Biotage® Flash 400

User Manual

Biotage®

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Introduction

Biotage® Flash 400 is a flash purification system based on prepacked cartridge technology that provides users of traditional self-packed glass columns with three critical operational benefits: speed, safety, and performance.

Speed

Unlike glass columns, which operate at low pressure and have very poor flow distribution, Biotage flash cartridges are optimized for high speed separations. Purifications that might otherwise require a full working day can be run in one hour. For a chemist running just a single reaction and separation per day, the annual gain in productivity can be as high as 15 additional weeks each year; time that could be used to develop new compounds or processes. With the rising cost of labor, the efficiencies afforded by this alone can exceed the cost of the flash system and a year's supply of cartridges.

Safety

Laboratory and process safety is a growing concern, with many companies carefully reviewing current procedures and techniques to reduce the risk of chemical exposure, injury, and consequently their liability. Biotage Flash systems eliminate the concerns of using glassware under pressure by utilizing durable polyethylene cartridges that are prepacked and completely self-contained, eliminating user exposure to silica dust, HP-API, or any contaminants left after a separation.

The Flash 400 system is designed and manufactured to meet the requirements of the EC machinery directive and the ATEX product directive, and contains ASME/CE rated pressure vessels. The design, fabrication, and pressure testing are reviewed and confirmed by an independent inspector.

The hoist mechanism, including associated pneumatics, valves, switches, and lifting hardware, should be regularly inspected in accordance with local regulations and directives. Contact your Biotage representative for additional information.

Performance

In addition to speed and safety, Biotage flash cartridges improve both the performance and the reproducibility of separations. The use of Biotage patented radial compression technology (see Figure 1) reduces interstitial spaces (void volume) within the packed bed. The optimized bed density means that compounds are collected in narrow bands, which results in higher separation efficiency. Unlike glass columns, each Biotage flash cartridge will perform in the same way, time after time.

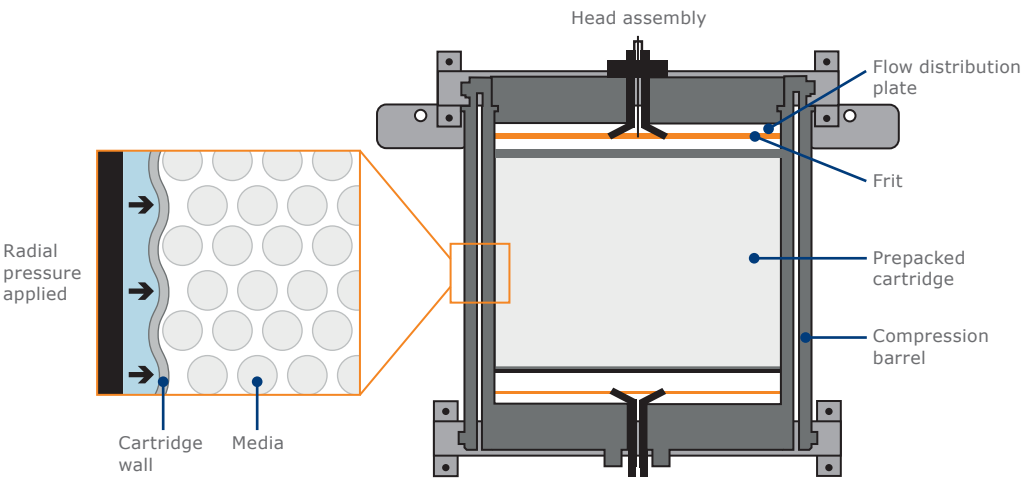

Figure 1. Radial compression module overview.

Description and Specifications

Figure 2. Flash 400 system. A = hoist, B = hoist control box, C = cartridge tool, D = prepacked cartridge, E = radial compression module, F = radial compression fluid reservoir, G = control panel, H = solvent inlets and fraction outlets, and I = air and nitrogen inlets.

Biotage® Flash 400 Frame

The Flash 400 radial compression module is mounted on a portable frame. The frame includes a side connection panel with bulkhead compression fittings for connecting solvent reservoirs (inlet A and B), collection vessels (outlet 1 and 2), a nitrogen supply (radial compression fluid reservoir and module), and a compressed air supply (solvent pump). The air supply for the hoist is connected at the rear of the hoist. For more information see “Installation” on page 14.

The system is fully plumbed and ready for installation. Figure 14 on page 8 shows the overall dimensions.

Radial Compression Module

The Flash 400 radial compression module (see E in Figure 2) is an ASME rated and CE marked pressure vessel. The barrel is fabricated from 316L stainless steel while the top head, bottom head, and clamps are machined from 316 stainless steel. The interior and exterior surfaces have been mechanically polished.

The radial compression module is rated at 170 psig (11.7 bar) maximum pressure. The system includes several pressure relief valves to help ensure that the operating pressure does not exceed this specification.

Note: The radial compression module’s polished surfaces must be protected to minimize mechanical damage.

Additional Radial Compression Barrel

The system supports two interchangeable barrels for use with either 400 mm x 300 mm (Flash 400M) or 400 mm x 600 mm (Flash 400L) cartridges. One of the radial compression barrel sizes is included in the system and the barrel of the other size can be ordered.

O-Rings

The head assembly includes a two piece stainless steel cartridge seal adapter with two Chemraz O-rings (A & B); see 5 and 6 in Figure 3. The cartridge seal adapter seals against the seal adapter plate when the face O-ring (A) is compressed. The radial O-ring (B) seals the adapter to the head.

The top and bottom head assemblies seal to a tapered surface on the cartridge and to the radial compression barrel with either Viton (as shipped) or EPDM (spares) O-rings (C & D); see 3 and 2 in Figure 3. These O-rings are non-product contact surfaces.

The Viton and EPDM O-rings are very compressible and will seal reliably up to 100 psig (6.9 bar). EPDM is resistant to polar solvents but will swell in many common aliphatic and aromatic solvents. Viton is resistant to non-polar solvents, but will swell in the typical polar modifiers. For solvent compatibility information, see Table 1.

Table 1 only covers a limited number of commonly used solvents. To check the compatibility of a particular solvent or solvent mixture, soak an O-ring in the solvent/mixture for one hour and then inspect it for swelling. If the O-ring swells in use, allow it to dry out in a fume hood until it returns to its normal size (typically overnight).

Inspect your O-rings before each run and replace any O-ring that shows signs of wear or damage or that leaks at your typical operating pressures. See Table 2 for part numbers and Figure 3 for location.

Type	Solvent Polarity	Solvent	O-Ring Material Composition		
			Viton	EPDM (Ethylene Propylene)	Chemraz
Normal Phase	0.1	Hexane	Good	Poor	Good
	2.4	Toluene	Fair	Poor	Good
	2.5	MTBE	Poor	Poor	Good
	3.1	DCM	Fair	Fair	Good
	3.9	IPA	Good	Good	Good
	4.0	THF	Poor	Poor	Good
	4.4	Ethyl Acetate	Poor	Good	Good
	5.1	Methanol	Poor	Good	Good
Reversed Phase	5.8	Acetonitrile	Poor	Good	Good
	6.4	DMF	Poor	Fair	Good
	...	Acids	Poor	Good	Good
	...	Bases	Poor	Good	Good
	10.0	Water	Good	Good	Good

Table 1. General solvent compatibility chart.

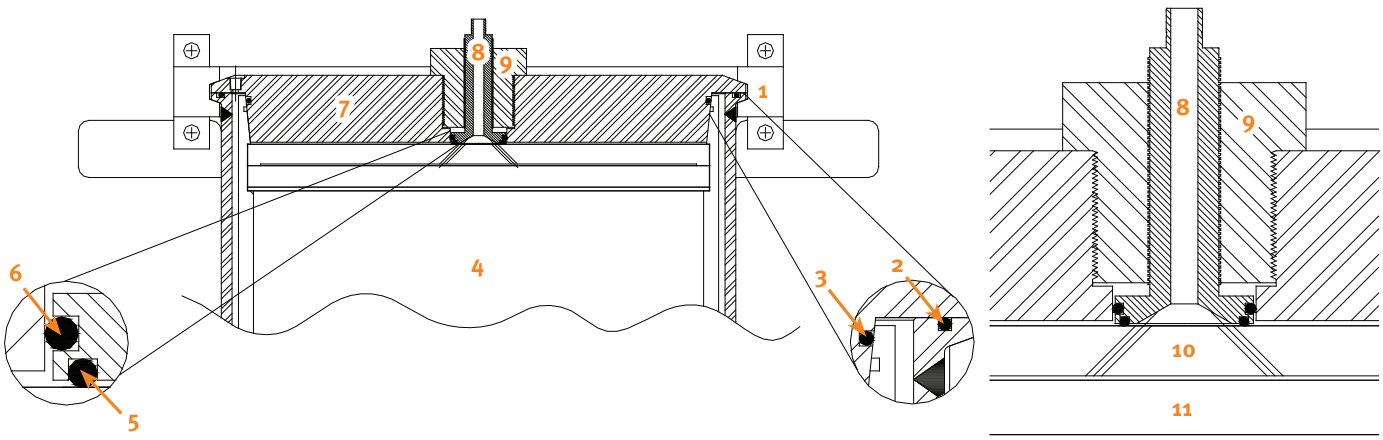

Figure 3. Cut-away view of the top head assembly (left) and expanded view of the cartridge seal adapter (right).
1 = top head clamp, 2 = O-ring "D" size 387, Viton (as shipped) or EPDM (spares), 3 = O-ring "C" size 460, Viton (as shipped) or EPDM (spares), 4 = cartridge, 5 = O-ring "A" size 222, Chemraz, 6 = O-ring "B" size 223, Chemraz, 7 = top head assembly, 8 = cartridge seal adapter (adjustable), 9 = seal adapter housing (fixed), 10 = flow distribution plate (inside the cartridge), and 11 = frit.

Flash 400 Compression Module	Part Number	No. Above	Material	Product Contact	Size Ref	Imp: CD, ID, OD (Inches)	Std. Qty. Installed	Spares In Start-Up Kit
Barrel O-Rings (D)	03020	2	Viton	No	#387	3/16, 18, 18³/₈	2	2
Barrel O-Rings (D)	03019	2	EPDM	No	#387	3/16, 18, 18³/₈	0	4
Barrel O-Rings (D)	03020-K	2	Kalrez	No	#387	3/16, 18, 18³/₈	0	0
Top/Bottom Head (C)	02939	3	Viton	No	#460	1/4, 15½, 16	2	0
Top/Bottom Head (C)	03011	3	EPDM	No	#460	1/4, 15½, 16	0	0
Top/Bottom Head (C)	08648	3	Chemraz	No	#460	1/4, 15½, 16	0	2
Top/Bottom Head (C)	02939-K	3	Kalrez	No	#460	1/4, 15½, 16	0	0
Cart Seal Adapter (A)	06875	5	Chemraz	Yes	#222	1/8, 1½, 1¾	2	2
Cart Seal Adapter (B)	03010	6	Chemraz	No	#223	1/8, 1⁵/₈, 1⁷/₈	2	2

Table 2. Radial compression module O-rings.

Top Head Assembly Valves

The top head assembly has the following valves.

Valve	Description
MV-02	Three-way injection valve. Selects the solvent or sample inlet (see Figure 4). During cartridge removal, compressed gas may be blown through this valve and through the cartridge to remove solvent.
MV-03	Cartridge compression vent valve. Open the valve to purge air from the radial compression chamber when compressing the cartridge (see Figure 5).
MV-04	Vacuum break valve, top. Open the valve to break any vacuum that develops when the cartridge is in use (see Figure 5). Used when preparing to remove a cartridge or testing if the cartridge seal adapter's O-ring has sealed properly.

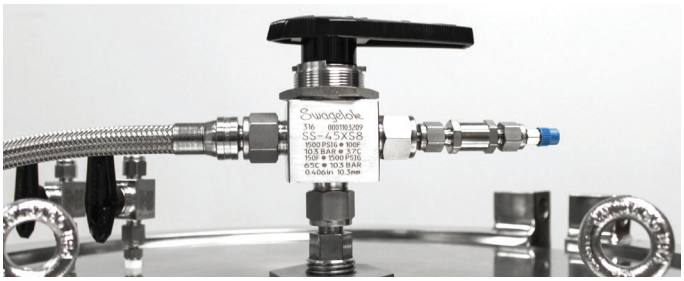

Figure 4. The three-way injection valve (MV-02) with the handle pointing toward the solvent inlet tube.

Figure 5. The cartridge compression vent valve (MV-03) and the top vacuum break valve (MV-04) closed (left image) and opened (right image).

Biotage® Flash 400 Prepacked Cartridge

The system supports two interchangeable barrels for use with either 400 mm x 300 mm (Flash 400M) or 400 mm x 600 mm (Flash 400L) cartridges, with the capacity to purify up to 8 kg* of crude reaction mixture. One of the radial compression barrel sizes is included in the system and the barrel of the other size can be ordered.

A variety of pre-packed cartridges are available depending on the purification goal and cartridges can be custom packed with the preferred chromatography media for your process. The media in each cartridge is self-contained, improving handling and eliminating exposure to contamination and impurities or HP-APIs (high potency active pharmaceutical ingredients).

The cartridges are shipped in a sealed polyethylene shipping bag to minimize water vapor adsorption. Each cartridge includes certificates of compliance and conformance with detailed information for your records in GLP or cGMP environments.

Note: Biotage cartridges are optimized for single use. All warranties are void if the cartridges are used multiple times.

Specification	Flash 400M	Flash 400L
Size D x H	400 x 300 mm	400 x 600 mm
Mass of Biotage® KP-Sil Silica	20 kg	40 kg
Column Volume	28 liters	56 liters
Sample Size	4 kg*	8 kg*
Flow Rate	1-6 L/min	1-6 L/min

Table 3. Flash cartridge specifications.

* The amount of sample that can be purified will depend on the stationary phase and ease of separation. Our new advanced spherical silicas with greater surface area routinely support purification using approximately double the traditional silica sample loadings.

Radial Compression Fluid Reservoir

Biotage provides an electropolished 304 stainless-steel fluid reservoir with the capacity of 12 liters (see F in Figure 2). The oval lid has a clamp that screws shut and a solvent proof, PTFE-encapsulated Viton O-ring to seal the lid in place.

The fluid reservoir is fitted with a pressure gauge (PG-03) and a safety relief valve (PSV-03) that activates at pressures in excess of 125 psi (8.6 bar).

Note: Biotage recommends using the same solvent for both the eluent and the radial compression fluid.

Figure 6. The pressure gauge on the radial compression fluid reservoir.

Control Panel

The system includes a control panel with the following pressure gauges and valves required to operate the system.

Label	Description
PG-01	Pump pressure gauge. Monitors the solvent pump (P-01) outlet pressure.
PG-02	Cartridge compression pressure gauge. Monitors the pressure inside the radial compression module.
MV-01	Solvent select valve. Selects which of the two solvent inlets (**A** or **B**) that will be used.
MV-06	Fraction select valve. Selects which of the two outlets (**1** or **2**) the elution stream will exit through.
MV-07	Cartridge compression valve. Opens the line between the radial compression chamber and the radial compression fluid reservoir, which compresses the cartridge if the fluid reservoir is pressurized. PG-02 and PG-03 readings will equalize. Closes the valve.
MV-08	Solvent pump valve. Turns the solvent pump on or off (**O** or **I**) by opening or closing the line between the air supply and the pump.
MV-09	Reservoir pressure valve. Pressurizes the radial compression fluid reservoir by connecting it to the nitrogen supply. Used when checking that the pressure in the radial compression fluid reservoir can be maintained. Vents the radial compression fluid reservoir by opening it to the atmosphere. The exhaust port is located on the side connection panel.
MV-11	Pump flow rate control. Regulates the compressed air pressure to the solvent pump (P-01). Turn the knob counterclockwise to increase the solvent flow rate and clockwise to decrease it.

