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FLOW CELL

OWNERS MANUAL FOR

MODEL NUMBERS

9550-0100 **9550-0053**
9550-0101 **9550-0122**

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Part No. 0115-0244 B Rev 9/89

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1. INTRODUCTION

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GENERAL INFORMATION

This manual describes the properties, proper use and maintenance procedures for the following flow cells used in the Linear Series 200 (UVIS – 200, 204, and 206) liquid chromatography detectors:

1. Model No. 9550-0100 – 6mm pathlength, 9 ul volume, stainless steel analytical flow cell

2. Model No. 9550-0122 – 10mm pathlength, 15.0 ul volume, stainless steel analytical flow cell

3. Model No. 9550-0053 – 3mm pathlength, 1.2 ul volume, stainless steel microbore flow cell

4. Model No. 9550-0101 – 3mm pathlength, 4.6 ul volume, stainless steel semi-preparative scale flow cell

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2. INITIAL OPERATION

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UNPACKING

Carefully unpack the flow cell from the shipping container and inspect both the cell and packing for any signs of damage. If any signs of damage are noted, contact the shipping company immediately.

If you have ordered this flow cell with a detector, it is already mounted and you need not read the next section.

INSTALLATION

Please refer to your detector's owners manual for the location of the following components:

1. For the flow cell presently mounted on your detector, disconnect the inlet and outlet tubing from the Chromatographic column, waste reservoir, or other devices.

2. Remove the flow cell housing cover by unscrewing its retaining thumb screw and pulling the cover straight back.

3. Free the inlet and outlet tubes from the tubing restraint by loosening the thumb screw and freeing the tubes out from under the clamp.

4. Remove the photodiode assembly by removing its two thumb screws. Take care as to avoid scratching or getting fingerprints upon the optical surface of the photodiode assembly. The photodiode assembly should be cleaned with spectroscopic grade methanol and lint free lens paper.

5. Remove the two thumb screws securing the flow cell assembly to the detector and pull the flow cell assembly straight back along the alignment dowels until it is freed from the optical bench.

NOTE: All Linear 100 and 200 Series flow cells are supplied pre-aligned. No alignment procedures are needed.

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6. Orient the new flow cell assembly so that the dowel rods, mounting screw holes, and tubing are in the proper position. Insure that the cell is mounted so that the inlet tube (that which is wrapped around the flow cell body) is positioned as the lower of the two tubes. Avoid scratching or placing fingerprints upon the flow cell windows. These windows should be cleaned with spectroscopic grade methanol and lint free lens paper. They may be dusted by blowing off debris with filtered, oil-free air.

7. Secure the flow cell assembly to the optical bench using the two thumb screws.

8. Lock the inlet and outlet tubing into place by tightening them down with the tubing restraint.

9. Replace the photodiode assembly.

10. Replace the flow cell housing cover by replacing its retaining screw.

11. Connect the flow cell inlet and outlet tubing to the appropriate components.

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3. FLOW CELL OPERATION

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APPLICATIONS

The performance characteristics of these flow cells is dependent upon their application. Flow Cell 9550-0100 is intended for use in analytical HPLC applications. Its 6mm pathlength yields superior sensitivity while its 9 ul volume maintains excellent peak shape. Flow Cell 9550-0122 is intended for use in analytical HPLC when maximal sensitivity is required. This flow cell should produce a 66% increase in sensitivity, however, the 15 ul volume may result in greater peak broadening. Both of these cells are designed to be used with 1/16" O.D. x 0.010" I.D. stainless steel tubing.

Flow Cell 9550-0053 is intended for use in microbore applications. Its 3mm pathlength and 1.2 volume provide an excellent combination of analytical sensitivity and peak shape. For best results, this cell should always be used with 1/16" O.D. x 0.005" stainless steel tubing.

Flow Cell 9550-0101 is designed for use in Semi-Preparative scale applications. Its 3mm pathlength and 4.6 volume is perfect for many of the high absorbing, large volume sample bands often encountered in this type of application. The cell should be used with 1/16" O.D. x .030" I.D. stainless steel tubing.

