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Complete HTHP Filter Press

171-00-C 500 mL, 2,000 PSI, 115 Volt, 800 Watt

171-01-C 500 mL, 2,000 PSI, 230 Volt, 800 Watt

Instruction Manual

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Ver. 6

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Intro

The OFI Testing Equipment (OFITE) High Temperature High Pressure (HTHP) Filter Press is designed to evaluate drilling fluids, cement slurries, fracturing and completion fluids under elevated temperatures and pressures. Evaluating fluids under HTHP conditions similar to the downhole environment is of paramount importance. Fluid properties must be monitored while under high temperatures and pressures as filtration behavior and wall cake building characteristics of permeable formations change with changing environments. These characteristics are affected by the shape, type and quantities of solids present in the fluid and their physical and electro-chemical interactions, all of which are affected by changing temperatures and pressures.

OFITE manufactures and provides HTHP filtration units in two basic sizes, 175 mL and 500 mL capacities. Both are used extensively throughout the world and in all environments, but in general the 175 mL units are designed for field portability, while the larger 500 mL units are designed for laboratory usage at higher temperatures and pressures. All OFITE filtration devices fully conform to American Petroleum Institute (API) specifications.

A complete HTHP Filter Press consists of a controlled pressure source, usually Nitrogen pressurization or Carbon Dioxide bulbs for the 175 mL units. Top and bottom pressure manifolds are provided to simulate the differential pressures found in a down-hole environment, and to prevent evaporation of the base fluid if exceeding the boiling point of that fluid. The test cells are provided in a variety of assemblies, depending upon the type of fluid tested, the filter media, and the temperatures and pressures desired. The test cells are encased inside a heating jacket which is adjustable.

A variety of filter media are available, the most common being the standard API filter paper, cement screens and ceramic filters, which may be obtained to match the pore throat or permeability of the formation. Natural formation cores may also be used of differing sizes. Different screens may be used, or slotted disks of varying sizes are frequently used for lost circulation materials studies.

The 500 mL heating jackets easily operate up to 400°F (204°C) with standard fittings and o-ring seals, but are capable of reaching 500°F (260°C) with optional o-ring seals for the cell assembly. Sufficient void space must be left inside the cell for the fluid to expand due to elevated temperatures. The higher the temperature the more space must be left, so the larger volume cells are typically used for higher temperatures above 350°F (176°C). Anyone running tests above 350°F (177°C) must substitute a complete set of o-rings after each and every test.

- A controlled pressure source (Not included)
- Two Nitrogen pressure regulators (primary and back pressure)
- A high-pressure test cell
- A heating jacket for heating the test cell
- A suitable stand
- A Back Pressure Assembly

Specifications

Size:	10" × 18" × 42" (25.4 × 45.7 × 106.7 cm)
Weight:	53 lb. (24.13 kg)
Shipping Size:	29" × 12" × 16" (74 × 30.5 × 41 cm)
Shipping Weight:	65 lb. (29.5 kg)
Maximum Temperature:	400°F (204°C)
Maximum Pressure (Cell):	2,000 PSI
Maximum Pressure (Receiver):	750 PSI (5.1 MPa) (13,880 kPa) - Set screw caps, 2 cm thick
Pressure Source:	Nitrogen (at least 1,500 PSI / 10,343 kPa) - Not Included
Test Cell Capacity:	500 mL
Heater:	800 Watt
Power Requirement:	#171-00-C - 115 VAC, 5 Amps, 50/60 Hz #171-01-C - 230 VAC, 3 Amps, 50/60 Hz

Components

#171-00-C HTHP Filter Press; Single-End, 500 mL Cell; 2,000 PSI; Complete with Nitrogen Manifold; 115V:

#171-01-C HTHP Filter Press; Single-End, 500 mL Cell; 2,000 PSI; Complete with Nitrogen Manifold; 230V:

- #153-12 Graduated Cylinder; 100 mL × 1 mL; Glass
- #154-20 Dual-Scale Thermometer with Metal Dial; 8" Stem; 50°–500°F (0°–250°C)
- #170-13-3 Cell O-ring; Viton; Qty: 6
- #170-17 Valve Stem O-ring; Qty: 6
- #170-19 Filter Paper; 2½" (6.35 cm); Specially Hardened for Filter Presses
- #170-26-1 Hardened Locking Screw; Qty: 6
- #170-35 6" Adjustable Wrench

#171-10 Back Pressure Receiver; 100 mL:

- #170-32 NPT Male Needle Valve, ⅛" × ⅛"
- #171-11 O-ring for 100 mL Back Pressure Receiver
- #171-12 Receiver Body
- #171-22 Retainer Pin

#171-20 Test Cell; 10"; 500 mL

- #170-13-3 Cell O-ring; Viton; Qty: 2
- #170-16 Valve Stem; Qty: 2
- #170-17 Valve Stem O-ring; Qty: 4
- #170-26-1 Hardened Locking Screw; Qty: 6
- #170-27 Allen Wrench; ⅝"
- #171-17 316 Stainless Steel Test Cell Body; 10"; 500 mL
- #171-21 Cell Cap

#171-24 1,350 & 750 PSI Nitrogen Manifold

- #170-08 Regulator; Qty: 2
- #170-20 Manifold Block
- #170-32 NPT Male Needle Valve, ⅛" × ⅛"
- #171-22 Retainer Pin
- #171-25-1 Relief Valve; Set at 750 PSI
- #171-25-2 Relief Valve; Set at 1,350 PSI
- #171-26 Hose, 5,000 PSI
- #171-28 Dual Manifold Body
- #171-38 Gauge, 2.5 in., 0–1,000 PSI, ¼" NPT
- #171-40 Gauge, 2.5 in., 0–1,500 PSI, ¼" NPT
- #171-42 Gauge, 2.5 in., 0–3,000 PSI, ¼" NPT

#171-00 Heating Jacket; 800 Watt; 115 Volt

- #170-10 Pilot Light for Thermostat
- #170-11 Heating Element, 115V, 200W; Qty: 4
- #171-32 Knob
- #171-44 Rubber Foot, ¾"
- #171-71 Thermostat, for HTHP Filter Press
- #171-82 Power Cord with Male Plug Only, 8'; 16/3 SJ; Round

