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Harvestainer Microcarrier Separation BioProcess Container User's Guide

DOC0024 • Revision B

April 2019

ThermoFisher SCIENTIFIC

Contents

Warnings and safety information

Congratulations! You have purchased a high-quality Thermo Scientific™ product. We have included safety information in this guide, based on our knowledge and experience. It is important, however, for you to work with your safety management personnel to ensure that this equipment is integrated into your safety practices. Please take some time to perform your own job safety analysis in order to identify and control each potential hazard.

WARNING: Read and understand this user's guide before using the Thermo Scientific Harvestainer BioProcess Container (BPC).

The Thermo Scientific Harvestainer™ BPC is designed to be operated under traditional pharmaceutical conditions. It is important to have a general understanding of bioreactors and harvesting prior to using the system for the first time. Read and understand this user's guide before operating; failure to do so could result in injury or potential loss of product.

WARNING: Use caution when handling.

Personnel operating, disposing, and handling the Harvestainer system need to know the hazards of any chemicals or materials that may be present on or in the system. Use general hazard communication techniques such as Safety Data Sheets, labels, and pictograph to communicate any hazards.

WARNING: Burst hazard.

Under normal operating conditions the BPC chamber is under slight pressure. Normal passive venting prevents any excess of pressure building up within the chamber. Chamber pressure and inlet line pressure should be monitored for proper settings.

- Contents under pressure
- Do not exceed 0.5 psi static BPC pressure
- Do not exceed 5 psi inlet pressure
- Ensure that the vent filter is both positioned and working properly

WARNING: Static electricity may build up in BPCs.

BPCs may act as insulators for electrostatic charge. If electrostatic charge is transferred to a BPC, the charge may be stored in the BPC and/or the product inside. This phenomena varies by product and use; therefore, it is the sole responsibility of the end user to ensure a

hazard assessment is conducted and the risk of electrostatic shock is eliminated.

It is good practice to dissipate electrostatic buildup by grounding all BPCs prior to coming in contact with them. When working with BPCs, the use of non-conductive materials, such as non-conductive gloves, is recommended.

How to use this guide

Scope of this publication

This document covers information about proper handling, operation, specifications, and disposal of Thermo Scientific™ Harvestainer™ BioProcess Containers (BPCs). It is intended for use by people who may or may not have experience with Thermo Scientific BPC systems, but who have some knowledge of bioproduction processes.

Document change information

A summary of the changes that have been made to this document are listed below.

Revision	Date	Section	Change	Author
Rev. A	02/2017	--	Initial release	G. Brau
Rev. B	04/2019	--	Various formatting changes	E. Hale
Rev. B	04/2019	How to use this guide	Moved “How to use this guide” section from Chapter 1 to front matter and renumbered chapters	E. Hale
Rev. B	04/2019	Chapter 7	Moved specifications tables and illustrations to a separate chapter	E. Hale

Related publications

Other publications related to the Harvestainer BPC are listed below.

Publication name	Doc. number
Thermo Scientific Harvestainer BPC Validation Guide	DOC0027
Thermo Scientific Harvestainer 3 L and 12 L Quick Start Guide	DOC0026
Thermo Scientific Harvestainer 25 L and 50 L Quick Start Guide	DOC0025

Input into Thermo Scientific technical publications

Your satisfaction with the scope, content, and accuracy of this publication is important to us. Please send any corrections or suggestions you have for this guide, or for any other Thermo Scientific technical publication, to TechnicalDocumentation@thermofisher.com.

Abbreviations/acronyms

See the list below for definitions of abbreviations and acronyms used in this publication.

BPC	BioProcess Container
ID	Inner diameter
OD	Outer diameter
PE	Polyethylene

1

System overview

1.1 Intended application statement

The Harvestainer BPC is intended to be used for your research use or further manufacturing and not for diagnostic use or direct administration into humans or animals.

The Harvestainer BPC is intended to be used as an in-process microcarrier bead separation system for cell culture media and detached or lysed cells. It is specifically designed for adherent cell lines cultured on microcarrier beads greater than 90 microns in size. The BPC is supplied as a ready-to-use gamma-irradiated system.

1.2 Product definition

The Harvestainer BPC for microcarrier separation is available in several hydrated microcarrier bead capacities: 3 L, 12 L, 25 L, and 50 L. In Thermo Scientific BPC nomenclature, the volume preceeding the BPC name represents the overall volume of the BPC. In the case of the Harvestainer BPCs the volume listed represents the volume, or capacity, of hydrated microcarrier beads it can hold. To determine the appropriate size Harvestainer system, see the frequently asked questions in Chapter 6 of this publication.

Design and construction of 3 L and 12 L systems

The 3 L and 12 L Harvestainer BPCs are constructed with three layers of material. The outer two layers are made of Thermo Scientific CX5-14 film and the middle layer is made from a polyester mesh. The standard configuration for the systems is shown in Figures 1.1 and 1.2. The 3 L and 12 L systems include the following components:

- The Microcarrier separation BPC captures the microcarrier beads and allows the detached or lysed cells and media to flow through. It is attached to the single-use support tray.
- The inlet line connects to the vessel containing the microcarrier beads, media and detached or lysed cells.
- The drain line connects to the next step in your process, storage BPC, or sterile container for additional purification operations.
- The single-use support tray is comprised of a top and bottom tray and two support rods. It is an integral part of the system that provides support and keeps the BPC in the correct angle for optimal drainage.

