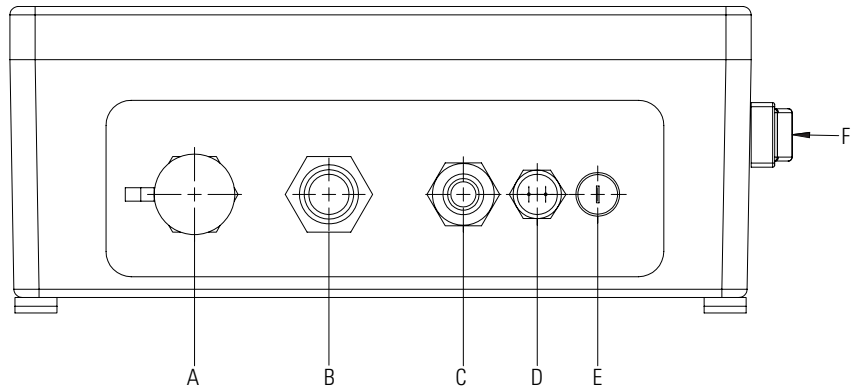
- A) DOWN ARROW (DECREMENT)**—Decrease value of a flashing display.
- B) UP ARROW (INCREMENT)**—Increase value of a flashing display.
- C) DISPENSE/COPY**—Set dispense volume, copy amount, or dispense time.
- D) FLOW CONTROL**—Set flow rate for selected tubing size. To change flow rate, press ▲ or ▼ arrows. (If pump is running, its speed will change with new settings.)
- E) CAL CONTROL**—Refine built-in calibration, using a measured volume.
- F) STOP/START**—Stop/Start motor.
- G) PRIME**—Run pump at full speed to fill or clear lines.
- H) DIRECTION**—To change motor direction.
- I) MODE SELECT**—INT for internal control; mA for remote current control; V for remote voltage control.
- J) SIZE**—Select tubing size and flow units, also displays maximum flow rate.
- K) GALLONS**—Flow and Volume units indicator.
- L) LITERS**—Flow and volume units indicator.

**Figure 3-1.** Control Panel

Press buttons to activate function.

Use up/down (▲, ▼) arrows to correct/change a flashing display.

Press STOP/START to enter new values.



- A) EXTERNAL RECEPTACLE
- B) MOTOR RECEPTACLE
- C) LINE CORD
- D) INTERLOCK CONNECTOR
- E) T8A FUSE (115V AC); T4A FUSE (230V AC)
- F) POWER SWITCH — ALL SETTINGS ARE RETAINED IN MEMORY

**Figure 3-2.** Connectors and Switch on Controller Side Panel

## Controller Setup

1. Connect Motor Cable plug to mating receptacle on the Controller.
2. Connect Interlock Cable plug to mating receptacle on the controller.
3. Connect power cord of Controller to grounded power line outlet.
4. Turn controller on and select TUBING SIZE.

**NOTE:** If CAL LED is lit, that tubing size has been previously field calibrated. If LED is not lit, the drive is operating with the built-in factory calibration. To clear a field calibration, press and hold the CAL switch until the CAL light goes out. This will take about 3 seconds. To recalibrate for better accuracy, see Calibration section.

5. MODE selection (INT, mA, V).
6. Select MOTOR DIRECTION (CW or CCW).
7. PRIME and CALibrate the pump (if required).
8. Press FLOW key and watch display to set the flow rate with UP/DOWN keys.
9. Press STOP/START key to begin pumping.

**NOTE:** Under some circumstances, tubing may creep into pump. If this problem occurs it can be remedied by installing a hose clamp or fitting immediately upstream of and very close to the inlet port.

**NOTE:** Pump will restart automatically after a brownout or powerout condition.

## Calibration

1. Select correct tubing size and flow rate.
2. Press CAL, calibration volume appears.
3. Press STOP/START, the pump will use its stored memory to dispense the specified calibration sample quantity. The pump will stop automatically.
4. Weigh/measure the sample.
5. Use UP/DOWN arrow keys to correct the flashing display.

**NOTE:** If the adjusted calibration is too great, “Err” will appear in the display. If this occurs, press the CAL control and repeat the calibration procedure. The microprocessor will retain one special calibration value per tubing size, even when power is turned off. The next calibration will replace the existing value.

6. Press size to exit the calibration cycle.

## Maximum Flowrate (OTHER Tubing)

1. To set the maximum flowrate for non-standard pumps or tubing sizes, OTHER press CAL, then FLOW. The maximum flowrate will then flash on the display.
2. Use UP/DOWN arrow keys to set desired flowrate.
3. Press SIZE to exit.

