OFI

MODEL 120

HPHT

CONSISTOMETER

INSTRUCTIONAL

MANUAL

OPERATING INSTRUCTIONS

OFI MODEL 120 HPHT CONSISTOMETER

GENERAL

The OFI Model 120 Consistometer was designed to determine the consistency of well cements under simulated downhole conditions. Its main usage is to estimate the time required for a cement to become to viscous to pump and it is also used as a quality control device to compare well cements. The Model 120 is fully capable of testing cements in strict accordance to the guidelines as listed within API Specification 10.

DESCRIPTION

The primary component of the Model 120 is the high pressure test cell which is machined from a solid piece of hardened steel alloy. The test cell cap and the magnetic drive assembly are sealed via specially designed metal "O" rings. These special "O" rings are instrumental in conducting tests at extremely high temperatures.

The magnetic drive assembly consists of an inner sealed encapsulator and outer driving assembly which contain rare earth magnets. The outer driver assembly is rotated at 150 rpm by an electric motor and the inner encapsulator is driven by magnetic force. Complete magnetic coupling is achieved until the inner encapsulater requires a torque of approximately 15 in-lbs. The API defines 100 Bc as 2040 gm-cm of torque which is considerably less than the maximum allowable by the magnetic drive system. This drive system eliminates packing problems and provides for a reliable maintenance free drive system.

The mixed cement is poured into a slurry cup assembly. Materials of construction and all necessary dimensions of the slurry cup are specified by the API. The slurry cup engages the drive table via two drive pins and the slurry cup rotates around a paddle which is engaged to the potentiometer assembly. An input voltage is applied to the potentiometer and the output voltage is directly proportional to the amount of torque the cement slurry exerts upon the paddle.

The output voltage, pressure and slurry temperature are measured and recorded via a strip chart recorder. The temperature of the slurry is also recorded on the strip chart in either degrees F or C.

The temperature of the slurry is maintained by a microprocessor based temperature controller. The test cell houses a 4000 watt heater and the temperature of the slurry is measured via an internal thermocouple assembly.

Pressure is maintained by the use of an air driven, hydraulic pump which utilizes mineral oil as the pressurizing medium. The pressure is measured via a transducer and indicator in units of psi and MPa. The indicator incorporates high and low alarms.

Upon termination of a test, the cell can be easily cooled by use of the coolant system. The system uses water as the cooling medium and is controlled by an electric solenoid.

INSTALLATION

1. Carefully remove the instrument from the wooden crate.

2. Please note that casters are provided to facilitate moving of the instrument and once in place the casters should be "LOCKED" by depressing the lever on the side of the caster.

3. An air or nitrogen (100-120 psi) supply should be connected to the air supply on the back of the instrument.

   PLEASE NOTE THAT THE UNIT UTILIZES 1/4 INCH NPT FEMALE CONNECTORS FOR ALL SUPPLY LINES.

4. The drain and coolant supply lines should be connected in similar manner.

5. Ensure that all electrical switches are in the "OFF" position and make the necessary electrical connections in accordance to local codes. Ensure that the unit is grounded.

6. To fill the oil reservoir, open the front cabinet door and remove the oil reservoir cap. Using a funnel, pour approximately four liters of mineral oil into the reservoir. Replace the cap ensuring that an air tight seal is formed. A sight glass is installed on the reservoir and oil should be added whenever the liquid falls below this level.

   The low pressure oil filter contains a considerable amount of oil and should be manually filled prior to initial use of the consistometer. Open the two panel doors on the left hand side of the machine and unscrew the oil filter from the filter base. Slowly fill the filter with oil until almost full. Return the filter to the base and hand tighten until the O ring performs an air tight seal.

7. It will be necessary to fill the air line lubricator with oil. This unit is located just upstream of the air inlet on the hydraulic pump. The lubricator has been adjusted at the factory and under normal operation, two to three drops of oil per minute should be discharging into the air stream. If adjustment is necessary, the control needle on top the lubricator should be rotated until normal discharge is obtained. Rotating the needle clockwise decreases the oil flowrate.

