Halliburton Reservoir Description Tool (RDT™) Formation Tester

OVERVIEW

When flexibility and versatility are required, the Halliburton Reservoir Description Tool (RDT™) tool collects—in a single deployment—formation pressure, fluid ID, and samples. Using the Focused Oval Pad and next-generation Integrated Characterization Section (ICS), combined with the Fluid Identification Section (FLID), the RDT tool captures the complete fluid composition and high-quality samples. It is easily customized to enable efficient formation pressures and complete fluid characterization. There is also no technology sacrifice to perform pressure and sampling at high pressures.

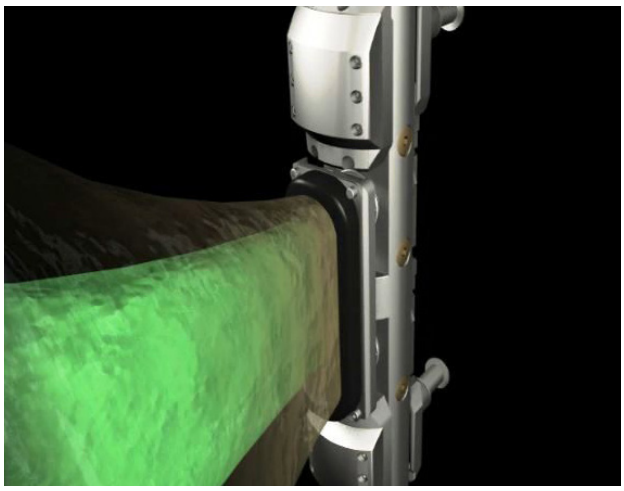
Complex conditions require unique solutions. The customizable service allows formation pressures and anisotropy data to be collected with standard Dual Probes. When sampling or downhole fluid identification is required, the RDT tool's Oval Pad is the industry's largest single-pad surface flow-area probe. For minimizing rig time, the Focused Oval Pad combines the extra-large surface flow area of the Oval Pad empowered by split-flow focusing. It delivers the lowest contamination samples possible with industry-leading efficiency.

The total performance of a system is limited by the weakest link, and collecting clean fluid samples requires best-in-class flushing pumps. The RDT Flow Control Pump Sections are proven to be the most versatile with a full range of differential pressures, the highest horsepower, and the fastest rates.The unique Dual-Probe Section offers increased efficiency through its ability to perform multiple tests with a single set of the tools. Dual Probes enable more reliable determination of formation pressure and mobility, as well as a more detailed understanding of heterogeneity and anisotropy.

BENEFITS

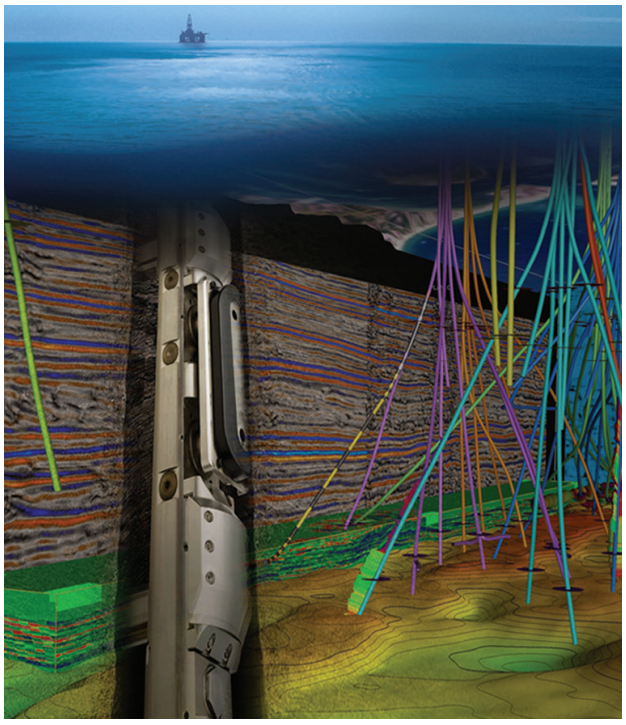
- Reduces rig time
  - Lowers risk of stuck tool
  - Increases operational efficiency
- Reduces risk of sanding/mitigates effects
  - Greater success in sample recovery
- Increases fluid sample purity
  - Reduces uncertainty in establishing connectivity
  - Increases confidence of flow assurance

For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com



HAL32533

Focused Oval Pad



HAL48811

Oval Pad

RESERVOIR DESCRIPTON TOOL (RDT™) FORMATION TESTER

Dual-Probe Section

DUAL-PROBE SECTION

The unique Dual-Probe Section (DPS) offers increased efficiency through its ability to perform multiple tests with a single set of the tools. Dual Probes enable more reliable determination of formation pressure and mobility, as well as a more detailed understanding of heterogeneity and anisotropy.

DPS PROBE SELECTION

Complex conditions require unique solutions. Our customizable service allows formation pressures and anisotropy data to be collected with our standard Dual Probes. When sampling or downhole fluid identification is required, we offer the Oval Pad, the industry's largest single-pad surface flow-area probe. For minimizing rig time, nothing but the best is required. The Focused Oval Pad combines the extra-large surface flow area of the Oval Pad empowered by split-flow focusing. It delivers the lowest contamination samples possible with industry-leading efficiency.

FOCUSED OVAL PAD

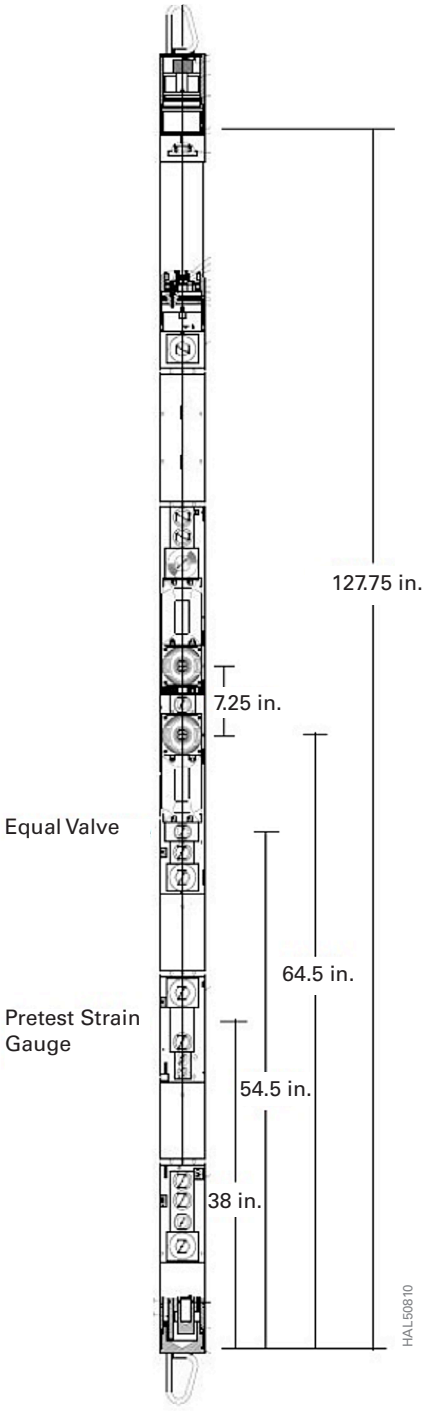
Cleaner, faster samples, even in low permeability

Combining the extra-large surface flow area of the Oval Pad and empowered by split-flow focusing, the Focused Oval Pad delivers the lowest contamination samples possible with industry-leading efficiency. With increased focus on high-quality samples in less rig time, the RDT Focused Probe delivers ultraclean samples with the fastest pump rates and largest focused probe area.

DPS OVAL PAD

Running circles around the competition

Our proven RDT Oval Pad has the advantage in all environments due to its larger flow area and vertical straddle of the formation.



