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BioFrac™ Fraction Collector

User Guide

Version 2.0

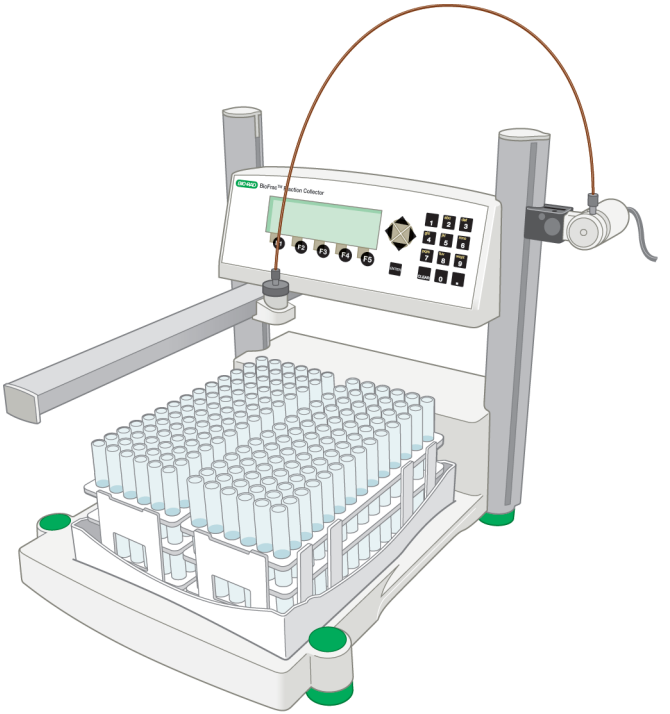
BIO-RAD

BioFrac™ Fraction Collector

User Guide

Version 2.0

Catalog # 741-0002



BIO-RAD

Bio-Rad Technical Support Department

The Bio-Rad Technical Support department in the U.S. is open Monday through Friday, 5:00 AM to 5:00 PM, Pacific Standard Time. Worldwide technical support is available on the Web at www.consult.bio-rad.com.

Phone: 1-800-424-6723, option 2

Fax: 1-510-741-5802

Email: LSG.TechServ.US@Bio-Rad.com (U.S.)

LSG.TechServ.Intl@Bio-Rad.com (International)

Web: www.consult.bio-rad.com

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1 Introduction

Overview

The BioFrac™ fraction collector provides automated collection options for analytical and preparative chromatography applications. It can be used as a stand-alone collector or as a companion to any chromatography system. The BioFrac fraction collector is capable of performing basic to complex fraction collection schemes and can be used at flow rates up to 100 ml/min. The fraction collector accommodates numerous rack options from microplates to bottles and carboys.

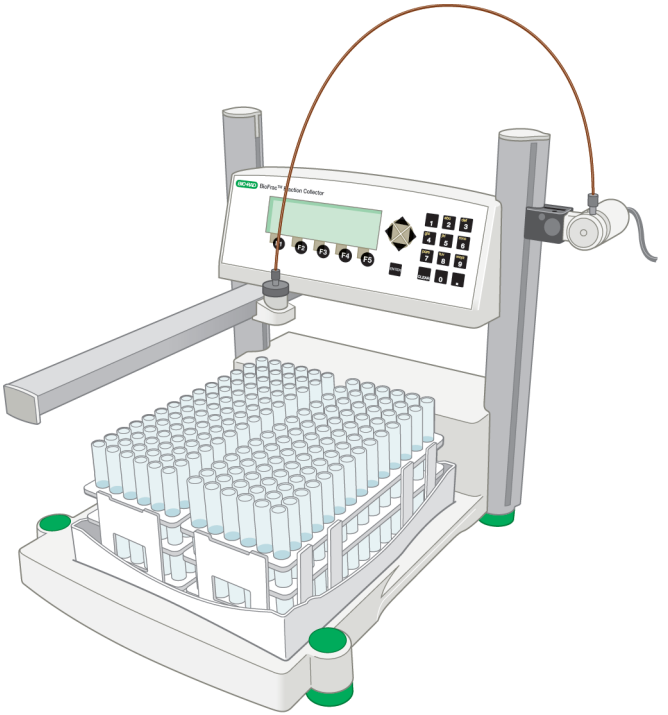


Fig. 1. BioFrac fraction collector with two F1 racks (12–13 mm tubes).

Features

The key features of the BioFrac fraction collector include the following:

- Microprocessor control with easy-to-use front panel controls and a menu-driven software interface for method setup
- Method library for saving up to 20 user-defined fraction collection methods
- Local and remote starting of the fraction collector
- Collection by time, volume, or drops

- Advanced fraction collection functions. Peak detection, Time, or Volume windows (up to 20) or a combination of Peak Detection with Time or Volume windows
- Manually adjustable control module that accommodates tube heights up to 150 mm
- Compatibility with chromatography systems from Bio-Rad as well as other manufacturers
- Modular system that can be stacked directly on top of the NGC™, BioLogic DuoFlow™, and BioLogic™ LP chromatography systems
- Accommodates several inexpensive, off-the-shelf racks for tubes (12–20 mm and 30 mm diameter), Eppendorf tubes or microcentrifuge tubes (0.5 ml, 1.5 ml, and 2 ml) and scintillation vials. Racks are autoclavable
- Ability to collect up to 180 fractions in tubes or 384 fractions in 96-well microplates
- Optional Prep-20 adaptor for preparative collection in up to 20 collection vessels of any size, from milliliter to liter collection volumes
- Optional ice bath (with tube grips) that doubles as a holder for microplates. Tube grips hold tubes firmly in any position while decanting. Rack allows cooling of 13 mm tubes on ice. As a microplate holder it accommodates 12-, 24-, 48-, and 96-well microplates and Titertube tubes that adhere to SBS standards for microplates
- Diverter valve to divert flow and minimize spillage during tube changes. Diverts unwanted eluent to waste and eliminates spills during fraction advances
- Multirun capability for overlaying fractions or collection of experiments sequentially
- Serpentine arm movement. Can be changed to a column or row pattern for microplates and Titertube tubes

- Optional drop former optimized for small-volume drop dispensing (recommended when collecting into microplates)
- Ability to start/stop an external pump and chart recorder
- Screen sleep mode for longer display life

Unpacking

When unpacking the fraction collector, carefully inspect the containers for any damage that may have occurred in shipping. Severe damage to a container may indicate damage to its contents. If you suspect damage to the contents may have occurred, file a claim immediately with the carrier in accordance with their instructions before contacting Bio-Rad Laboratories.



Caution: Do not lift the fraction collector by its dispenser arm.

Grip the base of the fraction collector and lift it slowly out of its packing. Do not lift the unit by its dispenser arm. Remove the remaining contents from each of the boxes and check all of the parts against the supplied packing list. The BioFrac fraction collector is shipped with the following:

- Fraction collector unit
- AC power cord
- Fittings kit (Figure 2)
- Instruction guide
- Tube rack #F1 (2) for 12–13 mm tubes
- Diverter valve (including an hex key)
- Combicon connector (included with instruction guide)

Note: If any part is missing or damaged, contact Bio-Rad Laboratories immediately.

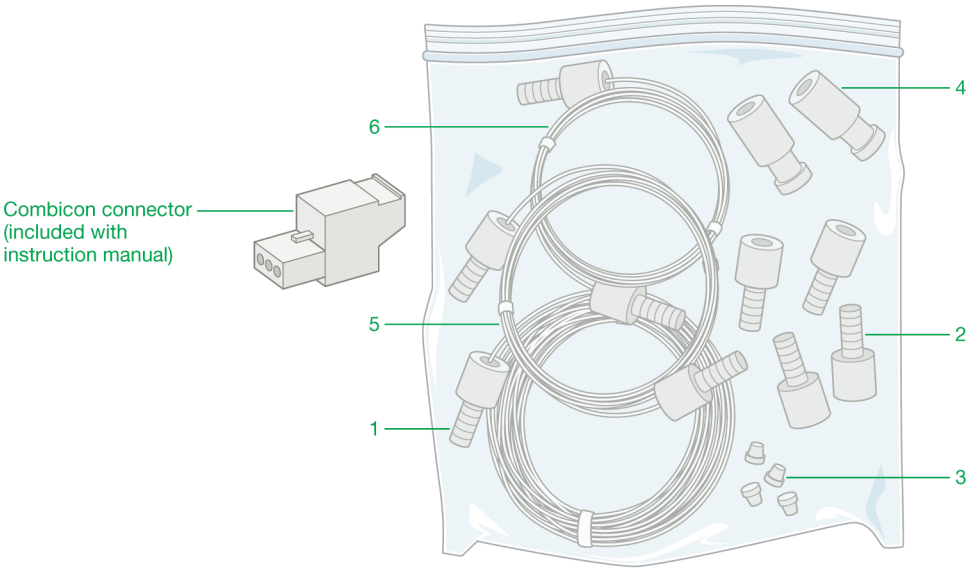


Fig. 2. Fittings kit.

LEGEND

Item	Quantity	Contents of Fittings Kit
1	1	1.0 m Tefzel tubing, 1/16" OD, 0.030" ID, with one 1/4-28 fitting
2	4	Fittings, 1/4-28, 1/16" OD
3	4	Ferrules, 1/16" OD
4	2	Unions, luer to 1/4-28
5	1	26” PEEK tubing, 1/16" OD, 0.030" ID, with two 1/4-28 fittings labeled collect HF
6	1	26” PEEK tubing, 1/16" OD, 0.020" ID, with two 1/4-28 fittings labeled collect

Physical Description

Figure 3 identifies the physical features of the BioFrac fraction collector, and the accompanying table describes the features in greater detail.

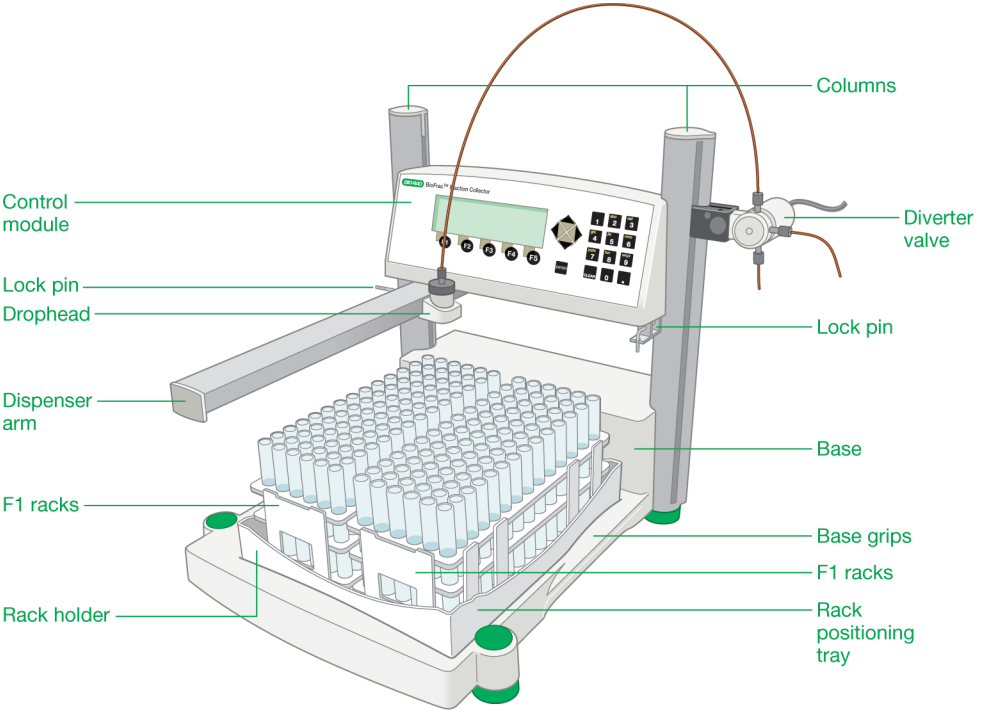


Fig. 3. Physical features of the BioFrac fraction collector.

Feature	Description
Control module	The fraction collector head contains the display, function keys, and alphanumeric keypad (see Chapter 2, Front and Rear Panel Controls and Connectors, on page 9). Its height may be adjusted to accommodate tube heights up to 150 mm.
Base	The fraction collector base holds the rack positioning tray, power switch, and I/O connectors. It is designed so that it can be stacked on top of the NGC, BioLogic DuoFlow, and BioLogic LP chromatography system workstations if benchspace is limited.
Columns	The columns hold the fraction collector head and serve as a rack for mounting the diverter valve or other devices, such as a pH probe and a UV monitor, using Bio-Rad bar clamps (Cat. #750-0265).
Rack positioning tray	Accurate dispensing requires that racks be positioned using the rack-positioning tray. Molded indents on the tray allow the rack feet to be placed securely on the rack-positioning tray. The tray holds two full racks (F1, F2, or F3) on one face and can be inverted for positioning of four half-racks (H1, H2, H3, or H4). See Chapter 3, System Configuration and Plumbing, on page 13 for available rack options.
Dispenser arm	The dispenser arm moves the drophead in a serpentine motion over each of the collection tubes. The arm movement can be changed to a column or row pattern for microplates and Titertube tubes.

Feature	Description
Drophead	Consists of the drop former, a photodiode cell for drop counting, and a clear glass tube that protects the photodiode cell from splashes. The inlet tubing is connected to the drop former, which provides uniform drop size. The drop former accepts 1/4-28 fittings. An optional drop former is available that has been optimized for small-volume drop dispensing (25 µl drops).
Diverter valve	The diverter valve minimizes spillage during drophead movement. The BioFrac diverter valve is designed to have a minimal internal volume and is 100% flushed in order to minimize loss of chromatographic resolution.
Lock pin	The height adjustment lock pins, located on either side of the front of the control module, are used to secure the drophead height.

2 Front and Rear Panel Controls and Connectors

The controls and connectors on the front and rear of the panel are illustrated and described in this chapter.

Front Panel Controls

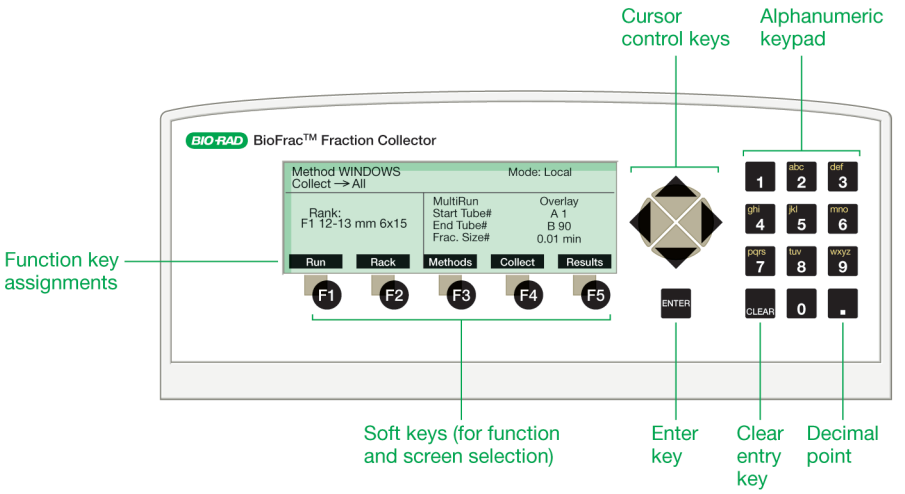


Fig. 4. Front panel controls.

Table 1. Front panel controls

Feature	Description
Cursor keys	Used to move the cursor on the LCD display up, down, left, or right.
Function keys	These five keys are located directly below the LCD display. The function each key executes is displayed above it.
Clear Entry key	Clears a cursor field or closes a menu option list.
Decimal point key	Used to enter a decimal point.
Enter key	Accepts a numeric value that has been entered.
Alphanumeric keypad	Used to enter a decimal value in numeric fields and alphanumeric characters in text fields. In a text field, the character displayed is incremented with each press of the keypad (for example, pressing the 2 key in turn displays 2, A, B, C, 2, and so on.)