8. Open the cover of the strip chart recorder and remove the paper cassette by depressing the key on the lower right corner of the cassette. The chart recorder pens were shipped with a plastic protector over the tips and must be removed before conducting a test. Remove the plastic protectors and insert the paper cassette.

PERFORMING A TEST

1. Before starting a test turn all electrical switches to the "OFF" position and close all valves.

2. Turn the "MAIN" and "RECORDER" switches to the "ON" position. Disengage the chart recorder cassette and allow the unit to warm up for about ten minutes.

3. Fill the slurry cup as outlined below.

FILLING THE SLURRY CUP

1. Lightly coat the inside of the slurry cup with a high temperature, waterproof grease to facilitate removal of set cement.

2. Prepare the cement slurry as stated within API Specification 10.

3. Invert the slurry cup and remove the bottom cap and the pivot bearing.

4. Fill the slurry cup with cement until it just reaches the internal threads. It is helpful to tap the side of the slurry cup while filling to remove any entrained air.

5. Replace the bottom cap and if properly filled, a small amount of cement will be displaced through the pivot bearing hole.

6. Remove the excess cement and replace the pivot bearing. Ensure that the paddle shaft engages with the pivot bearing.

7. Wipe the slurry cup clean to remove any cement on its exterior.

LOADING THE TEST CELL

1. Connect the slurry cup handle to the cup by engaging the handle into the two holes located in the top cap.

2. Lower the slurry cup into the test cell ensuring that the slurry cup drive pins engage the drive holes of the table.

3. Remove the handle from the slurry cup and insert it into the potentiometer.

4. Lower the potentiometer mechanism into the test cell ensuring that the contact springs of the potentiometer are in alignment with the test cell contacts.

5. To engage the drive bar of the slurry cup into the potentiometer rotate the cup with the motor for a few seconds while slightly applying pressure to the potentiometer. Note that if the unit is in an alarm condition the motor will not engage.

THE POTENTIOMETER IS CORRECTLY INSTALLED WHEN THE UPPER BEARING OF THE POTENTIOMETER IS RESTING UPON THE PADDLE SHAFT.

6. Remove the slurry cup handle. Align the test cell cap with the test cell and slowly lower the cap until the threads engage. Rotate the lid until it bottoms out on the metal "O" ring. Tap the handle on the lid with a rubber mallet a few times to achieve a solid seal.

7. Turn the "MOTOR" and the "15 VDC" switches on.

8. Move the thermocouple selector switch to the "SLURRY" position and plug the jack into the panel connector. Insert the slurry cup thermocouple through the center of the test cell cap and tighten the threaded gland finger tight and then loosen 1/8 turn.

9. Fill the test cylinder with hydraulic oil by positioning the "OIL RESERVOIR" valve to the "ON" position. Oil will be forced into the test cell and air will be expelled from the loosened thermocouple connection. When oil begins to flow from the thermocouple connection, tighten the gland with a wrench.

10. Apply pressure to the test cylinder by turning the "PUMP" switch to the "ON" position. Note that the pump will not activate if the unit is in an alarm condition. The pressure may then be increased by turning the air regulator clockwise until the desired pressure is obtained. Pressure is indicated on the pressure indicator. After the test pressure is obtained it is recommended to set the low and high pressure alarms at approximately 2000 psi above and below the test pressure. In the event of a leak or over pressurization the unit will prohibit the pump motor and heating system from operating. Pressure may be bled from the test cell by rotating the regulator counter clockwise and by slightly opening the "PRESSURE RELIEF" valve.

PRESSURE AND CONSISTENCY INDICATOR ALARMS

The pressure indicator incorporates high, low and set point alarms. In an alarm state the alarm annunciators (located directly above the digital display) are illuminated. In an alarm state the rotational drive, hydraulic pump and heating system are disabled. In addition, an audible alarm will sound if the "ALARM" switch is in the "ON" position. To access these alarms and change the set points perform the following.

