SMART PLUNGERS: OBTAINING DOWN HOLE PRESSURE AND TEMPERATURE DATA FROM A PLUNGER

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Smart plunger technology allows producers to receive fast and reliable down hole pressure and temperature information from a plunger equipped with an internal pressure and temperature gauge. The smart plunger is dropped in the well like any other plunger. Normal cyclical operation of the well returns the plunger to surface without the use of wire line, rig, and crew. When the smart plunger is retrieved at surface the operator connects to the plunger. A computer receives the time vs. pressure and temperature data for processing and display to the operator. See Illustration 1(a.) Red represents pressure and blue represents temperature (F.) The smart plunger is capable of logging normal rise and fall plunger runs, shut in build up tests; as well as, stationary down hole flowing applications.

The smart plunger is capable of logging up to eleven months of pressure and temperature data. The data logger has up to sixteen programmable set points. For example, the plunger can be programmed to sample data every second for the first 24 hours, then sample every five minutes for the next 24 hour period, then change to an hourly sample rate there after.

The smart plunger makes shut in build up tests simple and easy. One person can quickly obtain a build up test without the use of a rig or crew. To obtain a build up test, the operator must program the desired sample rates in the smart plunger. The operator then drops the smart plunger and shuts the well in. After reaching the pre-determined shut in time, the operator turns the well on. The smart plunger is caught in the lubricator, retrieved from the well and the build up test is downloaded from the smart plunger. Illustration 1(b) shows a six day shut in build up test using the smart plunger.

The smart plunger can be utilized as a plunger lift optimization tool. Not knowing exactly when a plunger hits bottom has plagued the plunger lift industry for years. If a producer sets the fall time too long, they are not utilizing all of the production time that the well is capable of delivering. If the fall time is not long enough, the plunger will not lift the whole column. The smart plunger graphs when the plunger hits fluid, see illustration 2(a.) # 1. The smart plunger can also graph when the plunger hits bottom. See illustration 2(a) # 3. A producer in Wyoming ran the plunger in seven wells. The operators had always assumed a fall time of thirty minutes in this particular field. After analyzing the data obtained from the smart plunger, the operator was able to decrease fall times and increase flow times in six wells. The data obtained from the smart plunger indicated that 30 minutes was not a sufficient amount of time to allow the plunger to reach bottom on the seventh well. The operator increased the fall time to 38 minutes. This increased fall time allowed the plunger to reach bottom, therefore removing all of the produced liquids from the wellbore. After optimizing plunger fall times, the operator averaged a production increase of 30 mcfd per well.

The smart plunger can be used as a surveillance tool. A producer in New Mexico suspected they had a hole in the production tubing. Temperature in a gas well should be very consistent, cooler on top and warmer on bottom. The operator dropped the smart plunger and allowed the plunger to make three runs. After retrieving the plunger and downloading the data, they plotted the temperature and pressure information. They noticed a consistent temperature drop/pressure spike in the data. See illustration 2(b). This data quickly confirmed that they did in fact have a hole in the tubing. The hole in the tubing is illustrated on the graph at point 1.

The flow-through smart plunger is capable of logging down hole pressure temperature data. The normal smart plunger travels up and down the hole, logging normal plunger runs. See illustration 3(a). The flow-through design allows the smart plunger to log stationary down hole flowing data. The flow-through plunger is dropped with a shuttle plunger. The shuttle plunger is equipped with spring loaded pad that pushes against the tubing. This design allows the shuttle and flow-through smart plunger to descend down the hole in a slow and predictable speed. After the plunger hits bottom, a thermal actuator in the shuttle plunger releases the flow-through smart plunger. When the

well is turned on, the shuttle plunger runs up hole and is retrieved. The flow-through smart plunger remains on bottom until it is retrieved. Illustration 3(c) depicts a ten day flowing bottom hole pressure test. The operator took the smart plunger flowing data and graphed it with flow rate, tubing and casing pressures.

