Model 75C-16
Single Cell, 16 Cube Curing Chamber

Instruction Manual

Manual No. Revision A

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fann®
Fann Instrument Company

Model 75C-16 Instruction Manual

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1 Introduction

Cements are a critical element in the drilling, completion, work over, and abandonment of wells. For each application, cement slurry is designed with specific properties and is given additives that provide predictable slurry density, volume, viscosity, compressive strength, fluid loss, gas migration, and thickening time. A curing chamber is used cure a number of two inch square cement cubes under elevated temperature and pressure for the purpose of determining the compressive strength of each cement cube.

The Fann Model 75C-16 (16 cubes single cell) curing chambers consists of a pressure vessel that is capable of achieving pressures up to5,000 psi and temperatures up to 700°F/371°C. The pressure is applied through the use of an air operated hydraulic pump. Heat is applied to the cylinder through band heaters attached to the outside of the pressure vessel. Internal cooling coils are also standard. Features of this model includes:

- Simple operation
- Reliable, modified Bridgeman seal
- Digital temperature controller
- High strength bronze and stainless steel molds conform to API specification

1.1 Document Conventions

The following icons are used as necessary in this instruction manual.

NOTE. Notes emphasize additional information that may be useful to the reader.

CAUTION. Describes a situation or practice that requires operator awareness or action in order to avoid undesirable consequences.

MANDATORY ACTION. Gives directions that, if not observed, could result in loss of data or in damage to equipment.

WARNING! Describes an unsafe condition or practice that if not corrected, could result in personal injury or threat to health.

ELECTRICITY WARNING! Alerts the operator that there is risk of electric shock.

HOT SURFACE! Alerts the operator that there is a hot surface and that there is risk of getting burned if the surface is touched.

EXPLOSION RISK! Alerts the operator that there is risk of explosion.

2 Safety

Safe laboratory practices and procedures should be observed while operating and maintaining this instrument. This section lists some precautions to follow.

2.1 Pressure

Pressurized air and water lines present a hazard if not depressurized before maintenance or disassembly. High pressure hydraulic lines can hold up to 5,000 psi (207 MPa). Operators must ensure that the pressure in these lines has been reduced to zero before attempting to disassemble any high pressure lines. Open the pressure manifold valve. Confirm that all pressure in the system has been relieved by observing the pressure gauge.

2.2 Temperature

The pressure chamber has an electric heating jacket that can heat the cement slurry to 700°F (371°C). The metal jacket itself can be considerably hotter. Before removing the pressure chamber, or performing any work on the heating jacket, allow it to cool to below 120°F (49°C). Monitor the temperature by observing the temperature controller display when the chamber is in the heating jacket.

2.3 Steam

Water is commonly used to pressurize the cement slurry being cured. When heat is applied, there is the potential for the water to become high temperature steam. Because of the risk of burn, body parts should be kept away from the manual pressure relief valve when it is being opened. As the automatic pressure relief valve opens, small amounts of hot water and steam will be released, which are a burn hazard.

2.4 Electrical

The power source for the cement curing autoclave is 230 Volts. There are electrically active terminals inside the instrument when the power switch is turned off. Physically disconnect the power cord from the outlet and instrument before attempting any electrical or mechanical maintenance.

3 Specifications

These specifications apply to the Model 75C-16.

Table 3-1 Model 75C-16 Specifications

Category	Specification
Electrical	
Input Voltage	230 VAC (+10%)
Input Power	9000W
Current	30A
Input Frequency	50-60Hz
Mechanical	
Height	61 in. (155 cm)
Width	33 in. (84 cm)
Depth	30 in. (76 cm)
Weight	1,500lbs (182kg)
Environmental	
Operating Temperature	(32º to 120º F) 0-50º C
Operating Humidity	0-95% noncondensing
Maximum Operation Condition	Temperature: 700F (371C) Pressure 5,000psi (34.4mPa)
Heater	
Heater Type	Band heaters
Heater Control	Solid state relay
Utilities – Water and Air	
Water In/Out	¼ inch MNPT (2)
Air Input	¼ inch MNPT (1): max 120psi, dry

4 Installation

Upon uncrating the instrument, verify that the instrument and any spare parts on the packing list have been received and are undamaged.

Leave space behind the instrument so that qualified personnel may have service access. If this is not possible, try to make the unit easy to disconnect and move for service.

Once the instrument has been moved to its desired location, compressed air, water, and electrical connections can be made. The air inlet, air exhaust, water inlet, and water drain connections are each ¼ inch female NPT connections and are located on the rear of the instrument. A number of ¼ inch male NPT tube fittings are included for international locations.