Figure 1.1. Illustration of the complete 3 L and 12 L systems.

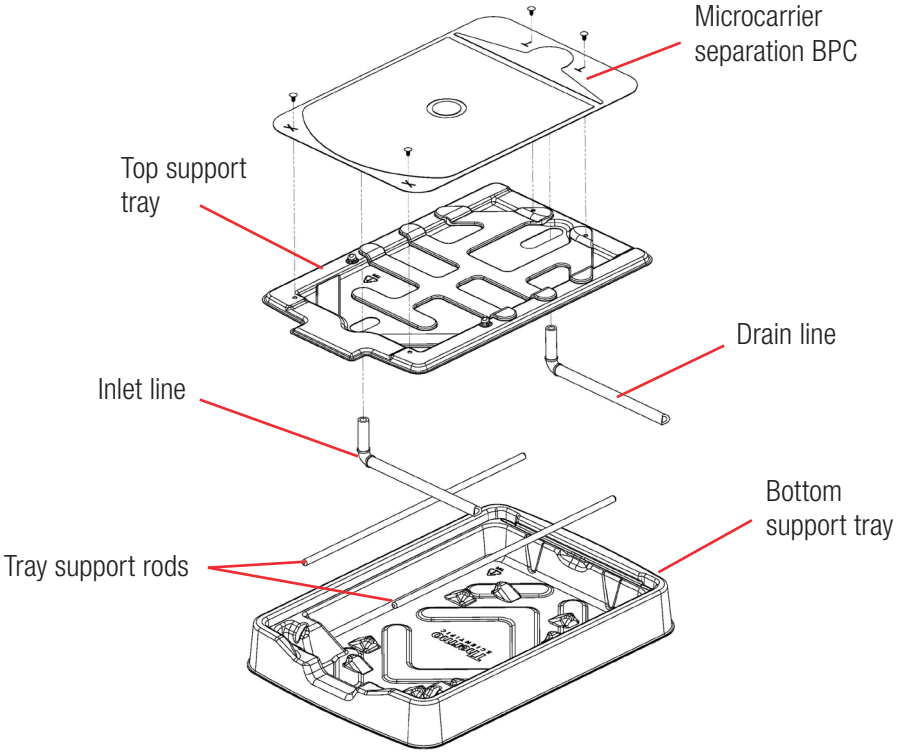
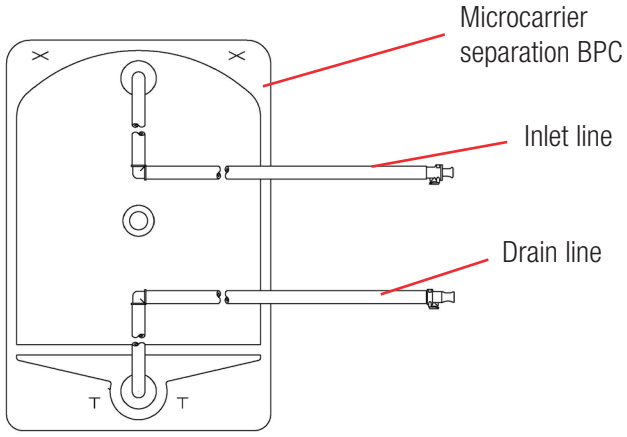


Figure 1.2. Illustration of the 3 L and 12 L BPC.



Design and construction of 25 L and 50 L systems

The 25 L and 50 L Harvestainer BPCs are designed with two chamber types. The 200 L outer BPC and the inner Microbarrier Labtainer BPC. The outer chamber is constructed of CX5-14 film only. The inner Microbarrier Labtainer BPC is constructed from a combination of CX5-14 film on one side and polyester mesh on the opposing side. The standard configurations for 25 L and 50 L systems are shown in Figures 1.3 and 1.4. The 25 L and 50 L systems include the following components:

- The BPC captures the microcarrier beads in the inner Microbarrier Labtainer BPC and allows the detached or lysed cells and media to flow through.
- Air vent filter for inflating the BPC and to allow venting during use.
- Inlet line for connecting from the vessel containing the microcarrier beads, cell culture media and detached or lysed cells into the BPC.
- Drain line uses a diptube connected to the dipwell port for top draining. This line connects the BPC to the next step in your process, storage BPC, or sterile container for additional purification operations.

Note: A support drum is required for the system and is sold separately. See section 1.3 for more details.

