Millipore®

User Guide

Viresolve® Pro Solution

Viresolve® Pro Device Modus
Viresolve® Pro Shield Modus
Viresolve® Pro Shield H Modus

Viresolve® Pro Device Magnus
Viresolve® Pro Shield Magnus
Viresolve® Pro Shield H Magnus

Viresolve® Pro Magnus Holder
Viresolve® Pro+ Magnus Holder

MERCK
MK_00110386PU Rev 9 09/2024

Contents

Introduction

The **Viresolve® Pro Shield** and the **Viresolve® Pro Shield H** are designed to be used upstream of the **Viresolve® Pro Device**. These devices cannot be used without the **Viresolve® Pro Device**.

Refer to the Viresolve® Prefilter Pod User Guide (document number: P88748) for instructions on using the **Viresolve® Pro Device** with a Viresolve® Prefilter.

The **Viresolve® Pro Magnus Solution** is typically used for mid- to large-scale volumes of proteins. The Viresolve® Pro Modus is typically used for mid-batch scale volumes of proteins. Components are color coded:

Device	Gasket Color	Label Color
Viresolve® Pro Shield	Red	Magenta
Viresolve® Pro Shield H	Yellow	Orange
Viresolve® Pro Device	Green	Blue

Catalog Numbers

This user guide includes instructions for the following catalog numbers:

Description	Primary Use	Quantity per Package	Catalog Number
Viresolve® Pro Device			
Viresolve® Pro Device Modus 1.1	Scale/pilot studies	1	VPMD101NB1
Viresolve® Pro Device Modus 1.2	Scale/pilot studies	1	VPMD102NB1
Viresolve® Pro Device Modus 1.3	Scale/pilot studies	1	VPMD103NB1
Viresolve® Pro Device Magnus 2.1	Large-volume processing	1	VPMG201NB1
Viresolve® Pro Device Magnus 2.2	Large-volume processing	1	VPMG202NB1
Viresolve® Pro Shield			
Viresolve® Pro Shield Modus 1.1	Scale/pilot studies	1	VPPS101NB1
Viresolve® Pro Shield Modus 1.2	Scale/pilot studies	1	VPPS102NB1
Viresolve® Pro Shield Modus 1.3	Scale/pilot studies	1	VPPS103NB1
Viresolve® Pro Shield Magnus 2.1	Large-volume processing	1	VPPS201NB1
Viresolve® Pro Shield Magnus 2.2	Large-volume processing	1	VPPS202NB1
Viresolve® Pro Shield H			
Viresolve® Pro Shield H Modus 1.1	Scale/pilot studies	1	VPPH101NB1
Viresolve® Pro Shield H Modus 1.2	Scale/pilot studies	1	VPPH102NB1
Viresolve® Pro Shield H Modus 1.3	Scale/pilot studies	1	VPPH103NB1
Viresolve® Pro Shield H Magnus 2.1	Large-volume processing	1	VPPH201NB1
Viresolve® Pro Shield H Magnus 2.2	Large-volume processing	1	VPPH202NB1
Viresolve® Pro Holders			
Viresolve® Pro Magnus Holder	1-3 devices	1	VMPH103000
	1-5 devices	1	VMPH105000
	1-7 devices	1	VMPH107000
Viresolve® Pro+ Holders			
Viresolve® Pro+ Magnus Holder	1-3 devices	1	VPMH203000
	1-5 devices	1	VPMH205000
	1-7 devices	1	VPMH207000

Operating Requirements

Viresolve® Pro Solution

NOTE Install the **Viresolve® Pro Magnus Solution** in either the **Viresolve® Pro Magnus Holder** *or* **Viresolve® Pro+ Magnus Holder**.

Wetting and flushing solution	Milli-Q® water, water for injection (WFI), or equivalent	
Filtration pressure	Constant pressure: 0.7 to 4.1 bar (10–60 psid) Or a constant-flow pumping system	
Minimum Inlet Pressure for Integrity Test (clean, dry air)	Manual testing	55 psig
	Automatic testing	70 psig
Operating temperature	4 to 30°C	
Maximum forward operating pressure	4.1 bar(g) (60 psig)	
Autoclaving	Do not autoclave - refer to Sanitization (Optional)	
Storage temperature	Room temperature	

Viresolve® Pro and Pro+ Magnus Holders

Hydraulic pressure setpoint	1100 psi ± 200 psi
Hydraulic pressure during operation	1800 psig
Piston extension	<40 mm (1.6 inch) from the base to the flange or 76 mm (3.0 inch) from the base to the nut

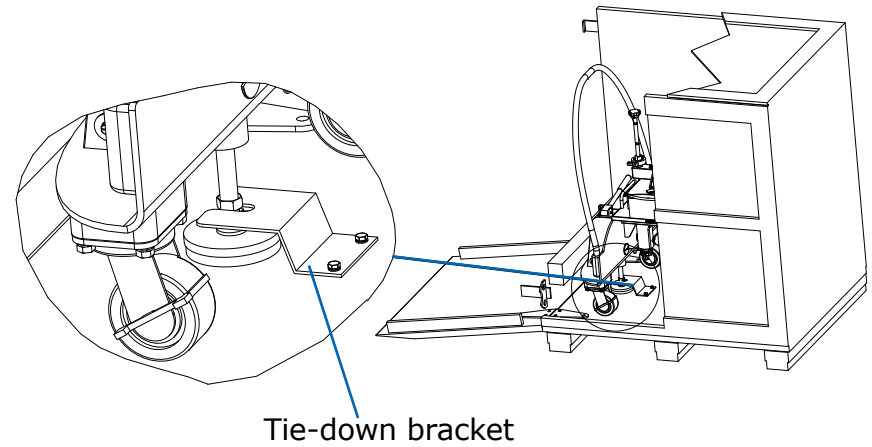
Unpacking the System

Unpacking the Viresolve® Pro Solution

1. Remove the units from the shipping box by grasping the units and the bag. Grasping the bags only may cause the bags to tear.
2. Retain packaging materials until the units are no longer used. If the bags appear opened or the units appears damaged, return the units in the original packaging.
3. Remove the units from the packaging and record the catalog numbers, lot numbers, and serial numbers. Catalog and lot numbers are printed on a peel-off label on the bag.

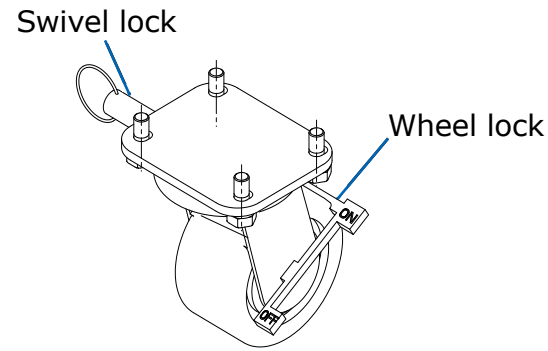
Unpacking the Viresolve® Pro and Pro+ Magnus Holder

1. Remove the front brace of the crate. Remove all documentation from the crate.
2. Open and remove the top panel and right-side panel of the crate.
3. Remove the bags from the holder and the clamp rod knobs.
4. Loosen and remove both bolts on both tie-down brackets.
5. Remove both tie-down brackets by loosening the jam nuts on the leveling pads.



Completely retract both leveling pads to their highest position to prevent damage to the pad when the holder is removed from the crate.

6. Unlock the wheels (place locks in the OFF position).



7. Carefully roll the holder down the ramp.
8. Use the swivel locks to adjust the wheels for either front or rear steering.

Installing the System

Installing the Viresolve® Pro Modus

1. Place the **Viresolve® Pro Shield**, **Viresolve® Pro Shield H**, and **Viresolve® Pro Device** on their support legs.

   NOTES Operate the units on a level surface to ensure adequate venting and product recovery.

   Flow direction is indicated by arrows molded on the units.

2. Using the sanitary port connections, connect the outlet port of the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H** to the inlet port of the **Viresolve® Pro Device**.

3. Attach tubing to the sanitary connections on the outlet port of the **Viresolve® Pro Device** and the inlet port of the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H**. Tubing may be attached to each of the vent valves of the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H** and the **Viresolve® Pro Device** and routed to a waste container.

4. Connect a user-supplied valve and pressure gauge assembly to the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H** inlet port.

NOTE The differential pressure across the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H** typically remains low during the run. A second gauge between the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H** outlet and the **Viresolve® Pro Device** inlet can be added to monitor the differential pressure. A second user-supplied valve may be added between the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H** and the **Viresolve® Pro Device** so that each unit may be flushed independently.

