



RAZEL R99-E SYRINGE PUMP

USER'S MANUAL



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Pump Overview

The Razel R99-E multiple speed syringe pump is compatible with syringe sizes from 5 to 50 cc and includes a safety shut-off switch that stops the pump when the end of the syringe is reached. The R99-E has a movable flow rate chart that is used as a guide for determining the switch setting necessary to achieve the desired flow rate. The flow rates on the movable chart apply only when using BD Multifit™ syringes; however other syringe brands may be used. The R99-E flow rates range from 0.25 to 143 cc/hr and the flow rate can be changed during an infusion.

R99-E Options

The Razel R99-E syringe pump is available with several different options and can be equipped with more than one option. The options included on each pump are indicated in the model number, which can be found on the serial number tag, as shown below.

Figure 1.1 - Serial Number Tag with Model Number

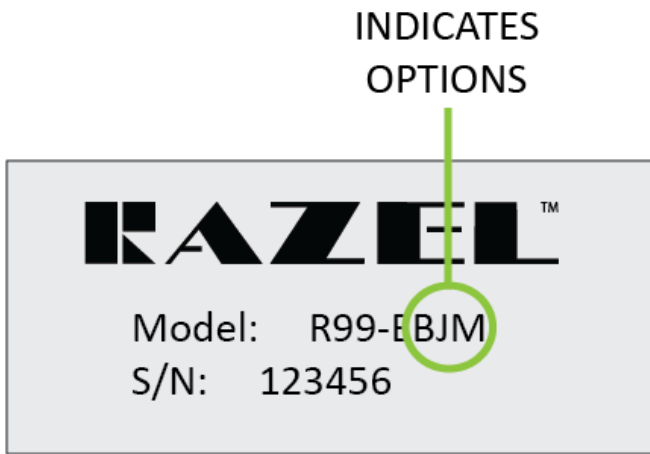


Figure 1.2 – R99-E Options

Option	Description
B	This option allows the pump to operate in reverse.
F	This is the alarm option.
JM	This option allows a range of flow rates from 0.025 to 430 cc/hr.
S	This option adds remote operation (TTL, 28VDC, switch closure).
Z	This option indicates the pump is equipped for 230VAC operation.
ES	This option indicates the pump is equipped with a grounding port.

User Interface

Figure 1.3 – R99-E Control Panel



Figure 1.4 - R99-F Back Panel (Alarm Included on F Option Only)

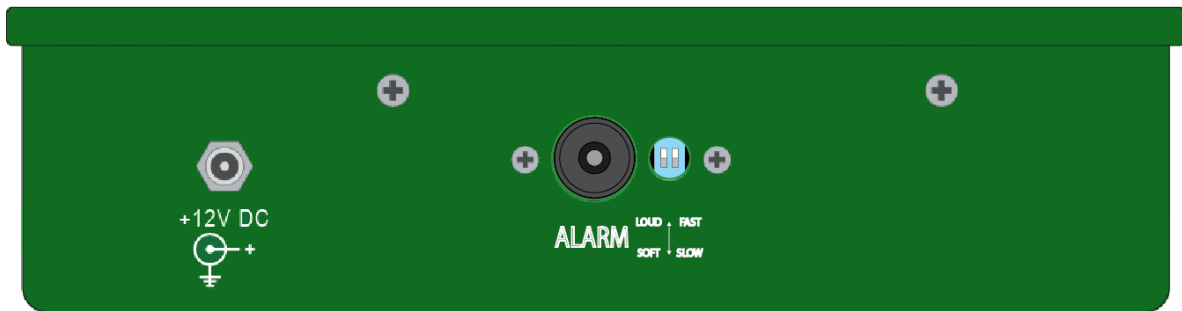


Figure 1.5 – R99-EB Front Panel (Forward/Reverse Switch Included on B Option Only)

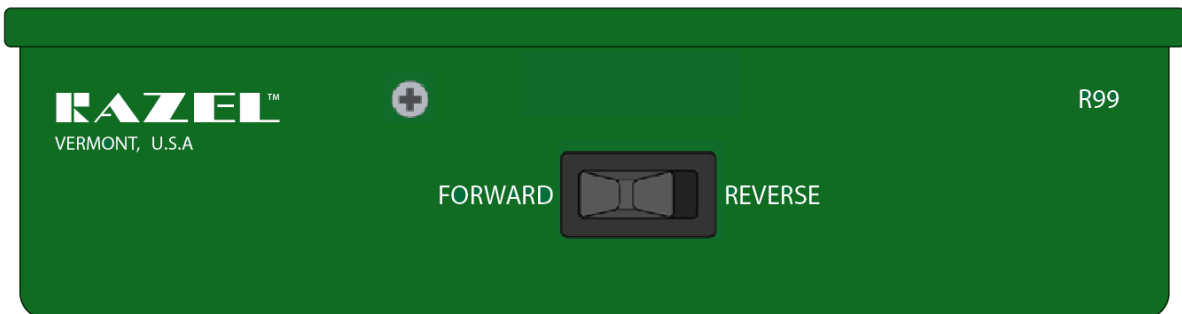


Figure 1.6 – R99-EXXX-ES Back Panel (Grounding Port Included With ES Option Only)