Dimensions and Ratings

Max Temperature	350°F (177°C)
Max Pressure	20,000 psi (138 MPa)
OD*	4.75 in. (12.07 cm)
Length	10.64 ft (324 m)
Weight	385 lb (174.63 kg)

* OD at probe dependent on hole size

Borehole Conditions

Borehole Fluids	Salt ■	Fresh ■	Oil ■	Air ■
Recommended Maximum Logging Speed	Stationary			
Tool Positioning	Centralized ■	Eccentralized ■		

Hardware Characteristics

Probe Spacing	7.25 in. (221 cm)		
Hole Size	5⅞ in. to 22.0 in. (19.37 cm to 55.88 cm)		
Probe Options	Dual Probe Oval Pad Focused Oval Pad	(5⅞ in. to 22 in.) (5⅞ in. to 17½ in.) (8½ in. to 12¼ in.)	(19.37 cm to 55.88 cm) (19.37 cm to 44.45 cm) (21.59 cm to 31.11 cm)
Pad Flow Area	Oval Pad (15.09 $in.^2$) / Focused Oval Pad (9.8 $in.^2$)		
Pretest Volume	100 cc	50 cc	
Pretest DD Pressure	10,000 psi (69 MPa)	20,000 psi (138 MPa)	
Pretest Rate	0.1 cc/sec - >15 cc/sec (Variable)		

Measurement

Strain Gauge Pressure Transducers	
Accuracy	Resolution
+/- 0.1% full scale	0.2 psi (1.4 KPa)
Pressure Transducer: Probe 1, Probe 2, Flowline	
Fluid Resistivity	
Accuracy	Resolution
10% full scale	0.02 ohm-m

Physical Strengths

Hardware	Tool Joints
Tension	200,000 lb (90,719 kg)*
Compression	200,000 lb (90,719 kg)*
Torque	600 ft-lb (813 N-m)*

* Strengths apply to new tools at 70°F (21°C) and 0 psi.

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RESERVOIR DESCRIPTON TOOL (RDT™) FORMATION TESTER

Dual-Port Straddle Section

DUAL-PORT STRADDLE SECTION

A paradigm shift has occurred in medium to low-permeability environments using the Reservoir Description Tool (RDT™) formation tester combined with the Dual-Port Straddle Packer (SPS). In the past, dual packers were not considered the first choice for sampling in medium to low-permeability formations as the sample quality obtained was poor.

The RDT Dual-Port Straddle Section uses controllable screen ports positioned at the top and the bottom of the annular interval. This spacing allows for the interval to be drained to take full advantage of segregation in the annular volume and obtain clean samples. Producing true radial flow, the Dual-Port SPS is also the best choice for mini DST and microfrac operations.

SEAMLESSLY COMBINED WITH RDT TOOL

When flexibility and versatility is required, the RDT tool will collect in a single deployment formation pressure, fluid ID, and samples. The Dual-Port SPS is one of the many options that can be combined as part of the RDT tool string and the combination of probes. It can be designed to cover all your pressure and sampling needs in a single run.

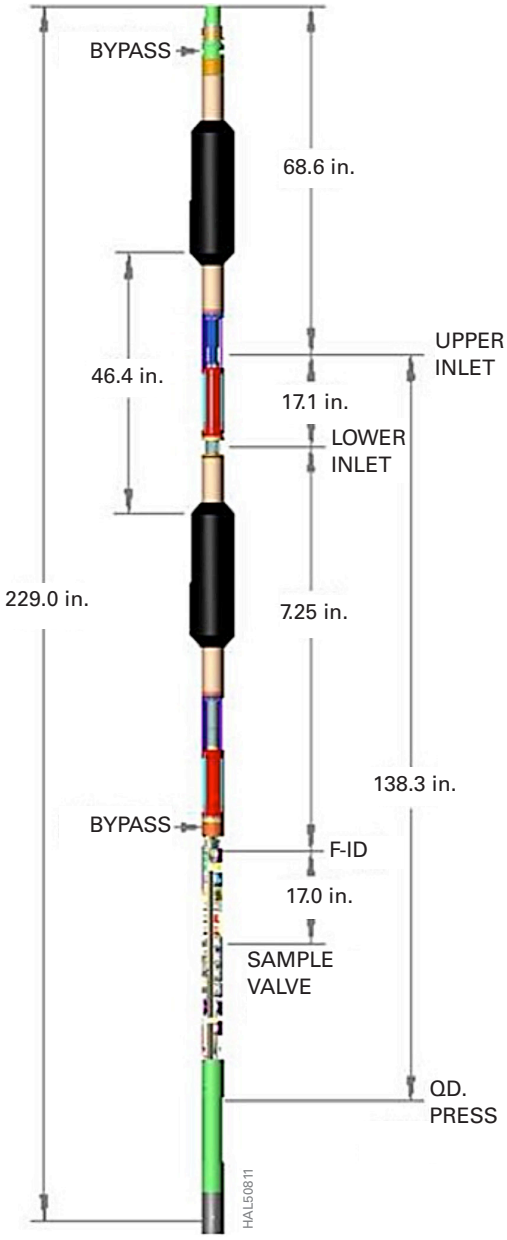
LARGE FLOW AREA

The advantage of the Dual-Port SPS is the increased flow area which enables faster flow rates and the ability to sample in very low-permeability environments. Dual-Port SPS should be used to flow a low-permeability formation while minimizing the drop in formation pressure during sampling. With a standard 1-m and 3-m spacing with dual-port capability, the RDT straddle packer can straddle a desired interval and lower perm environments or fractured or laminated zones.

DUAL PORT SAMPLING

Dual-port sampling opens up a new opportunity for sampling with straddle packers. The control of the flow from the upper and lower annular interval enables the mud and contamination to be drained to the bottom of the interval and the upper port to sample the segregated fluid. In the case of immiscible fluids, such as oil or gas sampling in water-based mud where the heavier phase is the contamination, the ability to sample high-quality hydrocarbon samples is possible in a very short period of time. In many cases, sampling using the Dual-Port SPS is faster than any other method for premium quality samples.

In a miscible system, such as oil, in oil-based mud, the Dual-Port SPS advantage improves the sample quality in low-permeability environments as it separates the mud in the sump from the desired fluid and improves contamination significantly.



FOCUSED FLOW INTERVALS

Upper and lower sections of the borehole may be flowed sequentially or at the same time by full surface control of the port. Dual pump with industry-leading pump rates can flow from both the upper and lower interval on an isolated flow patch to generate a focused flow interval.

FLOW CONTROL PUMP SECTIONS (FPS)

The total performance of a system is limited by the weakest link and collecting of clean fluid samples requires the best-in-class pump modules. The RDT flushing pumps are proven to be the most versatile with a full range of differential pressures and the highest horsepower and the fastest rates.

MINI DST AND MICROFRAC

The RDT Dual-Port SPS can perform using true radial flow-extended buildup for mini DST and microfrac operations. The Dual-Port SPS has a wide range of applications for more extensive test programs and opens up new design possibilities.