Rear Panel Connectors

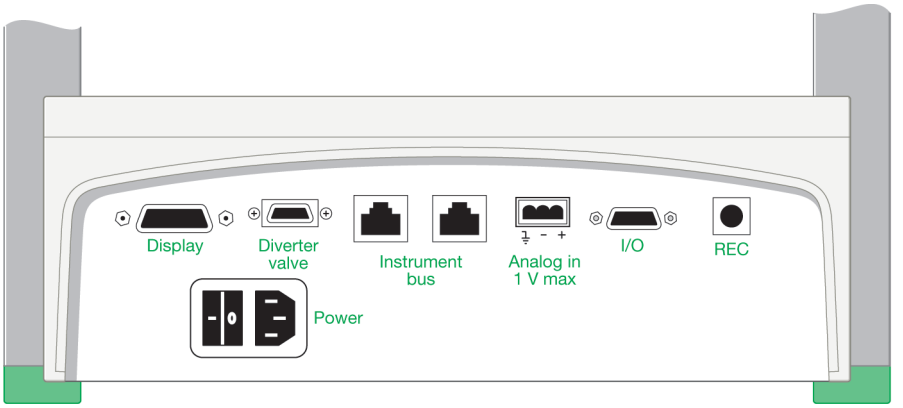


Fig. 5. Rear panel connectors.

Table 2. Rear panel connectors

Connector	Description
 Display	**Display cable** – connects the fraction collector control module to the power supply and other ports in the base of the fraction collector.
 Diverter valve	**Diverter valve connector** – used to connect the diverter valve to the fraction collector.
 I/O	**I/O connector** – a 15-pin D connector used for connecting the following instruments to the BioFrac™ fraction collector: ■ BioLogic™ LP chromatography system, Model EP-1 Econo™ pump. This system controls fraction advances. ■ Econo gradient pump. The fraction collector controls all fraction collection parameters. ■ External pump. With a BioFrac accessory cable (15-pin to bare wires) connected to the I/O port, the fraction collector can receive start, stop, and fraction advance signals from an external pump. (The pump must have compatible control circuitry logic. See Appendix B, Rear Panel Connector Information, on page 85.)
	**Instrument Bus** – for connecting the BioFrac to a BioLogic DuoFlow™ system using system cables 17, 18, 19, or 21.

Table 2. Rear panel connectors, continued.

Connector	Description
	**Rec connector** – this 8-pin mini-DIN connector controls the diverter valve or a chart recorder: ■ When connected to a BioLogic LP system or Model EP-1 Econo pump, the connector receives diverter valve control signals. ■ When connected to a chart recorder, the fraction collector controls paper feed, pen up/down, and event marks. (The chart recorder must have compatible control circuitry logic. See Appendix B, Rear Panel Connector Information, on page 85.)
 Analog in 1 V max	**Combicon connector** – used to connect a UV monitor or other detector for Peak Detection by Threshold. (See Chapter 3, System Configuration and Plumbing, on page 13 for cable information.)



3 System Configuration and Plumbing

The BioFrac™ fraction collector is shipped assembled and requires minimal plumbing and cabling to prepare it for use. Once assembled, the BioFrac device can be operated in the following configurations:

- BioLogic DuoFlow system control
- LP/Econo™ mode collection with Bio-Rad components
- Stand-alone fraction collection (Local mode) with Bio-Rad components
- Stand-alone fraction collection with components that are not manufactured by Bio-Rad

The following sections of this chapter describe how to set up the BioFrac fraction collector and how to connect instruments and devices to work with it.

Fraction Collector Setup

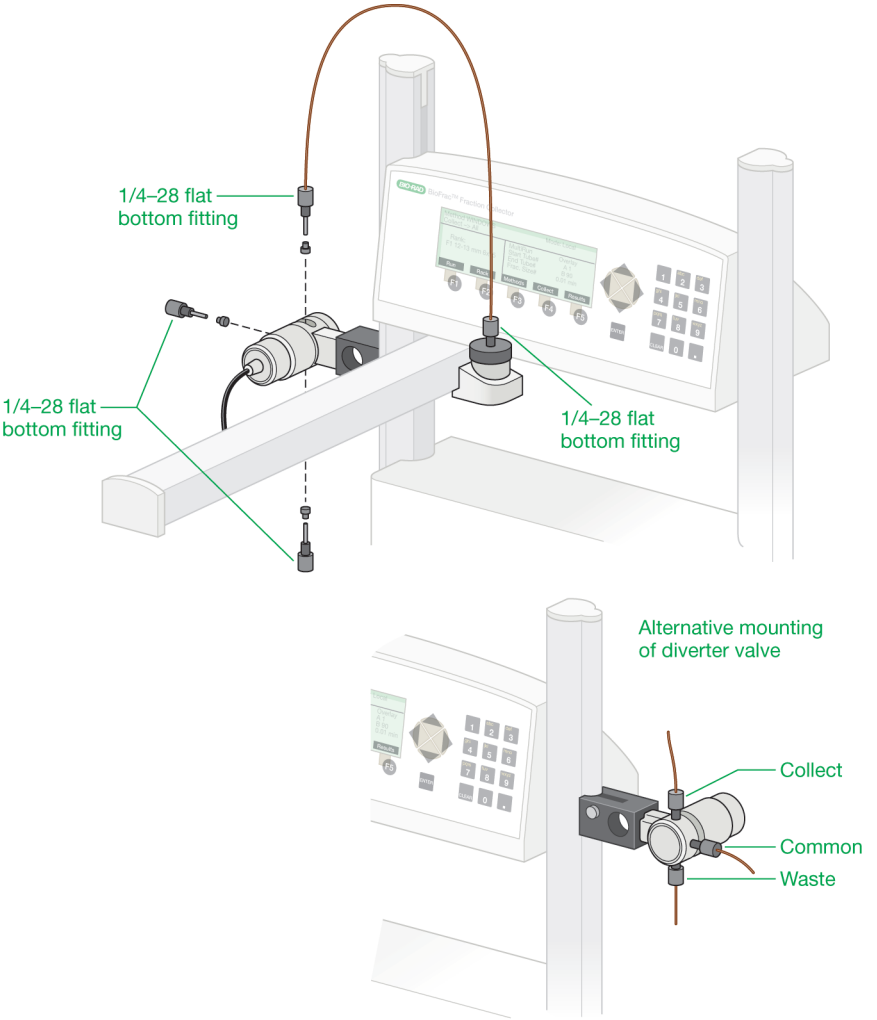


Fig. 6. Plumbing the BioFrac fraction collector.

To set up the BioFrac fraction collector

1. Place the fraction collector on a level surface on a laboratory or coldroom bench or in a cold cabinet. Alternatively, if benchspace is limited, the modular fraction collector can be stacked on top of the NGC, BioLogic DuoFlow™, or BioLogic™ LP chromatography system workstations.
2. Connect the fraction collector display cable to the port labeled Display on the back of the fraction collector. (See Figure 5 on page 10.)
3. Connect the diverter valve cable to the Diverter Valve port on the back of the fraction collector. (See Figure 5 on page 10.)
4. Attach the diverter valve to either the right or left column. The diverter valve should be attached so that the Collect port is pointed up and Waste port is pointing down (see Figure 6 on page 14). Use the included hex key to secure the diverter valve to the column.
5. Connect all power cords to available grounded, surge-protected outlets.
6. Connect the preassembled 26-inch PEEK 1/16" OD tubing, supplied in the BioFrac fittings kit, to the Collect port of the diverter valve and to the drophead. Use the 0.02" ID (orange) tubing for flow rates less than 20 ml/min and the 0.03" ID (green) tubing for flow rates greater than 20 ml/min.

   Note: The diverter valve is rated to a maximum pressure of 30 psi.

   If tubing other than that found in the fittings kit is used to plumb the fraction collector, make sure all tubing lengths are kept to a minimum. This reduces the delay volume (see Collect Using a Delay Function on page 67) and backpressure. Tubing choice is dependent on the flow rate and pressure characteristics of the pumping system. For flow rates above 20 ml/min, use 0.03" ID or 1/8" OD, 0.062" ID tubing (available from most tubing/fitting suppliers).
7. Attach the 0.03" ID Tefzel tubing, supplied in the fraction collector fittings kit, to the Waste port of the diverter valve and place the other end into a waste collection vessel.

   Note: If using flow rates greater than 20 ml/min, be sure to use tubing that has a 0.03" or larger ID.

8. Attach the tubing from your chromatography system to the Common port on the diverter valve using either a 1/4-28 fitting or luer to 1/4-28 union. The BioFrac fittings kit includes 1/4-28 fittings (for 1/16" OD tubing) and luer to 1/4-28 unions.

9. Connect the fraction collector to your chromatography system as described in the next section, Connecting Instruments and Devices to the BioFrac Fraction Collector.

Connecting Instruments and Devices to the BioFrac Fraction Collector

The BioFrac fraction collector can be operated in any of the following configurations.

- BioLogic DuoFlow system control. The system controls the operation of the fraction collector through the system bus. See Connecting to a BioLogic DuoFlow Chromatography System on page 17 for details.

- LP/Econo mode collection with Bio-Rad components such as the BioLogic LP system and Model EP-1 Econo™ Pump. The BioLogic LP system Econo pump controls all aspects of fraction collection.

- Stand-alone fraction collection (Local mode) with Bio-Rad components, such as the Econo gradient pump, a BioLogic QuadTec™ detector, a Model EM-1 Econo UV monitor, and/or a Model 1327 chart recorder.

  Note: The fraction collector provides complete control of fraction collection.

- Stand-alone fraction collection with components that are not manufactured by Bio-Rad, such as a pump, UV monitor, and/or chart recorder. In Local mode, the fraction collector provides complete control of fraction collection and can start/stop an external device such as a pump or chart recorder. In LP/Econo mode, the controller provides complete control

of fraction collection. Devices not manufactured by Bio-Rad must be capable of transistor to transistor logic (TTL) control.

Note: Before proceeding, make sure power to each component to be connected is turned off. Be sure to use a grounded, surge-protected outlet when plugging in the power cables.

Connecting to a BioLogic DuoFlow Chromatography System

Connect the BioFrac fraction collector to the BioLogic DuoFlow system using system cables 17, 18, 19, or 21.

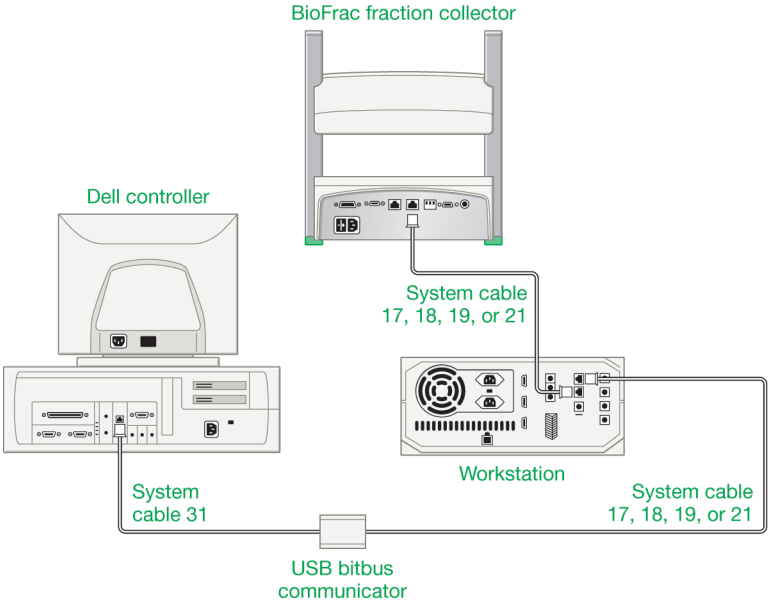


Fig. 7. Connecting the fraction collector to a BioLogic DuoFlow chromatography system.

To connect the fraction collector to a BioLogic DuoFlow system

1. Connect the bus cable to the connector marked INSTRUMENT BUS on the base of the fraction collector.
2. Connect the other end of the bus cable to either the INSTRUMENT BUS connector on the back of the BioLogic DuoFlow workstation or to other Bio-Rad components that are daisy chained to the BioLogic DuoFlow workstation by the instrument bus.
3. Place the BioFrac fraction collector in Local mode with the Main screen displayed (see Main Screen on page 36). Start the BioLogic DuoFlow software and press System in the manual screen fraction collector dialog box.

   Note: The BioFrac fraction collector must be in Local mode and on the Main screen before the BioLogic DuoFlow system can control it.

Connecting to a BioLogic LP System or to a Model EP-1 Econo Pump

To connect the fraction collector to the BioLogic LP system or Model EP-1 Econo pump requires system cables 3 and 15. System cable 15 relays the fraction advance signal to the BioFrac device, and system cable 3 allows the BioLogic LP system or Model EP-1 Econo pump to control the BioFrac fraction collector's diverter valve.

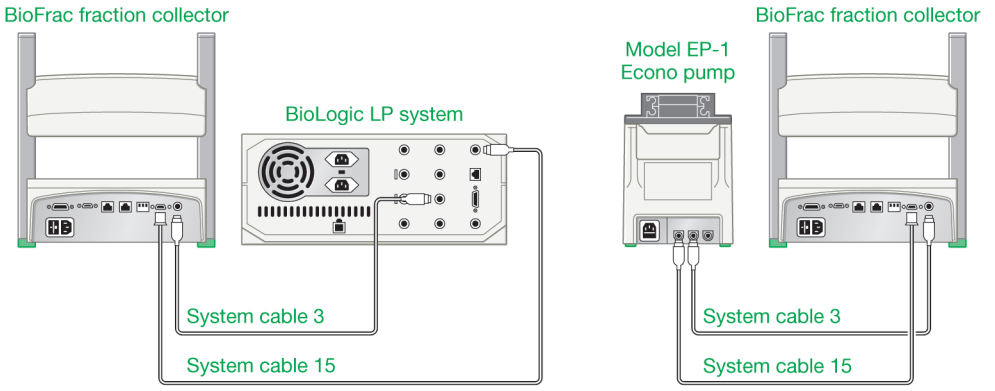


Fig. 8. Connecting the fraction collector to a BioLogic LP system and Model EP-1 Econo pump.

To connect the fraction collector to the BioLogic LP system or Model EP-1 Econo pump

1. Connect system cable 15:
    a. Connect the cable's 15-pin D connector to the port labeled I/O on the fraction collector.
    b. Connect the mini-DIN connector to the port labeled Fraction Collector on the BioLogic LP system or the port labeled  on the Model EP-1 Econo pump.
2. Connect system cable 3:
    a. Connect one of the cable's mini-DIN connectors to the REC port on the fraction collector.
    b. Connect the other mini-DIN connector to the port labeled Diverter Valve on the BioLogic LP system or the port labeled  on the Model EP-1 Econo pump.
3. If you are connected to a BioLogic LP system, press Collector on the faceplate and then press the MODEL softkey followed by the BIOFRAC (or 2128) softkey.
4. When prompted to verify that an external valve cable is connected, enter Yes.
5. Follow the procedure, To run the fraction collector in LP/Econo mode on page 75.

Connecting to the Econo Gradient Pump and a Chart Recorder

The following configuration shows the fraction collector set up with an Econo gradient pump and a chart recorder. This system allows full use of the fraction collector's advanced programming features.

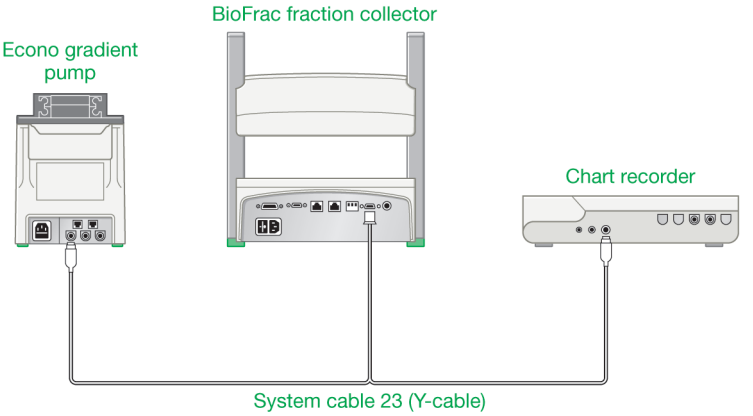


Fig. 9. Connecting the fraction collector, Econo gradient pump, and chart recorder.