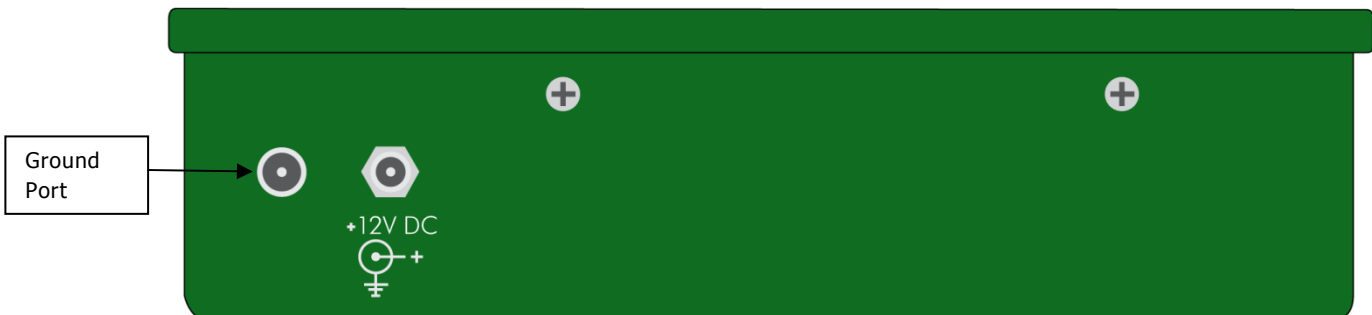


Figure 1.7 - Pump Mechanism Components

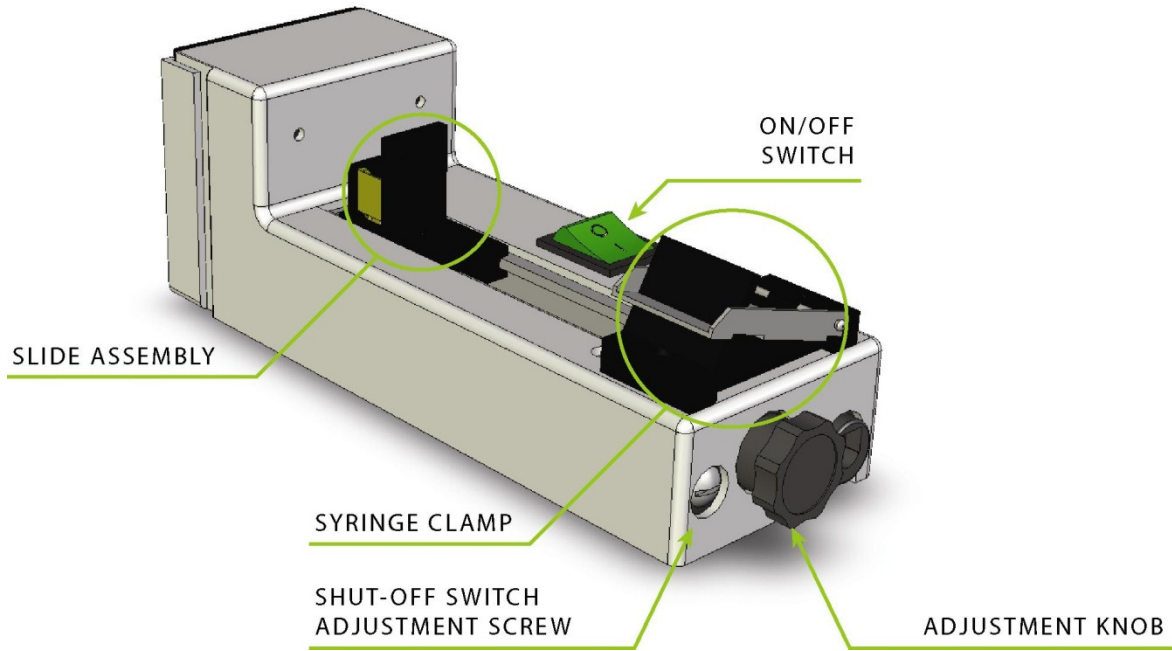
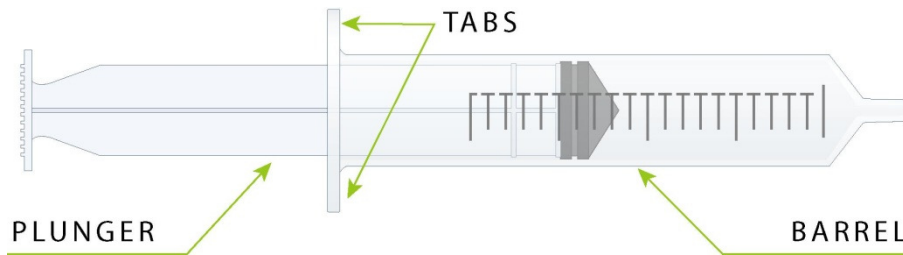


Figure 1.8 - Syringe Components Labeled



Automatic Shut-Off Switch

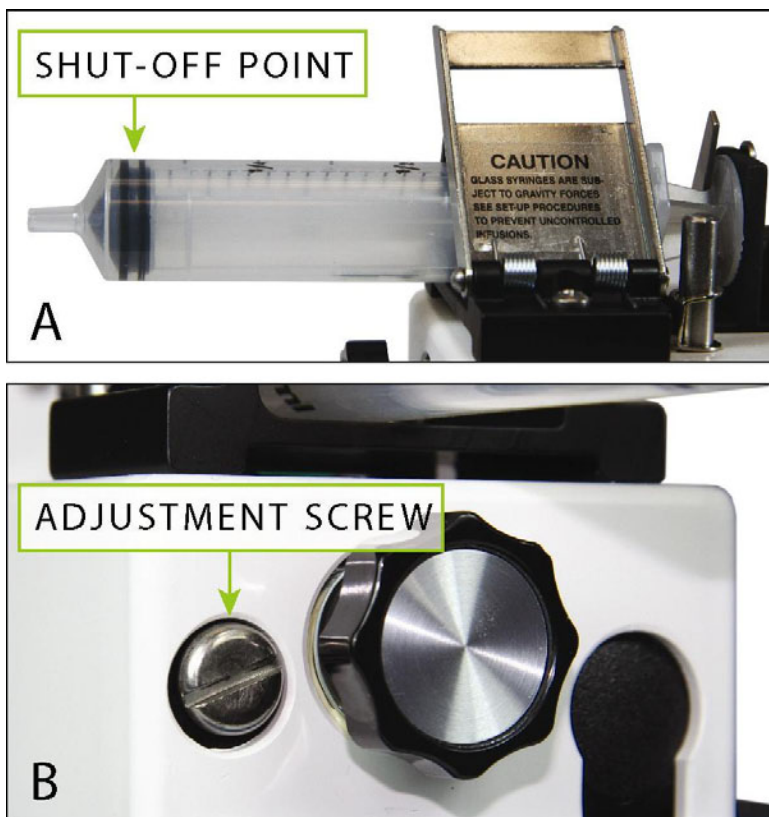
The automatic shut-off switch stops an infusion if the pump reaches the end of the syringe. In addition, the green ON/OFF switch light will turn off and if the pump is equipped with Option F, the audible alarm will sound.