1. Press the center button located on the indicator. The low alarm annunciator illuminates and the value indicated in the display represents the low alarm setpoint. If you wish to increase the value, press the button on the right. If you wish to decrease the value press the left button Once the appropriate setpoint is obtained press the center button. **Upon initial pressurization the low alarm setpoint must be below zero or the unit will be in an alarm condition and the motor, heating system and air driven hydraulic pump will be inoperable.**

2. The value in the display is now the high alarm setpoint and the high alarm annunciator is illuminated. Use the left and right keys to select the appropriate value and press the center button again.

3. The current value is the setpoint alarm and the setpoint indicator is illuminated. The setpoint alarm is not utilized in the Model 120. Press the center button again.

4. At this time the three alarm annunciators should be illuminated simultaneously. To store the new alarm values into memory press the center button. The indicator will return to the normal operating mode.

CONSISTENCY INDICATOR

The consistency indicator alarms function exactly like the pressure indicator alarms and can be accessed and adjusted in similar fashion. However, the consistency indicator only utilizes a high alarm and the other two alarms are not used to perform any function.

TEMPERATURE CONTROLLER

The temperature controller utilizes a high alarm setpoint which will bring the unit to an alarm condition if the temperature ever exceeds this value. An alarm condition is evidenced by the illumination of the "AL1" annunciator in the upper left hand corner of the display.

If the slurry thermocouple is unplugged and the thermocouple selector switch is placed in the "SLURRY" or "OFF" position an alarm condition will occur.

To adjust the high alarm setpoint perform the following.

1. The front cover located on the lower portion of the controller hinges downward.

2. Depress the scroll key (the right key behind the hinged panel) until a parameter appears. Continue to press the key until the parameter "AL1" appears.

3. Press the "UP" or "DOWN" arrow keys until the desired high alarm setpoint is obtained.

4. Wait approximately 10 seconds and the controller will automatically return to the normal display mode.

TIMER

The Model 120 incorporates a timer for convenience. The timer may be activated by turning the "TIMER" switch to the "ON" position. It may be reset to zero at the beginning of a test by depressing the "R" button on the timer's face.

APPLY HEAT TO THE TEST CELL

The Eurotherm Model 818 is the most important component of the temperature control system and it is strongly recommended that operators carefully study the Model 818 instruction manual to learn the features of the controller. Of particular importance to the operator are sections 1. 9 and 1.11 which entail programming temperature profiles and running programs.

1. Program the temperature profile you wish to perform into the Model 818 Controller.

2. To begin the thickening time test ensure that the chart recorder paper cassette is fully engaged, all alarms are properly set, the temperature profile is properly programmed and turn the "HEATER SWITCH" to the "ON" position and press the "RUN" button on the temperature controller panel. Many technicians leave the chart recorder paper cassette disengaged until they start a test.

   As the vessel heats up the pressure will increase due to the thermal expansion of the pressurizing oil. It is imperative that the pressure be maintained below the high pressure set point. This may be achieved by opening the pressure release valve as necessary to control the pressure.

3. The temperature controller will maintain the temperature schedule which was programmed and upon termination of a test it is **IMPERATIVE** that the "HEATER SWITCH" is returned to the "OFF" position.

TERMINATION OF TEST

1. After the cement has reached the desired consistency it is imperative that the slurry container be removed from the test cell as soon as possible. If the consistency alarm is activated turn the "ALARM" and the "15 VDC" switches to the "OFF" position.

2. Immediately start the cool down procedure by turning the "COOLANT" switch to the "ON" position. **DO NOT** release the pressure until the temperature has been reduced to a minimum of 200 degrees F.

3. After cooling to less than 200 degrees, release the pressure by switching the "PUMP" switch to the "OFF" position and by slowly opening the "PRESSURE RELEASE" valve. The pressure indicator should slowly return to zero.

4. To remove oil from the test cell, move the "OIL RESERVOIR" valve to the "VENT" position and open the "AIR TO CYLINDER" valve. Air pressure will force the oil back into the reservoir, and when air is venting to the atmosphere the "AIR TO CYLINDER" valve should be closed.