Table 4. The control panel.

Safety Positions

Before introducing compressed air or nitrogen into the system, ensure that the following valves on the control panel are in their safety position as listed in Table 5 below.

Valve	Safety Position
MV-11	Clockwise until stopped
MV-08	**O** (closed)
MV-09	(vent)
MV-07	(open/compress)

Table 5. Valve safety positions.

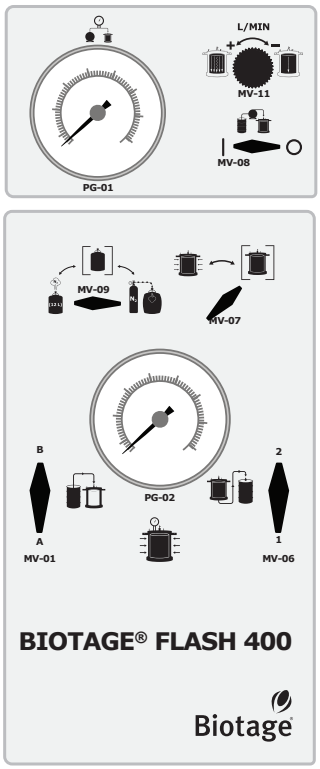

Figure 7. The control panel.

Pump Valve Handle with Safety Latch

The pump valve handle has an automatic safety latch feature to prevent accidental movement of the handle from one setting to another.

To operate this valve, the safety latch must be pressed in and held while the handle is moved. Upon release, the handle becomes latched in its current position.

To secure the handle in a specific position and prevent anyone from changing the setting, the latch mechanism includes an opening for installing a padlock or other locking device (see Figure 8).

Figure 8. Pump valve handle with safety latch.

Side Connection Panel

The side connection panel has the following ports and valves.

Label	Description
	Solvent inlets **A** and **B**.
	Fraction outlets **1** and **2**.
MV-10	Radial compression drain valve.
	Closes the valve.
	Drains the fluid from the radial compression chamber. Used before removing the cartridge.
MV-05	Vacuum break valve, bottom.
	Closes the valve.
	Breaks any vacuum that develops when the cartridge is in use. Used when preparing to remove a cartridge or when testing if the cartridge seal adapter's O-ring has sealed properly.
	Compressed air inlet for the solvent pump.
N_2	Nitrogen inlet. Used to pressurize the radial compression fluid reservoir and the radial compression module.
	Exhaust port for when venting the radial compression fluid reservoir using the MV-09 valve.
	Safety relief port for the radial compression module. The module is rated at 170 psig (11.7 bar) maximum pressure.

Table 6. The side connection panel.

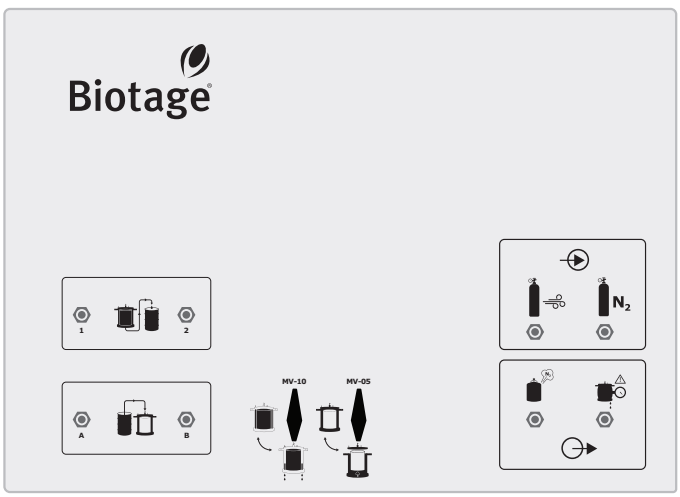

Figure 9. The side connection panel.

Hoist

The hoist (see A in Figure 2 on page 2) is used to move and seal the top head assembly, insert and remove cartridges, and when necessary, move the radial compression barrel. The maximum working load is 125 kg (275 lbs).

The hoist is pneumatically operated and has a separate, dedicated compressed air input connection with a maximum inlet pressure of 100 psig (6.9 bar). The air pressure to the hoist motor is set internally at the factory to approximately 30 psig (2.1 bar). For safety reasons, this internal setting must not be changed.

When not in use, the hoist must be locked in the "storage" position. See the instructions on page 30.

Figure 10. Hoist control box.

Cartridge Tool

The cartridge tool (see Figure 11) is used to insert and remove cartridges with the hoist.

Grasp the eyebolt at the top of the cartridge tool with both hands and lift the tool onto the top of the cartridge. Center the cartridge tool on the top of the cartridge and hand turn the knurled knob (below the eyebolt) clockwise until it will not turn any more. This opens the four plates in the tool and forces them to lock securely into the cartridge lifting groove.

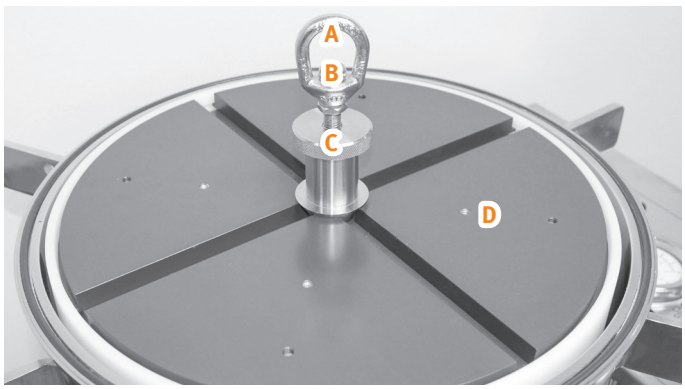

Figure 11. The cartridge tool. A = eyebolt, B= locking nut, C = knurled knob, and D = moveable plate (4).

If the knurled knob tightens without the plates fully extending, spread the plates by hand and push the spreader shaft down until it is in the grooves of the plates. Ensure that the cartridge tool outer ridge is fully engaged into the mating cartridge lifting groove. Re-tighten the knurled knob.

Ensure that the cartridge tool cannot be moved within the cartridge top. If the tool can be moved, loosen the knurled knob and repeat the tightening process to re-engage.

Move the hoist arm so that the safety hook is centered over the cartridge tool and then fasten the hook to the tool's eyebolt.

Head Sling Assembly

The head sling assembly (see Figure 12) is used to move and seal the top head assembly with the hoist. It can also be used to move the radial compression barrel to get access to the bottom head assembly or to change the barrel (see "Additional Radial Compression Barrel" on page 2).

To move the top head assembly, attach the pivot arms on the head sling assembly to the eyebolts on the top head assembly using the quick-release pins. Turn the pivot arms so that the end attached to the sling cable faces inward, toward the center of the head assembly, as shown in Figure 25 on page 18.

To seal the head assembly, attach the pivot arms on the head sling assembly to the fulcrum arms using the quick-release pins. Turn the pivot arms so that the end attached to the sling cable faces outward as shown in Figure 12.

To lift the radial compression barrel, attach the pivot arms to the fulcrum arms using the quick-release pins. Turn the pivot arms so that the end attached to the sling cable faces inward, toward the center of the barrel.

Attach the top ring of the head sling assembly to the hoist safety hook. Ensure that the top ring is attached to the hook with the narrow end up and the closure nut fully threaded and tightened.

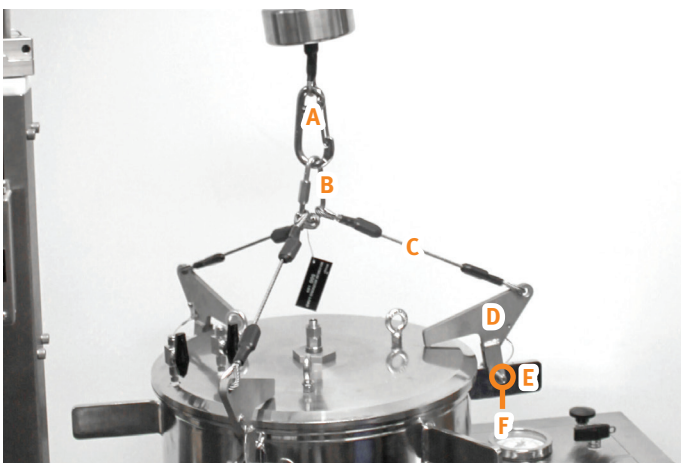

Figure 12. Sealing the head assembly. A = hoist safety hook, B = top ring, C = sling cable, D =pivot arm (3), E = fulcrum arm (3), and F = quick-release pin (3).

Start-Up Kit

Biotage provides a start-up kit consisting of the following items:

Description	QTY	UOM	P/N
Cartridge tool	1	Ea.	03468
Head sling assembly	1	Ea.	08327
Wedge tool (see Figure 13)	1	Ea.	05557
Barrel O-rings, size 387, Viton	2	Ea.	03020
Barrel O-rings, size 387, ethylene porpylene	4	Ea.	03019
Top and bottom head assembly O-rings, size 460, chemraz 505	2	Ea.	08648
Cartridge seal adapter O-rings, size 222 chemraz	2	Ea.	06875
Cartridge seal adapter O-rings, size 223 chemraz	2	Ea.	03010
Tubing assembly 1.2" FLEX	4	Ea.	07087
Tubing, 1/4" OD yellow LDPE	20	Ft.	01354
Tubing, 1/4" OD blue LDPE	20	Ft.	01487
Connector, male 1/4" tube x 1/4" MNPT	1	Ea.	02184
Nut, hex 3/8"-16 UNC 18-8 SST	2	Ea.	03286
Washer, flat 3/8" 18-8 SST	2	Ea.	03287
Muffler, 3/8" 40µ POREX	1	Ea.	01801
Quick guide	1	Ea.	416118
User manual (this publication)	1	Ea.	04149

For more information on the O-rings, see "O-Rings" on page 2.

Figure 13. The wedge tool.

System Dimensions and Valves, Gauges, and Regulators

All valves used on the Flash 400 system are fabricated from 316 stainless steel with a PTFE seat and rated by the manufacturer to at least 200% of the maximum system working pressure.

The pressure gauges operate in contact with the radial compression fluid. They are rated to at least 150% of the maximum working pressure and are graduated as appropriate for convenient operation. The bodies are stainless steel with glass lenses.

For details about each component, see Figure 14 below, Table 7 on page 9, and the Flash 400 flow diagram located on page 35. For information on the ports on the side connection panel, see Table 6 on page 6.

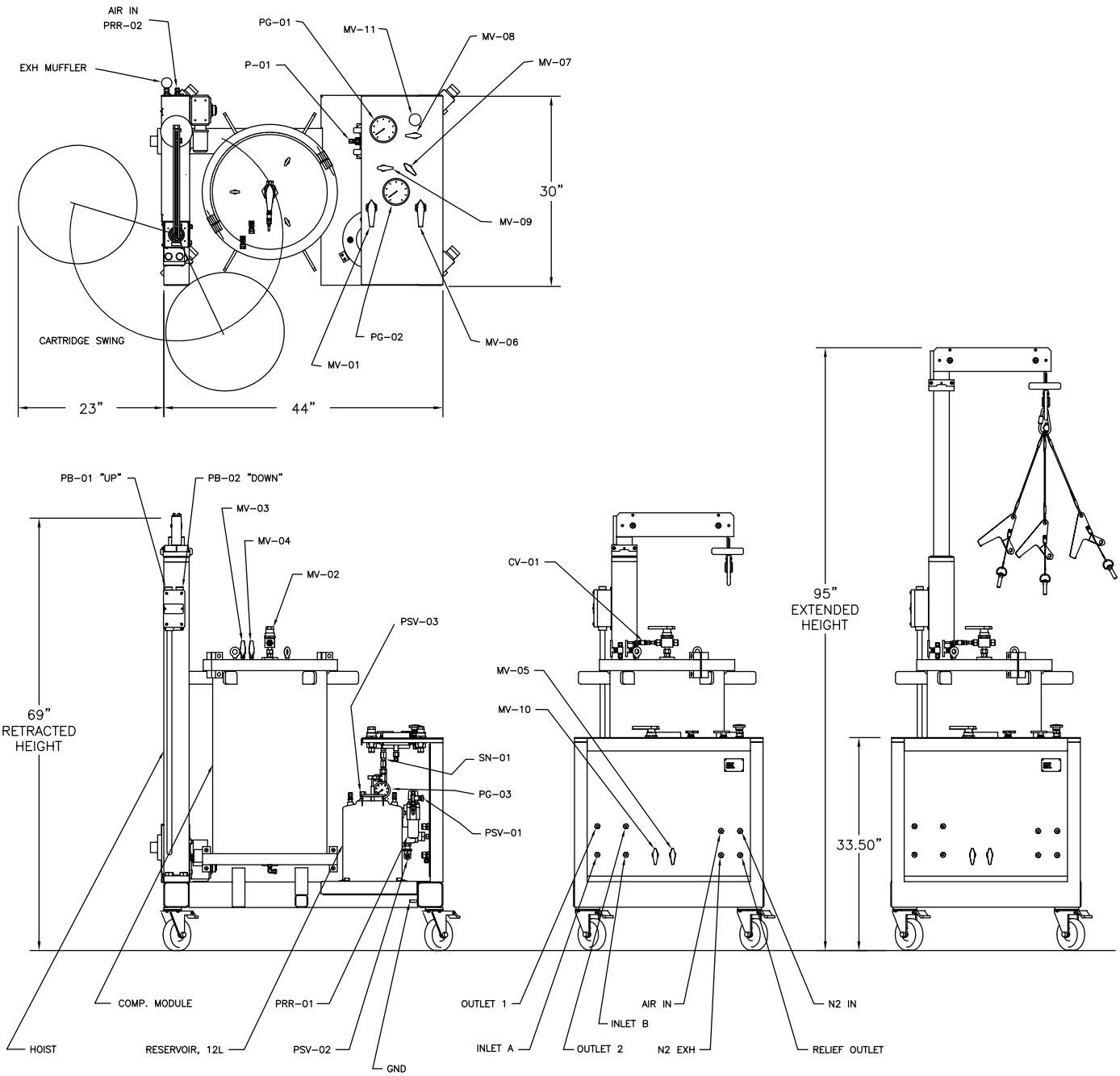

Figure 14. Component location and system dimensions.

Item	Description
MV-01	Solvent select valve. Selects which of the two solvent inlets (**A** or **B**) that will be used.
MV-02	Three-way injection valve. Selects the solvent or sample inlet (see Figure 4 on page 4). During cartridge removal, compressed gas may be blown through this valve and through the cartridge to remove solvent.
MV-03	Cartridge compression vent valve. Open the valve to purge air from the radial compression chamber when compressing the cartridge (see Figure 5 on page 4).
MV-04	Vacuum break valve, top. Open the valve to break any vacuum that develops when the cartridge is in use (see Figure 5 on page 4). Used when preparing to remove a cartridge or testing if the cartridge seal adapter's O-ring has sealed properly.
MV-05	Vacuum break valve, bottom. Closes the valve. Breaks any vacuum that develops when the cartridge is in use. Used when preparing to remove a cartridge or when testing if the cartridge seal adapter's O-ring has sealed properly.
MV-06	Fraction select valve. Selects which of the two outlets (**1** or **2**) the elution stream will exit through.
MV-07	Cartridge compression valve. Opens the line between the radial compression chamber and the radial compression fluid reservoir, which compresses the cartridge if the fluid reservoir is pressurized. PG-02 and PG-03 readings will equalize. Closes the valve.
MV-08	Solvent pump valve. Turns the solvent pump on or off (**O** or **I**) by opening or closing the line between the air supply and the pump.
MV-09	Reservoir pressure valve. Pressurizes the radial compression fluid reservoir by connecting it to the nitrogen supply. Used when checking that the pressure in the radial compression fluid reservoir can be maintained. Vents the radial compression fluid reservoir by opening it to the atmosphere. The exhaust port is located on the side connection panel.
MV-10	Radial compression drain valve. Closes the valve. Drains the fluid from the radial compression chamber. Used before removing the cartridge.
MV-11	Pump flow rate control. Regulates the compressed air pressure to the solvent pump. Turn the knob counterclockwise to increase the solvent flow rate and clockwise to decrease it.

