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HTHP Curing Chamber

Single Cell, Single Deep: #120-20
Single Cell, Double Deep: #120-25
Dual Cell, Single Deep: #120-30

Instruction Manual

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Ver. 1.7

OFI Testing Equipment, Inc.

*11302 Steeplecrest Dr. · Houston, Texas · 77065 · U.S.A.
Tele: 832.320.7300 · Fax: 713.880.9886 · www.ofite.com*

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Intro

The Model 200 HTHP Curing Chamber is utilized 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

Components:

- #122-001 Thermocouple Assembly
- #122-008 Heater Assembly
- #122-052 Rupture Disk, 5,500 PSI (38 MPa)
- #122-073 2-Amp Fuse, 5 mm × 20 mm
- #122-077 10-Amp Fuse, 5 mm × 20 mm
- #122-079 Circuit Breaker
- #122-083 Mold Assembly, 8 Specimen

Optional:

#120-21 Spare Parts for One Year's Operation 120-20:

#120-26 Spare Parts for One Year's Operation 120-25:

- #122-001 Thermocouple Assembly
- #122-008 Heater, Qty: 2
- #122-052 Rupture Disk, 5,500 PSI (38 MPa), Qty: 2
- #122-073 2-Amp Fuse, 5 mm × 20 mm, Qty: 4
- #122-074-1 5-Amp Fuse, 5 mm × 20 mm, Qty: 4
- #122-077 10-Amp Fuse, 5 mm × 20 mm, Qty: 4
- #122-079 25-Amp Circuit Breaker with Neutral Breaker

#120-31 Spare Parts for One Year's Operation 120-30:

- #122-001 Thermocouple Assembly, Qty: 4
- #122-008 Heater, Qty: 4
- #122-034 Valve, Qty: 4
- #122-052 Rupture Disk, 5,500 PSI (38 MPa), Qty: 4
- #122-072 1-Amp Fuse, 5 mm × 20 mm, Qty: 8
- #122-074-1 5-Amp Fuse, 5 mm × 20 mm, Qty: 4
- #122-079 25-Amp Circuit Breaker with Neutral Breaker, Qty: 2
- #122-083 Mold Assembly, 8 Specimen, Qty: 2

Specifications

Air Supply	Not more than 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 Electrical Power Supply
Weight	499 kg
Dimensions	84 × 76 × 152 cm
Shipping Weight	590 kg
Shipping Dimensions	99 × 91 × 168 cm
Industry Standards	SPI Specification 10 ASTM Standard C-109

**Maximum Temperature / Pressure Combinations
Safety Factor: 2.0**

Temperature °F (°C)	Pressure PSI (kPa)
72 (22)	5,750 (39,675)
85 (29)	5,600 (38,640)
125 (52)	5,250 (36,225)
190 (88)	4,800 (33,120)
260 (127)	4,400 (30,360)
375 (191)	4,000 (27,600)
550 (288)	3,600 (24,840)
650 (343)	3,400 (23,460)
746 (397)	3,275 (22,598)