Installing the Viresolve® Pro Magnus

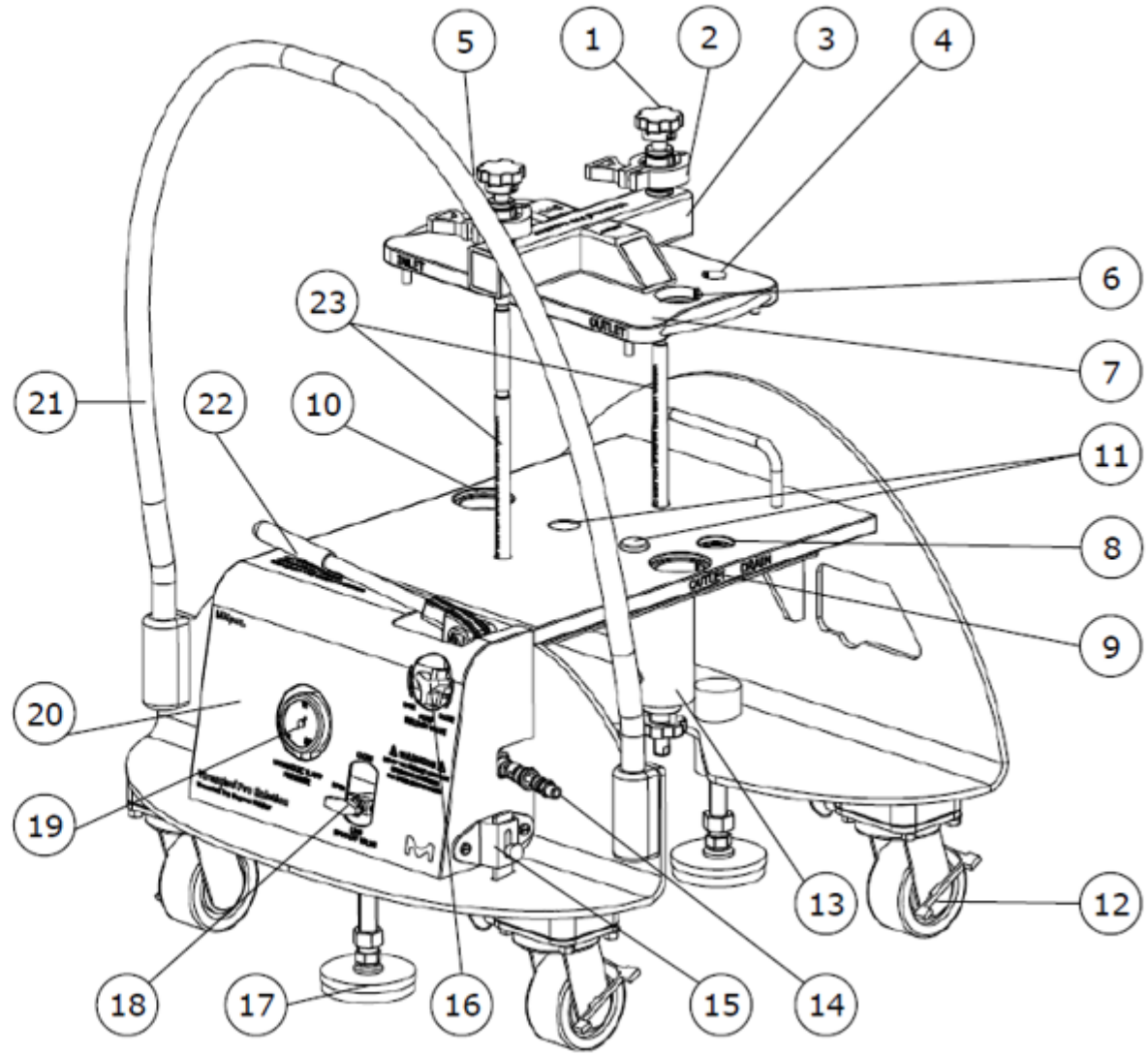
The **Viresolve® Pro Shield Magnus**, **Viresolve® Pro Shield H Magnus**, and **Viresolve® Pro Device Magnus** must be installed in a **Viresolve® Pro+ Magnus Holder**.

The **Viresolve® Pro Device Magnus** alone may be installed in a **Viresolve® Pro or Pro+ Magnus Holder**.

Refer to Viresolve® Pro+ Magnus Holder Parts List and Installing Viresolve® Pro Device (excludes Viresolve® Pro Shield and Viresolve® Pro Shield H) and Fitings for installation instructions.

Viresolve® Pro Magnus Holder Parts List

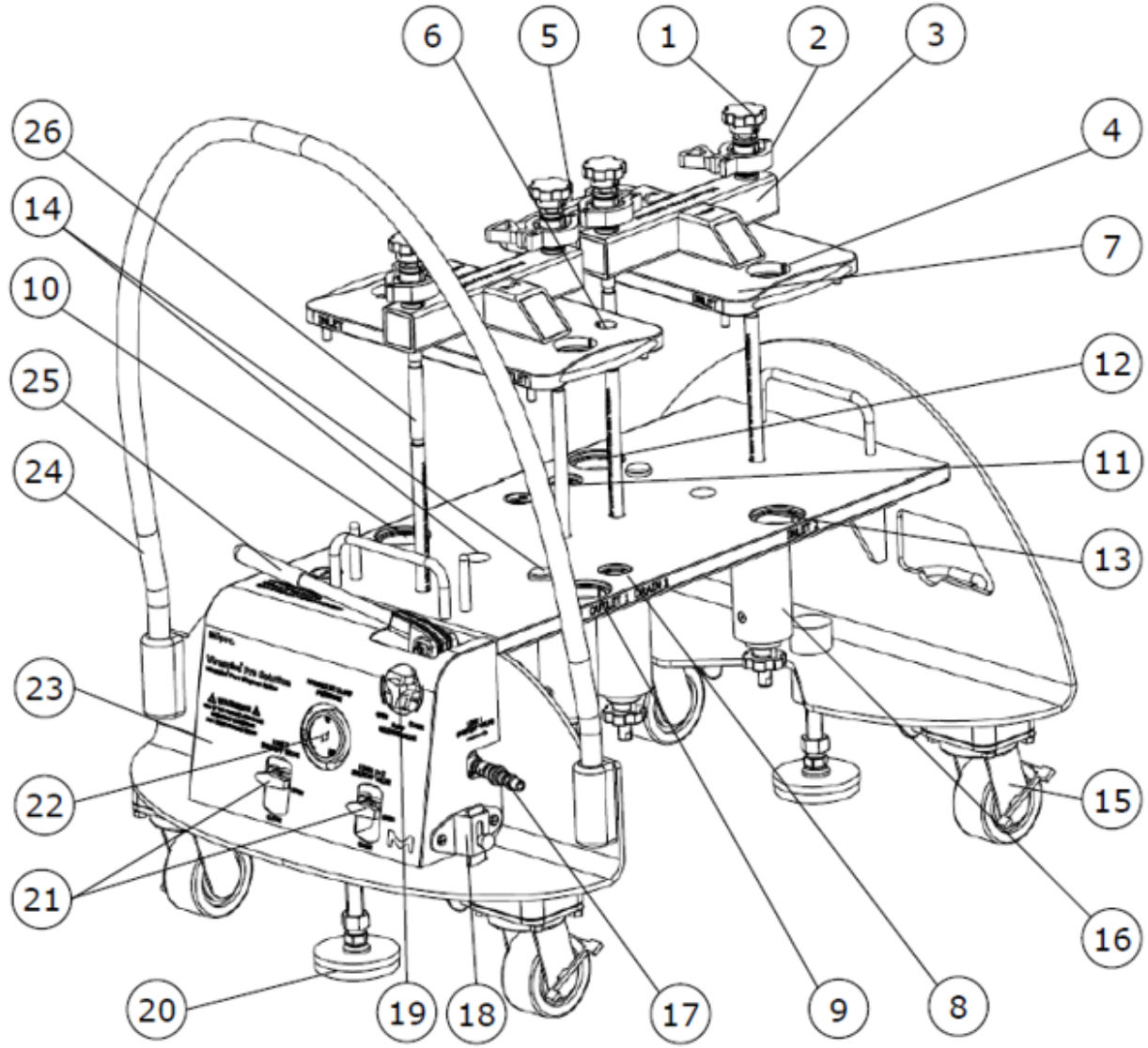
Key	Description	Quantity
1	Clamp rod knob	2
2	Split clamp assembly	2
3	Cross piece	1
4	Feed vent	1
5	Inlet	1
6	Outlet	1
7	Top Plate	1
8	Station drain	1
9	Station outlet	1
10	Station inlet	1
11	Device alignment key	2
12	Swivel wheel with lock	4
13	Hydraulic cylinder	2
14	Quick connector	1
15	Hydraulic pump cover latch	1
16	Hydraulic pump release valve	1
17	Leveling pad	2
18	Hydraulic line shut-off valve	1
19	Hydraulic pressure gauge	1
20	Hydraulic pump cover	1
21	Handle	1
22	Hydraulic pump handle	1
23	Clamp rod	2



Viresolve® Pro Magnus Holder

Viresolve® Pro+ Magnus Holder Parts List

Key	Description	Quantity
1	Clamp rod knob	4
2	Split clamp assembly	4
3	Cross piece	2
4	Inlet	2
5	Outlet	2
6	Vent port	2
7	Top Plate	2
8	Station 1 drain	1
9	Station 1 outlet	1
10	Station 1 inlet	1
11	Station 2 drain	1
12	Station 2 outlet	1
13	Station 2 inlet	1
14	Device alignment key	4
15	Swivel wheel with lock	4
16	Hydraulic cylinder	4
17	Quick connector	1
18	Hydraulic pump cover latch	1
19	Hydraulic pump release valve	1
20	Leveling pad	2
21	Hydraulic line shut-off valve	3
22	Hydraulic pressure gauge	1
23	Hydraulic pump cover	1
24	Handle	1
25	Hydraulic pump handle	1
26	Clamp rod	4



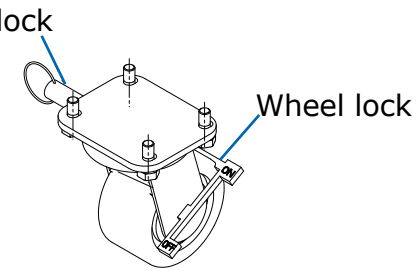
Viresolve® Pro+ Magnus Holder

Setting Up the Holder

For installation of Viresolve® Pro Device, numbers refer to Viresolve® Pro Magnus Holder Parts List.

For installation of Viresolve® Pro+ (Device and Shield or Shield H pre-filters), refer to Viresolve® Pro+ Magnus Holder Parts List.

1. Place the holder on a level surface. Lock the casters by depressing the lever to the ON Position.



2. The swivel on the casters may be locked with the pin.
3. Adjust the leveling pads to stabilize the holder.
   - Viresolve® Pro Magnus Holder: (17)
   - Viresolve® Pro+ Magnus Holder: (20)
4. Lock the leveling pads in place by tightening the jam nut against the holder frame.

Installing Longer Clamp Rods

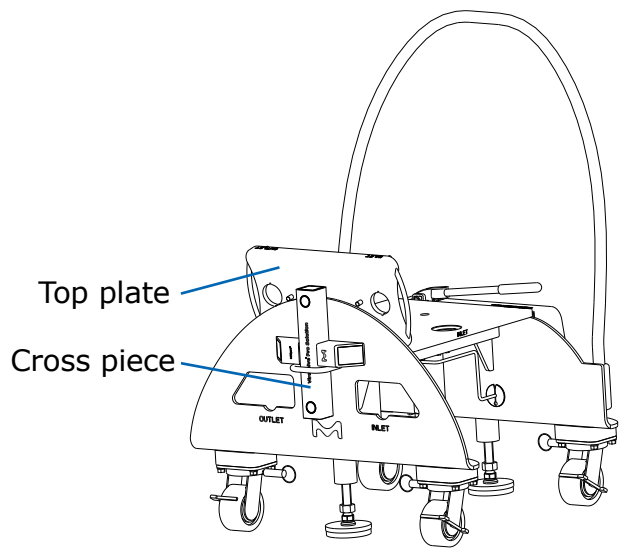
The holder is shipped with clamp rods to accommodate three Viresolve® Pro Devices:

- Viresolve® Pro Magnus Holder: (23)
- Viresolve® Pro+ Magnus Holder: (26)

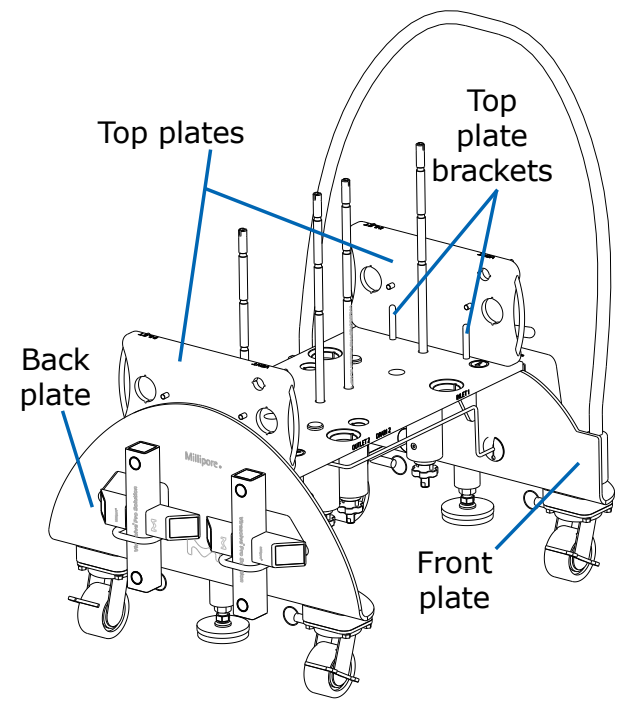
If more Viresolve® Pro Devices are required, follow this procedure to change the rod assemblies.