Connect filtered water to the connector labeled WATER INLET on the rear panel of the instrument. The fitting has a ¼ inch female N.P.T. connection. The water must be clean and free of debris. The water must be clean and free of debris that could cause failure of the pump or relief valve. A water filter is included and must be installed on the water inlet to promote trouble free pump and relief valve operation. Depending on the quality of the water supply, the filter may need to be replaced more frequently. Follow the water filter manufacturer's recommended replacement interval. Neglecting to install the water inlet filter will void the instrument warranty. Water inlet supply water must be filtered at 5µ or better and have a viscosity between 1–100 cst. Pump performance is affected by many operating conditions. Extreme temperatures, pressures, and high duty cycles will increase maintenance frequency. All units are lubricated at the factory with silicone free semi-synthetic grease. After 2-3 months of normal (50% duty) operation, the standard spool seals should be inspected for wear and re-lubricated. Based on this inspection, future maintenance intervals can be planned and further disassembly and lubrication of other moving seals may be necessary.

4.1 Connecting the Drain Line

Connect the water drain line to the connector labeled WATER DRAIN on the rear panel of the instrument. The fitting has a ¼ inch female N.P.T. connection. The drain system should be metal as it may be required to carry very hot water or steam up to 700°F periodically.

If the air exhaust connector discharges anything other than air, a malfunction has probably occurred

Connect compressed air to the connector labeled AIR INLET on the rear of the instrument. The fitting has a ¼ inch female N.P.T. connection. The compressed air must be dry and free from contamination. The air should be supplied at a pressure of 20-100 psig (1.4-6.8 bar). Compressed nitrogen may also be used in place of the compressed air if necessary. Drive air should be filtered between 5µ and 40µ and have a maximum dewpoint of 50°F. Very wet air will wash out lubricant and cause exhaust icing. Very dry air (dew point below 0°F) will dry out lubricant and cause premature failure of spool o-rings.

No connection is required for the AIR EXHAUST connector. It is simply used to vent air when removing water from the pressure vessel.

Electrical connections are made using the receptacle on the rear of the instrument. An appropriate power cord and plug is supplied with the instrument. Please observe the following precautions when making the wiring connections.

- Wiring should be done by a qualified installer in accordance with local electrical codes.
- The instrument should be securely connected to a separate earth ground. The ground wire must be larger in diameter than the supply conductors. A 6 gauge or larger ground wire is recommended.
- An 8BC or larger fire extinguisher to fight electrical and oil fires should be placed within 50 feet of the instrument.

Before attempting to operate the instrument, it is recommended that the operators read the remainder of the manual to become familiar with the curing chamber operation.

5 Using the Temperature Controller

The temperature controller is a fully functional, self-tuning, digital controller. This manual will describe briefly the two functions most often used by operators—ramp and soak programming and automatic tuning. All other features of the controller have been pre-set and should not be changed in most circumstances.

5.1 Programming a Ramp and Soak Temperature Profile

The temperature controller included with this instrument is capable of running a temperature profile consisting of a maximum of 10 segments. In addition, up to four temperature profiles may be stored in memory so that commonly used profiles will not have to be programmed each time.