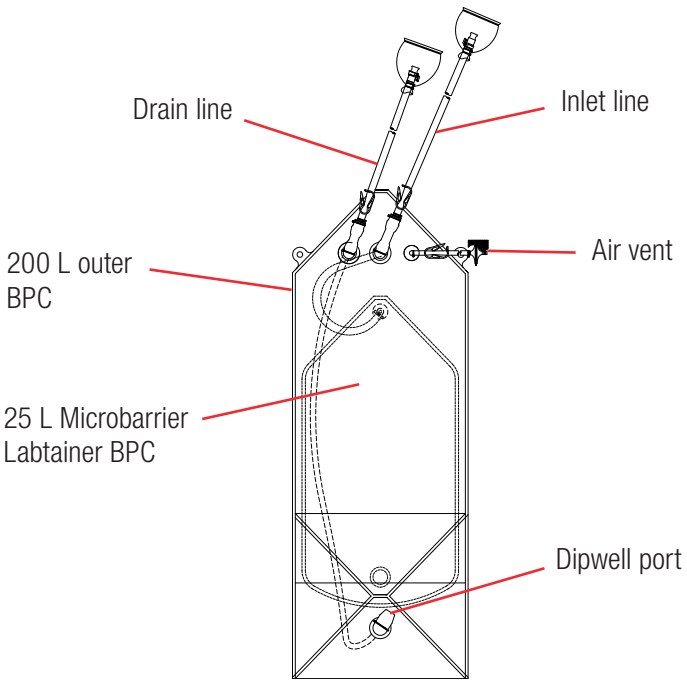
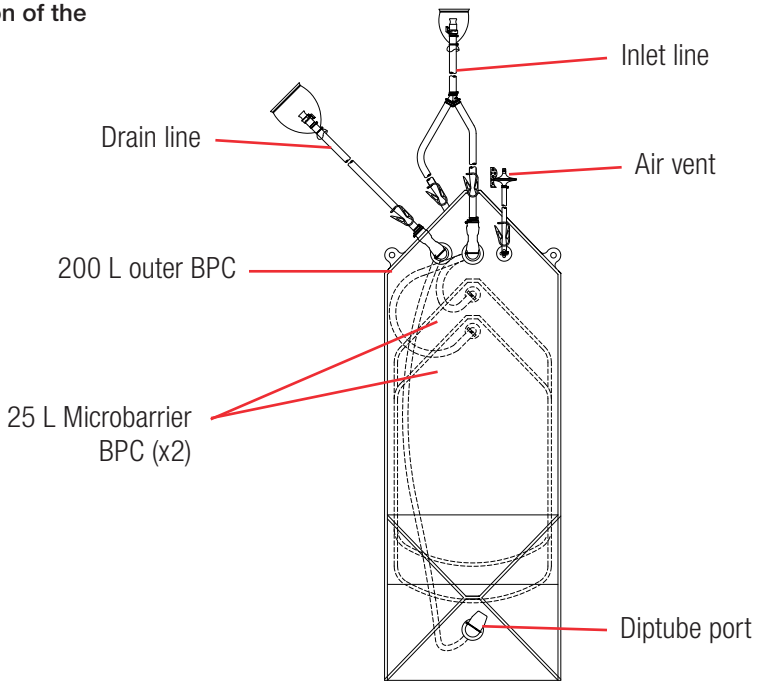


Figure 1.3. Illustration of the 25 L BPC.

Figure 1.4. Illustration of the 50 L BPC.

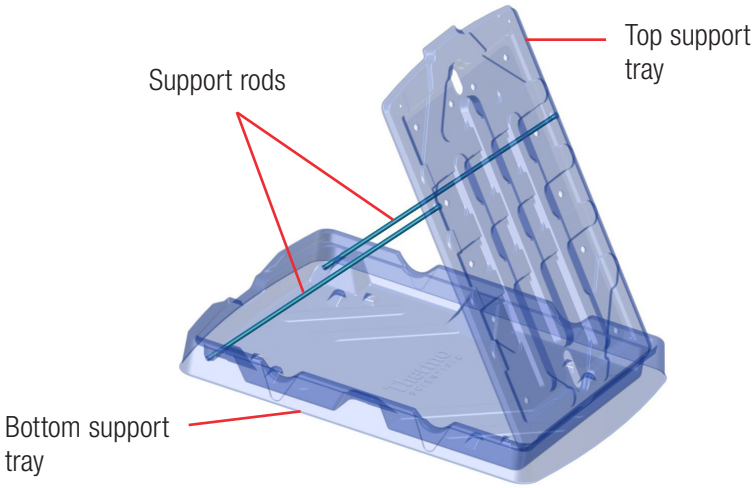


1.3 Required support equipment

Single-use support tray for 3 L and 12 L systems

Each 3 L and 12 L Harvestainer BPC comes equipped with a single-use support tray (Figure 1.5). The support tray is an integral part of the system, and is designed to hold the BPC at an angle for optimal flow and provide a secondary containment for extra security.

Figure 1.5. Illustration of the single-use support tray.



Support drum and dolly for 25 and 50 L systems

The 25 L and 50 L Harvestainer BPCs require a polyethylene (PE) conical drum to support the system. The dolly (optional) is available to ease the movement and placement of the drum. **Note:** The PE conical drum and the dolly are sold separately.

Peristaltic pumps

Moving fluid into and out of the BPC requires the use of two peristaltic pumps.

The tubing sizes for the inlet and drain lines, based on system capacities, are listed below in order to help you select an appropriate pump.

3 L and 12 L:

- 0.95 cm (3/8 in.) inner diameter (ID)
- 1.59 cm (5/8 in.) outer diameter (OD)
- 0.32 cm (1/8 in.) wall thickness

25 L and 50 L:

- 1.27 cm (1/2 in.) ID
- 1.91 cm (3/4 in.) OD
- 0.32 cm (1/8 in.) wall thickness

Storage BPC (optional)

The Harvestainer BPC is intended to be used as an in-process microcarrier bead separation system for cell culture media and detached or lysed cells. Fluid passing through the BPC will need to be moved into another vessel, storage BPC, or to the next step in your process.

2

Preparation and setup

2.1 Preparation before use

Evaluate the overall workflow of your process before starting. Figure 2.1 illustrates a typical workflow. Please see section 1.3 of this guide for information about required support equipment.