NOTE Clamp rods and capacities are listed in the Spare Parts and Accessories table.

1. Remove the clamp rod knobs (1) and the split clamp assemblies (2).
2. Remove the cross pieces (3) and store them in the brackets on the back plate of the holder.

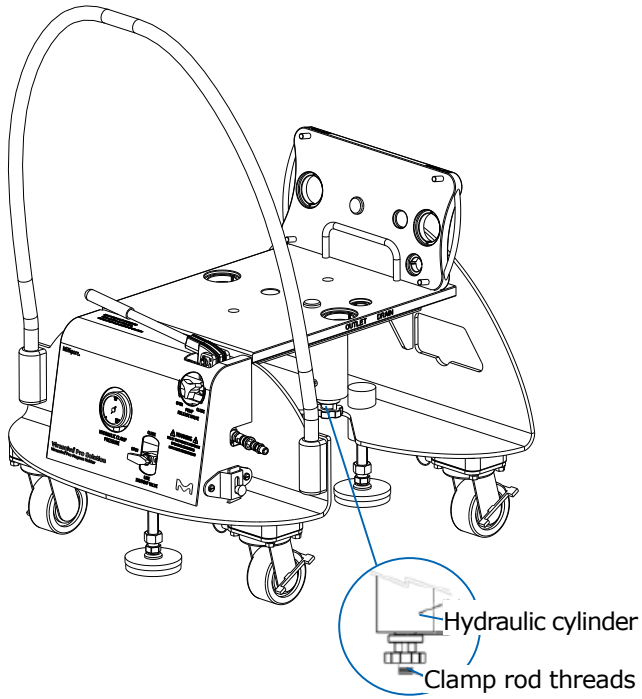


Viresolve® Pro Magnus Holder

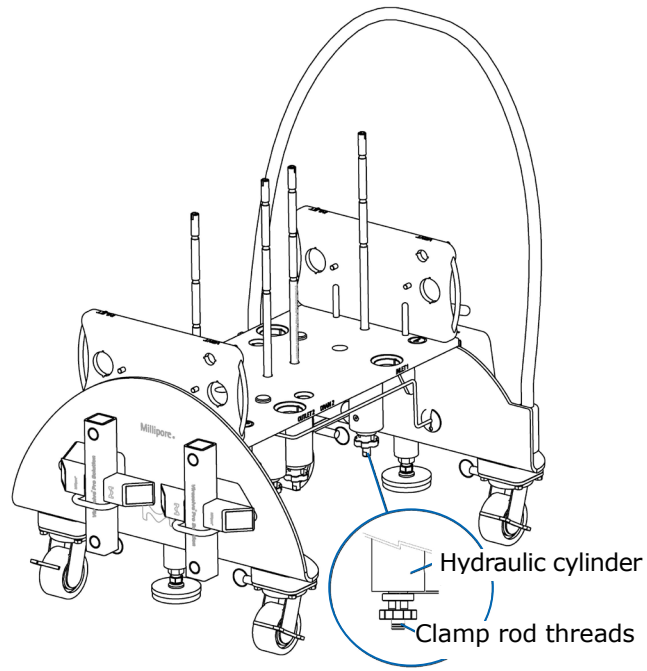


Viresolve® Pro+ Magnus Holder

3. Remove the top plates (between the brackets and the front/back plates) and store them.
4. Open the hydraulic line shut-off valves:
   - Viresolve® Pro Magnus Holder: ⑱
   - Viresolve® Pro+ Magnus Holder: ㉑
5. Open the hydraulic pump release valves:
   - Viresolve® Pro Magnus Holder: ⑯
   - Viresolve® Pro+ Magnus Holder: ⑲
6. Replace the clamp rod knobs on the clamp rods.
7. Remove the clamp rods by rotating the clamp rod knobs counterclockwise.
8. Remove the clamp rod knobs from the clamp rods and install them on the longer clamp rods.
9. Using the clamp rod knobs, carefully insert the longer clamp rods into the hydraulic cylinders. To ensure the clamping mechanism engages, screw the threaded end of the clamp rods fully into the hydraulic cylinders. Two or three threads should be visible below the fixed nut at the base of the cylinder when the clamp rod is correctly installed.



Viresolve® Pro Magnus Holder



Viresolve® Pro+ Magnus Holder

10. Remove the knobs from the clamp rods.

Installing the Viresolve® Pro Magnus Solution

The **Viresolve® Pro** and **Pro+ Magnus Holders** are designed for maximum flexibility to accommodate different manufacturing processes. This section describes the most common and optimum configuration. If other configurations are required, contact Technical Services. Visit our website for an animated version of these instructions.

Use only Viresolve® Pro Magnus disposable fittings in the holder. All fittings must have the green gaskets in place. Fittings kits must be ordered separately.

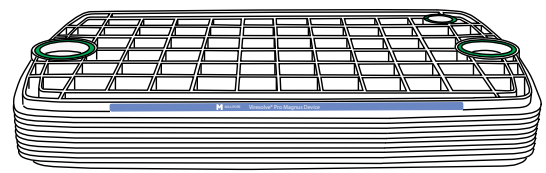
Align the tabs on the fittings with the slots in the holes. Secure the disposable fittings by rotating them 90°.

Viresolve® Pro Magnus Holder

NOTE Refer to Viresolve® Pro Magnus Holder Parts List for callouts and locations on the holder.

1. Insert a 1½ inch sanitary fitting into the inlet and outlet holes of the base plate.
2. Insert a ¾ inch vent blank fitting into the small holes labeled **Drain**, in the base plate.
3. Insert a 1½ inch blank fitting into the inlet holes in the top plate.
4. Insert the 1½ inch sanitary fitting into the outlet holes in the top plate.
5. Insert the ¾ inch vent fitting into the small holes labeled **Vent** in the top plate.

NOTE Devices are stamped with a **B** on the bottom and a **T** on the top. Ensure that the bottom is facing the base plate during installation. The alignment key prevents the device from locking into place if they are not properly oriented.



Viresolve® Pro Device
Blue label
Green gaskets

6. Place the first **Viresolve® Pro Device Magnus** on the base plate. Ensure that the alignment key engages. Place each additional unit on top of the first unit, ensuring that the alignment keys engage.
7. When all of the units are installed, place the top plate, with fittings installed, on the top unit. The key on the top plate engages in the top unit and the plate lies flat.
8. Place the cross pieces on the top plates by aligning the holes with the pins on the plate and the clamp rods.
9. Replace the split clamp assemblies.
10. Replace the clamp rod knobs.
11. Install the split clamp assembly on the rod in the groove directly above the cross piece. Adjust the rod level so that the clamp is as close as possible to the cross piece.

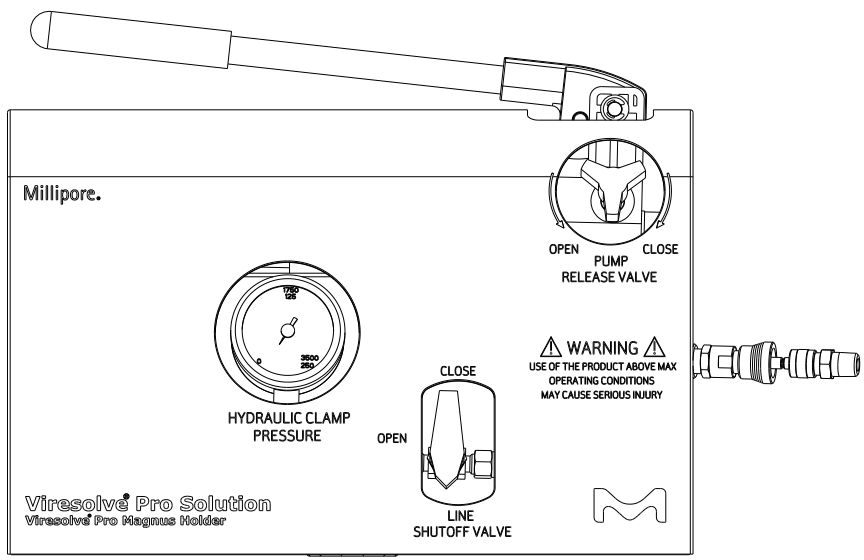
Checking the Gasket Seals

The units are ready to be compressed. Compression ensures that the gaskets are sealing correctly.