STATIC PRESSURE RATINGS AND FLOW-PRESSURE CHRACTERISTICS

Each of the four previously described flow cells are rated up to 1000 PSI nominal static pressure. Pressures exceeding 1000 PSI may result in cell leakage. If leakage occurs, the cell gaskets should be replaced (See the Flow Cell Maintenance Section for cell disassembly and repair).

Pressure vs. flow rate data for each of these flow cells are presented in Figures 1 through 3. It should be noted that this data reflects typical results obtained for the described flow cell with the standard length of appropriate I.D. stainless steel tubing used for the cell inlet and outlet lines with water as the system's solvent. To calculate the expected backpressure for a different solvent (Psolvent) in your system:

1. Determine the flow rate to be used.

2. Interpolate the pressure drop for water (P H_2O) using the appropriate graph for your cell.

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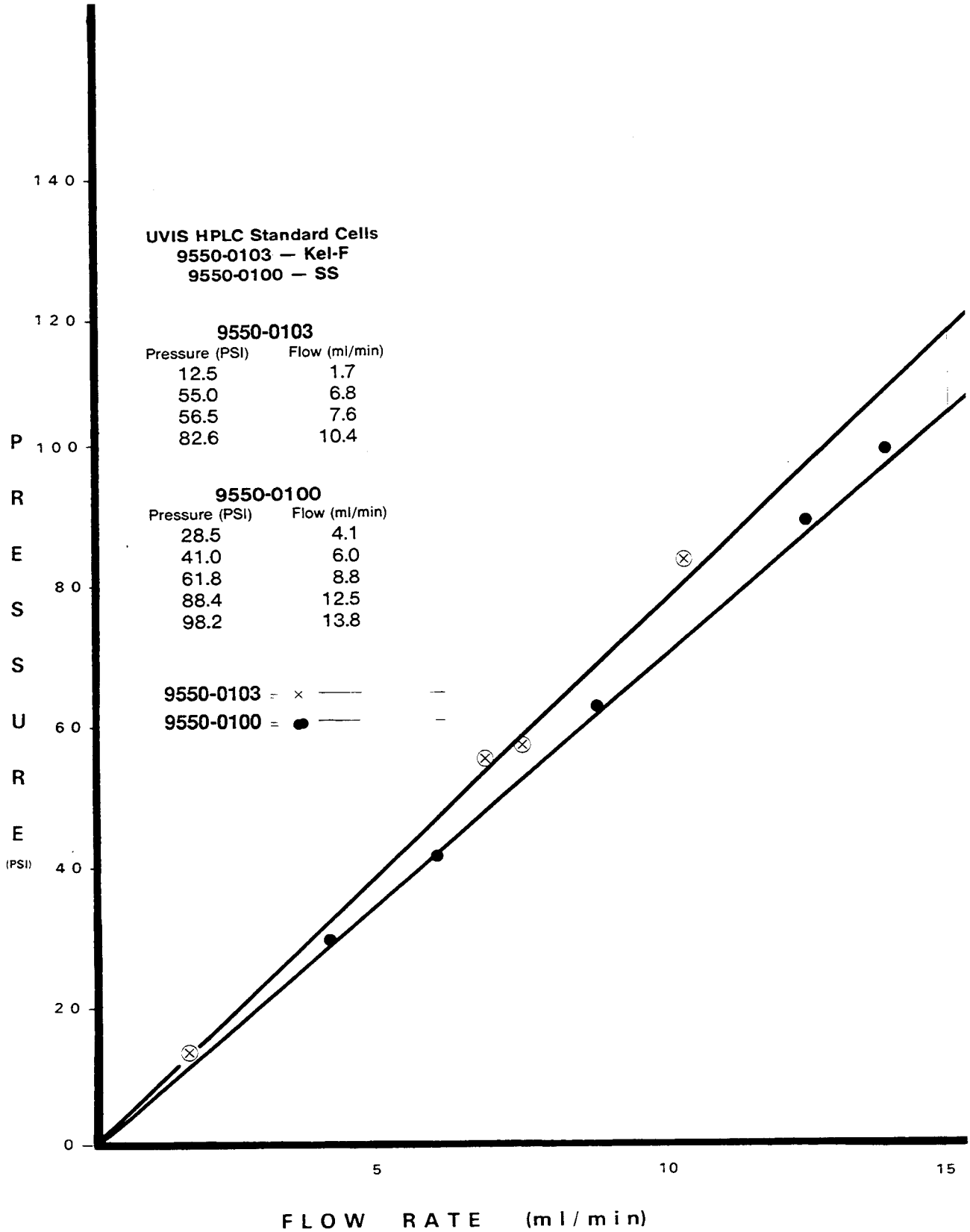