#171-01 Heating Jacket; 800 Watt; 230 Volt

- #170-10 Pilot Light for Thermostat
- #170-11 Heating Element, 115V, 200W; Qty: 4
- #171-32 Knob
- #171-44 Rubber Foot, ¾"
- #171-71 Thermostat, for HTHP Filter Press
- #165-40-4 Power Cord 230 Volts, Type C

Optional:

- #170-33 Cell Cap Removal Tool
- #170-37 Nitrogen Cylinder; 21" × 7"; Right-hand Thread
- #170-40 Carrying Tool for HTHP Cell Assembly
- #171-06 Safety Shield

#171-00-C-SP Spare Parts for One Year for 171-00-C:

- #153-12 Graduated Cylinder; 100 mL × 1 mL; Glass, Qty. 2
- #154-20 Dual-Scale Thermometer with Metal Dial; 8" Stem; 50° – 500°F (0° – 250°C)
- #170-13-3 Cell O-ring; Viton; Qty: 50
- #170-16 Valve Stem; Qty: 4
- #170-17 Valve Stem O-ring; Qty: 48
- #170-19 Filter Paper; 2½" (6.35 cm); Specially Hardened for Filter Presses; Qty: 5
- #170-26-1 Hardened Locking Screw; Qty: 12
- #170-27 Allen Wrench; ⅝"
- #171-11 O-ring for Back Pressure Receiver; Qty: 4
- #171-23-1 Safety Pin with 3" Lanyard; Qty: 2

Optional Items for HTHP Filtration Testing:

The items listed below are not included in the HTHP Filter Press, but they are items that will enable the technician to perform a more uniform and reproducible test while maintaining a high degree of safety. As optional items, the usage is not compulsory, but consideration should be given to these items when running tests at elevated temperatures and pressures.



Interval Timer, 60 minute
(#155-20)



Cell Cap Removal Tool (#170-33)
(Set Screw Cell Assemblies Only)



Cell Carrying Tool (#170-40)



HTHP Pressure Relief Tool
(#170-91)
(To release trapped pressure)



Safety Clamp (#170-92)
(Set Screw Cell Assemblies Only)



Safety Shield (#171-06)



High Pressure Nitrogen Assy.
(#171-31)



Thermocouple
Assembly (#171-45-1)
(Direct temperature measurement
of the fluid inside the cell)



Stand for HTHP Cell Assembly
(#171-190-028)

Safety

Pressure

There are two reasons for operating at elevated pressures when performing a filtration analysis.

1. To test fluids at temperatures above the boiling point, the vessel must be pressurized, which in turn elevates the vapor pressure (boiling point) so that the fluid remains liquid and does not turn to steam.
2. If testing for drilling applications, pressurization will more approximate down-hole conditions, enabling the technician to match both bottom hole temperatures and pressures.

HHP Filter Presses are pressurized either with Carbon Dioxide or with Nitrogen gas. Nitrogen is more inert and therefore less inclined to react with the test fluid. The OFITE 175 mL HHP Filter Press, #170-00 Series, is small enough to be portable, so it is usually pressurized with small (65 mm length) Carbon Dioxide (CO₂) bulbs, which contain 10 cm³ of CO₂ gas and weigh 8 grams. These bulbs are pressurized to approximately 1,000 PSI and they contain plenty of carrier gas to run a complete 30 minute filtration test, if running the standard API 500 PSI differential test, which is usually 600 PSI on the top manifold and 100 PSI on the bottom or back pressure.

For temperatures less than 200°F (93°C) a back pressure receiver is not required as the filtrate will not reach the boiling point. However when operating above the boiling point of water, a suitable back pressure receiver is required, otherwise the test fluid will turn to steam and the test is invalidated. The standard receiver tube supplied with the 175 mL HHP Filter Press holds 15 mL of filtrate, so it is very important that the receiver outlet ball valve is opened after approximately ten seconds of filtrate collection, as a fluid with poor filtration qualities can easily fill the 15 mL receiver tube almost instantaneously. If this happens the filtrate hopefully will all be ejected from the safety bleeder valve, but if there is too much fluid volume, the liquid may end up inside the regulator rendering it useless which will require servicing by a knowledgeable technician. In some cases, a larger volume receiver may be required and if so a 100 mL back pressure receiver (#171-10) is available with modifications to the legs. Normally the 100 mL receiver is used with the larger 500 mL Filter Press, but it may be used with either model.

If higher pressures and/or larger volumes are required, then Nitrogen is commonly used as a pressure source. A small Nitrogen cylinder (#170-37, size 21" × 7") provides the pressure source and when new, the cylinders are pressurized to 2,216 PSI / 153 Bar and they have a standard CGA-580, Compressed Gas Association – left handed thread fitting connection. CGA-590 right handed thread fittings are available upon request. A dual or single Nitrogen manifold assembly may be used and are available for pressurizing both the top and the bottom or back pressure devices simultaneously or individually as needed. If desired, the 175 mL capacity HHP Filter Press may be pressurized using Nitrogen gas.

Temperature

Normally when one experiences a loss of pressure it is not due to a failure of the metal alloy in the cell, but rather is a failure of the o-ring or Elastomer, which provides the seal. These o-rings may deform or melt under elevated temperatures usually over 400°F (204°C) causing a pressurization failure of the cell, which is often sudden and catastrophic. For example, if the valve stem o-ring suddenly fails, then steam at 400°F and under great pressure may shoot outward horizontally in one or several directions. A safety shield should always be used when operating any HTHP Filter Press and especially when one is going to extreme temperatures and pressures. For temperatures in excess of 400°F (204°C) special o-rings are available and they work very well. Above 350°F (176°C) all o-rings must be replaced after each and every test.

Heating Jacket

Turn the thermostat knob on the front of the metal plate to change the temperature of the heating jacket. The thermostat cover is marked from 1 to 10 and each whole number represents a separate temperature. Each filter press will heat up a little differently so it is a good idea to mark with a pen directly on the face-plate of the thermostat cover the temperature which corresponds with each number. The actual temperature of the heating jacket is measured with a stem thermometer and then the thermometer is placed into the cell body.