To connect the fraction collector, Econo gradient pump, and chart recorder

1. Connect the mini-DIN connector to the I/O connector on the Econo gradient pump.
2. Connect the 15-pin D-connector to the I/O connector on the fraction collector.
3. If a chart recorder is present, connect the cable's remaining end to the chart recorder DIN connector. If the chart recorder is not present, place this portion of the cable aside.
4. If collecting fractions by threshold, connect a detector to the fraction collector and chart recorder as described in this chapter.
5. Follow the procedures in Chapter 5, Stand-Alone Operation, on page 57.

Connecting the Model EP-1 Econo and Econo Gradient Pumps

The BioFrac fraction collector can start an Econo gradient pump or Model EP-1 Econo pump remotely. To make the necessary connections you will need a BioFrac accessory cable (catalog # 731-8290) and system cable 7 (catalog # 731-8267).

1. Connect the BioFrac accessory cable green/black and blue/white wires to the system cable 7 blue wire.
2. Connect the BioFrac accessory cable's orange/black wire to the system cable 7 yellow wire if you are connecting to an Econo gradient pump, or red wire if you are connecting to a Model EP-1 Econo pump.
3. Trim off all unused wires.
4. Connect the end of the BioFrac accessory cable with the 15-pin D connector to the I/O port on the BioFrac fraction collector.
5. Connect the system cable 7 mini-DIN connector to the I/O port on the Econo gradient pump or Model EP-1 Econo pump.
6. With the fraction collector in Local mode, press Run to start the fraction collector and pump.
7. If you are collecting by volume, be sure to enter the pump flow rate into the BioFrac device's flow rate entry field.

Note: Pressing Stop on the BioFrac fraction collector will not stop the Econo gradient pump run. The EGP program must be stopped from the Econo gradient pump faceplate.

Connecting to Components Not Manufactured by Bio-Rad

The BioFrac fraction collector is designed to work with a variety of components from other manufacturers. The BioFrac fraction collector can control remote devices such as pumps, chart recorders, and UV detectors, and it can accept start/stop signals from other equipment, such as pumps and UV detectors. The following is a description of the remote fraction collection control options. To connect the fraction

collector to another manufacturer's pump, UV monitor, and/or chart recorder, you need a BioFrac accessory cable (15-pin to bare wires), system cable 7 (mini-DIN to bare wires), and 2-wire shielded cable (26 gauge or larger, available from most electronics or hardware stores). In addition, the pump and chart recorder circuit logic must be Start/closed circuit = ON; Stop/open circuit = OFF. The UV monitor's analog output must be 100 mV or 1 V. (Refer to Appendix B, Rear Panel Connector Information (page 85), and Appendix C, Specifications (page 91), for details.)

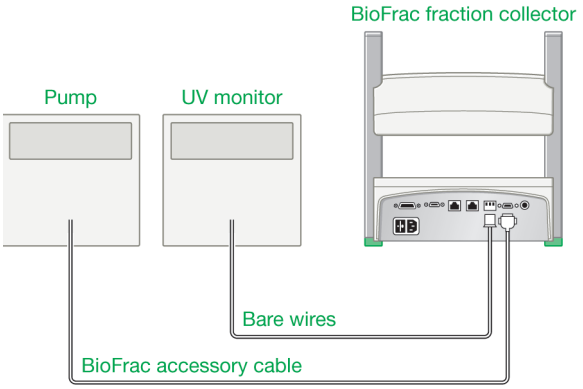


Fig. 10. Connecting the fraction collector to components other than Bio-Rad's.

To remotely start or stop an external pump from the BioFrac fraction collector

1. As described in Chapter 5, Stand-Alone Operation (page 57), set the fraction collector to Local mode. In Local mode, all fraction collection parameters are programmed on the BioFrac device's front panel.
2. Connect the BioFrac accessory cable (15-pin to bare wires; see Appendix B, Rear Panel Connector Information, on page 85) to the I/O port on the back of the fraction collector.

3. Connect the BioFrac accessory cable green/black wire (pin #9) to the start pin on the remote instrument. Refer to your particular pump's documentation for further information.

4. Connect the orange/black wire (pin #10) to the remote instrument's signal ground. When Run is pressed on the BioFrac instrument, the remote start relay pins (pins #9 and #10) are connected and the start signal is relayed to the remote device.

To remotely start or stop the fraction collector

1. Set up the fraction collection parameters as described in Chapter 5, Stand-Alone Operation, on page 57 with the fraction collector in Local mode. In Local mode, the fraction collector controls all aspects of fraction collection.

2. Connect a BioFrac accessory cable (15-pin to bare wires, see Appendix B, Rear Panel Connector Information, on page 85) to the I/O port on the back of the fraction collector.

3. Connect pin #5 (orange wire) to the signal ground, pin #15 (blue/white wire). Making this connection allows the BioFrac to listen for a start/stop signal.

4. Connect pin #6 (blue wire) to one terminal of the start/stop relay on the controlling device and connect pin #15 (blue/white wire) to the other terminal of the start/stop relay.

Refer to the documentation for your controller before completing the setup. Pressing start on the controlling device starts the BioFrac by connecting pin #6 to ground. Fraction collection is stopped when the last tube is reached, Stop is pressed on the BioFrac, or the connection between pin #6 and ground is broken by pressing Stop on the controlling device.

Note: When doing a remote start, we recommend that you test the collection parameters by pressing Run and then Stop on the BioFrac instrument before running an experiment. The BioFrac does a series of error checks at the start of a run and will not start a run if it finds an error in the setup.

To remotely control the drophead and diverter valve

1. Set up the fraction collection parameters as described in Chapter 6, LP/Econo Mode Operation, on page 75. In LP/Econo mode, the remote instrument controls all aspects of fraction collection.
2. Connect a BioFrac accessory cable (15-pin to bare wires; see Appendix B, Rear Panel Connector Information, on page 85) to the I/O port on the back of the fraction collector.
3. Connect the I/O port pin #1 (black wire) to the pin controlling the fraction advances on the remote instrument.
4. Connect the I/O port pin #15 (blue/white wire) to the signal ground of the remote instrument.
5. Connect system cable 7 (mini-DIN to bare wires; see Appendix B, Rear Panel Connector Information, on page 85), to the REC connector on the back of the fraction collector.
    a. Connect REC pin #2 (orange wire) to the diverter valve control pin on the remote controller.

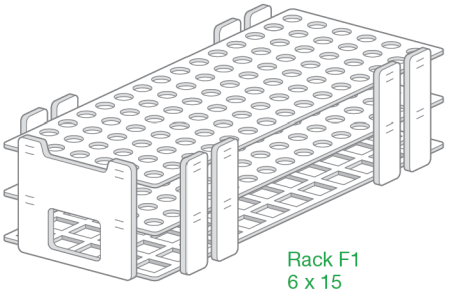
       Note: If you cannot control the BioFrac diverter valve remotely, connect REC pin #2 (orange wire) to REC pin #8 (green wire). This causes the BioFrac diverter valve to open when Engage is pressed on the fraction collector (see LP/Econo mode in Chapter 4, The User Interface, on page 35). If you cannot control the BioFrac diverter valve, you will need to supply a diverter valve with your system. The Collect port of the second diverter valve should be plumbed to the common port of the BioFrac diverter valve.

    b. Connect REC pin #8 (green wire) to the signal ground on the remote controller.
6. On the BioFrac LP/Econo Main screen press Engage (F1). The BioFrac will now wait for the fraction advance and diverter valve signals.

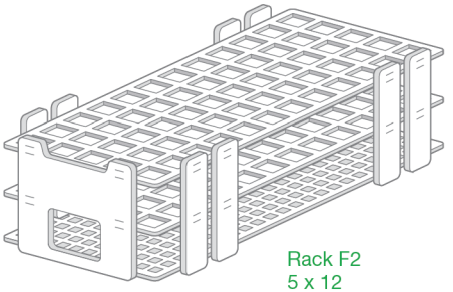
Setting Up the Fraction Collector Racks

The BioFrac fraction collector is designed to accommodate a variety of rack options, including both custom-molded and off-the-shelf racks. Custom racks include the ice bath/microplate and Prep-20 racks. The top of the ice bath rack holds microplate (12-, 24-, 48-, and 96-well) and Titertube tube racks that adhere to Society of Biomolecular Screening (SBS) standards for microplates. Inexpensive off-the-shelf racks, which accommodate tubes, scintillation vials, and Eppendorf tubes, can be purchased from Bio-Rad or most scientific product vendors. The rack options are shown in the next two figures and listed in Table 3.

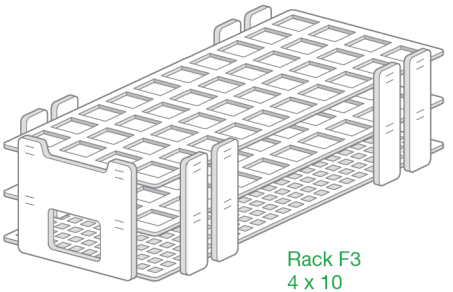
Off-the-shelf Racks



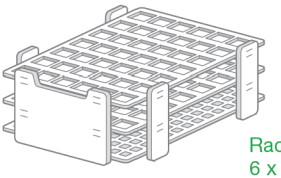
Rack F1
6 x 15



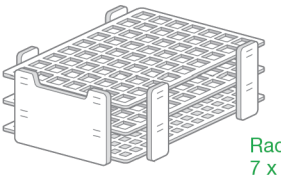
Rack F2
5 x 12



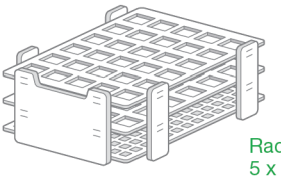
Rack F3
4 x 10



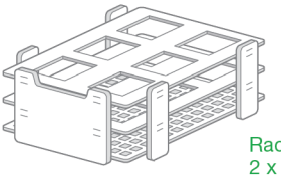
Rack H1
6 x 7



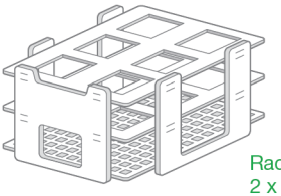
Rack H2
7 x 9



Rack H3
5 x 6

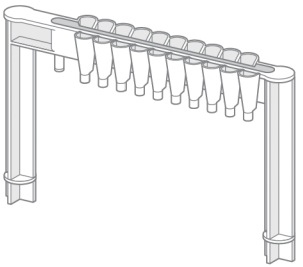


Rack H4
2 x 3

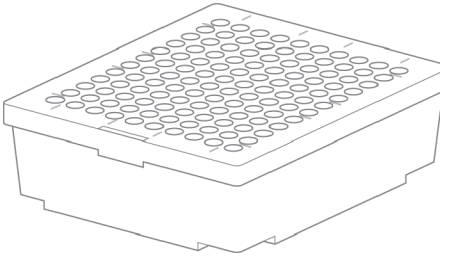


Rack H4 high
2 x 3

Custom Racks

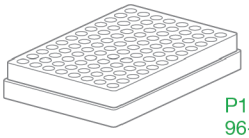


Prep-20 adaptor (optional)

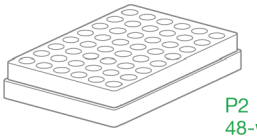


Ice bath (optional)/microplate rack

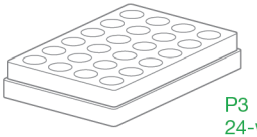
Microplates



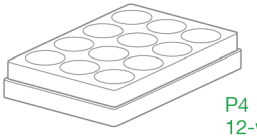
P1
96-well



P2
48-well



P3
24-well



P4
12-well

Bottles



2 x 2

Table 3. BioFrac fraction collector racks

Rack ID	Bio-Rad Catalog#	Rack Description	Rack Capacity	Format Column x Rows	Tubes Per Rack (Total)
F1	741-0010	Holds 12–13 mm diameter tubes up to 100 mm in height	2 racks	6 x 15	90 (180)
F2	741-0011	Grip rack, holds 15–16 mm diameter tubes up to 150 mm in height	2 racks	5 x 12	60 (120)
F3	741-0012	Grip rack, holds 18–20 mm diameter tubes up to 150 mm in height	2 racks	4 x 10	40 (80)
H1	741-0013	For 1.5–2.0 ml capless microtubes	4 racks	6 x 7	42 (168)
H2	741-0014	For 0.5 ml capless microtubes	4 racks	7 x 9	63 (252)
H3	741-0015	For 16 mm scintillation vials	4 racks	5 x 6	30 (120)
H4	741-0016	For 50 ml conical vials	4 racks	2 x 3	6 (24)
H4-High	741-0020	For 50 ml conical vials	4 racks	2 x 3	6 (24)
Ice bath/ microplate rack	741-0017	Ice bath for 13 mm diameter tubes up to 100 mm in height. This rack also serves as a holder for 12-, 24-, 48-, and 96-well microplates and microtiter tubes that adhere to the SBS standard format	1 rack	10 x 12	120
P1	224-0096	96-well standard plate	4 plates	96-well	96 (384)
	176-6023	96-deep well, 2 ml	4 plates	96-well	96 (384)
P2		48-well microplates	4 plates	48-well	48 (192)
P3		24-well microplates	4 plates	24-well	24 (96)
P4		12-well microplates	4 plates	12-well	12 (48)
TT1			4 racks	96-well	96 (384)

Table 3. BioFrac fraction collector racks, continued.

Rack ID	Bio-Rad Catalog#	Rack Description	Rack Capacity	Format Column x Rows	Tubes Per Rack (Total)
Prep-20	741-0018	Preparative rack	1	2 x 10	20 funnels
Bottle		For 250 ml bottles	1		4 bottles

Other racks compatible with the BioFrac fraction collector are available from Scienceware (www.belart.com). Compatible racks include the no-wire and no-wire grip full racks (248 x 105 x 64 mm and 246 x 104 x 64 mm) and half racks (128 x 105 x 43 mm and 128 x 105 x 43 mm) in formats listed for racks F1–F3 and H1–H4.

To prepare the BioFrac fraction collector for fraction collection, set up the unit as described in the following sections.

Racks F1, F2, and F3

Place the rack positioning tray into the base of the fraction collector, deep side facing up. Position each rack so that its legs are in the rack guides. Adjust the fraction collector's control module appropriately for the height of the tubes being used. The height adjustment lock pins (see Figure 11 on page 32) can be used to lock the drophead at the desired height. Tube number 1 is located in the front, left corner of the each rack.

Racks H1, H2, H3, H4, and H4-High

Place the rack positioning tray into the base of the fraction collector, deep side facing down. Position each rack so that its legs are in the rack guides. Adjust the fraction collector control module head appropriately for the height of the tubes being used. The height adjustment lock pins (see Figure 11 on page 32) can be used to lock the drophead at the desired height. Tube number 1 is located in the front, left corner of the each rack. For racks H1 and H2, use only capless microtubes.

Ice Bath

Remove the lid of the ice bath/microplate rack and fill the tub approximately ½ full with crushed ice, replace the lid and insert 13 x 100 mm culture tubes. Remove the rack positioning tray from the fraction collector and replace it with the ice bath rack. Adjust the fraction collector control module appropriately for the height of the tubes being used. The height adjustment lock pins (see Figure 11 on page 32) can be used to lock the drophead at the desired height. Tube number 1 is located in the front, left corner of the rack.

Microplates and Titertube Tubes (Racks P1, P2, P3, P4, and TT1)

Remove the rack positioning tray from the fraction collector and replace it with the ice bath/microplate rack. Position the ice bath/microplate rack such that rack tube number 1 is in the left, front corner. Mount the plates on the rack using the plate positioning tabs located on the top of the rack. Adjust the fraction collector control module appropriately for the height of the plates being used. The height adjustment lock pins (see Figure 11 on page 32) can be used to lock the drophead at the desired height. Position the plates such that tube A1 is in the left, front corner. In order to obtain a uniform fraction size when collecting fractions smaller than 0.5 ml, we strongly suggest that fraction size be specified in drops rather than time or volume. Alternatively, the microplate Drop Head Kit (catalog # 741-0088) can be used to obtain finer resolution of fraction sizes since it delivers an approximately 25 µl drop.

