

Production Logging

Production Logging Tools

A wide range of production logging tools for use in all type of downhole environments are available:

- Production logging tools for vertical, deviated, and horizontal wells
- Full range of sensors and running hardware for memory and electric line PL logging

Applications

- Flow rate measurements – continuous flowmeters, basket flowmeters, fullbore flowmeters, spinner array tool (SAT)
- Fluid identification / flow composition tools – gas holdup, capacitance water holdup, radioactive fluid density, differential pressure density, capacitance array
- Flow condition / well diagnostic tools – pressure, temperature, X-Y caliper, inclinometer
- Correlation tools – gamma ray, casing collar locator

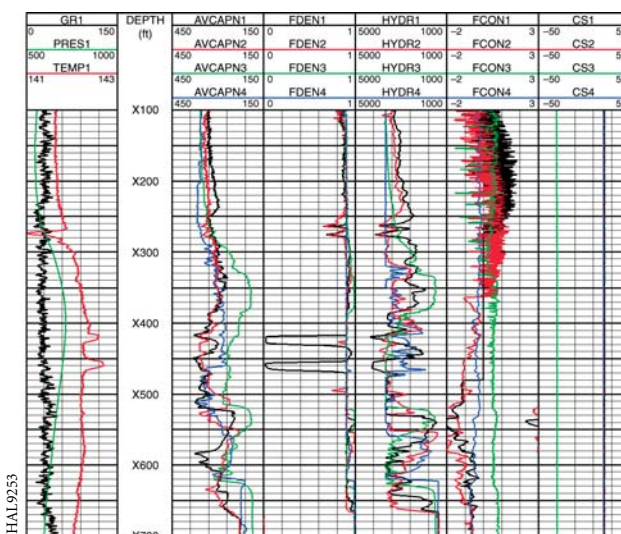
Memory Production Logging

The memory production logging string is normally deployed on slickline or coiled tubing. Simultaneous telemetry transmits the signals from standard sensors to a battery powered memory tool at the top of the toolstring. The memory tool is programmed using a computer and interfaces to record log values with intervals as short as 0.1 seconds or as long as many hours between readings.

Once the logging operation is complete, the procedure for merging the log-time and depth-time data is rapid.

Electric Line Production Logging

Using a computerized LOGIQ™-CH system, calibration, recording, and printing of well logs can be done in real time. When operating in this mode, the downhole telemetry transfers data from the toolstring to the surface system via electric line.



HAI-9253

This example provides a display of typical production logging tool data. For a complete interpretation temperature, pressure, holdup, and fluid velocity readings are necessary. Track 1 consists of the gamma ray (GR1), pressure (PR1), and temperature (TEMP1). The pressure data shows that this well has not achieved a steady production rate at this time. Tracks 2 through 4 provide data concerning the fluid holdup as measured by the CAT™ tool, radioactive fluid density, and fluid capacitance tool. Tracks 5 and 6 provide information about the fluid movement and cable speed. Track 2 consists of the average capacitance reading from four different passes of the CAT tool. Higher readings indicate hydrocarbons while water is around 450 counts or the right side of the track. Track 3 is the fluid density from four passes of the radioactive fluid density tool. Likewise, Track 4 consists of four passes of the fluid capacitance tool where low counts indicate water while the higher counts indicate hydrocarbons. Track 5 consists of four passes of the continuous spinner with pass 1 and 2 showing a nonsteady state. Track 6 shows the speed of the tool, and since the well was logged with a coiled tubing the two speeds are about 30 fpm down and 20 fpm up.

Features

- Great selection of flowmeter types and sizes, including the SAT tool for deviated or horizontal wells
- High sensitivity and low threshold velocity flowmeters
- Standard and compact tool sizes
- Multiple logging sensors in one string. All PL sensors can run simultaneously except the bottom only tools
- Advanced sensors such as the GHT™ gas holdup tool, CAT™ capacitance array tool, and spinner array tool (SAT) for horizontal and undulating wells
- Conveyance flexibility – toolstring can be deployed on electric line, slickline, coiled tubing, or drillpipe

- Greater consistency of data sets as a result of using the same sensors for electric line and memory operations
- Faster telemetry, accurate, safe, reliable operations
- The same telemetry platform is used to run production logging tools with casing inspection and/or pulse neutron tools, either sequentially in one trip in the hole or simultaneously if required

Associated Answer Products

- Hard copy log of multiple sensor measurements
- Wellsite production log analysis
- Advanced production log analysis at Applied Formation Evaluation Centers