Dimensions and Ratings

Max Temperature	350°F (177°C)
Max Pressure	20,000 psi (138 MPa)
Min OD*	4.75 in. (12.07 cm)
Length**	19.08 ft (5.82 m)
Weight	858 lb (389 kg)

* Tool OD Depending on Packer
** Length for Standard Configuration

Borehole Conditions

Borehole Fluids	Salt ■	Fresh ■	Oil ■	Air ■
Recommended Logging Speed	Stationary			
Tool Positioning	Centralized ■			

Hardware Characteristics

Inlet Ports	Upper/Lower (Screened and Controlled)
Inlet Sapcing	17.1 in. (Standard) 88.0 in. (Optional Extenders)
Packer Spacing	46.4 in. (Standard) 117.3 in. (Optional Extenders)
Packer Hole Size	5⅞ in. to 14 in. (14.9 cm to 35.6 cm) Packer Element Selection
Packer Hydraulic Fluid	Filter Mud

Measurement

Quartz Gauge Pressure Transducers	
Accuracy	Resolution
+/- 0.02% full scale	0.01 psi (0.07 KPa)
Strain Gauge Pressure Transducers	
Accuracy	Resolution
+/- 0.1% full scale	0.2 psi (1.4 KPa)
Fluid Resistivity	
Accuracy	Resolution
10% full scale	0.02 ohm-m
Fluid Temp	
Accuracy	Resolution
3% full scale	0.02°F

Physical Strengths

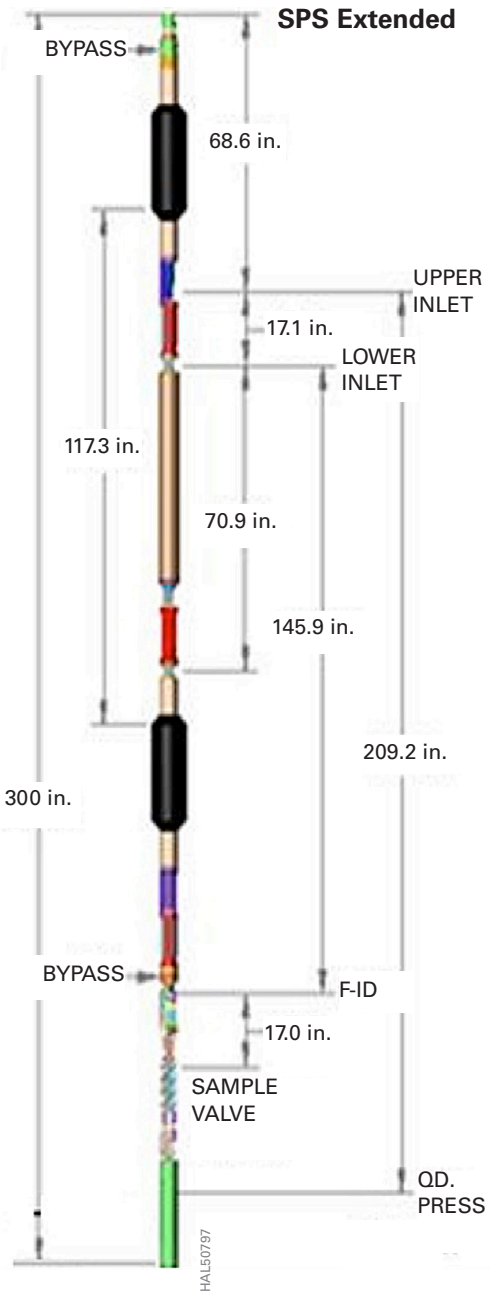
Hardware	Tool Joints
Tension	200,000 lb (90,719 kg)*
Compression	200,000 lb (90,719 kg)*
Torque	600 ft-lb (813 N-m)*

* Strengths apply to new tools at 70°F (21°C) and 0 psi.

SPS Extended

Length*	25.0 ft (7.62 m)
SPS Spacer Length**	70.9 in. (1.8 cm)

* Tool Length with One Spacer
** Spacer Quantity is Unlimited



Dual-Port SPS Available Packer List

Packer Name	OD (in.)	Min Run OD (in.)	Suggest Run OD (in.)	Max Temp (°F)	Target Hole Size (in.)	Min Hole (in.)	Max Hole (in.)
5.06HT	5.06	5.30	5.450	350	6.00	5.7	7.25
5.06LT	5.06	5.30	5.7-6.5	250	6.00	6.0	7.25
5.50HT	5.50	6.0	6.5-7.0	350	7.875	6.0	8.0
5.50LT	5.50	6.0	6.5-7.0	250	7.875	6.0	8.0
6.19HT	6.19	6.69	7.0-7.5	350	8.50	7.0	9.0
6.19LT	6.19	6.69	7.0-7.5	250	8.50	7.0	9.0
7.00HT	7.00	7.75	8.0-9.0	350	8.50	8.0	10.5
7.00LT	7.00	7.75	8.0-9.0	250	8.50	8.0	10.5
7x9HT	9.0	9.75	11.0-13.0	350	12.25	10	13.5
7x10LT	10.0	11.0	11.25-13.5	250	12.25	11.25	14.5
10HT	10.0	10.75	11.0-14	350	12.25	11	14.5

Drawdown Pressure

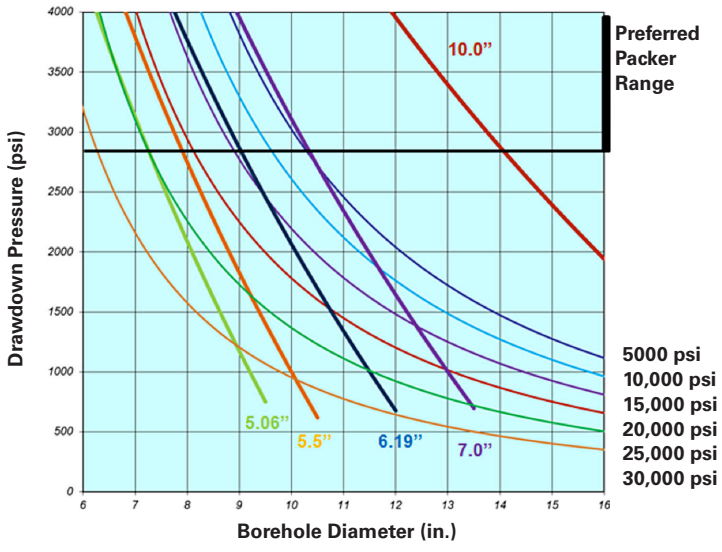
Hole Size (in.)	Packer OD (in.)	Packer Limit	5000	10000	15000	20000	25000	30000
6	5.06	4324						3190
8 1/2	6.19	3303			3154	2560	1965	1371
8 1/2	7	6370	4343	3749	3154	2560	1965	1371
10 5/8	9	3954	2718	2346	1974	1602	1230	858
12 1/4	9	2716	1953	1685	1418	1151	884	616
12 1/4	10	3670	1953	1685	1418	1151	884	616

Limit set at lowest value based on hydrostatic pressure

SPS Standoffs Selection According to Packer Size

Packer Size (in.)	Standoffs Required
5.06	None
6.19	7 in.
7.00	7.5 in.
9.00	10 in.
10.0	11 in.

SPS Operational Limits – Drawdown



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RESERVOIR DESCRIPTON TOOL (RDT™) FORMATION TESTER

Dual-Port Straddle Packer–High Strength

DUAL-PORT STRADDLE SECTION

A paradigm shift has occurred in medium to low-permeability environments using the Reservoir Description Tool (RDT™) formation tester combined with the Dual-Port Straddle Packer (SPS). In the past, dual packers were not considered the first choice for sampling in medium to low-permeability formations as the sample quality obtained was poor.

The RDT Dual-Port Straddle Section uses controllable screen ports positioned at the top and the bottom of the annular interval. This spacing allows for the interval to be drained to take full advantage of segregation in the annular volume and obtain clean samples. Producing true radial flow, the Dual-Port SPS is also the best choice for mini DST and microfrac operations.

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LARGE FLOW AREA

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DUAL-PORT SAMPLING

Dual-port sampling opens up a new opportunity for sampling with straddle packers. The control of the flow from the upper and lower annular interval enables the mud and contamination to be drained to the bottom of the interval and the upper port to sample the segregated fluid. In the case of immiscible fluids, such as oil or gas sampling in water-based mud where the heavier phase is the contamination, the ability to sample high-quality hydrocarbon samples is possible in a very short period of time. In many cases, sampling using the Dual-Port SPS is faster than any other method for premium quality samples.