Preparative (Prep-20) Adaptor

Attach Tygon tubing to each funnel that is long enough to reach the collection vessels (20 feet of 3/8" OD, 1/4" ID Tygon tubing is provided for this purpose.) Ensure that no kinks constrict flow in the tubing. Gravity flow from the prep adaptor requires that the container used for collection be mounted below the Prep-20 adaptor funnels. A drain trough is provided as added security in the event the tubing becomes plugged or kinked, preventing sample loss. The drain trough tubing should be inserted into a clean empty collection vessel.

To install the Prep-20 adaptor, remove the two green rubber plugs on the left, front and right, front of the fraction collector. After attaching the Tygon tubing, insert the Prep-20 adaptor into the preparative rack holder slots. Notice that the drain trough slopes slightly towards the drain funnel. The collection port tubing extends down the front of the fraction collector.

Note: The Prep-20 adaptor is rated for use with flow rates up to 100 ml/min. (For discussion of the plumbing for high flow rates, see Chapter 3, System Configuration and Plumbing, on page 13.)

Bottles

Place the rack positioning tray, deep side facing up, and place the bottles in the circles labeled A, B, C, and D. Adjust the fraction collector head appropriately for the height of the bottles being used.

Adjusting the Drophead Height

The BioFrac fraction collector accommodates collection vessel heights up to 150 mm. Detents, arranged at predefined heights, are positioned along both columns for added security. The detent positions accommodate all standard tube and microplate heights. Lock pins fit snugly within the detents to secure the control module height and prevent the control module from slipping.

To adjust the drophead height

1. Disengage the lock by pulling both lock pins outward from the fraction collector. The lock pins can be disabled by turning the handles sideways (Figure 11).
2. Move the control module to the desired height (Figure 12).
3. Move the control module up or down until the lock pins click into position.

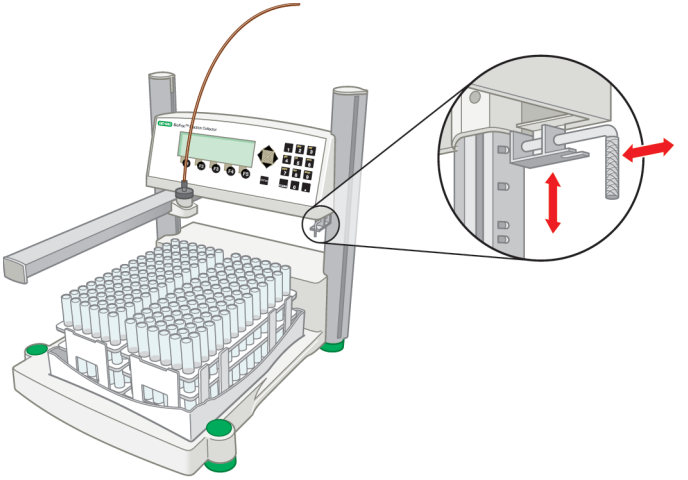


Fig. 11. Lock pin adjustment.

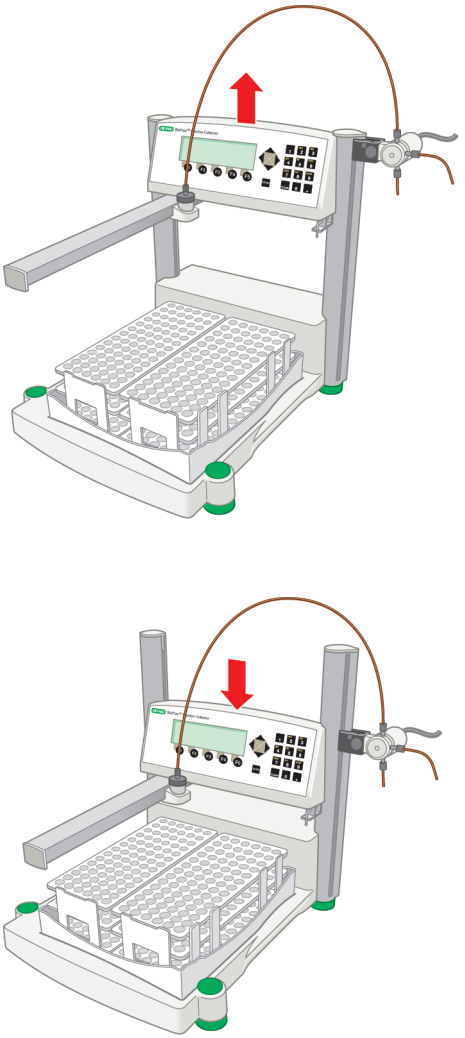


Fig. 12. Height adjustment.

4 The User Interface

Control of the fraction collector interface is through the arrow, ENTER, CLEAR, and alphanumeric keys that are located to the right of the display or through the function keys located below the display.

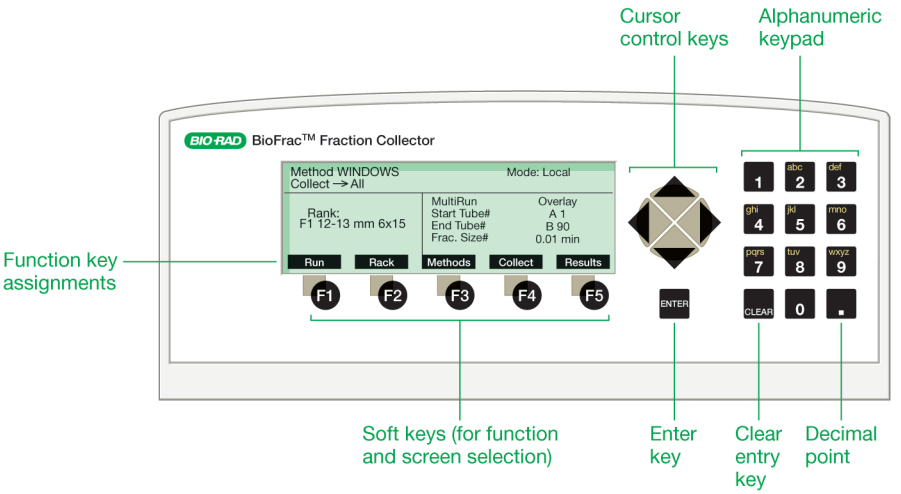


Fig. 13. BioFrac™ fraction collector user interface.

Navigation between the fields is accomplished using the arrow keys. Numbers and/or letters are entered into the alphanumeric fields using the alphanumeric keypad. Use ENTER to accept the changed parameter. CLEAR deletes the entered data. The left arrow key can also be used to backspace and delete one character at a time. Each button on the keypad shows the characters assigned to it. In numeric fields only numbers are accessible. In text fields sequential pressing of a key toggles through the available characters (for example pressing the 2 key in turn displays 2,

A, B, C, 2, and so on). The five function keys are used to move between different screens or perform predefined functions. When the cursor is in a menu selection field, pressing ENTER causes the menu to be displayed. Once a menu is displayed, the up/down arrow keys are used to navigate through the menu items. Pressing ENTER selects the menu item shown at the cursor position.

Main Screen

The Main screen provides information about the operation mode (Local or LP/Econo), method name, rack, and fraction collection parameters. The parameter fields displayed depend on whether the fraction collector is in Local mode (see Figure 14, Table 4, and Table 5) or LP/Econo mode (see Figure 15, Table 6, and Table 7).

Main Screen (Local Mode)

In Local mode, the Main screen is used to set the multirun mode, start and end tube numbers, fraction size, fraction size units, and flow rate (see Figure 14, Table 4, and Table 5). Function keys are used to start a run (see Local Mode) or switch to the Rack, Method Library, Advanced Collection, and Results screens.

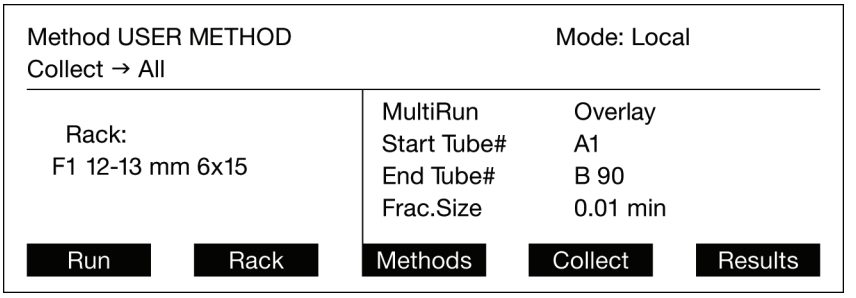


Fig. 14. Main screen (Local mode).

Table 4. Main screen parameters (Local mode)

Parameter	Function
Method	Displays the current method name (text only).
Collect	Displays the currently selected collection mode: All, Threshold, Windows, Windows/Threshold (text only).
Rack	Displays the currently selected rack (text only).
MultiRun	Menu for choosing the multiple run function: **Overlay** – causes collection to occur in the same tubes for each subsequent experiment. In this mode the initial end tube should be equal to or greater than the number of tubes required for each experiment. **Seq. Tube+1** – increments the start and end tube numbers at the end of each run so that one tube is skipped between runs. In this mode the initial end tube should be set to reflect the number of tubes required for each experiment rather than the number of tubes in the rack. If the incremented start or end tube number exceeds the rack's tube capacity, a message appears stating that there are not enough tubes for the next run. **Seq. Rack** – increments the start and end tube numbers at the end of each run so that each run starts at a different rack. In this mode, the initial end tube should be set to reflect the number of tubes required for each experiment rather than the total number of tubes available. If the incremented start or end tube number exceeds the rack's tube capacity, a message appears stating that there are not enough tubes for the next run.
Start Tube # End Tube #	Used to set the start tube and end tube. A, B, C, and D correspond to the specific rack position and the associated number corresponds to the tube position within each rack. Start tube and end tube are automatically updated at the end of an experiment if MultiRun is set to *Seq. Tube+1* or *Seq. Rack.*
Frac. Size	Defines the current fraction size in time (min), volume (ml), or drops.

Table 4. Main screen parameters (Local mode), continued.

Parameter	Function
min/ml/drop	Menu for choosing the fraction size units, time (min), volume (ml), drops. **Note:** If collecting by volume, the flow rate must be entered in the flow rate field.
Flow Rate	Used to define the flow rate. Must be set if collecting by volume. This field is not displayed if collecting in time or drop mode.

Table 5. Main screen function keys (Local mode)

Function Key	Function
Run	Starts an experiment and displays the Run screen (see Run Screen on page 42).
Rack	Displays the Rack screen (see Rack Screen on page 46).
Methods	Displays the Method Library screen (see Method Library Screen on page 48).
Collect	Displays the Advanced Collection parameter screen (see Advanced Collection Screen on page 51).
Results	Displays the Results screen. This screen displays the run results of the last completed experiment (see Results Screen on page 56). **Note:** The contents of this screen are lost when Run is pressed or the fraction collector is turned off.

Main Screen (LP/Econo Mode)

In LP/Econo mode, the Main screen is used to set the multirun mode and start and end tube numbers (see Figure 15, Table 6, and Table 7). All other fraction collection parameters are controlled remotely. Function keys are used to engage the fraction collector so that it will accept remote divert and fraction advance signals (see LP/Econo Mode) or to select a rack from the rack screen.

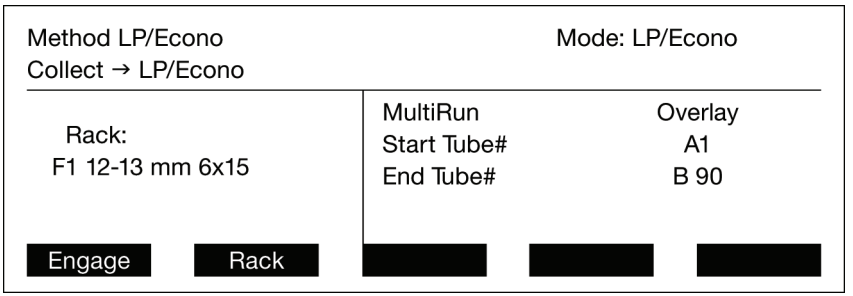


Fig. 15. Main screen (LP/Econo mode).

Table 6. Main screen parameters (LP/Econo mode)

Parameter	Function
Method	LP/Econo (text only).
Collect	LP/Econo (text only).
Rack	Displays the currently selected rack (text only).

Table 6. Main screen parameters (LP/Econo mode), continued.

Parameter	Function
MultiRun	Menu for choosing the multiple run function: **Overlay** – causes collection to occur in the same tubes for each subsequent experiment. In this mode, the fraction collector moves back to the start tube when the end tube is filled. Stop is used to disengage the experiment. **Seq. Tube+1** – increments the start and end tube numbers at the end of each run so that one tube is skipped between runs. In this mode, the initial end tube should be set to reflect the number of tubes required for each experiment rather than the number of tubes in the rack. If the incremented start or end tube number exceeds the rack's tube capacity, a message appears stating that there are not enough tubes for the next run. The start tube and end tube are incremented each time the fraction collector is disengaged by pressing stop or by filling the end tube. **Seq. Rack** – increments the start and end tube numbers at the end of each run so that each run starts on a different rack. In this mode, the initial end tube should be set to reflect the number of tubes required for each experiment rather than the total number of tubes available. If the incremented start or end tube number exceeds the rack's tube capacity, a message appears stating that there are not enough tubes for the next run. The start tube and end tube are incremented each time the fraction collector is disengaged by pressing stop or by filling the end tube.
Start Tube # End Tube #	Used to set the start and end tube. A, B, C, and D correspond to the rack position. The associated number corresponds to the tube position within each rack. Start tube and end tube are automatically updated at the end of an experiment if MultiRun is Seq. Tube+1 or Seq. Rack.

Table 7. Main screen function keys (LP/Econo mode)

Function Key	Function
Engage	Moves the drophead to the start tube and causes the fraction collector to listen for fraction advance and diverter valve signals.
Rack	Displays the Rack Selection screen.

Run Screen

The Run screen provides information about the progress of the current run. The information displayed on the screen depends on the type of method being used and whether the fraction collector is in Local or LP/Econo mode.

The Run Screen in Local Mode

In Local mode, the information displayed includes run status, run time, fraction filled, fraction size, and drophead position. In addition, UV (%AUFS, that is, absorbance units full scale) and threshold values are displayed during threshold collection (see Figure 16, Table 8, and Table 9). Run volume is displayed when collecting by volume. Four function keys are available during a run to stop or pause an experiment, do tube advances, and control the diverter valve.

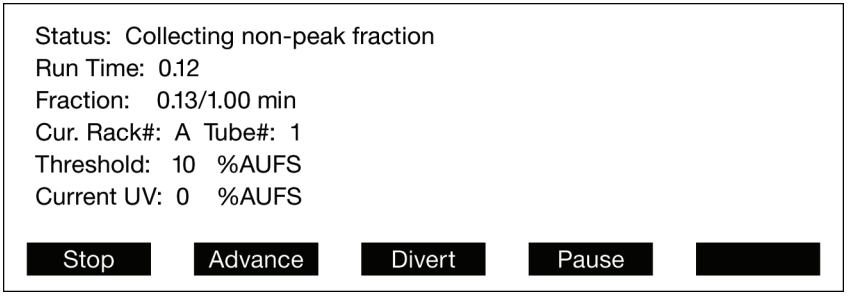


Fig. 16. Run screen (Local mode).

Table 8. Run screen parameters (Local mode)

Parameter	Function
Status	Displays the current fraction collection status: ■ Collecting – the diverter valve is in the collect position and fractions of a user-specified size are being collected. ■ Diverting – the diverter valve is in the Waste position. Run Paused!: The run is currently paused and the diverter valve is at Waste. A warning is displayed that the diverter valve is diverting to Waste. ■ Collecting Non-Peak – the diverter valve is in the collect position but is collecting fractions of non-peak size. ■ Will Collect at End of Delay – the fraction collector is waiting for the delay time before it switches the diverter valve to Collect. ■ Will Divert at End of Delay – the fraction collector is waiting for the delay time before it switches the diverter valve to Waste.
Run Time	Displays the current run time (in hours and minutes). Stops incrementing during a pause. If collecting by volume, the run volume is also displayed.
Cur. Rack # Tube #	Displays the current rack position and tube number.
Threshold	Displays the current threshold setting as a percentage of full scale (%AUFS). (Displayed only if collecting by threshold).
Current UV	Displays the current UV signal value as a percentage of full scale (%AUFS). (Displayed only if collecting by threshold).