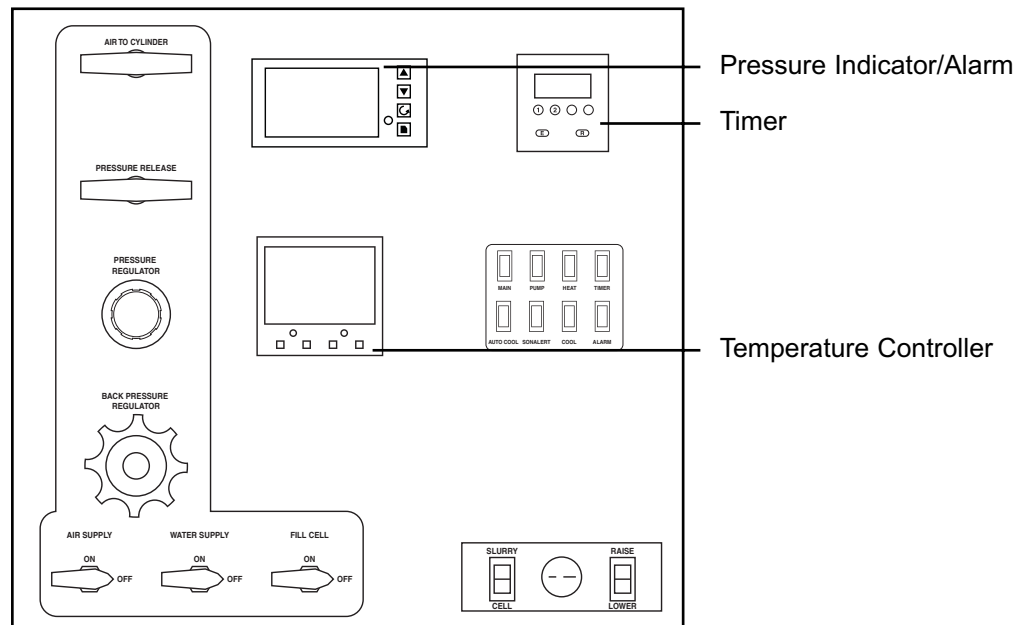
**Maximum Temperature / Pressure Combinations
Safety Factor: 1.5**

Temperature °F (°C)	Pressure PSI (kPa)
75 (24)	8,875 (61,193)
80 (27)	8,800 (60,676)
105 (41)	8,400 (57,918)
135 (57)	8,000 (55,160)
175 (79)	7,600 (52,402)
220 (104)	7,200 (49,644)
275 (135)	6,800 (46,886)
340 (171)	6,400 (44,128)
430 (221)	6,000 (41,370)
535 (279)	5,600 (38,612)
700 (371)	5,200 (35,854)
750 (399)	5,100 (35,164)

Setup

1. Carefully remove the instrument from the wooden crate.
2. Ensure all five valves on the front of the instrument are closed. These valves are labeled “FILL CELL”, “AIR SUPPLY”, “WATER SUPPLY”, “AIR TO CYLINDER”, and “PRESSURE RELEASE”.
3. An air/nitrogen (690 - 1,035 kPa or 100 - 150 PSI) supply line should be connected to the “AIR SUPPLY” on the back of the instrument. The Curing Chamber is equipped with a ¼" (6.35mm) NPT fitting for connecting the air supply. The fitting is located on the back of the Curing Chamber at the very bottom.
4. The “DRAIN” and “WATER SUPPLY” lines should be connected in a similar manner. These ¼" hose connections are located right next to the air supply connection on the back of the unit.
5. Ensure that all electrical switches are in the off (down) position and make the necessary electrical connections in accordance to local codes. Ensure that the unit is grounded.
6. Turn the “MAIN” switch to the on position.
7. Prepare the cement molds as outlined on the next page. Note that these procedures are stated within API Specification 10.

Curing Chamber Control Panel



Prepare Molds

Thinly coat the interior faces of the molds and the contact surfaces of the plates with grease to facilitate the removal of the cement specimens once they have cured.

Prepare Slurry

Prepare the cement slurry in accordance with Sect. 5 of API Specification 10.

Fill Molds

Place the slurry in the prepared molds in a layer equal to one-half of the mold depth. After all the specimen compartments are filled half full with slurry, puddle each specimen 25 times with a puddling rod. After puddling the first layer, stir the remaining slurry by hand using a puddling rod or spatula to eliminate segregation. Then fill each specimen to overflowing and puddle as the first layer. After puddling, strike off the excess slurry even with the top of the mold, using a straight-edge. Discard specimens in molds which show evidence of leaking. Place a greased cover plate on top of the mold. For one test determination, not less than three specimens should be used.