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. Move the slide assembly until it comes in contact with the syringe plunger (Figure 1.9A). When the pushbutton switches are all set to 0, and the pump is turned on, turn the adjustment screw (Figure 1.9B) until the green ON/OFF switch light turns off. Each clockwise $\frac{1}{2}$ turn of the adjustment screw will cause the switch to activate .025 inches later, and each counterclockwise $\frac{1}{2}$ turn of the adjustment screw will cause the switch to activate .025 inches sooner.

In order to reset the switch and resume pump operation, squeeze the tabs on the slide assembly, and move it back until the switch is deactivated.

Figure 1.9 - Automatic Shut-Off Switch Adjustment

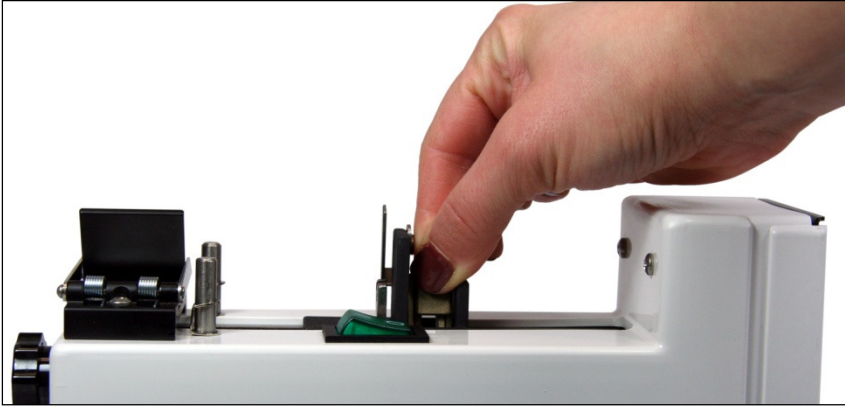


Loading a Syringe

Care should be exercised so that the syringe is positioned correctly. Accurate flow rates cannot be assured if the syringe is not properly loaded. It is important that the slide is making contact with the syringe plunger. Complete the following steps to properly load a syringe.

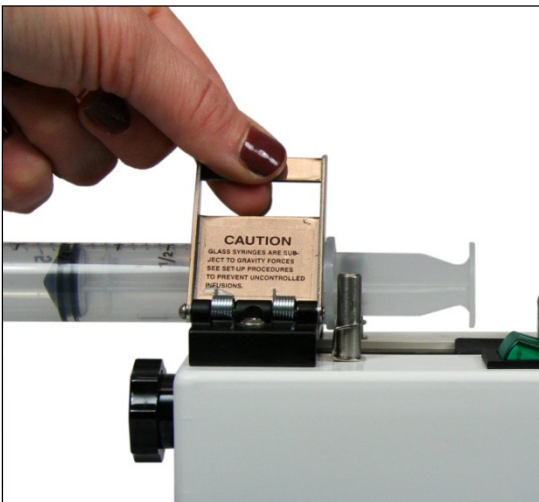
1. Move the slide to the rear (towards the motor) by squeezing the jaws and sliding it back, as shown in Figure 2.1.

Figure 2.1 – Moving the Slide Assembly to the Rear of the Pump



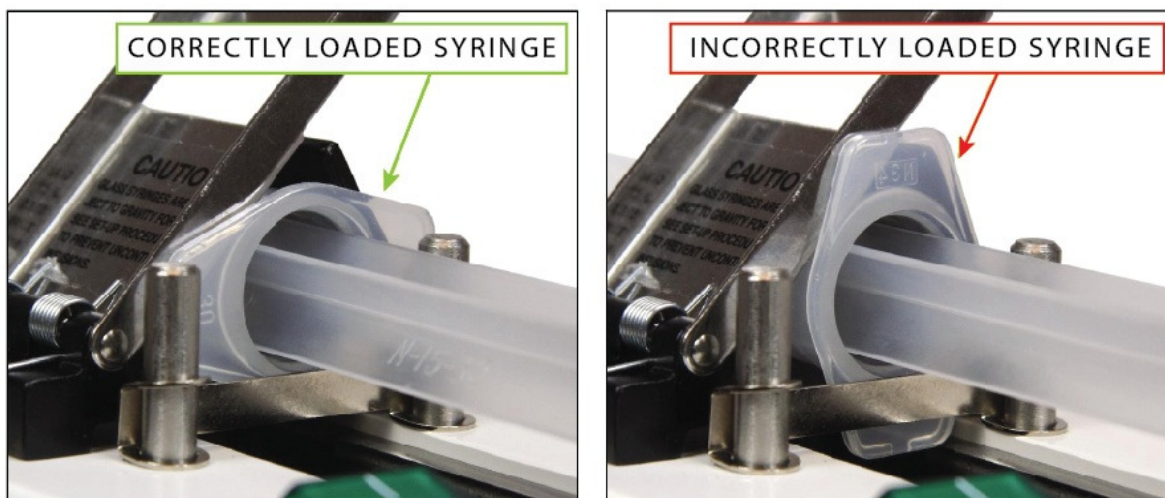
2. Select a syringe and fill with the appropriate fluid.
3. Insert the syringe by lifting the clamp cover and placing the syringe barrel into the clamp, as shown in Figure 2.2.

Figure 2.2 - Open Syringe Clamp and Insert Syringe



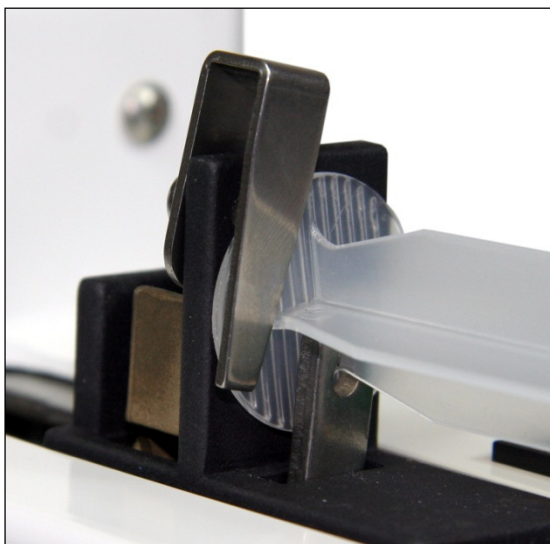
- B OPTION ONLY:** Ensure that the syringe tabs are properly inserted between the syringe clamp, and the retaining posts. Ensure that the syringe is loaded with the syringe tabs positioned horizontally, so that they do not impede the travel of the slide assembly, as shown in Figure 2.3.