5. Turn the "15 VDC" and "MOTOR" switches to the "OFF" position.

6. Slowly loosen the gland on the slurry cup thermocouple and carefully remove it from the test cell. Note if there appears to be any pressure on the vessel.

7. The test cell cap should be unscrewed and lifted out of the way. Remove the slurry container and cool in a water bath if necessary. It is imperative that the cement be promptly removed from the slurry container to prevent damage to the paddle and other components.

8. 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.

GENERAL MAINTENANCE

1. One of the most important elements concerning trouble free consistometer operation is keeping the interior of the test cell as clean as possible. Never insert a cement covered slurry cup into the test cell and periodically examine the mineral oil to ensure that the fluid is clean. If the mineral oil is not clean, replace it immediately. High pressure pumps and valves wear quickly when used with mineral oils that contain cement. Oil is fairly inexpensive, pumps and valves typically are not.

2. OFI uses a high pressure filter to protect valve stems and a low pressure filter to minimize cement that becomes trapped in the oil reservoir. Replace these filters when the flow of mineral oil 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. Inspect the metal "O" ring after every test and keep cement completely away from the "O" ring seal. It is advisable to remove the "O" ring after each test and wipe any particulate matter away from the seal.

4. Routinely check the air lubricator to ensure that it contains oil. If adjustment is necessary, please refer to the guidelines recommended in the INSTALLATION portion of this manual.

5. Depending upon the amount of use, the magnetic drive system should be removed and cleaned on a periodic bases. Thoroughly clean the test cell, drive system, and replace the metal "O" ring.

POTENTIOMETER CALIBRATION

It is recommended that the potentiometer be calibrated at least once a month.

1. Each OFI consistometer comes complete with a calibrating device. Place the calibrator on the front edge of the consistometer and insert the plug into the receptacle on the front panel.

2. Install the potentiometer on the calibrator as shown in the following drawing. Connect the three wires to the contact springs and install the weight hanger cord as illustrated.

3. Apply the weights as listed below and compare the indicated voltage with those listed. Providing that the spring is acting in a linear fashion, the measured reading and the listed reading should compare very closely. Each calibration spring will have its on unique properties and a curve should be developed similar to the one the following page for each potentiometer.

MASS (gms)	APPROXIMATE VOLTAGE
100	2.5
200	5.5
300	8.2
400	10.75

4. If the readings obtained are higher than what should be obtained the spring should be tightened by loosening the spring set screw and rotating the spring to apply additional torque. If the readings obtained are lower than what should be obtained the torque exhibited by the spring should be reduced by loosening the spring set screw and rotating the spring to decrease the torque. The contact arm should then be reset to zero.

5. Step 4 is a trial and error procedure and should be repeated until the actual values are relatively close to the approximate values in the above table.

POTENTIOMETER MAINTENANCE

The potentiometer assembly should be kept as clean as possible and should periodically be submerged in solvent to remove cement and other materials. Particulate matter near or inside the resistor groove may cause the resistor to burn out.

TROUBLE SHOOTING POSSIBLE POTENTIOMETER PROBLEMS

A. Highly fluctuating consistency (voltage) readings.

Examine the resistor and verify that the top of the resistor is smooth and consistent. If necessary, re-insert the resistor and lightly smooth the resistor wire with emery cloth.

B. Consistency (voltage) reads zero.

Loss of contact between the resistor and the contact arm. Adjust the contact arm either up or down.

Resistor has a sufficient enough space between the windings to prohibit conductance. Replace the resistor.

C. Potentiometer will not hold calibration.

Spring either damaged or worn by corrosion. Replace spring.

NEW RESISTOR INSTALLATION

1. Remove the four small screws which fasten the shaft bearing retainer to the potentiometer assembly.

2. Remove the contact arm.

3. The damaged resistor should be carefully lifted away from the potentiometer. The resistor groove should be cleared of any foreign material.