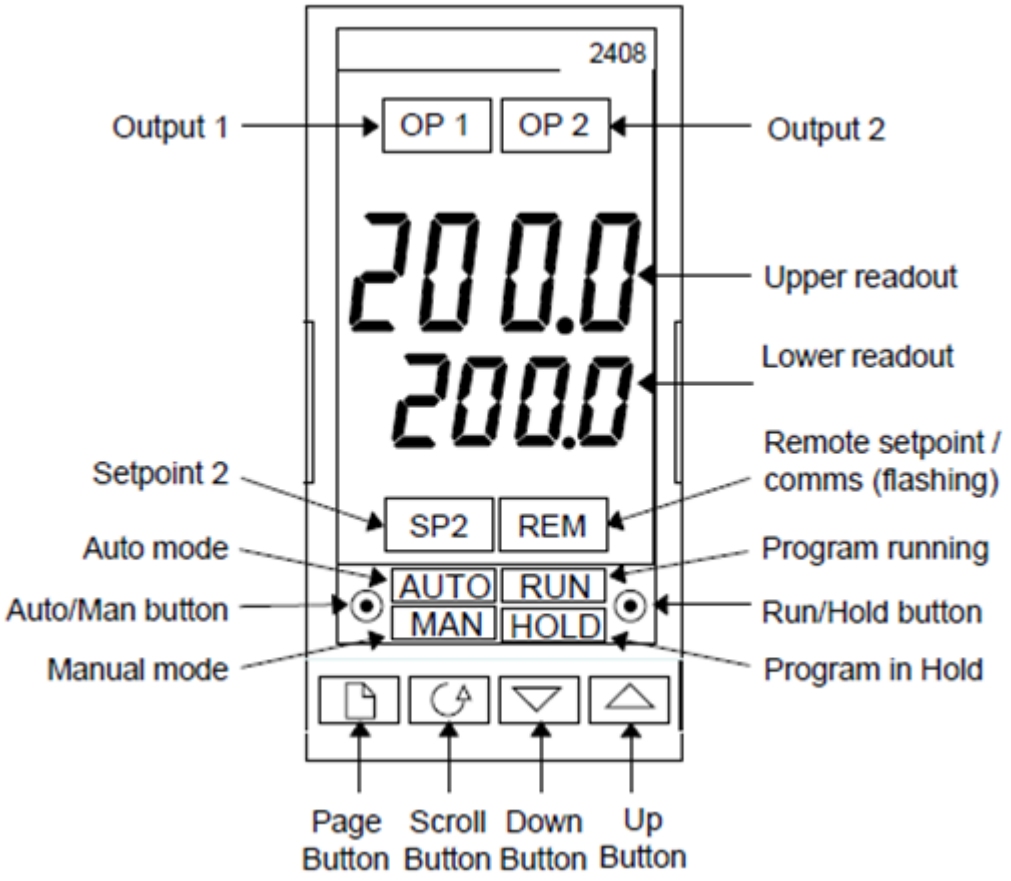

Figure 5-1 Temperature Controller Front Panel Layout

Table 5-1 Temperature Controller Front Panel Layout Guide

Button or indicator	Name	Explanation
OP1	Output 1	When lit, it indicates that the output installed in module position 1 is on. This is normally the heating output on a temperature controller.
OP2	Output 2	When lit, it indicates that the output installed in module position 2 is on. This is normally the cooling output on a temperature controller.
SP2	Setpoint 2	When lit, this indicates that setpoint 2, (or a setpoint 3-16) has been selected.
REM	Remote setpoint	When lit, this indicates that a remote setpoint input has been selected. 'REM' will also flash when communications is active.
◎ AUTO / MAN	Auto/Manual button	When pressed, this toggles between automatic and manual mode: • If the controller is in automatic mode the AUTO light will be lit. • If the controller is in manual mode, the MAN light will be lit. The Auto/Manual button can be disabled in configuration level.
RUN / HOLD ◎	Run/Hold button	• Press once to start a program (RUN light on.) • Press again to hold a program (HOLD light on) • Press again to cancel hold and continue running (HOLD light off and RUN light ON) • Press and hold in for two seconds to reset a program (RUN and HOLD lights off) The RUN light will flash at the end of a program. The HOLD light will flash during holdback.
🗋	Page button	Press to select a new list of parameters.
↻	Scroll button	Press to select a new parameter in a list.
▼	Down button	Press to decrease a value in the lower readout.
▲	Up button	Press to increase a value in lower readout.

WHAT IS SETPOINT PROGRAMMING?

Many applications need to vary temperature, or process value, with time. Such applications need a controller which varies a setpoint as a function of time; all 2408 and 2404 models can do this.

The setpoint is varied by using a *setpoint program*. Within each 2408 and 2404 controller, there is a software module called *the programmer*, which stores one, or more, such programs and drives the setpoint according to the selected program. The program is stored as a series of 'ramp' and 'dwell' segments, as shown below.

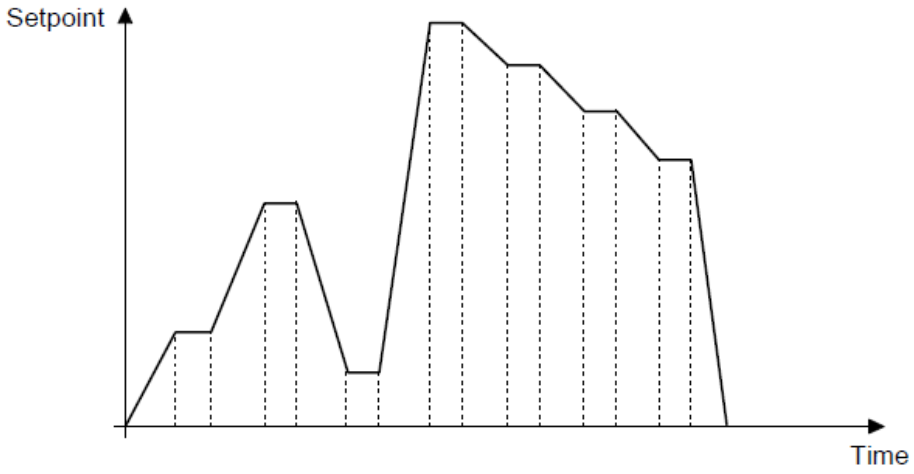

Fig 5-1 Setpoint profile

Figure 5-2 Setpoint Programming Overview

5.2 Programming a Ramp and Dwell Temperature Profile

To program a single or dual ramp and dwell profile, follow the steps below. complete instructions on temperature controller programming. The example below will describe how to program a ramp from 20˚C (room temperature) to 180˚C in 90 minutes, a second ramp from 180˚C to 200˚C in 240 minutes, and a continuous dwell at 200˚C.