Figure 2.1. Typical in-process workflow with bioreactor, pump, Harvestainer BPC, storage BPC, and bin.

- It is critical to note that cells must be detached from the microcarrier beads by established methods prior to using the Harvestainer BPC.
- Moving your culture through the Harvestainer BPC requires the use of two pumps. The two pumps are situated where one is on the inlet line and the other is on the drain line for continuous flow. Pump grade tubing may be required for long pump times.
- Depending upon the bead capacity of the Harvestainer BPC used, you may need a smooth surface to place the 3 and 12 L systems, or a PE drum with a dolly for 25 and 50 L systems.

- Lastly, identify the next step in your process. A storage BPC may be used here to capture the cell culture media, detached cells, and any cell debris.

2.2 Harvestainer connection information

Users should be knowledgeable about information necessary to make connections from the Harvestainer BPC to the vessel containing media and detached or lysed cells, and to the next step in your process. It is critical to understand the following:

- The location of the inlet and drain lines (Figures 2.2–2.4)
- The connectors or tubing to make connections
- The tubing size to use with a peristaltic pump

See Chapter 7 for detailed specification information about the above items.

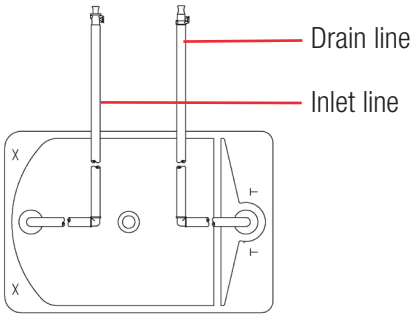


Figure 2.2. Location of drain and inlet lines on 3 and 12 L Harvestainer BPC.

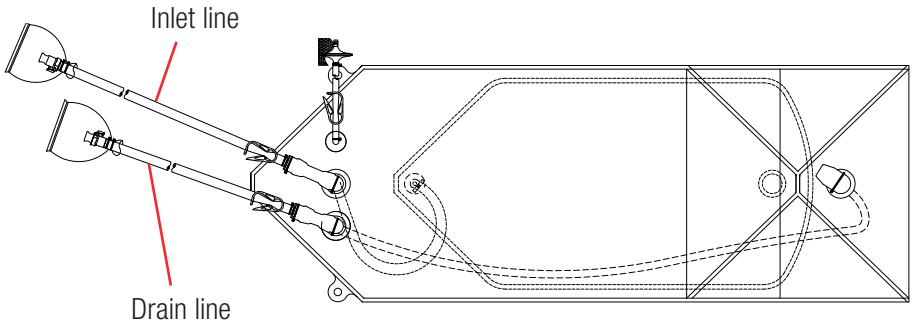


Figure 2.3. Location of drain and inlet lines on 25 L Harvestainer BPC.

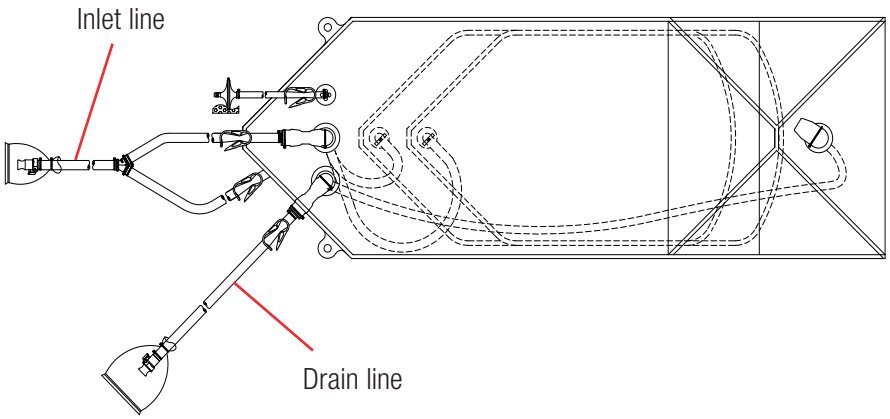


Figure 2.4. Location of drain and inlet lines on 50 L Harvestainer BPC.

3

Unpacking the Harvestainer BPC

This chapter provides an overview of the Harvestainer BPC unpacking process. For detailed information on unpacking, handling, and inspecting BPCs, refer to DOC0021—BPC Unpacking and Inspection Guide.

1. Inspect the condition of the shipping box for signs of damage (Figure 3.1). **Note:** If damaged, do not continue unpacking. Contact your sales representative.

Figure 3.1. Inspecting the box for damage.

2. Use a safety knife to carefully open the box (Figure 3.2). Remove the contents of the box (Figure 3.3).

Figure 3.2. (Left) Cutting open the side of the box.

Figure 3.3. (Right) Pulling out the packaged system.

3. Discard the box and bubble wrap per your site procedures.

4. Inspect the protective outer polybags for signs of damage (Figure 3.4). If the polybags are damaged, contact your sales representative.

Figure 3.4. Examing the outer polybags.

5. Remove the the protective double polybags as determined by your process. **Note:** For 3 L and 12 L systems, do not separate the single-use support tray from the BPC. The BPC and the tray are required for operation. In some cases, the support rods may come loose when unpacking. This will not damage the BPC.