Figure 2.3 - Syringe Properly Loaded in B Option Pump



- Move the slide forward until it makes contact with the syringe plunger.
- B OPTION ONLY:** Insert the plunger into the slide assembly clamp, as shown in Figure 2.4.

Figure 2.4 – Plunger Positioned in Slide Assembly Clamp on B Option Pump



- Run the pump (in FORWARD mode for B Option) until the slide assembly makes contact with the plunger and fluid drips from the syringe.

Specialty Syringes

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 ways:

1. The weight of the plunger may be sufficient to push the fluid out of the syringe if the syringe is held with the plunger above the syringe.
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 recommended 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. Use a syringe with a rubber seal on the plunger, i.e. an o-ring sealed or plastic syringe.

Small Syringes

Syringes with a capacity less than five milliliters can be held more securely in the syringe clamp if the R-ACC Micro Syringe Adapter is used. This adapter slides into the standard syringe clamp and can hold one micro syringe.

R99-E Operating Instructions

This chapter includes operating instructions that apply to all R99-E pumps, regardless of which options are included. Refer to **Chapter 1, R99-E Options** for specific instructions for each option.

Applying Power

Be sure the ON/OFF switch is set to OFF, then use the included power adapter to connect the pump to the appropriate power source. If the pump has a grounding port (R99-E-ES and R99-EJM-ES only), use the included grounding cord (PHM-156-EGC, green cord) to connect the pump to a grounded outlet. If using an extension cord or a power strip, ensure that the cord or strip is capable of being grounded as well (has three prongs that connects to an outlet).

Figure 3.1 - Applying Power to the Pump

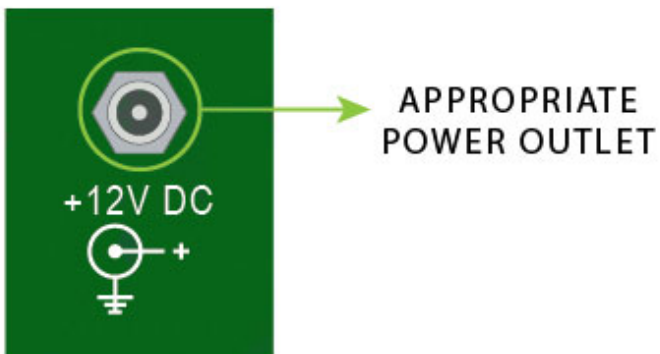
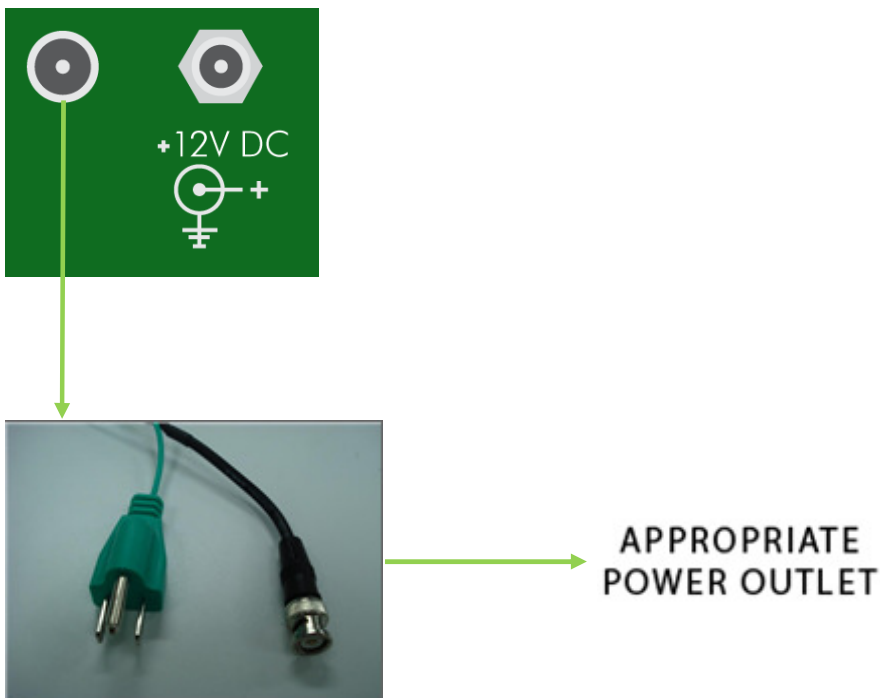


