SINGLE SPEED SYRINGE PUMP

R-200

USER'S MANUAL

DOC-329
Rev. 1.0

Razel Scientific Instruments; a company of Med Associates Inc.
166 Industrial Park Rd. Fairfax, VT 05454
www.razelscientific.com

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CHAPTER 1 | INTRODUCTION

The Razel Single Speed Syringe Pump for pre-clinical use (NOT FOR USE ON HUMANS) is designed to deliver infusions reliably and accurately to subjects.

The default speed of the R-200 motor is 3.33 RPM, but other speeds are available and can be requested by the user. The R-200 pump is activated by an active high TTL signal or a switch closure and remains activated for as long as the TTL signal is high, or switch is on. Thus, the amount of time that the pump is on determines the dose.

An adjustable Automatic Shut-off Switch stops the pump when the end of the syringe is reached.

Figure 1.1 - R-200 Single Speed Syringe Pump

Overview/Operation

FLUSH/ON/OFF Button

- The **FLUSH** position runs the pump at 20 RPM.
- The **ON** position turns the pump power on.
- The **OFF** position turns the pump power off.

RUN/STOP/REMOTE

- The **RUN** position runs the pump manually at the pumps defined RPM.
- The **STOP** position stops the pump.
- The **REMOTE** position allows the pump to be controlled via TTL or Contact Closure.

STATUS INDICATOR

- The **STATUS** indicator light is solid when the pump is in the ON position.
- The **STATUS** indicator light blinks when the pump is operated via the **FLUSH**, **RUN**, or when activated in **REMOTE.**
- The **STATUS** indicator light is off when the pump is in the **OFF** position, or the Automatic Shut-off Switch is engaged.

Pump Wiring

1. Connect via TTL Operate BNC connector for TTL activation or via Contact Closure for switch control.
2. Using the included AC adapter, connect the **28V 1A** to an AC outlet.

Figure 1.2 - Wiring Connections

TTL Operate

Upon receiving an active high operate signal, the pump will begin the infusion until the operate signal is turned off.

Contact Closure

Connect a switch to the Contact Closure for switch control.

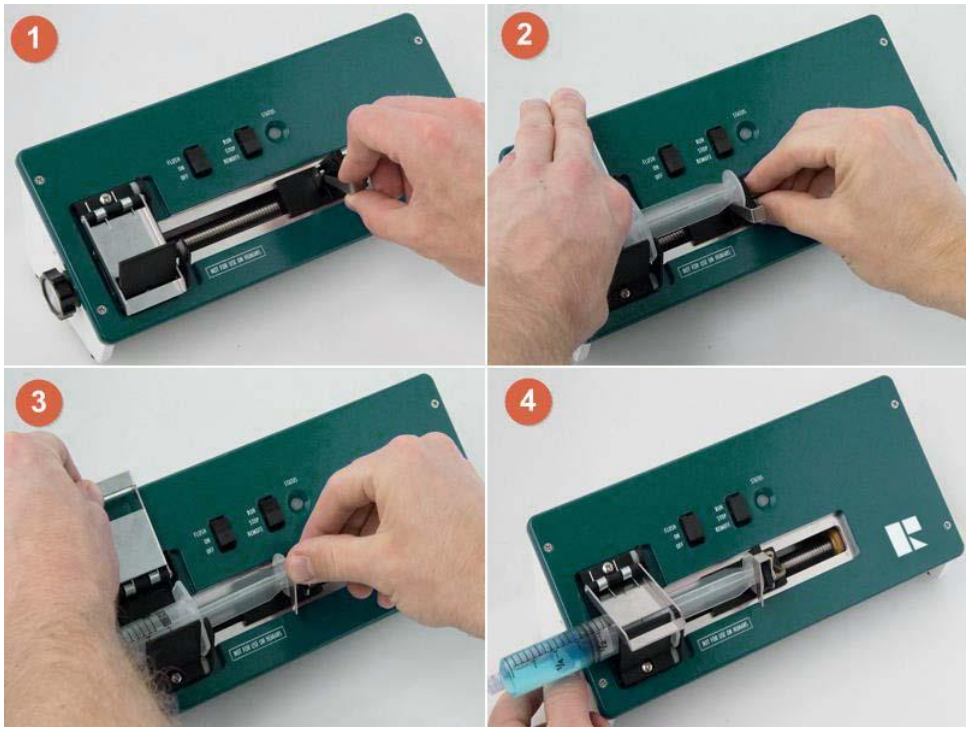
Figure 1.3 – Contact Closure

Pull out adapter plug from pump, install wires and tighten screws to secure, and reinstall adapter plug.

