

AUTOMATED FILTERABILITY APPARATUS

STANDARD OPERATING PROCEDURE

BACKGROUND

Filterability testing is a simple way to identify wines that have the potential to clog final membrane filters, such as those used for sterile filtration on the packaging line. Filterability testing should be conducted after cellar filtration once the wine is ready to be packaged. Testing should be conducted **as close as possible to packaging**.

Filterability testing uses a sample of the wine that will be packaged in conjunction with the same membrane material that will be used in the final filter. A sample of wine is pressurized as it passes through a 25 mm membrane filter disc (provided by the manufacturer and **made of the same material** as the membrane filter). The test measures the weight of wine filtered (grams) over time (seconds) and returns a filterability index value.

This machine will calculate two different values:

FILTERABILITY INDEX (FI)

$$FI = T_{400} - 2T_{200}$$

MODIFIED FILTERABILITY INDEX (MFI)

$$MFI = (T_{600} - T_{200}) - 2(T_{400} - T_{200})$$

WHERE:

- T_{400} = time (in seconds) it takes to filter 400 g of wine
- T_{200} = time (in seconds) it takes to filter 200 g of wine
- T_{600} = time (in seconds) it takes to filter 600 g of wine



INTERPRETING THE RESULTS:

- If $FI > 20$, filtration problems may occur
- If $FI \leq 20$, no filtration problems are expected
- If $FI \approx MFI$ and ≤ 20 , no filtration problems are expected
- If $FI \ll MFI$, filtration problems may occur, especially as filtration progresses
- If $FI \gg MFI$ and ≤ 20 , no filtration problems are expected

Note, filterability testing is not fully representative of what happens on the packaging line, and filtration can be impacted by factors such as the volume of wine to be filtered, membrane and pre-membrane condition, etc. For example, extremely large volumes of wine with moderate FI measurements could still clog membranes.

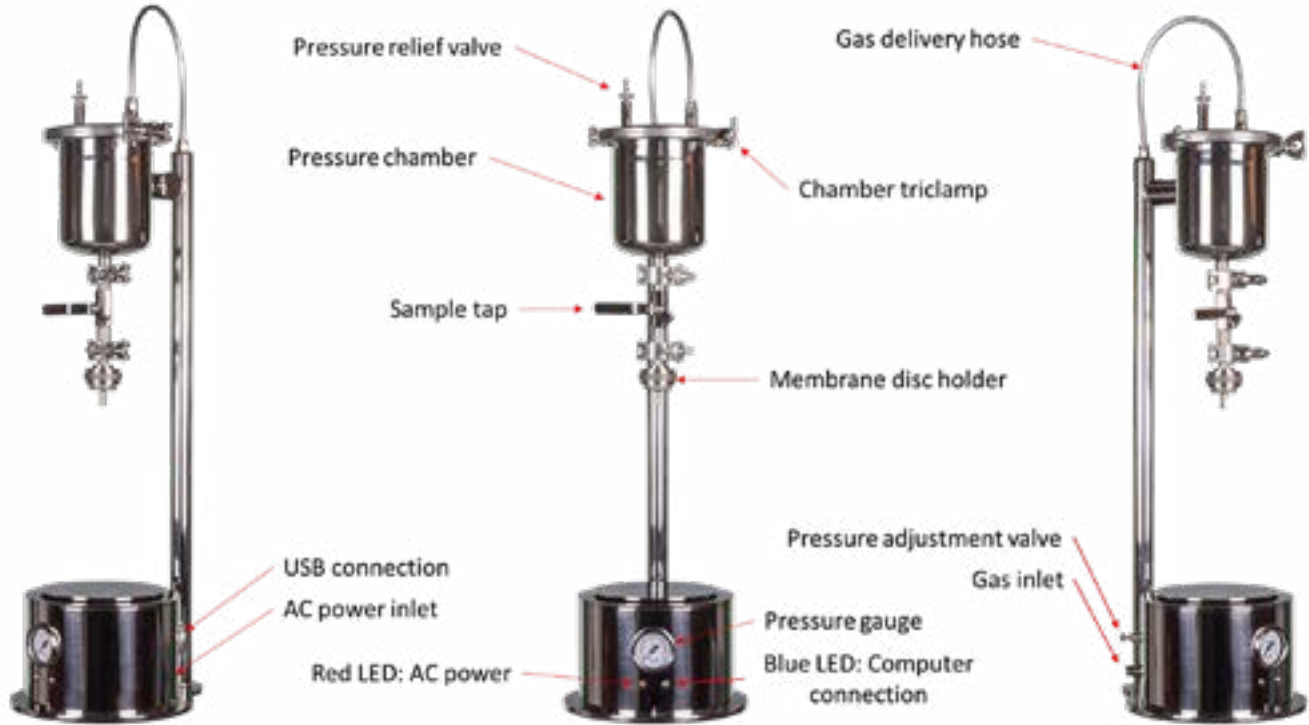
IMPORTANT CONSIDERATIONS

- Filterability testing can only be conducted on membrane media. This test is not intended to predict performance of depth (pre-filtration) material such as pads, lenticular modules, or depth cartridges.
- Filterability should be measured **as close as possible** to the packaging event. If packaging will take place over the course of several days, filterability should be determined daily.
- The temperature of the filterability sample should **match** the temperature that the wine will be on the packaging line.
- **Ensure the unit is level.** Check the level on the back of the unit.
- Samples should be analysed in **duplicate** to ensure data integrity.