Cement Molds

Operation

1. Loosen all twelve set screws on the cell cap with a torque wrench.
2. Unscrew the cell cap by turning it counter-clockwise.
3. Once the cell cap is completely unscrewed, flip the wench switch to "RAISE." The wench switch is located to the left of the cell on the Curing Chamber cabinet. The wench will automatically lift the cell cap off of the test cell.
4. Carefully lower the cement molds into the test cell, ensuring that the thermocouple port is centered correctly.
5. Remove the handle from the mold.
6. The sealing ring and threads on the cell cap should be lubricated periodically with a high temperature grease.
7. Flip the wench switch to "LOWER," helping align the cell cap as it is lowered to the test cell.
8. The test cell cap should be tightly screwed all the way into the test cell by hand, being careful not to damage the seal rings and the cap itself.
9. Tighten all the set screws on the cell cap by hand, using a circular sequence.
10. Adjust a torque wrench to 90 inch-pounds and tighten the set screws in a rotational sequence. In other words, tighten a set screw, skip four set screws, tighten the fifth set screw, skip four set screws, etc. until all of the set screws have been tightened. The torque wrench will click when the specific torque has been achieved.
11. Now adjust the torque wrench to 180 inch-pounds and tighten the set screws in the same rotational sequence as described above. In other words, tighten a set screw, skip four set screws, tighten the fifth set screw, skip four set screws, etc. until all of the set screws have been tightened. Again, be sure and listen for the click that signals the specific torque has been achieved.



It is imperative that the cap be tightened in a consistent and uniform manner to obtain a good seal.

12. Insert the thermocouple through the top of the test cell, tighten the threaded gland finger tight and then loosen 1/8 turn. Verify that the other thermocouple plug is connected to the side of the curing chamber cabinet.
13. Verify that the "AIR TO CYLINDER" and "PRESSURE RELEASE" valves are closed.

14. Turn the "WATER SUPPLY" valve on.
15. Turn the "AIR SUPPLY" valve on.
16. Turn the "FILL CELL" valve on. Water will flow into the test cell and air will be expelled from the loosened thermocouple connection.
17. With a 5/8" wrench handy, watch the top of the cell. When water begins to flow from the thermocouple connection, tighten the thermocouple fitting with the wrench.
18. Apply pressure to the test cylinder by turning the "PUMP" switch on. The pressure may then be increased by turning the "REGULATOR" clockwise until the desired pressure is obtained. This pressure is shown on the "PRESSURE INDICATOR." The system will automatically make adjustments to keep the pressure consistent. The pressure threshold may be reduced by slightly opening the "BACK PRESSURE REGULATOR." See the Appendix for how to set up the alerts on the "PRESSURE INDICATOR."
19. For temperature, you have a choice of manual control or running up a custom program. If you are controlling the temperature manually, use the up/down arrows on the "TEMPERATURE CONTROLLER" to set your temperature. If you are using a pre-set program, push and hold the "Run/Hold" button until the light for Run turns on. See the Appendix for how to custom program your "TEMPERATURE CONTROLLER."
20. Turn on the "HEATER" switch.
21. Turn on the "SONALERT" so that you will be notified with beeping noises should the unit experience any alarms.
22. The timer on the OFITE Curing Chamber incorporates a relay which can be used to automatically control the water cooling solenoid. The timer may be activated by turning the "TIMER" switch and pressing the "R" button on the "TIMER". If you are using the "AUTO COOL" feature, flip that switch on as well. See the Appendix for how to custom program your "TIMER."

Termination



1. After the cement has cured for the required amount of time, the test will need to be terminated. If you are running a custom program on the "TEMPERATURE CONTROLLER," push and hold the "Run/Hold" button until the light for Run and Hold both turn off. If you are manually handling the temperature, use the down arrow key to reduce the temperature. In either case, the "HEAT" switch should be turned off.
2. If you are not using the "AUTO COOL" feature in conjunction with the "TIMER," turn the "COOL" switch on.
3. After cooling to less than 80°C (180°F), release the pressure by switching the "PUMP" switch to the off position. Slowly open the "PRESSURE RELEASE" valve. The pressure gauge should be close to zero.

DO NOT RELEASE THE TEST PRESSURE UNTIL THE TEMPERATURE HAS BEEN REDUCED TO A MINIMUM OF 200°F.

