

## Gamma-Ray Tools

For Geosteering, MWD and Wireline Logging

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## GAMMA TOOL DESCRIPTION

The Gamma ray tool produces a measurement of the naturally occurring radiation found in rock formations. The Gamma Log produced by these tools is commonly used for depth correction, correlation with open hole logs and identifying low radiation and high radiation lithologies. CBG Gamma ray tools use a super sensitive hermetically sealed Sodium Iodide Scintillator crystal and a ruggedized high temperature photomultiplier for maximum log quality. Mechanical design techniques have been developed specifically for the MWD/Steering tool environment to ensure a rugged and

reliable tool. The short single piece aluminum chassis not only provides maximum strength and rigidity but minimizes vibration loads due to the low mass. The electronics are fully temperature compensated to maintain consistent count rates through the 350°F temperature rating. The tool uses a gross counting discriminator with an energy threshold set at approximately 15KeV, significantly lower than other tools, resulting in higher count rates and greater accuracy. CBG provides customized models of Gamma ray tools for Geosteering and MWD.

### NGT-T GAMMA TOOL for Geosteering and MWD

The NGT-T Gamma tool has become the industry standard for Geosteering and MWD applications. This tool was initially developed for the Steering tool industry in 1994 and was later upgraded to meet the severe environmental challenges of Measurement While Drilling. The standard model is equipped with an MDM15pin male connector on the top electronics end of the tool and an MDM15pin female connector on the bottom. This tool utilizes Pin#1 for Ground, Pin# 4 for Power and Pin# 8 for Signal. All 15 wires are passed along a protected wire guide from top connector to bottom. Electronics are encapsulated for additional protection. The crystal and photomultiplier are packaged in house utilizing our proprietary, unique design for ease of replacement or repair.



### NGT-T GAMMA TOOL with Pressure Housing Assembly

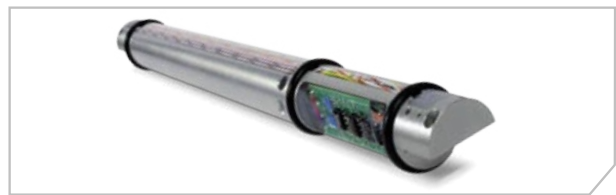
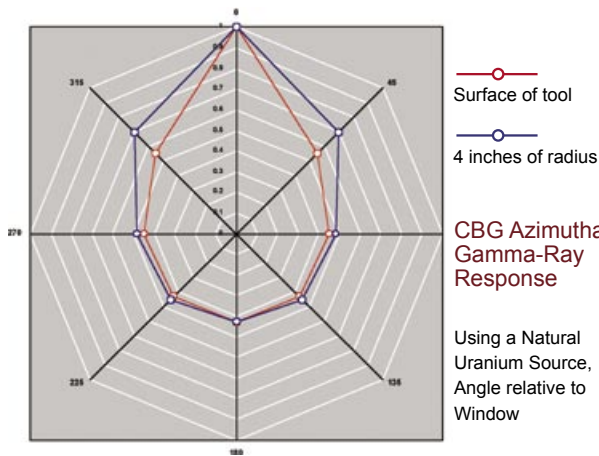
The NGT-T Gamma Tool can now be ordered to include the complete "Tensor Compatible" mechanical assembly. The NGT-T is mounted to the Bottom Bulkhead Retainer through a standard Shock Snubber Assembly. A connector "pigtail" converts the MDM15pin connector on the tool to a 200°C, GE, 4Pin/6Socket connector mounted within the bottom Intermodule End. At the top, a "pigtail" converts the MDM15pin connector on the NGT-T to a 200°C, GE, 6Pin/4Socket connector mounted within the top Intermodule End. A custom 24" BeCu Pressure Barrel results in a significantly shorter and lower cost tool than was previously available to the market.



### NGT-CS TOOL for Geosteering and MWD

The NGT-CS Gamma tool is the small diameter version of the popular NGT-T. At just 1.05" OD, it offers the same performance and durability of the NGT-T. A smaller diameter scintillator crystal with increased length matches the sensitivity of the larger tool.





### DGA FOCUSED GAMMA TOOL

The DGA Focused, or Azimuthal Gamma tool is a Tungsten collimated version of the NGT-T tool. It is mechanically and electrically identical to the NGT-T. A "window" is machined along the length of the Tungsten shield that surrounds the detector. Only gamma rays entering from the formation, through this window can be detected and counted. When aligned with the tool face or other physical reference, the DGA indicates the direction from which gamma ray intensities originate.

### NGT-B GAMMA TOOL for Wireline

The NGT-B Gamma Tool is a fully housed 1 11/16" OD, wireline logging tool. It is available to operate with the CBG high speed digital telemetry or as an analog, pulse output tool. The NGT-B incorporates the standard GO single-pin interface. Titanium housings and subs not only provides maximum protection in sour-gas environments, but minimizes attenuation of gamma rays due to the low density. Temperature compensated electronics insure stable count rates over the full temperature range to 350°F.



### NGT-S GAMMA TOOL for Wireline

The NGT-S Gamma Tool is the small diameter version of the NGT-B, with an OD of 1.375". Tool performance and stability are not sacrificed for this slim hole version of the NGT-B.



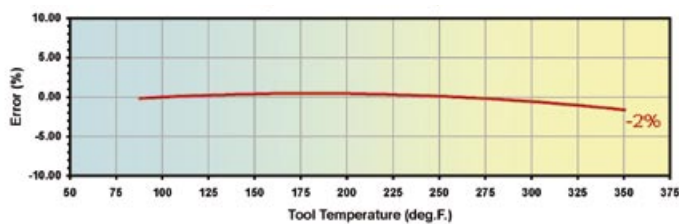
### Calibration

CBG Gamma tools are calibrated in the laboratory using an AEA Technology KUTH Field Verifier, Product Code No. 188074, to determine the API calibration factor for each tool. The nuclides described below are carefully chosen and combined to closely approximate the proper ratios as found in the KUTH API Calibration Test Pits located at the University of Houston, Houston Texas.

