OFITE®

Dependable Products From People You Trust

Benchtop HTHP Curing Chamber

Part No. 120-55

Instruction Manual

Updated 5/20/2010
Ver. 1.1

OFI Testing Equipment, Inc.
P.O. Box 925918 · Houston, Texas · 77292-5918 · U.S.A.
Tele: 713.880.9885 or 877.837.8683 · Fax: 713.880.9886 · www.ofite.com

©Copyright OFITE 2010

Table of Contents

Intro

The OFITE Benchtop HTHP Curing Chamber is designed to prepare well cement specimens for compressive strength tests. It is necessary to determine the amount of time required for a cement to develop compressive strength so that drilling/production operations can be resumed as quickly as possible. The goal is to design a slurry that can quickly develop compressive strength so that the “waiting on cement” time may be minimized. The OFITE HTHP Curing Chambers provide a means of curing cement specimens under typical downhole temperatures and pressures.

Description

Cement is poured into a special mold that produces specimens measuring 2" × 2" × 2". The mold is placed into the test cell and the pressure is increased via an air-driven hydraulic pump. Test temperature is governed by a PID temperature controller, which actuates the heater. After a predetermined amount of time, the temperature of the test cell is reduced by the cooling system. Specimens are removed and the compressive strength is determined as outlined in API Specification 10.

Components

#120-55-005	High-Pressure Filter
#120-55-006	Heater; Thinband; 1,650-Watt; 230-Volt; Qty: 2
#122-052	Rupture Disk; 5,500 PSI (37.9 MPa)
#152-38	AC Power Cord; 3-Conductor; International (Continental European)

Optional:

#120-56 Spare Parts for Benchtop Curing Chamber

Specifications

Air Supply	Maximum 150 PSI (1035 kPa)
Cooling Water Supply	40 PSI (276 kPa)
Readout	Digital
Safety Features	Pressure Relief Valve Safety Head with Rupture Disk
Power Requirements	220 Volts, 50/60 Hz, 40 Amp
Weight	215 lb (94.6 kg)
Dimensions	25" × 16" × 20" (63.5 × 40.6 × 50.8 cm)
Shipping Weight	255 lbs (115.8 kg)
Shipping Dimensions	30" × 20" × 24" (76.2 × 50.8 × 61 cm)
Industry Standards	API Specification 10, ASTM standard C-109

Maximum Temperature/Pressure Combinations

Temp °F (°C)	Pressure PSI (kPa)
125.0 (51.7)	5,250 (36,200)
190.0 (87.8)	4,800 (33,096)
260.0 (126.7)	4,400 (30,338)
375.0 (190.6)	4,000 (27,580)
400.0 (204.4)	3,800 (26,201)

Setup

The Benchtop Curing Chamber consists of two modules. The Cell Module houses the test cell, heaters, and pressure fittings. The Control Module houses all of the electronic controls and the timer.

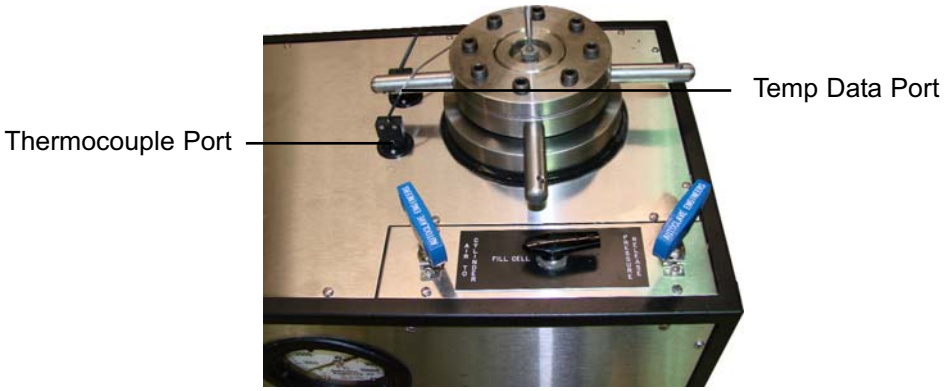
1. Carefully remove both modules from the crate.

2. Make sure the “Fill Cell”, “Air to Cylinder”, and “Pressure Release” valves are closed (turned fully clockwise).

3. Connect a Nitrogen supply (690 - 1,035 kPa or 100-150 PSI), a water supply, and a drain line to the designated ¼" (6.35 mm) ports on the back of the Cell Module.

4. Plug the data cable into the designated ports on the two modules.

5. Plug the thermocouple into the Thermocouple Port on the top of the Cell Module. Plug the temp data cable (male on both ends) into the Temp Data Port on the top of the Cell Module. Plug the other end of the cable into the designated port on the back of the Control Module.