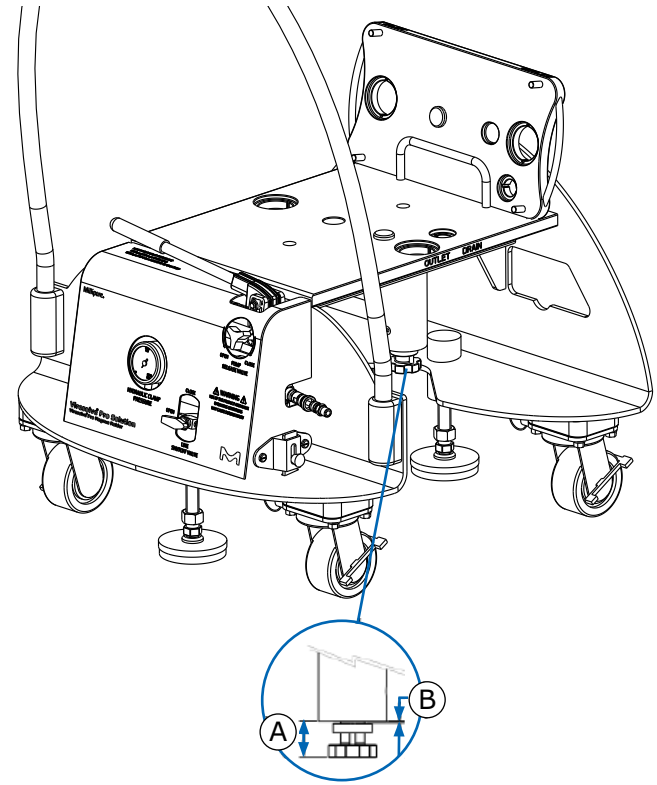
1. Close the hydraulic pump release valve and open the hydraulic line shut-off valves.
2. Using the hydraulic pump handle, increase the hydraulic pressure until the pressure gauge on the holder reads 76 bar ±13.8 (1100 psi ± 200).

   NOTE Do not increase the pressure if all hydraulic line shut-off valves are closed. The units will not be compressed, and process fluid may leak from the space between the fittings and units.

3. When 76 bar (1100 psi) registers on the gauge, close the hydraulic line shut-off valve.



NOTE To ensure that the units seal, verify that the piston does not extend more than 40 mm (1.6 inch) from the base to the flange or 76 mm (3.0 inch) from the base to the nut. If it extends too far, relieve the pressure in the hydraulic system, retract the clamp rods, repeat steps 9 through 11 of Viresolve® Pro Magnus Holder, then continue to Checking the Gasket Seals.

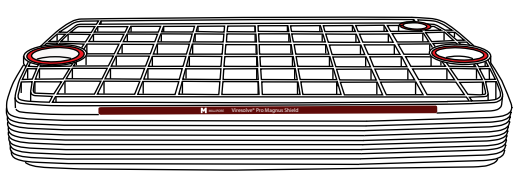


Viresolve® Pro+ Magnus Holder

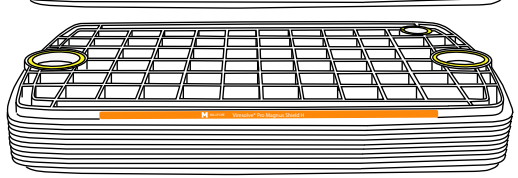
NOTE Refer to Viresolve® Pro+ Magnus Holder Parts List for callouts and locations on the holder.

1. Insert a 1½ inch sanitary fitting into the inlet and outlet holes of station 1 and station 2 on the base plate.
2. Insert a ¾ inch vent blank fitting into the small holes labeled **Drain** in the base plate.
3. Insert a 1½ inch blank fitting into the inlet holes in both top plates.
4. Insert the 1½ inch sanitary fitting into the outlet holes of both top plates.
5. Insert the ¾ inch vent fitting into the small holes labeled **Vent** on both top plates.

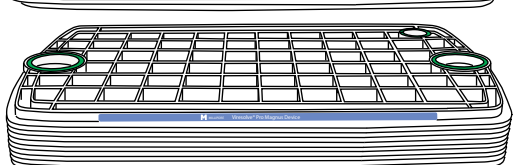
NOTE The **Viresolve® Pro Shield**, **Viresolve® Pro Shield H**, and **Viresolve® Pro Device** appear to be identical; however, the membranes inside the units are different. The labels and gaskets on the devices are color coded for easy identification. Do not interchange the units during installation.



Viresolve® Pro Shield
Magenta label
Red gaskets



Viresolve® Pro Shield H
Orange label
Yellow gaskets



Viresolve® Pro Device
Blue label
Green gaskets

Install the **Viresolve® Pro+ Magnus Holder**:

Station	Option
Scenario A	
1	**Viresolve® Pro Shield** or **Viresolve® Pro Shield H**
2	**Viresolve® Pro Device**
Scenario B	
1	**Viresolve® Pro Device**
2	None

NOTE Devices are stamped with a **B** on the bottom and a **T** on the top. Ensure that the bottom is facing the base plate during installation. The alignment key prevents devices from locking into place if they are not properly oriented.

6. Place the first **Viresolve® Pro Device Magnus** on the base plate in the station according to the table above for either Scenario A or Scenario B. Ensure that the alignment key engages. Place each additional unit on top of the first unit, ensuring that the alignment keys engage.
7. Place the first **Viresolve® Pro Shield Magnus** or **Viresolve® Pro Shield H Magnus** (or no device; none) on the base plate, in station 1 according to the table above for Scenario A. Ensure that the alignment key engages. Place each additional unit on top of the previous unit, ensuring that the alignment keys engage.
8. When all of the units are installed, place the top plates, with fittings installed, on the top unit. The key on the top plate engages in the top unit and the plate lies flat.
9. Place the cross pieces on the top plates by aligning the holes with the pins on the plate and the clamp rods.
10. Replace the split clamp assemblies.
11. Replace the knobs.
12. Install the split clamp assembly on the rod in the groove directly above the cross piece. Adjust the rod level so that the clamp is as close as possible to the cross piece.

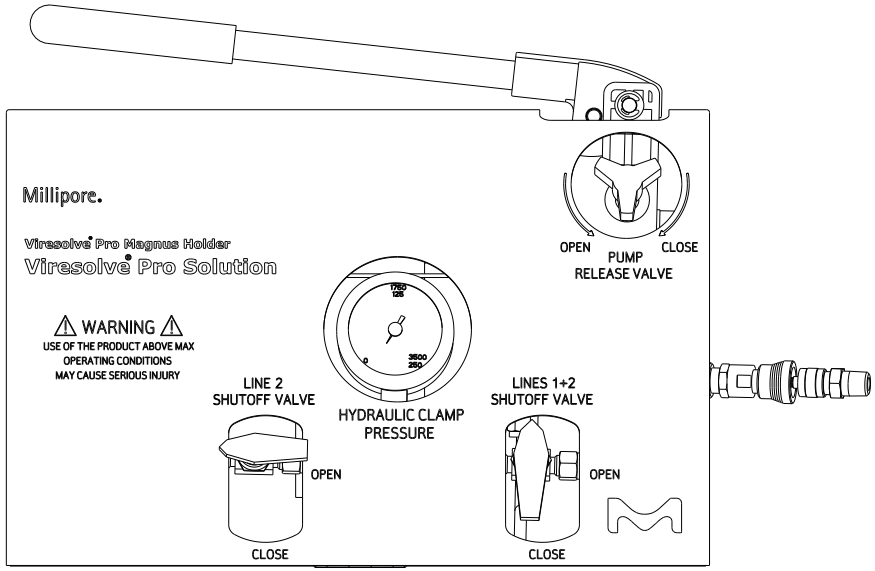
Checking the Gasket Seals for Use of Both Stations

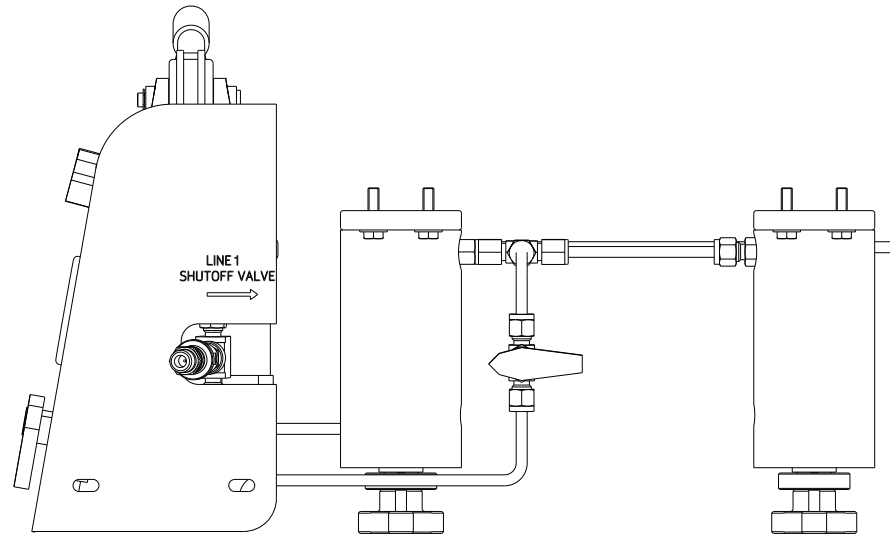
The units are ready to be compressed. Compression ensures that the gaskets are sealing correctly.

1. Close the hydraulic pump release valve and open the hydraulic line shut-off valves.
2. Using the hydraulic pump handle, increase the hydraulic pressure until the pressure gauge on the holder reads 76 bar ± 13.8 (1100 psi ± 200).

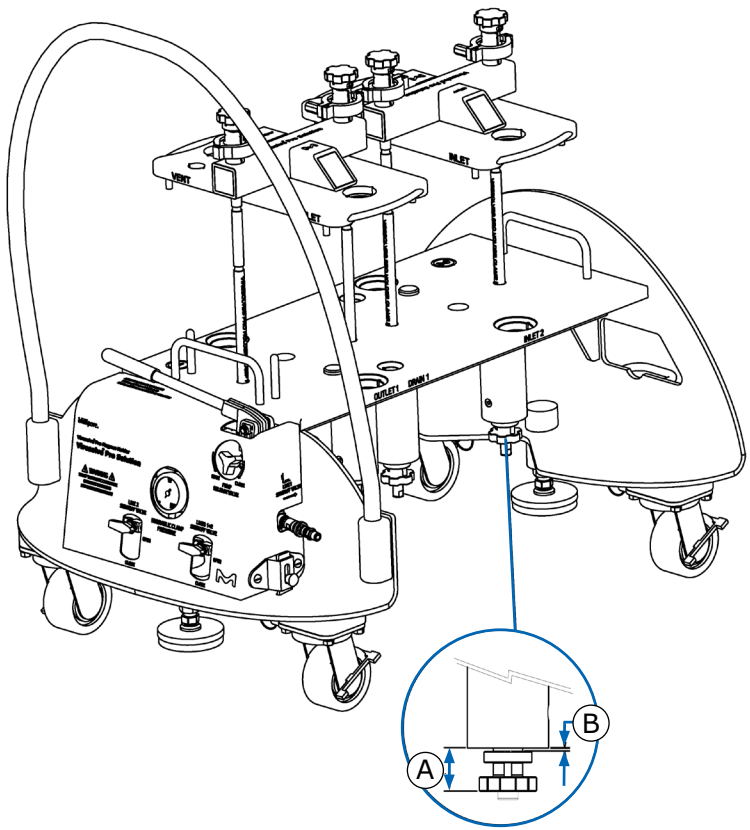
   NOTE Do not increase the pressure if all hydraulic line shut-off valves are closed. The units will not be compressed and process fluid may leak from the space between the fittings and units.