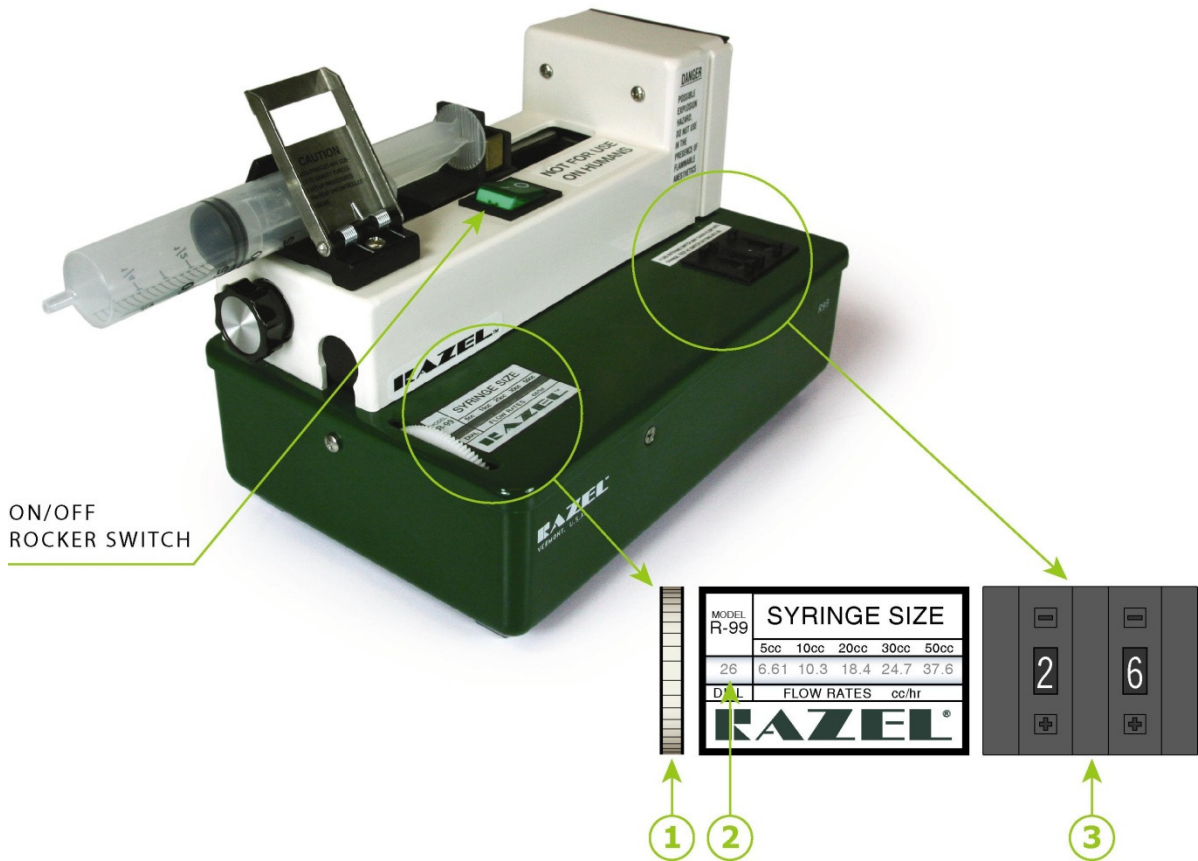
Figure 3.2 - Applying Ground to Pump (R99-E-ES and R99-EJM-ES only)



Selecting and Setting the Rate Using BD Multifit™ Syringes

The movable chart on the R99-E contains the flow rates in cc/hr that correspond with five sizes of BD Multifit™ syringes (5, 10, 20, 30 and 50cc). Other syringe brands may be used, however some calculations are required. Refer to **Chapter 6** of this manual for more detailed information on using other syringe brands.

Figure 3.3 – R99-E Rate Selection Diagram



1. Using the thumbwheel **1**, locate the desired flow rate on the movable chart that corresponds to the syringe size being used (applying Adjustment Factor if necessary, refer to **Chapter 6** of this manual).
2. Read the two-digit number on the left of the dial **2**.
3. Set the pushbutton switches to that number **3**.

Option-Specific Operating Instructions

This chapter includes operating instructions for R99-EJM pump equipped with the option for extended flow rates (JM). Refer to **Chapter 1, R99-E Options** for information regarding identifying pump options.

Option JM

Option JM allows flow rates from 0.025 to 430 cc/hr. This allows the user to utilize the flow rates available with the standard R99-E (0.25 to 143 cc/hr), while also making extended flow rates available.

To utilize the standard moveable chart flow rates with the R99-EJM pump, follow the instructions in **Chapter 3** and set the flow rate using the two middle pushbuttons, as shown below in Figure 5.1. To utilize the extended JM flow rates, refer to Figure 5.2 and 5.3.

Figure 4.1 – R99-EJM Pushbutton Switches

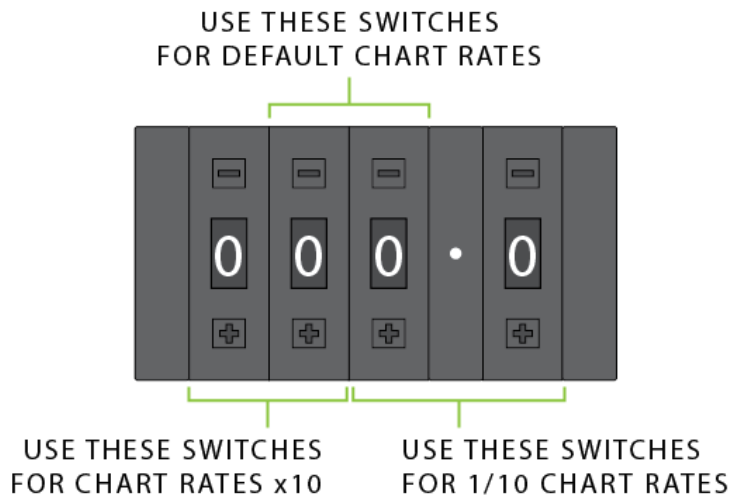
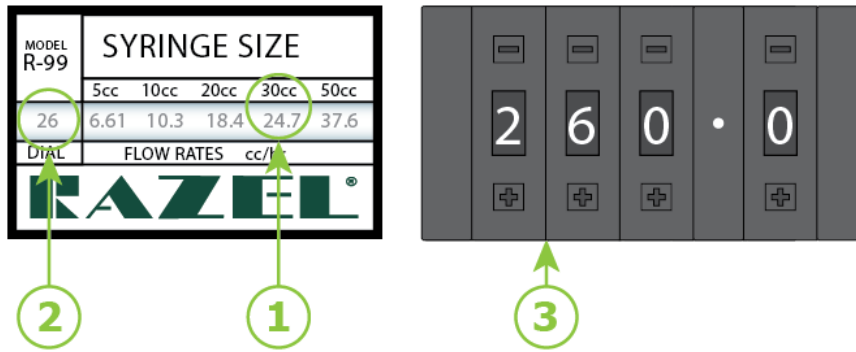


Figure 4.2 – Using x10 Speeds



1. Assume the desired flow rate is 250 cc/hr using a 30 cc BD Multifit™ syringe.
2. Locate 1/10 the desired flow rate on the movable chart (applying Adjustment Factor if necessary, refer to Chapter 6 of this manual) ①.
3. Read the two-digit number on the left of the dial ②.
4. Set the two left-most pushbutton switches to that number ③.