Item	Description
P-01	Pneumatic solvent pump. Moves solvent through the system.
PG-01	Pump pressure gauge. Monitors the solvent pump outlet pressure.
PG-02	Cartridge compression pressure gauge. Monitors the pressure inside the radial compression module.
PG-03	Reservoir pressure gauge. Monitors the radial compression fluid reservoir pressure.
PRR-01	Air pressure regulator (with filter and gauge). Regulates the incoming compressed air pressure for the solvent pump. Set to a maximum of 100 psig (6.9 bar).
PRR-02	Hoist air inlet. Compressed air supply inlet for the hoist, max 100 psig (6.9 bar). Air pressure to the hoist motor is set internally at the factory to approximately 30 psig (2.1 bar). This internal setting must not be changed.
PSV-01	Safety relief valve, solvent pump. Relieves the radial compression chamber if the pressure reaches 170 psig (11.7 bar). ASME rated.
PSV-02	Safety relief valve, chamber. Relieves the radial compression chamber if the pressure reaches 170 psig (11.7 bar). ASME rated.
PSV-03	Safety relief valve, fluid reservoir. Monitors the radial compression fluid reservoir pressure. When the cartridge compression valve (MV-07) on the control panel is set to on/compress, the reading on this gauge (PG-03) will be equal to the reading on the cartridge compression pressure gauge (PG-02).

Table 7. Flash 400 valves, gauges, and regulators.

Specifications

Item	Rating
Hoist load rating	Working load rating is 125 kg (275 lbs)
Nitrogen inlet	100 psig (6.9 bar) maximum
Compressed air inlet (solvent pump)	100 psig (6.9 bar) maximum
Compressed air inlet (hoist)	100 psig (6.9 bar) maximum
Compressed gas supply tubing	200 psig (13.8 bar) minimum working rating
System weight	Up to 650 kg (1433 lbs) typical
Installation floor load requirement	732 kg/m^2 (150 lbs/ft^2) minimum
Head assembly weight	68 kg (149 lbs) each head
Head clamp weight	11.3 kg (25 lbs) each half
Radial compression pressure	80 to 100 psig (5.5 to 6.9 bar)
Solvent pressure	Set to at least 20 psig (1.4 bar) less than radial compression pressure, 80 psig (5.5 bar) maximum

Table 8. Specifications.

Chemical Resistance

The following chemicals can be used in the wetted parts of the system:

- Acetone
- Dichloromethane (methylene chloride, DCM)
- Toluene
- Acetonitrile (MeCN)
- Tetrahydrofuran (THF)
- Triethylamine (TEA)
- N,N-dimethylformamide (DMF)
- Ethyl acetate (ethyl ethanoate, EtOAc)
- N-methyl-2-pyrrolidone (NMP)
- Dimethylsulfoxide (DMSO)
- Ethanol (EtOH)
- Methanol (MeOH)
- 2-propanol (isopropanol, IPA)
- Formic acid (methanoic acid, HCOOH)
- Acetic acid (Ethanoic acid, HOAc, AcOH)
- Deionized water (H_2O)
- Trifluoroacetic acid (TFA), max 5 % (by volume)
- n-Heptane
- Piperidine (pip)
- Pyridine (pyr)
- Ammonia (NH_3) conc.23-27 % (by weight)
- tert-Butyl methyl ether (TBME)
- Diethyl ether
- 10 mM phosphate buffered saline, pH= 7.4
- 50 mM phosphate-citrate buffer, pH= 5.0
- Boric acid/NaOH/KCl buffer, pH=11

Note: Always check the O-rings' compatibility with the solvent or solvent mixture that you want to use. For more information, see "O-Rings" on page 2.

Safety

Intended Use

Biotage Flash 400 system is intended solely for purification. The system must be operated in a controlled environment with an ambient temperature between 4°C and 32°C (39°F and 90°F) by trained professionals. The system must not be installed or used near a potential ignition source. It is the responsibility of the customer to classify (zone) their particular environment in order to verify that it meets the requirements of the directive 1999/92/EC. All operations must be performed:

- According to the user documentation delivered with the system.
- According to instructions available at www.biotage.com.
- According to instructions given by the technical support staff from Biotage.
- Within limits set by the system's technical specification and in line with user standard operating procedures (SOPs).

Failure to follow those instructions and operate within the limits set by the technical specification may result in personal injury and/or equipment damage.

Working Volume

The data plate on the radial compression module states a working volume as required by the Pressure Equipment Directive (PED) 2014/68/EU. In line with regulations, this is the available volume after the cartridge and allowable permanent parts have been excluded from the total theoretical volume. The volume is therefore not the volume of a cartridge, or a purification metric such as "column volume". For further information on scale-up, please contact your local Biotage representative.

Education, Training, and Competence

It is your responsibility to provide all applicable health and safety regulations to your personnel. You must also ensure that all personnel involved in the operation and maintenance of the system fulfill the following criteria:

- Have the necessary education, training, and competence required for the intended use of the system.
- Observe general and specific safety regulations for the use of the system and its accessories at all times in order to reduce the risk of personal injury, fire, and explosion.

Warranty and Liability

See the "Biotage Terms & Conditions of Sale" document at www.biotage.com.

Service

All service must be performed by an authorized Biotage service engineer. Before handing over the system for service, it should be emptied of all liquid and cleaned from harmful residues.

It is the responsibility of the customer to inform Biotage® 1-Point Support™ representatives if the system has been used with hazardous biological, radioactive, or toxic samples and/or solvents, prior to any service being performed. If returning equipment to Biotage, this should be done in accordance with the material return procedures supplied separately by Biotage.

Only genuine Biotage spare parts must be used in the system.

Labels

Labels used on the system:

CE 0036	In accordance with all the essential requirements of all applicable European product directives; see the Declaration of Conformity.
Ex	In accordance with the ATEX Product Directive, 2014/34/EU for Group II, Category 2G equipment. The equipment is intended for use in areas in which explosive atmospheres caused by gases, vapors, or mists or air/dust mixtures are likely to occur.
	Manufacturer.
	Consult accompanying user documentation.

Note: The system is ASME rated and in accordance with both U.S. and Canadian safety standards; see the Declaration of Conformity.

Safety Requirements

You must observe all safety requirements when installing and operating the system. Failure to install or use the system in a manner specified by Biotage may result in personal injury and/or equipment damage.

If the system has been damaged or does not function properly, turn off the gas supplies, depressurize the system (all pressure gauges should read zero (0) bar/psig), open the vacuum break valves (see MV-04 and MV-05 in Figure 14 on page 8), and contact Biotage 1-Point Support (www.biotage.com).

Installation

- The system must be unpacked and installed by an authorized Biotage service engineer. Prepare the installation site as described on page 14.
- Follow regional safety practices when handling and moving shipping boxes and containers, and when moving the system.
- The total weight of the package including the system is up to 1043 kg (2300 lbs) depending on the system configuration. Use suitable lifting equipment when moving the package.
- The system can weigh up to 650 kg (1433 lbs). It must be installed on a level floor that can support the system weight concentrated on the four wheels.
- The system must be placed in a well-ventilated walk-in fume hood or an equivalent enclosure that is capable of exhausting 0.6 m^3/min (21.2 ft^3/min). Follow local and national safety regulations for installing a system inside a fume hood and the safety regulations supplied by the fume hood manufacturer.
- Never install or use the system near a potential ignition source.
- The system, when operated with non-polar solvents such as hexane, methylene chloride, etc., can build up a high static electricity charge, which in certain conditions can be dangerous. To eliminate any risk of a static discharge, the system and ancillary containers must be grounded before use as described on page 14. Failure to follow these grounding instructions may result in equipment damage, personal injury, or death.
- A trained person must verify that the system and ancillary containers are grounded before each run. Nominal resistance must be below 5 Ohm between ground and each metal point in the system.
- Only nitrogen must be used to move radial compression fluid through its flow path due to the risk of exothermal reaction and/or explosion.
- Ensure that the inert gas tubing connected to the system cannot come in contact with chemicals. Corrosives and solvents can dissolve the tubing.
- The outlets of the three safety relief valves (located on the radial compression module, the air pressure regulator to the solvent pump, and the radial compression fluid reservoir) must be directed away from the operator.
- To avoid injury to yourself or damage to the system, never apply gas pressures greater than 100 psig (6.9 bar) to the system inlet gas ports.
- Do not over-tighten the fittings or the tubing may become damaged.
- Never modify the system components in any way and always use spare parts supplied by Biotage. Failure to follow this warning may result in serious personal injury or death. Please contact your Biotage representative for questions regarding this.

Operation

- Use the system only for its intended purpose, as described in the user documentation delivered with the system and user documentation available at www.biotage.com. If the system is used in a manner not specified by Biotage, the safety features of the system may be compromised.
- The system must not be operated unattended.
- Never operate the system if damaged.
- Only nitrogen must be used to move radial compression fluid through its flow path due to the risk of exothermal reaction and/or explosion.
- Inspect the head clamps before and after each use. If the clamp, threaded studs, nuts, or washers show any sign of wear or damage, replace it/them. Only use clamps, studs, nuts, and washers supplied by Biotage.
- Confirm that the head clamps are tight before compressing the radial compression module. Hand-tighten the clamps, to a torque of 34 Nm (25 ft-lb). Ensure that the space between the clamp halves is distributed evenly on both sides. The gap should be approximately 10 mm (0.4") on both sides. If the cartridge is not sealed properly, replace the O-rings (see Figure 3 on page 3) and retry, or contact Biotage 1-Point Support.
- Ensure that all clamps are properly closed before introducing pressure into the system.
- Before removing the head assembly, ensure that the system is depressurized (all pressure gauges should read zero (0) bar/psig) and completely drained, and the vacuum break valves (see MV-04 and MV-05 in Figure 14 on page 8) are open.
- Ensure that the pump pressure gauge on the control panel (see PG-01 in Figure 14 on page 8) reads zero (0) bar/psig before disconnecting the stainless steel overbraided solvent inlet tube from the three-way injection valve, or the three-way injection valve.
- Never remove a tube or system component when it is under pressure.

- The clamp halves must be held to prevent them from falling when striking them with the wedge tool or a plastic-faced mallet. Each half weighs approximately 11.3 kg (25 lbs).
- When closing the radial compression fluid reservoir lid, ensure that it is seated properly to ensure a secure seal.
- Only use unmodified Biotage cartridges.
- Never attempt to run the system without a cartridge, or with the wrong size of cartridge.
- Always equilibrate the cartridge.
- Equilibrate the cartridge at a low flow rate to avoid extreme temperature rise.
- Only use waste containers and fraction collection vessels that are grounded or made of glass.
- A fume extractor must be used for open waste containers and fraction collection vessels.
- Do not place solvent reservoirs on top of any part of the system. Any spillage can seriously damage the equipment, resulting in potential safety hazards.
- The system contains various exhaust ports. If the solvent in use should not be released as a liquid or vapor into the general atmosphere, contact Biotage for instructions on how to safely vent these vapors and liquids.
- To prevent spray hazards, the cartridge compression vent port on the top head assembly (see MV-03 in Figure 14 on page 8) and the safety relief port for the radial compression module on the side connection panel (see Table 6 on page 6) must have the supplied frits or appropriate tubing installed during operation.
- Disposing of the used cartridge and media as a unit reduces the exposure of plant personnel to the residual solvent and any potentially hazardous by-products. Biotage recommends prompt disposal of used cartridges.
- The cartridge shipping containers are not considered leak proof. The containers are resistant to most solvents for 100 days when stored at 37.8°C (100°F) or less. Some solvents may dissolve the plastic shipping bag.
- Follow all applicable safety procedures when working with bottled gas.
- Follow all generally-accepted lab safety procedures and applicable laws and regulations.
- Always follow local and national safety regulations related to storage, handling and disposal of chemicals, samples and waste.
- Read and understand the safety data sheet (SDS) provided by the chemical manufacturer before storing, handling, working with, or disposing of any chemical or hazardous substance.
- In many cases the system will be used in a Class I, Division I, Group C/D hazardous area (equivalent to EEx D IIc T4) as defined by the ANSI/NFPA 70, American National Standards for Electrical Installations. Many solvents are both flammable and toxic and must be handled by trained operators who follow government and corporate safety regulations and guidelines.
- Personnel working with or near the system must wear applicable safety clothing and gear (such as solvent-resistant clothing and gloves, steel toe shoes, and hearing, face, and eye protection) that comply with local and national safety regulations.

Hoist

- The hoist motor internal air pressure setting must not be changed from the factory-set value.
- When operating the hoist, do not attempt to lift loads greater than 125 kg (275 lbs), and always wear steel toe safety shoes, and hearing and eye protection.
- Visually inspect the hoist, cartridge tool, and head sling assembly before each use to ensure that no parts are damaged or loose. If any problems are found, solve them before using the equipment.
- Confirm that the four plates of the cartridge tool are fully extended and engaged with the cartridge lifting groove, the knurled knob is fully tightened (clockwise), and the locking nut is in place before attempting to raise the cartridge.
- Ensure that the top ring on the head sling assembly is attached to the hoist with the narrow end up and the closure nut fully threaded and tightened, and that the cables are not twisted and are clear of obstacles.
- To avoid cable damage, do not raise the cable so high that the cable safety wrap (above the hoist hook eyelet) is drawn into the hoist pulley.
- Use caution when moving the head assembly while attached to the hoist; the weight of the head assembly (68 kg; 149 lbs) can cause it to swing excessively if the hoist is rotated at a high speed.
- Do not perform any maintenance tasks on the hoist unless it is completely disconnected from the inlet air supply.

Installation

Warning

- The system must be unpacked and installed by an authorized Biotage service engineer.
- Follow regional safety practices when handling and moving shipping boxes and containers, and when moving the system.
- The total weight of the package including the system is up to 1043 kg (2300 lbs) depending on the system configuration. Use suitable lifting equipment when moving the package.
- Observe general and specific safety regulations for the use of the system and its accessories at all times in order to reduce the risk of personal injury, fire, and explosion; see the "Safety" chapter on page 11.

Site Requirements

Before the system is installed, the installation site should be prepared as follows:

Fume Hood/ Ventilation System

The system must be placed in a well-ventilated walk-in fume hood or an equivalent enclosure that is appropriate for safe handling and exhausting large quantities of sample, solvent, and fractions and capable of exhausting 0.6 m^3/min (21.2 ft^3/min). Follow local and national safety regulations for installing a system inside a fume hood and the safety regulations supplied by the fume hood manufacturer.

A fume extractor must be used for open waste containers and fraction collection vessels.

Never install or use the system near a potential ignition source.

Floor Load Capacity

The system can weigh up to 650 kg (1433 lbs). It should be installed on a level floor that has a minimum floor load rating of 732 kg/m^2 (150 lb/ft^2). The system is stable under normal usage.

Note: If the system will be moved from one area to another, carefully evaluate the floor condition between each point to ensure that the load ratings are adequate.