6. Make sure all of the switches on the control module are off. Plug the unit into a grounded electrical outlet.

7. Turn the “Main” switch on.

Control Module

Cell Module

Control Module:

Main Switch - Provides power to the entire unit.
Pump Switch - Provides power to the pump.
Heat Switch - Provides power to the heaters.
Timer Switch - Provides power to the timer.
Auto Cool Switch - Automatically begins cooling at the end of the test.
Sonalert Switch - During an alarm condition, the unit will beep only if this switch is on.
Cool Switch - Manually begins cooling.
Alarm Switch - If this switch is on, the unit will enter an alarm condition when the temperature exceeds 400°F (200°C).
Temperature Controller - Controls the temperature in the test. (see page 12 for instructions)
Timer - Displays the current duration of the test and controls the Auto Cool function. (see page 15 for instructions)

Cell Module:

Pressure Gauge - Displays the pressure inside the test cell.
Regulator - Controls the pressure inside the test cell. Turn it clockwise to open and counter-clockwise to close.
Fill Cell Valve - Allows the cell to fill with water, which adds pressure.
Air to Cylinder Valve - Pumps air into the cell to displace the water and allow it to drain.
Pressure Release Valve - Releases pressure from the cell.

Setup

Preparing the Slurry

It is very important to begin a test as soon as possible after preparing the cement slurry. Before you prepare the slurry, make sure the unit is ready to begin a test. If you plan to use a custom temperature profile, program the temperature controller (see page 12 for instructions) first before mixing the cement.

1. Spread a thin coat of grease on all interior surfaces of the cement molds (#120-85-003). This will make it easier to remove the cement after the test.

2. Prepare the cement slurry according to API Specification 10.

3. Fill half of each mold with the prepared slurry.

4. With a puddling rod, tap the bottom inside of the cement mold to remove any trapped air bubbles.

5. Stir the remaining slurry and fill each mold to overflowing.

6. Puddle each specimen to remove any trapped air bubbles.

7. Using a straight edge, scrape the excess slurry from the top of each specimen to make them level.

8. Attach the top plate and secure it in place with the screws provided.

Cement Molds

Operation

Before beginning a test, make sure all switches are in the off position and all valves are closed.

1. Loosen all eight set screws on the cell cap with a torque wrench.

2. Unscrew the cell cap and remove it from the cell.

3. Prepare the cement slurry as described on page 6. Carefully lower the cement molds into the test cell.

4. Remove the handle from the mold.

5. Lubricate the threads of the cell cap with high-temperature thread lubricant (#165-44). Coat the cell cap o-ring with a thin layer of grease.

6. Place the cell cap back onto the cell and screw it in place hand tight. Be careful not to damage the seal rings and the cap itself.

7. Tighten all the set screws on the cell cap by hand.

8. Adjust the supplied torque wrench to 90 inch-pounds. Tighten the first screw until the torque wrench clicks. Skip four screws and tighten the fifth until the torque wrench clicks. Continue in this manner, tightening every fifth screw until all eight have been tightened.

9. Now adjust the torque wrench to 180 inch-pounds and tighten all of the set screws as described in the previous step.

The cap must be tightened consistently and uniformly every time to create a good seal.

10. Loosen the thermocouple compression fitting in the center of the cell cap. Insert the thermocouple through the compression fitting. Tighten the fitting finger tight and then loosen it 1/8 of a turn.

11. Make sure the “Air to Cylinder” and “Pressure Release” valves are closed. Turn the “Regulator” completely counter-clockwise.

12. Turn the “Pump” switch on.

13. Open the “Fill Cell” valve. Water will flow into the test cell and the displaced air will be forced out through the loosened thermocouple compression fitting.

14. Keep a 5/8" wrench handy and watch the top of the cell. When water begins to flow from the compression fitting, tighten it with the wrench. This will ensure that no air remains in the cell.

15. Set the pressure in the test cell by turning the “Regulator” clockwise until the gauge reads the desired pressure. If the pressure rises too high, slowly open the “Pressure Release” valve. When the pressure has dropped, close the valve.

16. Set the temperature controller on the Control Module to the desired temperature.


Note

The temperature controller features both manual and automatic operating modes. To use the manual mode, simply use the up and down arrows to set the test temperature. To use the automatic mode, refer to page 12 for instructions.

17. Turn on the “Heater” switch.

18. Turn the “Sonalert” on to be notified of an alarm condition.

19. Program the set points on the timer and press the “R” button. See page 15 for more information.

Termination

When the test is complete, the cement slurry will be fully cured. The system must be shut down very carefully to avoid injury or damage to equipment.

1. Turn the “Heat” switch off. If the timer is in automatic mode, press and hold the “Run/Hold” button until the “Run” indicator goes off. If the timer is in manual mode, use the arrows to bring the temperature down to 0.