FIGURE 1

3.2

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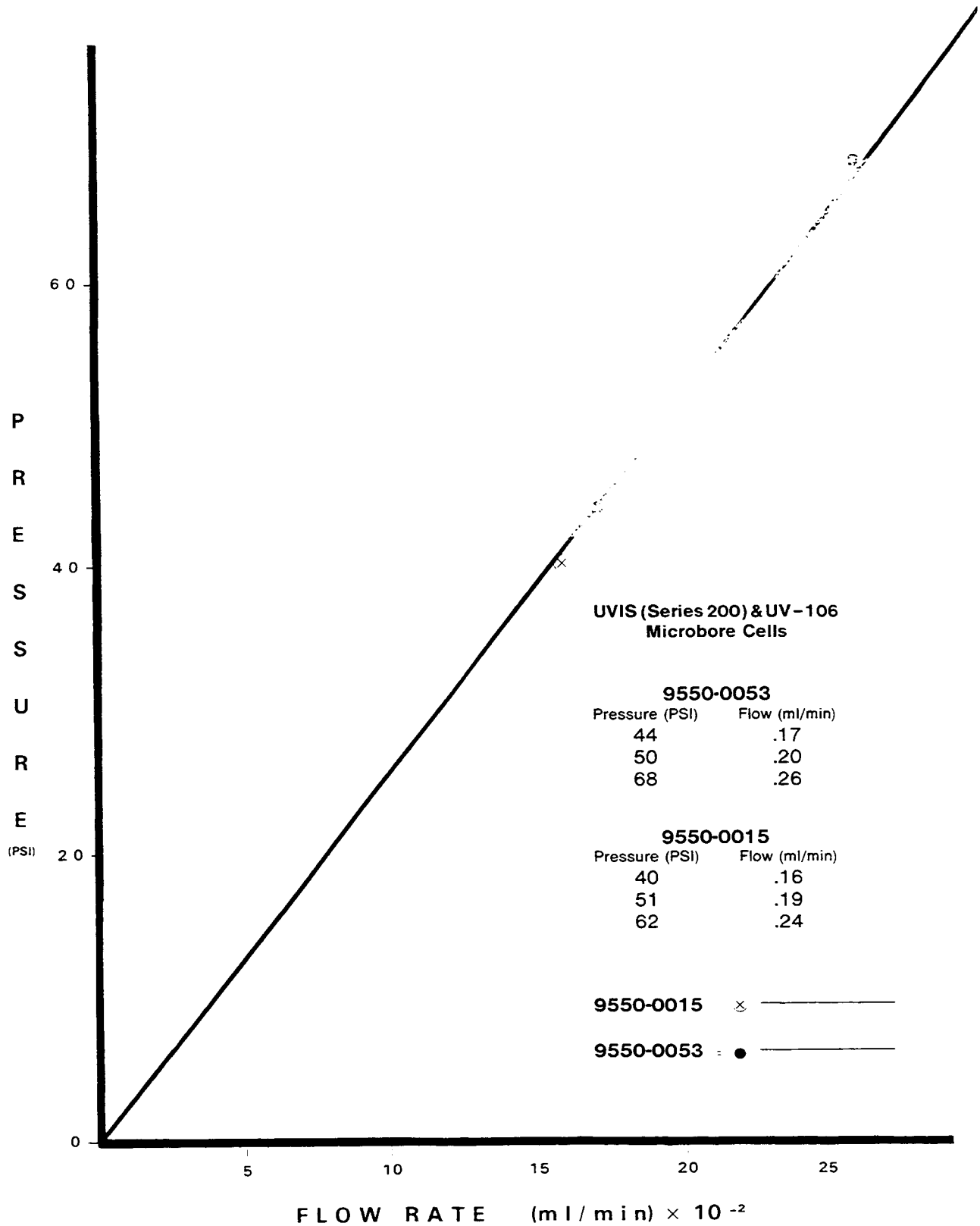
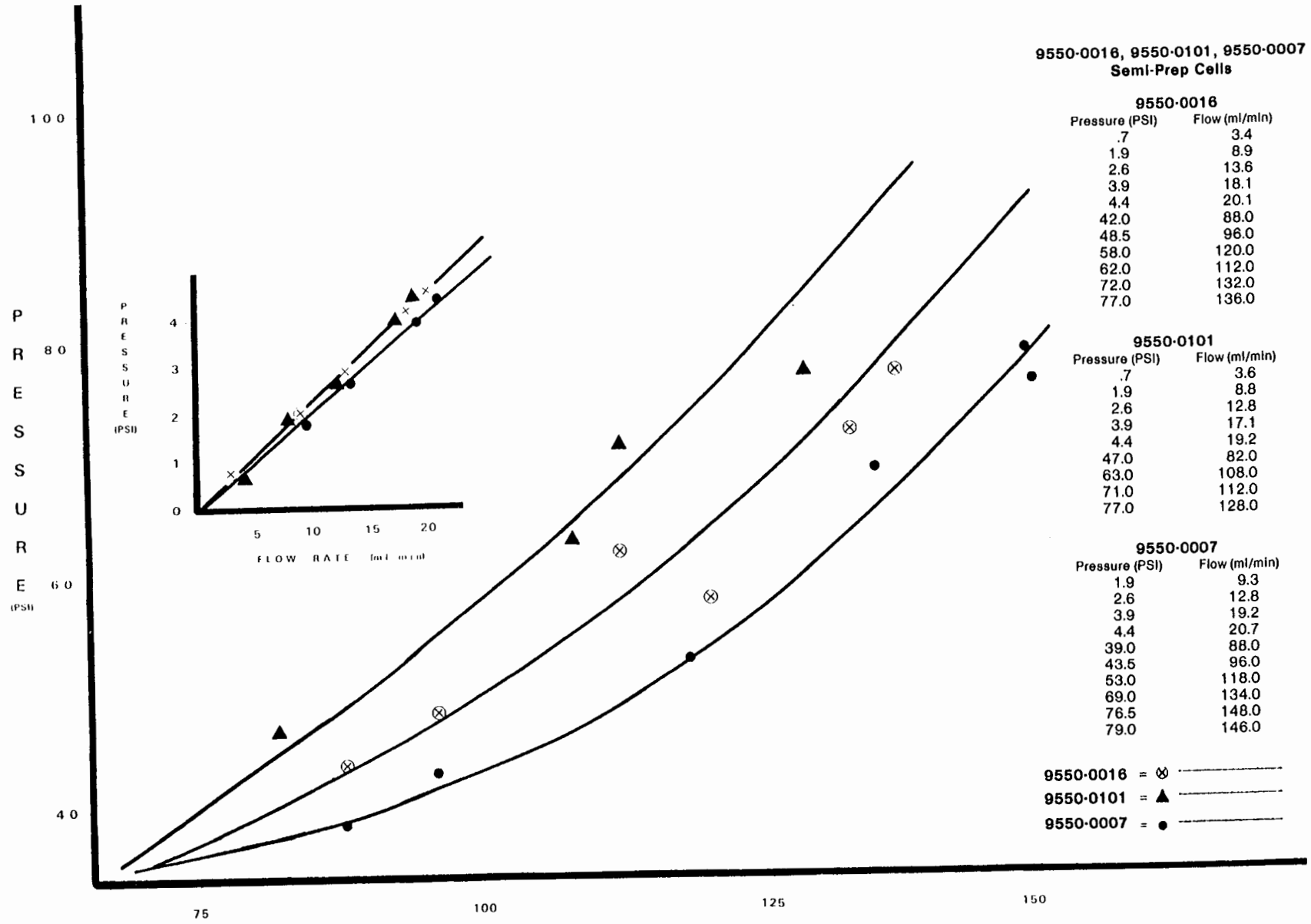