The heating jacket will get very hot during the test so be careful not to touch the outside of the jacket at any time during the heat-up period or the test. It is especially easy to get burned when installing or removing the back pressure receiver as the technician is working in a very confined space. The power cord is supplied for either 115 Volts or 230 Volts and due to the various types of plug connectors around the world, it may be necessary to change the plug on the end of the power cord. The power cable is 8 feet in length and the heating jacket should be placed no farther than 8 feet from the appropriate electrical outlet. The heat up time will vary from one instrument to the next and the pilot light will turn on when the set temperature has been reached. The temperature of the fluid inside the cell however will not be at the set temperature, so always allow one hour of heating time for the fluid, after the cell has been fully inserted into the heating jacket.



The HTHP Filter Press is a very safe instrument to operate as long as the instructions are strictly followed. It is imperative that the technician thoroughly understands the assembly and disassembly procedures and also why the order of steps is in place. Care should be taken to never use defective parts and that OFITE's temperature, pressure, and fluid volume limits are strictly adhered to at all times.

The heating jacket and cell will get very hot during the normal duration of the test so the operator should take care to avoid burns. The operator should be careful when attaching and removing pressure manifolds from the heating jacket, especially the back pressure receiver assembly, which involves operating in a small confined space.

Safety Retainer Pin

Always use a safety retainer pin with an attached lanyard, and get in the habit of securing the cotter pin to the pin. Improper placement of retainer pins in the past have resulted in the pressure manifold separating from the filter press which can cause damage to the equipment.



Retainer Pin with Lanyard



Safety Retainer Pin with Lanyard (#171-23-1)

Normally the 500 mL HTHP Filter Press uses Nitrogen as a pressure source, for both inlet and outlet pressure. Nitrogen is more inert than CO_2 and is widely used as a pressure source for the laboratory filtration devices. Pressures vary with the type of Nitrogen tank and fully loaded tanks can hold as much as 6,000 PSI. Nitrous Oxide (N_2O) which is available in small bulbs should never be used as a pressure source for HTHP filtration. Under high temperatures and pressures, Nitrous Oxide can detonate in the presence of grease, oil or carbonaceous material. Nitrogen pressurization will require a separate Nitrogen regulator and tank.





Working Pressure

OFITE clearly stamps the working pressure of the cell assembly along with the assembly serial number on each cell body and cell cap. These pressure limits should never be exceeded on the pressure manifolds and fluid volumes inside the cell should strictly comply with instructions (see page 18).

However, in the past HTHP cells and caps from various manufacturers were often not stamped, or in some cases, very old cell assemblies were stamped "2500". Cell assemblies with set screw secured caps should never be taken to 2,500 PSI, under any temperature or condition.

The 175 mL HTHP Filter Press (#170-00 and #170-01) are furnished with a standard 1,500 PSI working pressure cell assembly. The cell assembly included with the 500 mL HTHP Filter Presses is rated to 2,000 PSI working pressure. Please note, the 1,500 PSI and 2,000 PSI cell assemblies do not have interchangeable parts. When ordering replacement cell caps, know the pressure rating of the cell you are ordering for.

Cell Cap, 1,500 PSI, Set Screws: 0.75 inch thick

Cell Cap, 2,000 PSI, Set Screws: 0.94 inch thick

Locking Set Screws

Locking set screws should have sharp points on the end. If the tip becomes worn and flattened, pressure may be lost in the cell or the cell cap may become damaged. Any set screw cell cap that has elongated set screw holes should be discarded as they are unsafe.



Locking Screw for HTHP Cell Caps 2,000 PSI, 90 Cone Point (#170-26-1)



Cell Cap, 1,500 PSI, HTHP Filter Press 60 mesh screen. 2.5" x 0.75" Note - Round Set Screw Holes. (#170-14)

O-ring Seals

The choice of o-rings, or elastomers as they are commonly called, is very important in any high temperature high pressure environment. OFITE uses Viton o-rings, a copolymer of Vinylidene, which are less pliable than some Buna rings which may be encountered from other manufacturers, but they withstand the higher temperatures better than the Buna rings. The maximum temperature for the Viton o-rings is 400°F (204°C). OFITE suggests that all o-rings (cell caps, cell bodies, and valve stem) are changed each time after running a test of 350° F (176° C) or above.

Filtrate Collection

If using a back pressure receiver, collect filtrate from the ball valve 10 to 15 seconds after the initiation of filtration collection. Do not count this as a separate notation, but the volume should be counted towards the spurt loss value. The receiver tube on the 500 mL HTHP Filter Press holds only 100 mLs of liquid. A fluid with very poor filtration qualities can very quickly fill the receiver tube. This results in fluid blowing out the safety bleeder valve, and if the volume is too much for the bleeder valve to handle, the fluid then goes into the regulator. This will prevent the regulator from operating and will require servicing.

Fluid Expansion Space

Cells should never be filled completely with fluid. Always leave some room for the fluid to expand under temperature. This keeps the cell caps from becoming overstressed and possibly leading to a cell pressure failure or even a loss of the cell cap completely.

Periodically check all gauges to ensure the proper pressures are in the cell, as the pressure often increases or decreases depending upon the test procedure and conditions.

API Recommended Void Space		
Fluid / Temperature	Void Space	Fluid Volume
Water-based drilling fluid. < 300°F	0.6" (1.5 cm)	405 mL
Water-based drilling fluid. > 300°F	1.5" (4.0 cm)	353 mL
Oil-Based Drilling Fluid. Any temperature.	1" (2.5 cm)	382 mL



Void Space in a 1,500 PSI rated cell body

Cell Corrosion

Test fluids under high temperature and pressure can corrode the cell body and caps. Carefully inspect the cell body and caps for corrosion before and after each test.