Retrieving the flow-through smart plunger is a simple task. The fishing plunger has a special retrieving mechanism. The plunger latches onto the flow-through smart plunger, this process allows the flow-through plunger to run up hole. The plunger is then retrieved from the lubricator, and the data is collected just like the traveling smart plunger. See illustration 3(b.)

Because the smart plunger requires no rig, crew, or scheduling build up tests and gradient reports simple and quickly obtainable. The single person operation is convenient for remote and hard to reach locations.

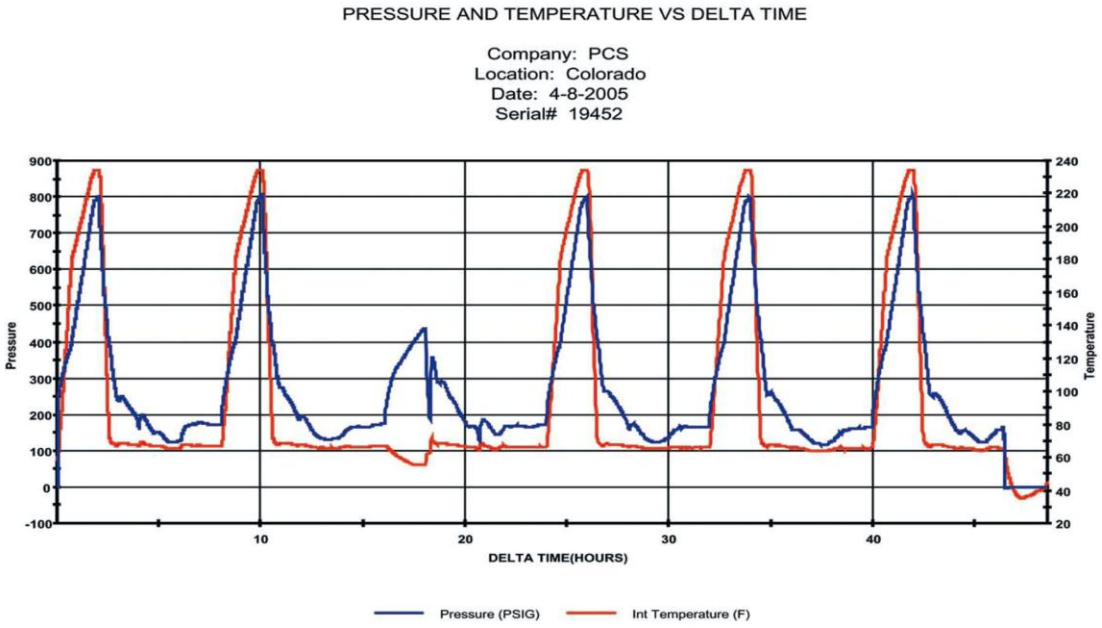

Illustration 1A

PRESSURE AND TEMPERATURE VS DELTA TIME

Company: 6 Day Build Up Test
Location: Colorado
Date: 12-29-05
Serial# 19565
Max. Pressure: 932.030 Max. Temperature: 153.651