CHAPTER 2 | SYRINGE PLACEMENT

Loading a Syringe

Figure 2.1 – Loading a Syringe



1. Squeeze the jaws and move the slide towards the rear of the pump. Rotate the plunger lock so it pushes the rib guide is in the upwards position .
2. Open the syringe clamp and position the syringe so the barrel Flange is in between the clamp and flange guard. Squeeze the jaws and move the slide up to the end of the plunger.
3. Ensure plunger rib is seated in rib guide and rotate the plunger lock forward around the plunger flange.
4. Close the clamp and rotate the manual advance knob, use the **FLUSH**, or **RUN** function until liquid drips out of the syringe or tubing. This ensures that fluid will be infused properly when the pump is activated.

Glass Syringes

Extra caution is needed when using glass syringes with a ground glass plunger. These syringes exhibit almost no sliding friction and thus can cause an uncontrolled infusion in the following two ways:

1. The weight of the plunger may be sufficient to push the fluid out of the syringe if it is positioned with the plunger above the barrel.
2. The weight of the fluid in the tubing may be sufficient to siphon the fluid out of the syringe if the catheter infusion site is below the height of the syringe.

To test for these two conditions, it is suggested that the syringe be connected to the tubing and held vertically at the height of the pump. If no motion occurs, the syringe can then be placed in the pump.

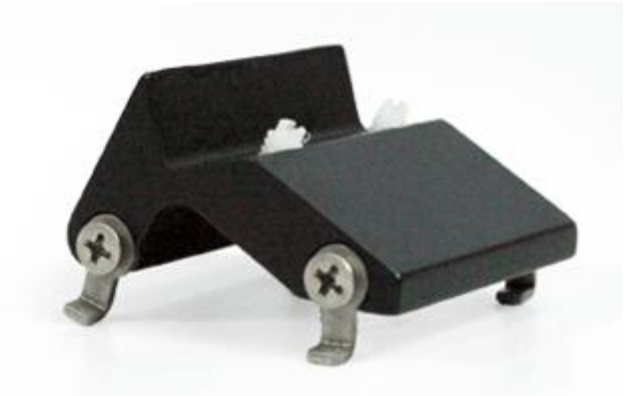
The following may reduce the danger of an uncontrolled infusion:

1. Lower the relative height of the infusion pump in relation to the infusion site. With the pump below the infusion site, the instrument will pump the fluid to the higher elevation.
2. Use a smaller bore catheter, which will reduce the weight of the fluid in the tubing and increase the friction on the flowing fluid.
3. Position the pump so that the syringe is vertical (plunger below), thus the weight of the syringe plunger will be acting against the weight of the fluid.
4. Use a syringe with a rubber seal on the plunger, i.e. an O-ring sealed or plastic syringe.

Small Syringes

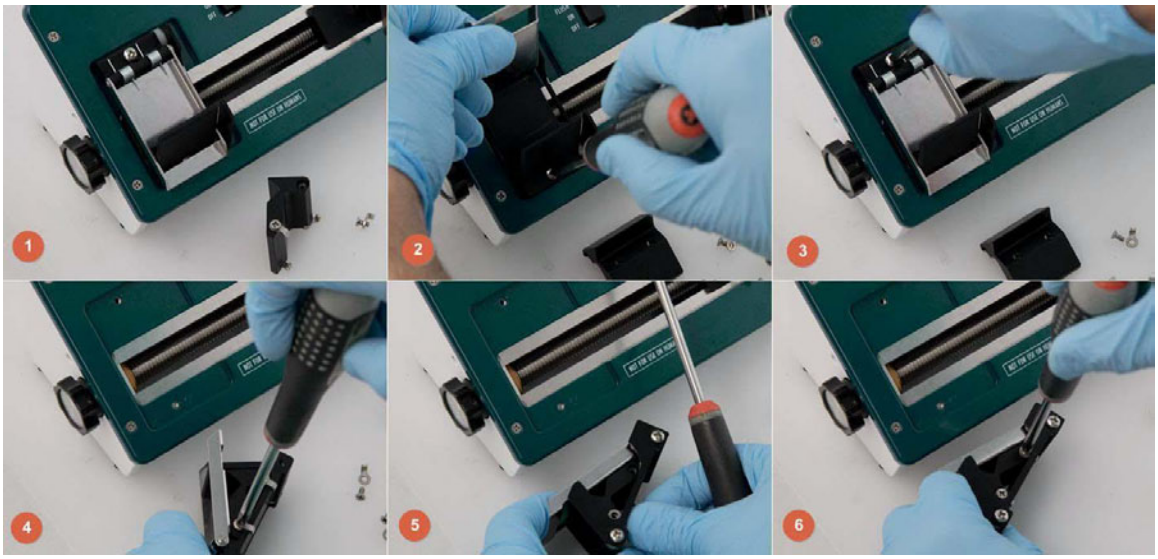
Syringes of less than 5mL in capacity can be held more securely in the syringe clamp if the R-ACC Micro Syringe Insert is used. This R-ACC slides into the standard syringe clamp and can hold up to two micro syringes if required. See Figure 2.2.