## DISPense/copy

A first press of the DISP key results in the last entered dispense volume being displayed. The “VOL” annunciator will illuminate and flash. The INC/DEC keys are used to change the dispense volume, if desired. The STOP/START key then initiates delivery of the set volume. The amount remaining to be dispensed will be displayed during countdown. The dispense function is exited by pressing any key except Increment, Decrement, DISP, or STOP/START.

A second press of the DISP key causes the COPY annunciator to illuminate and flash. The STOP/START key is then used to set the desired volume without the need to know the volume in specific units. A third press of the DISP key enters the volume dispensed. The COPY annunciator stops flashing. The STOP/START key is then used to initiate delivery of the copied volume. The number of copies dispensed will be displayed after each dispense. The STOP/START key is used to pause the copy dispense during dispensing; copy dispense can then be continued using the STOP/START key.

A fourth press of the DISP key results in the last entered dispense time being displayed. The SEC annunciator will illuminate and flash. The INC/DEC keys are used to change the dispense time, if desired, from 1 to 9999 seconds. The STOP/START key then initiates delivery for the set time interval. The remaining time will be displayed during countdown. Pressing the DISP key a fifth time exits this mode.

## Keypad Lockout Enable/Disable

Press and hold FLOW. After five (5) seconds, display will change to all dashes. Then, while holding FLOW, press PRIME five (5) times.

The MODE “INT”: annunciator will flash when the keypad is locked.

## Remote Control

Selectable input (0–20 mA, 4–20 mA, 0–10V DC )

±0.5% linearity control

2300V isolation potential

STOP/START; CW/CCW; PRIME via contact closure

## Remote Control Setup

1. Place the power switch in the off position.



**CAUTION: Power must be turned off before connecting the external remote control cable to prevent damage to the drive.**

2. Connect the cable from the external remote control to the mating receptacle on the bottom panel.
3. Select type of remote control input and output required as follows:
  - a). Press and hold the MODE key while turning the power switch to the on position. After two seconds, release the MODE key. The initial display will show: “inP”. After two seconds the display will show either 0–20 or 4–20.

**NOTE:** Press the up (increment) or down (decrement) arrows to select between 4–20 and 0–20 for current loop control.

- b). Press the MODE key again. The initial display will show: “out”. After two seconds the display will show either 0–20, 4–20, or 0–10.

**NOTE:** Press the up (increment) or down (decrement) arrows to select between 4–20 and 0–20 for current loop output, or 0–10 for voltage output.

4. Press the MODE key to select mode of operation. The LED's indicate the selected mode. Select either mA or V.

**NOTE:** If only remote STOP/START, PRIME and/or CW/CCW is to be used, the MODE control can be set to any of the three positions.

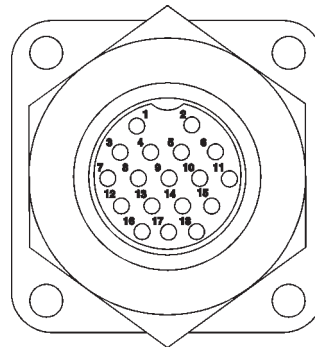
5. To adjust the voltage or current scaling for other than zero to full scale:
  - a). Press the MODE key and then the FLOW key at the same time. The display will show “LO” and then the flow rate for minimum current/voltage (factory default = 0).
  - b). Use the UP/DOWN arrow keys to change the flow rate for minimum current/voltage.
  - c). Press the FLOW key. The display will show “HI” and then the flow rate for maximum current/voltage. Use the UP/DOWN arrow keys to change the flow rate for maximum current/voltage or press the SIZE key to set it to maximum flow rate (factory default). Press any other key to save and exit.

The same scaling will be used for both input and output. Each tube size has its own scaling.

## Remote Control Setup (continued)

**NOTE:** The maximum flow rate for a tubing will change after a calibration is performed. To retain control of the entire flow range, the “HI” scale setting must be changed to the new maximum flow rate after a calibration is performed.

6. Remote STOP/START can be configured to be optional (“OFF”) or mandatory (“ON”). When “ON” is selected, drive will not run unless remote STOP/START is closed. When “OFF” is selected (factory default), remote STOP/START can be used to start drive, but drive can also be started by keypad or remote inputs when remote STOP/START is open. Internal mode or remote mode (mA or V) each have their own STOP/START configuration, so first select the desired operating mode before changing STOP/START setup.
  - a) Press and hold the MODE key until the display changes to “STOP”. The display will alternate with an “ON” or “OFF”.
  - b) Use the UP/DOWN arrow keys to select “ON” or “OFF”.
  - c) Press any other key to save and exit.