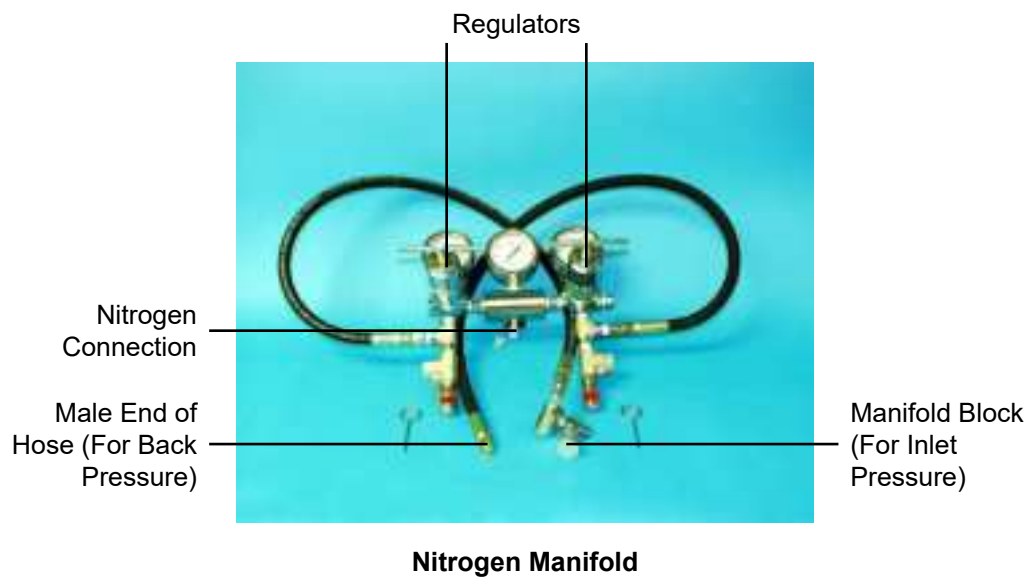
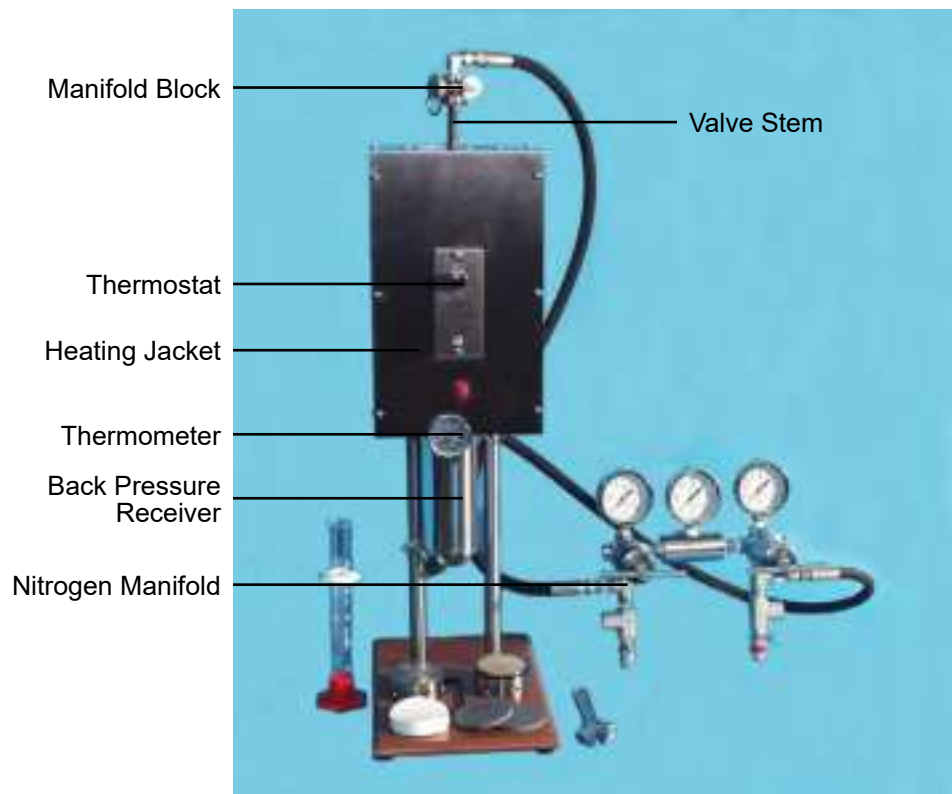
Some materials are more susceptible to corrosion than others. Also, some fluids and additives are more corrosive than others. OFITE offers a variety of cell materials for different levels of corrosion resistance and cost.

The 175 mL HTHP Filter Press uses two regulators as standard equipment. Both may be operated with Carbon Dioxide (CO₂) or Nitrogen (N₂) gas.

1. Concoa Regulator 8051140-00-1: Top or Main Pressure.
 - a. Maximum Inlet Pressure – 3,000 PSI
 - b. ¼ inch NPT Connections
 - c. Single stage regulator

Regulator Safety

1. Never subject the regulator to inlet pressure greater than its rated inlet pressure as shown on the regulator body.
2. Do not allow oil, oil bearing materials, grease, or other combustibles to contaminate the inside or outside of the regulator, especially where Oxygen is in use.
3. To minimize heat effects, avoid the use of piping or tubing between the pressurized cylinder and the regulator. If unavoidable it should be as short as practical and equipped with a shutoff valve located just before the regulator.
4. The 8051140 regulator has been internally cleaned for Oxygen but it is not recommended to pressurize HTHP Filtration tests with Oxygen due to its potentially explosive nature.
5. Never pressurize a regulator that has loose or damaged parts or is in questionable condition. Never loosen a connection or attempt to remove a part until gas pressure has been relieved.
6. Before transporting pressurized cylinders that are not secured on a cart designed for such transport, remove all regulators and recap the cylinders.
7. Check the regulator and all connections for leaks after installation and periodically thereafter. Also check for leaks after any service in which parts or connections were loosened. Brush with an approved leak detection solution and bubbles should indicate a leakage.
8. An appropriately sized pressure relief device downstream of the regulator should be installed in your system to prevent damage to equipment and/or injury to personnel should an internal failure of the regulator occur.
9. Do not purge oxidizing or flammable gases in the presence of flame, lit cigarettes, or other sources of ignition or towards people.



Quick Start

1. Plug unit into an appropriate electrical source.
2. Place a thermometer into the heating jacket. Pilot light turns on when target temperature is reached.
3. Inspect and install all o-rings into the cell body, cell caps and valve stems. Lubricate with silicone grease.
4. Stir test sample for at least 10 minutes.
5. Install and tighten the valve stem on the inlet end of the cell.
6. Invert the cell and pour in the proper volume of test fluid, being careful not to spill liquid onto the o-ring in the cell body.
7. Carefully place a circle of filter paper on top of the o-ring.
8. Align the cell body and cap arrows. Gently push the cell cap into the cell body being careful not to damage the o-ring.
9. Inspect the cap locking screws and the seats on the cell caps for deformities.
10. Tighten completely the six cap locking screws. Ensure that all are completely tight.
11. Install and tighten completely the valve stem.
12. Invert the cell and place into the heating jacket so that the outlet end is positioned downward.
13. Rotate the cell inside the jacket so that it seats into the pin.
14. Move the thermometer from the heating jacket to the cell body.
15. Heat for exactly one hour beginning now.
16. Connect the back pressure receiver to the outlet valve stem and secure with the retainer pin and lanyard.
17. Connect the high and low pressure lines to the appropriate ends of the assembly with the retainer pins and lanyards.
18. Adjust both the inlet and outlet pressure to the recommended back pressure.
19. Open the inlet valve stem to allow pressure inside the cell body. This will prevent evaporation of the liquid inside.
20. After the 1 hour heat up time (no. 15), increase the pressure on the inlet side to 500 PSI above that of the back pressure.