Production Logging Tools Specifications Summary

PL Tool Category	Tool Type	Tool Length in. (mm)	Range of Measurement	Resolution	Accuracy	Weight lb (kg)	Others	
Correlation	Casing Collar Locator	18.5 (470)				12.1 (5.5)	Acquisition time: 1 sec typical	
	Production Gamma Ray	23.1 (586)		Sensitivity Threshold 20 keV approx.		9.4 (4.25)	Sensitivity: 1 counts/API	
Flow Condition / Well Diagnostic	Dual Caliper	37.5 (953)	2 to 9 in.	0.015 in.	0.1 in. <150°C; 0.2 in. <165°C; 0.3 in. <177°C	14.5 (6.6)		
	Quartz Pressure Gauge	19.01 (483)	0 to 15,000 psi	0.008 psi and <0.005°C	0.02% FS	8.8 (4)	Linearity <0.01% FS	
	Fast Response Platinum Resistance Thermometer	12.5 (318)	50 to 350°F (10 to 177°C)	0.006°F (0.003°C)	0.9°F (0.5°C)	10 (4.5)	Response time <0.5 sec	
	Inclinometer Accelerometer	10.7 (272)	+2 g to -1 g	0.004 g	0.01 g			
Fluid Identification	Enhanced Capacitance Water Holdup Tool	26.2 (665)	Yw 0 to 100% best Yw<40%	0.1% external limitation	±1.0% for Yw < 40%	10 (4.5)		
	Radioactive Fluid Density Tool	22.9 (582)	0 to 1.25 g/cc	0.01 g/cc	± 0.03 g/cc	9.6 (4.3)		
	Differential Pressure Fluid Density Tool	51.9 (1318)	0 to 1.5 g/cc	0.001 g/cc	± 0.03 g/cc		Max well angle 70°	
	Capacitance Array Tool	51.43 (1306)	See details under flow imager, 12 capacitance sensors in 360° with RB information				17.3 (7.8)	12 miniature capacitance sensor
	Gas Holdup Tool	24 (610)	0 to 100% gas holdup within 2.9 to 9.9 in. pipe (3 1/2 in. 9.2 lb/ft and 10 3/4 in. 51 lb/ft)	1%	± 3%	8 (3.6)	1 sec typical	

Production Logging Tools Specifications Summary

PL Tool Category	Tool Type	Tool Length in. (mm)	Range of Measurement	Resolution	Accuracy	Weight lb (kg)	Others
Flowmeter	Inline Spinner Flowmeter	21 (533)	Max fluid velocity 3,450 ft/min	Threshold approx 8 ft/min in water	10 pulses/rev	10.6 (4.8)	Spinner shroud OD 1 11/16, 2 1/8, 3 1/8 in.
	Continuous Spinner Flowmeter (Bearing)		Max fluid velocity 2,000 ft/min	Threshold approx 5 ft/min in water	10 pulses/rev	3.5 (1.6) mechanical section only	Spinner shroud OD 1 11/16, 2 1/8, 3 1/8 in.
	Continuous Spinner Flowmeter (Jeweled)	9 (229)	Max fluid velocity 3,450 ft/min	Threshold approx 5 ft/min in water	10 pulses/rev	3.5 (1.6) mechanical section only	Spinner shroud OD 1 11/16, 2 1/8, 3 1/8 in.
	Caged Full Bore Flowmeter 3 Arm	34.9 (886)	500 ft/min (2.54 m/s), 28,250 BPD in 7-in. casing; with solid shaft tool can work up to 1,200 ft/min	1.7 ft/min approx (0.01m/s), 100 BPD in 7-in. casing	10 pulses/rev	10 (4.5)	Available for different casing size 4 1/2 to 9 5/8 in. (114 to 244 mm)
	Caged Full Bore Flowmeter 6 Arm	34.9 (886)	500 ft/min (2.54 m/s), 28,250 BPD in 7-in. casing; with solid shaft tool can work up to 1,200 ft/min	1.7 ft/min approx (0.01m/s), 100 BPD in 7-in. casing	10 pulses/rev	10 (4.5)	Available for different casing size 4 1/2 to 9 5/8 in. (114 to 244 mm)
	Diverter Flowmeter	70.7 (1796)	Minimum 6-8 m ³ per day. Maximum approx. 400 m ³ /d (6 psi drop ~120 lb uplift in 5 1/2-in. casing)	Threshold approx 8 ft/min in water	10 pulses/rev		3 1/2 to 9 5/8 in. (90 to 244 mm)
	Spinner Array Tool	46 (1168)	3 1/2 to 7-in. casing	12 ft/min in water	3/8-in. spinner 3 pulses/rev	Approx 15 (6.8)	6 miniature spinner equi-spaced around circumference
Combination Tool	Quartz Pressure CCL	19.01 (483)	Same as quartz pressure gauge and CCL individual tools			8.8 (4.0)	
	Capacitance / Temperature / Flow	Approx. 18.5 (470) w/o flow mech section	Same as capacitance / temperature flow individual tool. Flowmeter mechanical section can be any type of continuous or full bore flowmeter.			Approx 5.4 (2.5) w/o flow mech section	
Deployment Tools	Head Tension Unit	22.8 (580)	-400 kg (compr.) to +1000 kg	Hysteresis 5% FS	Temperature Drift 5% FS	10 (4.5)	Repeatability ±2% FS
	Roller Centralizer	Different roller centralizers are available with 3 or 4 arms with single or double rollers in each arm. Also have different centralization force as per operational requirement. Approx Length - 33.25 in. (845 mm) and weight around 12 lb.					
	Spring Centralizer	Different compact spring bows are available with 3 to 6 springs. Also have different centralization force as per operational requirement. Approx Length - 28 in. (711 mm) and weight around 10 lb.					
	Swivel	This is a monoconductor swivel joint which allows free rotation between the upper and lower heads while maintaining electrical continuity through the tool. Different sizes available, Approx Length - 11 in. (280 mm) and weight 4 lb.					
	Knuckle Joints	7 (178)	Ball type knuckle for deployment in deviated well				3.5 (1.6)

1. Tools specified have nominal OD of 1 1/16 in. Tools with OD of 1 3/8 in. are also available.

2. All tools have maximum pressure rating of 15,000 psi and maximum temperature rating of 350°F or 177°C. For higher pressure or higher temperature tools contact your local Halliburton representative.

3. Telemetry is very high speed capable of running 62 tools in combination (virtually no limit on tool combination for telemetry).