FIGURE 2

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9550-0016, 9550-0101, 9550-0007
Semi-Prep Cells

9550-0016

Pressure (PSI)	Flow (ml/min)
.7	3.4
1.9	8.9
2.6	13.6
3.9	18.1
4.4	20.1
42.0	88.0
48.5	96.0
58.0	120.0
62.0	112.0
72.0	132.0
77.0	136.0

9550-0101

Pressure (PSI)	Flow (ml/min)
.7	3.6
1.9	8.8
2.6	12.8
3.9	17.1
4.4	19.2
47.0	82.0
63.0	108.0
71.0	112.0
77.0	128.0

9550-0007

Pressure (PSI)	Flow (ml/min)
1.9	9.3
2.6	12.8
3.9	19.2
4.4	20.7
39.0	88.0
43.5	96.0
53.0	118.0
69.0	134.0
76.5	148.0
79.0	146.0

9550-0016 = ⊗
9550-0101 = ▲
9550-0007 = ●

FIGURE 3

3.4

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3. Multiply the pressure drop figure by the viscocity of the solvent in question (C_{PS}).

$$P \text{ solvent} = (P\ H_2O)\ (C_{PS})$$

Under typical conditions, laminar flow exists in each of these flow cells. In this case, the following relationship holds:

$$\text{Pressure} = (\text{Flow rate})\ (\text{Resistance})$$

The following data is included for your convenience for determining total back pressure for a system consisting of a given length of tubing and given flow cell.

Tubing I.D. (inches)	Max Flow Rate for Laminar Flow (ml/min) with Water as Solvent	Resistance/Length $\frac{(PSI)\ (MIN)}{(ml)\ (cm)}$
0.005	11.54	3.780
0.010	23.10	0.112
0.030	69.20	4×10^{-3}

Flow Cell Model Number	Resistance of Flow Cell (less Tubing) $\frac{(PSI)\ MIN)}{(ml)}$
9550-0101	1.8×10^{-2}
9550-0100/0122	2.6×10^{-1}
9550-0053	30.19

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4. FLOW CELL MAINTENANCE

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Cell Cleaning	4.1
Cell Disassembly	4.1
Flow Cell Reassembly	4.3

CELL CLEANING:

If at all possible, we discourage the disassembly of flow cells for routine cleaning purposes. Most cells can be adequately cleaned by flushing with several milliliters of appropriate solvent. We recommend the following solvents for this purpose:

1. Methanol
2. Tetrahydrofuran
3. Methylene chloride
4. HPLC Grade Water
5. 6 N Nitric Acid following by flushing with HPLC Grade Water

CELL DISASSEMBLY:

If flushing proves inadequate for cleaning purposes or if the flow cell becomes leaky, requiring gasket replacement, the following procedure should be followed for flow cell disassembly: (See Figure 4)

1. Remove the flow cell assembly from the detector as described in the installation section of this manual.
2. Remove the two screws which secure the flow cell body to the flow cell mount and free the flow cell from its mount.
3. Using a wide, flat-blade screwdriver, remove the window retaining nut (Item 11).
4. Remove the retaining washer (Item 10). Note that it is installed concave-side up.
5. With a fine pair of forceps, gently lift out the flow cell window (Item 9). Be careful not to scratch these windows. Clean the window using spectroscopic grade methanol and lint-free lens paper.
6. Note the orientation of the tear drop of the flow cell gasket (Item 8.). It should be installed so that both the optical bore (the large hole) and fluid bore (the small hole) are not covered. Remove the cell gasket with a pair of fine forceps.

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7. Repeat steps 3 through 6 above for the other side of the cell.

8. If the inlet or outlet tubes are clogged, remove them as follows:

   a. Remove the exit tubing (Item 7) by unscrewing its fitting (Item 2) and pulling the tube straight forward.

   b. Unscrew the heat exchanger restraint screw (Item 5) and remove the screw and washer (Item 4).

   c. Unwind the inlet tubing (Item 1) from around the cell body (Item 6).

   d. Remove the inlet tubing (Item 1) by unscrewing its fitting and pulling the tube straight out.

   e. Remove the remaining heat conductive epoxy out of the heat exchanger groove which circumscribes the cell body.