Dimensions

Review Figure 14 on page 8 to determine the space allowances needed to set up and operate the system. Consider the following clearance recommendations:

- A minimum of 25 cm (10") clearance on the sides of each unit for solvent/air connections.
- A minimum height clearance of 250 cm (100") for the hoist to reach full extension.
- Enough space behind the system to allow operator access.
- A minimum clear radius of approximately 60 cm (24") is required in front of the system to provide clearance for the range of motion of the hoist when inserting and removing cartridges.

Operating Temperature

4°C to 32°C (39°F to 90°F)

Nitrogen Supply

100 psig (6.9 bar), dry and clean.

Compressed Air Supply

100 psig (6.9 bar), clean and dry; however, slightly lubricated is allowable.

Note: If lubricated air is used, appropriate safety precautions must be taken to prevent the lubricant in the air exhaust from contaminating the surrounding area.

Ground the System

Warning

- The system, when operated with non-polar solvents such as hexane, methylene chloride, etc., can build up a high static electricity charge, which in certain conditions can be dangerous. To eliminate any risk of a static discharge, the system and ancillary containers must be grounded before use as described below. Failure to follow these grounding instructions may result in equipment damage, personal injury, or death.
- A trained person must verify that the system and ancillary containers are grounded before each run. Nominal resistance must be below 5 Ohm between ground and each metal point in the system.

Whenever organic solvents flow from one point to another there is the possibility of dangerous static electric buildup along the path. To eliminate any risk of a static discharge, the systems and ancillary containers must be grounded before use.

To ground the system, connect a ground wire between the 3/8"-16 UNC threaded ground stud on the system (see Figure 15) and a grounding point, such as a metal cold water pipe.

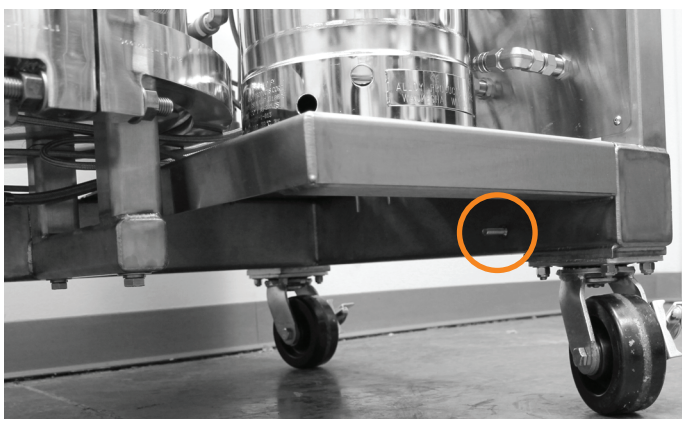

Figure 15. Electrical ground stud location.

Note: To be an acceptable grounding point, the entire run of pipe must be made of metal. Have a qualified person, such as an electrician, verify that the point is grounded before operating the system.

Verify that the system and ancillary containers are grounded using an electrical multimeter (DVM). Nominal resistance must be below 5 Ohm between ground and each metal point in the system.

Gas Supply Connections

Warning

- To avoid injury to yourself or damage to the system, never apply gas pressures greater than 100 psig (6.9 bar) to the system inlet gas ports.
- Only nitrogen must be used to move radial compression fluid through its flow path due to the risk of exothermal reaction and/or explosion.
- Ensure that the inert gas tubing connected to the system cannot come in contact with chemicals. Corrosives and solvents can dissolve the tubing.
- Do not perform any maintenance tasks on the hoist unless it is completely disconnected from the inlet air supply.

Recommended Tubing

Biotage recommends stainless steel or brass tubing or stainless steel overbraided PTFE tubing for the gas supply lines. The tubing must be rated to at least 200 psig (13.8 bar) at the maximum working temperature. The gas tubing must be protected from abrasion, kinking, or mechanical damage.

Before connecting gas tubing to the system:

1. Blow the gas tubing clean with clean, dry gas.
2. Ensure that the pump valve (MV-08) and the reservoir pressure valve (MV-09) on the control panel are in the following positions:

Valve	Position
MV-08	**O** (closed)
MV-09	(vent)

3. Ensure that the air pressure regulator (see PRR-01 in Figure 14 on page 8) is turned down to zero.

Nitrogen

Nitrogen is used to pressurize the radial compression fluid reservoir and the radial compression module.

Connect a dry and clean nitrogen gas supply to the nitrogen port on the side connection panel (see Figure 16). Set the pressure to 100 psig (6.9 bar).

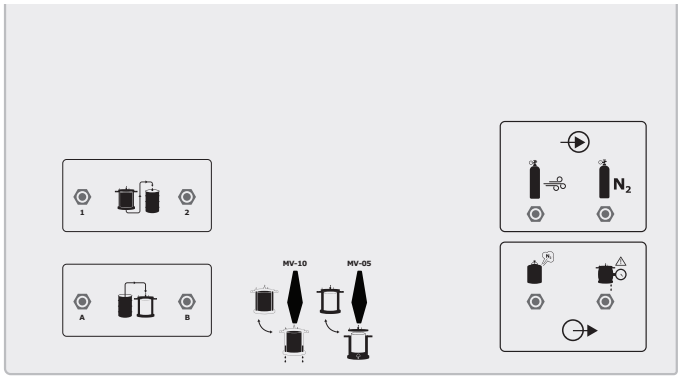

Figure 16. The side panel connections.

N_2 = Nitrogen inlet for cartridge compression.

= Compressed air inlet for the solvent pump.

Compressed Air

Both the solvent pump and the hoist need compressed air to operate:

- **Solvent Pump:** Connect a compressed air supply to the air port on the side connection panel (see Figure 16). Set the pressure to a maximum of 100 psig (6.9 bar).
- **Hoist:** Connect a compressed air supply to the hoist air inlet (see Figure 17). Set the pressure to a maximum of 100 psig (6.9 bar). Note that the actual air pressure supplied internally to the hoist motor is factory-set to approximately 30 psig (2.1 bar) to ensure hoist safety. For safety reasons, this internal setting must not be changed.

Use clean and dry compressed air; however, slightly lubricated is allowable. If lubricated air is used, appropriate safety precautions must be taken to prevent the lubricant in the air exhaust from contaminating the surrounding area.

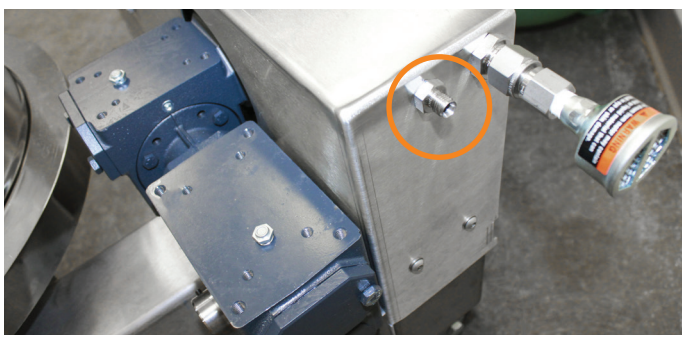

Figure 17. The hoist air inlet (PRR-02).

Solvent Inlets (A and B)

Warning

- Take appropriate measures to protect against static discharge by ensuring that the system and ancillary containers are grounded (see page 14).
- Do not place solvent reservoirs on top of any part of the system. Any spillage can seriously damage the equipment, resulting in potential safety hazards.

It is possible to connect up to two solvent reservoirs (eluent) to the system. The solvent reservoirs must be slightly pressurized (2 to 5 psig; 0.1 to 0.3 bar) so that the solvent pump will have a sufficient supply of solvent and not cavitate while drawing the solvent from a reservoir. Mounting the solvent reservoirs at a height above the solvent pump (P-01) inlet should satisfy this requirement. The solvent reservoirs must be grounded and the distance from the reservoirs to the Flash 400 system should be minimized.

Connect a solvent reservoir to one of the inlet ports (**A** or **B**) on the side connection panel (see Figure 16 on page 15) using one of the supplied two meter long stainless steel overbraided tubes.

 = Solvent inlets on the side connection panel.

Fraction Outlets (1 and 2)

Warning

- Only use waste containers and fraction collection vessels that are grounded.

Connect two of the supplied two meter long stainless steel overbraided tubes to the outlet ports (**1** and **2**) on the side connection panel (see Figure 16 on page 15). Collect the eluting fractions in grounded vessels that are suitable for the separated compounds.

A slight draw on the outlet may be beneficial to prevent unnecessary strain on the solvent pump.

 = Fraction outlets on the side connection panel.

Drain Valve and Exhaust Ports

Warning

- Only use waste containers and fraction collection vessels that are grounded.

The radial compression drain valve (MV-10) on the side connection panel (see Figure 16 on page 15) is used to drain the 10 liters of radial compression fluid from the chamber during the cartridge removal procedure. Place a grounded waste container of a suitable size underneath the drain tube; see Figure 18.

The system contains various exhaust ports. If the solvent in use should not be released as a liquid or vapor into the general atmosphere, contact Biotage for instructions on how to safely vent these vapors and liquids.

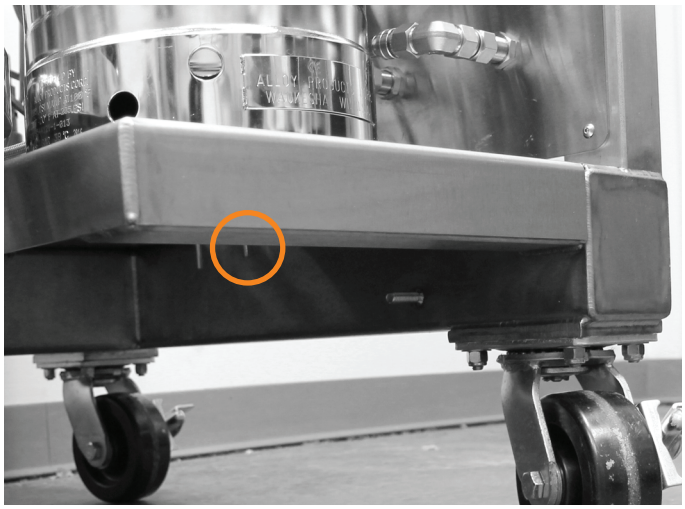

Figure 18. The drain tube connected to the radial compression drain valve (MV-10) on the side connection panel is located underneath the Flash 400 frame, on the right side.

Tube Connections

The dual-ferrule type fittings (1/2" fittings) should be assembled to the tubing as described below:

1. Slide the nut and ferrules onto the tube as shown in Figure 19.
2. Push the tube into the fitting until it seats and then finger-tighten the nut. Use a 7/8" wrench to turn the nut 1 to 1¼ turn past finger-tight (the first time, after that less is required). Do not over-tighten.
3. Test the seal by gently pulling on the tube.

Figure 19. How to slide the nut and ferrules onto the tubing.

Operation

Warning

» Before operating the system, please read and observe the safety requirements in the "Safety" section on page 11.

Note: As part of GLP, we recommend that you keep a logbook of runs performed on the system (with the date, time, user, used solvent or solvent mixture, and pressure settings for each run).

Install a Cartridge

Remove the Top Head Assembly

Warning

» Before removing the head assembly, ensure that the system is depressurized and completely drained (all pressure gauges should read zero (0) bar/psig), and the vacuum break valves (MV-04 and MV-05) are open.

Note: Refer to Figure 14 on page 8 for component locations when performing this procedure.

Retract the Cartridge Seal Adapters

1. Ensure that the system is depressurized and completely drained (all pressure gauges should read zero (0) bar/psig), and the vacuum break valves (MV-04 and MV-05) are open; see the instructions on page 27.
2. Disconnect the three-way valve from the cartridge seal adapter using a 7/8" open-end wrench; see Figure 20.

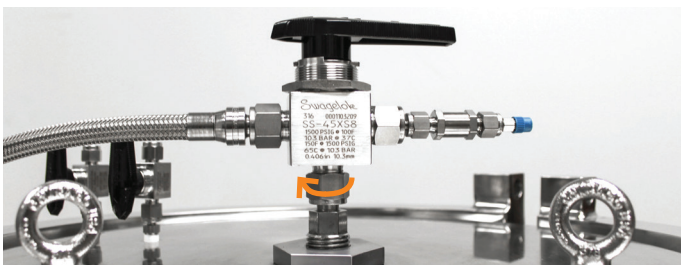

Figure 20. Removing the three-way injection valve.

3. Disconnect the stainless steel overbraided outlet tube from the outlet fitting in the middle of the bottom head assembly using a 7/8" open-end wrench; see Figure 21.

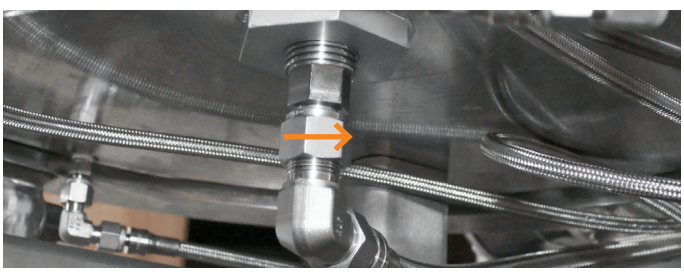

Figure 21. The outlet tube at the bottom head assembly.

4. To avoid damaging the cartridge seal adapters on the top and bottom head assemblies and the new cartridge, retract both the adapters fully by turning them counterclockwise (see Figure 22) until you feel resistance. This may require a 3/4" open-end wrench.

Figure 22. Retracting the top cartridge seal adapter.

Remove the Top Head Clamp

Warning

» The clamp halves must be held to prevent them from falling when striking them with the wedge tool or a plastic-faced mallet. Each half weighs approximately 11.3 kg (25 lbs).

» Inspect the head clamps before and after each use. If the clamp, threaded studs, nuts, or washers show any sign of wear or damage, replace it/them. Only use clamps, studs, nuts, and washers supplied by Biotage.

5. Remove the top head clamp by loosening the nuts on the sides of each threaded stud using a pair of appropriate wrenches (see Figure 23) or one wrench and a deep-socket and ratchet. Slide the nuts and washers off and remove the studs.

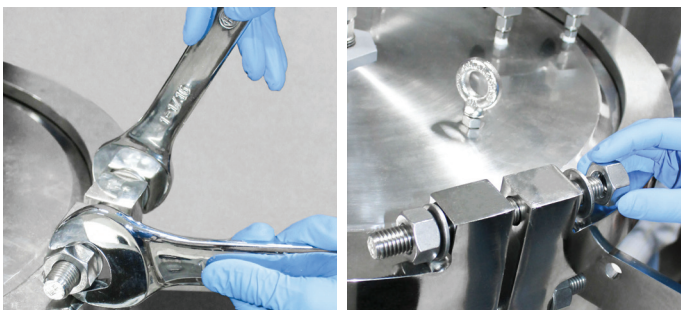

Figure 23. Removing the top head clamp.

6. Carefully slide both halves of the top head clamp off the head assembly and place them on a clean, smooth surface where they will not fall and get damaged.

   Note: If necessary, use the wedge tool provided (see Figure 13 on page 7) and/or a plastic-faced mallet to gently strike and loosen the clamp halves. The clamp halves must be held to prevent them from falling when striking them with the wedge tool or a plastic-faced mallet.

Lift the Top Head Assembly from the Radial Compression Barrel

Warning

- When operating the hoist, do not attempt to lift loads greater than 125 kg (275 lbs).
- Visually inspect the hoist and head sling assembly before each use to ensure that no parts are damaged or loose. If any problems are found, solve them before using the equipment.
- Ensure that the top ring on the head sling assembly is attached to the hoist with the narrow end up and the closure nut fully threaded and tightened, and that the individual cables are not twisted and are clear of obstacles.
- To avoid cable damage, do not raise the cable so high that the cable safety wrap (above the hoist hook eyelet) is drawn into the hoist pulley.
- Use caution when moving the head assembly while attached to the hoist; the weight of the head assembly (68 kg; 149 lbs) can cause it to swing excessively if the hoist is rotated at a high speed.