Note: The last digit on the switch can be used as a fine adjustment

Figure 4.3 – Using 1/10 Speeds



1. Assume the desired flow rate is 2.5 cc/hr using a 30 cc BD Multifit™ syringe.
2. Locate 10 times the desired flow rate on the movable chart (applying Adjustment Factor if necessary, refer to Chapter 6 of this manual) ①.
3. Read the two-digit number on the left of the dial ②.
4. Set the two right-most pushbutton switches to that number ③.

CHAPTER 6

Using Other Syringe Brands and Sizes

Common Syringe Brands and Sizes

When using the R99-E with a syringe that is not a BD Multifit™, or is a size that is not included on the movable scale, an adjustment factor must be used to determine the switch setting necessary to attain the desired flow rate. These adjustment factors are shown in the table below.

Figure 0.1 – Syringe Brand Adjustment Factors

SIZE (cc)	BRAND				
	BD MULTIFIT™ GLASS	HAMILTON™ GLASS	KENDALL MONOJECT™ PLASTIC	BD PLASTIPAK™ PLASTIC	TERUMO® PLASTIC
5 - 6	1.00	0.77	1.16	1.04	1.22
10 - 12	1.00	0.99	1.17	0.97	1.16
20	1.00		1.10	0.95	1.06
30 - 35	1.00		1.11	0.91	1.04
50 - 60	1.00		0.90	0.90	1.08

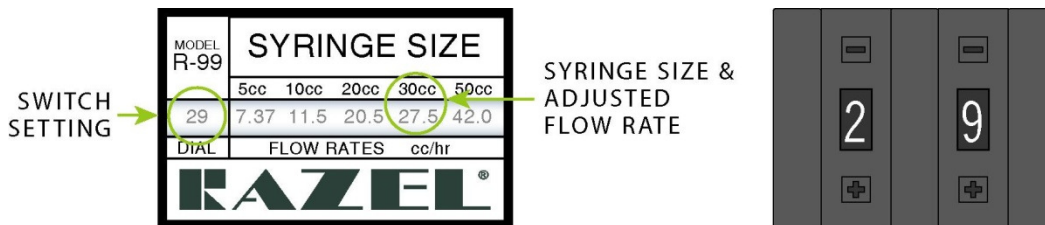
To find the appropriate switch setting, divide the desired flow rate (cc/hr) by the adjustment factor from Figure 0.1 that corresponds to the syringe being used. Locate the adjusted rate on the movable chart and set the switches accordingly.

For example, to find the switch setting necessary for a flow rate of 25 cc/hr using a 30 cc BD Plastipak syringe:

$$25 / 0.91 = 27.47 \text{ cc/hr}$$

Locate the rate closest to 27.47 cc/hr on the movable chart, as shown in Figure 0.2. Set the switches to 29 to achieve a flow rate of 25 cc/hr using the 30 cc BD Plastipak syringe.

Figure 0.2 – Locating the Adjusted Flow Rate on the Movable Chart



Other Syringe Brands and Sizes

Syringe brands and sizes not included in Figure 0.1 may also be used with the R99-E. The cross-sectional area of the syringe must be used to calculate the appropriate switch setting. The equation for calculating the switch setting is as follows:

$$\text{SWITCH SETTING} = \frac{\text{DESIRED RATE (cc/hr)}}{0.23446 \times \text{SYRINGE CROSS SECTIONAL AREA (cm}^2\text{)}}$$

For example, if a flow rate of 50 cc/hr is desired using a 20 cc Monoject plastic syringe, the calculation is as follows:

$$\text{SWITCH SETTING} = \frac{50}{0.23446 \times 3.308} = 64$$

Figure 0.3 and Figure 0.4 are lists of cross-sectional areas of various syringes from different manufacturers. These sizes have some importance when using a syringe type pump, because of the accuracy of the flow rate is determined by the cubic centimeters of fluid per unit length of syringe.

Figure 0.3 – Syringe Cross-Sectional Areas

BD MULTIFIT™ glass	
syringe size (cc)	cross-section (cm ²)
1	0.176
2	0.626

HAMILTON™ glass	
syringe size (cc)	cross-section (cm ²)
.05	0.008
.10	0.017
.25	0.042
.50	0.083
1	0.167
2.5	0.417

UNIMETRICS™ glass	
syringe size (cc)	cross-section (cm ²)
.05	0.008
.10	0.017
.25	0.042
.50	0.083
1	0.167

BD PLASTIPAK™ plastic	
syringe size (cc)	cross-section (cm ²)
1	0.173
2.5	0.578

MONOJECT™ plastic	
syringe size (cc)	cross-section (cm ²)
1	0.173
3	0.622
6	1.263
12	1.977
20	3.308
35	4.474
60	5.545

TERUMO™ plastic	
syringe size (cc)	cross-section (cm ²)
3	0.629

Figure 0.4 – Syringe Cross-Sectional Areas

MULTIFIT™, glass		HAMILTON™, glass		UNIMETRICS™, glass	
Syringe size	Cross-section	Syringe size	Cross-section	Syringe size	Cross-section
1ml	0.176 sq cm	.05ml	0.008 sq cm	.05ml	0.008 sq cm
2ml	0.626 sq cm	.10ml	0.017 sq cm	.10ml	0.017 sq cm
5ml	1.084 sq cm	.25ml	0.042 sq cm	.25ml	0.042 sq cm
10ml	1.692 sq cm	.50ml	0.083 sq cm	.50ml	0.083 sq cm
20ml	3.017 sq cm	1ml	0.167 sq cm	1ml	0.167 sq cm
30ml	4.047 sq cm	2.5ml	0.417 sq cm		
50ml	6.173 sq cm	5ml	0.833 sq cm		
		10ml	1.667 sq cm		

MONOJECT™, plastic		B-D PLASTIPAK™, plastic		TERUMO™, plastic	
Syringe size	Cross-section	Syringe size	Cross-section	Syringe size	Cross-section
1ml	0.173 sq cm	1ml	0.173 sq cm	3ml	0.629 sq cm
3ml	0.622 sq cm	2.5ml	0.578 sq cm	5ml	1.327 sq cm
6ml	1.263 sq cm	5ml	1.129 sq cm	10ml	1.961 sq cm
12ml	1.977 sq cm	10ml	1.635 sq cm	20ml	3.189 sq cm
20ml	3.308 sq cm	20ml	2.850 sq cm	30ml	4.191 sq cm
35ml	4.474 sq cm	30ml	3.662 sq cm	60ml	6.651 sq cm
60ml	5.545 sq cm	60ml	5.556 sq cm		

MULTIFIT is the trademark of Becton, Dickinson & Co., Rutherford, NJ.