2. If “Auto Cool” is off, turn on the “Cool” switch. This will begin circulating water through the test cell.

3. When the temperature in the cell drops below 180°F (80°C), turn off the pump and slowly open the “Pressure Release” valve.

Do not attempt to release the pressure until the temperature is below 180°F (80°C).

4. Close the “Fill Cell” valve.

5. Slowly open the “Air to Cylinder” valve. This will force the water out of the cell and into the drain line. When air starts escaping from the drain, close the “Air to Cylinder” valve.

6. Make sure the pressure gauge reads 0. Slowly loosen the thermocouple compression fitting and remove the thermocouple.

7. Loosen the screws on the cell cap. Unscrew the cap and remove it from the cell. Remove the cement molds from the cell and allow them to cool as directed in API Specification 10.

8. Put the cell cap back on the cell to prevent dust and debris from settling inside. Close all valves and turn all switches off.

Maintenance

1. One of the most important elements of trouble free operation is keeping the interior of the test cell as clean as possible. Never insert a cement covered cement mold into the test cell and periodically examine the test cell to ensure that it is clean. High-pressure valves wear quickly when exposed to fluids containing cement and other particulate matter. Also make sure the air used for the air supply is clear.

2. OFITE uses a high pressure filter to protect valve stems. We recommend that filtered water be used in the curing chamber to prevent particulate matter from entering the pump and possibly causing damage. Clean or replace these filters when fluid flow is reduced from that of a clean system. Remember: Filters are inexpensive when compared to the costs of replacing the components they were designed to protect.

3. The test cell cap threads have been lubricated prior to shipment and periodically should be re-lubricated.

Appendix

Fuses

The Benchtop Curing Chamber uses several fuses and circuit breakers to protect the electrical components. Each of these should be checked periodically. The fuses are located inside the Control Module behind the left side panel. The circuit breakers are located inside the Cell Module behind the back panel.

1. Main Circuit Breaker - Check if you are having problems with power to the unit.

2. Heater Circuit Breaker - Check if the unit's heaters are not functioning.

3. The three fuses in the Control Module are all 1-amp (#122-072). They each protect different systems within the unit.

   - F3: Instruments and Cooling
   - F4: Pump, Heat, and Sonalert
   - F5: Main Relay

Appendix

Temperature Controller

The controller allows you to program a temperature profile for your test. This profile will be divided into at least two segments. Each segment controls a portion of the test and determines the temperature, time, and behavior of the test cell during a specified time period.

The four buttons along the bottom of the display provide access to the temperature profiles. Begin by pressing the “PAGE” button three times. The display will read "Prog List". Now, press the “SCROLL” key repeatedly until the setting you wish to change is shown on the display. Then press either arrow key until the appropriate value is displayed. Once you've chosen a value, press the “SCROLL” key again to select a new setting.
The first group of settings should read as follows:

Setting	**Value**
Prg1	1
Hb	OFF
Hb.u	0.0
Rmp.u	min
Dwl.u	min
Cyc.n	1

Important

These settings will be the same for every test. Do not change them.

1. Begin by defining the first segment of the test.
    a. Press the “SCROLL” key repeatedly until “Seg” appears on the display.
    b. Press either arrow key repeatedly until “1” appears on the display. You are now editing segment 1.

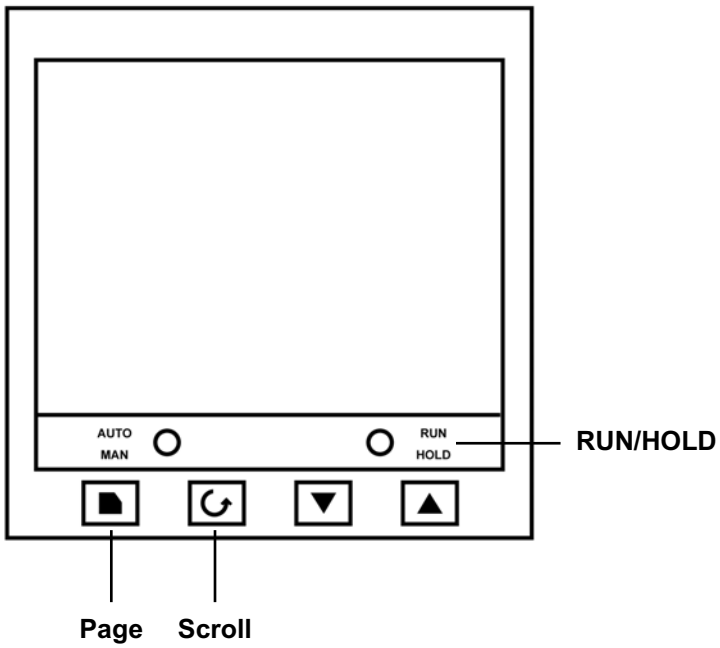
2. The first setting is “Type”.
    a. Press the “SCROLL” key until the word “Type” appears on the display.
    b. The available options are “rmp.r”, “rmp.t”, or “dwell”. Press either arrow key until the appropriate value appears on the display.