6. Inspect the BPC for obvious signs of damage before use.

4

Operating the Harvestainer system

4.1 Operating 3 L and 12 L systems

4.1.1 Required resources

- **Scale:** As determined by your process, a scale may be required to measure the contents in the next step.
- **Peristaltic pumps and tubing:** Have two peristaltic pumps on hand for the inlet and drain lines in order to maintain continuous flow. Based on the estimated pump time, consider adding pump-grade tubing between the connections or slide the pump down the line periodically to minimize spallation.
- **Connections:** Have either the mating connectors or a sterile tubing welder on hand for connections between the bioreactor and the Harvestainer BPC, and from the Harvestainer BPC to the next step in your process. For 3 L and 12 L systems, the tubing welder must be able to handle tubing with an ID of 0.95 cm (3/8 in.) and an OD of 1.59 cm (5/8 in.). If you are using connectors, prior to starting, evaluate them for compatibility at each connection point.
- **Fume hood:** For use with connectors, a fume hood and appropriate materials to make an aseptic connection may be required.
- **Sterile tubing sealer:** A sterile tubing sealer may be required for sealing lines prior to disposal.

4.1.2 Pre-operation checklist

Ensure the following before operating the Harvestainer system:

- The BPC, drum, insert, and optional dolly are free of all packaging materials.
- The cells and microcarriers are separated as defined by your process.
- The next step of your process has been identified, and you know how to connect the Harvestainer to the BPC.
- Your material has been labeled per your company's hazard communication policy.

4.1.3 Process steps

1. Place the Harvestainer system on a flat surface that is free of sharps and sharp edges. Label the BPC.

2. Carefully lift up the tab on the top support tray (Figure 4.1) so that you can easily access the contents inside the tray.

3. Extend the lines while holding up the tray (Figure 4.2).

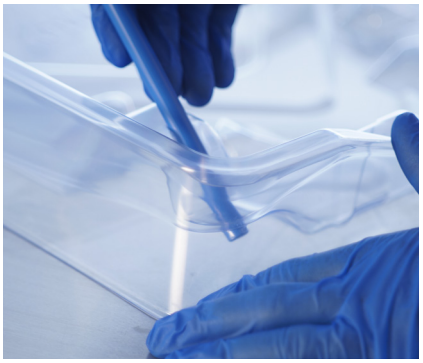
Figure 4.1. (Left) Lifting up the BPC by the top tab of the tray.

Figure 4.2. (Right) Extending the lines.

4. Place the two support rods that are stored inside the tray into the rod support slots between the top and bottom trays on each side (Figure 4.3–4.6). Press the top support tray into the top rod slot to secure.

Figure 4.3. (Left) Placing the support rod into the bottom tray.

Figure 4.4. (Right) Placing the support rod into the top tray.



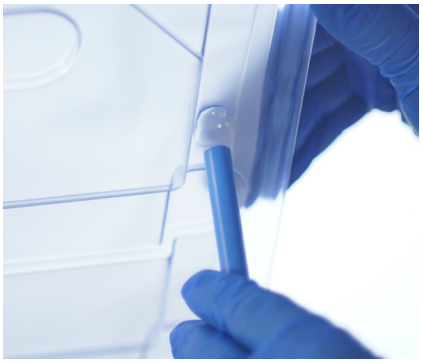
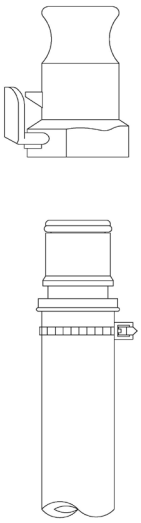


Figure 4.5. (Left) Placing the first support rod.

Figure 4.6. (Right) Placing the second support rod.

5. Use a sterile tubing welder or the quick connect end treatment to connect the inlet line to the vessel containing the microcarrier beads, cell culture media, and detached or lysed cells. To identify the inlet line, find the line with a quick connect body (female) end treatment (Figure 4.7).

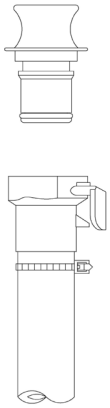
Figure 4.7. Inlet line end treatment, for use in identifying line.



6. Use a sterile tubing welder or the quick connect end treatment to connect the drain line (Figure 4.8) to the next step in your process. To identify the drain line, find the line with a quick connect insert (male) end treatment (Figure 4.9).

Figure 4.8. (Left) Sterile tubing welder connecting the Harvestainer BPC to a storage BPC.

Figure 4.9. (Right) Drain line end treatment, for use in identifying line.



7. Insert the drain and inlet line tubing lines into their respective peristaltic pump heads (Figure 4.10).

Figure 4.10. Placing tubing into a peristaltic pump.

8. If clamps are present on either line, open (disengage) the clamps on both the drain and inlet lines.

9. If you are using peristaltic pumps, start the inlet line pump first until the BPC has filled about a third of the way, and then start the drain line pump. Set the pumps at the same flow rates to maintain a continuous flow (Figure 4.11). See section 2.4 of this guide for more information about flow rates and other operating specifications.

Figure 4.11. Starting the drain line pump once the Harvestainer BPC is about 1/3 filled.

10. Once the separated microcarrier beads, cells, and media have gone through, turn off the pumps and open (disengage) all inlet lines to allow for any residual content to go through the line. Then pump any remaining amount through the drain line (Figure 4.12).

Figure 4.12. Pumping the drain line.

