



FILTRATION TESTS

The filtration and wall building characteristics of a drilling mud are important for providing a relative measure of the amount of mud filtrate invasion into a porous and permeable formation and the amount of filter cake that will be deposited on the wall of the well bore wherever filtration occurs. From a drilling viewpoint these properties give an indication of the amount of water (or oil) wetting that can take place in filtrate sensitive formations and the potential for tight hole or differential sticking problems. For productive, hydrocarbon bearing formations these properties give an indication of the amount of filtrate invasion and permeability damage that can be expected.

TEST PROCEDURE

Filtration tests are conducted under two different conditions.

1. The standard API filtration test is conducted at surface (or room) temperature and 700 kPa, (100 psi), pressure for thirty minutes. For this test the fluid loss is the volume (in milliliters) of filtrate collected in this time period and the filter cake thickness (in millimeters) is the thickness of the cake that is deposited on the filter paper in this time period.
2. The API high temperature, high-pressure test, (HTHP test) is conducted for thirty minutes of filtration at a temperature of 149°C, (300°F), and a differential of 3450 kPa, (500 psi). For this test the filtrate must be collected under a backpressure of 700 kPa, (100 psi) in order to prevent vaporization of the filtrate.
3. For all filtration tests the filter paper characteristics are Whatman 50 or equivalent and the filtration area is 4560 mm².
4. Many filtration tests are conducted with a “half area” filter press. In this event the filter cake thickness will be the same but the fluid loss must be corrected to the full size paper by doubling the collected filtrate volume in the thirty minute time period. All HTHP instruments are half area presses.

STANDARD FILTRATION TEST INSTRUMENTS

Rig Style, Standard Filter Press

This type of filter press has a test cell with a removable lid and base that is placed onto the cross beam of a frame with a screw handle at the top for holding these component parts together during the test.

The instrument is assembled in the following order:

1. Base cap with filtrate tube, rubber gasket, screen, filter paper, rubber gasket fixed to the mud cell (cylinder) using the locking dowel.
2. Drilling mud poured into the cell to within 10 mm from the top.
3. Rubber gasket and lid put on the cell and placed onto the cross beam of the test cell frame.
4. Turn down the screw handle firmly and connect the pressure source making sure the pressure relief valve is closed.

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Half Area Filter Press

This type of instrument is typical of a “half area” cell for which the filtrate volume must be doubled when the fluid loss is reported. The instrument is self-contained with a CO₂ cartridge in a cylinder for its pressure source that is adjusted using the T-handle of the built-in regulator at the top of the instrument. The mud cell is a rubber boot that is placed inside a holding cup to separate the mud from the pressure source. The lip of the boot serves as the sealing surface onto which the half area filter paper is placed prior to securing the lid into place. The lid, in the form of a screw cap or other locking device, is either knurled on the inside to simulate a screen or it may contain an actual, fixed screen. The relief valve (sliding bar) on the side of the cell must be open to apply pressure to the outside of the boot and closed when the filtration test is complete in order to permit pressure to be relieved.

Model MB Filter Press

This instrument consists of a mud cell assembly, pressure regulator and gauge mounted on the top of the carrying case. The cell is attached to the regulator by means of a coupling adapter by simply inserting the male cell coupling into the female filter press coupling and turning clockwise 1/4 turn. The cell is closed at the bottom by a lid fitted with a screen, by placing the lid firmly against the filter paper and turning to the right until hand tight. This forces the filter paper against the O-ring fitted in the O-ring groove at the base of the cell. Pressure is supplied by a CO₂ cartridge and may be released by a bleed-off valve prior to uncoupling the cell. (The bleed-off valve is closed when the valve is screwed in).

STANDARD API TEST PROCEDURE

1. Pour the mud sample into the cell, secure the lid and make sure all valves are in the correct positions to permit the application of pressure to the sample to be filtered. If necessary place a fresh CO₂ cartridge in the holding cylinder and screw the cylinder on quickly and securely to puncture the cartridge.
2. Place an appropriately sized, graduated cylinder under the filtration tube.
3. Using the pressure gauge as an indicator apply 700 kPa pressure to the sample and begin timing the test.
4. Collect the filtrate in the graduated cylinder for 30 minutes. At this time, remove the graduated cylinder, turn off and relieve the pressure on the test sample.
5. Report the volume of collected fluid as the fluid loss in milliliters making sure the volume is doubled if a half area filter press was used.
6. Disassemble the test cell, discard the mud, and use extreme care to save the filter paper with minimal disturbance to the filter cake. Remove excess mud from the filter cake by light washing or lightly sliding a finger across the filter cake. Measure the thickness of the filter cake and report in millimeters. If desirable, the filter cake texture may also be noted as being dry to slick and mushy to firm to provide an indication of its friction factor and compressibility.
7. Wash all components thoroughly in fresh water and wipe dry with a clean cloth or paper towel.