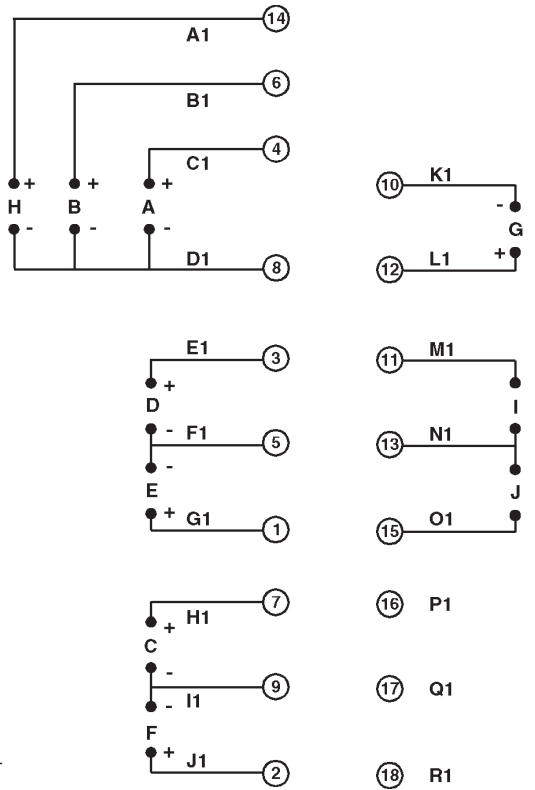


**Figure 3-3.** Remote Control Connector Pin Configuration

# Remote Control Setup (continued)

- A1)** RED/YELLOW
- B1)** BLUE
- C1)** GREEN
- D1)** YELLOW
- E1)** WHITE
- F1)** ORANGE
- G1)** BLACK
- H1)** BROWN
- I1)** VIOLET
- J1)** RED
- K1)** GREY
- L1)** TAN
- M1)** PINK
- N1)** RED/GREEN
- O1)** RED/BLACK
- P1, Q1, R1)** N.C.

- A)** STOP/START
- B)** CW/CCW
- C)** OUTPUT 0-20mA; 4-20mA
- D)** INPUT 0-20mA; 4-20mA
- E)** INPUT 0-10V
- F)** OUTPUT 0-10V
- G)** TACH OUTPUT
- H)** PRIME
- I)** MOTOR RUNNING N.O. CONTACT
- J)** MOTOR RUNNING N.C. CONTACT



**NOTE:** Colors are those of Remote Cable, Cat. number 77300-32.

**Figure 3-4.** Remote Control Wiring Schematic

## Models 945-1610 and 945-1615 Controller

Models 945-1610 (115V model) and 945-1615 (230 V model) are supplied with an electronic controller (see Figure 3-5) for controlling pump speed.

1. Place FWD-OFF-REV switch in the desired position, clockwise (FWD) or counterclockwise (REV) direction.
2. Adjust SPEED control for the desired pump speed.

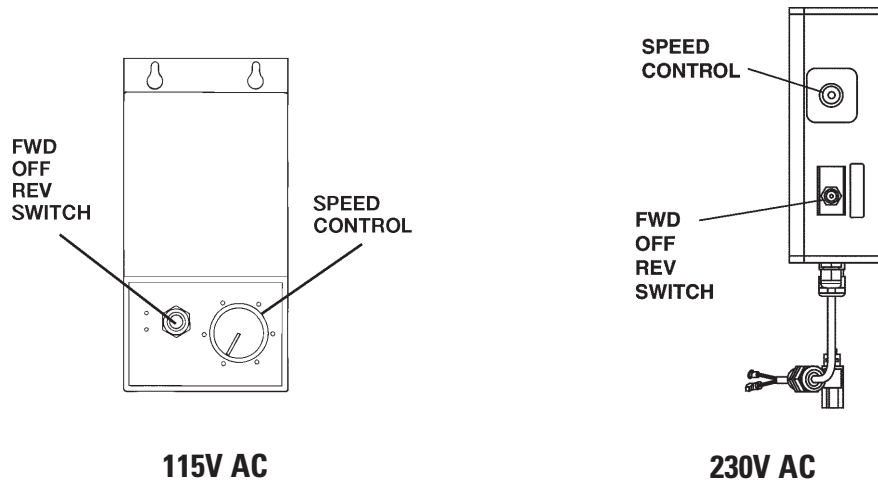


Figure 3-5. Controller



## Model 945-1620

Adjust flow rate with adjustment knob on top of regulator. Vary flow rate from 20 psig to 100 psig. At higher pressures, the pump speed may exceed 321 rpm.



**CAUTION: Do not exceed 321 rpm. Speeds in excess of 321 rpm may cause damage to unit.**

(Lock flow rate by using snap-action push-pull knob on filter regulator.)  
For continuous-duty or high-speed application, use of the lubricator is recommended. Adjust the lubricator with the adjustment knob on top. For higher speeds, set lubricator to provide 1–3 drops/minute. Use a lower setting for lower speeds. See below for RECOMMENDED LUBRICANTS.  
(Lock lubrication rate by using snap-action push-pull knob.)