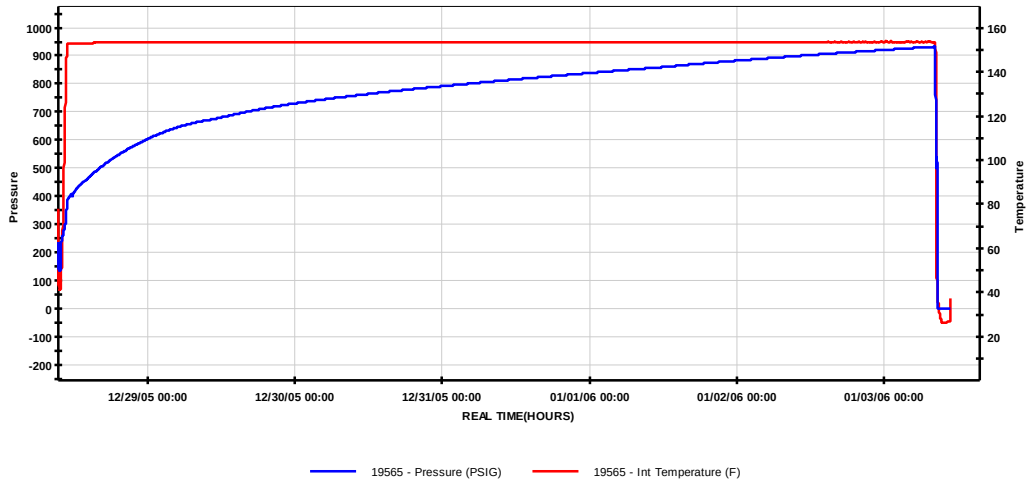

Illustration 1B

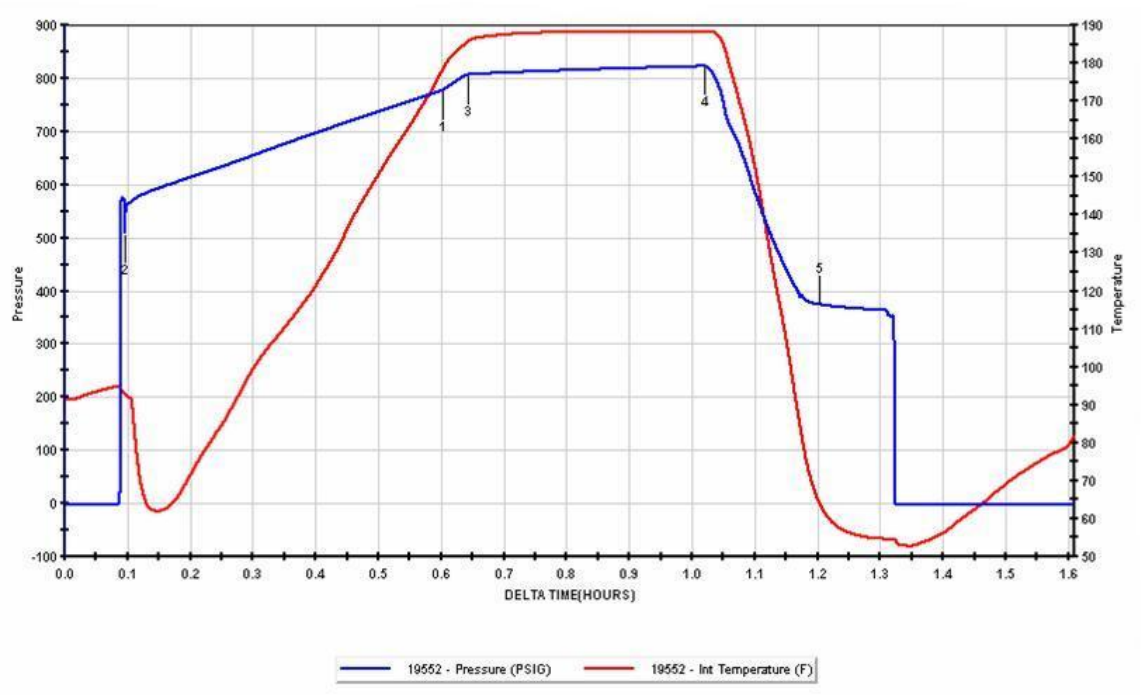

Illustration 2A

TEMPERATURE VS DELTA TIME

Company: Tubing Hole
Location: Colorado
Date: 1/19/2006
Serial# T5017
Max. Temperature: 249.261