1. ProG/LiSt > From the home display press the page button until you reach the ProG/LiSt header.

Press

2. Hb/OFF > Leave the holdback disabled in the OFF position.

Press

3. Hb U/0 > Leave the holdback value at 0.

Press 

4. rmP.U/min > Select min for ramp units

Press 

5. dwL.U/min > Select min for dwell units

Press 

6. CYC.n/1 > In this example we are only running one program cycle, select 1.

Press 

7. SEG.n/1 > Select 1.

Press 

8. tYPE/rmP.t > For this segment type we will choose to ramp to a new setpoint in a set time. Select rmP.t.

Press 

9. tGt/180 > For this example the target setpoint is 180 degrees Celsius. Select 180.

Press 

10. dur/90 > For this example our duration time in this segment is 90 minutes. Select 90.

Press 

11. SEG.n/2 > Select 2.

Press 

12. tYPE/rmP.t > Select rmP.t.

Press 

13. tGt/200 > For this example, our second ramp is to 200 degrees Celsius. Select 200.

Press 

14. dur/240 > Duration time for segment two is 240 minutes. Select 240.

Press 

15. SEG.n/3 > Select 3.

Press 

16. tYPE/End > For this example, we have chosen to dwell at 200 degrees Celsius continuously. Select End.

Press 

17. End.t/dwEll > Select dwell for an indefinite dwell.

Press  to return to the ProG/LiSt header.

5.3 Running a Program Using the RUN/HOLD Button

If there are multiple programs programmed into the controller, you must first select the number of the program that you want to run. Do this in the 'run' list. Then:

RUN HOLD ◎	RUN / HOLD button	Press once to run a program (RUN light on) Press again to hold a program (HOLD light on) Press again to cancel hold and continue running (HOLD light off, RUN light on) Press and hold in for two seconds to reset a program (RUN and HOLD lights off).

The heater power switch on the front panel must be turned on after you have initiated a program.

Never operate the controller in manual set point mode. Always run the controller in automatic mode as this allows the controller to properly control the relays and heaters and prevent component failure or even fire. The curing chamber was designed to run in automatic mode only. To prevent temperature overshoot it is advised to program at least a dual ramp into the controller with the second ramp being much shallower in rate than the first. Because there is a large amount of thermal mass in the system, temperature control is only predictive and does not necessarily have any immediate feedback from heat input. The PID control has been set at the factory and should not be changed.

6 Front Panel Controls

All the functions of the curing chamber are controlled from the front panel. It is very important for the user to have a thorough understanding of each control and its effect on the operation of the curing chamber.

The front panel controls can be roughly divided into four different sections: the hydraulic pressure controls, the pneumatic controls, the cooling water controls, and the electrical/electronic controls.

6.1 Hydraulic Pressure Controls

This section consists of the PRESSURE gauge, the PRESSURE RELEASE valve, the RELIEF VALVE, and the WATER SUPPLY valve. Components that make up this section are used to control the flow and pressure of the water used to pressurize the cylinder and to display the cylinder pressure.

The PRESSURE gauge is used to display the pressure inside the pressure vessel.

The PRESSURE RELEASE valve is used to release pressure from the pressurized cylinder. The PRESSURE RELEASE valve must also be fully opened to remove water from the cylinder.

The RELIEF VALVE may be used to set the upper limit on the system pressure up to 3,000 psig/204 bar or 5,000 psig/340 bar depending on model. When the hydraulic force on the relief valve exceeds the spring force of the relief valve, the relief valve will open and release pressure until the hydraulic and spring forces balance again. The relief valve will then close preventing any additional pressure release until the hydraulic force again exceeds the spring force. Turn the RELIEF VALVE knob clockwise to increase pressure and counterclockwise to reduce pressure.

The unit may be equipped with a WATER SUPPLY valve. If so, this valve must be opened to fill the cylinder or operate the pump. It must be closed when draining water from the cylinder or when the curing chamber is not in operation. Failure to close the WATER SUPPLY valve before draining the cylinder will cause the cylinder to refill with water and may create a flooding hazard.

6.2 Pneumatic Controls

The pneumatic section consists of the air pressure REGULATOR, the PUMP AIR PRESSURE gauge, and the AIR TO CYLINDER valve. The components in this section are used to fill and drain water from the pressure vessel and to power the air driven hydraulic pump that applies pressure to the cylinder.

The PUMP AIR PRESSURE gauge shows the pressure of the air delivered to the pump. The air pressure to the pump is controlled by adjusting the air pressure REGULATOR as described below. If there is no pressure indicated on this gauge, the pump will not operate.