The flow cell body may be cleaned by soaking it in spectroscopic grade methanol. For best results, an ultrasonic bath should be used.

FLOW CELL REASSEMBLY: (See Figure 4)

NOTE: For best results, the flow cell gaskets should be replaced each time the cell is disassembled.

1. With a pair of fine forceps, replace the cell gasket (Item 8) in its proper orientation so that both the optical bore (large hole) and fluid bore (small hole) are exposed by the tear drop.

2. Carefully replace the cell window (Item 9).

3. Install the retaining washer (Item 10) so that its concave surface faces away from the cell body.

4. Replace the window retaining nut (Item 11). Tighten to 14 inch-pounds. To avoid possible damage to the windows, **do not exceed 14 inch-pounds of torque.**

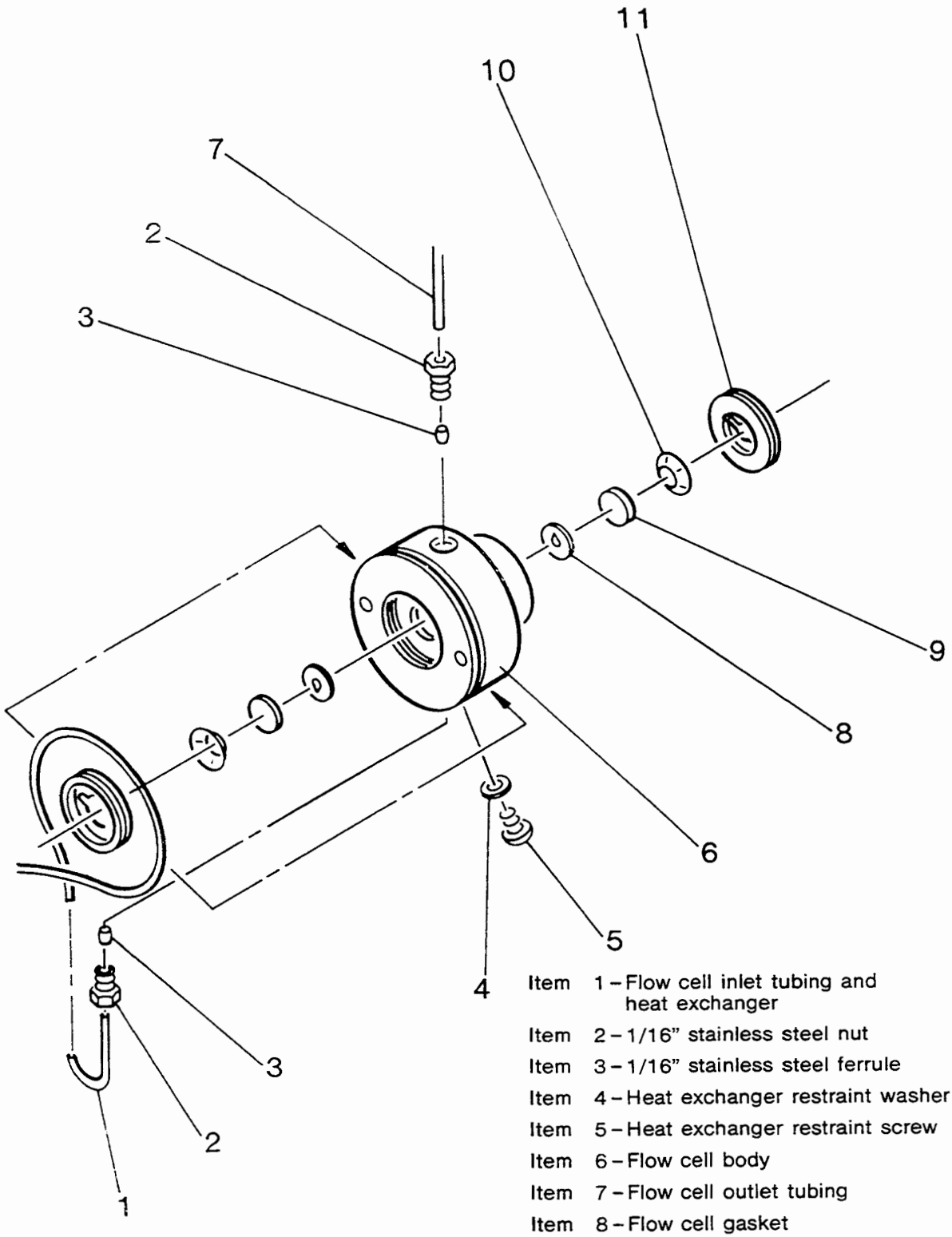
5. Repeat steps 1 through 4 for the other side of the flow cell.