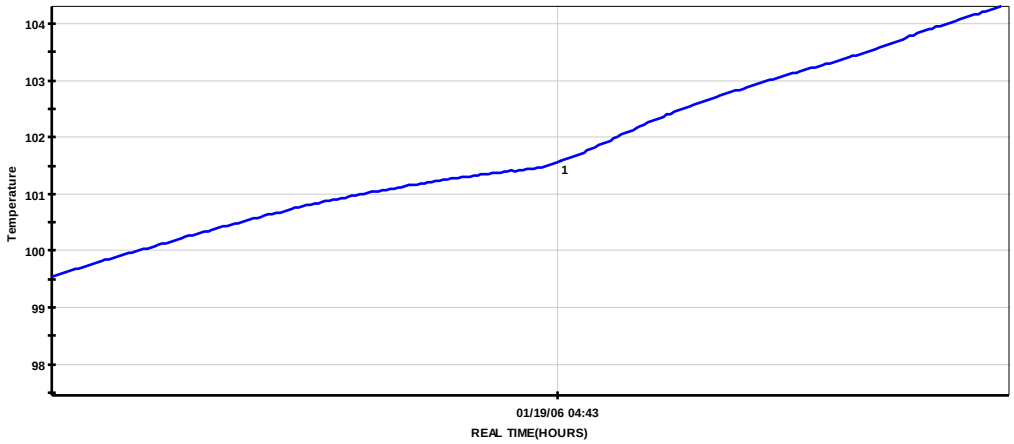

Illustration 2B

Illustration 3A

Illustration 3B

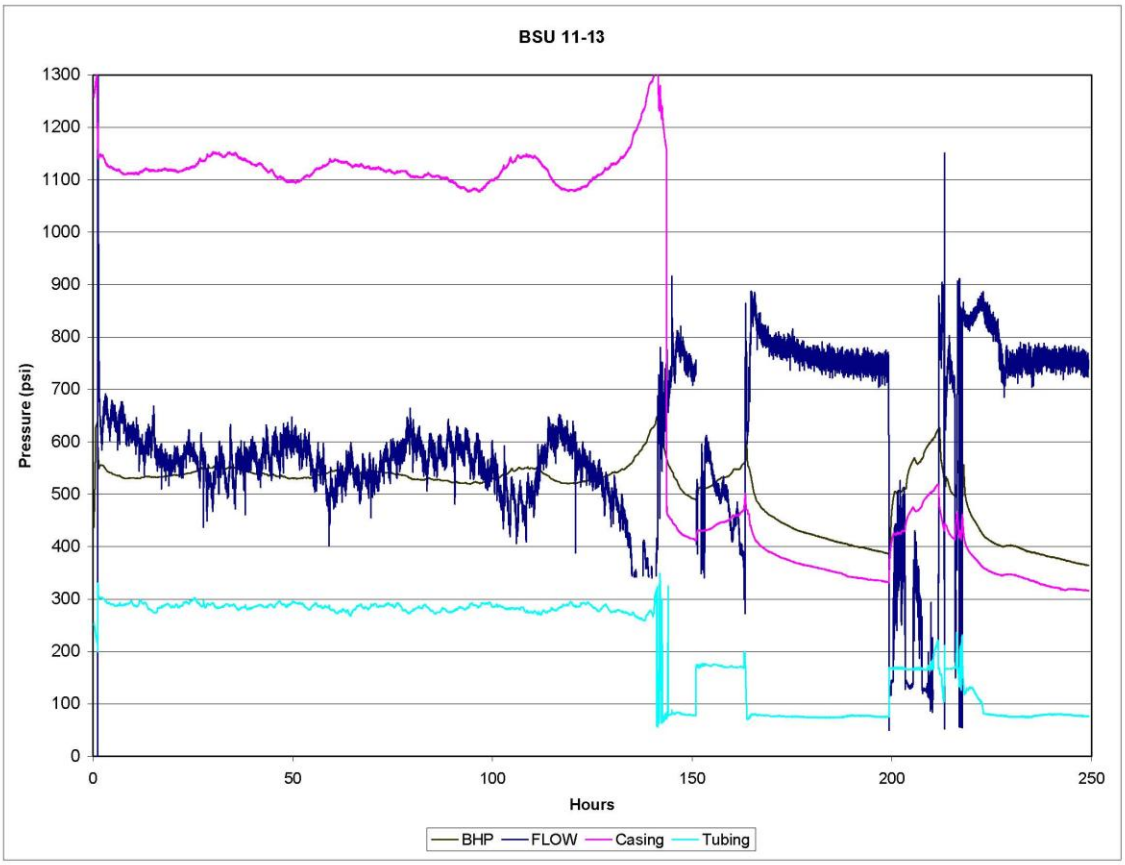

Illustration 3C