11. Dispose of the BPC and tray as described in Chapter 5 of this guide.

4.2 Operating 25 L and 50 L systems

4.2.1 Required resources

- **Scale:** As determined by your process, a scale may be required to measure the contents in the next step.
- **Air line:** Have a compressed air line available to inflate the Harvestainer BPC.
- **Peristaltic pumps and tubing:** Have two peristaltic pumps on hand for the inlet and drain lines in order to maintain continuous flow. Based on the estimated pump time, consider adding pump-grade tubing between the connections or slide the pump down the line periodically to minimize spallation.
- **Connections:** Have either the mating connectors or a sterile tubing welder on hand for connections between the bioreactor and the Harvestainer BPC, and from the Harvestainer BPC to the next step in your process. For 25 L and 50 L systems, the tubing welder must be able to handle tubing with an ID of 1.27 cm (1/2 in.) and an OD of 1.91 cm (3/4 in.). If you are using connectors, prior to starting, evaluate them for compatibility at each connection point.

- **Fume hood:** For use with connectors, a fume hood and appropriate materials to make an aseptic connection may be required.

- **Sterile tubing sealer:** A sterile tubing sealer may be required for sealing lines prior to disposal.

4.2.2 Pre-operation checklist

Ensure the following before operating the Harvestainer system:

- The BPC, drum, insert, and optional dolly are free of all packaging materials.
- The cells and microcarriers are separated as defined by your process.
- The next step of your process has been identified, and you know how to connect the Harvestainer to the BPC.
- Your material has been labeled per your company's hazard communication policy.

4.2.3 Process steps

1. Place the Harvestainer BPC at the top of the drum and align the bottom dipwell port (Figure 4.13) with the bottom hole of the drum insert (Figure 4.14). Label the BPC.

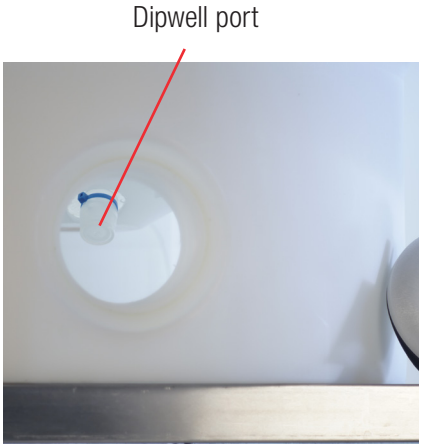
Figure 4.13. (Left) Aligning the BPC with the bottom hole.

Figure 4.14. (Right) The dipwell port just above the bottom hole.

2. Open the bottom access screw cap of the drum (Figure 4.15) and reach inside to ensure that the dipwell port is aligned in the bottom hole of the insert (Figure 4.16).

Figure 4.15. (Left) Removing the bottom access screw cap of the drum.

Figure 4.16. (Right) Proper placement of the dipwell port in the drum.



3. Ensure all clamps are closed (engaged) on the BPC, except for the air vent filter line (Figure 4.17).

Figure 4.17. Closing a clamp.

4. Connect the air vent filter to your compressed air line and inflate the BPC (Figure 4.18). Once the BPC is inflated, disconnect the compressed gas line and keep the air vent line open during use.

Figure 4.18. Connecting air vent filter to compressed air line.

Note: Do not exceed 0.5 psi BPC internal pressure ratings or air flow rates. Refer to the operational specifications in Chapter 3 for more information.

5. Use the type of end treatment to identify the inlet and drain lines. The inlet line includes a quick connect insert (male) end treatment, and the drain line includes a quick connect body (female) end treatment. See the specifications in Chapter 7 for more information about the lines and end treatments.

6. Connect the inlet line to the bioreactor using either a sterile tubing welder (Figure 4.19) or a connector (quick connect body) under a fume hood using aseptic techniques.

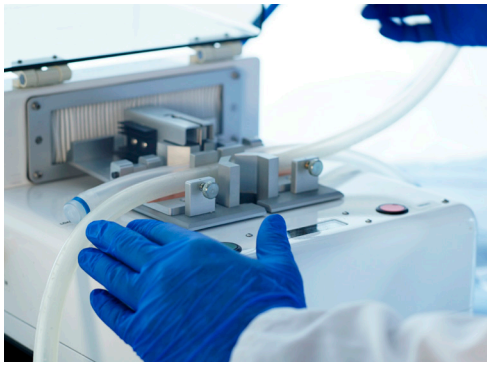


Figure 4.19. Sterile welding the inlet line to the bioreactor's harvest line.

7. Connect the drain line to the next step of your process using either a sterile tubing welder or a quick connect insert under a fume hood, using aseptic techniques.

8. Insert the inlet and drain lines into their respective peristaltic pump heads (Figure 4.20).

Figure 4.20. Placing tubing into a peristaltic pump.

9. Checkpoint—Confirm that the BPC is inflated, connected to your bioreactor and to the next step in your process, and the inlet and drain lines have been inserted into their respective pumps before moving on to the next step.

10. Ensure that all the clamps are open (disengaged) on all the lines so that liquid can pass through.

11. Ensure that the clamp on the air vent line is open.

12. First, turn on the inlet line pump and let the BPC fill up to about a third of the total volume, and then turn on the drain line pump. Both pumps need to be set at the same flow rate to maintain a continuous flow (Figure 4.21). See Table 7.6 in Chapter 7 of this publication for more information about flow rates and other operating specifications.