7. Move the hoist arm so that the safety hook is centered over the top head assembly.
8. Attach the top ring of the head sling assembly to the hoist safety hook. Ensure that the top ring is attached to the hook with the narrow end up and the closure nut fully threaded and tightened (see Figure 24).

Figure 24. The hoist control box and the head sling assembly attached to the hoist safety hook.

9. Attach the pivot arms on the head sling assembly to the eyebolts on the top head assembly:
   a. If required, raise or lower the head sling assembly to allow the pivot arms to reach the head eyebolts.
   b. Place the pivot arm's slotted leg over a head eyebolt. Turn the pivot arm so that the end attached to the sling cable faces inward, toward the center of the head assembly, as shown in Figure 25A. Ensure that the cable is not twisted and clear of obstacles.
   c. Press and hold the release button on the pivot arm's quick-release pin, insert the pin through the aligned holes in the pivot arm leg and the eyebolt loop, and then release the button. This locks the pivot arm to the head eyebolt; see Figure 25B.
   d. Repeat steps b through c for the two remaining pivot arms.

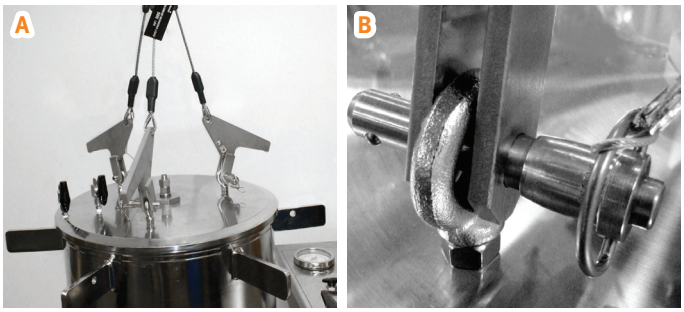

Figure 25. A: The pivot arms on the head sling assembly are attached to the eyebolts on the top head assembly. B: The quick-release pin locks the pivot arm to the head eyebolt.

10. Once the pivot arms are secure, press and hold the ⇧ button on the hoist control box (see Figure 24) until the head assembly is clear of the radial compression barrel.
11. Slowly move the head assembly while attached to the hoist toward the front of the Flash 400 frame until it is completely clear of the frame and the radial compression module. Use caution as the weight of the head assembly (68 kg; 149 lbs) can cause it to swing excessively if the hoist is rotated at a high speed.
12. Align the head assembly over a clean, padded surface capable of supporting its weight (68 kg; 149 lbs).
13. Press and hold the ⇩ button on the hoist control box until the head assembly comes to rest on the padded surface and there is slack in the head sling assembly.
14. Remove the head sling assembly from the hoist safety hook. Leave the head sling assembly attached to the head assembly.

Insert a Cartridge into the Radial Compression Barrel

Warning

- Only use unmodified Biotage cartridges.
- When operating the hoist, do not attempt to lift loads greater than 125 kg (275 lbs).
- Visually inspect the hoist and cartridge tool before each use to ensure that no parts are damaged or loose. If any problems are found, solve them before using the equipment.
- Confirm that the four plates of the cartridge tool are fully extended and engaged with the cartridge lifting groove, the knurled knob is fully tightened (clockwise), and the locking nut is in place before attempting to raise the cartridge.
- To avoid cable damage, do not raise the cable so high that the cable safety wrap (above the hoist hook eyelet) is drawn into the hoist pulley.

When inserting a cartridge, it is critical to ensure that it stays level and aligned in the vertical axis. The bottom head O-ring should be sufficiently lubricated with solvent. A dry O-ring may cause the cartridge to tilt to one side while seating, resulting in incomplete sealing.

1. Fully retract the upper and lower cartridge seal adapters and remove the head assembly as described on page 17 to page 18.

2. Move the cartridge shipping container holding the new cartridge next to the hoist.
3. Open the container and pull the plastic shipping bag away from the top of the cartridge.
4. Remove the sealing label at the top of the cartridge; see Figure 26.

Figure 26. The sealing label at the top of the cartridge.

5. Grasp the eyebolt at the top of the cartridge tool (see A in Figure 27) with both hands and lift the tool onto the top of the cartridge.
6. Center the cartridge tool on the top of the cartridge and hand turn the knurled knob below the eyebolt (see C in Figure 27) clockwise until it will not turn any more. This opens the four plates in the tool (see D in Figure 27) and forces them to lock securely into the cartridge lifting groove.

   Note: If the knurled knob tightens without the plates fully extending, spread the plates by hand and push the spreader shaft down until it is in the grooves of the plates. Ensure that the cartridge tool outer ridge is fully engaged into the mating cartridge lifting groove. Re-tighten the knurled knob.
7. Ensure that the cartridge tool cannot be moved within the cartridge top. If the tool can be moved, loosen the knurled knob and repeat the tightening process to re-engage, as in the previous step.

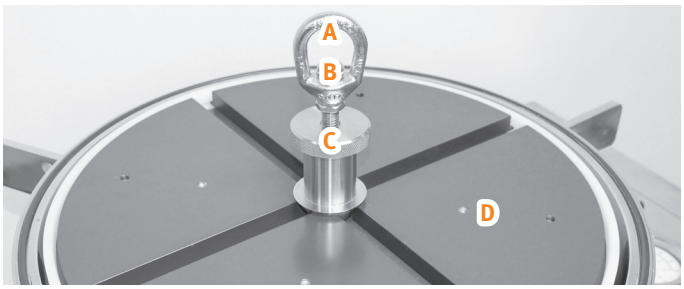

Figure 27. The cartridge tool. A = eyebolt, B= locking nut, C = knurled knob, and D = moveable plate (4).

8. Move the hoist arm so that the safety hook is centered over the cartridge tool and then fasten the hook to the tool's eyebolt; see Figure 28.

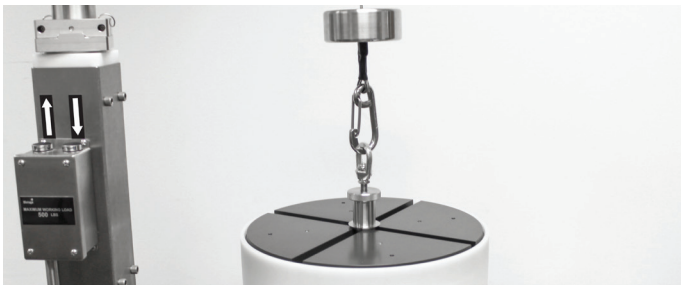

Figure 28. The hoist control box and the hoist safety hook attached to the cartridge tool.

9. Inspect the O-rings and lubricate the bottom head O-ring with radial compression fluid:
   a. Carefully inspect the barrel and head O-rings (C and D in Figure 29) at the top and bottom head assemblies. If an O-ring shows any signs of wear or damage, replace it (see Table 2 on page 3). To get access to the O-rings at the bottom, remove the barrel as described on page 29.

      Note: The O-ring choice should be compatible with the solvent (eluent) to be used; see Table 1 on page 3. To check the compatibility, remove the O-rings and soak them in the solvent for one minute and then slide them back into place. If the O-rings have swollen to the point that they no longer fit in the grooves, replace them with O-rings of a different material (EPDM, Viton, or Chemraz). To restore swollen O-rings, allow them to dry in a clean and dry environment.

   b. Carefully inspect the cartridge seal O-rings (A and B in Figure 29) at the bottom head assembly to ensure that they are seated properly and in a good condition. If an O-ring shows any signs of wear or damage, replace it (see Table 2 on page 3).
   c. Reinstall the radial compression barrel as described on page 30.
   d. Ensure that the bottom vacuum break and radial compression drain valves (MV-05 and MV-10) on the side connection panel are closed.

Valve	Position
MV-05	(closed)
MV-10	(closed)

   e. Wet the bottom head O-ring by manually adding 100 to 200 mL of radial compression fluid to the bottom of the radial compression barrel. This will avoid damaging the O-ring.

Note: Do not insert the cartridge if the bottom head O-ring is not properly lubricated. The liquid can be drained after the cartridge has been inserted by placing a grounded waste container of a suitable size underneath the drain tube connected to the radial compression drain valve (see Figure 18 on page 16) and then opening the valve.

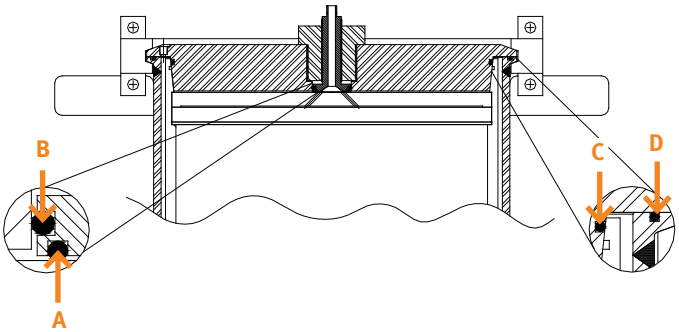

Figure 29. The cartridge seal O-rings (A and B), the barrel O-ring (C), and the head O-ring (D).

10. Press and hold the ⇧ button on the hoist control box (see Figure 28 on page 19) until the cartridge is clear of the shipping container and to a height that will let it clear the top of the radial compression barrel.
11. Remove the sealing label at the bottom of the cartridge and any other packaging materials.
12. Slowly move the hoist arm to center the cartridge over the radial compression barrel.
13. Press and hold the ⇩ button on the hoist control box until the cartridge has been lowered into the radial compression barrel. Carefully guide the cartridge into place, holding it level and ensuring it seats fully onto the O-ring in the bottom head assembly.

    Note: Check that there is an even space all around between the cartridge perimeter and the radial compression barrel. This will help to confirm that the cartridge is seated properly.
14. Disconnect the hoist safety hook from the cartridge tool and move the hoist arm out of the way.
15. Turn the cartridge tool's knurled knob counter-clockwise to release the tool from the cartridge.
16. Grasp the eyebolt at the top of the cartridge tool with both hands and lift the tool out of the cartridge. Place the tool on a clean, smooth surface where it will not fall until reused.

Note: Retain the cartridge's plastic shipping bag and container. These should be used later when disposing of the used cartridge.

Reinstall the Top Head Assembly

Note: Refer to Figure 14 on page 8 for component locations when performing this procedure.

Place the Top Head Assembly onto the Radial Compression Barrel

Warning

- When operating the hoist, do not attempt to lift loads greater than 125 kg (275 lbs).
- Visually inspect the hoist and head sling assembly before each use to ensure that no parts are damaged or loose. If any problems are found, solve them before using the equipment.
- Ensure that the top ring on the head sling assembly is attached to the hoist with the narrow end up and the closure nut fully threaded and tightened, and that the individual cables are not twisted and are clear of obstacles.
- To avoid cable damage, do not raise the cable so high that the cable safety wrap (above the hoist hook eyelet) is drawn into the hoist pulley.
- Use caution when moving the head assembly while attached to the hoist; the weight of the head assembly 68 kg (149 lbs) can cause it to swing excessively if the hoist is rotated at a high speed.

1. Move the hoist arm so that the safety hook is centered over the top head assembly.
2. Attach the top ring of the head sling assembly to the hoist safety hook. Ensure that the top ring is attached to the hook with the narrow end up and the closure nut fully threaded and tightened, and that the cables are not twisted (see Figure 31).
3. Press and hold the ⇧ button on the hoist control box (see Figure 31) to raise the top head assembly until it is higher than the radial compression barrel.
4. Slowly move the hoist arm to center the head assembly over the radial compression barrel. Use caution as the weight of the head assembly (68 kg; 149 lbs) can cause it to swing excessively if the hoist is rotated at a high speed.
5. Carefully inspect the cartridge seal O-rings (A and B in Figure 29) at the top head assembly to ensure that they are seated properly and in a good condition. If an O-ring shows any signs of wear or damage, replace it (see Table 2 on page 3).
6. To avoid damaging the barrel O-ring and the lower cartridge seal O-ring (A and C in Figure 29) at the top head assembly, lubricate them using a clean, lint-free cloth dampened with the solvent to be used or food grade grease.
7. Align the top head valves (MV-03 and MV-04) with the hoist beam to ensure that the valves will not intrude on the attachment of the pivot arms to the fulcrum arms in the next section.
8. Press and hold the ⇩button on the hoist control box until the head assembly has been lowered onto the radial compression barrel. Be sure to align the head assembly and barrel flange evenly as it is lowered.

Seal the Top Head Assembly Using the Head Sling Assembly

9. Once the top head assembly is placed on the radial compression barrel, release one of the head sling assembly's pivot arms.
10. If required, lower the hoist to allow the pivot arm to reach the pre-drilled hole in the nearest barrel fulcrum arm.
11. Place the pivot arm's slotted leg over the barrel fulcrum arm. The end attached to the sling must be facing outward as shown in Figure 31.
12. Press and hold the release button on the pivot arm's quick-release pin, insert the pin through the aligned holes, and then release the button. This locks the pivot arm to the fulcrum arm; see Figure 30.

Figure 30. The quick-release pin locks the pivot arm to the fulcrum arm.

13. Repeat steps 11 through 12 for the two remaining pivot arms.

    Note: The cables must be straight, kink-free, and clear of obstacles in order to apply an even force on the top head assembly.

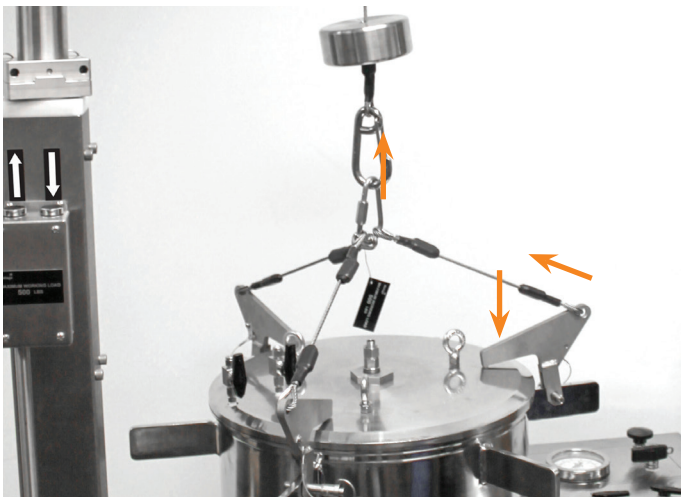

Figure 31. Sealing the head assembly. The upward pull by the hoist on the outer ends of the pivot arms results in a downward push on the top of the head assembly by the inner ends of the pivot arms.

14. Press and hold the ⇧ button on the hoist control box (see Figure 31) until the top head is closed onto the barrel and the hoist stalls. The head assembly should now be firmly sealed.

    Note: If the head will not close, do not apply force as this can damage the barrel O-ring. Instead lift the head assembly off the radial compression barrel and repeat steps 6 through 14 in this section.

15. Lower the hoist, remove the head sling assembly's pivot arms from the barrel's fulcrum arms, and move the hoist arm out of the way.

Reinstall the Top Head Clamp

Warning

» Inspect the head clamps before and after each use. If the clamp, threaded studs, nuts, or washers show any sign of wear or damage, replace it/them. Only use clamps, studs, nuts, and washers supplied by Biotage.