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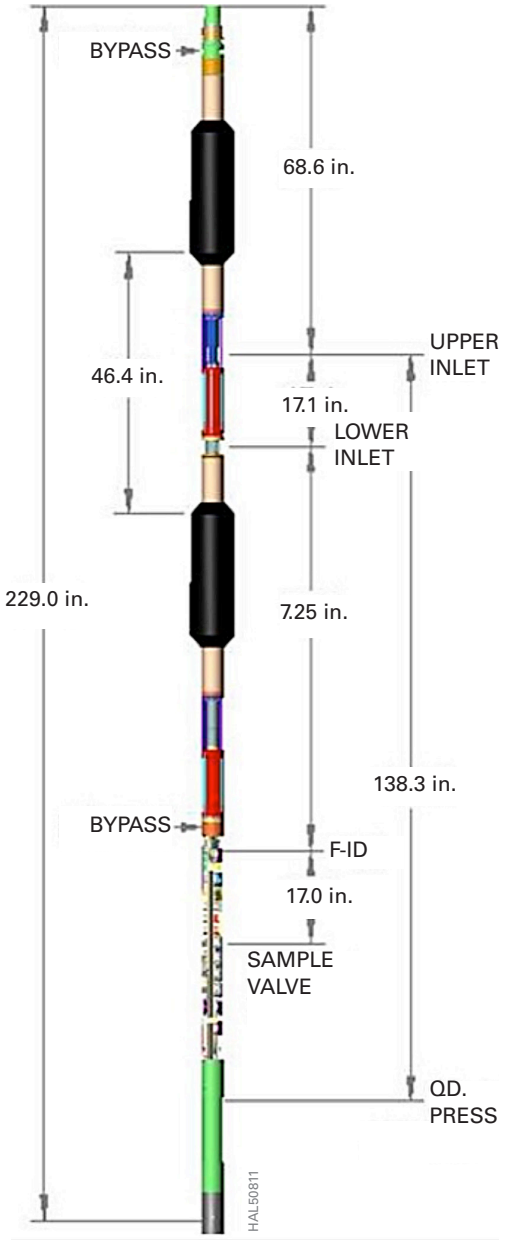

FOCUSED FLOW INTERVALS

Upper and lower sections of the borehole may be flowed sequentially or at the same time by full surface control of the port. Dual pump with industry-leading pump rates can flow from both the upper and lower interval on an isolated flow patch to generate a focused flow interval.

FLOW CONTROL PUMP SECTIONS (FPS)

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MINI DST AND MICROFRAC

The RDT Dual-Port SPS can perform using true radial flow-extended buildup for mini DST and microfrac operations. The Dual-Port SPS has a wide range of applications for more extensive test programs and opens up new design possibilities.

Dimensions and Ratings

Max Temperature	350°F (177°C)
Max Pressure	20,000 psi (138 MPa)
Min OD*	4.75 in. (12.07 cm)
Length**	19.08 ft (5.82 m)
Weight	858 lb (389 kg)

* Tool OD Depending on Packer
** Length for Standard Configuration

Borehole Conditions

Borehole Fluids	Salt ■	Fresh ■	Oil ■	Air ■
Recommended Logging Speed	Stationary			
Tool Positioning	Centralized ■			

Hardware Characteristics

Inlet Ports	Upper/Lower (Screened and Controlled)
Inlet Sapcing	17.1 in. (Standard) 88.0 in. (Optional Extenders)
Packer Spacing	46.4 in. (Standard) 117.3 in. (Optional Extenders)
Packer Hole Size	8½ in. to 14 in. (21.59 cm to 35.6 cm) Packer Element Selection
Packer Hydraulic Fluid	Filter Mud

Measurement

Quartz Gauge Pressure Transducers	
Accuracy	Resolution
+/- 0.02% full scale	0.01 psi (0.07 KPa)
Strain Gauge Pressure Transducers	
Accuracy	Resolution
+/- 0.01% full scale	0.2 psi (1.4 KPa)
Fluid Resistivity	
Accuracy	Resolution
10% full scale	0.02 ohm-m
Fluid Temp	
Accuracy	Resolution
3% full scale	0.02°F

Physical Strengths

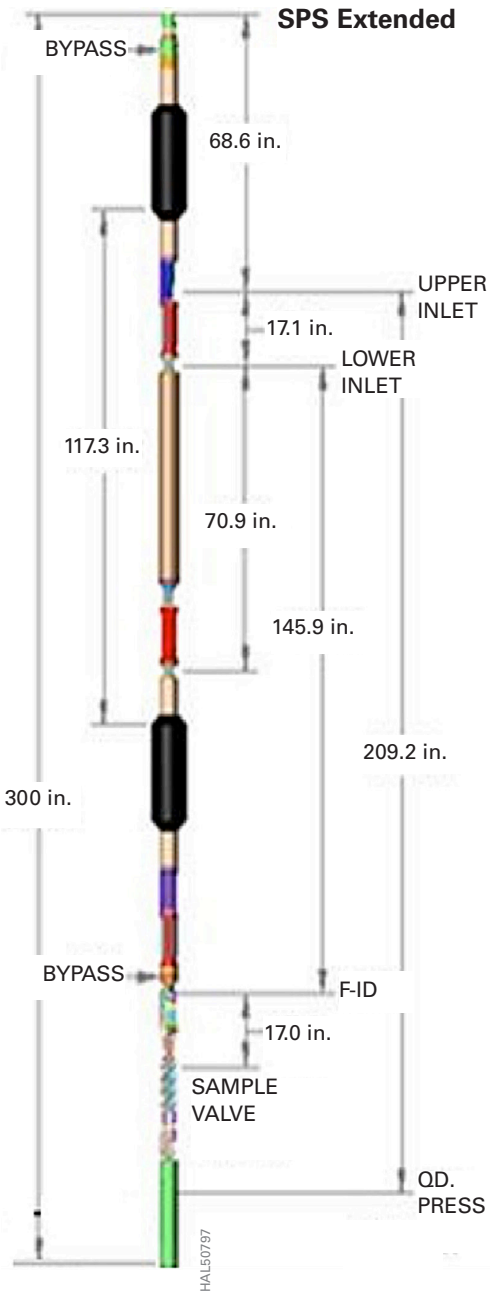
Hardware	Tool Joints
Tension	200,000 lb (90,719 kg)*
Compression	200,000 lb (90,719 kg)*
Torque	600 ft-lb (813 N-m)*

* Strengths apply to new tools at 70°F (21°C) and 0 psi.

SPS Extended

Length*	25.0 ft (7.62 m)
SPS Spacer Length**	70.9 in. (1.8 cm)