    Rmp.r programs the controller to steadily increase the temperature by a specified rate (degrees per minute). If you choose this value, your next option will be “Tgt”, which is your target temperature and then “Rate” which is the rate you want the temperature to increase.

    Rmp.t increases the temperature over a specified time interval (minutes). If you choose this value, your next option will be “Tgt” (target temperature) and then “Dur” (duration in minutes).

    Dwell holds the temperature at its current setting for the duration specified.

Temperature Controller



3. Now define the second segment.
    a. Press the “SCROLL” key until “Seg” appears on the display.
    b. Press either arrow key until “2” appears on the display. You are now editing segment 2.

4. Continue this process with each segment in the test.

5. When you reach the last segment, set the “Type” to “end”. The next setting will be “End.t”.

    If you choose “**sop**”, the heat will be turned off and the test ended.

    If you choose “**dwell**”, the heat will be held at the current temperature indefinitely.

Example 1:

Heat the sample at 2.5° per minute and stop at 150°. Hold at 150° for 180 minutes and then stop the heat.

Setting	**Value**	**Description**
Prg	1	
Hb	OFF	
Hb.u	0.0	
Rmp.u	min	
Dwl.u	min	
Cyc.n	1	

Seg	1	Segment 1
Type	rmp.r	Increase temperature at a specified rate
Tgt	150	Heat to 150°
Rate	2.5	Increase temperature at 2.5° per minute
Seg	2	Segment 2
Type	dwell	Hold on the current temperature
Dur	180	Hold for 180 minutes
Seg	3	Segment 3
Type	end	This is the last segment
End.t	sop	Stop the heat

Example 2:

Heat the sample to 200° over a period of 90 minutes. Then increase the temperature to 300° at a rate of 3° per minute. Hold that temperature indefinitely.

Setting	**Value**	**Description**
Prg	1	
Hb	OFF	
Hb.u	0.0	
Rmp.u	min	
Dwl.u	min	
Cyc.n	1	
Seg	1	Segment 1
Type	rmp.t	Increase temperature for a specified time
Tgt	200	Heat to 200°
Dur	90	Increase temperature for 90 minutes
Seg	2	Segment 2
Type	rmp.r	Increase temperature at a specified rate
Tgt	300	Heat to 300°
Rate	3	Increase temperature at 3° per minute
Seg	3	Segment 3
Type	end	This is the last segment
End.t	dwell	Hold at the current temperature indefinitely

Appendix

Auto Cool

The timer on the front of the Control Module controls the automatic cooling system. When the “Timer” switch is turned on, the timer automatically starts counting upwards from 0. When the “R” button is pressed, the timer resets to 0 and resumes counting upwards.

Two set points can be programmed into the timer. When the first set point is reached, the timer activates the water solenoid and begins circulating water through the test cell. When the second set point is reached, the timer deactivates the solenoid and stops the flow of water into the cell.

For example, assume you want to run the test for 5 hours then cool the cell for 2 hours. The following steps will program the timer:

1. Press “1” to program setpoint 1. Use the “1” key to set the first digit to 0. Press the “2” key to set the hours to 5 and use the two blank keys to set the hours and minutes to 0.

2. Press “E” to save these settings.

3. Press “2” to program setpoint 2. Use the “1” key to set the first digit to 0. Press the “2” again to set up the hours to 7 and use the two blank keys to set the hours and minutes to 0.

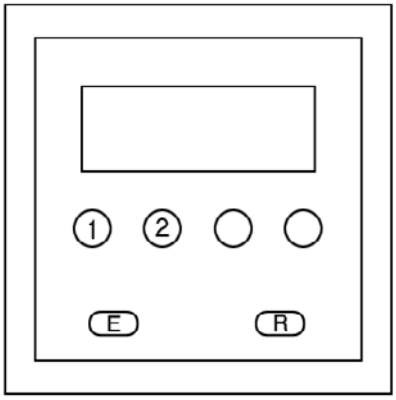
   Be sure to program setpoint 2 with the total time from the beginning of the test, not from the last setpoint. In this example, the initial test time of 5 hours plus the cooling time of 2 hours equals a total of 7 hours for setpoint 2.

4. Press “E” to save these settings.

Note

Now when you press the “R” button, the timer will begin counting upwards. At five hours it will begin cooling and at seven hours it will stop.

The “Auto Cool” switch must be on for this feature to work.



Timer Front Panel Layout