4. Carefully place the new resistor into the groove and ensure that it is centered between the two terminating contacts.

5. The resistor should be pushed completely into the groove with either a mallet or a piece of wood. It is very important to ensure that the resistor is completely inserted into the groove and that its upper surface is level.

6. Install a new contact arm and if necessary, bend the arm either up or down to obtain consistent contact with the resistor.

7. Re-install the shaft bearing retainer and calibrate the potentiometer before use.

CALIBRATION SPRING INSTALLATION

1. Remove the contact arm and the shaft bearing retainer.

2. Carefully lift the calibration spring from the potentiometer assembly.

3. Install the new spring and when properly installed, it should tighten when the center shaft is rotated counter clockwise.

4. Install a new contact arm and make adjustments as necessary to obtain consistent contact with the resistor.

5. Loosen the three adjustment screws on the underside of the potentiometer assembly and rotate the spring adjuster until the spring rests at a relaxed state.

6. Ensure that the contact arm aligns with the contact strip and tighten the three set screws.

7. Rotate the center shaft to ensure that the spring does not bind or rub the potentiometer housing.

8. Replace the shaft bearing retainer and calibrate the potentiometer.

MAINTENANCE OF THE MAGNETIC DRIVE SYSTEM.

GENERAL INFORMATION

The MagneDrive has been designed to fulfill additional requirements not obtained in conventional packed drives. Leakage, contamination, and packing heat generation problems are eliminated. The external drive magnet assembly consists of an outer holder containing the stator magnets. This outer holder is placed over a pressure sealed housing containing the encapsulated rotor magnets mounted on a center rod. A strong magnetic field makes the inner center rod rotate at the same rpm as the outer holder.

GENERAL INSTRUCTIONS

The MagneDrive depends on expert assembly and maintenance for its best performance and operation. When handling the magnet assembly, a clean area must be provided which is free from all metallic particles.

ROTOR ASSEMBLY CLEANING

Clean the MagneDrive assembly at least once a week, (depending on usage) using the following procedure.

1. Remove the cover and gland from the bottom of the MagneDrive.

2. Pull the slurry cup table and rotor assembly up through the vessel opening.

3. Clean all abrasive particles from the rotor assembly and lay assembly on a clean flat non-magnetic surface.

4. Flush vessel and MagneDrive housing with mineral oil. Use a soft bristle brush to clean ID. of MagneDrive.

5. Assemble MagneDrive

6. Thread slurry cup table onto rotor shaft assembly.

   NOTE: Pour a small amount of mineral oil into the vessel. This oil will act as a cushion when inserting the magnetic rotor assembly.

7. Insert rotor assembly into MagneDrive housing, press down on slurry cup table until it bottoms on top bearing.

OUTER ASSEMBLY CLEANING

If disassembly of outer drive assembly is necessary for cleaning, the bottom and top retainers only may be removed for flushing and cleaning, allowing the magnets to stay in place in the outer holder.

Special care and handling techniques are required to install these magnets. If new magnets are required, it is recommended that the customer return the drive magnet assembly to the factory for installation.

ENCAPSULATION REPAIR

The encapsulation (rotor) can become bowed slightly if not handled carefully when out of the housing. Such bowing may also occasionally happen from rough handling of a fully assembled unit during transportation. This condition can cause excessive bearing wear and may even allow the encapsulation to hit the housing ID. If bowing is suspected, it can be verified and corrected easily by the following procedure:

1. Carefully mount the encapsulation between centers in a lathe.

2. Turn slowly and, using an indicator, determine both if the encapsulation is bowed and the location of the high spot.

3. Mark the high spot with a crayon.

4. With the encapsulation still between centers, straighten by tapping at the high spot using a mallet and wood block.

6. Repeat above procedures as necessary until T.I.R. is less than 0.005".

Spare parts for the magnetic drive are available from OFI Testing Equipment..

The assembly drawing enclosed will assist you in identifying and describing parts required. Always specify the serial number of your unit when ordering parts so that the possibility of error may be reduced by direct reference to the file on your unit.

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