	This equipment is pressurized. Ensure that pressure is released from the system prior to opening the wine chamber. This can be done using the pressure release valve on the top of the pressure chamber.
	Ensure that the area is clean and dry at all times, and clean any liquid spills as soon as possible to prevent electrical damage . Keep the unit clean and dry when not in use.



APPARATUS AND COMPONENTS:



**ADDITIONAL MATERIALS NEEDED:**

- Distilled water in a squeeze bottle
- Wine to be analyzed – 750 mL
- Tweezers for handling membrane discs (oils from your fingers can impact the filter performance)
- 25 mm membrane test disc – identical to the packaging membrane in use
- 1000 mL plastic jug or similar

PROCEDURE

1. Confirm that temperature of the filterability sample matches the temperature that the wine will be on the packaging line.
2. Remove the gas delivery hose. Then, remove the pressure chamber lid by removing the chamber triclamp.
3. Invert the sample bottle a few times to ensure homogeneity.

4. Remove the lower section of the membrane disc holder:

5. Ensure the sample tap is closed, and then pour a small volume of the sample (~20 mL) into the wine chamber to rinse, and then discard into the collection jug by opening the sample tap. Repeat this step.
6. Ensure the sample tap is closed, and then pour in approximately 700 mL wine. A minimum of 650 mL wine is required to complete the measurement.
7. Place the lid on the pressure chamber, ensuring that the pressure relief valve is open. Secure the lid with the chamber triclamp.
8. Release a small amount (~10 mL) of the wine through the sample tap to clear any air in the sample tap assembly. Repeat until no air bubbles are evident in the liquid stream from the sample tap. At least 650 mL of sample wine should remain in the wine chamber.



9. Close the pressure relief valve:






10. Insert the gas delivery hose. The wine chamber is now primed.



11. Assemble the membrane disc holder lower section:

a	Identify the membrane disc holder lower section components. From left to right: 1. Silicone o-ring. 2. Membrane disc support. 3. Second silicone o-ring. 3. Lower section of the membrane disc holder.	
b	Place one silicone o-ring inside the lower section of the membrane disc holder.	



<p>c</p>	<p>Insert the membrane support disc.</p>	
<p>d</p>	<p>Insert the membrane test disc. Ensure correct orientation of the membrane disc. Then, wet the membrane disc with some distilled water from a squeeze bottle.</p>	
<p>e</p>	<p>Insert the second o-ring on top of the membrane test disc.</p>	

12. Attach the membrane disc holder to the apparatus immediately below the sample tap via the threaded section.





13. Turn on the power to the apparatus (red LED will illuminate) and ensure the USB cable to the computer is connected at the right rear of the unit (blue LED will illuminate)



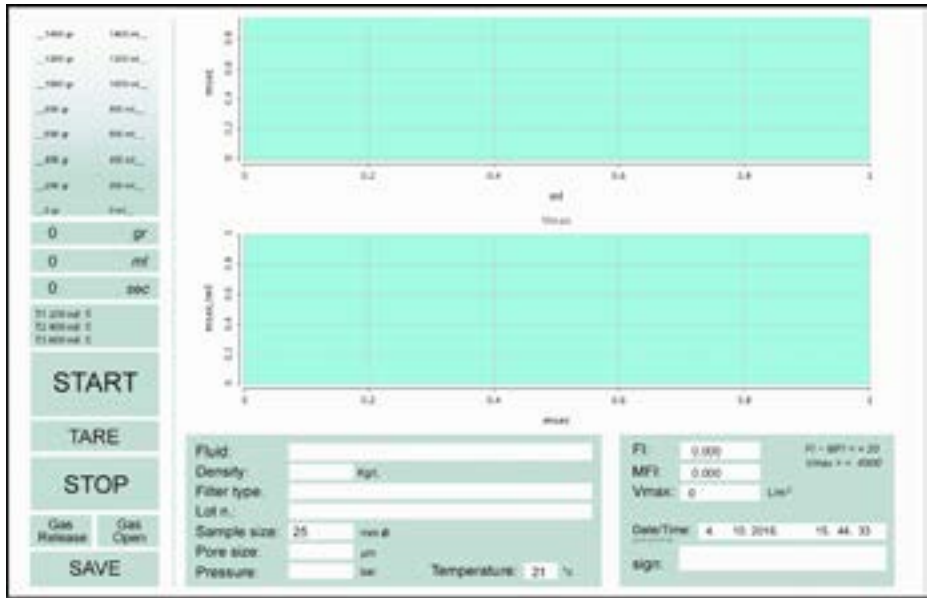
14. Connect the gas inlet to the left rear of the unit.