» Confirm that the head clamps are tight before compressing the radial compression module. Hand-tighten the clamps, to a torque of 34 Nm (25 ft-lb). If the cartridge is not sealed properly, replace the O-rings (see Figure 3 on page 3) and retry, or contact Biotage 1-Point Support.

16. Inspect the head clamp. If the clamp, threaded studs, nuts, or washers show any sign of wear or damage, replace it/them.
17. Place the two clamp halves around the perimeter of the top head assembly and barrel flange joint; see Figure 32. If necessary, use a heavy plastic-faced mallet to line up the holes in the clamp halves.

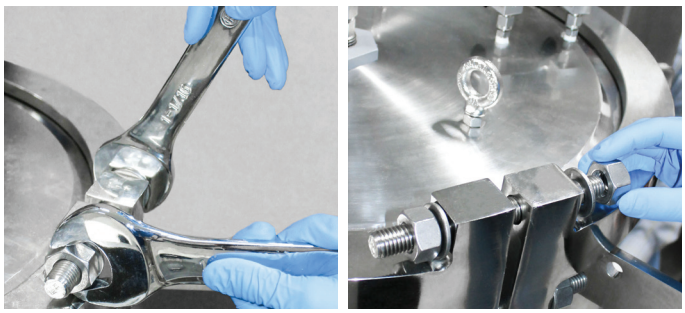

Figure 32. Reinstall the top head clamp.

18. Slide the threaded studs and washers through the clamp holes and snugly tighten the nuts on each side using a pair of appropriate wrenches (see Figure 32) or one wrench and a deep-socket and ratchet; then use a torque wrench to torque the nuts to 34 Nm (25 ft-lb). Ensure that the space between the clamp halves is distributed evenly on both sides. The gap should be approximately 10 mm (0.4") on both sides and the clamp must make contact with the head all the way around.

Tighten the Cartridge Seal Adapters

19. Turn the bottom cartridge seal adapter (in the bottom head assembly) clockwise until hand-tight; see Figure 33.

Figure 33. Sealing the bottom cartridge seal adapter.

20. Using a 3/4" small handled open-end wrench, turn the adapter clockwise an additional 1/4 or 1/2 turn. Alternately, you can use a torque wrench with 3/4" deep socket to torque the adapter to 2.8 Nm (25 inch-pounds).
21. Repeat steps 19 and 20 for the top cartridge seal adapter (in the top head assembly).
22. Reconnect the three-way injection valve on the top head assembly (MV-02).
23. Reconnect the stainless steel overbraided outlet tube to the outlet fitting on the bottom of the radial compression module.

Note: A test must be performed after the cartridge has been compressed to ensure that the cartridge seal adapters are sealed properly; see page 23.

Fill the Radial Compression Fluid Reservoir

Warning

» When closing the radial compression fluid reservoir lid, ensure that it is seated properly to ensure a secure seal.

Note: Refer to Figure 14 on page 8 for component locations when performing this procedure.

1. Ensure that the system is depressurized. On the control panel, the pump pressure (PG-01) and cartridge compression pressure (PG-02) gauges must read zero (0) bar/psig and the reservoir pressure valve (MV-09) and cartridge compression valve (MV-07) must be set to the following positions:

Valve	Position
MV-07	(open/compress)
MV-09	(vent)

2. Loosen the securing clamp holding the radial compression fluid reservoir in position using an Allen key (see Figure 34) and then carefully remove the reservoir from the frame.
3. Remove the lid from the radial compression fluid reservoir and fill the reservoir with approximately 10 liters of radial compression fluid.

   Note: Biotage recommends using the same solvent for both the eluent and the radial compression fluid.
4. Install the lid on the radial compression fluid reservoir by tilting and lowering it into the mouth of the reservoir. Hand-tighten the clamp to secure the lid and ensure that the lid is seated properly to ensure a secure seal.
5. Return the reservoir to its position in the frame and fasten the securing clamps; see Figure 34.

Figure 34. The securing clamps for the radial compression fluid reservoir.

Pressurize the Radial Compression Module and Fluid Reservoir

Warning

» Take appropriate measures to protect against static discharge by ensuring that the system and ancillary containers are grounded (see page 14).

» Only nitrogen must be used to move radial compression fluid through its flow path due to the risk of exothermal reaction and/or explosion.

Note: The upper and lower cartridge seal adaptors must be sealed against the cartridge before compressing the cartridge or serious cartridge contamination or damage may occur. See “Tighten the Cartridge Seal Adapters” on page 21.

Note: Refer to Figure 14 on page 8 for component locations when performing this procedure.

1. Ensure that the tubing is reconnected correctly to the top and bottom head assemblies.
2. Close the line between the radial compression chamber and the radial compression fluid reservoir by closing the cartridge compression valve (MV-07) on the control panel.

Valve	Position
MV-07	(closed/isolate)

3. Close the cartridge compression vent valve (MV-03) and the top vacuum break valve (MV-04) on the top head assembly; see Figure 35.

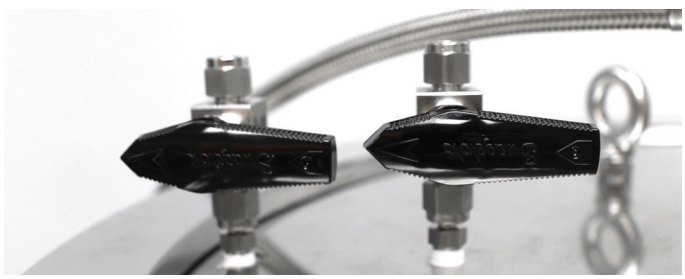

Figure 35. The cartridge compression vent valve (left) and the top vacuum break valve (right) closed.

4. Ensure that the bottom vacuum break and radial compression drain valves (MV-05 and MV-10) on the side connection panel are closed.

Valve	Position
MV-05	(closed)
MV-10	(closed)

5. Set the nitrogen supply pressure to between 80 and 100 psig (5.5 to 6.9 bar).
6. Turn the reservoir pressure valve (MV-09) on the control panel to its pressurize position. This pressurizes the radial compression fluid reservoir.

Valve	Position
MV-09	(pressurize)

7. Check the fluid reservoir pressure gauge (PG-03) on the reservoir to ensure that the nitrogen pressure is between 80 and 100 psig (5.5 to 6.9 bar). If it is not, adjust the nitrogen supply pressure. Note that excessive nitrogen pressure (above 124 psig/8.5 bar) will activate the reservoir safety relief valve (PSV-03).
8. Open the line between the radial compression chamber and the radial compression fluid reservoir by opening the cartridge compression valve (MV-07) on the control panel. This compresses the cartridge.

Valve	Position
MV-07	(open/compress)

9. Wait until the fluid reservoir and chamber pressures equalize as shown by the cartridge compression pressure and the fluid reservoir pressure gauges (PG-02 and PG-03).
10. Purge any air from the system by holding an adsorbing cloth over the cartridge compression vent valve (MV-03) on the top head assembly and slowly opening the vent valve (MV-03) until you hear a small stream of air exiting. Keep the valve open until a steady stream of radial compression fluid (solvent) exits, and then close the valve.
11. Once the radial compression chamber reaches full pressure, i.e. when the cartridge compression pressure and the fluid reservoir pressure gauges (PG-02 and PG-03) read the same, close the line between the radial compression chamber and the radial compression fluid reservoir by closing the cartridge compression valve (MV-07) on the control panel. Both the reservoir and the chamber will remain pressurized, but independent of each other.

Valve	Position
MV-07	(closed/isolate)

12. Check for audible leaks, then turn the reservoir pressure valve (MV-09) on the control panel to the position in-between vent and pressurize.

Valve	Position
MV-09	(in-between vent and pressurize)

13. After 15 minutes, re-check the fluid reservoir pressure gauge (PG-03) to confirm that the pressure drop is less than 0.03 bar/minute (0.5 psig/minute).

Test the Cartridge Sealing

Note: Refer to Figure 14 on page 8 for component locations when performing this procedure.

1. Ensure that the cartridge is compressed properly as described in the “Pressurize the Radial Compression Module and Fluid Reservoir” section above.
2. Close the three-way injection valve (MV-02) on the top head assembly by turning the handle at a 90 degree angle to the valve body; see Figure 36.

Figure 36. The three-way injection valve when closed.

3. Turn the outlet select valve (MV-06) on the control panel to the outlet **1** position.
4. Connect a regulated gas (compressed air or nitrogen) source to the outlet **1** port on the side connection panel. This arrangement should include a suitable pressure gauge such that the pressure at the outlet **1** port can be read after the gas source is shut off.
5. Test the top cartridge seal adapter:
   a. Apply 30 psig (2.1 bar) of pressure to the outlet **1** port. Allow the pressure to stabilize, and then shut off the gas source (gas must not be able to leak back to the gas source).
   b. Record the “starting” pressure reading at the outlet **1** port.
   c. Open the top vacuum break valve (MV-04) on the top head assembly and wait for ten minutes; see Figure 37 on page 24.
   d. Check the gas pressure at the outlet **1** port and compare it with the starting pressure reading. If the pressure is within 2 psig (0.1 bar) of the starting pressure, the top cartridge seal adapter is sealing properly. If the test fails, try the remedies in “Corrective Action for Failed Cartridge Sealing Test” below.

e. Close the top vacuum break valve (MV-04).

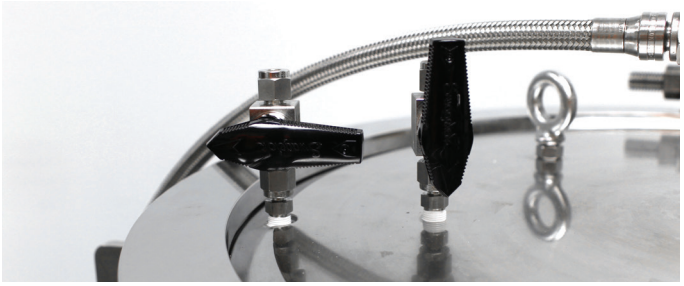

Figure 37. The cartridge compression vent valve (left) closed and the top vacuum break valve (right) open.

6. Test the bottom cartridge seal adapter:
   a. Apply 30 psig (2.1 bar) of pressure to the outlet **1** port. Allow the pressure to stabilize, and then shut off the gas source (gas must not be able to leak back to the gas source).
   b. Record the "starting" pressure reading at the outlet **1** port.
   c. Open the bottom vacuum break valve (MV-05) on the side connection panel and wait for ten minutes.

Valve	Position
MV-05	(open)

   d. Check the gas pressure at the outlet **1** port and compare it with the starting pressure reading. If the pressure is within 2 psig (0.1 bar) of the starting pressure, the bottom cartridge seal adapter is sealing properly. If the test fails, try the remedies in "Corrective Action for Failed Cartridge Sealing Test" below.

Corrective Action for Failed Cartridge Sealing Test

If one of the preceding cartridge sealing tests fails, use the following corrective actions.

Check for Leaks

Rerun the applicable cartridge seal adapter test and use soapy water on the external fittings to check for leaks. If no leaks are found, inspect the cartridge seal adapter O-rings as described below.

Inspect the Cartridge Seal Adapter O-Rings

1. Release the air pressure at the outlet **1** port on the side connection panel by disconnecting the gas source used for the sealing test.
2. Depressurize and drain the system as described on page 27.
3. Remove the top head assembly as described on page 17.
4. Inspect the top cartridge seal adapter O-rings (labeled "A" and "B" in Figure 38). Ensure that they are not cut, flattened, or otherwise damaged. Replace the O-rings if they are damaged; see Table 2 on page 3.
5. If the bottom cartridge seal adapter test failed:
   a. Remove the cartridge, as described on page 28, to access the bottom cartridge seal adapter.
   b. Inspect the bottom cartridge seal adapter O-rings (labeled "A" and "B" in Figure 38). Ensure that they are not cut, flattened, or otherwise damaged. Replace the O-rings if they are damaged; see Table 2 on page 3.
6. Reassemble the system and rerun the cartridge sealing test.

Note: If multiple failures are encountered, please contact Biotage 1-Point Support.

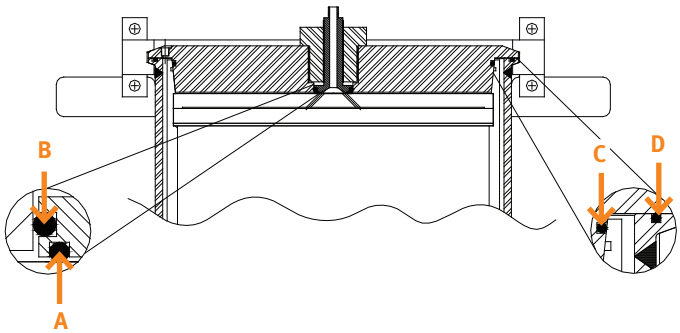

Figure 38. The cartridge seal O-rings (A and B), the barrel O-ring (C), and the head O-ring (D).

Test a Biotage® Flash 400 Cartridge

All new cartridges shipped from Biotage are guaranteed to perform according to specifications. Testing is optional, and only needs to be performed if in-house protocol requires it.

Contact Biotage 1-Point Support for information relating to implementing possible testing procedures. See contact information on the back of this document or visit our website www.biotage.com.

Equilibrate the Cartridge

Warning

- Always equilibrate the cartridge.
- Equilibrate the cartridge at a low flow rate to avoid extreme temperature rise.
- Only use waste containers that are grounded.
- Take appropriate measures to protect against static discharge by ensuring that the system and ancillary containers are grounded (see page 14).
- Do not place solvent reservoirs on top of any part of the system. Any spillage can seriously damage the equipment, resulting in potential safety hazards.

1. Ensure that the pump valve (MV-08) on the control panel is closed (**O**) and the pump pressure gauge (PG-01) reads zero (0) bar/psig.
2. Connect your solvent reservoir (eluent) to one of the solvent inlet ports (**A** or **B**) on the side connection panel and select the same port with the inlet select valve (MV-01) on the control panel. Ensure that the reservoir is grounded.
3. Insert one of the outlet tubes (**1** or **2**) into a grounded waste container and select the same port with the outlet select valve (MV-06) on the control panel.
4. Confirm that the three-way injection valve handle (MV-02) on the top head assembly points toward the 1/2" stainless steel overbraided solvent inlet tube connected to the solvent pump (P-01); see Figure 39.

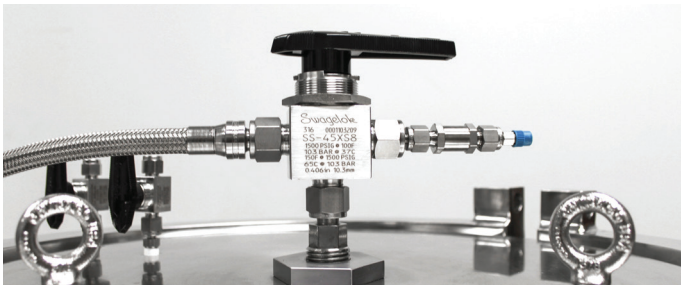

Figure 39. The three-way injection valve on the top head assembly with the handle pointing toward the solvent inlet tube.

5. Turn the flow rate knob (MV-11) on the control panel fully clockwise until it stops. This will prevent any flow of compressed air to the solvent pump (P-01).
6. Open (**I**) the pump valve (MV-08) on the control panel.
7. Turn the flow rate knob (MV-11) counterclockwise until the solvent pump (P-01) begins to pulse. Continue turning counterclockwise until the desired flow rate has been reached.
8. When sufficient solvent has passed through the cartridge, close (**O**) the pump valve (MV-08) on the control panel and empty the waste container.

Load the Sample

Warning

- Take appropriate measures to protect against static discharge by ensuring that the system and ancillary containers are grounded (see page 14).
- Do not place solvent reservoirs on top of any part of the system. Any spillage can seriously damage the equipment, resulting in potential safety hazards.