If the PUMP AIR PRESSURE drops significantly when the pump is operating, an air line may be blocked or the compressor may be insufficient to deliver the volume of air required.

The air pressure REGULATOR is used to control the air pressure to the air driven hydraulic pump. Higher hydraulic pressures require higher air pressures. To adjust the pressure of the air supplied to the pump, pull the knob on the regulator out to unlock it. Turn the regulator knob clockwise to increase the pressure and counterclockwise to decrease the pressure. When the adjustment is complete, push the knob in to lock it in place if desired

The AIR TO CYLINDER valve is used to introduce pressurized air into the test cylinder for the purpose of forcing the water out of the cylinder at the completion of a test. The PRESSURE RELEASE valve must be open in order to drain the water using the AIR TO CYLINDER valve.

The AIR SUPPLY valve is used to turn the supply of air to the pump and oil reservoir on and off.

The AIR EXHAUST valve is used to vent the air trapped in the oil reservoir after the AIR SUPPLY valve is closed. When the air trapped in the oil reservoir is vented, no oil will flow out of the reservoir and there will be no back pressure on the oil reservoir to prevent the oil from being removed from the pressure vessel.

The AIR TO CYLINDER valve is used to introduce air pressure into the pressure vessel for the purpose of forcing the oil back into the reservoir at the completion of a test.

Under no circumstances should the AIR TO CYLINDER valve be opened when pressure is on the cylinder. To do so will flood the air lines with oil and create a hazard.

6.3 Cooling Water Controls

The cooling water controls are used to cool the test cylinder at the completion of a test. Fann pressurized curing chambers are equipped with internal cooling coils

for quick cooling of the cylinder and faster turnaround between tests. The cooling water control consists of a COOLING WATER valve or switch.

The COOLING WATER valve allows water to flow through the cooling coils inside the pressure vessel. This valve should be turned on at the completion of a test to cool the pressure vessel. Some curing chambers may have a switch and solenoid valve instead of a manual valve. Operation is virtually the same.

6.4 Electrical Controls

The primary electrical controls are the POWER, HEATER, PUMP, and TIMER switches. The unit may also have a WATER SUPPLY switch if not equipped with a WATER SUPPLY valve. These controls, along with the rest, are discussed in detail below.

The switch labeled POWER controls electrical power to the entire instrument. Nothing else is operable if this switch is not on. The switches labeled HEATER, PUMP and TIMER turn on power to the heater, hydraulic pump, and elapsed timer, respectively.

The unit may be equipped with a WATER SUPPLY switch. If so, this switch must be in the ON position to fill the cylinder or operate the pump. It must be in the OFF position when draining water from the cylinder or when the curing chamber is not in operation.

Failure to turn the WATER SUPPLY switch OFF before draining the cylinder will cause the cylinder to refill with water and may create a flooding hazard.

7 Operation

The majority of common operational errors may be avoided by observing the two following rules.

When you are ready to run a test, before doing anything related to operating the instrument, make certain every valve is closed. The same is true when stopping a test.

Never open the AIR TO CYLINDER valve when the instrument is under pressure.

7.1 Curing Chamber Operation, How to Run a Test

This section provides detailed instructions on curing chamber operation.

1. Close all the valves on the front panel.
2. Turn POWER switch to the ON position. This supplies power to the entire instrument. Wait a few seconds until the temperature controller initializes.
3. Program the temperature ramp and soak parameters into the temperature controller.

Be sure the pressure vessel is sealed before turning the heaters on. Failure to do so may cause the oil the cylinder to flash or catch fire.

4. Assemble each pair of mold bodies. The inside of the molds may be lightly greased, if desired. Place a mold body on the mold bottom and fill with cement slurry in accordance with API specifications. Place a cover on each mold with the slotted side down. Repeat for remaining mold sets, stacking the molds as they are filled.
5. Clamp the molds together using the threaded rod provided.

6. Lower the molds into the pressure vessel.

Be careful not to damage the metal sealing surfaces of the pressure vessel when lowering the molds into the vessel.

7. Make certain the cylinder plug threads are thoroughly lubricated. Thread the plug into the cylinder and tighten securely by hand.

Do not tighten with a hammer. Doing so my cause permanent damage to the cylinder.

8. Tighten the set screws in the plug. The screws must be tightened in the order shown and in three torque increments of 15, 30, and 40 ft-lbs.

Do not tighten the set screws when the instrument is under pressure.

9. Insert the thermocouple into the opening in the center of the cylinder plug, but do not tighten completely. The air will be vented through the thermocouple opening as the cylinder fills. Be sure to plug the thermocouple into the receptacle on the rear of the instrument.