21. Open the outlet valve stem to initiate filtration. Set a timer for 30 minutes.
22. Collect filtrate by opening the receiver outlet valve at intervals of 10 sec., 1, 7.5 and 30 minutes.
23. After 30 minutes, close the inlet and outlet valve stems.
24. Allow at least 5 minutes for the filtrate in the receiver to cool down.
25. Blow out any remaining filtrate from the receiver into the graduate cylinder.
26. Turn the manifold regulator t-screws counter clockwise until they turn freely.
27. Open the inlet manifold needle valve to release any line pressure and remove the block from the valve stem.
28. Remove the back pressure receiver assembly from the outlet valve stem.
29. Remove the cell from the heating jacket.
30. Air-cool or water-cool the cell until it may be safely handled.
31. Position the cell with the inlet end upwards and release the cell pressure by loosening the inlet valve stem.
32. Hand tighten the inlet valve stem.
33. Invert the cell, loosen the 6 outlet cap locking screws, and remove the cell cap from the cell.
34. Carefully remove the filter paper and filter cake.
35. Discard the fluid inside the cell and thoroughly wash out the cell body.
36. Inspect all o-rings for deformities. Replace all o-rings if the test was conducted above 350°F (176°C).
37. Record the total filtrate volume by doubling the amount of filtrate collected in the graduate cylinder.
38. Record the depth of the filter cake and describe its appearance.
39. Record the 7.5 minute spurt loss if desired.



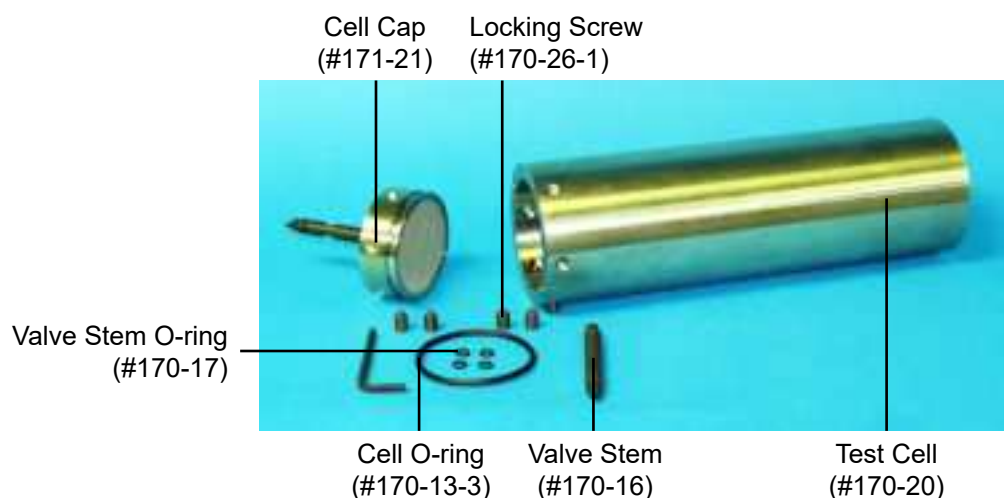
Note

Leave the Filter Press in a condition so that it may be used again with no preparation or clean-up of the assembly. Unplug the electrical cord if not being immediately used.

Operation

1. Plug the heating jacket into an appropriate power source. Place a dial type metal thermometer into the heating well and preheat to 10°F (6°C) above the desired test temperature. A pilot light will come on when the heating jacket reaches the temperature set by the control knob.
2. Be sure all of the o-rings are in good working condition (pliable with no nicks or cuts, etc.), and are not damaged during the assembly procedures. Carefully install an o-ring (#170-13-3) in the o-ring groove in the cell body and another o-ring (#170-13-3) in the cell cap (Note: They are the same o-ring). Place a thin film of silicone grease on all o-rings.

When testing above 300°F (150°C) it is recommended to replace the o-rings after every test.



3. Prepare the sample according to API specifications. Stir the test sample for 10 minutes with a high speed mixer.
4. Place two o-rings in the o-ring grooves on each valve stem. Screw one valve stem into the test cell on the inlet side of the cell. Tighten the valve stem completely. To increase the life of the valve stem and cap, apply a thin layer of high-temperature thread lubricant (#165-44-1) to the o-ring on the bottom of the valve stem.
5. Invert the cell body and carefully pour the sample into the cell, leaving the appropriate amount of void space as indicated by the chart on page 18. Be careful not to spill fluid on the o-ring inside the cell.



Temperature – Pressure – Volume: Recommendations
Do not to spill fluid on the o-ring groove inside the cell

API Recommended Void Space		
Fluid / Temperature	Void Space	Fluid Volume
Water-based drilling fluid. < 300°F	0.6" (1.5 cm)	405 mL
Water-based drilling fluid. > 300°F	1.5" (4.0 cm)	353 mL
Oil-Based Drilling Fluid. Any temperature.	1" (2.5 cm)	382 mL



Void Space in a 1,500 PSI rated cell body

6. Place a circle of filter paper on top of the cell o-ring and gently push the paper downward so it contacts the o-ring without the paper binding or pinching.
7. Inspect the cap locking screws. If the cap locking screws are no longer pointed, there is a possibility of stress failure and the screws should be replaced.
8. Inspect the cap locking screw seats in the cell cap (indentures in the cell cap). If the cap locking screw seats are no longer round, there is a possibility of stress failure and the cap should be replaced.
9. Make sure the arrow on the cell cap lines up with the arrow on the cell body and slowly push the cell cap into the cell. Ensure that the o-ring does not slip out of the o-ring groove during insertion of the cell cap. Not attaching or tightening the valve stem on the cap makes this operation easier.

