

# SureLog-iPZIG

## At-Bit Inclination and Image Gamma Ray Service

### APPLICATIONS

- Real-time geosteering
- Horizontal, ERD, and directional drilling
- Steering within formations with dipping beds
- Casing point selection by detecting formation changes at the bit

### BENEFITS

- Optimal well placement in reservoirs
- Accelerated production
- Reduced well tortuosity and dogleg severity
- Early bed boundary detection

### FEATURES

- Inclination and natural gamma ray measurements situated at the bit
- Azimuthal natural gamma ray image measurements at bit
- Wireless electromagnetic communication between upper and lower subs with data transmitted real-time via PathFinder MWD system
- Compatible with positive displacement motors and rotary steerable tools
- Stand-alone battery operated electronics
- Compatible with all mud types

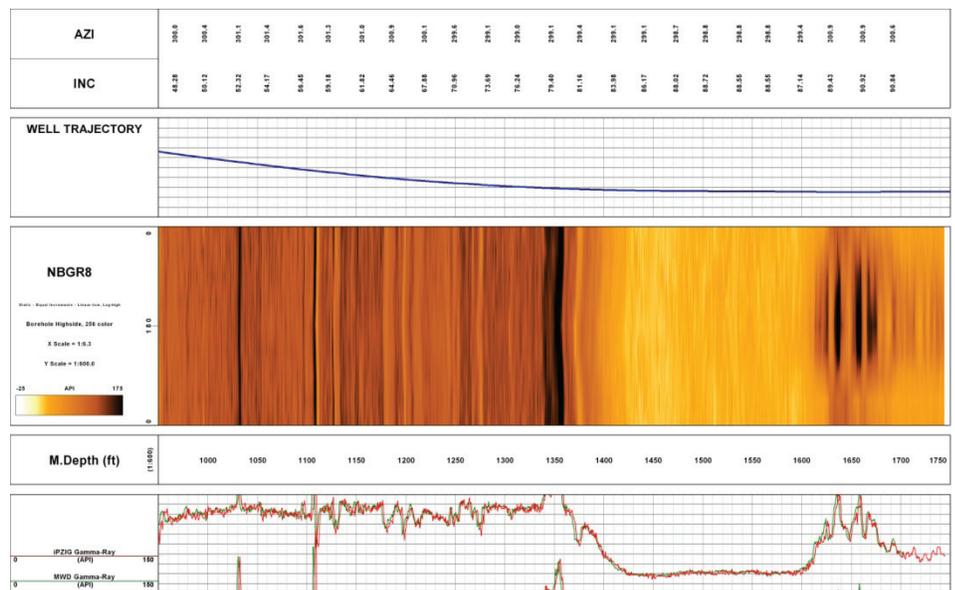
The SureLog™ tool family includes the iPZIG\* system. The iPZIG tool provides at-bit gamma ray images along with traditional natural gamma ray measurements, dynamic inclination, RPM and temperature. The at-bit gamma ray image can be provided in sectors for superior real-time geosteering capabilities that include formation bed dip calculations.

Operating directly behind the drill bit, the iPZIG at-bit inclination and gamma ray service provides real-time measurements that reduce directional drilling risk in critical hole sections. The early indication of changes in lithology, delivered by the gamma ray log, helps to accurately land horizontal wells.

Designed to operate as two separate subs, a lower sub, located directly above the drill bit, acquires data and transmits data to the upper sub, located above the drilling mud motor. The upper sub provides communication to measurement/logging-while-drilling systems.

The iPZIG can accommodate flexible bottomhole assembly (BHA) designs, and is compatible with any drilling mud motor. iPZIG provides the closest to the bit sensor offsets available in the industry and is the only tool to provide both gamma and inclination at the bit. These measurements are used to help determine well path placement and de-termined position in real-time while drilling.

The iPZIG sub is an accurate, cost effective geosteering solution whether drilling for optimum reservoir drainage, setting casing, or just to determine position real-time while drilling.



iPZIG eight sector gamma ray image and comparison of near-bit total gamma ray measurement with conventional MWD gamma ray logged through build and horizontal sections of the well.