6. If the cell tubing was removed, re-install as follows:

   a. Replace the cell inlet tubing by replacing its fitting into the inlet hole (the one next to the hole for the heat exchanger restraint).

   b. Bend the tubing around the cell so that it circumscribes the cell body in the heat exchanger groove before it approaches the hole for the heat exchanger restraint.

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Item 1 – Flow cell inlet tubing and heat exchanger
Item 2 – 1/16" stainless steel nut
Item 3 – 1/16" stainless steel ferrule
Item 4 – Heat exchanger restraint washer
Item 5 – Heat exchanger restraint screw
Item 6 – Flow cell body
Item 7 – Flow cell outlet tubing
Item 8 – Flow cell gasket
Item 9 – Flow cell window
Item 10 – Flow cell window retaining washer
Item 11 – Flow cell window retaining nut

FIGURE 4

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c. To improve heat exchange between the inlet tubing and flow cell body, a heat conductive expoxy should be applied into the groove before the tubing is installed.

NOTE: We recommend the use of Loctite Thermal Conductive Adhesive (17099) and Activator (17100), Loctite Corp., Newington, CT 06111.

d. After the epoxy has been applied, secure the tubing into the heat exchanger groove by replacing the heat exchanger restraining screw (Item 5) and washer (Item 4).

e. Replace the cell outlet tubing by placing its fitting into the outlet tubing hole.

9. Reinstall the flow cell body on the flow cell holder using the two mounting screws. Insure that the protruding nose piece of the flow cell is inserted into the cell mount.

10. Reinstall the flow cell onto the detector as outlined in the installation section of this manual.

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5. TROUBLESHOOTING GUIDE

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General Problems 5.1

This section is organized in a symptom, problem, and remedy format. For a more complete guide to troubleshooting, consult the appropriate section in your detector's owners manual.

GENERAL PROBLEMS

SYMPTOM	PROBLEM	REMEDY
1. Noisy Baseline	a. Bubble trapped in flow cell	a. Increase flow rate and/or back pressure
	b. Exterior surface of flow cell window is dirty	b. Clean flow cell window with spectroscopic grade (S.G.) methanol and lens paper
	c. Photodiode assembly is dirty	c. Clean photodiode assembly with S.G. methanol and lens paper
	d. Flow cell is dirty	d. Flush flow cell with several ml of appropriate solvent
		d. Disassemble and clean flow cell
2. Excessive Baseline Drift	a. Detector is warming up	a. Allow 60 minutes for warm-up period
	b. Column is equilibrating	b. Allow several column volumes to pass through the system
	c. Tubing is leaking	c. Check for leaks in fittings and tighten

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	d. Flow cell is leaking	d. Check flow cell for leaks around window. d. Check torque on T-cell ram retaining screws
	e. Flow cell windows dirty	e. Clean exterior of windows with S.G. methanol e. Flush flow cell with appropriate solvent e. Disassemble and clean flow cell
	f. Photodiode window is dirty	f. Clean photo-diode window with S.G. methanol and lens paper
3. Excessive Back Pressure	a. Exit tubing is clogged	a. Replace exit tubing
	b. Entrance tubing is clogged	b. Replace entrace tubing
	c. Flow cell fluid and/or optical bores clogged	c. Disassemble flow cell and clean in 6 N Nitric acid followed by wash in HPLC water