**Figure 3-6.** Model 945-1620

## Recommended Lubricants

Use a misting type oil rated 50 to 200 SSU (ISO Grade 7 to 46) at 100°F (38°C). Unscrew the bowl to fill the lubricator. Press up on the bottom drain to empty bowl.

## Models 945-1625 and 945-1815 Operating Controls

The following chart highlights items included in each model and the operating controls.

Model No.	Motor Included	ON-OFF Switch
945-1625	Yes	Yes
945-1815	Yes	Yes



**Figure 3-7.** Model 945-1625

## Section 4 Maintenance and Troubleshooting

### REPLACING MOTOR BRUSHES

MODELS 875-2612

875-2614

945-1610

945-1615

945-2610

945-2615

Tools Required: Phillips screwdriver

**WARNING:** Power must be removed from motor before performing this procedure.

1. Cut off power to the pump by disconnecting line cord or, if wired permanently, by removing the fuse. Do not assume that turning off the switch at the motor (or controller) is "safe enough."
2. To access the motor brushes, remove six screws securing the access plate and remove plate (see Figure 4-1).
3. Loosen screw terminal at top of brush housing and disconnect brush wire.
4. Press down on brush retainer to disengage tabs then rotate brush retainer slightly toward front of motor and remove brush retainer.
5. Slide brush assembly out of housing.
6. Install new brush assembly with brush wire toward rear of motor and spring assembly on top.
7. Insert brush retainer against brush springs and push down, then rotate retainer slightly toward rear of motor to engage tabs of retainer under rear edge of brush housing.
8. Attach brush wire to screw terminal at top of brush housing. Be sure wire is clear of access opening.
9. Attach cover plate with six screws.

**NOTE:** Always replace both brushes at the same time.

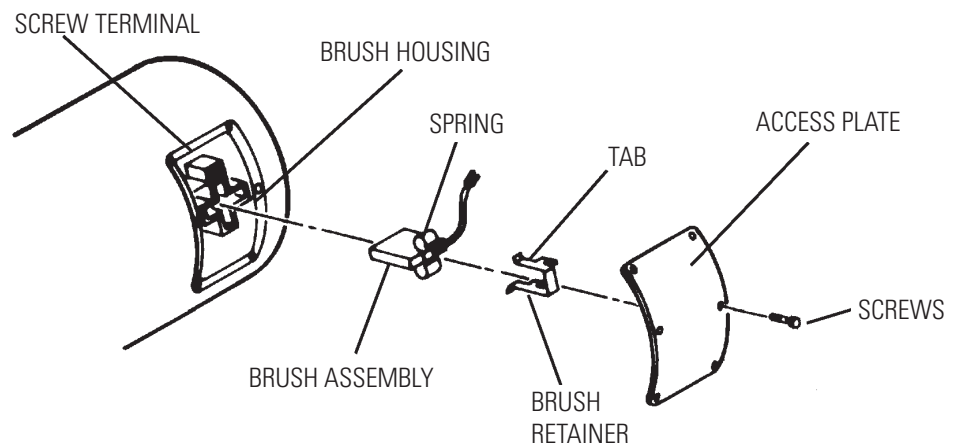
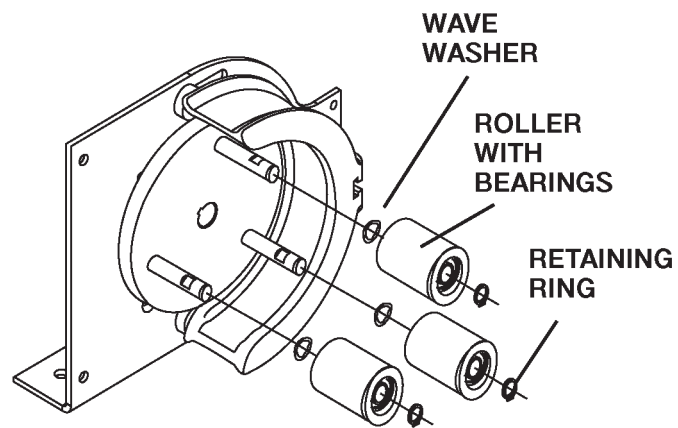


Figure 4-1. Motor Brush

## REPLACING ROLLERS

To replace rollers:

1. Using a retaining ring tool (Part Number 109852-CR), remove the retaining rings from the ends of the roller axles and slide the rollers off. Take care to avoid opening the retaining rings too wide.
2. Check to be sure that the wave washers are installed on the axles against the rotor plate.
3. Slide the new rollers, Replacement Roller Kit 108656-CR, onto the axles, placing the ends with the flush bearing surface inward toward the rotor plate against the wave washers, and the etched ends with the recessed bearing surface outward toward the free ends of the roller axles.
4. Replace the retaining rings. You may have to push the rollers in to compress the wave washers to allow the retaining rings to engage the grooves in the axles.