4. With the "PRESSURE RELEASE" valve open, water can now be removed from the test cell. Slowly open the "AIR TO CYLINDER" valve. Air pressure will force water from the test cell. When air is escaping out of the vent, the "AIR TO CYLINDER" valve should be closed.
5. Slowly loosen the fitting on the thermocouple and remove it from the test cell.
6. The cap screws should be loosened and the test cell cap should be unscrewed. Use the wench switch to raise the cell cap. Remove the cement specimens and cool as stated within API Specification 10.
7. Return the test cell cap to the test cell to prevent dust and other matter from entering the test cell. Close all valves and return all switches to the off position.

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.

Troubleshoot

The OFITE Curing Chamber utilizes several fuses that are integral to the unit's proper functioning. Located on the left side of the Curing Chamber cabinet, these should be checked periodically and whenever you are experiencing problems with the Curing Chamber.

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. F4, F5, F6, F7 Fuses - A light indicates when they need to be replaced.

The OFITE Curing Chamber also contains a built in test you can perform to make sure the "PRESSURE INDICATOR/ALARM" is functioning properly. To perform this test, press in the white plastic key located on the far right. The unit should beep and the entire "PRESSURE INDICATOR/ALARM" panel should light up in a circular motion.



F4-F7 Fuses

Pressure Indicator/Alarm Key

Main Circuit Breaker

Heater Circuit Breaker

Appendix

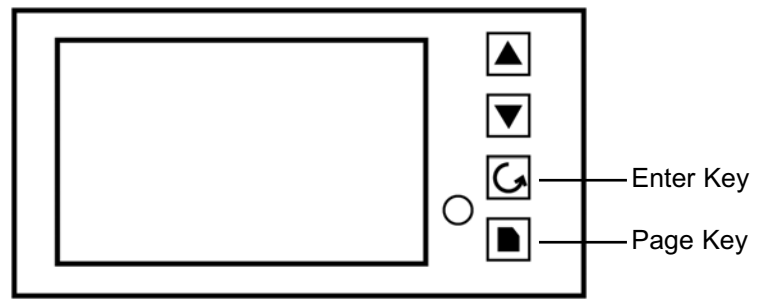
Pressure Indicator

The pressure indicator not only shows you the current pressure, but it also alerts you when the pressure rises above the value you set.

The display shows the current pressure in KPSI. This means a reading of 12.501 indicates a pressure of 12,501 PSI.

To set the high-pressure alarm:

1. Press the “Page” button until the display reads “AL”.
2. Press the “Enter” button until the display reads “1FSH”.
3. Press the up and down arrows to set the high-pressure setpoint.