<b>Tool Specifications</b>			
Nominal OD, in [mm]	4 ¾ [120.7]	6 ¾ [171.5]	8 [203.2]
Maximum OD, in [mm]	5.25 [133.4]	7.25 [184.2]	8.25 [209.6]
UXM tool joint	3 ½ IF Box/Pin	5 ½ FH Box/Pin	5 ½ IF Box/Pin
LXM tool joint	3 ½ Reg Pin/Box	4 ½ Reg Pin/Box	6 ⅝ Reg Pin/Box
UXM length, ft [m]	7.13 [2.17]	5.92 [1.81]	5.92 [1.81]
LXM length, ft [m]	3.33 [1.02]	3.66 [1.12]	3.66 [1.12]
UXM weight, lbm [kg]	375 [170]	620 [282]	756 [344]
LXM weight, lbm [kg]	210 [95]	370 [168]	510 [232]
LXM equivalent stiffness, in [mm]	4.43 [112.5] ID/ 2.25 [57.2]OD	5.99 [152.1] ID/ 2.81 [71.4]OD	6.96 [176.8] OD/ 2.81 [71.4] ID
LXM avg. moment of inertia, in <sup>4</sup> [mm <sup>4</sup> ]	17.6 [722.7]	60 [2,463.7]	112 [4,598.9]
UXM equivalent stiffness, in [mm]	4.52 [114.8] ID/ 2.25 [57.2]OD	6.34 [161.0] ID/ 2.81 [71.4]OD	7.34 [186.4] OD/ 2.81 [71.4] ID
UXM avg. moment of inertia, in <sup>4</sup> [mm <sup>4</sup> ]	19.2 [788.4]	76.2 [3,128.9]	122 [5,099.6]
<b>Tool Joints, 4 ¾ in</b>		<b>Tool Joints, 6 ¾ in</b>	
API 3 ½ IF, field (UXM)		API 5 ½ FH, field (UXM)	
Makeup torque, ft.lbf [N.m]	9,000 [12,202]	Makeup torque, ft.lbf [N.m]	25,000 [33,895]
Bending-strength ratio	2.06	Bending-strength ratio	1.81
API 3 ½, Reg (LXM)		API 4 ½ Reg, (LXM)	
Makeup torque, ft.lbf [N.m]	8,000 [10,847]	Makeup torque, ft.lbf [N.m]	24,000 [32,540]
Bending-strength ratio	4.41	Bending-strength ratio	4.02
<b>Tool Joints, 8 in</b>			
API 5 ½ IF, field (UXM)			
Makeup torque, ft.lbf [N.m]	38,000 [51,520]		
Bending-strength ratio	2.35		
API 6 ⅝ Reg (LXM)			
Makeup torque, ft.lbf [N.m]	38,000 [51,520]		
Bending-strength ratio	3.48		
<b>Operating Limits<sup>†</sup></b>			
Max. dogleg, rotating, deg/ft	17/100	10/100	10/100
Max. dogleg, sliding, deg/ft	31/100	16/100	16/100
Max. tension, lbf [kg]	263,000 [119,295]	400,000 [181,437]	450,000 [204,117]
Max. torque, ft.lbf [N.m]	9,000 [12,203]	23,000 [31,184]	35,000 [47,453]
Max. operating temp., degF [degC] <sup>††</sup>	302 [150], 350 [175]	302 [150], 350 [175]	302 [150], 350 [175]
<b>Measurement Specifications</b>			
Gamma ray sensor offset, in [mm]	16.69 [423.9]	21.00 [533.4]	21.29 [540.8]
Inclination sensor offset, in [mm]	34.1 [866.1]	38.55 [979.2]	39.14 [994.2]
Inclination range, deg	5 to 180	Inclination accuracy, deg	0.3
At bit rpm	30 to 450	Total gamma range, API	0 to 1,200