HAMILTON is the trademark of Hamilton Company, Reno, NV.

UNIMETRICS is the trademark of Unimetrics Corp., Anaheim, CA.

MONOJECT is the trademark of Sherwood Medical Industries, St. Louis, MO.

PLASTIPAK is the trademark of Becton, Dickinson & Co., Rutherford, NJ.

TERUMO is the trademark of Terumo Corporation, Piscataway, NJ.

CHAPTER 7

Options B and F

Option B

Option B allows the pump to operate in reverse. The FORWARD/REVERSE switch located on the side panel determines the direction that the pump will operate in. It is important to verify the position of this switch prior to running the pump. The infusion direction (forward or reverse) can be changed during an infusion.

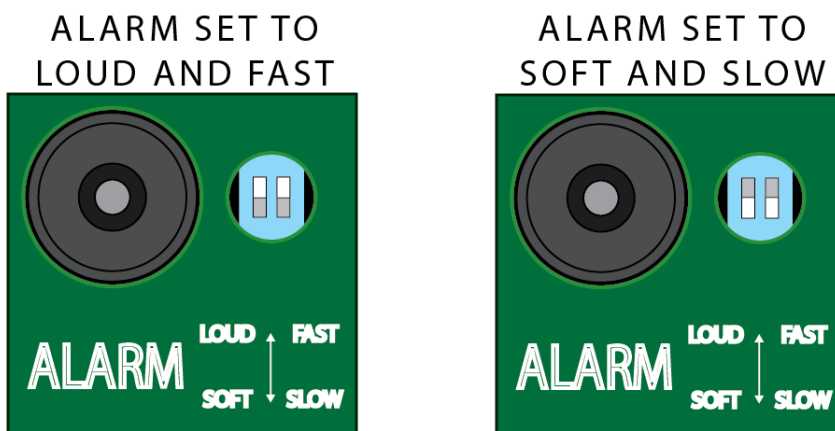
Figure 0.1 - Option B Forward / Reverse Switch



Option F

Option F is an audible alarm that sounds when the Automatic Shut-Off Switch is activated (refer to **Chapter 1, Automatic Shut-Off Switch**). The speaker and control switches are located on the back panel of the pump. The left switch controls the volume of the alarm (LOUD is approximately 70 dB at 8" and SOFT is approximately 40 dB at 8"). The right switch controls the frequency of the alarm (FAST is two beeps per second and SLOW is one beep per seven seconds). The switches can be adjusted to satisfy the individual requirements of each application.

Figure 0.2 – Option F Speaker and Control Switches



APPENDIX A

Technical Specifications

Accuracy

The R99-E Syringe Pump is accurate within 2% and is calibrated at 115 volts A.C.

Pressure Limits

Flow rates may become inaccurate if the pressure exceeds the values shown in Figure A.1.

Figure A.1 – R99-E Pressure Limits

Syringe Size (cc)	Maximum Pressure	
	psi	mmHg
10	20	1000
20	10	500
30 - 35	7	400
50 – 60	5	270

Electrical

The R99-E pump is equipped with a 12V table top power supply.

Input voltage: 100-240VAC (50/60Hz); Maximum Current: 0.5A.

Output voltage: 12VDC; Maximum Current: 1.50A; 18-Watt.

Available Flow Rates

The flow rate of the R99-E depends on the size of the syringe being used. The table below indicates the flow rate range for each syringe size. If the syringe being used is not a BD Multifit™, be sure that the Adjustment Factor is used when selecting the switch setting (refer to Chapter 6).

Table A.1 – R99-E Flow Rates

Model	Flow Rate Range (cc/hr)				
	5 cc Syringe	10 cc Syringe	20 cc Syringe	30 cc Syringe	50 cc Syringe
R99-E	0.25 – 25	0.40 – 39	0.71 – 70	0.95 – 94	1.45 - 143
R99-EJM	0.025 – 75	0.040 – 117	0.071 – 210	0.095 – 282	0.145 - 430

Pump Motor

The R99-E pushes a syringe by imparting linear motion through the rotation of a stainless steel lead screw. The relationship between rotary speed and linear travel is:

$$1 \text{ revolution} = .07692 \text{ inches} = .19538 \text{ cm}$$

The motor is a stepper type and each step is $.09375^\circ$, which is equivalent to 3840 steps per revolution. Thus each step is equivalent to $.00002003$ inches or $.00005088$ centimeters of linear motion.

When the pushbutton switches are at the following settings, the corresponding motor speeds and number of pulses per second are:

Figure A.2 – R99-E Motor Speeds and Pulse Rates

SWITCHES	MOTOR SPEED (RPM)	PULSE RATE (PPS)
01	.020	1.28
10	.200	12.80
20	.400	25.60
50	1.000	64.00
90	1.800	115.20
99	1.980	126.72

With the JM option, the corresponding numbers are:

Figure A.3 – R99-EJM Option Motor Speeds and Pulse Rates

SWITCHES	MOTOR SPEED (RPM)	PULSE RATE (PPS)
00.1	.005	.128
00.5	.010	.640
200	4.00	256.0
299	5.98	382.72

Maintenance Instructions

Care and Use

Care should be exercised to prevent fluids from coming in contact with the switches. If contact occurs, the accuracy of the flow rate may be affected. Use the flow rate check described in this chapter to validate flow rates.