    Note: During this step, the inner Microbarrier Labtainer BPC may rest against the bottom. This is normal, does not compromise the system's performance, and avoids placing a heavy weight load onto the connections between the inner and outer BPCs.

Figure 4.21. Microcarrier Separation BPC system in process.

13. Once the separated microcarrier beads, cells, and media have gone through, turn off the pumps and open (disengage) all inlet lines to allow any residual content to go through the line. Then pump any remaining amount through the drain line (Figure 4.22).

Figure 4.22. Pumping the residual contents.

See Chapter 5 of this guide for information about disposal of the Harvestainer.

5

Disposal

5.1 Disposal of 3 L and 12 L systems

1. If clamps are present and the BPC is drained, close (engage) all clamps (Figure 5.1), including the air vent line, to prevent spills of any residual liquids.

Figure 5.1. Closing clamps.

2. Disconnect the inlet and drain lines using either a sterile tubing sealer, welder, or under a hood with liquid tight caps or plugs using aseptic techniques as defined by your processes.

3. Collapse (Figure 5.2) and transport (Figure 5.3) the system for disposal.

Figure 5.2. Collapsing the Harvestainer system.

Figure 5.3. Carrying the system to be disposed.

Note: Two people may be needed to carry the Harvestainer.

4. Dispose of the microcarrier beads according to your procedures.

5. Dispose of the BPC in an appropriate waste container or incinerator per local regulatory requirements.

5.2 Disposal of 25 L and 50 L systems

1. Once the Microcarrier Separation BPC is drained, close (engage) all clamps to prevent spills of any residual liquids.

2. Disconnect the inlet and drain lines using either a sterile tubing sealer, welder or under a hood with liquid tight caps or plugs using aseptic techniques as defined by your processes.

3. Transport the BPC in the drum for disposal.

Note: When the BPC is full of microcarrier beads, it needs the support of the drum to maintain structural integrity.

4. Dispose of the microcarrier beads according to your procedures.

5. Dispose of the BPC in an appropriate waste container or incinerator per local regulatory requirements.

6. The drum may be reused according to your procedures.

6

Frequently asked questions

Question: **What is the filter size for the Harvestainer?**

Answer: The Harvestainer system has been qualified to retain greater than 90 µm microcarriers.

Question: **How do I calculate my bead volume to determine what size Harvestainer system I need?**

Answer: Multiply the number of grams of carriers by the swell factor of the carrier beads to find the total milliliters. Then divide by 1,000 to convert to total liters.

Question: **Why am I not getting the recovery rate expected through the Harvestainer system?**

Answer: You may not be allowing enough time for disassociation to occur.

Question: **Can I reuse the Harvestainer system?**

Answer: The Harvestainer system is a single-use product. It is not intended to be used more than once.

7

Specifications

Standard 3 L and 12 L Harvestainer BPCs

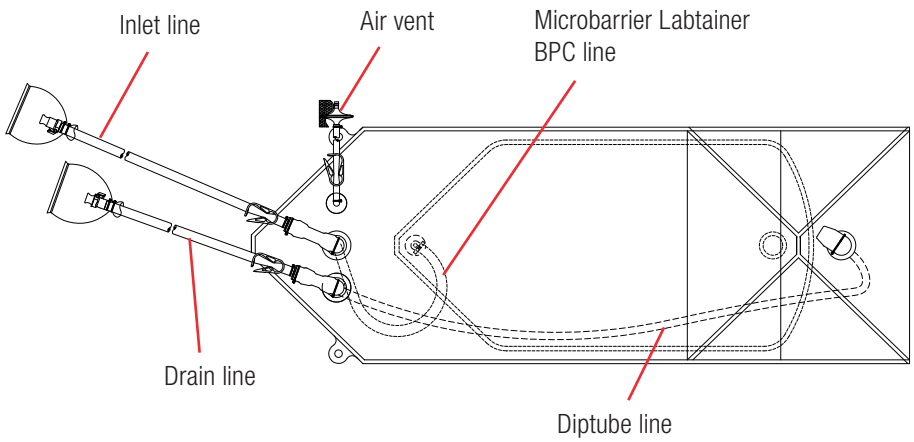


Table 7.1. Materials used in the 3 L and 12 L Harvestainer BPCs.

Description	Tubing set (ID x OD x length)	End treatment
Inlet line	C-Flex 374 tubing 0.95 x 1.59 x 5.08 cm (3/8 x 5/8 x 2 in.) to polypropylene elbow to C-Flex 374 tubing 0.95 x 1.59 x 122 cm (3/8 x 5/8 x 48 in.)	Polycarbonate quick connect insert (male, MPX series)
Drain line	C-Flex 374 tubing 0.95 x 1.59 x 5.08 cm (3/8 x 5/8 x 2 in.) to polypropylene elbow to C-Flex 374 tubing 0.95 x 1.59 x 122 cm (3/8 x 5/8 x 48 in.)	Polycarbonate quick connect body (female, MPX series)