3. When 76 bar (1100 psi) registers on the gauge, close the hydraulic line 1+2 shut-off valve. Leave line 1 and line 2 shut-off valves open.





NOTE To ensure that the units seal, verify that the piston does not extend more than (B) 40 mm (1.6 inch) from the base to the flange or (A) 76 mm (3.0 inch) from the base to the nut. If it extends too far, relieve the pressure in the hydraulic system, retract the clamp rods, and repeat steps 10 through 12 of Viresolve® Pro+ Magnus Holder, then continue to Checking the Gasket Seals for Use of Both Stations.



Installing Viresolve® Pro Device in Station 1 (excludes Viresolve® Pro Shield and Viresolve® Pro Shield H) and Fittings

1. Close the hydraulic pump release valve (16) and open hydraulic lines 1 and 2 shut-off valve. Close line 2 shut-off valve.

2. Using the hydraulic pump handle (22), increase the hydraulic pressure until the pressure gauge on the holder reads 76 bar (1100 psi).

3. When 76 bar (1100 psi) registers on the gauge, close the lines 1+2 shut-off valve. Leave the line 2 shut-off valve closed.

Setup and Preparation

Viresolve® Pro Modus

1. Close the **Viresolve® Pro Device Modus** vent.
2. Open the vent valve of the **Viresolve® Pro Shield Modus** or **Viresolve® Pro Shield H Modus**.
3. Connect flushing or wetting fluid source to the inlet of the **Viresolve® Pro Shield Modus** or **Viresolve® Pro Shield H Modus**.

   NOTE Tubing may be attached to the vent valves and routed to a waste container.
4. Flow fluid into the unit inlet at 0.3 bar (5 psid), allowing the unit to vent. Close the vent valve after a continuous stream of liquid is observed exiting the vent.
5. Open the vent valve of the **Viresolve® Pro Device Modus**.
6. Flow fluid into the **Viresolve® Pro Device Modus** inlet at 0.3 bar (5 psid), allowing the unit to vent. Close the vent valve after a continuous stream of liquid is observed exiting the vent.
7. Flush/wet per the following to fully wet the units and reduce leachable:

Unit	Required Flush Volumes		Pressure bar (d) (psid)
	(L/m²)	(L)	
Viresolve® Pro Device			
Viresolve® Pro Device Modus 1.1	50	0.85	2.1–4.1 (30–60)
Viresolve® Pro Device Modus 1.2		3.5	
Viresolve® Pro Device Modus 1.3		11.0	
Viresolve® Pro Shield			
Viresolve® Pro Shield Modus 1.1	100	1.7	2.1–4.1 (30–60)
Viresolve® Pro Shield Modus 1.2		7.0	
Viresolve® Pro Shield Modus 1.3		22.0	
Viresolve® Pro Shield H			
Viresolve® Pro Shield H Modus 1.1	100	1.7	2.1–4.1 (30–60)
Viresolve® Pro Shield H Modus 1.2		7.0	
Viresolve® Pro Shield H Modus 1.3		22.0	

NOTE Wetting below the recommended wetting pressure range may result in integrity test failure or reduced permeability due to incomplete wetting.

Viresolve® Pro Magnus Solution

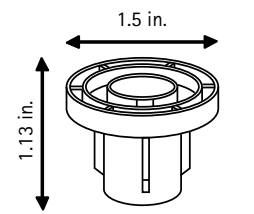
The **Viresolve® Pro+ Magnus Holder** does not include tubing, pressure gauges, or sanitary valves. These items are user supplied. This section describes recommended best practices for installation of tubing, pressure gauges, and valves. Contact Technical Services for additional information.

1. Attach the feed tubing, pressure gauge and valve to the fitting on the base plate of station 1 labeled **Inlet 1**.
2. Attach connector tubing (approximately 15 inches [38.1 cm]) from the fitting on the base plate of station 1 labeled **Outlet 1** to a pressure gauge, valve, and fitting on the base plate of station 2 labeled **Inlet 2**.
3. Attach filtrate tubing, pressure gauge, and valve to the fitting on the bottom plate of station 2 labeled **Outlet 2**.

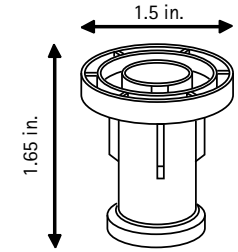
   NOTE The pressure gauges connected to inlet 2 and outlet 2 monitor the differential pressure of the **Viresolve® Pro Device**. The valve connected to inlet 2 isolates the **Viresolve® Pro Device Magnus** for integrity testing.

4. Attach a valve to the 1½ inch fitting on the station 1 top plate labeled **Outlet**. This valve vents the downstream side of the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H**.
5. Attach a valve to the 1½ inch fitting on the station 2 top plate labeled **Outlet**. This valve vents the downstream side of the **Viresolve® Pro Device**.
6. Attach a valve to the ¾ inch fitting on the station 1 top plate labeled **Vent**. This valve vents the upstream side of the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H**.
7. Attach a valve to the ¾ inch fitting on the station 2 top plate labeled **Vent**. This valve vents the upstream side of the **Viresolve® Pro Device**.

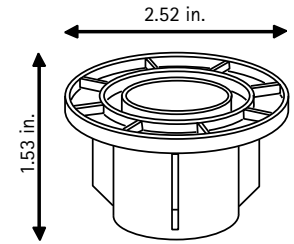
   NOTE Tubing may be attached to each of the vent valves described in steps 4-7 and routed to a waste container.



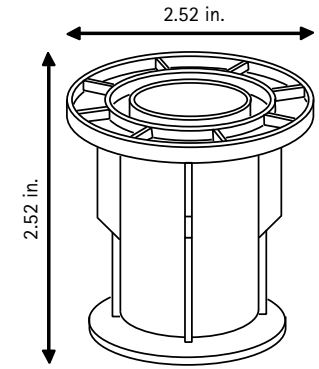
Vent plug/blank



Vent fitting



Feed/permeate plug/blank



Feed/permeate fitting

The system is now ready for use.

NOTE When the units are in operation, the observed clamping pressure may increase up to 124 bar (1800 psi).

Flushing and Wetting the Viresolve® Pro Magnus Solution

1. Close the **Viresolve® Pro Device Magnus** inlet valve and the ¾ and 1½ inch **Viresolve® Pro Device** vents on the top plate. If using a valve connected to outlet 2 on the base plate, leave this valve open.
2. Open the ¾ inch vent of the **Viresolve® Pro Shield Magnus** or **Viresolve® Pro Shield H Magnus** on the top plate.
3. Connect the flushing or wetting fluid source to the inlet of the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H**.

   NOTE Tubing may be attached to the vent valve and routed to a waste container.

4. Flow fluid into the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H** inlet at 0.3 bar (5 psid), allowing the shields to vent. Close the ¾ inch vents after a continuous stream of liquid is observed exiting from the vent.
5. Open the 1½ inch **Viresolve® Pro Shield** or **Viresolve® Pro Shield H** OUTLET on the top plate. Close after continuous stream of liquid exits the vent.
6. Open the ¾ inch **Viresolve® Pro Device** vent on the top plate. Then open the inlet.
7. Flow fluid into the **Viresolve® Pro Device** inlet at 0.3 bar (5 psid), allowing the device to vent. Close the ¾ inch vent after a continuous stream of liquid exits the vent.
8. Open the 1.5 inch **Viresolve® Pro Device** vent on the top plate. Close after a continuous stream of liquid exits the vent.
9. Flush/wet per the following specifications to fully wet the units and reduce leachable:

Unit	Required Flush Volumes		Pressure bar (d) (psid)
	L/m²	L	
Viresolve® Pro Device			
Viresolve® Pro Device Magnus 2.1	50	25.5	2.1 to 4.1
Viresolve® Pro Device Magnus 2.2		76.5	(30 to 60)
Viresolve® Pro Shield			
Viresolve® Pro Shield Magnus 2.1	50	25.5	2.1 to 4.1
Viresolve® Pro Shield Magnus 2.2		76.5	(30 to 60)
Viresolve® Pro Shield H			
Viresolve® Pro Shield H Magnus 2.1	100	51	2.1 to 4.1
Viresolve® Pro Shield H Magnus 2.2		153	(30 to 60)

NOTE Wetting below the recommended wetting pressure range may result in integrity test failure or reduced permeability.

Flow Rate Calculation

1. Measure the flow rate through the units using a flow meter, graduated cylinder, and stopwatch, or by placing the outlet tubing into a collection container on a balance.
2. Record the flow rate until a stable flow rate is observed for three consecutive minutes (initial permeability rates may be low). Record water temperature.
3. Close the inlet valve and turn off the feed pump if applicable.
4. Depressurize the system and empty the feed vessel.

   CAUTION!

   Do not depressurize the system if the permeate pressure exceeds the feed pressure. Vent permeate pressure prior to depressurizing feed side of the Viresolve® Pro Device. Contact Technical Service for recommended practices to avoid reverse pressurization.

5. Calculate the temperature-corrected flow rate ($Q_{25°\,C}$) using the following equation:
   $Q_{25°\,C} = Q_p * F$

   Where:

   Q_p is the filtrate flow rate in mL/min (with a density of 1 g/cc for water to convert weight to volume).

   F is the temperature correction factor from the following table.

6. The **Viresolve® Pro Device** installation may be pre-use integrity tested. Refer to Integrity Testing for instructions.