Figure 2.2 - R-ACC Micro Syringe Insert



Micro Syringe Insert Installation

Figure 2.3 – R-ACC Micro Syringe Insert Installation



1. Using a Phillips screwdriver, remove the screw and grab washers from the R-ACC,
2. Lift clamp and remove bottom clamp assembly screw.
3. Remove the top clamp assembly screw and remove clamp assembly from the pump.
4. Install R-ACC to the clamp assembly by reinstalling grab washes. Ensure the R-ACC is in the correct orientation. The R-ACC high angled section should mate up to the clamp angled section and the grab washers should wrap around the bottom of the clamp assembly.
5. Slide the grab washers under flange guard on the right side of the clamp assembly.
6. Secure grab washers to the R-ACC using the Phillips head screws.
7. Reinstall clamp assembly, see images 2 and 3.

CHAPTER 3 | AUTOMATIC SHUT-OFF SWITCH

The Automatic Shut-off Switch is activated when the pump reaches the end of the syringe, and it causes the pump to cease operation and the **STATUS** indicator light will turn off, providing a visual indication that the infusion is complete. The Automatic Shut-off Switch uses an internal micro-switch that detects when the slide assembly reaches a certain point. This point is adjustable so that the pump can accommodate various sizes and brands of syringes.

To adjust the Automatic Shut-off Switch, insert an empty syringe with the plunger at the desired shut-off position. With the pump in the **ON** position, rotate the adjustment screw using the included 9/64" Allen key until the **STATUS** light turns off.

Adjusting the Automatic Shut-off Switch clockwise will allow the pump to operate longer before the automatic shut-off switch activates. Rotating the screw counterclockwise will cause the automatic shut-off switch to activate sooner. To resume pump operation once the Automatic Shut-off Switch has been activated, the slide must be moved back until the switch is deactivated (**STATUS** indicator light will illuminate when deactivated).

Figure 3.1 - Automatic Shut-off Switch Adjustment

CHAPTER 4 | FLOW RATES

The flow rate of the R-200 pump depends on the size of the syringe being used. The tables in this chapter contain the flow rates that correspond with several commonly used syringe brands and sizes, however the equation shown below can also be used to calculate the flow rate.
The following equation determines the **approximate** flow rate of the pump:

Flow Rate (mL/min) = .19538 x Motor RPM x Syringe Cross Sectional Area (cm^2)

NOTE: If the syringe cross-sectional area is unknown, or in applications where precise control of infusion volume is required, it is recommended that users calibrate each infusion pump using the syringe size of choice. A calibration curve should be created that shows volume output plotted as a function of RPM and Time. The desired flow rate should be validated using this method.

Syringe Cross-Sectional Areas

MULTIFIT, glass

Syringe Size	Cross-section
1 mL	0.176 sq cm
2 mL	0.626 sq cm
5 mL	1.084 sq cm
10 mL	1.692 sq cm
20 mL	3.017 sq cm
30 mL	4.047 sq cm
50 mL	6.173 sq cm

HAMILTON, glass

Syringe Size	Cross-section
10 mL	0.00167 sq cm
25 mL	0.00417 sq cm
.05 mL	0.00833 sq cm
.10 mL	0.01667 sq cm
.25 mL	0.04167 sq cm
.50 mL	0.08333 sq cm
1 mL	0.16667 sq cm
2.5 mL	0.41667 sq cm
5 mL	0.83333 sq cm
10 mL	1.6667 sq cm