Pressure Indicator

Appendix

Set Temperature

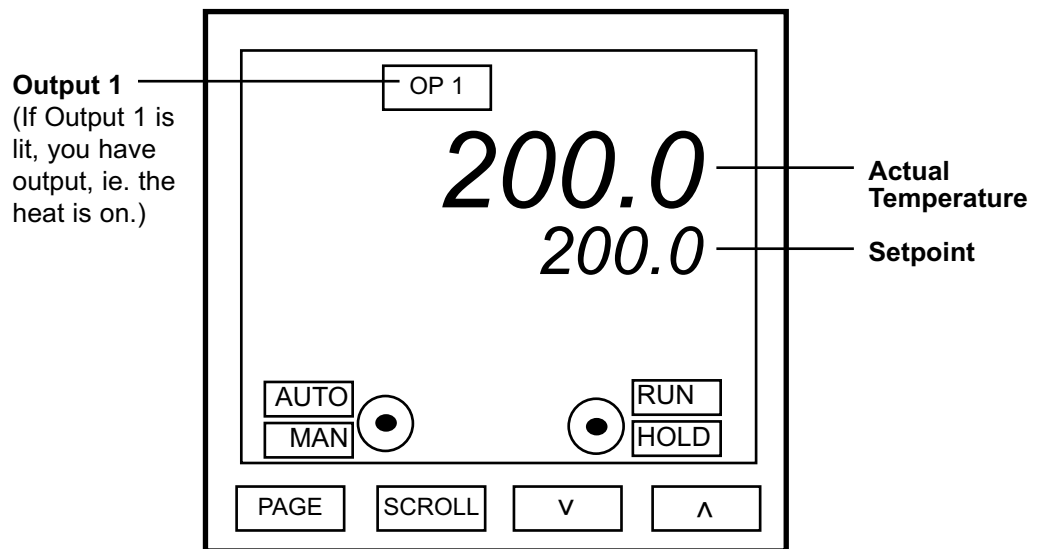


The Eurotherm Model 2404 Temperature Controller is the most important component of the temperature control system and it is strongly recommended that operators carefully study the Model 2404 instruction manual included with the Curing Chamber.

If a test requires a custom program, it is important to build and save the program prior to creating the slurry and loading the molds.

Below is an example that illustrates how to program the controller. In this example, the target temperature is 150°C, which is obtained at a rate of 2.5 degrees per minute. The target temperature of 150°C is maintained for the duration of 180 minutes (3 hours), after which you want to stop the heat.

Press the “Page” button three times, and you will see “ProG List.” Use the scroll button to decide which setting to change. Use the arrow buttons to change the values for that setting.



**Temperature Controller
Front Panel Layout**

For the test described on the previous page, you will want the following settings:

<u>ProG List</u>	<u>Setting</u>	<u>Explanation</u>
Prg 1	1	Settings may be hidden. Do not change the first six settings.
Hb	OFF	
Hb.u	0.0	
Rmp.u	min	
Dwl.u	min	
Cyc.n	1	
Seg	1	
Type	rmp.r	(ramp rate - other choices include ramp time, dwell)
Tgt	150	(final temperature)
Rate	2.5	(rate per minute)
Segn	2	
Type	dwell	(holds the temperature for the amount of time chosen for Dur below)
Dur	180	(duration time)
Segn	3	
Type	end	
End.t	sop	

To run the test, push and hold the “Run/Hold” button until the light for Run turns on. To stop the test, Push and hold the “Run/Hold” button until the light for Run and Hold both turn off. Be sure and turn the “HEATER” switch off as well.

The temperature controller utilizes a high alarm setpoint which will bring the unit to an alarm condition if the temperature ever exceeds the set value. This value is defaulted to 200°C or 400°F, but can be programmed to different values.

An alarm condition will also occur if the slurry thermocouple is unplugged.

When a alarm condition occurs, the Curing Chamber will start to beep if the “SONALERT” switch is turned on, the “ALARM” switch will light up red, and the “TEMPERATURE CONTROLLER” will display “IFSH”. The heat and pump will be turned off. After the alarm condition is over, everything will be turned back on.

Appendix

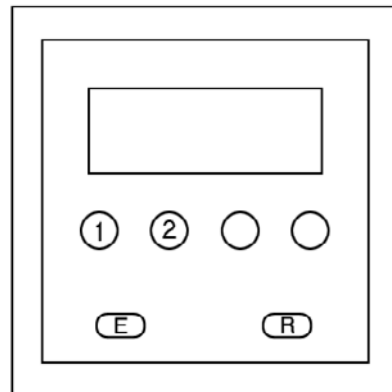
Set Timer

The OFITE Curing Chamber incorporates a timer for auto-cooling. The timer may be activated by turning the "TIMER" switch to the on position. It must be reset to zero at the beginning of a test by depressing the "R" button on the timer's face. The timer has been set in units of hours and minutes but may be programmed to operate in a variety of units.

As an example, suppose you wish to ramp the temperature up to 350°F in one hour and maintain it for four hours. After the test, you want it to cool for two hours.

1. Press "1" to set up 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 set up 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.
4. Press "E" to save these settings.

The program is started when "R" is pressed and the "AUTO COOL" switch placed in the "ON" position. After 5 hours the water solenoid would energize and begin cooling the unit. The unit would cool for 2 hours and then the solenoid would de-activate.



Timer Front Panel Layout