The sample can either be injected via the three-way injection valve on the top head assembly or through one of the solvent inlet lines (**A** or **B**). If using the latter option, ensure that additional solvent is flushed through the line after sample loading in order to transfer all of the sample onto the cartridge.

Collect Fractions

Warning

- Only use waste containers and fraction collection vessels that are grounded.
- Take appropriate measures to protect against static discharge by ensuring that the system and ancillary containers are grounded (see page 14).

Note: Running the solvent pump dry at high speed for an extended amount of time may damage the pump.

1. Equilibrate the cartridge and load the sample as described above.
2. Insert one of the outlet tubes (**1** or **2**) into a grounded collection vessel and select the same port with the outlet select valve (MV-06) on the control panel.
3. Confirm that the three-way injection valve handle (MV-02) on the top head assembly points toward the 1/2" stainless steel overbraided solvent inlet tube connected to the solvent pump (P-01); see Figure 39.
4. Turn the flow rate knob (MV-11) on the control panel fully clockwise until it stops. This will prevent any flow of compressed air to the solvent pump (P-01).
5. Open (**I**) the pump valve (MV-08) on the control panel.
6. Turn the flow rate knob (MV-11) counterclockwise until the solvent pump (P-01) begins to pulse. Continue turning counterclockwise until the desired flow rate (as measured by the flow of the eluent exiting the outlet tube) has been reached.

   Note: By recording the reading from the pump pressure gauge (PG-01) on the control panel, you can use this value as a guideline for setting the flow rate for a future operation.
7. When done, close (**O**) the pump valve (MV-08) on the control panel.

Purge and Flush the Cartridge

Warning

- Ensure that the pump pressure gauge (PG-01) reads zero (0) bar/psig before disconnecting the stainless steel overbraided solvent inlet tube from the three-way injection valve.
- Take appropriate measures to protect against static discharge by ensuring that the system and ancillary containers are grounded (see page 14).
- Do not place solvent reservoirs on top of any part of the system. Any spillage can seriously damage the equipment, resulting in potential safety hazards.
- Only use waste containers that are grounded.

Before you remove a cartridge from the radial compression module, the cartridge must be purged of previous solvent (mobile phase), flushed with solvent (or a series of solvents) to remove any remaining impurities, and then purged of excess flushing solvent.

Note: Refer to Figure 14 on page 8 for component locations when performing this procedure.

Purge the Cartridge

1. Insert one of the stainless steel overbraided outlet tubes that are connected to outlet **1** and **2** on the side connection panel into a 16-liter or larger grounded waste container. Ensure that the same outlet port is selected with the outlet select valve (MV-06) on the control panel.
2. Ensure that the pump valve (MV-08) on the control panel is closed (**O**) and the pump pressure gauge (PG-01) reads zero (0) bar/psig.
3. Disconnect the stainless steel overbraided solvent inlet tube from the three-way injection valve on the top head assembly (MV-02) and connect a source of clean, dry nitrogen or compressed air to the injection valve.
4. Set the gas supply pressure to between 5 and 25 psig (0.3 and 1.7 bar).
5. Turn on the gas supply and allow it to flow through the cartridge until the liquid flow subsides to the point where only droplets are observed entering the waste container.

Flush the Cartridge

Run the flushing solvent (or series of solvents) through the cartridge to remove any remaining impurities and then purge the excess flushing solvent from the cartridge.

Note: To avoid damaging a cartridge, purge the cartridge with clean, dry nitrogen or compressed air (i.e. repeat steps 1 through 5 above) before flushing with a new solvent.

6. Disconnect the gas supply from the three-way injection valve (MV-02) and reconnect the stainless steel overbraided solvent inlet tube.
7. Connect a reservoir containing the flushing solvent to one of the solvent inlet ports (**A** or **B**) on the side connection panel and select the same port with the inlet select valve (MV-01) on the control panel. Ensure that the reservoir is grounded.

   Note: Biotage cartridges are optimized for single use. All warranties are void if the cartridges are used multiple times. Biotage proprietary cartridge packing procedures ensure high quality, consistency and efficiency. It is a fact of science that reconditioning stationary phases for the purpose of multiple uses of the cartridges is likely to have a negative impact on the performance of the cartridges and may mean that the specifications of the cartridges shift. Methods must be developed to take this into account. If you nevertheless choose to reuse the cartridges, the last flushing should be based on those recommended in Table 9 below.

Cartridge Type	Storage Solvent
Normal-phase (silica)	Inert, non-polar organic solvent, such as ethyl acetate. **Note:** Do not store a cartridge in hydrocarbons, water, or buffer solutions.
Reversed-phase (C18)	100% methanol

Table 9. Recommended solvents for cartridge storage.

8. Confirm that the three-way injection valve handle (MV-02) on the top head assembly points toward the 1/2" solvent inlet tube connected to the solvent pump (P-01); see Figure 39 on page 25.
9. Turn the flow rate knob (MV-11) on the control panel fully clockwise until it stops. This will prevent any flow of compressed air to the solvent pump (P-01).
10. Open (**I**) the pump valve (MV-08) on the control panel.
11. Turn the flow rate knob (MV-11) counterclockwise until the solvent pump (P-01) begins to pulse. Continue turning counterclockwise until the desired flow rate has been reached. Flush with at least two column volumes or confirm cleansing with a special peak analysis.
12. Stop all flow from the solvent pump (P-01) by closing (**O**) the pump valve (MV-08) on the control panel.
13. Purge the excess flushing solvent from the cartridge by repeating steps 1 through 5 above. The small amount of solvent remaining in the cartridge after it is flushed with nitrogen or compressed air is sufficient to protect the cartridge.

Depressurize and Drain the System

Warning

- Only use waste containers that are grounded.
- Ensure that the pump pressure gauge (PG-01) reads zero (0) bar/psig before disconnecting the stainless steel overbraided solvent inlet tube from the three-way injection valve.

Note: Refer to Figure 14 on page 8 for component locations when performing this procedure.

1. Purge and flush the cartridge as described on page 26.
2. Stop all flow from the solvent pump (P-01) by closing (**O**) the pump valve (MV-08) on the control panel.
3. Disconnect the compressed air supply from the air port on the side connection panel; see Table 6 on page 6.
4. Vent the system by turning all valves on the control panel to their safety position:

Valve	Safety Position
MV-11	Clockwise until stopped
MV-08	**O** (closed)
MV-09	(vent)
MV-07	(open/compress)

5. Place a grounded waste container of a suitable size underneath the drain tube connected to the radial compression drain valve (MV-10); see Figure 18 on page 16.
6. Open the radial compression drain valve (MV-10) on the side connection panel to relieve the cartridge compression pressure.

Valve	Position
MV-10	(open)

7. Once radial compression fluid stops draining from the MV-10 valve, open the cartridge compression vent valve (MV-03) on the top head assembly so that the radial compression fluid (solvent) can drain by gravity (see Figure 40). It may be helpful to apply a slight vacuum to the drain tube if the radial compression fluid does not readily drain by gravity.
8. Open the top vacuum break valve (MV-04) on the top head assembly; see Figure 40.

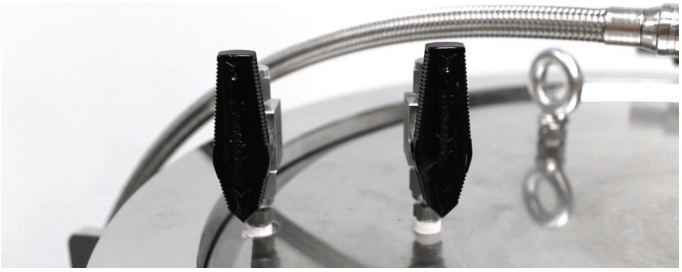

Figure 40. The cartridge compression vent valve (left) and the top vacuum break valve (right) open.

9. Open the bottom vacuum break valve (MV-05) on the side connection panel.

Valve	Position
MV-05	(open)

10. Ensure that the pump pressure gauge (PG-01) reads zero (0) bar/psig.
11. Disconnect the stainless steel overbraided solvent inlet tube from the three-way injection valve on the top head assembly (MV-02) and connect a line with unlubricated compressed air or nitrogen to blow out any remaining eluent in the cartridge.
12. Insert one of the stainless steel overbraided outlet tubes that are connected to the outlet ports (**1** and **2**) on the side connection panel into a grounded waste container. Ensure that the same outlet port is selected with the MV-06 valve on the control panel. The required waste container size depends on the cartridge size; minimum 20 liters (up to 30 liters) for Flash 400M and minimum 40 liters (up to 60 liters) for Flash 400L.
13. Maintain a continuous flow of gas until little or no solvent is seen entering the waste container. The cartridge must be empty before it is removed.

Remove and Handle the Used Cartridge

Warning

- When operating the hoist, do not attempt to lift loads greater than 125 kg (275 lbs).
- Visually inspect the hoist and cartridge tool before each use to ensure that no parts are damaged or loose. If any problems are found, solve them before using the equipment.
- Confirm that the four plates of the cartridge tool are fully extended and engaged with the cartridge lifting groove, the knurled knob is fully tightened (clockwise), and the locking nut is in place before attempting to raise the cartridge.
- To avoid cable damage, do not raise the cable so high that the cable safety wrap (above the hoist hook eyelet) is drawn into the hoist pulley.
- The cartridge shipping containers are not considered leak proof. The containers are resistant to most solvents for 100 days when stored at 37.8°C (100°F) or less. Some solvents may dissolve the plastic shipping bag.
- Disposing of the used cartridge and media as a unit reduces the exposure of plant personnel to the residual solvent and any potentially hazardous by-products. Biotage recommends prompt disposal of used cartridges.

Note: Since the cartridge and/or O-rings may swell in some solvents, it is recommended that the cartridge be removed and disposed of properly, immediately after use. If a cartridge stands in the radial compression barrel for an extended period of time, it may be difficult to remove the head clamps or the cartridge.

1. Purge and flush the cartridge as described on page 26.
2. Depressurize and drain the system as described on page 27.
3. Remove the top head assembly as described on page 17.
4. Move the cartridge shipping container and plastic shipping bag next to the hoist.
5. Grasp the eyebolt at the top of the cartridge tool with both hands and lift the tool onto the top of the cartridge; see Figure 41A.
6. Center the cartridge tool on the top of the cartridge and hand turn the knurled knob (below the eyebolt) clockwise until it will not turn any more; see Figure 41B. This opens the four plates in the tool and forces them to lock securely into the cartridge lifting groove.

   Note: If the knurled knob tightens without the plates fully extending, spread the plates by hand and push the spreader shaft down until it has re-engaged and is in the grooves of the plates. Ensure that the cartridge tool outer ridge is fully engaged into the mating cartridge lifting groove. Re-tighten the knurled knob.
7. Ensure that the cartridge tool cannot be moved within the cartridge top. If the tool can be moved, loosen the knurled knob and repeat the tightening process to re-engage, as in the previous step.

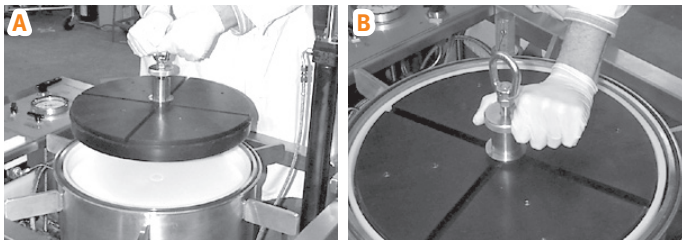

Figure 41. Placing the cartridge tool onto the top of the cartridge using both hands. B: Turning the knurled knob clockwise until the four plates are fully spread (the knob will not turn any more).

8. Move the hoist arm so that the safety hook is centered over the cartridge tool and then fasten the hook to the tool's eyebolt; see Figure 42.

Figure 42. The hoist safety hook attached to the cartridge tool and the hoist control box to the left.

9. Press and hold the ⇧ button on the hoist control box (see Figure 42) until the cartridge is clear of the radial compression barrel.
10. Wrap the plastic shipping bag around the cartridge and secure the bag. This will help to minimize the possible dripping of solvent onto the system and the work area.
11. Slowly move the hoist arm to center the cartridge over the shipping container.
12. Press and hold the ⇩ button on the hoist control box until the cartridge has been lowered into the shipping container.
13. Disconnect the hoist safety hook from the cartridge tool and move the hoist arm out of the way.
14. Turn the cartridge tool's knurled knob counter-clockwise to release the tool from the cartridge.
15. Grasp the eyebolt at the top of the cartridge tool with both hands and lift the tool out of the cartridge and place it on a clean, smooth surface where it will not fall.
16. Move the shipping container out of the way and dispose of the cartridge in accordance with local regulations as soon as possible. The cartridge shell and frits are made of polyolefins and can be incinerated. The internal media is inert except for extreme conditions. The most restricting factors in safe disposal are the substances that remain adsorbed or suspended on the media.

Note: Do not attempt to open a used cartridge. Attempting to reprocess a cartridge by removing the frits or replacing media voids all Biotage safety and performance warranties. In addition this will yield a poorly performing cartridge and may cause system damage.

Clean the System

Warning

» Only use waste containers that are grounded.

Clean the system before the next run and before long term storage.

Note: Refer to Figure 14 on page 8 for component locations when performing this procedure.

1. Run clean solvent through the solvent inlet tubing and the solvent pump:
   a. Ensure that the pump valve (MV-08) on the control panel is closed (**O**).
   b. Connect a solvent reservoir containing a suitable solvent to one of the inlet ports (**A** or **B**) on the side connection panel.
   c. Ensure that the same inlet port is selected with the MV-01 valve on the control panel.
   d. Disconnect the stainless steel overbraided solvent inlet tube from the three-way injection valve on the top head assembly (MV-02) and insert it into a grounded waste container of a suitable size.
   e. Turn the flow rate knob (MV-11) on the control panel fully clockwise until it stops. This will prevent any flow of compressed air to the solvent pump (P-01).
   f. Open (**I**) the pump valve (MV-08) on the control panel.
   g. Turn the flow rate knob (MV-11) counterclockwise until the solvent pump (P-01) begins to pulse. Continue turning counterclockwise until the desired flow rate has been reached.
   h. When complete, reconnect the stainless steel overbraided solvent inlet tube to the three-way injection valve on the top head assembly (MV-02).
2. Disconnect the stainless steel overbraided lines in the outlet system and rinse them with clean solvent. Let them dry and then reconnect them.
3. Wipe down the interior head surfaces and the inside of the radial compression module with a lint free cloth using a suitable cleaning solution. To remove the radial compression barrel, see the instructions below.
4. Empty and wash the radial compression fluid reservoir. Let it dry before you put the lid back into place.

   Note: It is important that no solvent or foreign material be allowed to contaminate the fluid reservoir as this may foul the tubing, valves, or a future run that uses a different eluent/radial compression fluid system.
5. Inspect all O-rings. Ensure that they are not cut, flattened, or otherwise damaged. Replace the O-rings if they are damaged; see Table 2 on page 3.

   O-rings may swell or become misshapen by absorbing surrounding solvent at high pressure. In most cases the absorbed solvent will evaporate and the O-rings will return to their original size if they are stored in a clean, cool, dry, well-ventilated place. For most solvents, O-rings may be used multiple times. Spares of all O-rings are shipped with the system to allow you to operate with one set of O-rings while the other set dries; see Table 2 on page 3.
6. Clean the cartridge tool using a lint-free cloth lightly dampened with a suitable cleaning solution.

Remove the Radial Compression Barrel

To get access to the bottom head assembly, remove the radial compression barrel as described below.