Table 9. Run screen function keys (Local mode)

Function Key	Function
Stop	Stops the current experiment and displays the Results screen.
Advance	Advances the drophead by one tube.
Divert/Collect	Toggles the diverter valve between Collect and Waste.
Pause	Pauses fraction collection and switches the diverter valve to Waste during the pause.
Resume	Resumes fraction collection after a pause.

The Run Screen in LP/Econo Mode

In LP/Econo mode the Run screen shows the current diverter valve status and drophead position (see Figure 17 and Table 10). This screen has a Stop function key that causes the fraction collector to stop listening for fraction advance and diverter valve signals and returns the drophead to the home position.

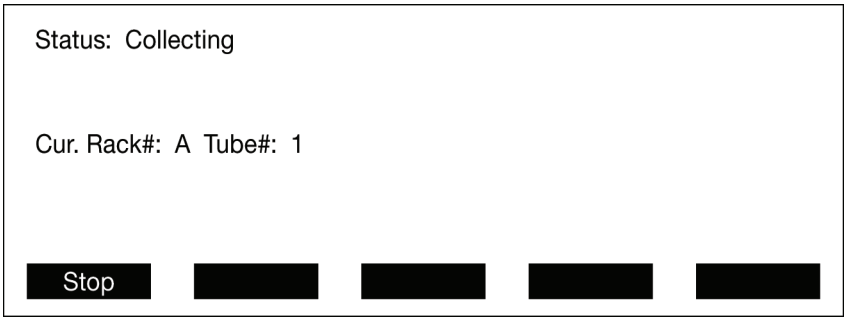


Fig. 17. Run screen (LP/Econo mode).

Table 10. Run screen parameters (LP/Econo mode)

Parameter	Function
Status	Displays the current fraction collection status. Collecting – the diverter valve is in the Collect position. Diverting – the diverter valve is in the Divert to Waste position.
Cur. Rack # Tube #	Displays the current rack position and tube number.
Overlay Cycle	The number of times that the fraction collector has overlaid fractions in the current set of runs. (Displayed only in Overlay mode).

Rack Screen

The Rack screen is used to select the rack type and collection pattern to be used in a method (see Figure 18, Table 11, and Table 12). The default collection pattern is serpentine; however, it may be changed to collection by row or by column when collecting in microplates or Titertube tubes. The Divert Between Tubes feature can be used to reduce the amount of liquid spilled during tube advances. When this option is turned on (default), the diverter valve switches to waste during tube advances. However, if this option is turned off (recommended when collecting in drop mode at low flow rates), the diverter valve switches to Waste only when the drophead is moving between nonadjacent tubes.

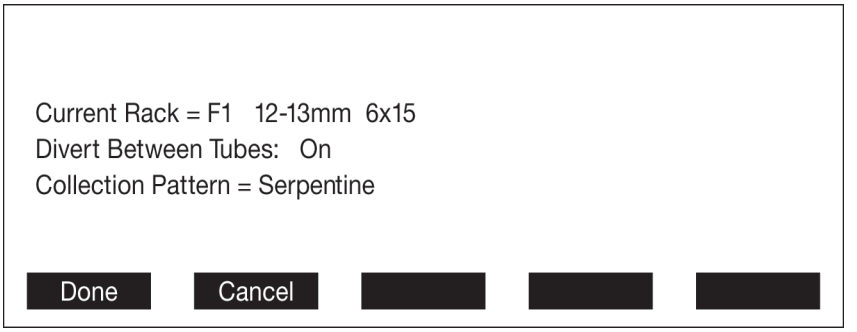


Fig. 18. Rack screen.

Table 11. Rack screen parameters

Parameter	Function
Current Rack	Menu used for rack selection.
Divert Between Tubes	Allows the user to turn off the Divert Between Tubes function. The fraction collector still diverts when the drophead is moving between nonadjacent tubes.
Collection Pattern	Displays the current fraction collection pattern. This pattern can be changed to row or column for microplates and Titertube tubes.

Table 12. Rack screen function keys

Function Key	Function
Done	Accepts all changes and returns to the Main screen.
Cancel	Aborts all changes and returns to the Main screen.

Method Library Screen

The Method Library screen is used to retrieve, save, or delete user-defined collection methods (see Figure 19 and Table 13). Up to 20 methods may be stored. Function keys are used to load, save, and delete methods or to get to the Calibration screen (see Calibration Screen on page 49).

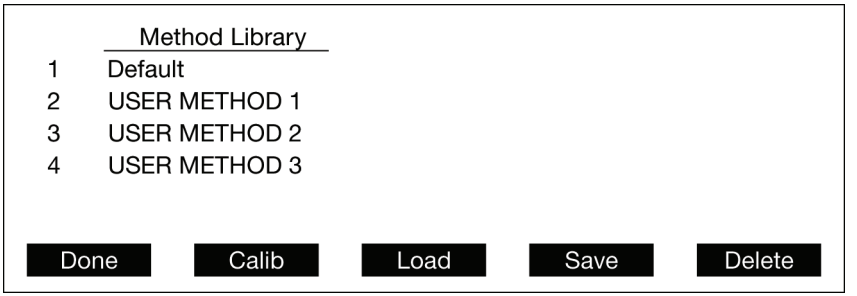


Fig. 19. Method Library screen.

The Method Library displays the Default and user-defined methods.

Table 13. Method Library screen function keys

Function Key	Function
Done	Returns the display to the Main screen.
Calib	Displays the Calibration screen (see Calibration Screen on page 49).
Load	Loads the method pointed to by the cursor.
Save	Allows the current fraction collection parameters to be saved as a method. A method name can be up to 16 characters long.
Delete	Deletes the method pointed to by the cursor.

Calibration Screen

Use the Calibration screen to adjust the drophead calibration, screen contrast, sleep mode, and to zero the analog-to-digital converter (AtoD). Refer to Table 14 for more information about the use of each function key.

Table 14. Calibration screen function keys

Function Key	Function
Done	Returns the display to the Method Library screen.
Contrst	Allows the user to set the display contrast. The up and down arrow keys are used to increase and decrease the screen brightness, respectively.
X–Y axis	Places the fraction collector in rack calibration mode. Allows the user to calibrate the fraction collector X–Y arm. Calibration should rarely be required. Calibration is done on an F1 rack that has 13 x 100 mm glass tubes in positions A1, A15, and B90 (plastic tubes should not be used). See Calibrating the Fraction Collector X–Y Arm on page 50. **Caution:** Using this function overwrites the previous calibration.
Zero AD	Allows the user to zero any voltage offset in the analog-to-digital (AtoD) converter. The AtoD is used to convert the analog UV signal used for threshold collection to a digital signal. In the event of an offset in the AtoD voltage, the Current UV signal (see Figure 16) displayed on the run screen may be in error. This calibration should rarely be required. To zero the AtoD, press Zero AD, connect a shorting plug (Combicon connector with the analog IN(+) and IN(–) pins connected to the analog IN (ground)), then press Next.

Table 14. Calibration screen function keys, continued.

Function Key	Function
Sleep	Allows the user to select how many minutes the display should wait before going into sleep mode. Pressing any button will wake up the display.

Calibrating the Fraction Collector X–Y Arm

To calibrate the Fraction Collector X–Y arm



Caution: Using this function overwrites the previous calibration.

1. Remove the drop former top by twisting it counterclockwise and gently lifting it out.
2. Press X–Y Axis and then Next.
3. While looking through the drophead, center it over tube A15 using the arrow keys, and press Next.
4. Center the drophead over tube A1 using the arrow keys, press Next.
5. Center the drophead over tube B90 using the arrow keys, press Save.
6. Replace the top of the drop former by inserting it into the drophead and twisting it clockwise.

Advanced Collection Screen

The Advanced Collection screen is used to turn threshold and windows collection on or off and to set threshold and delay parameters (see Figure 20, Table 15, and Table 16). Threshold parameters are displayed only when threshold is turned on. From this screen, the threshold level and UV detector input voltage (100 mV or 1 V) can be entered and the user can specify whether non-peak fractions are to be collected or not. A bubble filter time constant can also be entered. During threshold collection the bubble filter function suppresses unwanted fraction advances due to air bubbles passing through the UV detector. See Appendix A, Bubble Filter Time, on page 83, for more information about the bubble filter function.

When windows collection is turned on, the Table function key, F3, is used to display the Collection Windows Table screen (see Collection Windows Table Screen on page 54). The Collection Windows Table screen is used to enter all collection windows parameters. If you are collecting by threshold and windows, turn on threshold before entering the Collection Windows Table screen.

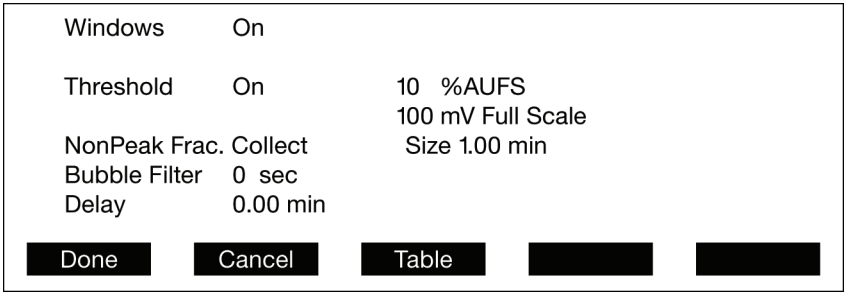


Fig. 20. Advanced Collection screen.

Table 15. Advanced Collection screen parameters

Parameter	Function
Windows	Menu for turning Collection by Windows on or off.
Threshold	Menu for turning Collection by Threshold on or off.

Table 15. Advanced Collection screen parameters, continued.

Parameter	Function
%AUFS	Current threshold setting. (Displayed only when Threshold is on).
Full Scale	Menu for defining the UV detector's output voltage. (Displayed only if Threshold is on.) The detector input voltage can be set to either 100 mV or 1 V.
NonPeak Frac.	Turns collection of non-peak fractions on or off. (Displayed only if Threshold is on).
Size	The non-peak fraction size. The non-peak fraction size has the same units as the fraction size and delay parameters. (Displayed only when Threshold is on).
Bubble Filter	Time constant entered in seconds, used to filter false peaks above a threshold due to electrical noise or air bubbles. Typically a bubble filter time of 0 or 1 sec will suffice. For a discussion of bubble filter time, refer to Appendix A, Bubble Filter Time, on page 83. (Displayed only when Threshold is on).
Delay	A delay time used to precisely synchronize the UV signal with event marks on the chart recorder and tube advances. Delay must be less than or equal to the fraction size. **Note:** Using delay will result in a timing offset between tube advances and the displayed fraction fill volume shown on the Run screen. Delay has the same units as the fraction size parameter. For a discussion of the delay function, see Collect Using a Delay Function on page 67.

Table 16. Advanced Collection screen function keys

Function Key	Function
Done	Accepts all changes and returns to the Main screen.
Cancel	Aborts all changes, including changes made in the Collection Windows Table screen (see the Table function key).
Table	Changes the screen to the Collection Windows Table screen (see Collection Windows Table Screen on page 54). (Visible only when Windows is on).

Collection Windows Table Screen

The Collection Windows Table screen is used to enter the collection windows parameters (see Figure 21, Table 17, and Table 18). Up to 20 different collection windows can be defined, each with a different fraction size and threshold. The threshold parameter column (Thold) shown in Figure 21 is displayed only when threshold collection has been turned on in the Advanced Collection screen (see Advanced Collection Screen on page 51). Windows start and end parameters are entered in minutes (when collecting by time or drops) or in milliliters (when collecting by volume). The menu at the top of the fraction size column can be used to change the fraction size units. The global fraction size and threshold entered on the Main screen (see Main Screen on page 36) and Advanced Collection screen, respectively, are the default fraction size and threshold for the first window.

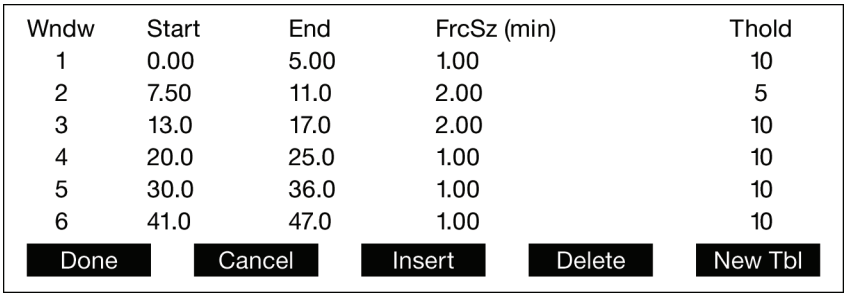


Fig. 21. Collection Windows Table screen.

Table 17. Collection Windows Table screen parameters

Parameter	Function
Start	The Collection Windows Table start and end times are in units of time (min) or volume (ml).
End	The Collection Windows Table start and end times are in units of time if collecting fractions by drop.

Table 17. Collection Windows Table screen parameters, continued.

Parameter	Function
FrcSz	The fraction size for the current window (min, ml, drops). The header for this column is also a menu that can be used to change the fraction size units to min, ml, or drops.
Thold	The threshold value for each collection window.

Table 18. Collection Windows Table Screen function keys

Function Key	Function
Done	Saves any changes, contingent upon pressing Done on the Advanced Collection screen, and exits the Collection Windows Table screen.
Cancel	Aborts all changes and returns to the Advanced Collection screen.
Insert	Inserts a new window at the position pointed to by the cursor. **Caution:** If 20 windows are defined, pressing Insert causes window #20 to be deleted.
Delete	Deletes a window at the position pointed to by the cursor.
New	Deletes all windows.

Results Screen

The Results screen provides a list of the tubes associated with each peak or window. When collecting by threshold, a peak is defined as the tubes collected while the UV signal was above threshold. The Results screen is displayed at the end of each run, if the run was not started remotely, or can be viewed by pressing F5 on the Main screen (see Main Screen on page 36). The information on this screen is lost when a new run is started or the fraction collector is turned off.

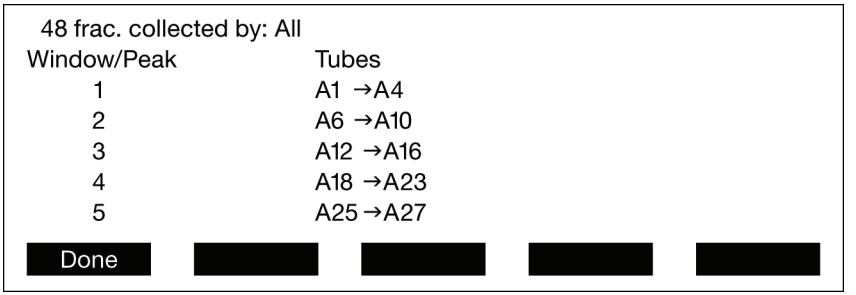


Fig. 22. Results screen.

Table 19. Results screen parameters

Parameter	Function
Window/Peak	If collecting by Windows, the window number is displayed. If collecting by Threshold or by Windows and Threshold, the peak number is displayed.
Tubes	List of the tubes associated with each window or peak.

The Done key returns you to the Main screen.

5 Stand-Alone Operation

Normal operation of the BioFrac™ fraction collector is in Local mode (stand-alone mode). As a stand-alone fraction collector, the BioFrac device may be used to collect fractions based on time (minutes), volume (milliliters), or drops (up to a flow rate of 5.0 ml/min). In Local mode, the fraction collector controls all aspects of fraction collection and is not in communication with Bio-Rad's BioLogic DuoFlow™ chromatography system, BioLogic™ LP system, or Model EP-1 Econo™ pump. However, it may be connected to separate components, such as a UV monitor, a chart recorder, and a pump, as described in Connecting Instruments and Devices to the BioFrac Fraction Collector on page 16.

There are four modes of collection, each of which can include a delay function:

- **Collect All** — enables you to collect an entire run without diverting any fluid to waste.
- **Peak Detection by Threshold** — enables you to collect peaks by defining a threshold value (percent of full scale) above which fractions will be collected. This method can be used only when the fraction collector is connected to a UV monitor. When the UV signal is less than the threshold, fluid is diverted to waste. Alternatively, it may be collected in tubes with a non-peak fraction size. A slope function is built into the threshold function so that double peaks above the set threshold level are detected and collected separately.