**Figure 4-2.** Exploded Roller Sub-Assembly

# MOTOR REPLACEMENT

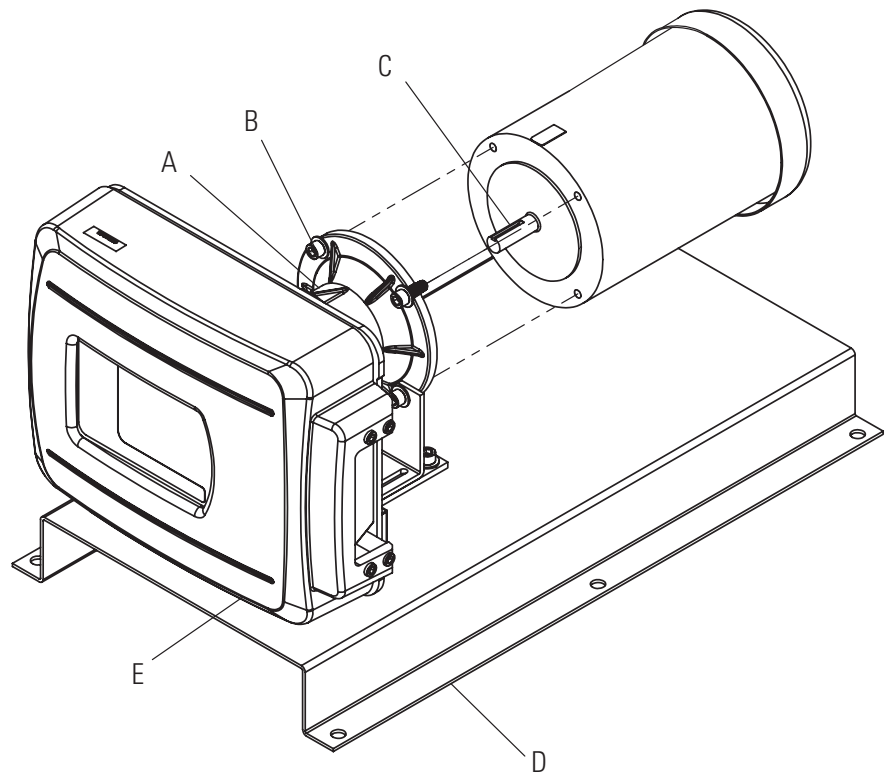
Tools required:

56 C frame mounting, 5/16 inch Hex key.

ISO-71 frame mounting, 10 mm wrench.

To install replacement motor refer to Figure 4-3 and follow these steps:

1. Apply anti-seize compound to shaft and key. Slide motor forward to engage the male motor coupling with the female gear head coupling. Rotate pump rotor if necessary to align the couplings.
2. Using the 5/16 inch hex key, bolt the motor to the gear head adapter by inserting the four bolts through the gear head adapter into the motor. Torque bolts from 17 to 19 foot-pounds.



- A) Gear Head    B) Bolt    C) Shaft  
D) Base        E) Door Assembly

**Figure 4-3.** Motor Mounting

## Replacement Parts

The following list identifies the replaceable parts and includes the part numbers.

Description	Part Number	Qty per Unit
Motor Brush Set (115V AC), Models 875-2612, 945-1610 and 945-2610	A-4156-CR	1
Motor Brush Set (230V AC), Models 875-2614, 945-1615 and 945-2615	A-4158-CR	1
Door Assembly	109473-CR	1
MASTERFLEX B/T, Roller Kit	108656-CR	1
MASTERFLEX B/T, Rotor Assembly/with Rollers	108024-CR	1
Window	109467-CR	1
Shoulder Spacer Kit	109461-CR	6
Safety Switch Assy	109388-CR	1
Fuse - 8.0A, 3AG, (115V AC) Models 875-2611 and 945-2610	77500-27	1
Models 945-1610	77500-28	1
Fuse - T10A, (115V AC), Models 945-1625	77500-29	1
Fuse - T3.6A, (230V AC), Models 945-1815	77500-24	1
Fuse - T4.0A, 5 x 20mm, (230V AC), Models 875-2613, 945-1615 and -2615	77500-26	1
Controller (115V AC) for Model 945-1610	875-2611	1
Controller (230V AC) for Model 945-1615	875-2613	1
Motor (115V AC) Models 945-1610	109545-CR	1
Models 875-2611 and 945-2610	109593-CR	1
Models 945-1625	109556-CR	1
Motor (230V AC) Models 875-2613 and 945-2615	109594-CR	1
Model 945-1615	109546-CR	1
Model 945-1815	109557-CR	1
Air Motor, Model 945-1620	108288-CR	
Motor Mounting Hardware	108688-CR	1
Retaining Ring Kit	7584-07	1
Cable, Control, Extension 20 ft.	108680	1
Line Cord - European, Models 875-2613, 945-1615, 945-1815 and 945-2615	50001-70	1

All MASTERFLEX *PERFECTPOSITION* B/T tubing formulations in sizes B/T 87 and B/T 91 can be used with this pump. Be sure tubing material matches application.