- Using the allen wrench, tighten the six locking set screws into the cell and secure the cell cap in place. Using hand-touch be very sure that all of the set screws are completely tightened. The cell may become permanently stuck inside the heating jacket if one or more set screws are left protruding from the cell.



- Tighten completely the valve stem into the cell cap with a wrench.
- Invert the cell and place it in the heating jacket with the outlet (filter) side of the cell pointed down. Rotate the cell in the heating jacket so that the pin in the bottom of the heating well seats into the hole in the bottom of the test cell. This will anchor the cell in the well and prevent it from rotating as the valve stems are opened and closed.
- Move the thermometer from the heating jacket to the thermocouple hole on top of the test cell. The heating time of the sample should be one hour (no more and no less). Set a timer to 60 minutes. Begin the heating at this time.



Note

Do not initiate filtration when the thermometer indicates the desired temperature has been reached. The fluid inside the cell may not have yet reached the proper temperature. An API funded project found that for most fluids, it usually takes upwards of an hour for the fluid inside the cell to reach the target temperature. If accurate temperature measurement is required during the heating portion of the test, a thermocouple assembly (#171-45-1) is available which will directly and accurately measure the fluid temperature inside the cell.

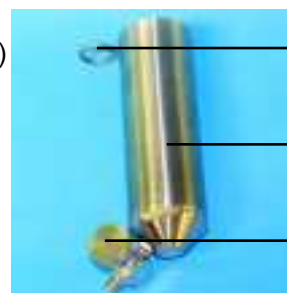
- Connect the manifold block to the inlet valve stem and lock it in place with the retaining pin and lanyard. Check that the safety bleeder needle valve (#170-32) is closed (knob tightened clockwise).

15. Connect the male end of the low pressure hose to the back pressure receiver. Make sure the receiver needle valve is closed.
16. Place the back pressure receiver on the bottom valve stem and lock it in place with the retaining pin and lanyard.

Safety Pin and Lanyard (#171-23-1) Needle Valve (#170-32)



Elbow (#171-24-3)
Manifold Block (#170-20)



Retaining Pin (#171-22)
Back Pressure Receiver (#170-11)
Needle Valve (#170-32)

17. Keeping the valve stems closed, adjust the top and bottom regulators on the manifold to the recommended back pressure for your test.

The upper and lower limits of the test pressure differential are determined by the test temperature. If the test is conducted at a temperature less than the boiling point of water, then no back pressure will be required and filtrate may be collected directly into a graduated cylinder. If however tests are conducted above the boiling point of water, then as this temperature exceeds 212°F (100°C), the back pressure must be increased above the vapor pressure, at the test temperature, in order to prevent vaporization of the filtrate. If running a standard API test, the 500 PSI differential pressure must be maintained, so the top pressure will have to be increased 500 PSI over whatever the back pressure is. The table below shows the back pressures recommended for various test temperatures.

Recommended Minimum Back Pressure					
Test Temperature		Vapor Pressure		Minimum Back Pressure	
°F	°C	psi	kPa	psi	kPa
200-299	95-149	12.1-67	84-462	100	700
300-374	150-189	67-184	462-1269	200	1400
375-399	190-199	184-247	1269-1704	275	1900
400-424*	200-219	247-326	1704-2245	350	2500
425-450*	220-230	326-422	2245-2912	450	3100

**For tests above 400°F, use Teflon o-rings.*

18. Open (loosen) the inlet valve stem ½ turn to pressurize the sample. Maintain this pressure on the fluid until the temperature has stabilized. This will prevent vaporization of the test solution if heating above the boiling point of the liquid.

19. After the one hour heat up time, increase the pressure on the inlet pressure unit to 500 PSI (3,448 kPa) more than the back pressure.
20. Open (loosen) the outlet valve stem $\frac{1}{2}$ turn to initiate filtration as soon as possible. The filtration test begins now. Set a timer to 30 minutes.

Closely monitor the pressure gauges. If at any time during the test the pressure inside the cell rises above the setpoint, carefully open the needle valve on the Inlet pressure assembly just enough to bleed off the excess pressure. Then close the valve. If the cell pressure decreases due to collection of filtrate, increase the pressure with the inlet regulator.

21. To collect filtrate, carefully open the needle valve on the bottom of the back pressure receiver while holding a graduated cylinder to the valve port. Close the valve immediately after the outlet pressure just begins to decrease and filtrate is collected.

Collect filtrate at 10 seconds, 1 minute, 7.5 minute, and 30 minute intervals. The initial 10 second collection is precautionary in nature, as a fluid with little filtration properties may fill up the receiver tube almost immediately, potentially damaging the regulator. Do not record the 10 second volume collected separately, but do record this volume collected at the other time intervals. Timers pre-set to 7.5 minutes and 30 minutes are helpful.

While collecting filtrate, maintain the test temperature within $\pm 5^{\circ}\text{F}$ ($\pm 3^{\circ}\text{C}$). If the back pressure rises during the test, cautiously reduce the pressure by opening the needle valve on the receiver and drawing off some of the filtrate into the graduated cylinder.

22. After 30 minutes the test is over. Immediately close (tighten) the top and bottom valve stems to seal off the cell.

Failure to close the valve stems before releasing pressure (step 24) will damage a regulator by drawing fluid into it.



23. Allow a minimum of 5 minutes for the filtrate in the receiver to cool to avoid vaporizing. Collect filtrate by opening the needle valve on the receiver, and leave it open until fluid ceases to evacuate the valve.
24. Turn the manifold regulator t-screws on both the inlet and back pressure receiver regulators counterclockwise until the t-screw feels loose. This will close off the flow of pressurized gas.
25. Release the pressure from the inlet pressuring unit by opening the needle valve (turn counterclockwise).
26. Remove the top retaining pin and lanyard and remove the manifold block from the valve stem.



27. Remove the back pressure assembly by releasing the retainer pin and lanyard.

Avoid touching the hot heating jacket, especially when removing the back pressure receiver.

28. Drain any residual filtrate collected in the receiver into the graduated cylinder.

29. Record the total amount of filtrate collected in the graduate cylinder by multiplying the amount in milliliters by 2.

30. Remove the cell from the heating jacket after once again checking that the valve stems are tightly closed. An optional Cell Carrying Tool (#170-40) makes this a simple and safe operation.