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FLOW CELL REPLACEMENT PARTS

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FLOW CELL REPLACEMENT PARTS

CELL NO. 9550-0100
Stainless Steel (SS), 6mm, 9 ul, HPLC Flow Cell

ITEM NUMBER	DESCRIPTION
9550-0100	6mm x 9 ul, Stainless Steel, Analytical Flow Cell
2855-0010	1/16" SS Male Nut for Tubing
2857-0018	1/16" SS Ferrule
2858-0013	Beveled Window Retaining Washer
2858-0016	Heat Exchanger Restraint Washer
3750-0003	Sapphire Window
9051-0002	6mm x 9 ul, SS Cell Body
9051-0007-01	Cell Gasket
9051-0362	Cell Holder
9051-0059	Cell Window Retaining Nut
9051-0177	SS Tubing, 1/16" O.D. x .010" I.D. for Cell Inlet or Outlet Tubing

CELL NO. 9550-0053
Stainless Steel (SS), 3mm, 1.2 ul, Microbore Flow Cell

ITEM NUMBER	DESCRIPTION
9550-0053	3mm x 1.2 ul, SS, Microbore Flow Cell
2855-0011	1/16" SS Nut for Tubing
2857-0018	1/16" SS Ferrule
2858-0013	Beveled Window Retaining Washer
2858-0016	Heat Exchanger Restraint Washer
3750-0003	Sapphire Window
9051-0007-02	Cell Gasket
9051-0362	Cell Holder
9051-0059	Cell Window Restraining Nut
9051-0101	3mm x 1.2 ul Cell Body
9051-0097	SS Tubing 1/16" O.D. x .005" I.D. for Cell Inlet or Outlet Tubing

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CELL NO. 9550-0101
Stainless Steel (SS), 3mm, 4.5 ul, Semi-Prep Cell

ITEM NUMBER	DESCRIPTION
9550-0101	3mm x 4.5 ul, Stainless Steel, Semi-Preparative Scale Flow Cell
2855-0010	1/16" SS Tubing Nut
2857-0018	1/16" SS Ferrule
2858-0013	Beveled Window Retaining Washer
3750-0003	Sapphire Window
9051-0007-01	Cell Gasket
9051-0362	Cell Holder
9051-0059	Cell Window Retaining Nut
9051-1040	SS Tubing, 1/16" O.D. x .030" I.D. for Cell Inlet or Outlet Tubing
9051-0100	3mm x 4.5 ul Cell Body

CELL NO. 9550-0122
Stainless Steel (SS), 10mm, 15 ul, Analytical Cell

ITEM NUMBER	DESCRIPTION
9550-0122	10mm x 15 ul, SS, Analytical Flow Cell
2855-0010	1/16" SS Male Tubing Nut
2857-0018	1/16" SS Ferrule
2858-0013	Beveled Window Retaining Washer
3750-0003	Sapphire Window
9051-0007-01	Cell Gasket
9051-0059	Window Retaining Nut
9051-0179	10mm x 15 ul Cell Body
9051-0177	SS Tubing 1/16" O.D. x .010" I.D. for Cell Inlet or Outlet Tubing
9051-0222	Cell Holder

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WARRANTY

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WARRANTY

Linear Instruments Corporation guarantees all flow cells to be free of defects of materials and workmanship upon arrival. Linear Instruments Corporation will repair or replace, at their discretion, all flow cells which prove to be defective due to workmanship or materials.

For warranty service or repair, all Linear Instruments Corporation products must be returned to Linear Instruments Corporation or to a warranty service facility designated by Linear Instruments Corporation.

For products returned to Linear Instruments Corporation for warranty service, the Buyer shall prepay shipping charges to Linear Instruments Corporation and Linear Instruments Corporation shall pay shipping charges to return the product to the Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned from another country.

Linear Instruments Corporation warrants that its software and firmware designated for use with a Linear Instruments Corporation product will execute its programming instructions when properly installed on that product. Linear Instruments Corporation does not warrant that the operation of the instrument, software or firmware will be uninterrupted or error free.

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by the Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

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