  Note: False peaks above a threshold (such as electrical noise or air bubbles) may be filtered using the bubble filter time function. See Appendix A, Bubble Filter Time, on page 83.

- **Windows Collection** — enables you to specify periods of time or volumes (windows) during which fractions are to be collected. For example, a window can be defined to start after an initial void volume. The BioFrac fraction collector lets you define up to 20 different time or volume windows. The liquid delivered during a collection window is collected into tubes, whereas the liquid delivered outside of a collection window is diverted to waste.

- **Peak Detection by Threshold with Time or Volume Windows** — enables you to combine the Peak Detection by Threshold and the Time or Volume Windows methods discussed above. This method can be used only when the fraction collector is connected to a UV monitor. You can program up to 20 different time or volume windows, each with its own threshold level. This is a useful feature to compensate for baseline drift.

  Note: False peaks above a threshold (such as electrical noise or air bubbles) may be filtered using the bubble filter time function. See Appendix A, Bubble Filter Time, on page 83.

- **Delay Function** — the purpose of the delay function is to synchronize the fraction collection event marks and the signal from the UV monitor (output on a chart recorder) with the actual delivery of liquid into collection tubes. This features allows easy post-run analysis of a chromatogram. The delay function is slightly different for each of the collection modes: All, Threshold, Windows, and Threshold with Windows. As a consequence, the event marks on the chart recorder will vary depending on the individual application.

Regardless of the type of collection method programmed, the method will end once the end tube number is reached. Always ensure that the start and end tube numbers are set to allow completion of your collection method.

Collect All

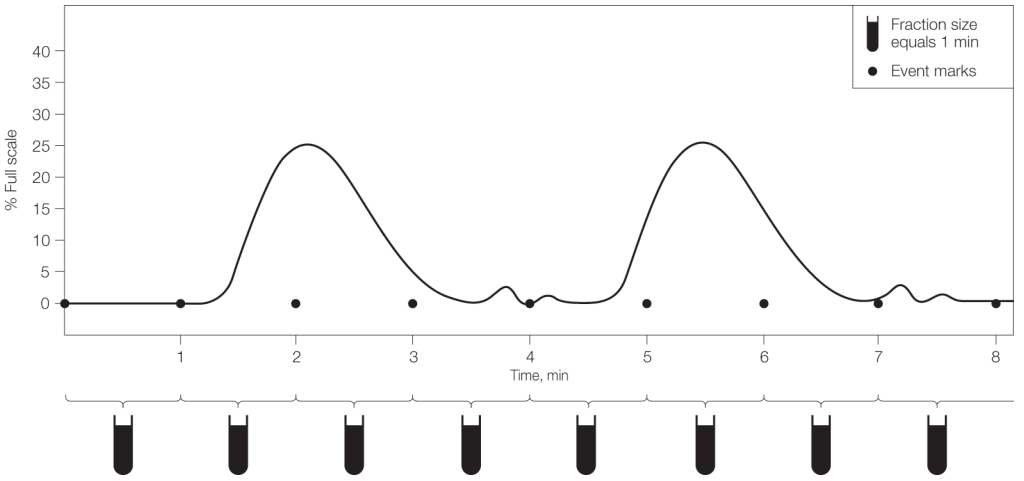


Fig. 23. Running a Collect All method.

To run a Collect All method

1. On the Main screen, ensure that Collect is set to Collect –> All. If the screen is not set to Collect –> All, press Collect (F4) and turn Windows and Threshold off. Alternatively, press Method (F3) and load the method Default.
2. To select a rack, press Rack (F2) and choose a rack from the Rack menu. Choose whether you want the diverter valve to divert to waste during fraction advances. If you are collecting in microplates or Titertube tubes, choose a collection pattern: Serpentine, Row, or Column.

   Note: Whenever a new rack is selected, the start tube and end tube values are updated to reflect the maximum number of tubes available for the selected rack.
3. Choose the appropriate MultiRun mode for your experiment (see Table 4 on page 37 for a description of the MultiRun function).
4. Set the start tube and end tube rack position and tube number.

The fraction collector stops when the last tube is reached unless a stop command is received before it reaches the last tube. At the end of a run, the start tube number and end tube number will be automatically updated according to the MultiRun mode selected.

5. Set the fraction size units (min, ml, or drops) and enter the fraction size. If collecting by volume, you must enter a flow rate.
6. (Optional) Press Collect (F4) and set the delay time (see Collect Using a Delay Function on page 67).
7. (Optional) Press Methods (F3) and save your method.
8. Press Run (F1) to start the experiment.

   At any point during the run you can use the Run screen function keys (see Table 8 on page 43).

Peak Detection by Threshold

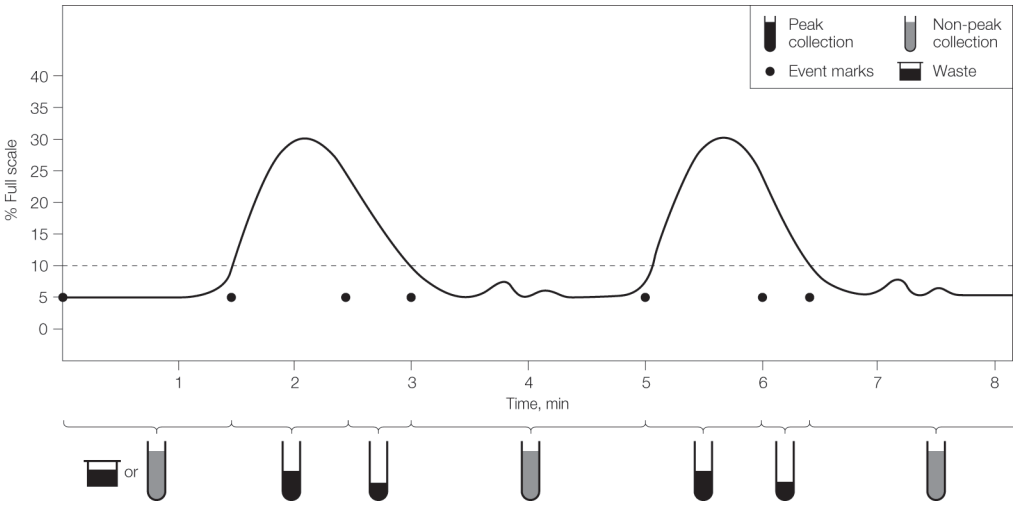


Fig. 24. Running a Collect by Threshold method.

To run a Collect by Threshold method

1. To select a rack, press Rack (F2) and then choose a rack from the Rack menu. Choose whether or not you want the diverter valve to divert to waste during fraction advances. If you are collecting in microplates or Titertube tubes, choose a collection pattern: Serpentine, Row, or Column.

   Note: Whenever a new rack is selected, the start tube and end tube values are updated to reflect the maximum number of tubes available for the selected rack.

2. Choose the appropriate MultiRun mode for your experiment (see Table 4 on page 37 for a description of the MultiRun function).

3. Set the start tube and end tube rack position and tube number.

The fraction collector stops when the last tube is reached unless a stop command is received before it reaches the last tube. At the end of a run, the start tube number and end tube number are automatically updated according to the MultiRun mode selected.

4. Set the fraction size units (min, ml, drops) and set the fraction size. If collecting by volume, you must enter a flow rate.
5. Press Collect (F4) and turn Threshold on. Set the global %AUFS and set the detector input voltage to either 100 mV or 1 V full scale depending on your detector's output voltage. Press Done. On the Main screen, Collect should now read Collect –> Threshold.
6. For collection of non-peak fractions, change NonPeak Frac. from Divert to Collect and enter a size for the non-peak fractions.
7. (Optional) Set the bubble filter time. This function detects and filters false peaks (such as electrical noise or air bubbles). Typically, a bubble filter time of 0 or 1 sec will suffice. (For a discussion of the bubble filter time function, see Appendix A, Bubble Filter Time, on page 83.)
8. (Optional) Press Collect (F4) and set the delay time.
9. (Optional) press Method (F3) and save your method.
10. Press Run (F1) to start the experiment.

    At any point during the run you may use the Run screen function keys (see Table 8 on page 43).

Collect by Windows

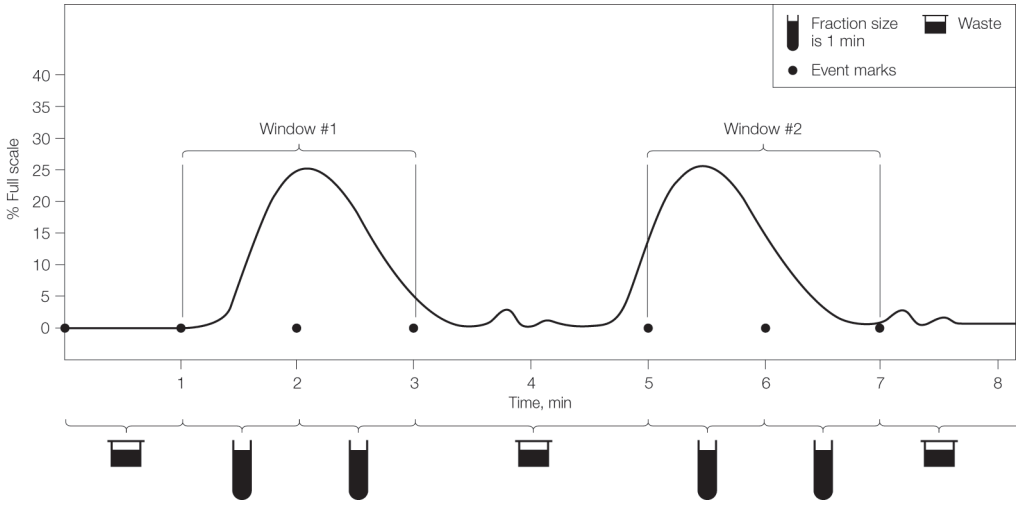


Fig. 25. Running a Collect by Windows method.

To run a Collect by Windows method

1. To select a rack, press Rack (F2) and then choose a rack from the Rack menu. Choose whether you want the diverter valve to divert to waste during fraction advances.
2. (Optional) If you are collecting in microplates or Titertube tubes, choose a collection pattern: Serpentine, Row, or Column.
3. Whenever a new rack is selected, the start tube and end tube values are updated to reflect the maximum number of tubes available for the selected rack.
4. Choose the appropriate MultiRun mode for your experiment (see Table 4 on page 37 for a description of the MultiRun function.
5. Set the start tube and end tube rack position and tube number. The fraction collector stops when the last tube is reached unless a stop command is received before reaching the last tube. At the end of a run, the start tube

number and end tube number are automatically updated according to the MultiRun mode selected.

6. Set the fraction size units (min, ml, or drops) and set the fraction size. If collecting by volume, you must enter a flow rate.
7. Press Collect (F4) and turn Windows on.
8. Press Table (F3) and enter the windows and fraction size in the Collection Windows Table screen. Note that the fraction size entered in the Main screen is the default size. The fraction size can be changed for each window. When finished, press Done. On the Main screen, Collect should now read Collect –> Windows.
9. (Optional) press Collect (F4) and set the delay time (see Collect Using a Delay Function on page 67).
10. (Optional) press Method (F3) and save your method.
11. Press Run (F1) to start the experiment.

    Note: At any point during the run you can use the Run screen function keys (see Table 8 on page 43).

Collect by Windows and Threshold

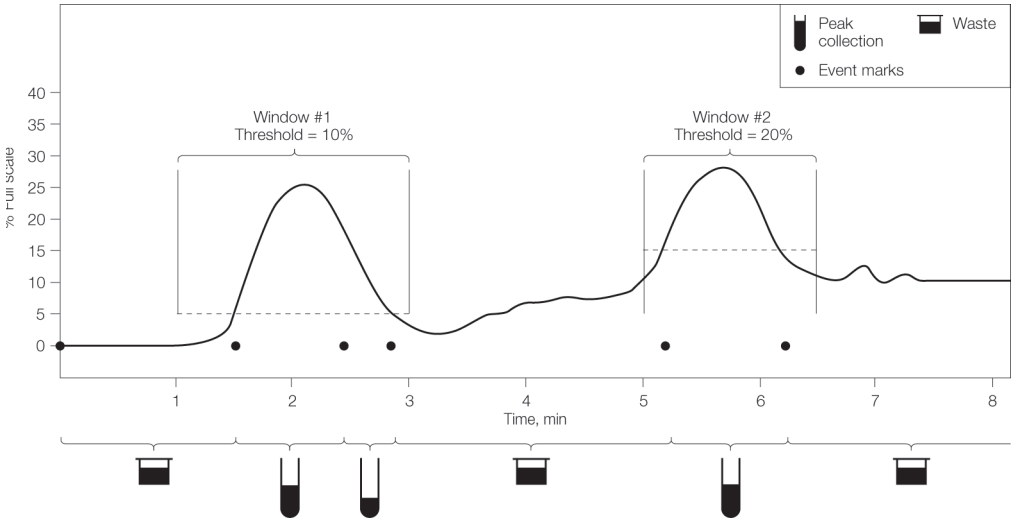


Fig. 26. Running a Collect by Windows and Threshold method.

To run a Collect by Windows and Threshold method

1. To select a rack, press Rack (F2) and then choose a rack from the Rack menu. Choose whether you want the diverter valve to divert to waste during fraction advances. If you are collecting in microplates or Titertube tubes, choose a collection pattern: Serpentine, Row, or Column.

   Note: Whenever a new rack is selected the start tube and end tube values are updated to reflect the maximum number of tubes available for the selected rack.

2. Choose the appropriate MultiRun mode for your experiment (see Table 4 on page 37 for a description of the MultiRun function).

3. Set the start tube and end tube rack position and tube number. The fraction collector stops when the last tube is reached unless a stop command is received before reaching the last tube. At the end of a run, the start tube

number and end tube number are automatically updated according to the MultiRun mode selected.

4. Set the fraction size units (min, ml, drops) and set the fraction size. If collecting by volume, you must enter a flow rate.

5. Press Collect (F4) and turn Threshold on. Set the global %AUFS (absorbance units full scale) and set the detector input voltage to either 100 mV or 1 V full scale depending on your detector's output voltage. Press Done.

   On the Main screen, Collect should now read Collect –>Threshold.

6. For Collection of non-peak fractions, change NonPeak Frac. from Divert to Collect and enter a size for the non-peak fractions.

7. (Optional) Set the bubble filter time. This function detects and filters false peaks (such as electrical noise or air bubbles). Typically, a bubble filter time of 0 or 1 sec will suffice. (For discussion of the bubble filter time function, see Appendix A, Bubble Filter Time, on page 83).

8. (Optional) Press Collect (F4) and set the Delay time (see Collect Using a Delay Function on page 67).

9. (Optional) Press Method (F3) and save your method.

10. Press Run (F1) to start the experiment.

    At any point during the run you can use the Run screen function keys (see Table 9 on page 44).

Collect Using a Delay Function

The delay volume is the volume of fluid contained in the path between the significant detector, typically the UV monitor, and the fraction collector drophead. When the system is plumbed, there is typically a length of tubing between the detector(s) and the fraction collector. Fluid in the path of the detector must pass through this tubing to arrive at the fraction collector. Thus the length of the tubing defines the delay volume. Although the volume in the tubing is generally small, it may be significant when collecting a small fraction size. To synchronize the detector signal with the fraction collector, the fraction collector advance can be delayed while the fluid passes through the tubing. The fraction collector advance can occur when the fluid reaches the drophead of the fraction collector. Although this is most important when using threshold fraction collection, it is advantageous to have this synchronization at all times. Delay can be entered in units of time, volume, or drops and has the same units as the fraction size. The delay volume can be determined by either of the following methods.

- Use a syringe and fill the tubing (from the UV monitor outlet to the fraction collector drophead) with water. Then expel the water into a separate container and weigh it.
- Use the known volume of any inline devices and measure the length of the tubing between the UV detector and the drophead. Table 20 lists the volume of commonly used tubing and devices.