* Tool Length with One Spacer
** Spacer Quantity is Unlimited



Dual-Port SPS Available Packer List

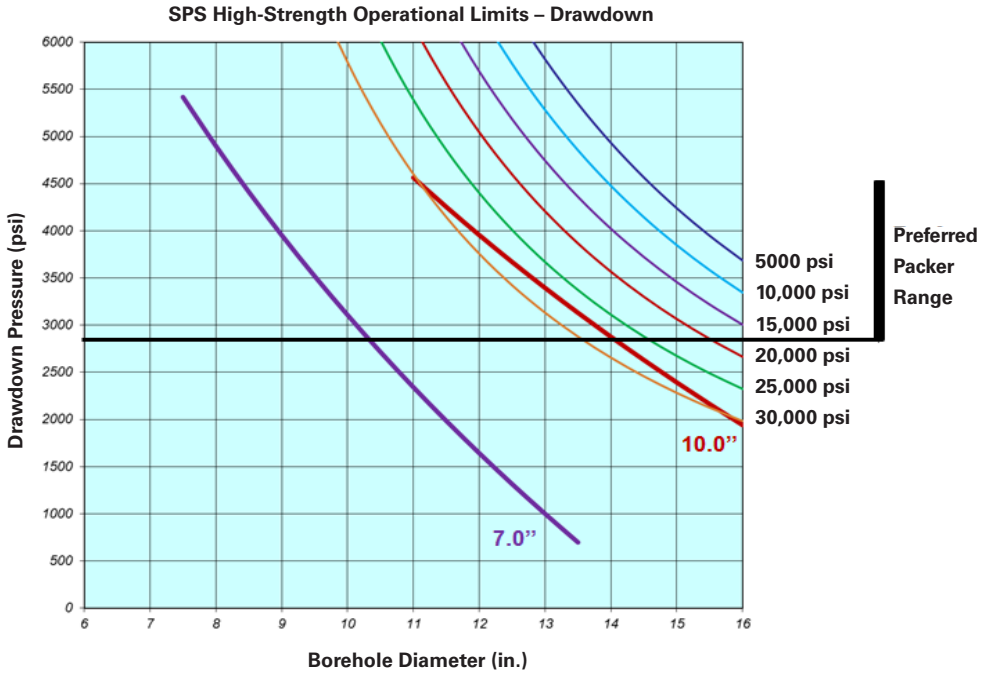
Packer Name	OD (in.)	Min Run OD (in.)	Suggest Run OD (in.)	Max Temp (°F)	Target Hole Size (in.)	Min Hole (in.)	Max Hole (in.)
7.00HT	7.00	7.75	8.0-9.0	350	8.50	8.0	10.5
7.00LT	7.00	7.75	8.0-9.0	250	8.50	8.0	10.5
7x9HT	9.0	9.75	11.0-13.0	350	12.25	10	13.5
7x10LT	10.0	11.0	11.25-13.5	250	12.25	11.25	14.5
10HT	10.0	10.75	11.0-14	350	12.25	11	14.5

Drawdown Pressure

Hole Size (in.)	Packer OD (in.)	Packer Limit
8 ½	7	6370
10 ⅝	9	3954
12 ¼	9	2716
12 ¼	10	3584

SPS Standoffs Selection According to Packer Size

Packer Size (in.)	Standoffs Required
7.00	7.5 in.
9.00	10 in.
10.0	11 in.



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RESERVOIR DESCRIPTON TOOL (RDT™) FORMATION TESTER

Flow Control Pump-out Section

The total performance of a system is limited by the weakest link, and collecting clean fluid samples require best-in-class flushing pumps. The Reservior Description Tool (RDT™) Flow Control Pump Sections are proven to be the most versatile with a full range of differential pressures, the highest horsepower, and the fastest rates.

Dimensions and Ratings

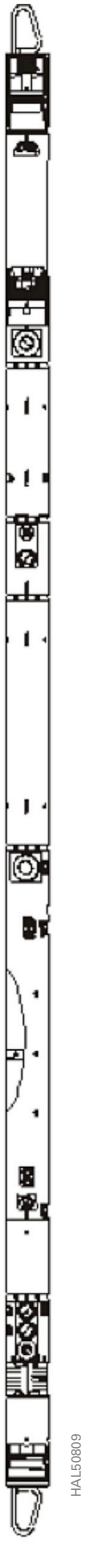
Max Temperature	350°F (177°C)
Max Pressure	20,000 psi (138 MPa)
OD	4.75 in. (12.07 cm)
Length	12.05 ft (367 m)
Weight	450 lb (204 kg)

Borehole Conditions

Borehole Fluids	Salt ■	Fresh ■	Oil ■	Air ■
Recommended Maximum Logging Speed	Stationary			
Tool Positioning	Centralized ■		Eccentralized ■	

Pump Performance

Pumps per String	Two Pumps
Dual Pump Capable	Yes (Both pumps can run at the same time)
	4K Pump
Max Differential Pressure	4,000 psi ΔP
Max Pump Rate	43 cc/sec @ 500 psi ΔP (Dual Pump 86 cc/sec)
	6K Pump (optional kit)
Max Differential Pressure	6,000 psi ΔP
Max Pump Rate	25 cc/sec @ 500 psi ΔP (Dual Pump 50 cc/sec)
	8K Pump (optional kit)
Max Differential Pressure	8,000 psi ΔP
Max Pump Rate	20 cc/sec @ 500 psi ΔP (Dual Pump 40 cc/sec)
	10K Pump (optional kit)
Max Differential Pressure	10,000 psi ΔP
Max Pump Rate	15 cc/sec @ 500 psi ΔP (Dual Pump 30 cc/sec)



Measurement

Low Oil Volume Switch	Indicator
Motor Temperature	RDT
Motor Speed	Tachometer
Hydraulic Pressure Transducer	Strain Guage
Pump Inlet Pressure Transducer	Strain Guage
Pump Outlet Pressure Transducer	Strain Guage
Pump Displacement	Linear Potentiometer

Physical Strengths

Hardware	Tool Joints
Tension	200,000 lb (90,719 kg)*
Compression	200,000 lb (90,719 kg)*
Torque	600 ft-lb (813 N-m)*

* Strengths apply to new tools at 70°F (21°C) and 0 psi.

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RESERVOIR DESCRIPTON TOOL (RDT™) FORMATION TESTER

Quartz Gauge Section–HG

Dimensions and Ratings

Max Temperature	350°F (177°C)
Max Pressure	20,000 psi (138 MPa)
OD	4.75 in. (12.06 cm)
Length	4.2 ft (128 m)
Weight	261 lb (118.38 kg)
Quartzdyne	20,000 psi (138 MPa)

Borehole Conditions

Borehole Fluids	Salt ■	Fresh ■	Oil ■	Air ■
Recommended Logging Speed		Stationary		
Tool Positioning		Centralized ■	Eccentralized ■	

Measurements

Quartz Gauge Pressure Transducers	
Accuracy	Resolution
+/- 0.01% full scale	0.01 psi (0.07 KPa)

Physical Strengths

Hardware	Tool Joints
Tension	200,000 lb (90,719 kg)*
Compression	200,000 lb (90,719 kg)*
Torque	600 ft-lb (813 N-m)*

* Strengths apply to new tools at 70°F (21°C) and 0 psi.

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RESERVOIR DESCRIPTON TOOL (RDT™) FORMATION TESTER

Fluid-Identification Section

Fluid density is the cornerstone of fluid identification and fluid contacts downhole, and a critical measurement for formation testing. The Reservoir Description Tool (RDT™) Fluid-Identification Section (FLID) combines a best-in-class high-resolution density sensor with co-located complementing sensors to accurately measure miscible and immiscible formation fluids.

HIGH-RESOLUTION FLUID DENSITY

The unique vibrating tube densometer enables high-resolution fluid density measures accurate fluid density and the change in density from filtrate to native fluid.

CONTAMINATION

Density contrast from filtrate to native fluid will indicate the level of contamination and determine when the desired sample purity is reached using Fluid Studio. The high-resolution of the FLID densomenter ensures all changes in fluid density are measured and contamination determined.

MAKING SENSE OF IMMISCIBLE FLUIDS

Using the combination of volume vs. high-resolution sensors allows the FLID to produce a volumetric map of the fluids. This map enable you to see the volumes of all flowing fluids and make real-time sampling decisions. Immiscible maps are a valuable tool in understanding complex fluids that in the past were treated as poor-quality data.

CO-LOCATED SENSORS

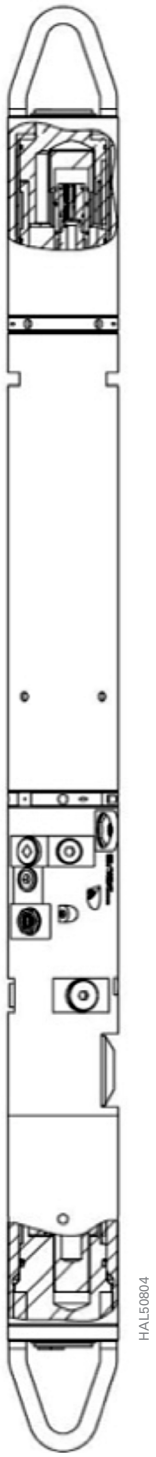
Utilizing multiple sensors of density, capacitance, and resistivity to perform fluid identification allows multiple sensor confirmation of fluids. This is very valuable in the case of free gas or water, which can interfere with the fluid analysis.