Temperature		
°F	°C	Correction Factor*
86.0	30	0.896
84.2	29	0.915
82.4	28	0.935
80.6	27	0.956
78.8	26	0.978
77.0	25	1.000
75.2	24	1.023
73.4	23	1.047
71.6	22	1.072
69.8	21	1.098
68.0	20	1.125
66.2	19	1.152
64.4	18	1.181

Temperature		
°F	°C	Correction Factor*
62.6	17	1.212
60.8	16	1.243
59.0	15	1.276
57.2	14	1.310
55.4	13	1.346
53.6	12	1.383
51.8	11	1.422
50.0	10	1.463
48.2	9	10506
46.4	8	1.551
44.6	7	1.598
42.8	6	1.648
41.0	5	1.699
39.2	4	1.751

*Based on water fluidity relative to 25°C (77°F) fluidity value

$F = (\mu_{T°C}/\mu_{25°C})$ *or* $(\mu_{T°F}/\mu_{77°F})$

Typical temperature-corrected flow rate range at 2.1 bar (30 psi) at 25°C:

Installation Setup		Flow Rate Range
Viresolve® Pro Shield or Viresolve® Pro Shield H	**Viresolve® Pro Device**	
Viresolve® Pro Shield Modus 1.1	Viresolve® Pro Device Modus 1.1	77–213 mL/min
Viresolve® Pro Shield Modus 1.2	Viresolve® Pro Device Modus 1.2	315–875 mL/min
Viresolve® Pro Shield Modus 1.3	Viresolve® Pro Device Modus 1.3	990–2750 mL/min
Viresolve® Pro Shield Magnus 2.1	Viresolve® Pro Device Magnus 2.1	131–363 LMH/bar (9–25 LMH/psi)
Viresolve® Pro Shield Magnus 2.2	Viresolve® Pro Device Magnus 2.2	
Viresolve® Pro Shield H Modus 1.1	Viresolve® Pro Device Modus 1.1	77–213 mL/min
Viresolve® Pro Shield H Modus 1.2	Viresolve® Pro Device Modus 1.2	315–875 mL/min
Viresolve® Pro Shield H Modus 1.3	Viresolve® Pro Device Modus 1.3	990–2750 mL/min
Viresolve® Pro Shield H Magnus 2.1	Viresolve® Pro Device Magnus 2.1	131–363 LMH/bar (9–25 LMH/psi)
Viresolve® Pro Shield H Magnus 2.2	Viresolve® Pro Device Magnus 2.2	

If the flow rates of the installation do not meet the specification listed in this table, check the water temperature and wetting pressure, and repeat the $Q_{25°C}$ measurement. Rewet at a higher wetting pressure, up to 4.1 bar (60 psid) to ensure adequate wetting.

Sanitization (optional)

1. Flow 0.5 N NaOH at room temperature through the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H** and the **Viresolve® Pro Device** for up to 60 minutes between 0.7 and 4.1 bar (10–60 psid). The caustic solution may be left in the units for a static soak at room temperature for up to 16 hours. This is the maximum time the units can be in contact with a caustic solution. Validate the volume and time needed based on specific bioburden requirements.
2. Rinse the units after sanitization with at least three times the total hold-up volume of buffer. End users should determine their system holdup volume. Refer to Post-Use Buffer Flush (Optional for Product Recovery) for unit holdup volume. The filtrate pH may be monitored to increase or reduce the flushing volume required.
3. Rinse the units with buffer or water with both vent ports open. Allow at least 2 L/m^2 buffer to exit through both vent ports.
4. Close both vent ports.

NOTE The total hold-up volume is the sum of the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H** and the **Viresolve® Pro Device** hold-up volumes plus the user-calculated upstream and downstream volume.

Measuring Buffer Flux

1. Fill the feed vessel with the appropriate volume of buffer.
2. Perform the venting procedure as described in Post-Use Buffer Flush (Optional for Product Recovery). Filter buffer through the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H** and the **Viresolve® Pro Device** at the selected processing pressure.
3. Measure the flow rate through the units using a flow meter, graduated cylinder, and stopwatch, or by placing the outlet tubing into a collection container on a balance.
4. Record the elapsed time and the volume or weight of filtrate collected. Record the flow rate until a stable flow rate is observed for three consecutive minutes (initial permeability rates may be low). Record buffer temperature.
5. Close the outlet valve then close the inlet valve.
6. Depressurize the feed vessel.
7. Calculate the Q25°C (refer to the table in Flow Rate Calculation).

NOTE The buffer flux may be different from the water flux due to buffer components. However, the buffer flux will establish a baseline relative to the feed stream.

Filtering Product

1. Add the desired volume of protein to the feed vessel and record the protein temperature.
2. Attach a collection container to the **Viresolve® Pro Device** outlet. Pressurize the feed vessel to the selected operating pressure or set the pumping system to the desired flow rate. Avoid introducing air into the feed lines.
3. Apply feed pressure to the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H** inlet and open the inlet valve. When the feed inlet pressure is greater than the **Viresolve® Pro Device** filtrate pressure, open the **Viresolve® Pro Device** outlet.
4. Perform product filtration using process parameters determined during process development. If product flow rate is measured, product flux may be calculated.
5. When the filtration endpoint is reached, close the outlet valve then the inlet valve.

NOTES Depending on how pressure is applied to the inlet (i.e. constant pressure from vessel, pumping at constant pressure or pumping from constant flow), the operation of the inlet and outlet valves must ensure the filtrate pressure does not exceed the feed pressure. Contact Technical Services for recommended practices to avoid reverse pressurization.

Operation at flux below validated operating range may impact retention performance if flux is below 50 LMH. Contact Technical Service for more information.

Post-Use Buffer Flush (Optional for Product Recovery)

The total hold-up volume is the sum of the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H** and the **Viresolve® Pro Device** hold-up volumes plus the user-calculated upstream and downstream volumes.

1. Add the desired volume of buffer to the feed vessel.
2. Apply feed pressure to the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H** inlet and open the inlet valve. When the feed inlet pressure is greater than the **Viresolve® Pro Device** filtrate pressure, open the **Viresolve® Pro Device** filter outlet.
3. Perform post-use buffer flush filtration using process parameters determined during process development.
4. When the buffer flush endpoint is reached, close the outlet valve then the inlet valve.

NOTE Repeat steps 1–4 with water to prepare **Viresolve® Pro Device** for post-use integrity testing

Integrity Testing

Test the integrity of the installation by measuring the diffusional flow rate of air through the water wetted membrane. Refer to the table below for the diffusion flow rate specification. For multi **Viresolve® Pro Device Magnus** installations, add the individual diffusion specifications to obtain the specification for the entire installation.

Viresolve® Pro Device	Air Water Diffusion Flow Rate at 50 psig (3.4 bar) in water at 25°C (cc/min)
Magnus 2.1	≤20
Magnus 2.2	≤60
Modus 1.1	≤0.7
Modus 1.2	≤2.7
Modus 1.3	≤8.8

The integrity test may be performed three ways:

- Automated using an automated integrity tester
- Automated using a downstream mass flowmeter
- Manually using a graduated cylinder inverted in a vessel of water

The Integritest® automated integrity test instruments are recommended. Refer to the instrument user guide for instructions.

In other automated integrity testers, the auto or default stabilization time setting can stop the test prematurely, and the resulting equilibration time may not be sufficient to achieve an accurate air diffusion measurement. Contact Technical Service for guidance with other integrity testers.

NOTES Do not integrity test the **Viresolve® Pro Shield** or the **Viresolve® Pro Shield H**.

Isolate the **Viresolve® Pro Device** from the **Viresolve® Pro Shield** or **Viresolve® Pro Shield H** to obtain an accurate diffusion flow value.

Close the valve connected to the Viresolve® Pro Device inlet and attach the Integritest® automatic integrity tester or air source to the vent. For the Viresolve® Pro Device Magnus installation, do not test from Outlet 2 on the base plate as it may allow water to flow into the Integritest® automatic integrity tester external valves.

If decreased permeability is noted after the pre-use integrity test, re-vent and re-wet at 2.1 bar (30 psid) to a minimum of 50 L/m^2 to ensure the removal of any air trapped in the Viresolve® Pro Device.

Automated Integrity Testing

1. For post-use testing, after product recovery, flush WFI or Milli-Q® water through the **Viresolve® Pro Device** installation for a minimum of 50 L/m^2 at 2.1 to 4.1 bar (30 to 60 psi) until a stable flow rate is observed for three consecutive minutes. Following these wetting procedures ensures a fully wetted membrane.
2. Open the valve connected to the outlet. For **Viresolve® Pro Device Magnus** installations, open the valve connected to outlet on the base plate to drain the system.
3. For **Viresolve® Pro Device Magnus** installations, ensure that the valve connected to the **Viresolve® Pro Device** top plate outlet is closed.
4. If the installation fails the integrity test, re-wet the **Viresolve® Pro Device** at 2.1 bar (30 psid) or higher, ensuring proper venting, and check the integrity test protocols used.

CAUTION!

Do not use alcohol to rewet the **Viresolve® Pro Device**.

Manual Integrity Testing

1. For post-use testing, after product recovery, flush WFI or Milli-Q® water through the **Viresolve® Pro Device** installation for a minimum of 50 L/m^2 at 2.1 to 4.1 bar (30 to 60 psid).
2. Connect process air line to inlet on the **Viresolve® Pro Device Modus** or the ¾ inch vent on the **Viresolve® Pro Device Magnus** top plate.
3. Increase air pressure to 3.4 bar (50 psid).
4. For **Viresolve® Pro Device Magnus** installations, open the valve connected to Outlet 2 on the base plate to drain
5. For **Viresolve Pro Device Magnus** installations, ensure that the valve connected to the **Viresolve® Pro Device** top plate outlet is closed.
6. Drain water through the outlet line. After the filtrate flow is reduced to slow dripping, start a timer and allow the system to stabilize for at least 20 but no more than 60 minutes.
7. Measure the diffusion flow rate using a downstream mass flow meter or inverted cylinder.
8. Measure the diffusion flow rate for one to five minutes.
9. Compare the test results to the specifications.
10. Release the pressure in the feed vessel. Disconnect the **Viresolve® Pro Device**.
11. If the installation fails the integrity test, re-wet at 2.1 bar (30 psid), ensure proper venting, and check the integrity test protocols used.

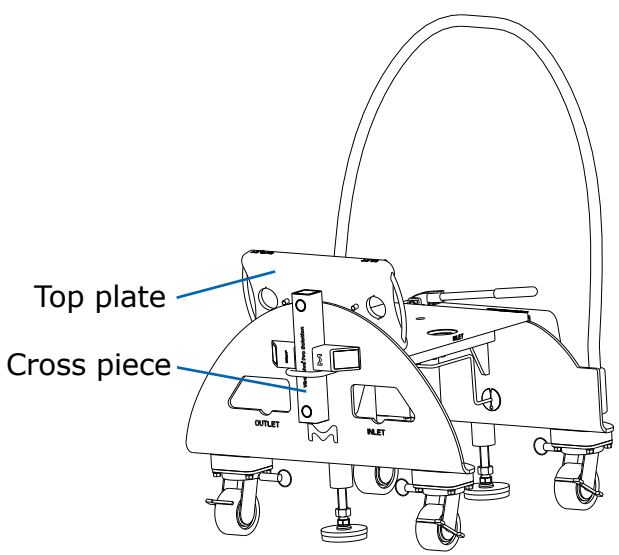
NOTE Integrity testing introduces air into the **Viresolve® Pro Device**. If integrity testing prior to use, ensure the device is fully wetted after the integrity test by re-venting and re-wetting with a minimum of 50 L/m^2 2.1 to 4.1 bar (30 to 60 psid) of WFI or buffer after the integrity test.