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HIGH TEMPERATURE, HIGH PRESSURE FILTRATION TEST INSTRUMENTS

Baroid, OFI Instruments

These instruments are O-ringed valve stems that act as valves which are closed when the stem is tightened into the mud cell and opened by unscrewing the valve stem approximately one-half turn. The pressure regulator and backpressure cylinder is attached to the valve stems with locking pins. The cell of this type of instrument is loaded by unscrewing the setscrews in the cell body until the cap can be removed. With the valve stem in the body and closed (tightened) mud is added to the cell to within 10 - 15 mm from the top. Filter paper is placed on top of the O-ring, which has its own groove in the cell body. The cap is placed in the cell making sure that the setscrew seats in the cap match the screws in the cell. The pressure source is a CO₂ cartridge located in the barrel of the regulator assembly. The backpressure attachment is required only for tests conducted at temperatures above 95°C. The mud cell is placed into the heating well and seated on the alignment pin located in the well. The filtrate volume obtained from this instrument must be doubled in order to correct the volume to the full sized paper.

FANN, OFI Instruments

These instruments use threaded valve stems with valves to which the pressure regulator assembly by closing the valve on the cell, inverting it and then adding the drilling mud to within 10 - 15 mm from the top. Filter paper is placed on the O-ring in its groove. The cap of the cell is secured using set screws and lowered in to the heating well which has provision to pass the valve and valve stem assembly of the cell through its base. The backpressure assembly is used for tests with temperatures in excess of 95°C. Pressure is supplied from CO₂ cartridges in the barrel of the regulator assembly. The cartridge is punctured when the barrel is tightened onto the regulator assembly. This is a half area instrument whose filtrate volume must be doubled to correct it to the standard full size test.

HIGH TEMPERATURE, HIGH PRESSURE FILTRATION TEST

The following is the standard procedure adopted by the API for testing at 149°C and 3450 kPa:

1. Connect the heating jacket to the correct voltage, place a thermometer in the well of the jacket and preheat the jacket to 155°C. Adjust the thermostat in order to maintain a constant temperature.
2. Take warm mud from flow line or preheat to 50 - 55 C while stirring.
3. Load cell as recommended by the manufacturer. Care should be exercised not to fill cell closer than 15 mm from top to allow for expansion.
4. Place the cell in the heating jacket with both top and bottom valves closed. Transfer the thermometer from the heating jacket to the well of the test cell.
5. Place the pressure assembly on the top valve stem and lock into place. Place the bottom pressure receiver and lock into place. Apply 700 kPa to both pressure units with valves closed. Open top valve and apply 700 kPa while heating.
6. When temperature reaches 149°C, open bottom valve and increase pressure on the top assembly to 4150 kPa to start filtration. Collect filtrate for 30 minutes maintaining the 149°C temperature, plusminus 2°C. If desired record surge volume after two (2) seconds. If backpressure rises above 700 kPa during the test, cautiously bleed off pressure by collecting portion of the filtrate. Record the total volume.

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7. The filtrate volume should be corrected to a filter area of 4581 mm². (If the filter area is 2258 mm² double filtrate volume and report.)
8. At the end of test, close both valves. Back T-handle screw off the regulator and bleed off pressure from both regulators. CAUTION: Filtration cell will still contain about 3500 kPa. Maintain cell in upright position and cool to room temperature. (After the cell is cool, continue to hold cell upright (cap down) and loosen the top valve to bleed off pressure slowly).
9. After the cell has cooled and the pressure has been bled off, the cell may be inverted to loosen the cap screws with an Allen wrench, remove the cap with a gentle rocking motion, carefully retain the filter cake for analysis and thoroughly clean and dry all components.
10. Do not use filtrate for chemical analysis.
11. If filter cake compressibility is desired the test can be repeated using 1400 kPa on the top-pressure and 700 kPa for bottom pressure.
12. Record both temperature and pressure with the results of the filtration test at all times. The temperature of 149°C was selected so as to be within the range where high temperature mud treating procedures and chemicals are required.