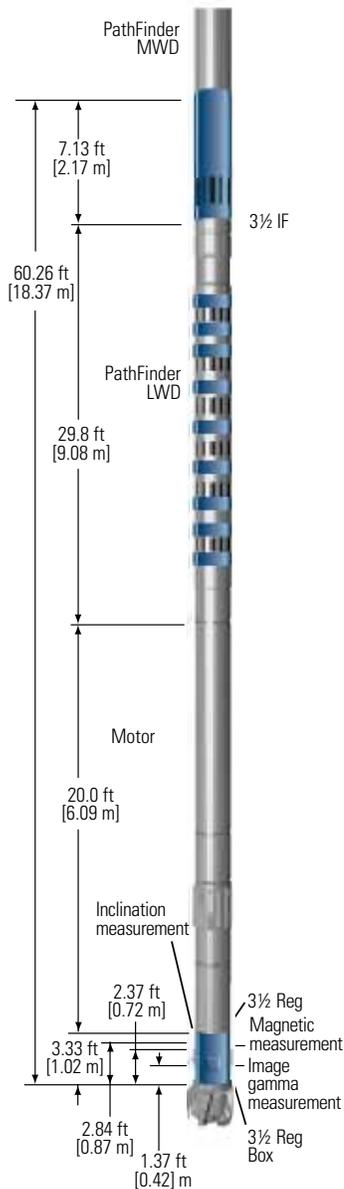
<sup>†</sup>Contact APS Technology for limitations in specific applications.

<sup>††</sup>Standard tool configuration 32 to 302 degF [0 to 150 degC], optional Survivor Series rating 32 to 350 degF [0 to 175 degC].

# iPZIG 475

## At-Bit Inclination and Image Gamma Ray Service

# Mechanical Specifications



### Tool Specifications

Nominal OD, in [mm]	4 3/4 [120.7]	Max. OD, in [mm]	5.25 [133.4]
Internal diameters, in [mm]		Internal diameters, in [mm]	
UXM	3.50 [88.9], 2.80 [71.1], 2.50 [63.5]	LXM	3.80 [96.5], 1.10 in [27.9]
Length, ft [m]		Length, ft [m]	
UXM	7.13 [2.17]	LXM	3.33 [1.02]
Tool joints, box/pin		Tool joints, box/pin	
UXM	3 1/2 IF	LXM	3 1/2 Reg
Weight, lbm [kg]		Weight, lbm [kg]	
UXM	375 [170]	LXM	210 [95]
UXM Equivalent stiffness, in [mm]	4.52 [114.8] OD/2.25 [57.2] ID	UXM Avg. moment of inertia, in <sup>4</sup> [cm <sup>4</sup> ]	19.2 [788.4]
LXM Equivalent stiffness, in [mm]	4.43 [112.5] OD/2.25 [57.2] ID	LXM Avg. moment of inertia, in <sup>4</sup> [cm <sup>4</sup> ]	17.6 [722.7]

### Tool Joint Specifications

API 3 1/2 IF, field (UXM)	
Makeup torque, lbf.ft [N.m]	9,000 [12,202]
Bending-strength ratio	2.35
API 3 1/2 Reg, (LXM)	
Makeup torque, lbf.ft [N.m]	8,000 [10,847]
Bending-strength ratio	4.41

### Sensor Measurement Points

Image gamma measurement, ft [m]	1.37 [0.42]
Magnetic measurement, ft [m]	2.37 [0.72]
Inclination measurement, ft [m]	2.84 [0.87]

### Operating Specifications

Max. dogleg, rotating, °/100 ft	17	Max. dogleg, sliding, °/100 ft	31
Max. tension, lb [kg]	263,000 [119,295]	Maximum torque, lbf.ft [N.m]	9,000 [12,203]
Max. temp., degF [degC]	302 [150], 350 [175] <sup>†</sup>	Flow rates, galUS/min [m <sup>3</sup> /min]	125 to 375 [0.473 to 1.420]