## Accessories

Description	Part Number
Retaining Ring Tool	109852-CR
Cable, Interlock Extension, 25 ft.	109389
Mounting Bracket Digital Controller Models 945-2610 & -2615 only	985-1055
Remote Cable 875-2611, -2613, 945-2610 and 2615 ONLY	77300-32
Handheld Remote Controller 875-2611, -2613, 945-2610 and -2615 ONLY	7592-83
Footswitch Washdown 875-2611, -2613, 945-2610 and -2615 ONLY	7592-30

## Cleaning

Keep the drive enclosure clean with mild detergents. Never immerse nor use excessive fluid.

## Troubleshooting Models 945-2610 and 945-2615

Symptom	Cause	Remedy
A. Motor does not rotate. Display does not light.	A1. No power.	<ol style="list-style-type: none"> <li>1. Check fuse and replace if defective.</li> <li>2. Check that unit is plugged into a live line.</li> <li>3. Check connection of power cord.</li> <li>4. Check the line cord for continuity and replace if defective.</li> <li>5. Return for servicing.</li> </ol>
	A2. Defective remote control.	<ol style="list-style-type: none"> <li>1. Place power switch in off position.</li> <li>2. Check that remote cable connector is inserted fully into the AC receptacle.</li> <li>3. If motor still does not rotate, select INT with the MODE control and press the STOP/START control.</li> <li>4. If the motor rotates, replace the remote control with similar unit. If motor will not rotate, return drive for servicing.</li> </ol>
B. Motor does not rotate. Display lights.	B. MODE control not properly set.	<ol style="list-style-type: none"> <li>1. Check that the MODE control is set to INT for operation with front panel control or to mA or V for operation with remote control.</li> <li>2. If motor still does not rotate, return for servicing.</li> </ol>

## Error Codes

If an error message is displayed, refer to the following list for possible corrective action you can take. If these do not correct the problem, contact your dealer.

Symptom	Cause	Remedy
"Err 1"	Changing speed reference too fast (motor undershoots). No encoder pulses from motor.	Clear by pressing stop/start. Check all motor/encoder connections.
"Err 2"	Changing speed reference too fast (motor overshoots). Motor over-speed.	Clear by pressing stop/start. Check all motor/encoder connections.
"Err 4"	Bad PROM.	Return unit for repair.
"Err 5"	Bad zero crossing detector or crystal.	Return unit for repair.
"Err 6"	Bad EEPROM data, operator parameters set to default values.	Avoid fast switching of power to the unit.
"Err 7"	Bad EEPROM data, A/D span cal, span cal set to default.	Return unit for repair.
"Err 8"	EEPROM write/verify error.	Return unit for repair.

## Section 5 Specifications

### Models 875-2611

875-2612

875-2613

875-2614

945-2610

945-2615

#### Output:

Speed:	11 to 321 r/min
Torque output, Maximum:	1440 oz-in (104 kg•cm)
Speed regulation:	
Line	±0.25% F.S.
Load	±0.25% F.S.
Drift	±0.25% F.S.
Display:	Four-digit, seven segment LED
Remote outputs:	
Voltage speed output	(0–10V DC)
Current speed output	(0–20 mA or 4–20 mA)
Tach output	(TTL, 128 to 7680 Hz)
Motor running output	(N.O. & N.C. contact closure)

#### Input:

Supply voltage limits:	
945-2610	90 to 130 Vrms @ 50/60 Hz
945-2615	200 to 260 Vrms @ 50 Hz
Current, max.:	
945-2610	6.5A
945-2615	3.3A
Remote Inputs:	Start/Stop, CW/CCW, PRIME (contact closure)
Voltage input	(0–10V DC)
Current input	(0–20 mA or 4–20 mA)

#### Construction:

Dimensions (L × W × H):	
870-2611, -2613	9 in × 11 in × 4 1/2 in (229 mm × 279 mm × 114 mm)
870-2612, -2614	28.25 in × 15.88 in × 15.13 in 718 mm x 403 mm x 384 mm
Weight:	
870-2611, -2613	9.4 lbs (4.3 kg)
870-2612, -2614	89.0 lbs (40.37 kg)
Enclosure Rating:	IP 56 (NEMA 4) Per IEC 60529