31. The test cell will still be under approximately 600 PSI (4.140 kPa) pressure. To avoid possible serious injury, keep the cell upright and cool it to room temperature before disassembling. The cell must be below 100°F (38°C). Cool at least one hour at room temperature before loosening the cap locking screws.

32. Place the cooled cell upright with the outlet side down. The optional stand for the HTHP cell assembly (#171-190-082) makes a great cell holder. This will help preserve the filter cake. Open (loosen) the inlet valve stem to bleed off pressure from the cell body. There should be a noticeable release of pressure from the cell.

Hold a rag or piece of paper over the valve stem in order to catch any liquid or solids that might be ejected under pressure from the cell. This will help prevent an unsightly residue build-up on the ceiling which may occur over time.



Note

Pressure cannot be relieved from the cell by opening the outlet valve stem as the filter cake may seal off the cell.

A good indication that pressure is trapped inside the cell body occurs if the set screws are unusually difficult to loosen (especially the 4th, 5th and 6th ones) and the cell cap begins to extrude out of the cell body as the set screws are progressively loosened. To relieve the pressure a straightened wire or small drill bit inserted through the Inlet cell cap hole should relieve the trapped pressure inside the cell. If pressure is still trapped then the OFITE Pressure Relief Tool (#170-91) will relieve the pressure safely. Wear gloves and be sure this function is performed on the inlet side of the cell as the filter cake may seal off the outlet end of the cell.



33. Loosen, but do not remove, the six cap locking screws, and separate the cap from the cell with a slight rocking motion. The OFITE Cell Cap Removal Tool (#170-33) makes it easy to remove tight difficult to remove cell caps.
34. There are several ways to remove the filter along with the filter cake:
 - a. Hold the cell and invert it over a sink and let the weight of the fluid inside the cell push the filter outward.
 - b. Careful manipulation with a spatula often will remove intact a filter and filter cake without losing fluid.
35. Discard the fluid inside the cell unless it is required for further testing. Save the filter cake for analysis.
36. Clean and dry the apparatus thoroughly after each use.
37. Inspect all o-rings for deformities and replace as necessary. Replace all o-rings if the test was conducted above 350°F (176°C).



Tip

After each test, the HTHP filter press should be left so that a new test may be performed with no clean-up and a minimum of assembly.

Data

Filtrate Volume

The HTHP filter press has a filtration area of 3.55 in² (22.9 cm²). This is half the area of a standard filtration test, which is 7.1 in² (45.8 cm²). To compare the results of this test to a standard filtration test, double the total filtrate volume collected for the full 30 minutes.

$$V_s = 2 (V_{30})$$

Spurt Loss (Optional)

Spurt Loss is the amount of filtrate collected before the filter cake has had a chance to form and is expressed in millimeters. To calculate the spurt loss, use the following equation:

$$V_1 = 2 [V_{7.5} - (V_{30} - V_{7.5})] = 2 (2V_{7.5} - V_{30}) = 4V_{7.5} - 2V_{30}$$

Where:

- V_s = Standard Filtrate Volume (mL)
- V_1 = Spurt Loss
- $V_{7.5}$ = Filtrate volume collected after 7.5 minutes (doubled)
- V_{30} = Filtrate volume collected after 30 minutes (doubled)

Filter Cake

Wash the filter cake on the paper with a gentle stream of water. Measure and report the thickness of the filter cake to the nearest 1/32" (0.8 mm). A ruler with the "zero mark" at the very edge of the ruler is useful here. Cake descriptions may be subjective and such notations such as hard, soft, rubbery, and fine, etc. convey adequate information on cake quality.

Maintenance

1. HTHP cell assemblies should periodically be checked for:
 - a. Cell Corrosion – Stress cracking or pitting
 - b. Cylinder Shear – Raised areas above the cell set screw holes
 - c. Elongated set screw holes in the cell bodies
 - d. End Cap Compression – Elongated set screw depressions on cell caps
 - e. Set screws which are no longer tapered on the inside
 - f. Elastomers – Check for flat spotting and melting
 - g. Valve stems should be sharply pointed and not dull on outlet side.
2. Always thoroughly clean up after each tests.
 - a. Replace all elastomers if previous test was in excess of 300°F (149°C).
 - b. Clean out and blow dry if possible, the back pressure receiver.
 - c. Cell body must be completely cleaned with special attention to the o-ring groove.
3. Periodically check for leaks.
 - a. Cell Assembly – Immerse sealed pressurized cell assembly in a sink filled with water – look for bubbles.
 - b. Top Pressure Assembly – Immerse regulator, valves, and sealed cell assembly in a sink full of water and look for bubbles. Hold assembly by the gauge and do not let the gauge get wet.
 - c. Back Pressure Receiver – Similar to “B”. Hold assembly by the gauge and do not allow it to get wet.



Power Cord Maintenance

- a. Check the power cord for insulation wear and loose connections near the heating jacket and plug.
- b. Place the heating jacket no farther from the electrical outlet than the length of the power cord.
- c. Keep the power cord away from the hot surface of the heating jacket.

Installing wiring, power cords, or electrical connectors will void the warranty.