UNIMETRICS, glass

Syringe Size	Cross-section
.05 mL	0.00833 sq cm
.10 mL	0.01667 sq cm
.25 mL	0.04167 sq cm
.50 mL	0.08333 sq cm
1 mL	0.16667 sq cm

MONOJECT, plastic

Syringe Size	Cross-section
1 mL	0.173 sq cm
3 mL	0.622 sq cm
6 mL	1.263 sq cm
12 mL	1.977 sq cm
20 mL	3.308 sq cm
35 mL	4.474 sq cm
60 mL	5.545 sq cm

B-D PLASTIPAK, plastic

Syringe Size	Cross-section
1 mL	0.173 sq cm
2.5 mL	0.578 sq cm
5 mL	1.129 sq cm
10 mL	1.635 sq cm
20 mL	2.850 sq cm
30 mL	3.662 sq cm
60 mL	5.556 sq cm

TERUMO, plastic

Syringe Size	Cross-section
3 mL	0.629 sq cm
5 mL	1.327 sq cm
10 mL	1.961 sq cm
20 mL	3.189 sq cm
30 mL	4.191 sq cm
60 mL	6.651 sq cm

Pump Speeds and Flow Rates

The following tables contain the flow rates in **milliliters per minute** for several commonly used syringe brands and sizes. The most commonly used RPM is 3.33, however additional available pump speeds have been included in the tables.

MULTIFIT, glass

Motor RPM	1 mL	2 mL	5 mL	10 mL	20 mL	30 mL	50 mL
0.50	0.017	0.061	0.106	0.165	0.295	0.395	0.603
1.00	0.034	0.122	0.212	0.331	0.589	0.791	1.206
1.50	0.052	0.184	0.318	0.496	0.884	1.186	1.809
2.00	0.069	0.245	0.424	0.661	1.179	1.581	2.412
3.33	0.115	0.408	0.706	1.102	1.965	2.636	4.02
5.00	0.172	0.612	1.059	1.653	2.947	3.954	6.031
10.00	0.344	1.223	2.118	3.306	5.895	7.907	12.061
15.00	0.516	1.835	3.177	4.959	8.843	11.861	18.092
20.00	0.688	2.446	4.236	6.612	11.789	15.814	24.122

B-D PLASTIPAK, plastic

Motor RPM	10 mL	20 mL	30 mL	50-60 mL
0.50	0.160	0.278	0.358	0.542
1.00	0.320	0.557	0.715	1.084
1.50	0.480	0.835	1.073	1.626
2.00	0.640	1.114	1.431	2.169
3.33	1.066	1.856	2.385	3.614
5.00	1.600	2.784	3.577	5.421
10.00	3.198	5.895	7.155	10.843
15.00	4.798	8.353	10.732	16.264
20.00	6.397	11.137	14.310	21.686

MONOJECT, plastic

Motor RPM	12 mL	20 mL	35 mL	50-60 mL
0.50	0.193	0.323	0.437	0.542
1.00	0.386	0.646	0.874	1.084
1.50	0.579	0.969	1.311	1.626
2.00	0.773	1.292	1.748	2.169
3.33	1.288	2.154	2.914	3.614
5.00	1.931	3.231	4.371	5.421
10.00	3.863	6.462	8.741	10.843
15.00	5.794	9.694	13.112	16.264
20.00	7.726	12.925	17.483	21.686

CHAPTER 5 | MAINTENANCE AND TROUBLESHOOTING

Cleaning: Clean the pump case using a soft cloth that is dampened with water and a detergent. The pump case is entirely aluminum.

DO NOT AUTOCLAVE

DO NOT SUBMERGE

Lubrication: A few drops of food grade oil lubricant on the lead screw is recommended annually.

Mechanical: If the syringe is not emptying, check if the tubing is kinked or if the syringe is bound. Check the pressure capability of the pump by installing a new syringe filled with only water, if the slide is not capable of pushing the syringe, both the lead screw and the slide should be inspected for wear; and any worn part should be replaced by Razel Scientific Instruments.

APPENDIX A | CONTACT INFORMATION

Please contact Razel Scientific Instruments for information regarding any of our products.

For Technical questions, email support@med-associates.com.

For Sales questions, email sales@med-associates.com.

Visit our website at www.razelscientific.com.