Dimensions and Ratings

Max Temperature	350°F (177°C)
Max Pressure	20,000 psi (138 MPa)
OD	4.75 in. (12.07 cm)
Length	3.63 ft (1.106 m)
Weight	140 lb (63.5 kg)

Borehole Conditions

Borehole Fluids	Salt ■	Fresh ■	Oil ■	Air ■
Recommended Logging Speed	Stationary			
Tool Positioning	Centralized ■	Eccentralized ■		



Measurements

Fluid Density Sensor	
Accuracy	Resolution
+- 0.01 g/cc	0.0001 g/cc
Strain Gauge Pressure Transducer	
Accuracy	Resolution
+/- 0.1% full scale	0.2 psi (1.4 KPa)
Bulk Capacitance	
Accuracy	Resolution
10% full scale	1 pF
Resistivity	
Accuracy 10% full scale	Resolution 0.02 ohm-m
Fluid Temperature	
Accuracy	Resolution
0.1% full scale	0.01°F (-18˚C)

Physical Strengths

Hardware	Tool Joints
Tension	200,000 lb (90,719 kg)*
Compression	200,000 lb (90,719 kg)*
Torque	600 ft-lb (813 N-m)*

* Strengths apply to new tools at 70°F (21°C) and 0 psi.

For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com

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RESERVOIR DESCRIPTON TOOL (RDT™) FORMATION TESTER

Integrated Characterization Section A

NEW GENERATION OF DOWNHOLE FLUID COMPOSITION

The Reservoir Description Tool (RDT™) Integrated Characterization Section (ICS) expands measurements of fluid composition downhole by using ICE Core® technology. Based on our unique multivariate optical computing technique, this enables high-resolution hydrocarbon compositional analysis.

MEASUREMENT OF SATURATES, RESINS, AROMATICS, AND ASPHALTENES (SARA)

With superior signal-to-noise ratio compared to conventional downhole techniques, our ICE Core technology uses direct optical computing of the full wavelength to create a unique fingerprint of the fluid, including differentiation of the C6+ SARA fractions.

GAS COMPOSITION

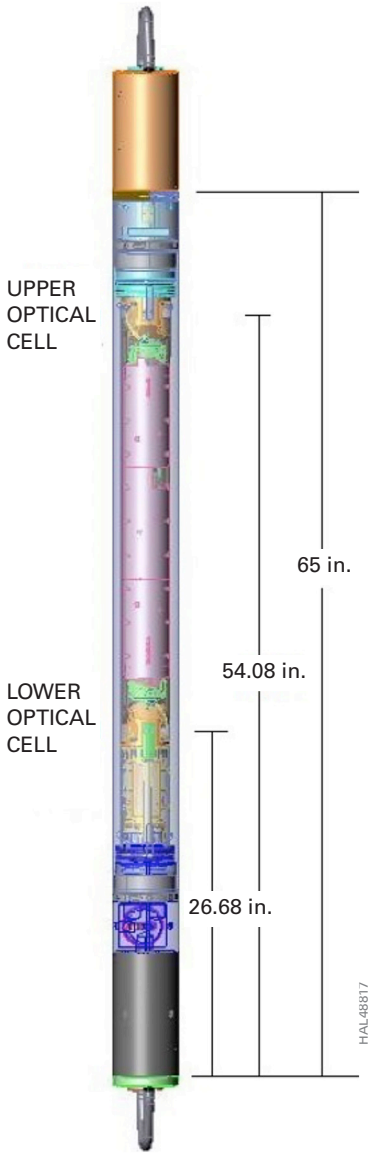
ICE Core technology in ICS-A measures single-phase gas component – C1.
We also measure total gas GOR directly, not as an estimate from C1, making the measurement more accurate.

DISPLAY WEIGHT PERCENTAGE

The ICS measures an absolute density of each measured component. It can be displayed in weight percentages, making the final results directly comparable to lab measurements with an easy-to-use composition display.

SAMPLE PURITY DETERMINATION

The ICS with multiple ICE Core samples uses gas and the liquid-phase composition to determine contamination. As methane gas isn't present in oil-based mud, the gas volume and GOR can be used. When combined with the saturates and aromatics composition, the change in liquid-phase content can also be determined as the SARA fingerprint of filtrate and native fluid differs.



Dimensions and Ratings

Max Temperature	350˚F (177˚C)
Max Pressure	25,000 psi (172 MPa)
OD	4.75 in. (12.065 cm)
Length	5.40 ft (1.646 m)
Weight	261 lb (118.38 kg)

Borehole Conditions

Borehole Fluids	Salt ■	Fresh ■	Oil ■	Air ■
Recommended Logging Speed	Stationary			
Tool Positioning	Centralized ■	Eccentralized ■		

Optical Sensing Unit

Quantity	One
Number of Channels	20
Detectors	Single Thermopile
Optical Window	Sapphire

Measurements

Strain Gauge Pressure Transducers	
Accuracy	Resolution
+/- 0.1% full scale	0.2 psi (1.4 KPa)
Fluid Temperature	
Accuracy	Resolution
3% full scale	0.02°F (-18°C)

ICS-A - Compositional Specifications Optical Sensor Version 1

Sensor	**Range**	**Accuracy**	**Fluid Type**		
			Light Oil	Medium Oil	Gas/Condensate
GOR	0 to 2000 GOR units	Greater of 200 scf/bbl or 20% of range	✓	✓	
Methane	0 to 0.3 g/cc	10% Partial Density	✓	✓	✓
Saturates	0.3 to 0.7 g/cc	10% Partial Density	✓	✓	
Aromatics	0.05 to 0.3 g/cc	20% Partial Density	✓	✓	

For clean samples with less than 15% contamination, single-phase samples, and for transmittance better than 10%

The ranges for different fluid types are based on table below +/- 15%

Oil Type	Reservoir Fluid	API Range	GOR scf/bbl
Heavy	>0.875 g/cc	15 - 20 API	< 400
Medium	0.690 - 0.875 g/cc	20 - 32 API	250 - 1,250
Light	0.525 - 0.775 g/cc	32 - 40 API	1,000 - 1,750
Volatile	0.400 - 0.740 g/cc	35 - 50 API	1,650 - 3,500
Condensate	0.245 - 0.600 g/cc	40 - 65 API	3,200 - 25,000
Wet Gas	0.010 - 0.450 g/cc	N/A	20,000 - 50,000
Dry Gas	<0.375 g/cc	N/A	> 50,000

NOTE:
- Excludes subcategories of Extra Heavy, Medium Heavy, and Medium Light.
- Ranges assume reservoir fluids from 3,000 to 15,000 psi and 150°F to 300°F.

Physical Strengths

Hardware	Tool Joints RDT
Tension	200,000 lb (90,719 kg)*
Compression	200,000 lb (90,719 kg)*
Torque	600 ft-lb (813 N-m)*

* Strengths apply to new tools at 70°F (21°C) and 0 psi.

For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com

RESERVOIR DESCRIPTON TOOL (RDT™) FORMATION TESTER

Integrated Characterization Section B

NEW GENERATION OF DOWNHOLE FLUID COMPOSITION

The Reservoir Description Tool (RDT™) Integrated Characterization Section (ICS) expands measurements of fluid composition downhole by using ICE Core® technology. Based on our unique multivariate optical computing technique, this enables high-resolution hydrocarbon compositional analysis.

MEASUREMENT OF SATURATES, RESINS, AROMATICS, AND ASPHALTENES (SARA)

With superior signal-to-noise ratio compared to conventional downhole techniques, our ICE Core technology uses direct optical computing of the full wavelength to create a unique fingerprint of the fluid, including differentiation of the C6+ SARA fractions.