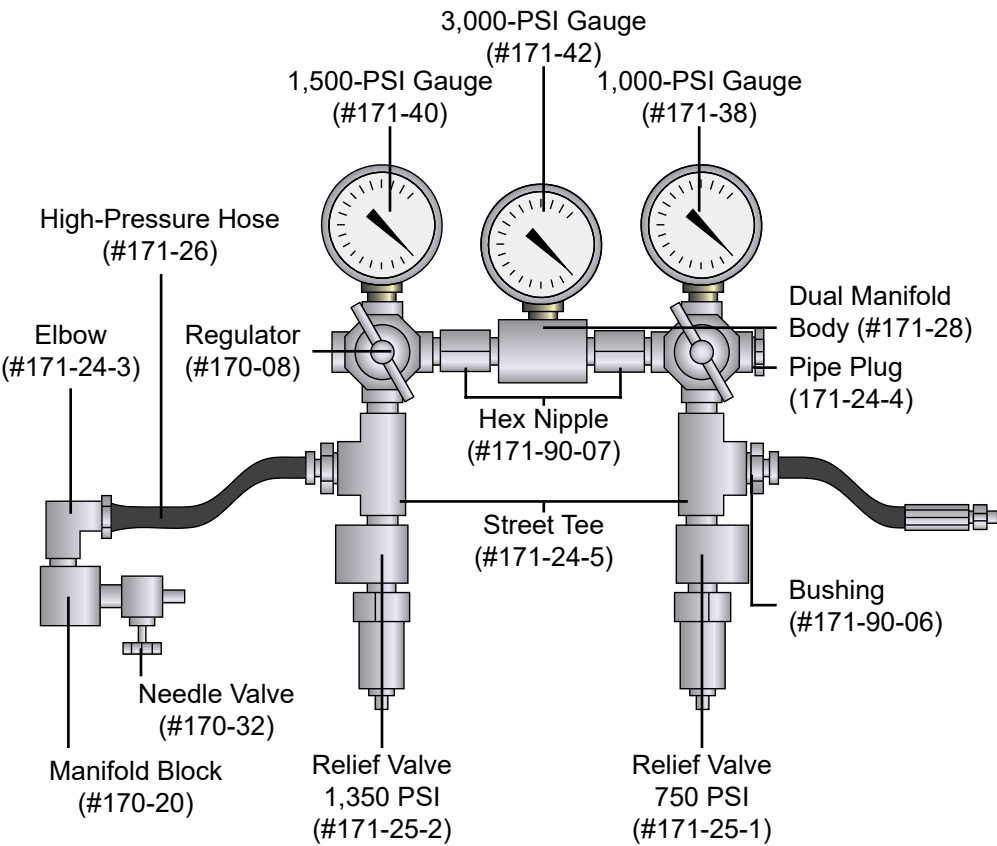


Note

Regulator Maintenance and Troubleshooting

Symptoms	Cause: Resolution
Gas leak at the regulator outlet when the adjusting screw is loosened fully counterclockwise	Seat leak or *creep: Repair the regulator
Outlet pressure increases while downstream valves are closed	Seat leak or *creep: Repair the regulator
Gas leak from the spring housing case	Diaphragm failure: Repair the regulator
Excess drop in outlet pressure with the regulator flow open	Blocked seat assembly or inlet filter: Repair the regulator
Gas leak from any pipe thread joint	Loose fitting: Remove the connection. Clean the affected surfaces. Reapply Teflon tape and tighten.
Gas leak from relief valve	Faulty relief valve: replace the valve. Seat leak or *creep: Repair the regulator
Inconsistent repeat readings	Seat sticking: Repair the regulator. Bad pressure gauge: Replace the gauge.
Gauge does not return to zero with no pressure applied to the regulator.	Gauge has physical damage: Replace the gauge.
*Creep is an increase in outlet pressure that occurs when pressure escapes even when the valve is closed. Regulator seats can be compromised by particles in the process stream which can cause minor imperfections in the sealing surface. The high flow and small orifice created during pressure regulation combine to turn a very small particle into a fast projectile. This projectile can nick the sealing surface of the seat and cause leaks. Filtering particulates from the process stream should be a high priority, and a small filter can reduce the potential for creep and increase the life expectancy and accuracy of the regulator.	

Diagram



Warranty and Return Policy

Warranty:

OFI Testing Equipment, Inc. (OFITE) warrants that the products shall be free from liens and defects in title, and shall conform in all respects to the terms of the sales order and the specifications applicable to the products. All products shall be furnished subject to OFITE's standard manufacturing variations and practices. Unless the warranty period is otherwise extended in writing, the following warranty shall apply: if, at any time prior to twelve (12) months from the date of invoice, the products, or any part thereof, do not conform to these warranties or to the specifications applicable thereto, and OFITE is so notified in writing upon discovery, OFITE shall promptly repair or replace the defective products. Notwithstanding the foregoing, OFITE's warranty obligations shall not extend to any use by the buyer of the products in conditions more severe than OFITE's recommendations, nor to any defects which were visually observable by the buyer but which are not promptly brought to OFITE's attention.

In the event that the buyer has purchased installation and commissioning services on applicable products, the above warranty shall extend for an additional period of twelve (12) months from the date of the original warranty expiration for such products.

In the event that OFITE is requested to provide customized research and development for the buyer, OFITE shall use its best efforts but makes no guarantees to the buyer that any products will be provided.

OFITE makes no other warranties or guarantees to the buyer, either express or implied, and the warranties provided in this clause shall be exclusive of any other warranties including ANY IMPLIED OR STATUTORY WARRANTIES OF FITNESS FOR PURPOSE, MERCHANTABILITY, AND OTHER STATUTORY REMEDIES WHICH ARE WAIVED.

This limited warranty does not cover any losses or damages that occur as a result of:

- Improper installation or maintenance of the products
- Misuse
- Neglect
- Adjustment by non-authorized sources
- Improper environment
- Excessive or inadequate heating or air conditioning or electrical power failures, surges, or other irregularities
- Equipment, products, or material not manufactured by OFITE
- Firmware or hardware that have been modified or altered by a third party
- Consumable parts (bearings, accessories, etc.)

Returns and Repairs:

Items being returned must be carefully packaged to prevent damage in shipment and insured against possible damage or loss. OFITE will not be responsible for equipment damaged due to insufficient packaging.

Any non-defective items returned to OFITE within ninety (90) days of invoice are subject to a 15% restocking fee. Items returned must be received by OFITE in original condition for it to be accepted. Reagents and special order items will not be accepted for return or refund.

OFITE employs experienced personnel to service and repair equipment manufactured by us, as well as other companies. To help expedite the repair process, please include a repair form with all equipment sent to OFITE for repair. Be sure to include your name, company name, phone number, email address, detailed description of work to be done, purchase order number, and a shipping address for returning the equipment. All repairs performed as "repair as needed" are subject to the ninety (90) day limited warranty. All "Certified Repairs" are subject to the twelve (12) month limited warranty.

Returns and potential warranty repairs require a Return Material Authorization (RMA) number. An RMA form is available from your sales or service representative.

Please ship all equipment (with the RMA number for returns or warranty repairs) to the following address:

OFI Testing Equipment, Inc.
Attn: Repair Department
11302 Steeplecrest Dr.
Houston, TX 77065
USA

OFITE also offers competitive service contracts for repairing and/or maintaining your lab equipment, including equipment from other manufacturers. For more information about our technical support and repair services, please contact techservice@ofite.com.