**Models 875-2611**  
**875-2612**  
**875-2613**  
**875-2614**  
**945-2610**  
**945-2615**  
**(continued)**

**Environment:**

Temperature, Operating:	32° to 104°F (0° to 40°C)
Temperature, Storage:	–49° to 149°F (–45° to 65°C)
Humidity (non-condensing):	10% to 90%
Altitude:	Less than 2000 m
Pollution Degree:	Pollution Degree 3 (Sheltered locations)
Chemical Resistance:	Exposed material is painted aluminum, plastic and vinyl

**Compliance:**

115V: UL508C, UL778  
CSA C22.2 No. 14, C22.2 No. 108  
230V (for CE Mark):  
EU Low Voltage Directive (EN61010-1),  
EU EMC Directive (EN61326) and  
EU Machinery Directive (EN809)

## Models 945-1610 and 945-1615

### Output:

Pump Speed:	12 to 321 rpm
Torque output, maximum:	1100 oz-in (104 kg•cm)
Tubing compatibility:	Sizes 87 or 91
Flow Range:	Up to 10 GPM (37.85 LPM)

### Input:

Supply voltage limits:	
Model 945-1610	90 to 130 Vrms @ 60 Hz
Model 945-1615	200 to 260 Vrms @ 50 Hz
Current, max:	
Model 945-1610	6.5A
Model 945-1615	3.3A

### Construction:

Dimensions (L × W × H):	
Models 945-1610, -1615	27.63 in × 15.88 in × 16.75 in 701 mm × 403 mm × 426 mm
Weight:	
Models 945-1610, -1615	89 lbs (40.4 kg)
Enclosure Rating:	
Models 945-1610, -1615	IP56 per IEC 60529

### Environment:

Operating Temperature:	0°C to 40°C (32°F to 104°F)
Storage Temperature:	-20°C to 60°C (-4°F to 140°F)
Humidity: (non-condensing)	10% to 90%
Altitude:	Less than 2000 m
Pollution Degree:	Degree 3 per EN 61010-1 (Sheltered Locations)
Chemical Resistance:	Exposed material is painted aluminum, plastic and vinyl

### Compliance:

115V: UL778, CSA C22.2 No. 108  
230V: (for CE Mark)  
EU Low Voltage Directive (EN61010-1)  
EU EMC Directive (EN61326)  
EU Machinery Directive (EN809)

## Model 945-1620

### Output:

Pump Speed:	35 to 321 rpm
Torque output, maximum:	1100 oz-in (104 kg-cm)
Tubing compatibility:	Sizes 87 and 91
Flow Range:	up to 10 GPM (37.8 LPM)


### Input:

Compressed air:	24 cfm (0.68 m <sup>3</sup> /min) @ 100 psig
-----------------	--

### Construction:

Dimensions (L × W × H):	27.63 in × 15.88 in × 15.13 in 701 mm × 403 mm × 384 mm
Weight:	63 lbs (28.5 kg)
Enclosure Rating:	IP56 per IEC 60529

### Environment:

Operating Temperature:	1°C to 40°C (34°F to 104°F)
Storage Temperature:	-10°C to 65°C (-14°F to 149°F)
Humidity: (non-condensing)	20% to 80%
Altitude:	Less than 2000 m
North American Rating:	Class I, Division 2, Groups A, B, C, & D, T6
ATEX Rating:	CE  II 3 G c IIC T6
Group:	II (Non-mining equipment)
Category:	3 (No ignition source)
Zone:	2 (Infrequent exposure)
Type of Atmosphere:	G (Gas)
Gas Group	IIC (Hydrogen/Acetylene)
Method of Protection:	"c" (Non-electrical equipment construction)
Temperature Classification:	T6 (85°C max. surface temperature)
Chemical Resistance:	Exposed materials are powder coated aluminum, CRS, plastic, and vinyl

### Compliance (for CE mark):

EN809 (EU Machine Directive)
EN13463-1 and EN13463-5 (EU ATEX Directive)

## Models 945-1625 and 945-1815

### Output:

Pump Speed:	
Model 945-1625	321 rpm
Model 945-1815	271 rpm
Torque output, maximum:	1100 oz-in (104 kg-cm)
Tubing compatibility:	Sizes 87 or 91
Flow Range:	Up to 10 GPM (37.85 LPM)

### Input:

Supply voltage limits:	
Model 945-1625	90 to 130 Vrms @ 60 Hz
Model 945-1815	200 to 260 Vrms @ 50 Hz
Current, max:	
Model 945-1625	8.0A
Model 945-1815	4.0A