Disassembling the Holder

Viresolve® Pro Magnus Holder

NOTE Refer to Viresolve® Pro Magnus Holder Parts List for callouts and locations on the holder.

1. Ensure that the **Viresolve® Pro Device** is not under gas or liquid pressure. Remove all connections.
2. Depressurize the hydraulic cylinders by opening the hydraulic line shut-off valve and the hydraulic pump release valve. Confirm that the hydraulic pressure gauge reads 0 psi.
3. Remove the clamp rod knobs and the split clamp assemblies.
4. Remove the cross piece, then the top plate. Store the cross piece on the hanger on the back of the unit.
5. Remove the disposable fittings from the top plate by rotating until the tabs align with the slots and pulling the fittings out. Discard the fittings.
6. Store the top plate on the bracket along the back or front of the unit.



7. Unload all units. Remove all of the disposable fittings from the base plate and the inlet and outlet ports by rotating until the tabs align with the slots and pulling the fittings out.

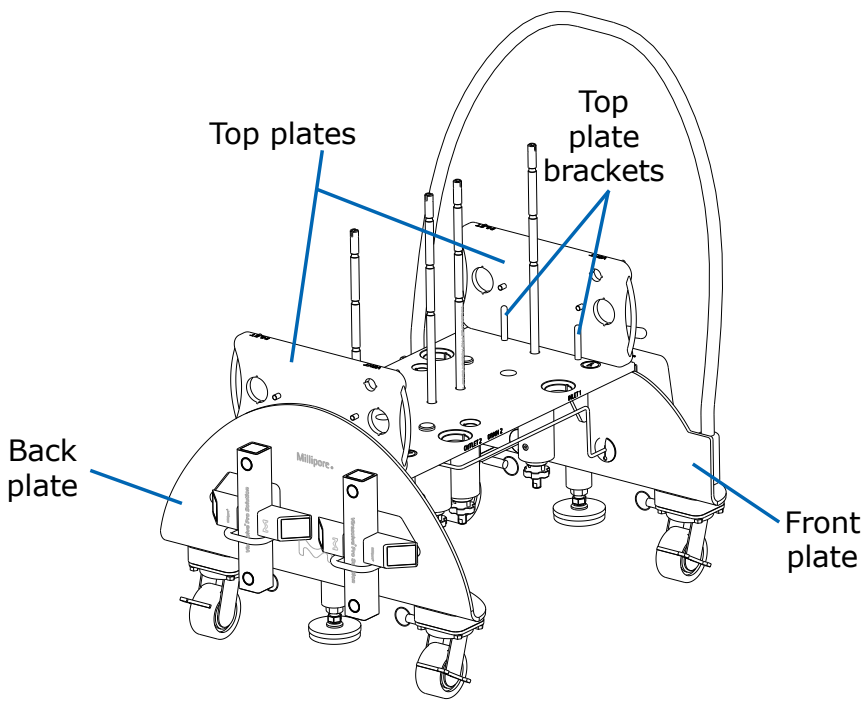
   NOTE Gaskets may stick together during disassembly.

8. Remove and properly dispose of all fluid-contact surfaces, ensuring compliance with local regulations.
9. Clean all other holder surfaces as necessary.

Viresolve® Pro+ Magnus Holder

NOTE Refer to Viresolve® Pro+ Magnus Holder Parts List for callouts and locations on the holder.

1. Ensure that the **Viresolve® Pro Device** and **Viresolve® Pro Shield** or **Viresolve® Pro Shield H** are not under gas or liquid pressure. Remove all connections.
2. Depressurize the hydraulic cylinders by opening the hydraulic line shut-off valves and the hydraulic pump release valve. Confirm that the hydraulic pressure gauge reads 0 psi.
3. Remove the clamp rod knobs and the split clamp assemblies.
4. Remove the cross piece, then the top plate. Store the cross piece on the hanger on the back of the unit.
5. Remove the disposable fittings from the top plate by rotating until the tabs align with the slots, pulling the fittings out. Discard the fittings. Store the top plate on the bracket on the back or front of the unit.



6. Unload all units. Remove all the disposable fittings from the base plate and the inlet and outlet ports by rotating until the tabs align with the slots and pulling the fittings out.

   NOTE Gaskets may stick together during disassembly.

7. Remove and properly dispose of all fluid-contact surfaces, ensuring compliance with local regulations.
8. Clean all other holder surfaces as necessary.

Maintaining the Hydraulic System

These procedures may be required by facility maintenance procedures or may be recommended by an authorized Technical Services representative.

Replacing the Hydraulic Fluid

1. Depressurize the hydraulic cylinders by opening the hydraulic line shut-off valves:
   - Viresolve® Pro Magnus Holder: ⑱
   - Viresolve® Pro+ Magnus Holder: ㉑

   And by opening the hydraulic pump release valves:
   - Viresolve® Pro Magnus Holder: ⑯
   - Viresolve® Pro+ Magnus Holder: ⑲
2. Remove the pump cover.
3. Place a drip pan under the hydraulic pump compression fitting. Remove the compression fitting.
4. Loosen the compression fitting nuts closest to each hydraulic cylinder and pull the steel tubing out of the fitting.
5. Replace and tighten the compression fitting on the hydraulic pump.
6. Loosen and remove the hydraulic pump vent valve.
7. Pour hydraulic fluid into hydraulic pump reservoir until the fluid level meets the fluid level line on the pump reservoir.
8. Replace the hydraulic pump vent valve and leave in the OPEN position.
9. Close the hydraulic pump release valve:
   - Viresolve® Pro Magnus Holder: ⑯
   - Viresolve® Pro+ Magnus Holder: ⑲
10. Open the hydraulic line shut-off valves:
    - Viresolve® Pro Magnus Holder: ⑱
    - Viresolve® Pro+ Magnus Holder: ㉑
11. Operate the hydraulic pump until hydraulic fluid comes out of the steel tubing near the hydraulic cylinders.
12. Connect the steel tubing to each hydraulic cylinder.
13. If necessary, pour hydraulic fluid into hydraulic pump reservoir until the fluid level meets the fluid level line on the pump reservoir.
14. Tighten each compression fitting approximately ¾ turn beyond finger tight.
15. Follow the procedures for Bleeding the System and Testing the System.

Replacing the Hydraulic Gauge

1. Relieve the pressure in the hydraulic system by opening the hydraulic line shut-off valve:
   - Viresolve® Pro Magnus Holder: ⑱
   - Viresolve® Pro+ Magnus Holder: ㉑

   And by opening the hydraulic pump release valves:
   - Viresolve® Pro Magnus Holder: ⑯
   - Viresolve® Pro+ Magnus Holder: ⑲
2. Close the hydraulic line shut-off valves:
   - Viresolve® Pro Magnus Holder: ⑱
   - Viresolve® Pro+ Magnus Holder: ㉑
3. Place a drip pan under the pressure gauge and loosen the compression fittings attached to the cross fitting.
4. Disconnect the steel tubing from the cross and lift out the pressure gauge and cross fitting.
5. Unplug the gauge from the cross.
6. Plug the new gauge onto the cross fitting. The gauge points in the correct direction.
7. Connect the steel tubing to each of the other three connections to the cross.
8. Tighten each compression fitting approximately ¾ turn beyond finger tight.
9. Follow the procedures for Bleeding the System and Testing the System.

Replacing the Hydraulic Pump

1. Relieve the pressure in the hydraulic system by opening the hydraulic line shut-off valve:
   - Viresolve® Pro Magnus Holder: ⑱
   - Viresolve® Pro+ Magnus Holder: ㉑

   And by opening the hydraulic pump release valves:
   - Viresolve® Pro Magnus Holder: ⑯
   - Viresolve® Pro+ Magnus Holder: ⑲
2. Turn the hydraulic pump vent valve to the CLOSED position.
3. Close the hydraulic pump release valve:
   - Viresolve® Pro Magnus Holder: ⑯
   - Viresolve® Pro+ Magnus Holder: ⑲
4. Place a drip pan under the hydraulic pump and loosen the compression fitting nearest to the pump.
5. Disconnect the steel tubing from the pump.
6. Remove the mounting bolts from each side of the pump and slide the pump out of the mounting bracket.
7. Note the orientation of the elbow fitting attached to the outlet of the pump. Remove the elbow fitting and remove any pipe tape on the threads.
8. Tape the elbow fitting and install on the new pump outlet. The elbow must be tight and pointing in the same orientation as on the old pump.
9. Slide the new pump onto the mounting bracket.
10. Reinstall the two mounting bolts which hold the pump in place.
11. Re-connect the steel tubing to the pump. Tighten the compression fitting approximately ¾ turn beyond finger tight.
12. Follow the procedures for Bleeding the System and Testing the System.

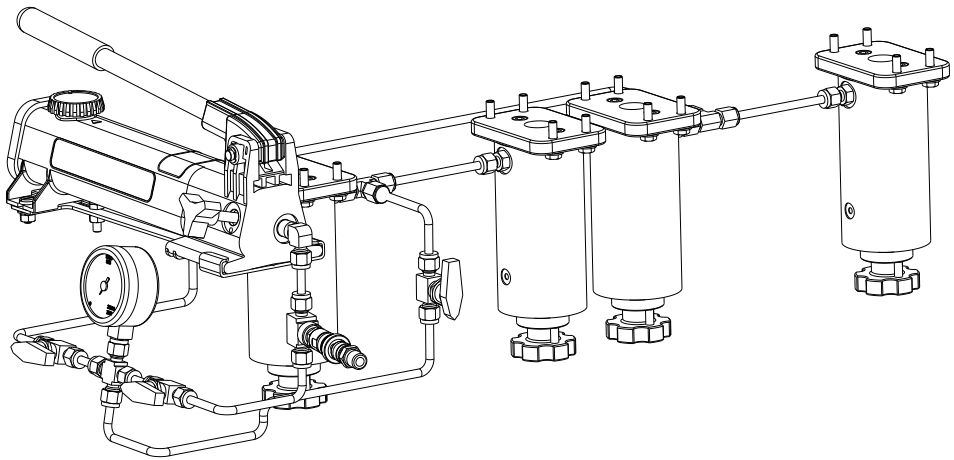
Bleeding the System

1. Turn the hydraulic pump vent valve to the VENT position.
2. Remove the split clamp assemblies from the rods.
3. Open the hydraulic line shut off valves:
   - Viresolve® Pro Magnus Holder: (18)
   - Viresolve® Pro+ Magnus Holder: (21)
4. Close the hydraulic pump release valve:
   - Viresolve® Pro Magnus Holder: (16)
   - Viresolve® Pro+ Magnus Holder: (19)
5. Using the hydraulic pump, increase the hydraulic pressure until the pressure gauge reads 62–76 bar (900–1100 psi). The pistons extend to their full length.
6. Relieve the hydraulic system pressure by opening the hydraulic pump release valve.
7. Repeat steps 4 through 6 two more times to allow any air in the system to be pushed back to pump reservoir.
8. If necessary, pour hydraulic fluid into hydraulic Pump reservoir until the fluid level meets the fluid level line on the pump reservoir.
9. Install the split clamp assemblies.