Table 20. Volume of commonly used tubing and inline devices

Tubing Dimensions	PEEK Tubing Color	Volume
0.005 inch (0.127 mm) ID*	Red	0.322 µl/inch
0.010 inch (0.254 mm) ID	Blue	1.288 µl/inch
0.020 inch (0.508 mm) ID	Orange	5.145 µl/inch
0.030 inch (0.762 mm) ID	Green	11.577 µl/inch
0.040 inch (0.016 mm) ID	–	20.581 µl/inch
0.050 inch (1.270 mm) ID	–	32.160 µl/inch

Table 20. Volume of commonly used tubing and inline devices, continued.

Tubing Dimensions	PEEK Tubing Color	Volume
0.062 inch (1.575 mm) ID	–	49.474 µl/inch
Devices		
Backpressure regulator (40 psi)		80 µl
Bio-Rad pH probe/flow cell		80 µl
Diverter valve		12 µl
Conductivity cell		6 µl

* Inner diameter

To run a Collect method using a delay function

1. On the Main screen, set the fraction size units (min, ml, or drops).
2. From the Advanced Collection screen, press Collect (F4).

   If collecting by volume, the delay volume can be entered directly. If collecting by time, the delay time is calculated from the delay volume divided by the flow rate.

3. To calculate the delay in drops, divide the delay volume by the drop volume (1 drop = 50 µl for the standard drophead or = 25 µl for the microplate drophead).

The examples on the following pages demonstrate the use of the delay function.

Example: Collect All with Delay

Figure 27 shows an example in which the delay is 0.2 min and the fraction size is 1 min. The diverter valve remains at divert during the delay time. The chart recorder makes the first tick mark (following the start/run mark) at 1.0 min, and each subsequent tick mark at 1 min intervals. The drophead advances at 1.2 min and continues advancing at 1 min intervals. Each fraction size is still 1 min.

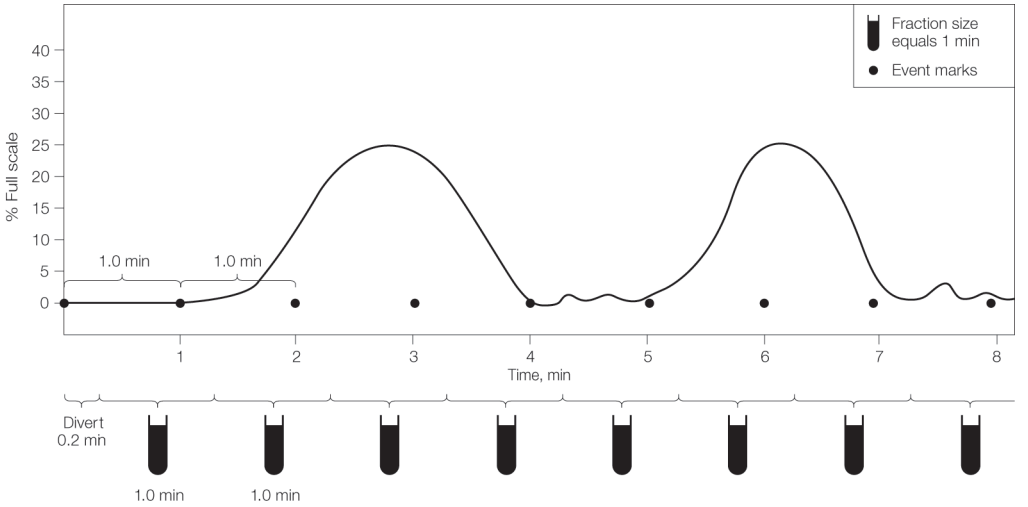


Fig. 27. Example showing Collect All with a delay of 0.2 minutes.

Figure 28 shows an example of a Collect All experiment in Drop mode with a 2-drop delay and a 10-drop fraction size. In this case the chart recorder makes its first tick mark (following the start/run mark) at 8 drops:

(fraction size – delay = 10 drops – 2 drops = 8 drops)

Each subsequent tick mark occurs at 10-drop intervals. The drophead advances at 10-drop intervals following the start of the run. Note that if the delay size equals the fraction size, the start/run mark and the first event mark are superimposed. This means that the first observed tick mark (following the start/run mark) corresponds to the second fraction advance.

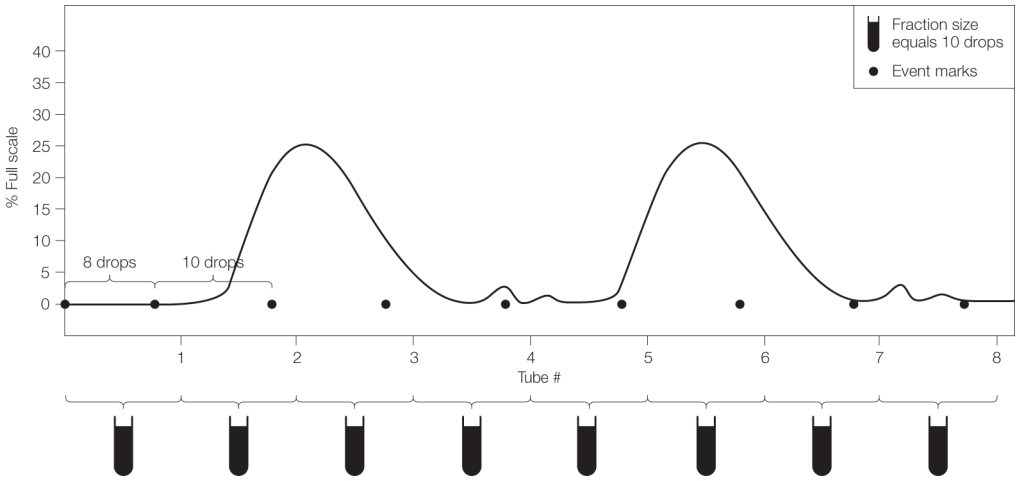


Fig. 28. Example showing Collect All with a delay of 2 drops.

Example: Peak Collection by Threshold and Delay

Figure 29 shows an example in which Delay is used during the collection of peaks by threshold. Assume the following for the run:

Flow rate	1 ml/min
Peak fraction size	1 min
Delay time	0.25 min
Threshold value	10% AUFS
Non-peak destination	Waste

At the start of the run an event mark is recorded. Initially the liquid is diverted to waste because the monitor signal is below threshold. When the UV signal rises above the specified threshold of 10%, an event mark is recorded and the volume corresponding to the delay time (or the delay volume) is collected in tube 1. At the end of this time, there is a tube advance and the peak is collected in 1-minute fractions. As the falling edge of the peak passes through the threshold, an event mark is recorded, but there is no tube advance until the volume corresponding to the delay time is collected. All subsequent peaks follow this same pattern, with a tube containing the delay volume separating each peak.

Note: When the delay time is set to zero, an empty tube separates the peaks.

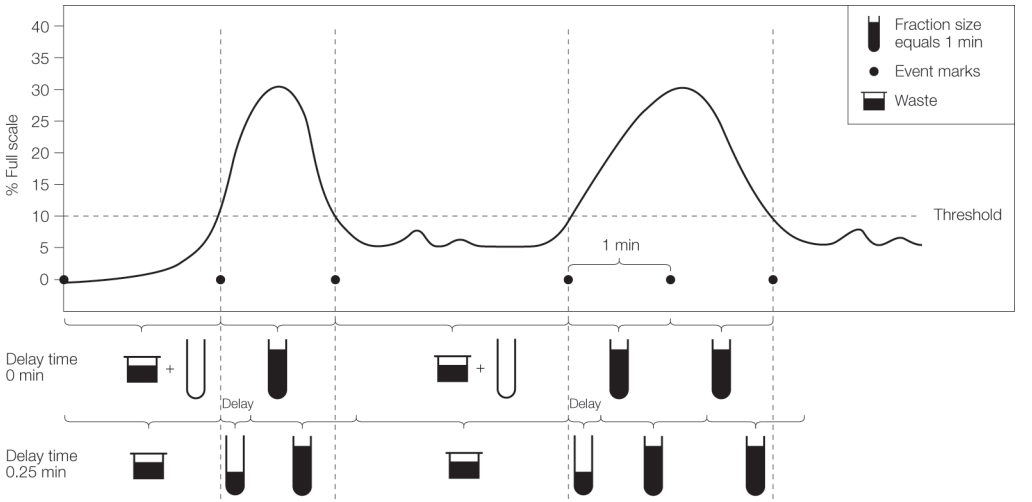


Fig. 29. Peak Collection by Threshold using a delay of 0.25 minutes.

When the non-peak (below threshold) liquid is diverted to tubes, the delay volume (at the rising edge) of the peak is collected as part of the non-peak fraction. To clearly distinguish between the two types of fractions in this situation, we suggest programming a much larger non-peak fraction size.

Example: Collection Using Time Windows and Delay

Case 1, where start time = 5 min and delay time = 0 min
Case 2, where start time = 5 min and delay time = 0.25 min

Assume the following:

Flow rate	1 ml/min
Peak fraction size	1 min
Time window #1	Start 5, End 8
Time window #2	Start 10, End 12

Note that each time or volume window is separated by a tube containing the delay volume. If delay time is zero, then tube #1 will be empty and subsequent time or volume windows collected are separated by empty tubes.

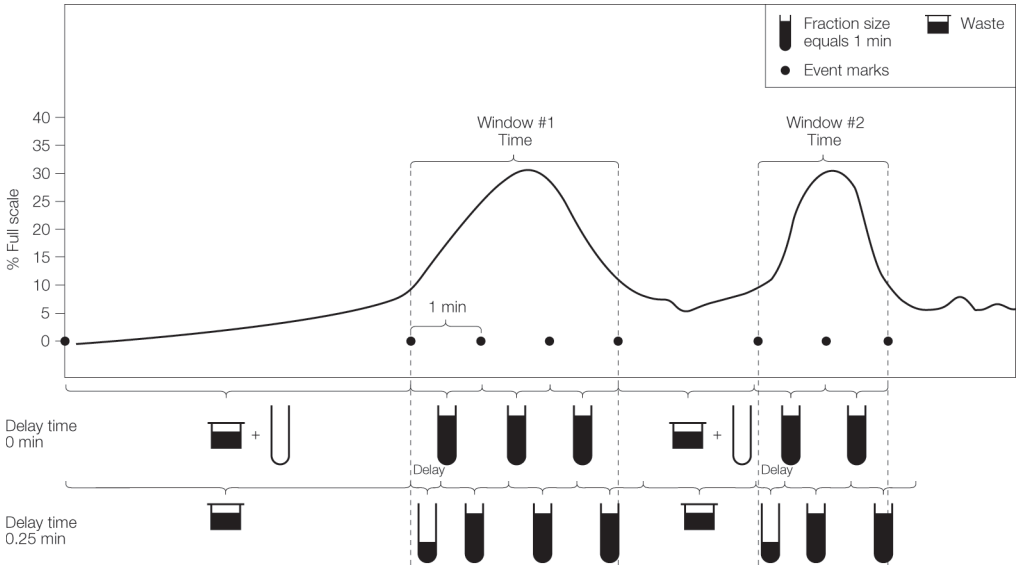


Fig. 30. Collection windows and a delay.

6 LP/Econo Mode Operation

In LP/Econo™ mode all aspects of fraction collection are controlled by an external controller. In this mode, only Rack, MultiRun, Start Tube, and End Tube parameters can be set from the fraction collector Main screen. Time and volume windows and threshold and delay functions are not programmable from the fraction collector in this mode. However, if the fraction collector is connected to a BioLogic™ LP chromatography system, Collect All, Threshold, Collection Windows, and Threshold and Collection Windows (all with delay volume, if desired) can be controlled through the BioLogic LP system. When the BioFrac™ fraction collector is connected to a Model EP-1 Econo pump, only Collect All (with delay volume using void (Vo)) is available. Any controller capable of sending TTL fraction advance and diverter valve signals can be used in this mode if it has compatible control circuitry logic (see Appendix B, Rear Panel Connector Information, on page 85).

To run the fraction collector in LP/Econo mode

1. Change mode to LP/Econo and ensure the appropriate cable is connected to the fraction collector. (See Chapter 3, System Configuration and Plumbing, on page 13 for cabling information.) Connect system cable 15 to the I/O port on the fraction collector and to the BioLogic LP system or Model EP-1 Econo pump.
2. Connect system cable 3 to the Rec port on the BioFrac fraction collector and to the BioLogic LP System or Model EP-1 Econo pump (see Chapter 3, System Configuration and Plumbing, on page 13 for cabling information).
3. To select a rack, press Rack (F2) and then choose a rack from the menu. Choose whether you want the diverter valve to divert to waste during fraction

advances. If you are collecting in microplates or Titertube tubes choose a collection pattern: Serpentine, Row, or Column.

Note: Whenever a new rack is selected, the start tube and end tube values are updated to reflect the maximum number of tubes available for the selected rack.

4. Choose the appropriate MultiRun mode for your experiment (see Table 6 on page 39 for a description of the MultiRun function).
5. Set the start tube and end tube rack position and tube number as follows:
   - If you are overlaying fractions, set the start tube and end tube numbers on the fraction collector to correspond to the required number of fractions derived from programming the fraction size on the BioLogic LP system, the Model EP-1 Econo pump, or other controller. For example, assuming the number of fractions calculated is 30:
     - If start tube number is A1, then end tube number is A30
     - If start tube number is B16, then end tube number is B45
   - If you are doing sequential fraction collection, set Multi Run = Seq. Tube +1 or Seq. Rack and set the start tube and end tube numbers on the fraction collector to be greater than or equal to the number of fractions required for the run. When the run is ended by pressing Stop or by reaching the last tube, the BioFrac fraction collector will automatically increment start tube and end tube according to the MultiRun function selected (see Table 6 on page 39).
   - Alternatively, sequential tube collection can be controlled by the BioLogic LP chromatography system. In this case, however, no tubes are skipped between runs. To run in this mode, set MultiRun to Seq. Tube+1 or Seq. Rack and set end tube to be greater than or equal to the total number of tubes required for all runs. For example, if you will be doing three runs requiring 25 tubes each, then 75 tubes are required. Set the MultiRun parameter on the BioLogic LP system as described in the BioLogic LP system manual.

6. Press Engage (F1) to cause the fraction collector to move to the start tube, and listen for fraction advance and diverter valve signals. The BioFrac will wait for fraction advance commands from the external controller.

   Note: At any point during the run you can use the Run screen's Stop function key (see The Run Screen in LP/Econo Mode on page 45) to stop the fraction collector.

7 Maintenance and Troubleshooting

Maintenance

The BioFrac™ fraction collector requires little maintenance to ensure reliable operation. To clean the case, first unplug the fraction collector. Use a damp cloth to wipe down the outer case. Avoid getting the power switch and rear panel connectors wet.

Over time the clear glass ring inside the drophead may require cleaning. This ring protects the drop detector from splashes or dust buildup. To clean the ring, simply unscrew the inlet fitting and lift out the clear inside ring that protects the detector. Wipe the ring clean using a damp cloth.

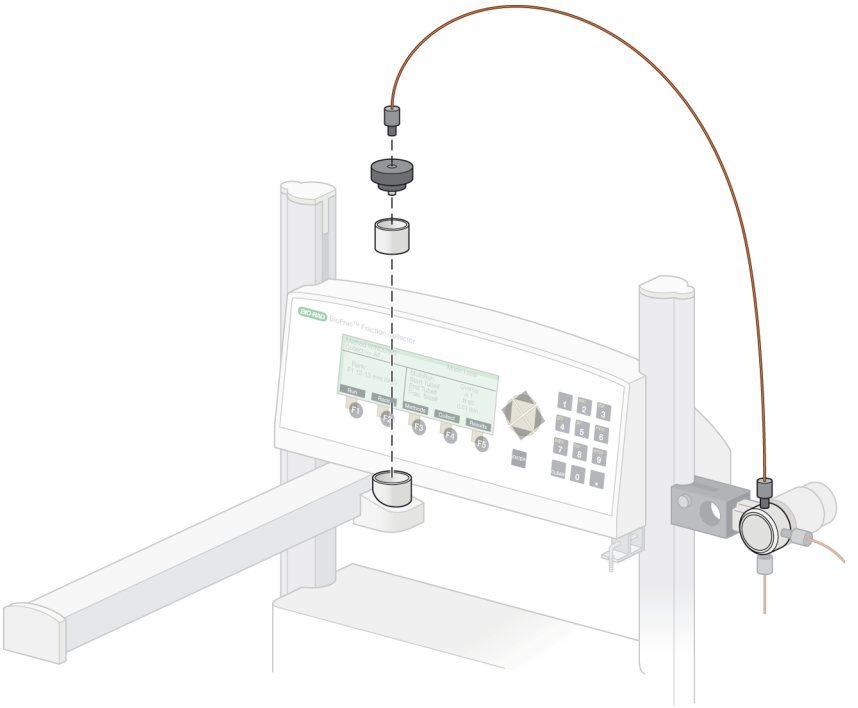


Fig. 31. Cleaning the drophead window.