Nuclides	Content	Activity
Natural Thorium (Th-232)	90ppm	0.168 uCi
Natural Uranium (U-238)	40ppm	0.233 uCi
Natural Potassium (K-40)	11.7%	1.685 uCi

### Temperature Stability

CBG Gamma Tools are fully rated to 350°F, with a survival rating up to 400°F. Electronic circuits are temperature compensated to maintain consistent count rates. Each tool, new and repaired, is logged in the laboratory from room temperature to 350° and back to insure a count rate stability of no less than 95%.



### Shock and Vibration Testing

Shock and Vibration testing is routinely employed to insure that environmental specifications are being met as well as for troubleshooting some repairs. CBG uses the Vibration Test Systems equipment, in house to perform these tests. Tests are performed to meet tool specifications of 50-300 Hz and 30G.

### Service and Repair

All tools are 100% assembled and tested by CBG. Each component of the tool can be readily repaired or replaced. CBG has developed a reputation for fast turn around times when service is required. The proprietary detector assembly allows access to the scintillator crystal and photomultiplier tube for troubleshooting and replacement, without having to send the entire assembly away to a third party for repair. Components, assembly and test procedures are continually updated by CBG to insure the most accurate and reliable tool on the market today!

### Custom Designs

CBG will work with your Engineers to develop a customized gamma tool design for your specific application. We have developed numerous designs for companies that require electrical and/or mechanical changes from our standard products.

◀ Typical Temperature Stability of Count Rate  
NGT-T MWD Gamma-ray Tool



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## C B G G A M M A - R A Y T O O L S P E C I F I C A T I O N S

	NGT-T w/out housing assembly	NGT-T with housing assembly	NGT-CS	DGA FOCUSED GAMMA	NGT-B	NGT-S
<b>Application</b>	Geosteering/MWD	Geosteering/MWD	Geosteering/MWD	Geosteering/MWD	Wireline/Production	Wireline/Production
<b>Mechanical</b>						
Diameter (OD)	1.36"	1.875"	1.050"	1.30"	1.6875"	1.375"
Length (make up)	13.6"	34.05"	18.83"	13.6"	22.25"	25.2"
Weight	1.7 lb.	15.0 lb.	1.5 lb.	3.0 lb.	6.0 lb.	4.0 lb.
Operating Temp.	-77° to +350° F.	-77° to +350° F.	-77° to +350° F.	-77° to +350° F.	-77° to +350° F.	-77° to +350° F.
End Connectors	MDM-15 Pin	200°C, 10 Pin GE	MDM-15 Pin	MDM-15 Pin	GO Single Pin	GO Single Pin
Material		BeCu			Ti-6Al-4V	Ti-6Al-4V
Pressure		18,000 PSI			18,000 PSI	18,000 PSI
<b>Performance</b>						
Sensitivity	2.0 Counts per API	1.7 Counts per API	1.8 Counts per API	0.6 Counts per API	1.7 Counts per API	1.5 Counts per API
Accuracy	+/- 5% to 300° F. +/- 10% to 350° F.	+/- 5% to 300° F. +/- 10% to 350° F.	+/- 5% to 300° F. +/- 10% to 350° F.	+/- 5% to 300° F. +/- 10% to 350° F.	+/- 5% to 300° F. +/- 10% to 350° F.	+/- 5% to 300° F. +/- 10% to 350° F.
Resolution (Thin-Bed, 8" hole diameter, 50% points)	6.8"	6.8"	6.8"	8.8"	8.8"	8.8"
<b>Environmental</b>						
Survival Temp.	400° F.	400° F.	400° F.	400° F.	400° F.	400° F.
Max Heat/Cool	5° F./Minute	5° F./Minute	5° F./Minute	5° F./Minute	5° F./Minute	5° F./Minute
Vibration (3 axis) 50-300 Hz Random	30 G. 30 G.	30 G. 30 G.	30 G. 30 G.	30 G. 30 G.	30 G. 30 G.	30 G. 30 G.
Shock (Z-axis)	500 G., 0.5 mS.	500 G., 0.5 mS.	500 G., 0.5 mS.	500 G., 0.5 mS.	250 G., 0.5 mS.	250 G., 0.5 mS.
Shock (Y-axis)	1000 G., 0.5mS.	1000 G., 0.5mS.	1000 G., 0.5mS.	1000 G., 0.5mS.	500 G., 0.5mS.	500 G., 0.5mS.
<b>Power Requirements</b>						
Input Voltage	22-30 Volts	22-30 Volts	22-30 Volts	22-30 Volts	46-48 Volts	46-48 Volts
Input Current	18-14 mA. (constant power)	18-14 mA. (constant power)	18-14 mA. (constant power)	18-14 mA. (constant power)	20-23 mA	20-23 mA
Maximum Voltage	31.5 Volts	31.5 Volts	31.5 Volts	31.5 Volts	50 Volts	50 Volts
<b>Output Signal</b>						
Pulse	+5V to 0V, 2(+/-0.5) microseconds	+5V to 0V, 2(+/-0.5) microseconds	+5V to 0V, 2(+/-0.5) microseconds	+5V to 0V, 2(+/-0.5) microseconds	CBG Telemetry /Pulse	CBG Telemetry / Pulse

For more information, call us today at 512-491-7541

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