10. Fill the pressure vessel with water as follows. With all valves closed, open the WATER SUPPLY valve or turn the WATER SUPPLY switch to the ON position. This allows water to flow into the pressure vessel. As the pressure vessel fills with water, air will be exhausted from the pressure cylinder at the thermocouple connection. You should hear a hissing sound and feel air escaping as the cylinder fills. As soon as the hissing stops and water appears, tighten the thermocouple gland securely.

Do not tighten the thermocouple connector until water appears or air may be trapped in the vessel preventing pressurization.

11. Adjust the pressure in the vessel as desired for the start of the test. This is accomplished by placing the PUMP switch in the ON position, adjusting the pump air pressure and adjusting the pressure relief valve until the desired pressure is reached.

12. Turn HEATER switch to the ON position and press the RUN key on the temperature controller.

13. Turn the TIMER switch to the ON position.

14. The test will now run until stopped by the operator.

Top of curing chamber may become extremely hot. Severe burns can result from touching the pressure vessel or plug

7.2 Pressure Control

Follow the steps below to configure the pump and relief valve for automatic pressure control.

1. Make certain the PUMP switch is in the OFF position, the WATER SUPPLY valve is turned to the ON position, the COOLING WATER valve is in the OFF position, and the instrument is supplied with compressed air.

2. Turn the PUMP AIR PRESSURE ADJUST regulator clockwise until air pressure is sufficient to raise pressure to the desired pressure set point. The air pressure should not exceed 100 psig (690 kPa).

3. Turn the RELIEF VALVE knob clockwise until the regulator pressure is sufficient to prevent the regulator from opening at the required pressure set point.

4. Turn the PUMP switch to the ON position and increase pressure until the pressure exceeds the desired set point. Turn the PUMP switch to the OFF position. Make certain the system is holding pressure before proceeding. The pump contains metal-to-metal inlet and outlet check valves that may not be bubble tight, so a small amount of pressure leakage is to be expected. This should not be a problem under normal operation.

5. Turn the RELIEF VALVE knob counterclockwise slowly until the test cylinder pressure begins to drop. Continue turning the regulator knob slowly until the pressure in the test cell is at the upper limit of the desired test pressure.

6. Release pressure in the test cell using the PRESSURE RELEASE valve.

7. Turn the PUMP AIR PRESSURE ADJUST regulator counterclockwise until the PUMP AIR PRESSURE is approximately zero.

8. Turn the PUMP switch to the ON position.

9. Slowly turn the PUMP AIR PRESSURE ADJUST regulator knob clockwise until the pump actuates. Continue to slowly turn the regulator knob clockwise until the lower limit for the control pressure is reached.

As the test cylinder gets hot, pressure in the test cylinder will increase. When the pressure in the test cylinder exceeds the control pressure upper set point, the relief valve will open and pressure will be reduced. If the heating rate is reduced, as during the transition from a temperature ramp to a temperature soak, the pressure in the test cylinder may decrease. If the pressure falls below the control pressure lower limit, the pump will actuate and bring the pressure back within the established limits.

The pump and relief valve will have hysteresis or a “deadband” in their operation. For example, if the relief valve is set to open at 2000 psig, it may open at 2000 psig, but may not close until the pressure falls to some lower value, perhaps 1900 psig. This 100 psig differential between opening and closing is referred to as the deadband or hysteresis. As another example, the pump may be set to actuate if the pressure falls to 2000 psig, but the pressure may reach perhaps 2100 psig before the pump stops. This 100 psig differential between the initial pressure and the final pressure is also known as deadband or hysteresis. If the upper and lower set points are too close together, this deadband may overlap and cause system instability. The system will then go into a continuous oscillation where the pump increases pressure and the relief valve releases all the pressure the pump is able to build. The solution to this problem is to decrease the lower set point, raise the upper set point, or both.

7.3 Stopping a Test

When the cement cubes have cured for the desired time and it becomes necessary to stop the test, follow the steps below.

1. Turn the HEATER switch to the OFF position.

2. Press the RUN/HOLD key for two seconds on the temperature controller to stop the program.

3. Slowly open the CYLINDER COOLING valve to start the flow of cooling water through the internal cooling coils.

Do not remove the thermocouple or cylinder plug until the instrument has cooled below 200°F/93°C. Doing so may cause water in the cylinder to turn to steam causing a hazardous condition. Also maintain a pressure of at least 500 psig (34 bar) to prevent steam from forming inside the vessel.