Standard 25 L and 50 L Harvestainer BPCs

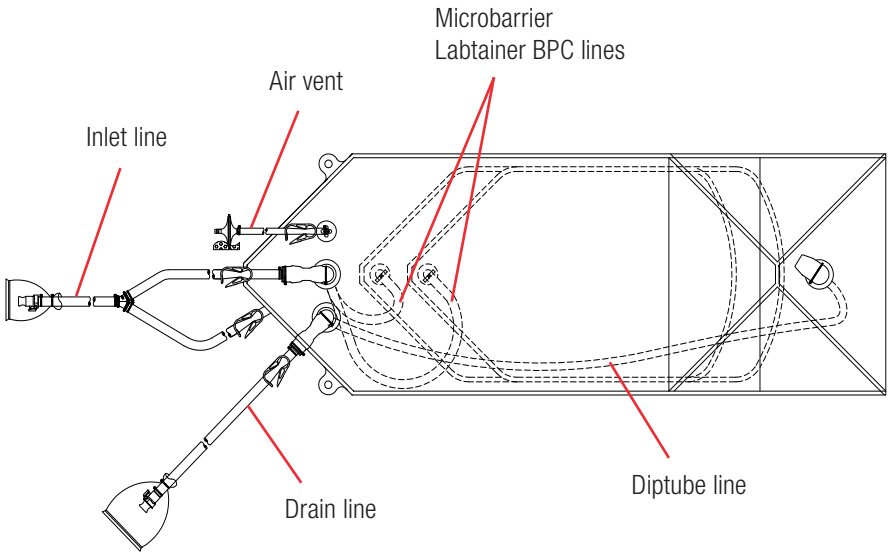


Table 7.2. Materials used in the 25 L Harvestainer BPC.

Description	Tubing set (ID x OD x length)	End treatment
Inlet line	C-Flex 374 tubing 1.27 x 1.91 x 183 cm (1/2 x 3/4 x 72 in.)	Polycarbonate quick connect body (female, MPX series)
Microbarrier Labtainer BPC line	Inlet line port to C-Flex 374 tubing 1.27 x 1.91 x 45.7 cm (1/2 x 3/4 x 18 in.)	Microbarrier Labtainer BPC
Drain line	C-Flex 374 tubing 1.27 x 1.91 x 122 cm (1/2 x 3/4 x 48 in.)	Polycarbonate quick connect insert (male, MPX series)
Diptube line	Drain line port to braided silicone 1.27 x 2.03 x 112 cm (1/2 x 0.8 x 44 in.)	Dipwell port
Air vent	C-Flex 374 tubing 0.64 x 1.27 x 15.2 cm (1/4 x 1/2 x 6 in.)	Intervene high-flow and max-flow gas filter

Table 7.3. Materials used in the 50 L Harvestainer BPC.

Description	Tubing set (ID x OD x length)	End treatment
Inlet line	Two lines of C-Flex 374 tubing 1.27 x 1.91 x 30.5 cm (1/2 x 3/4 x 12 in.) to a polypropylene y-fitting to C-Flex 374 tubing 1.27 x 1.91 x 152 cm (1/2 x 3/4 x 60 in.)	Polycarbonate quick connect body (female, MPX series)
Microbarrier Labtainer BPC lines (x2)	Inlet line port to C-Flex 374 tubing 1.27 x 1.91 x 45.7 cm (1/2 x 3/4 x 18 in.)	Microbarrier Labtainer BPC
Drain line	C-Flex 374 tubing 1.27 x 1.91 x 122 cm (1/2 x 3/4 x 48 in.)	Polycarbonate quick connect insert (male, MPX series)
Diptube line	Drain line port to braided silicone 1.27 x 2.03 x 112 cm (1/2 x 0.8 x 44 in.)	Dipwell port
Air vent	C-Flex 374 tubing 0.64 x 1.27 x 15.2 cm (1/4 x 1/2 x 6 in.)	Intervene high-flow and max-flow gas filter

Table 7.4. Single-use support tray dimensions.

Parameter	3 L	12 L
Height	7.11 cm (2.80 in.)	7.59 cm (2.99 in.)
Width	38.61 cm (15.20 in.)	57.10 (22.48 in.)
Depth	55.25 cm (21.75 in.)	81.28 cm (32.0 in.)
Weight	1.36 kg (3.0 lbs)	3.08 kg (6.8 lbs)

Table 7.5. Chamber dimensions.

Parameter	3 L	12 L	25 L	50 L
Height	46.94 cm (18.5 in.)	70.36 cm (27.7 in.)	137.16 cm (54 in.)	137.16 cm (54 in.)
Width	28.96 cm (11.4 in.)	50.04 cm (19.7 in.)	48.26 cm (19 in.)	48.26 cm (19 in.)
Depth	N/A	N/A	48.26 cm (19 in.)	48.26 cm (19 in.)
Weight	0.11 kg (0.25 lbs.)	0.25 kg (0.56 lbs.)	2.36 kg (5.2 lbs.)	2.90 kg (6.4 lbs.)
Surface area	2,303 cm^2 (357 in^2)	5,909 cm^2 (916 in^2)	20,923 cm^2 (3,243 in^2)	20,923 cm^2 (3,243 in^2)

Table 7.6. Operational specifications.

Parameter	3 L	12 L	25 L	50 L
Air flow for BPC inflation	N/A	N/A	4 L/min 0.5 psi	4 L/min 0.5 psi
Liquid flow for inlet and draining	2.5 L/min	3.3 L/min	6.7 L/min	6.7 L/min
Maximum internal BPC pressure rating	0.5 psi	0.5 psi	0.5 psi	0.5 psi
Microcarrier bead capture capacity	3 L	12 L	25 L	50 L

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