15. Open the gas supply to the apparatus (the regulator on the wall) and ensure it is delivering approximately (but no less than) 3 bar pressure to the apparatus. Using the on-board pressure adjustment valve at the left rear of the unit, adjust the chamber pressure to 2 bar by observing the pressure gauge on the front of the unit.
16. Place a plastic jug on the scale to catch the filtered sample.



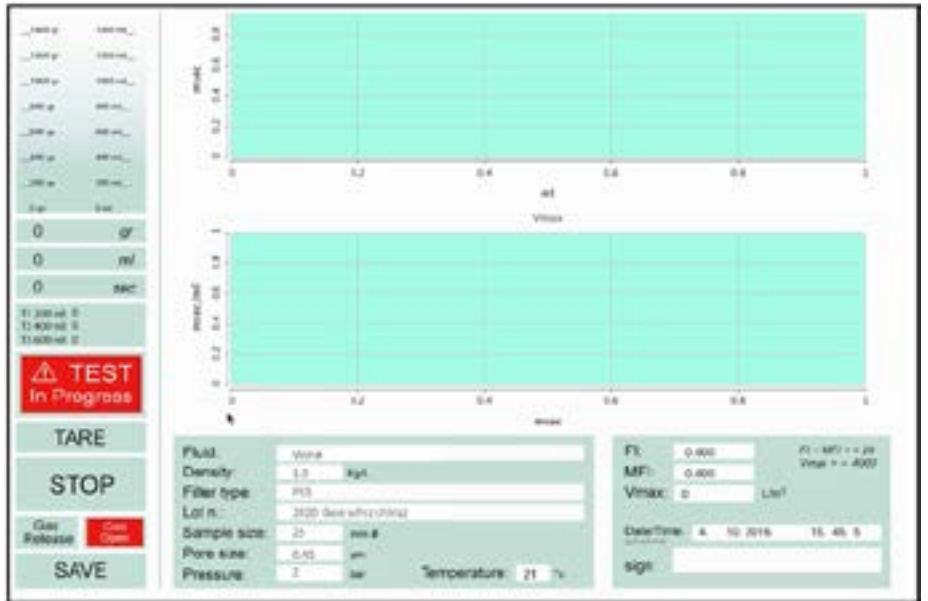
17. Open the FI software on the computer. The following screen will appear:



18. Enter the following information:
- Fluid = Wine, water blank etc.
 - Density (kg/L) = specific gravity. Use 1 kg/L if not measuring specific gravity.
 - Filter type = PES, nylon etc.
 - Lot n. = Sample identification, eg “Tank 216” etc.
 - Membrane disc size = 25 mm
 - Pore size = 0.45 um (typically)
 - Pressure = 2 bar

19. Open the sample tap. No wine will flow as gas pressure is controlled by the computer and surface tension on the membrane test disc is sufficient to withhold the liquid.

20. Click “TARE” then click “START”. The “Gas Open” button will illuminate red and the unit is then pressurised. The “START” button will change to a red “TEST In Progress” button and the assay will begin:



21. The mass, volume and time counters will activate (left side of screen, middle). At approximately 30 g, the charts will activate. This small time delay ensures complete wetting of the membrane test disc and allows the system to stabilize. The mass and volume columns on the upper left of the screen will also now begin to rise.

22. The test and calculations are completed when the instrument has measured 600 g of wine through the filter, at which point the “Gas Release” button will illuminate red and the pressure will release from the pressure chamber. A window will appear asking to save the file. Click “save.”

23. Open the pressure relief valve to ensure that all pressure is released.

24. If the assay is incomplete after 10 minutes, the sample has likely failed the filterability test. Allow the unit to filter 400 g of wine, at which point it will return an FI value. Then, click “STOP.” In such cases, the lower chart will show high values, indicating significant membrane blockage.



25. If the test does not fail and has collected 600 g of wine, three measurements will be reported on the lower right side of the screen:
- FI = Filterability Index.
 - MFI = Modified Filterability Index.
 - V_{\max} = Maximum volume in L/m².
26. Turn off the sample tap.
27. Disassemble and rinse the membrane disc holder to examine the test disc. Identify if the membrane disc was correctly seated. If it was not, the test must be repeated.



28. Remove the pressure chamber triclamp and lid. Clean and dry the jug.
- 29.
- **If the same wine must be remeasured**, proceed with the next measurement without rinsing.
 - **If a different wine must be measured**, wash down the vessel with distilled water from a squirt bottle before rinsing with the new sample. Proceed with the next measurement.
30. After all tests have been conducted for the day, clean the apparatus:
- Close the sample tap and fill the vessel with warm water up into the top of the pressure vessel and then drain. Repeat at least once.
 - Ensure that instrument, the balance pan, and its surroundings are cleaned of any wine spills.
31. Close the tap on the main supply of gas to the apparatus. Ensure that the power to the filterability instrument is turned off.

CLEANING PROCEDURE

Clean the entire apparatus with diluted dish soap or detergent. Fill a large beaker with warm water and add a few drops of dish soap or detergent. Place all fittings inside the beaker and allow to soak. Scrub gently, rinse, and allow to dry (use canned air to dry the membrane support disc). Spray the USB connection with canned air to ensure it is free of dust.