4. When the cylinder and plug have cooled sufficiently, close the WATER SUPPLY valve or turn the WATER SUPPLY switch to the OFF position.
5. Slowly open the PRESSURE RELEASE valve to vent the pressure.
6. With all pressure released from the cylinder and the PRESSURE RELEASE valve open, open the AIR TO CYLINDER valve. This transfers the water from the pressure vessel to the drain. A hissing sound will be heard when the pressure vessel is empty.
7. Unscrew the thermocouple in the cylinder plug and remove.
8. Loosen set screws on the cylinder plug.
9. Unscrew the cylinder plug and remove. Tap the handles lightly with a hammer if necessary.
10. Remove the molds from the pressure vessel.
11. The curing of the cement cubes is now complete.

7.4 Pressure Relief Valve/Regulator Cooling

The blue pressure relief valve may be equipped with an automatic solenoid cooling valve. This is to prevent failure of temperature sensitive parts within the valve by protecting them from excessive heat. This feature maybe turned off by shutting off the water supply to the pressure relief solenoid cooling valve. There is a small brass toggle valve connected to the automatic solenoid valve. This valve turns the pressure relief valve cooling on or off. We recommend leaving this turned on if you continually run high temperature tests or turning it off if your tests generally do not run very hot. If left on, the unit will consume large amounts of water. We give the option to not use it if you are so inclined to save water. Some curing chambers may only have a coiled tube “heat exchanger” type of cooling.

7.5 Long-term Testing

All curing chambers will come equipped with an isolation valve between the pump and cylinder. The use of the isolation valve was determined to be useful in case of pump, release valve and/or pressure regulator failure. The test cell may be isolated

by turning the valve to the closed position. Any one of those components may then be replaced or repaired without interrupting the test in progress.

8 Maintenance and Troubleshooting

8.1 Maintenance

Curing chambers can be relatively reliable and trouble free—provided they are serviced and maintained properly. Instruments that are neglected and receive infrequent service or are subject to abuse are certain to cause trouble. The maintenance requirements for the curing chamber are very simple and should consume little time.

1. Thoroughly clean the test cylinder after every test.
2. Coat the cylinder and plug threads with high-temperature black molybdenum grease or the equivalent.
3. Lubricate the sealing surfaces of the plug and pressure vessel before each test.
4. Replace the low pressure water filter element periodically.
5. Clean all cube mold parts after cement cube removal.

8.2 Troubleshooting

The following section consists of a table listing possible remedies for the most common curing chamber problems.. If more extensive maintenance or service of the instrument is required, please contact Fann Instrument Company.

Table 8-1 Troubleshooting Guide

Symptom	Cause	Remedy
Pump will not stroke and/or water comes out AIR EXHAUST fitting	AIR TO CYLINDER valve has been opened while cylinder is pressurized, flooding the air lines and pump pneumatic side with water.	Remove air lines and drain water. Remove pump and disassemble pump pneumatic side to remove water. If contamination is not too severe, you may let the pump stroke under no pressure until the water is removed.
System builds pressure but will not	Leak	Check fittings for leaks and tighten fittings.

Symptom	Cause	Remedy
hold pressure	PRESSURE RELEASE and AIR TO CYLINDER valves are not closed tightly	Close valves tightly.
	PRESSURE RELEASE or AIR TO CYLINDER valves are worn out.	Replace valve stem or entire valve. PRESSURE RELEASE valve is most likely to wear out.
System builds pressure and water runs out between pressure vessel and top plug.	Metal seal surfaces on plug and cylinder are dirty.	Clean sealing surfaces.
	Sealing surfaces are worn, pitted, or scratched.	Lap sealing surfaces.
	Set screws were not torqued properly.	Torque properly.
Instrument not receiving power	Instrument not plugged in.	Connect instrument to the correct power source.
	Blown fuse or thrown breaker on circuit supplying power.	Check fuses and breakers on electrical supply circuit.
Heater will not get hot.	Blown fuse.	Check fuses inside electrical box. Replace any that are blown.
	HEATER switch not in the ON position.	Turn HEATER switch to ON position.
	Faulty heater.	Replace.
	Faulty solid state relay.	Replace.
Temperature display is erratic.	Faulty thermocouple.	Replace thermocouple.
	Loose connection in thermocouple wiring.	Check for loose wiring and correct if necessary.
Temperature displays ---- instead of temperature	Open circuit in thermocouple.	Replace thermocouple.
	Open circuit in thermocouple circuitry	Check thermocouple circuitry for open circuits or loose connections.
Pump strokes but little or no pressure	Valve open, severe leak, blown rupture disc.	Locate problem and correct.