1. If applicable, remove the top head assembly as described on page 17.
2. Move the hoist arm so that the hoist safety hook is centered over the barrel.
3. Remove the head sling assembly from the head assembly and attach the top ring of the head sling assembly to the hoist safety hook. Ensure that the top ring is attached to the hoist with the narrow end up and the closure nut fully threaded and tightened.
4. Attach the pivot arms on the head sling assembly to the barrel's fulcrum arms:
   a. If necessary, raise or lower the head sling assembly to allow the pivot arms to reach the fulcrum arms.
   b. Place the pivot arm's slotted leg over the barrel fulcrum arm. The end attached to the sling must be facing inward, toward the center of the barrel. Ensure that the cable is not twisted and clear of obstacles.
   c. Press and hold the release button on the pivot arm's release pin, insert the pin through the aligned holes, and then release the button. The quick-release pin is shown in Figure 30 on page 21. This locks the pivot arm to the fulcrum arm.
   d. Repeat steps b through c for the two remaining pivot arms.
   e. Press and hold the ⇧ button on the hoist control box (see Figure 42) until the hoist stalls.
5. Remove the bottom clamp as described in "Remove the Top Head Clamp" on page 17.
6. Press and hold the ⇧ button on the hoist control box (see Figure 42) until the barrel is clear of the bottom head assembly.
7. Slowly move the hoist arm to the side to get access to the bottom head assembly.

Reinstall the Radial Compression Barrel

1. Slowly move the hoist arm to center the barrel over the bottom head assembly.
2. Press and hold the ⇩ button on the hoist control box (see Figure 42 on page 28) until the barrel is placed onto the bottom head assembly.
3. Reinstall the bottom clamp as described in “Reinstall the Top Head Clamp” on page 21.

Lock the Hoist in the Storage Position

When not in use, the hoist must be locked in the “storage” position.

1. Remove the clamp by pressing the release button on the two quick-release pins; see Figure 43A.
2. Attach the hoist safety hook to a fulcrum arm; see Figure 43B.

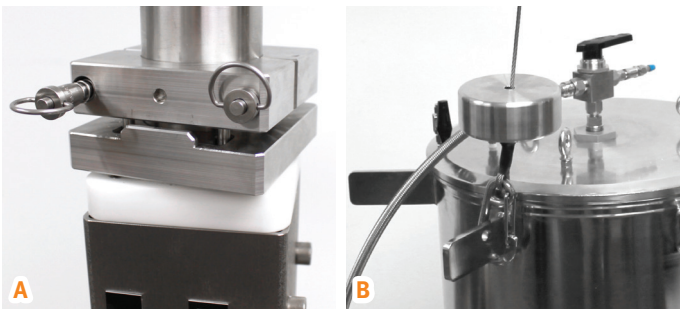

Figure 43. A: Unlock the hoist clamp by pressing the release button on the two quick-release pins. B: The hoist safety hook attached to the fulcrum arm.

3. Lower the hoist boom arm to its lowest position by pressing the ⇩ button on the hoist control box (see Figure 42 on page 28).
4. Re-install the clamp into the lower hole and lock it into position using the quick-release pins; see Figure 44.

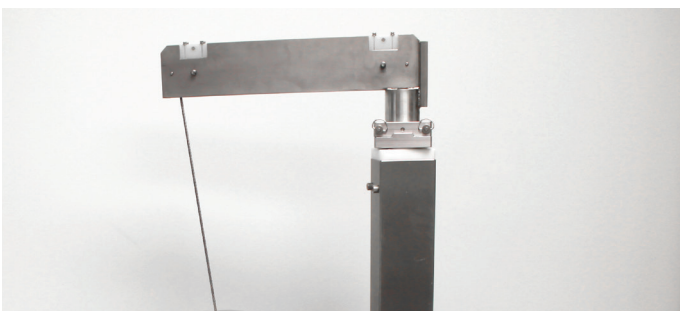

Figure 44. The hoist locked in the “storage”position.

Troubleshooting

Biotage Flash systems are robust and operate with a minimum amount of required maintenance. This section explains how to troubleshoot some commonly occurring situations where the system, or one of its components, does not seem to be working properly.

The most common occurrences are simple air leaks. To locate the source of a leak, we recommend that you apply a leak detection liquid or soapy water to the suspected area. Once the leak has been located, adjustments or repairs are relatively straightforward and can be done without contacting Biotage. However, if any assistance is needed, we invite you to contact Biotage 1-Point Support; see contact information on the back of this document or visit our website www.biotage.com.

Biotage® Flash 400 Radial Compression Module

Problem	Possible Cause	Possible Solution
Fluid or gas leaks from the top or bottom of the radial compression module.	1. The top or bottom head clamp is loose. 2. The head O-ring seal is leaking.	1. Tighten the head clamps. 2. Remove the top head assembly (see page 17) and, if it is leaking at the bottom, the radial compression barrel (see page 29), and replace the head O-ring (labeled D in Figure 38 on page 24) at the top and/or bottom head assemblies.
Fluid leaks from the safety relief valve.	1. Radial compression pressure is too high. 2. Safety relief valve is defective.	1. Check the cartridge compression pressure gauge (PG-02). Set the nitrogen gas supply pressure to between 80 and 100 psig (5.5 to 6.9 bar). 2. Contact Biotage 1-Point Support; see contact information on the back of this document or visit our website www.biotage.com.
Top head assembly will not seat.	1. The cartridge is not properly seated. 2. The cartridge is too long. 3. Bottom head assembly is out of alignment.	1. a. Remove the top head assembly (see page 17) and cartridge. b. Lubricate the bottom head O-ring (labeled D in Figure 38 on page 24) with the used solvent and reinsert the cartridge. c. Lubricate the barrel O-ring and the lower cartridge seal O-ring (labeled A and C in Figure 38 on page 24) at the top head assembly and reinstall the top head assembly. Clamp before the lubricating solvent evaporates. 2. Only use cartridges supplied by Biotage and of a length that corresponds to the radial compression module in use. 3. Loosen the bottom clamp, realign the head assembly to the center, and tighten the clamp.
Air bubbles in the collection line.	1. Solvent supply is empty.	1. Turn off the solvent pump by closing (**O**) the pump valve (MV-08) on the control panel and then check the solvent level in the solvent reservoir. Refill if necessary.

Solvent Compatibly of O-Rings

Table 1 on page 3 summarizes the typical solvent compatibility of the different O-ring materials. Check the solvent compatibility of an O-ring by soaking it for one hour in your mobile phase. If an O-ring swells in use, please let it dry out overnight in a fume hood before reusing. Biotage recommends replacing an O-ring if any tears or scratches appear, or if it leaks solvent at typical operating pressure.

Radial Compression Fluid Reservoir

Problem	Possible Cause	Possible Solution
Fluid leaks from the safety relief valve.	1. Radial compression pressure is too high. 2. Safety relief valve is defective.	1. Check the fluid reservoir pressure gauge (PG-03) on the reservoir. Set the nitrogen gas supply pressure to between 80 and 100 psig (5.5 to 6.9 bar). 2. Contact Biotage 1-Point Support; see contact information on the back of this document or visit our website www.biotage.com.
Gas leaks around the top of the fluid reservoir.	1. Lid is not aligned. 2. O-ring is defective.	Release the pressure and then re-seat the lid or replace the lid O-ring. To release the pressure: a. Close the line between the radial compression chamber and the radial compression fluid reservoir by closing the MV-07 valve on the control panel (see Table 4 on page 5). b. Release the fluid reservoir pressure by turning the MV-09 valve on the control panel to its vent position (see Table 4 on page 5). c. Ensure that the fluid reservoir pressure gauge (PG-03) on the reservoir reads zero (0) bar/psig.

Operation

Problem	Possible Cause	Possible Solution
No flow.	1. Flow path incorrect. 2. No solvent (eluent).	1. The three-way injection valve on the top head assembly must point toward the stainless steel overbraided solvent inlet tube connected to the solvent pump (P-01). 2. Turn off the solvent pump by closing (**O**) the pump valve (MV-08) on the control panel and then check the solvent level in the solvent reservoir. Refill if necessary.
Flow rate is too low.	1. Tubing is blocked. 2. Solvent pump pressure too low. 3. Flow is restricted. 4. Cartridge is partially plugged.	1. a. Depressurize the system (see page 27). b. Disconnect the solvent inlet tube from the three-way injection valve (MV-02) on the top head assembly and insert it into a grounded waste container. c. Turn on the solvent pump and set the flow rate to max, i.e. open (**I**) the pump valve (MV-08) and turn the flow rate knob (MV-11) on the control panel counterclockwise until it stops. d. Check the flow rate into the waste container. If less than 6 liters/min, replace the solvent inlet tube. 2. Check the pump pressure gauge (PG-01) and adjust the pressure using the flow rate knob (MV-11) on the control panel. High viscosity solvents require higher pressure. 3. Check for possible flow restriction in other tubing. 4. If the previous measures do not help, try flushing the cartridge using the procedure on page 26. If that does not help, replace the cartridge.

General Information

Patents

One or more of the products in this manual may be covered by one or more of the following patents: US 6,139,733, US 6,294,087, US 6,221,252, and US 6,436,284.

Price List and Ordering Information

Please contact your Biotage distributor for the latest price and ordering information.

Download User Documentation

You can download the latest version of this document and other user documentation at www.biotage.com. If you have problems downloading, please contact your local Biotage representative.

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Appendix

Warranty and Liability

See the “Biotage Terms & Conditions of Sale” document at www.biotage.com.

Essential Tools List

Tools Provided by Biotage

	Tool	Description
1	Cartridge tool	Used to install and remove cartridges with the hoist. The tool is made of stainless and black steel, and is 15 cm (5.9") high by 19 cm (7.5") in diameter.
2	Head sling assembly	Used to install and remove the head assembly with the hoist. It has three cables with pivot arms. Each cable is approximately 30 cm (11.8") long.
3	Wedge tool	Used to help loosen the head clamps on the radial compression module.

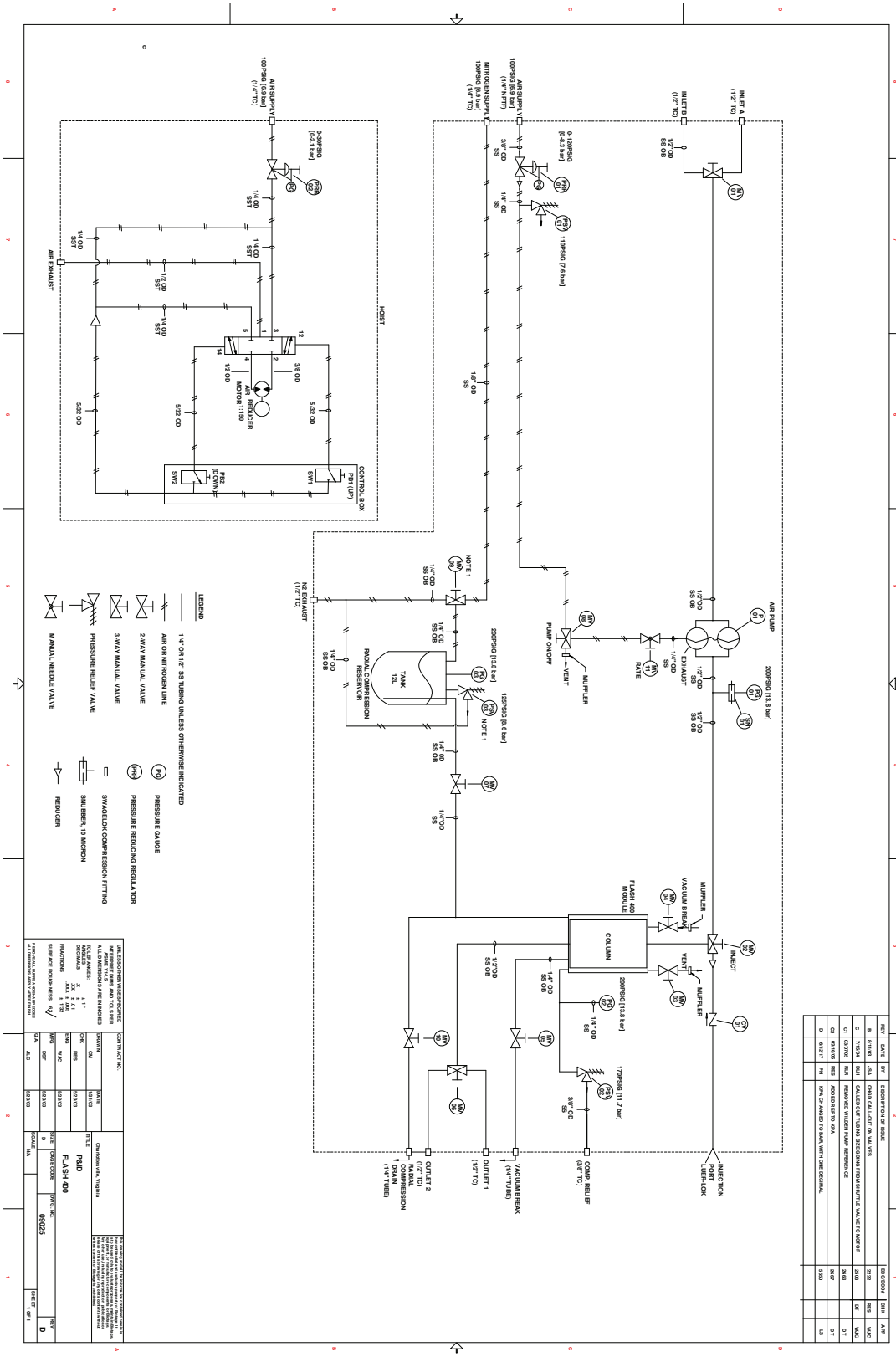
Tools Provided by the Customer

	Tool	Description
1	Fork lift	To remove the system from its shipping crates and transport it to its operating location.
2	Plastic-faced mallet	Essential for removing the head clamps on the radial compression module. Recommendation: a weighted, non-scarring mallet with a gross weight of no less than 1.5 kg (3.3 lbs).
3	Cart	Used to move cartridges to the system. Also serves as a temporary storage surface for the head assembly while changing cartridges. Note that the head assembly weighs 68 kg (149 lbs).
4	Hand tools	3/4" small handled open-end wrench. Alternately, you can use a torque wrench with 3/4" deep socket. The torque wrench must be able to work in the 2.8 Nm (25 inch-pounds) range. 7/8" open-end wrench. Two wrenches of the appropriate size (depends on system version) for the head clamp nuts or one wrench and a deep-socket and ratchet. The torque wrench must be able to work in the 34 Nm (25 ft-lb) range. Optional: crowfoot wrenches, ratchet to fit sockets, and adjustable open end wrench (“Crescent”) with 1" opening.

Biotage® Flash 400 Spare Parts

Part No.	Description
03020	Barrel O-Ring (D), 387 Viton
03019	Barrel O-Ring (D), 387 EPDM
03020-K	Barrel O-Ring (D), 387 Kalrez
02939	Top/Bottom Head O-Ring (C), 460 Viton
03011	Top/Bottom Head O-Ring (C), 460 EPDM
08648	Top/Bottom Head O-Ring (C), 460 Chemraz
02939-K	Top/Bottom Head O-Ring (C), 460 Kalrez
06875	Cart Seal Adapter O-Ring , 222 Chemraz
03010	Cart Seal Adapter O-Ring, 223 Chemraz
06361	Motor, Air Up to 1.5 HP Max 100 psi
06842	Adapter, Flow Seal
06843	Housing, Seal Adapter
03468	Cartridge Tool

Biotage® Flash 400 Process and Instrumentation Drawing



Notes

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