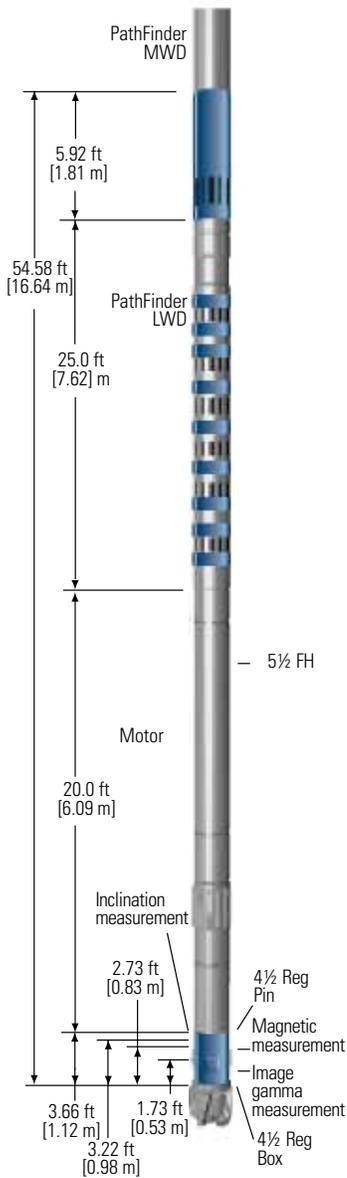
Note: All dimensions are nominal. Configuration options are available. Tool drawing is not to scale.

<sup>†</sup>Standard tool configuration 32 to 302 degF [0 to 150 degC], optional Survivor Series rating 32 to 350 degF [0 to 175 degC].

# iPZIG 675

## At-Bit Inclination and Image Gamma Ray Service

# Mechanical Specifications



### Tool Specifications

Nominal OD, in [mm]	6¾ [171.5]	Max. OD, in [mm]	7.25 [184.2]
Internal diameters, in [mm]		Internal diameters, in [mm]	
UXM	5.10 [129.5], 4.00 [101.6], 3.50 [88.9]	LXM	5.30 [134.6], 2.00 [27.9]
Length, ft [m]		Length, ft [m]	
UXM	5.92 [1.81]	LXM	3.66 [1.12]
Tool joints, box/pin		Tool joints, box/pin	
UXM	5½ FH	LXM	4½ Reg
Weight, lbm [kg]		Weight, lbm [kg]	
UXM	620 [282.0]	LXM	370 [168.0]
UXM equivalent stiffness, in [mm]	6.34 [161.0] OD/2.81 [71.4] ID	UXM avg. moment of inertia, in <sup>4</sup> [cm <sup>4</sup> ]	76.2 [3,128.9]
LXM equivalent stiffness, in [mm]	5.99 [152.1] OD/2.81 [71.4]	LXM avg. moment of inertia, in <sup>4</sup> [cm <sup>4</sup> ]	60.0 [2,463.7]

### Sensor Measurement Points

Image gamma measurement, ft [m]	1.73 [0.53]
Magnetic measurement, ft [m]	2.73 [0.83]
Inclination measurement, ft [m]	3.22 [0.98]

### Tool Joint Specifications

API 5½ FH, field (UXM)	
Makeup torque, lbf.ft [N.m]	25,000 [33,895]
Bending-strength ratio	1.81
API 4½ Reg, (LXM)	
Makeup torque, lbf.ft [N.m]	24,000 [32,540]
Bending-strength ratio	4.02

### Operating Specifications

Max. dogleg, rotating, °/100 ft	10	Max. dogleg, sliding, °/100 ft	16
Max. tension, lb [kg]	400,000 [181,437]	Maximum torque, lbf.ft [N.m]	38,000 [51,520]
Max. temp., degF [degC]	302 [150], 350 [175] <sup>†</sup>	Flow rates, galUS/min [m <sup>3</sup> /min]	250 to 750 [0.946 to 2.839]