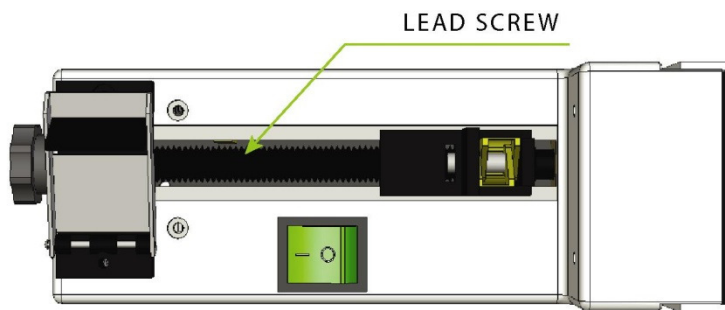
Cleaning

Use a cloth dampened with water or a mild detergent to clean the pump housing. Always apply liquids to the cloth, not directly to the pump. The white pump housing is ABS plastic and the green chassis is powdercoated aluminum.

Lubrication

Apply petroleum jelly or silicone spray to the lead screw once annually.

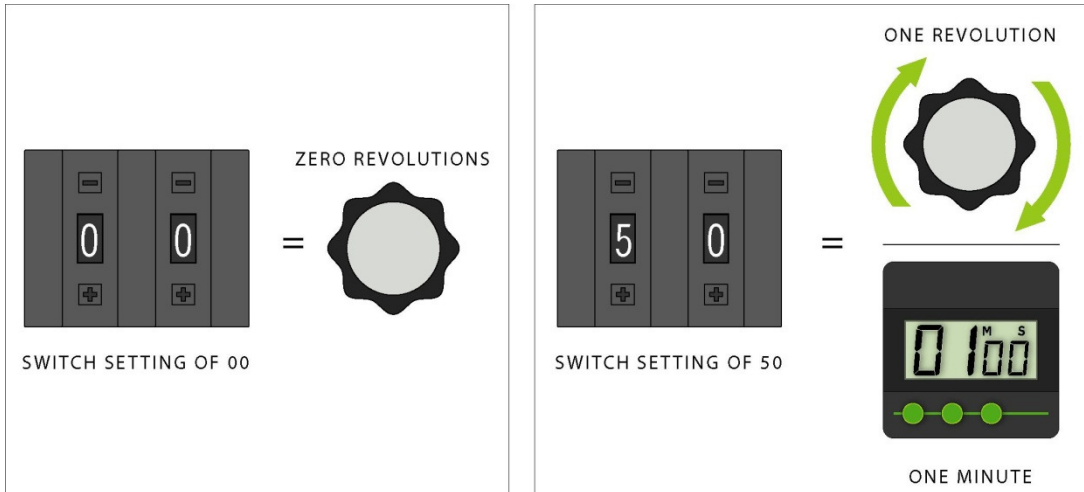
Figure B.1 - Lead Screw Location



Flow Rate Validation

Begin by setting all of the switches to '0' and turning the pump on. Verify that the pump motor is not pulsing. If the pump is pulsing with all switches set to zero, contact Razel Technical Support. Next, set the R99-E switches to 50 and turn the pump on. The Adjustment Knob (refer to Figure 1.) should rotate at 1 RPM. If the Adjustment Knob does not rotate at 1 RPM with the R99-E switches set to 50, contact Razel Technical Support.

Figure B.2 – Flow Rate Validation



APPENDIX C

Troubleshooting

Problem	Corrective Action
The syringe is not emptying.	<ul style="list-style-type: none"> • Verify that power is applied to the pump and it is switched on; • Verify that the Automatic Shut-Off Switch is not activated (refer to Chapter 1, Automatic Shut-Off Switch); • Check the IV tubing for kinks; • Verify that the switches are not all set to zeros; • B OPTION ONLY: Confirm that FORWARD/REVERSE switch is set to FORWARD; • Contact Razel Technical Support.
Flow rate is not accurate	<ul style="list-style-type: none"> • If the syringe being used is not a BD Multifit™, be sure that the Adjustment Factor was used when selecting the switch setting (refer to Chapter 6); • Verify that the switch setting is correct; • Perform the Flow Rate Validation (refer to Flow Rate Validation above); • Contact Razel Technical Support.

APPENDIX D

Warranty Information

Limited Warranty

Razel Scientific Instruments Division of Mansfield Research and Development, LLC (Razel) warrants the products bearing its name and trademark against all defects in material, workmanship, and performance to the original purchaser for a period of one (1) year from the date of shipment by Razel. Razel warrants that its products will meet the electrical and mechanical specifications stated in Razel's catalog, although specifications in the catalog are subject to change without notice. Razel at its option will repair or replace a product that is found to be defective during the warranty period. Defective merchandise must be received at:

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No more than thirteen (13) months from the date of original shipment by Razel. All shipments must include a Return Authorization Number (RMA #), obtainable by Razel, and must be sent freight prepaid by the sender. Razel holds the right to charge a 15% restocking fee on items purchased and returned due to any circumstance other than malfunction.

Limitations of Warranty

This warranty is nontransferable and does not apply to any defects or damages resulting from alteration, modification, neglect, misuse, usage of improper power sources, damage in transportation, abuse or any cause other than normal use of the equipment. This warranty does not apply to products resold by Razel that are manufactured by other companies. No warranty or claim is made by Razel regarding the efficacy of any product for any particular application. This warranty gives the user specific legal rights, and the user may have other rights, which may vary from state to state.

Except for the Limited Warranty stated above, Razel disclaims any and all other warranties, express or implied, oral or written, including any implied warranties or merchantability or fitness for a particular purpose. Some states do not allow limitations or implied warranties, so the above limitation may not apply to you.

In no event shall Razel be liable for any damages whatsoever arising out of the use of its products, including without limitation any direct, incidental or consequential damages, any damages for loss of profits, business interruption, loss of information or any pecuniary loss, even if Razel has been advised of the possibility of such damages. Some states do not allow the exclusion of limitation of liability for incidental or consequential damage, so the above limitation may not apply to you.