GAS COMPOSITION

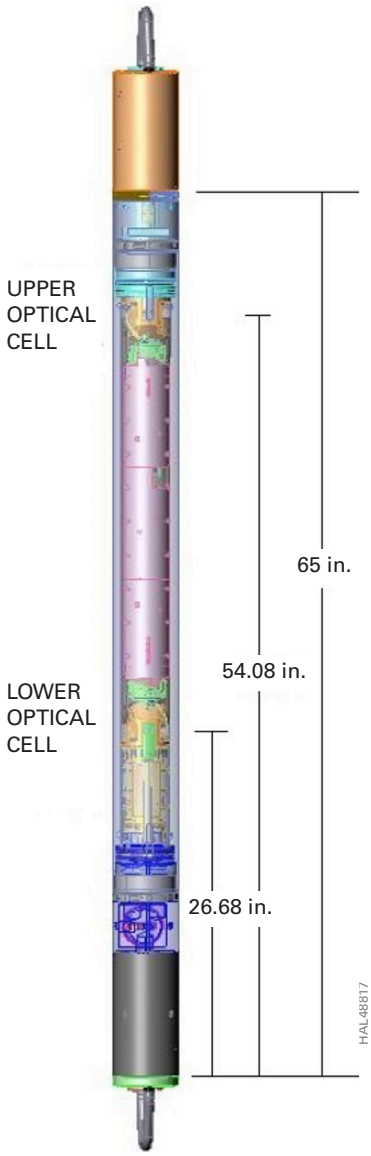
ICE Core technology measures single-phase gas components – C1, C2, C3, and CO_2 gas. We also measure total gas GOR directly, not as an estimate from C1, making the measurement more accurate.

DISPLAY WEIGHT PERCENTAGE

The ICS measures an absolute density of each measured component. It can be displayed in weight percentages, making the final results directly comparable to lab measurements with an easy-to-use composition display.

SAMPLE PURITY DETERMINATION

The ICS with multiple ICE Core samples uses gas and the liquid-phase composition to determine contamination. As methane gas isn't present in oil-based mud, the gas volume and GOR can be used. When combined with the saturates and aromatics composition, the change in liquid-phase content can also be determined as the SARA fingerprint of filtrate and native fluid differs.



Dimensions and Ratings

Max Temperature	350˚F (177˚C)
Max Pressure	25,000 psi (172 MPa)
OD	4.75 in. (12.065 cm)
Length	5.40 ft (1.646 m)
Weight	261 lb (118.38 kg)

Borehole Conditions

Borehole Fluids	Salt ■	Fresh ■	Oil ■	Air ■
Recommended Logging Speed	Stationary			
Tool Positioning	Centralized ■	Eccentralized ■		

Optical Sensing Unit

Quantity	One
Number of Channels	20
Detectors	Single Thermopile
Optical Window	Sapphire

Measurements

Strain Gauge Pressure Transducers	
Accuracy	Resolution
+/- 0.1% full scale	0.2 psi (1.4 KPa)
Fluid Temperature	
Accuracy	Resolution
3% full scale	0.02°F (-18°C)

ICS-B - Compositional Specifications Optical Sensor Version 2

Sensor	Range	Accuracy	Fluid Type			
			Volatile Oil	Light Oil	Medium Oil	Gas/ Condensate
GOR	0 to 2000 GOR units	Greater of 200 scf/bbl or 20% of Range		✓	✓	
GOR	2000 to 4000 GOR units	Greater of 500 scf/bbl or 25% of Range	✓			
Methane	0.02 to 0.3 g/cc	10% Partial Density	✓	✓	✓	✓
Ethane	0.02 to 0.12 g/cc	15% Partial Density		✓	✓	✓
Propane	0.015 to 0.07 g/cc	20% Partial Density		✓	✓	✓
CO_2 (gas phase)	0.015 to 0.07 g/cc	20% Partial Density				✓
Saturates	0.3 to 0.7 g/cc	10% Partial Density		✓	✓	
Aromatics	0.05 to 0.3 g/cc	20% Partial Density		✓	✓	
C6 Plus	0.35 to 0.80 g/cc	10% Partial Density	✓	✓	✓	
Phase (water cut)	0 to 100%	10% by Volume		✓	✓	

For clean samples with less than 15% contamination, single-phase samples, and for transmittance better than 10%

The ranges for different fluid types are based on table below +/- 15%

Oil Type	Reservoir Fluid	API Range	GOR scf/bbl
Heavy	>0.875 g/cc	15 - 20 API	< 400
Medium	0.690 - 0.875 g/cc	20 - 32 API	250 - 1,250
Light	0.525 - 0.775 g/cc	32 - 40 API	1,000 - 1,750
Volatile	0.400 - 0.740 g/cc	35 - 50 API	1,650 - 3,500
Condensate	0.245 - 0.600 g/cc	40 - 65 API	3,200 - 25,000
Wet Gas	0.010 - 0.450 g/cc	N/A	20,000 - 50,000
Dry Gas	<0.375 g/cc	N/A	> 50,000

NOTE:
- Table 4 excludes subcategories of Extra Heavy, Medium Heavy, and Medium Light.
- Table 4 ranges assume reservoir fluids from 3,000 to 15,000 psi and 150°F to 300°F.

Physical Strengths

Hardware	Tool Joints RDT
Tension	200,000 lb (90,719 kg)*
Compression	200,000 lb (90,719 kg)*
Torque	600 ft-lb (813 N-m)*

* Strengths apply to new tools at 70°F (21°C) and 0 psi.

For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com

RESERVOIR DESCRIPTON TOOL (RDT™) FORMATION TESTER

Integrated Characterization Section C

NEW GENERATION OF DOWNHOLE FLUID COMPOSITION

The Reservoir Description Tool (RDT™) Integrated Characterization Section (ICS) expands measurements of fluid composition downhole by using ICE Core® technology. Based on our unique multivariate optical computing technique, this enables high-resolution hydrocarbon compositional analysis.

MEASUREMENT OF SATURATES, RESINS, AROMATICS, AND ASPHALTENES (SARA)

With superior signal-to-noise ratio compared to conventional downhole techniques, our ICE Core technology uses direct optical computing of the full wavelength to create a unique fingerprint of the fluid, including differentiation of the C6+ SARA fractions.

GAS COMPOSITION

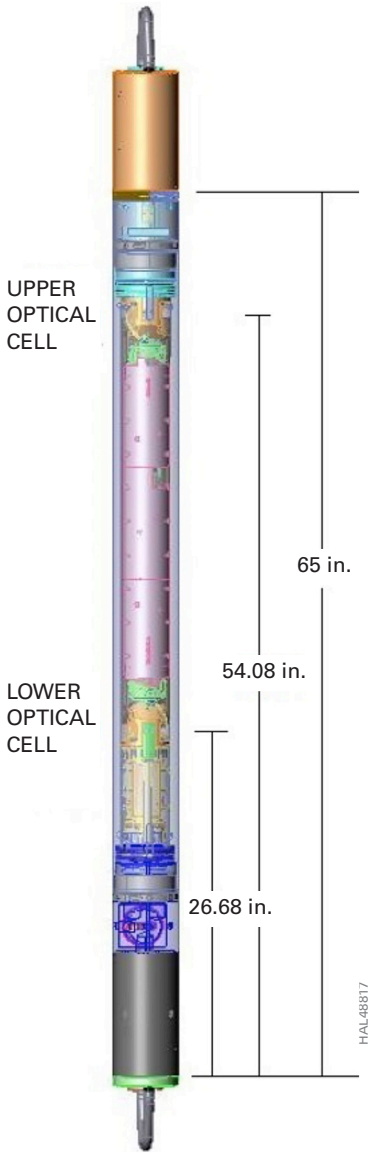
ICE Core technology measures single-phase gas components—C1, C2, C3, C4-5, and CO_2. We also measure total gas GOR directly, not as an estimate from C1, making the measurement more accurate.

DISPLAY WEIGHT PERCENTAGE

The ICS measures an absolute density of each measured component. It can be displayed in weight percentages, making the final results directly comparable to lab measurements with an easy-to-use composition display.