Symptom	Cause	Remedy
is obtained.	Pressure vessel has trapped air.	Open thermocouple connector slightly and release trapped air.
	AIR SUPPLY valve not opened or air not connected to instrument.	Connect air supply and open AIR SUPPLY valve.
	Severely clogged low pressure filter.	Replace low pressure filter element.
	Faulty pump check valve.	Clean and/or overhaul pump outlet check valve.
Pump builds and maintains pressure to a certain level than then stops.	If water is coming from pump muffler, the pump high pressure seal is probably worn out.	Overhaul or replace pump.
Pressure cannot be released.	Stainless steel lines are plugged with cement.	Remove lines and inspect for blockage. Replace any that are plugged.
Pump will not stroke and/or oil comes out AIR EXHAUST fitting	AIR TO CYLINDER valve has been opened while cylinder is pressurized; flooding the air lines and pumps pneumatic side with oil.	Remove air lines and drain oil. Remove pump and disassemble pump pneumatic side to remove oil. If contamination is not too severe, you may let the pump stroke under no pressure until the oil is removed. This tends to create an oil mist that will fill the entire lab.
System builds pressure but will not hold pressure	Leak	Check fittings for leaks and tighten fittings.
	PRESSURE RELEASE and AIR TO CYLINDER valves are not closed tightly	Close valves tightly.
	PRESSURE RELEASE or AIR TO CYLINDER valves are worn out.	Replace valve stem or entire valve. PRESSURE RELEASE valve is most likely to wear out.
System builds pressure and oil runs out between pressure vessel and	Metal seal surfaces on plug and cylinder are dirty.	Clean sealing surfaces.
	Sealing surfaces are worn, pitted, or scratched.	Lap sealing surfaces.

Symptom	Cause	Remedy
top plug.	Set screws were not torqued properly.	Torque properly.
Instrument not receiving power	Instrument not plugged in.	Connect instrument to the correct power source.
	Blown fuse or thrown breaker on circuit supplying power.	Check fuses and breakers on electrical supply circuit.
Heater will not get hot.	Blown fuse.	Check fuses inside electrical box. Replace any that are blown.
	HEATER switch not in the ON position.	Turn HEATER switch to ON position.
	Faulty heater.	Replace.
	Faulty solid state relay.	Replace.
Temperature display is erratic.	Faulty thermocouple.	Replace thermocouple.
	Loose connection in thermocouple wiring.	Check for loose wiring and correct if necessary.
Temperature displays ---- instead of temperature	Open circuit in thermocouple.	Replace thermocouple.
	Open circuit in thermocouple circuitry	Check thermocouple circuitry for open circuits or loose connections.
Pump strokes but little or no pressure is obtained.	Valve open, severe leak, blown rupture disc.	Locate problem and correct.
	Pressure vessel has trapped air.	Open thermocouple connector slightly and release trapped air.
	Oil reservoir is empty	Fill reservoir with oil
	AIR SUPPLY valve not opened or air not connected to instrument.	Connect air supply and open AIR SUPPLY valve.
	Severely clogged low pressure filter.	Replace low pressure filter element.
	Faulty pump check valve.	Clean and/or overhaul pump outlet check valve.
	No air supplied to air operated valve (if so equipped).	Check air lines leading to valve. Check valve solenoid valve. Restore air supply.

Symptom	Cause	Remedy
Pump builds and maintains pressure to a certain level than then stops.	If no oil is coming from pump muffler, oil reservoir ran dry.	Add oil to reservoir.
	If oil is coming from pump muffler, the pump high pressure seal is probably worn out.	Overhaul or replace pump.
Pressure cannot be released.	Stainless steel lines (3/8 inch) are plugged with cement.	Remove lines and inspect for blockage. Replace any that are plugged.

9 Warranty and Returns

9.1 Warranty

Fann Instrument Company warrants only title to the equipment, products and materials supplied and that the same are free from defects in workmanship and materials for one year from date of delivery. THERE ARE NO WARRANTIES, EXPRESS OR IMPLIED OF MERCHANTABILITY, FITNESS OR OTHERWISE BEYOND THOSE STATED IN THE IMMEDIATELY PRECEDING SENTENCE. Fann's sole liability and Customer's exclusive remedy in any cause of action (whether in contract, tort, breach of warranty or otherwise) arising out of the sale, lease or use of any equipment, products or materials is expressly limited to the replacement of such on their return to Fann or, at Fann's option, to the allowance to Customer of credit for the cost of such items. In no event shall Fann be liable for special, incidental, indirect, consequential or punitive damages. Notwithstanding any specification or description in its catalogs, literature or brochures of materials used in the manufacture of its products, Fann reserves the right to substitute other materials without notice. Fann does not warrant in any way equipment, products, and material not manufactured by Fann, and such will be sold only with the warranties, if any, that are given by the manufacturer thereof. Fann will only pass through to Customer the warranty granted to it by the manufacturer of such items.

9.2 Returns

For your protection, items being returned must be carefully packed to prevent damage in shipment and insured against possible damage or loss. Fann will not be responsible for damage resulting from careless or insufficient packing.

Before returning items for any reason, authorization must be obtained from Fann Instrument Company. When applying for authorization, please include information regarding the reason the items are to be returned.

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