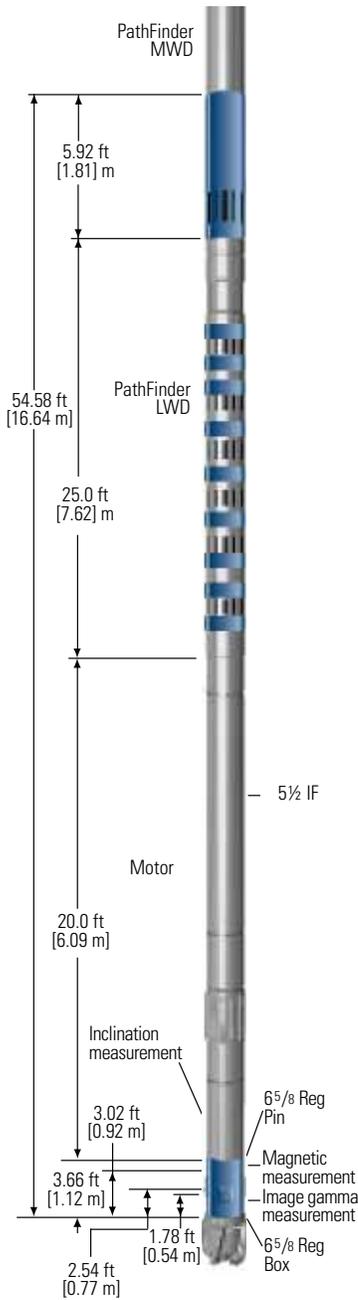
Note: All dimensions are nominal. Configuration options are available. Tool drawing is not to scale.

<sup>†</sup>Standard tool configuration 32 to 302 degF [0 to 150 degC], optional Survivor Series rating 32 to 350 degF [0 to 175 degC].

# iPZIG 800

## At-Bit Inclination and Image Gamma Ray Service

# Mechanical Specifications



### Tool Specifications

Nominal OD, in [mm]	8 [171.5]	Max. OD, in [mm]	8.25 [209.6]
Internal diameters, in [mm]		Internal diameters, in [mm]	
UXM	5.10 [129.5], 4.00 [101.6], 3.50 [88.9]	LXM	5.30 [134.6], 2.00 [27.9]
Length, ft [m]		Length, ft [m]	
UXM	5.92 [1.81]	LXM	3.66 [1.12]
Tool joints, box/pin		Tool joints, pin/box	
UXM	5½ IF	LXM	6⅝ Reg
Weight, lbm [kg]		Weight, lbm [kg]	
UXM	756 [344]	LXM	510 [232]
UXM equivalent stiffness, in [mm]	7.34 [186.4] OD/2.81 [71.4] ID	UXM avg. moment of inertia, in <sup>4</sup> [cm <sup>4</sup> ]	122.0 [5,099.6]
LXM equivalent stiffness, in [mm]	6.99 [176.8] OD/2.81 [71.4]	LXM avg. moment of inertia, in <sup>4</sup> [cm <sup>4</sup> ]	112 [4,598.9]

### Sensor Measurement Points

Image gamma measurement, ft [m]	1.78 [0.54]
Magnetic measurement, ft [m]	2.54 [0.77]
Inclination measurement, ft [m]	3.02 [0.92]

### Tool Joint Specifications

API 5½ IF, field (UXM)	
Makeup torque, lbf.ft [N.m]	38,000 [51,520]
Bending-strength ratio	2.35
API 6⅝ Reg, (LXM)	
Makeup torque, lbf.ft [N.m]	38,000 [51,520]
Bending-strength ratio	4.38

### Operating Specifications

Max. dogleg, rotating, °/100 ft	10	Max. dogleg, sliding, °/100 ft	16
Max. tension, lb [kg]	450,000 [204,117]	Maximum torque, lbf.ft [N.m]	35,000 [47,453]
Max. temp., degF [degC]	302 [150], 350 [175] <sup>††</sup>	Flow rates, galUS/min [m <sup>3</sup> /min]	250 to 750 [0.946 to 2.839]

Note: All dimensions are nominal. Configuration options are available. Tool drawing is not to scale.

<sup>††</sup>Standard tool configuration 32 to 302 degF [0 to 150 degC], optional Survivor Series rating 32 to 350 degF [0 to 175 degC].