When finished using the BioFrac fraction collector, be sure to rinse all salts from the diverter valve with water. Leaving salt solution in the valve may cause salt crystals to form, which could plug or damage the valve. Rinsing salt from the valve will increase the valve's lifetime.

Troubleshooting

Table 21 lists some common issues you may encounter using the BioFrac fraction collector, their causes, and possible solutions.

Table 21. Issues, causes, and solutions

Issue	Possible Cause	Solution
No LCD display	No power to unit.	Check the power switch to be sure it is on. Check the power cord connections. Check the power at the outlet. Make sure the fraction collector display cable is plugged into the base unit. If problem persists, contact Bio-Rad. **Note:** The unit contains no fuses to replace or circuit breakers to reset.
LCD display is difficult to read	LCD setting needs adjustment.	Increase or decrease the brightness as described in Chapter 4, The User Interface, on page 35.
Drops miss tube	Rack type is incorrect. Tube rack is misaligned. Drop former is missing. Unit not level. Drophead is misaligned.	Select the correct rack type. Reposition tube rack. Insert drop former. Place the unit on level surface. Turn the unit off and on to reposition the arm. Recalibrate the drophead as described in Chapter 4, The User Interface, on page 35.
Drops not counted	Flow rate is too high. Drophead is dirty.	When collecting by drops, do not exceed 5 ml/min (3 ml/min for the microplate drophead). Clean the drophead as described in Maintenance on page 79.
Flow continues after pump stops	Excessive backpressure.	Change to tubing with larger ID.
During peak detection bubbles are not being filtered	Bubble filter setting is not appropriate. Bubbles are too slow to trigger the bubble filter.	Check the bubble filter setting. Reset the bubble filter time according to the guidelines in Appendix A, Bubble Filter Time, on page 83. No corrective action.

Table 21. Issues, causes, and solutions, continued.

Issue	Possible Cause	Solution
Fraction collector causes a high backpressure	Tubing is kinked. Wrong tubing is being used. Divert valve or tubing is plugged.	Replace tubing. Connect the appropriate size tubing for the flow rate being used (see Chapter 3, System Configuration and Plumbing, on page 13). Rinse the diverter valve with water to remove salt crystals or other particulate matter.
Fraction collector will not go to system mode when connected to a BioLogic DuoFlow™ chromatography system	BioFrac system is not in Main screen. BioFrac system is not in Local mode. Bus cable is not connected.	Place the fraction collector in Local mode and make sure the Main screen (start-up screen) is displayed.

A Bubble Filter Time

The bubble filter time function is used in conjunction with the Peak Collection by Threshold. The bubble filter time function distinguishes true chromatographic peaks from unwanted signals such as electrical spikes or the passage of an air bubble. Such false signals are characterized by extremely fast rise and fall times.

The bubble filter time function is entered at the end of the threshold programming sequence. The default value is off (bubble filter = 0 seconds).

A signal that exceeds the set threshold value with a rise time of >6.0% full scale (AUFS) in 0.1 seconds is perceived by the fraction collector as possibly signifying a false peak. In such cases, the fraction collector looks for a bubble filter time set by the user. If the signal falls to 2% of the pre-rise FS level within the set bubble filter time, the signal is rejected and the false peak is not collected. Signals that exceed the threshold value and are of a longer duration than the bubble filter time are collected as true peaks.

Very sharp, true chromatographic peaks (such as those from an HPLC application) may rise at a sufficient rate to trigger this function. As a consequence, if an unsuitable bubble filter time has been set, then the early part of such peaks may not be collected.

The bubble filter time can be set from 0 to 10 sec. For most chromatographic applications, a filter time of 0 or 1 sec will suffice. The actual setting depends upon both flow rate and peak duration and should be optimized for each type of separation. Generally speaking, a very short bubble filter time should be used with sharp peaks of short duration.

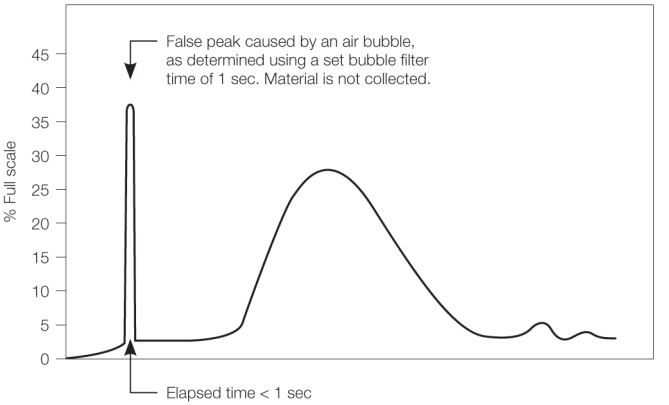


Fig. 32. Bubble filter time.

B Rear Panel Connector Information

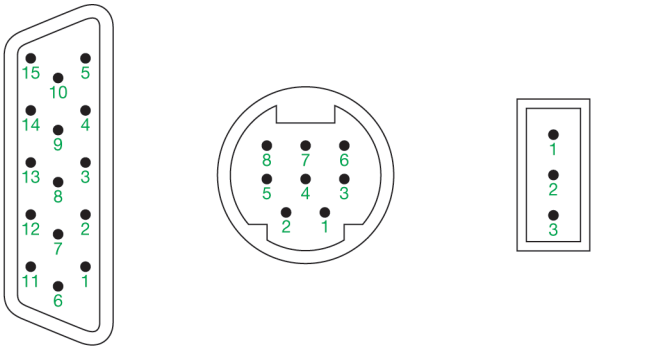


Fig. 33. 15-pin D, 8-pin mini-DIN, and 3-pin Combicon connectors.

The sections that follow describe each of the connectors in Figure 33:

- 15-Pin D Connector on page 86
- 8-Pin Mini-DIN Connector on page 88
- 3-Pin Combicon Connector on page 89

15-Pin D Connector

Table 22. 15-Pin D connector input signals

Pin #	Input Signals	Type	Active	Wire Color*	Description
1	ADVANCE	Pulse	Low	Black	Receives remote fraction advance signals (100 ms pulse). Active in LP/Econo™ mode.
5	LISTEN FOR REMOTE START	Level	Low	Orange	Connection of pin #5 and #15 (signal Ground) tells the fraction collector to wait for a remote start signal on pin #6. Active in Local mode.
6	RUN/STOP	Level	Low	Blue	Grounding of pin #6 by the start/stop relay starts the currently programmed method. Pins #6 and #15 should be connected to the run/stop relay on the controlling device. Active in Local mode.

* BioFrac™ fraction collector accessory cable

All input and output pins, except the relay terminals, are TTL compatible. All input pins are with 10 kΩ pull-up. The relay pins are used to control low-voltage DC contact-closure type devices, such as 12 V, 10 mA.

Caution: Do not apply 110 VAC or 220 VAC directly to the relay terminal pins.

Table 23. 15-Pin D connector output signals

Pin #	Output Signals	Type	Active	Wire Color	Description
4	READY	Level	Low	Green	Indicates that the fraction collector diverter valve is connected and functioning properly.
9	START REMOTE	Relay	Closed	Green/Black	Relay used for starting a remote device such as a pump. Relay is closed when Run is pressed and opened when Stop is pressed. Active in Local mode.
10	DEVICE			Orange/Black	
11	EVENT MARK	Pulse	Low	Blue/Black	Sends a negative pulse (200 ms) for each fraction advance. If the delay function is being used, the drophead advance will be separated from the event mark by the delay time, volume, or drops.
15	SIGNAL GROUND			Blue/White	Signal ground.

All input and output pins, except the relay terminals, are TTL compatible. All input pins are with 10 kΩ pull-up. The relay pins are used to control low-voltage DC contact-closure type devices, such as 12 V, 10 mA.

Caution: Do not apply 110 VAC or 220 VAC directly to the relay terminal pins.

8-Pin Mini-DIN Connector

Table 24. 8-Pin mini DIN connector input signals

Pin #	Input Signals	Type	Active	System Cable 7 Wire Color	Description
2	WASTE/COLLECT	Level	Low	Orange	Controls diverter valve. Connection of pin #2 to pin #8 (signal ground) causes the diverter valve to change to collect. Controlled by a relay on a remote device. Active in LP/Econo mode.

All input and output pins, except the relay terminals, are TTL compatible. All input pins are with 10 kΩ pull-up. The relay pins are used to control low-voltage DC contact-closure type devices, such as 12 V, 10 mA.

Caution: Do not apply 110 VAC or 220 VAC directly to the relay terminal pins.

Table 25. 8-Pin mini DIN connector output signals

Pin #	Output Signals	Type	Active	Wire Color	Description
3	EVENT MARK	Pulse	Low	Yellow	Sends a negative pulse (200 ms) for each fraction advance. If the delay function is being used, the drophead advance will be separated from the event mark by the delay time, volume, or drops. Active in Local mode.
4	PAPER FEED/ STOP	Level	High	Red	Chart recorder control, paper feed/stop. Active in Local mode.

Table 25. 8-Pin mini DIN connector output signals, continued.

Pin #	Output Signals	Type	Active	Wire Color	Description
5	PEN UP/DOWN	Level	Low	Brown	Chart recorder control, pen up/down. Active in Local mode.
6, 7	ADS TERMINAL	Level	Low	Purple blue	Event marks for Method Start and Fraction Advance by way of a relay. Pins #6 and #7 are closed for 200 ms with each fraction advance. Active in Local mode.
8	SIGNAL GROUND			Green	Signal ground.

All input and output pins, except the relay terminals, are TTL compatible. All input pins are with 10 kΩ pull-up. The relay pins are used to control low-voltage DC contact-closure type devices, such as 12 V, 10 mA.

Caution: Do not apply 110 VAC or 220 VAC directly to the relay terminal pins.

3-Pin Combicon Connector

Table 26. 3-Pin Combicon connector

Pin #	InputSignals	Type	Active	Description
1	ANALOG GROUND	Common		UV monitor input: analog ground
2	ANALOG IN(–)	Input		UV monitor input 100 mV and 1 V (–)
3	ANALOG IN(+)	Input		UV monitor input 100 mV and 1 V (+)



C Specifications

The specifications for the BioFrac™ fraction collector follow in Table 27.

Table 27. BioFrac fraction collector specifications

Fractionation	
■ Time	0.01 to 9999.9 min
■ Drop	1 to 99999 drops; flow rate 5.0 ml/min (maximum)
■ Volume	0.02 to 99999 mls.
Collection methods	Time, drop, time windows and volume windows (up to 20 windows), peak detection, time or volume windows plus peak detection
Peak detection	Threshold, including slope detection algorithm for collection of double peaks above a set threshold
Drop counting capability	Up to 5 ml/min flow rates
Maximum collection volume	Virtually unlimited when used with the Prep-20 adaptor
Tube change time	<350 ms, with rack F1 <350 ms, with rack F2
Detector input	±0 to 100 mV and ±0 to 1 V
Event marker	TTL diverter/peak mark; contact closure fraction mark
Input power	100–240 VAC, ±10%, 50/60 Hz, single phase
Input current	1.2 A (max.); fuse rating inside the power supply is 2 A
Power consumption	45 W
Fusing	No external fusing

Table 27. BioFrac fraction collector specifications, continued.

3-way diverter valve	3-way diverter valve mounts on either the left or right column. Minimizes spillage during fraction advances.
External operation	Can be controlled by the BioLogic DuoFlow™ or BioLogic™ LP chromatography system, the Model EP-1 Econo™ pump, or other systems via external commands.
Wetted parts	All nonmetal, including Tefzel, PEEK
Safety certification	EN 61010-1
EMI certification	EN 61326
Environmental	
■ Operating temp	4–40°C
■ Storage temp	4–40°C
■ Humidity	5–95%, noncondensing
Weight	6.9 kg; 15.3 lb
Dimensions	44.5 x 35.6 x 38.7 cm
	17.5 x 14.0 x 15.2 in

D Warranty and Ordering Information

The BioFrac™ fraction collector is warranted for one year against defects in materials and workmanship. If any defects should occur during this warranty period, Bio-Rad Laboratories will replace the defective parts without charge. However, the following defects are specifically excluded:

- Defects caused by improper operation
- Repair or modification done by anyone other than Bio-Rad Laboratories or their authorized agent
- Defects caused by use with fittings or other spare parts not specified by Bio-Rad Laboratories
- Damage caused by deliberate or accidental misuse
- Damage caused by disaster
- Damage due to use of improper solvent or sample
- Tubing and fittings

Warranty Information

Model _____

Serial Number _____

Date of Delivery _____

Warranty Period _____

Ordering Information

Catalog Number	Product Description
741-0002	**BioFrac Fraction Collector**, includes a 110 V power cord, rack F1(2), Econo™ system cable 15, and fittings kit
741-0010	**Rack Set F1**, accepts 12–13 mm diameter tubes (90 tubes max)
741-0011	**Rack Set F2**, accepts 15–16 mm diameter tubes (60 tubes max)
741-0012	**Rack Set F3**, accepts 18–20 mm diameter tubes (40 tubes max)
741-0013	**Rack Set H1**, accepts 42 capless 1.5 ml Eppendorf/microtubes (168 tubes max)
741-0014	**Rack Set H2**, accepts 63 capless 0.5 ml Eppendorf/microtubes (252 tubes max)
741-0015	**Rack Set H3**, accepts 30 reduced-volume scintillation vials, 16 mm (120 vials max)
741-0016	**Rack Set H4**, accepts 6 scintillation vials, 30 mm (24 vials max)
741-0017	**BioFrac Ice Bath/Microplate Rack**, holds 120 tubes, 12–13 mm, on ice or up to 4 microplates/Titertube racks (SBS standard format)
741-0018	**BioFrac Prep-20 Rack**, for preparative collection in up to 20 collection vessels, includes drain tubing and 20 feet of Tygon tubing
741-0008	**BioFrac Diverter Valve**
741-0088	**BioFrac Microplate Drophead Kit**, includes drophead that delivers 25 µl drops compared to standard drophead delivery of 50 µl
731-8286	**System Cable 15**, 15-pin D to mini-DIN, for connecting the fraction collector to the BioLogic™ LP system controller or the Model EP-1 Econo pump

Catalog Number	Product Description
731-8263	**System Cable 3**, mini-DIN to mini-DIN cable, for connecting the fraction collector to a BioLogic LP system controller or a Model EP-1 Econo pump (for control of the diverter valve)
731-8290	**BioFrac Accessory Cable**, 15-pin D to bare wires, for connecting the fraction collector to non–Bio-Rad equipment
731-8287	**System Cable 16**, 8-pin mini-DIN to DIN cable, for connecting the fraction collector to a Model 1327 chart recorder
731-8264	**System Cable 4**, 8-pin mini-DIN to banana plug cable, for connecting the Model EM-1 Econo UV monitor to the Model 1327 chart recorder
731-8267	**System Cable 7**, 8-pin mini-DIN to bare wires cable, for connecting the BioFrac fraction collector to non-Bio-Rad equipment
741-0007	**BioFrac Fittings Kit**
Collection Tubes*	
223-9500	**1.5 ml Capless Micro Test Tubes**, polypropylene, natural, 500/box
223-9750	**13 x 100 mm Clear Polystyrene Test Tubes**, 1,000/box
223-9751	**13 x 100 mm Natural Polypropylene Test Tubes**, 1,000/box
224-0096	**Costar 96-Well Flat Bottom EIA Plate**, polystyrene, 5 per package, box of 100

*Additional tube sizes are available from Bio-Rad. Contact your local Bio-Rad representative for a liquid handling catalog.



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