SAMPLE PURITY DETERMINATION

The ICS with multiple ICE Core samples uses gas and the liquid-phase composition to determine contamination. As methane gas isn't present in oil-based mud, the gas volume and GOR can be used. When combined with the SARA composition, the change in liquid-phase content can also be determined as the SARA fingerprint of filtrate and native fluid differs.



Dimensions and Ratings

Max Temperature	350˚F (177˚C)
Max Pressure	25,000 psi (172 MPa)
OD	4.75 in. (12.065 cm)
Length	5.40 ft (1.646 m)
Weight	261 lb (118.38 kg)

Borehole Conditions

Borehole Fluids	Salt ■	Fresh ■	Oil ■	Air ■
Recommended Logging Speed	Stationary			
Tool Positioning	Centralized ■		Eccentralized ■	

Optical Sensing Unit

Quantity	One
Number of Channels	20
Detectors	Single Thermopile
Optical Window	Sapphire

Measurements

Strain Gauge Pressure Transducers	
Accuracy	Resolution
+/- 0.1% full scale	0.2 psi (1.4 KPa)
Fluid Temperature	
Accuracy	Resolution
3% full scale	0.02°F (-18°C)

ICS-C - Compositional Specifications Optical Sensor Version 3

Sensor	Range	Accuracy	Fluid Type			
			Volatile Oil	Light Oil	Medium Oil	Gas/ Condensate
GOR	0 to 2000 GOR units	Greater of 200 scf/bbl or 20% of Range		✓	✓	
GOR	2000 to 4000 GOR units	Greater of 500 scf/bbl or 25% of Range	✓			
Methane	0.02 to 0.3 g/cc	10% Partial Density	✓	✓	✓	✓
Ethane	0.02 to 0.12 g/cc	15% Partial Density		✓	✓	✓
Propane	0.015 to 0.07 g/cc	20% Partial Density		✓	✓	✓
Butane/Pentane	0 to 0.04 g/cc	25% Partial Density				✓
CO_2 (gas phase)	0.015 to 0.07 g/cc	20% Partial Density		✓	✓	✓
Saturates	0.3 to 0.7 g/cc	10% Partial Density		✓	✓	
Aromatics	0.05 to 0.3 g/cc	20% Partial Density	✓	✓	✓	
Resins	0.04 to 0.19 g/cc	20% Partial Density		✓	✓	
Asphaltenes	0.02 to 0.14 g/cc	20% Partial Density		✓	✓	
C6 Plus	0.35 to 0.80 g/cc	10% Partial Density		✓	✓	
Phase (water cut)	0 to 100%	10% by Volume		✓	✓	
API	20 to 40	+/- 4 API Units		✓	✓	

For clean samples with less than 15% contamination, single-phase samples, and for transmittance better than 10%

The ranges for different fluid types are based on table below +/- 15%

Oil Type	Reservoir Fluid	API Range	GOR scf/bbl
Heavy	>0.875 g/cc	15 - 20 API	< 400
Medium	0.690 - 0.875 g/cc	20 - 32 API	250 - 1,250
Light	0.525 - 0.775 g/cc	32 - 40 API	1,000 - 1,750
Volatile	0.400 - 0.740 g/cc	35 - 50 API	1,650 - 3,500
Condensate	0.245 - 0.600 g/cc	40 - 65 API	3,200 - 25,000
Wet Gas	0.010 - 0.450 g/cc	N/A	20,000 - 50,000
Dry Gas	<0.375 g/cc	N/A	> 50,000

NOTE:
- Table 4 excludes subcategories of Extra Heavy, Medium Heavy, and Medium Light.
- Table 4 ranges assume reservoir fluids from 3,000 to 15,000 psi and 150°F to 300°F.

Physical Strengths

Hardware	Tool Joints RDT
Tension	200,000 lb (90,719 kg)*
Compression	200,000 lb (90,719 kg)*
Torque	600 ft-lb (813 N-m)*

* Strengths apply to new tools at 70°F (21°C) and 0 psi.

For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com

RESERVOIR DESCRIPTON TOOL (RDT™) FORMATION TESTER

Multi-Chamber Section

Dimensions and Ratings

Max Temperature	350°F (177°C)
Max Pressure	20,000 psi (138 MPa)
OD	4.75 in. (12.07 cm)
Length	8.9 ft (271.27 m)
Weight	290 lb (131.54 kg)

Borehole Conditions

Borehole Fluids	Salt ■	Fresh ■	Oil ■	Air ■
Recommended Logging Speed		Stationary		
Tool Positioning		Centralized ■	Eccentralized ■	

Hardware Characteristics

	Standard Sample Chamber	
Volume	1,000 cc	
DOT	20,000 psi (138 MPa)	DOT Certified
Working Pressure	25,000 psi (172 MPa)	
Samples per MCS	Three	
	Nitrogen Compensated Sample Chamber	
Volume	400 - 700 cc*	
DOT	20,000 psi (138 MPa)	DOT Certified
Working Pressure	25,000 psi (172 MPa)	
Samples per MCS	Three	

* Dependent on nitrogen charge

Physical Strengths

Hardware	Tool Joints
Tension	200,000 lb (90,719 kg)*
Compression	200,000 lb (90,719 kg)*
Torque	600 ft-lb (813 N-m)*

* Strengths apply to new tools at 70°F (21°C) and 0 psi.

Standard Zero Shock Samples Chamber

Sample Size Recovered ~ 1000 cc

Nitrogen Compensated Samples Chamber

Sample Size Recovered ~ 400-700 cc

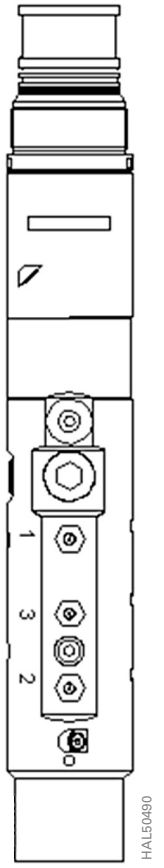
For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com

RESERVOIR DESCRIPTON TOOL (RDT™) FORMATION TESTER

Bulk Chamber Section

The RDT Bulk Sampling Section (CVS) is available in dual and single sample configuration to obtain zero shock or dump samples starting at 1 gal (3.8 L). The dual sample option enables two separate bulk samples to be taken using controlled sample valves. The dual sample configuration can use either dual 2.75 gal (10.4 L) chambers or dual 1.0 gal (3.8 L) chambers.

The single sample option enables a single bulk sample to be obtained with zero shock using either 2.75 gal (3.8 L) or 1.0 gal (3.8 L) chambers. The single sample chamber volume can expanded by stacking multiple chambers to the desired volume.



Dimensions and Ratings

Max Temperature	350°F (177°C)
Max Pressure	20,000 psi (138 MPa)
OD	4.75 in. (12.07 cm)
Length	2.3 ft (70 m)
Weight	75 lb (34 kg)

Chamber Length Depending on Volume

Borehole Conditions

Borehole Fluids	Salt ■	Fresh ■	Oil ■	Air ■
Recommended Logging Speed	Stationary			
Tool Positioning	Centralized ■		Eccentralized ■	

Bulk Samples

Dual Chambers	2 x 2.75 gal (20,000 psi/138 MPa)
Dual Chambers	2 x 1.0 gal (30,000 psi/207 MPa)
Single Chambers	Unlimited Stacked 2.75 gal (20,000 psi/138 MPa)
Single Chambers	Unlimited Stacked 1.0 gal (30,000 psi/207 MPa)
	Bulk Sample Chambers Bottom Only

Physical Strengths

Hardware	Tool Joints
Tension	200,000 lb (90,719 kg)*
Compression	200,000 lb (90,719 kg)*
Torque	600 ft-lb (813 N-m)*

* Strengths apply to new tools at 70°F (21°C) and 0 psi.

For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com

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