### Construction:

Dimensions (L × W × H):	27.63 in × 15.88 in × 15.13 in 701 mm × 403 mm × 384 mm
Weight:	88 lbs (39.9 kg)
Enclosure Rating:	IP65 per IEC 60529

### Environment:

Operating Temperature:	0°C to 40°C (32°F to 104°F)
Storage Temperature:	-10°C to 60°C (-14°F to 140°F)
Humidity: (non-condensing)	10% to 90%
Altitude:	Less than 2000 m
Pollution Degree:	Degree 3 per EN 61010-1 (Sheltered Locations)
Chemical Resistance:	Exposed material is painted aluminum, plastic and vinyl

### Compliance:

115V: UL778, CSA C22.2 No. 108  
 230V: (for CE mark)  
 EU Low Voltage Directive (EN61010-1)  
 EU EMC Directive (EN61326)  
 EU Machinery Directive (EN809)

## Models 945-3399 and 945-4399

<b>Output:</b>	
Pump Speed:	35 to 321 rpm
Torque output, maximum:	1100 oz-in (104 kg-cm)
Tubing compatibility:	Sizes 87 or 91
Flow Range:	Up to 10 GPM (37.85 LPM)
<b>Input:</b>	
	1750 rpm maximum
	1/2 hp (0.37 kW)
	293 oz-in minimum
	NEMA 56C motor for 945-3399 or
	IEC 72 71-14F130 frame for 945-4399
<b>Construction:</b>	
Dimensions (L × W × H):	27.63 in × 15.88 in × 15.13 in 701 mm × 403 mm × 384 mm
Weight:	63 lbs (28.5 kg)
Enclosure Rating:	IP65 per IEC 60529
<b>Environment:</b>	
Operating Temperature:	1°C to 40°C (34°F to 104°F)
Storage Temperature:	-10°C to 65°C (-14°F to 149°F)
Humidity: (non-condensing)	20% to 80%
Altitude:	Less than 2000 m
Chemical Resistance:	Exposed materials are powder coated aluminum, CRS, plastic, and vinyl
<b>Compliance</b> (for CE mark):	EN809 (EU Machine Directive)

## Section 6 Warranty, Product Return and Technical Assistance

### Warranty

*Use only MASTERFLEX precision tubing with MASTERFLEX pumps to ensure optimum performance. Use of other tubing may void applicable warranties.*

This product is warranted against defects in material or workmanship, and at the option of the manufacturer or distributor, any defective product will be repaired or replaced at no charge, or the purchase price will be refunded to the purchaser, provided that: (a) the warranty claim is made in writing within the period of time specified on this warranty card, (b) proof of purchase by bill of sale or receipted invoice is submitted concurrently with the claim and shows that the product is within the applicable warranty period, and (c) the purchaser complies with procedures for returns set forth in the general terms and conditions contained in the manufacturer's or distributor's most recent catalog.

This warranty shall not apply to: (a) defects or damage resulting from: (i) misuse of the product, (ii) use of the product in other than its normal and customary manner, (iii) accident or neglect, (iv) improper testing, operation, maintenance, service, repair, installation, or storage, (v) unauthorized alteration or modification, or (b) post-expiration dated materials.

THIS WARRANTY IS THE EXCLUSIVE REMEDY OF THE PURCHASER, AND THE MANUFACTURER AND DISTRIBUTOR DISCLAIM ALL OTHER WARRANTIES, WHETHER EXPRESS, IMPLIED, OR STATUTORY, INCLUDING WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. NO EMPLOYEE, AGENT, OR REPRESENTATIVE OF THE MANUFACTURER OR DISTRIBUTOR IS AUTHORIZED TO BIND THE MANUFACTURER OR DISTRIBUTOR TO ANY OTHER WARRANTY. IN NO EVENT SHALL THE MANUFACTURER OR DISTRIBUTOR BE LIABLE FOR INCIDENTAL, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES.

*The warranty period for this product is two (2) years from date of purchase.*

## **Product Return**

To limit charges and delays, contact the seller or Manufacturer for authorization and shipping instructions before returning the product, either within or outside of the warranty period. When returning the product, please state the reason for the return. For your protection, pack the product carefully and insure it against possible damage or loss. Any damages resulting from improper packaging are your responsibility.

## **Technical Assistance**

If you have any questions about the use of this product, contact the Manufacturer or authorized seller.

Thermo Fisher Scientific  
28W092 Commercial Ave.  
Barrington, Illinois U.S.A. 60010-2392  
1-800-637-3739 (U.S. and Canada only)  
11 (847) 381-7050 (Outside U.S.)  
(847) 381-7050 (Local)

[www.thermo.com](http://www.thermo.com)  
[fluidhandling@thermofisher.com](mailto:fluidhandling@thermofisher.com)