Testing the System

1. Install one **Viresolve® Pro Device Magnus** and one **Viresolve® Pro Shield Magnus** or **Viresolve® Pro Shield H** in the holder.
2. Close the hydraulic pump release valve:
   - Viresolve® Pro Magnus Holder: (16)
   - Viresolve® Pro+ Magnus Holder: (19)
3. Open the hydraulic line shut off valves:
   - Viresolve® Pro Magnus Holder: (18)
   - Viresolve® Pro+ Magnus Holder: (21)
4. Using the hydraulic pump, increase the hydraulic pressure until the pressure gauge reads 62–76 bar (900–1100 psi).
5. Allow the system to sit for a minimum of 15 hours. The hydraulic system pressure should drop no more than 200 psi over the 15 hour period. No hydraulic connections should be wet or show evidence of leaking. If any hydraulic connections are wet, or if the hydraulic system pressure has dropped more than 200 psi, the system is NOT ready for operation. Check all connections. Bleed and test the system until the hydraulic system is secure.

Calibrating the Hydraulic Gauge Using the Quick Connector



NOTE The quick connector is composed by one male bulkhead connection and one female bulkhead connection.

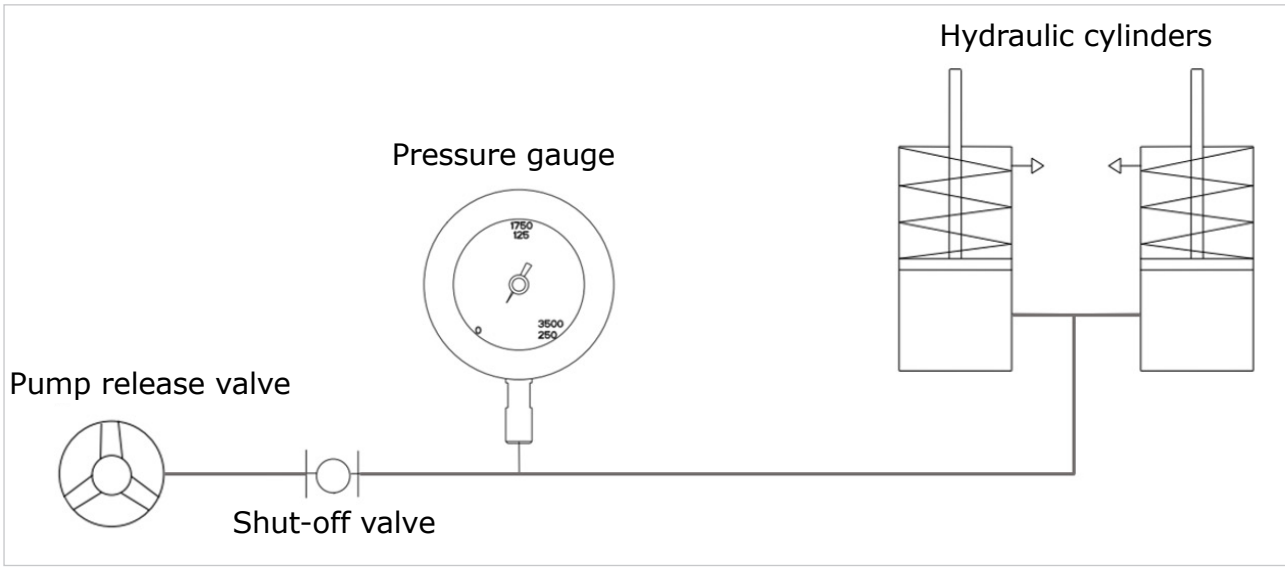
1. Relieve the pressure in the hydraulic system by opening the hydraulic line shut-off valve:
   - Viresolve® Pro Magnus Holder: ⑱
   - Viresolve® Pro+ Magnus Holder: ㉑

   And by opening the hydraulic pump release valves:
   - Viresolve® Pro Magnus Holder: ⑯
   - Viresolve® Pro+ Magnus Holder: ⑲
2. Ensure that the hydraulic pressure gauge indicates 0 psi.
   - Viresolve® Pro Magnus Holder: ⑲
   - Viresolve® Pro+ Magnus Holder: ㉒
3. Ensure that the pump vent valve is in the Vent position.
4. Connect the reference pressure gauge (calibrated) to the quick connector male bulkhead connection.
5. Plug the quick connect male bulkhead connection assembly into the female bulkhead connection.
6. Enusure that all system fittings and connections are tight and leak free.
7. Verify that the reference pressure gauge and the hydraulic pressure gauge readings are 0.0 psi/0.0 bar when no pressure is applied.
8. Close the hydraulic pump release valve.
9. Using the hydraulic pump, increase the pressure and cross-check the gauge reading with the digital indicator reading on several pressure values.
10. Record all results
11. When verification is completed, open the hydraulic release valve.
12. Unplug the male bulkhead connection assembly.
13. Bleed the system (refer to Bleeding the System).

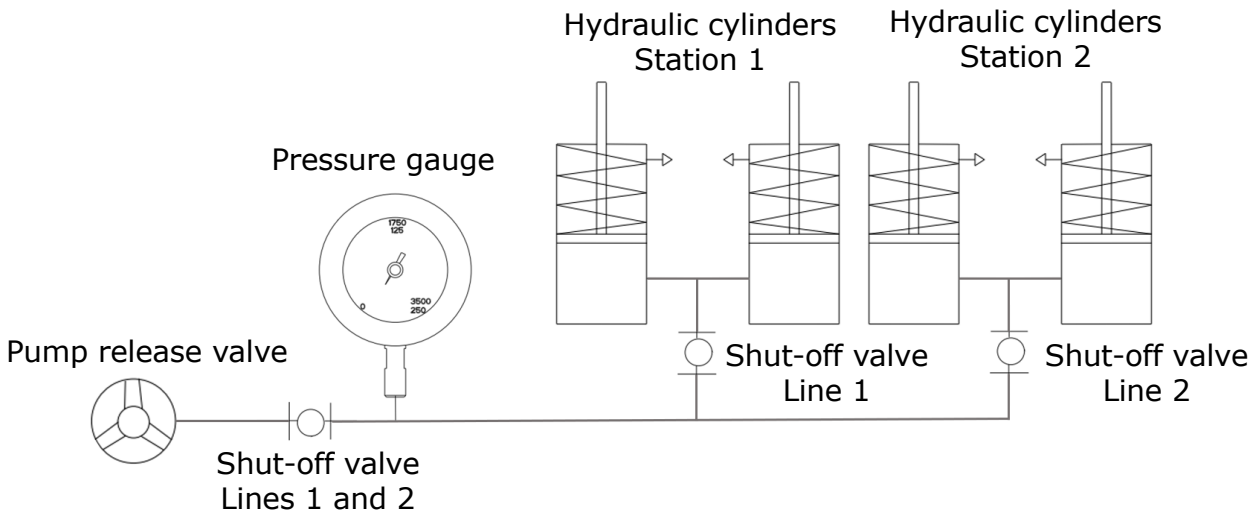
Viresolve® Pro Solution Hydraulic P&ID

P&ID (*piping and instrumentation diagram*) shows the piping and related components of the physical process flow.

Viresolve® Pro Magnus Holder Hydraulic P&ID



Viresolve® Pro+ Magnus Holder Hydraulic P&ID



Spare Parts and Accessories

Catalog Number	Description	Quantity
VPMHRD0103	Clamp rods for one to three: • Viresolve® Pro Device Magnus • Viresolve® Pro Shield • Viresolve® Pro Shield H (1 set required per position)	2
VPMHRD0105	Clamp rods for one to five: • Viresolve® Pro Device Magnus • Viresolve® Pro Shield • Viresolve® Pro Shield H (1 set required per position)	2
VPMHRD0107	Clamp rods for one to seven: • Viresolve® Pro Device Magnus • Viresolve® Pro Shield • Viresolve® Pro Shield H (1 set required per Position)	2
VPMHINSERT	Split clamp insert	1
VPMHRDKNOB	Rod knob	1
VPMHADAPSK	Viresolve® Pro+ Magnus Holder Fittings Kit (standard): (3) 1½ inch sanitary fittings (2) 1½ inch blank (1) ¾ inch vent fitting (1) ¾ inch vent blank	1
VPMHADAPSF	1½ inch sanitary flange fittings	6
VPMHADAPSB	1½ inch blanks	6
VPMHADAPVF	¾ inch vent fittings	6
VPMHADAPVB	¾ inch vent blanks	6
MP0DHYPUMP	Hydraulic pump	1
MP0DHYGAGE	Hydraulic system pressure gauge (for design without quick connector)	1
MP0DHFLUID	Hydraulic fluid	1
YY2004045	1½ inch TC clamp	1
VPMHSOVALVE	¼ inch ball valve (for design with quick connector)	1
VPMHFNPTVAL	¼ inch ball valve (for design without quick connector)	1
VPMHHYGAGE	Hydraulic system pressure gauge (for design with quick connector)	1
VPMHHYCYL	Hydraulic cylinder	1

We provide information and advice to our customers on application technologies and regulatory matters to the best of our knowledge and ability, but without obligation or liability. Existing laws and regulations are to be observed in all cases by our customers. This also applies in respect to any rights of third parties. Our information and advice do not relieve our customers of their own responsibility for checking the suitability of our products for the envisaged purpose.

For technical assistance please visit:
www.sigmaaldrich.com

For additional information and documentation please contact:
Merck KGaA, Darmstadt, Germany
Corporation with General Partners
Frankfurter Str. 250
64293 Darmstadt, Germany
Phone: + 49 6151-72 0

For requests from USA and Canada please contact:
MilliporeSigma
A subsidiary of Merck KGaA, Darmstadt, Germany
400 Summit Drive
Burlington, MA 01803 USA
Phone: 1-800-645-5476

MK_00110386PU Rev 9 09/2024