

## Remit-To Address:

Canberra Industries/ORLLC  
 General Post Office  
 PO Box 27746  
 New York, NY 10087-7746

**CANBERRA Industries Inc.**  
**800 Research Parkway**  
**Meriden CT 06450**  
**Tel: (800) 243-3955 Fax: (203) 235-1347**



## Customer Address:

Davin Wallace  
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<b>Quote #</b>	<b>ESE-072815</b>
Date Issued	9/4/2015
Valid For:	60 Days
Delivery:	90 Days
F.O.B. Point:	Meriden, CT
Freight Terms:	Prepay and Add
Terms:	NET 30
	Subject to
	Credit Approval

Item Number	Quantities		Description	Unit Price	Total Price
	Quoted	Model No.			
<b>Gamma Spectroscopy System</b>					
100	1	WELL DETECTOR	WELL-TYPE DETECTOR CONFIGURATION	\$ 33,910.00	\$33,910.00
101	1	GCW1522-DET	GERMANIUM WELL DETECTOR GCW1522		
102	1	D-30	DEWAR (30) LITER		
103	1	C-30	C-30 RTV COLLAR FINAL ASSEMBLY		
104	1	7500SL-0	CRYOSTAT DIPSTICK FINAL ASSY 7500SL-0		
105	1	CH-WELL-S-ULB-0	CHAMBER WELL STD ULB-0		
106	1	ENDC-ULB-16WELL-0	ULB ALU 16MM WELL ENDCAP 3.00 DIAM		
107	1	2002CSL-10	2002CSL PREAMPLIFIER 10-PIN		
108	1	CFA-2002C-CX	COAX DETECTOR RC COLD PA ASSEMBLY		
109	1	RCP-CABLE-10	RCP PREAMP 10FT CABLE SET		
110	1	CFE-4	COLD FINGER EXTENSION - 4" LONG		
200	1	747	TOP OPENING LEAD SHIELD -(11" ID X 16" DEEP X 4" WALL) -NOTE: All handling and installation of shield components is the responsibility of the customer. - For vertical dipstick cryostat only	\$ 18,241.00	\$18,241.00

The products, technology and pricing referenced herein are for US sale and installation only, unless otherwise specified.  
 Canberra Industries, Inc. 800 Research Parkway - Meriden, CT 06450 - Tel 203-238-2351 - Fax 203-235-1347

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<b>Gamma Spectroscopy System</b>					
300	1	DSA-LX	DIGITAL SIGNAL ANALYZER Desktop Multi-Channel Analyzer (MCA) -DSP based pulse processing -16,000 channel spectral memory -Multi-range high voltage power supply -Digital stabilizer -Sample Changer support -USB communication interface -PHA and MCS modes -Requires Genie-2000 Basic Spectroscopy Software (S502C/S500C V3.3 or later).	\$ 11,164.00	\$11,164.00
400	1	S502C	GENIE 2000 BASIC - 1 INPUT Basic Spectroscopy Software, including; -Acquisition control for Canberra MCAS -MCA display, multiple peak searches, and calibration. -Batch and interactive operation. -Supports one MCA input only. -Supports one input only on AIM. -Does not support multiplexers. -Requires Windows 7 (32- or 64-bit) or XP Professional Operating System for V3.3 or greater.	\$ 1,296.00	\$1,296.00
500	1	S501C	GENIE 2000 GAMMA OPTION	\$ 4,271.00	\$4,271.00

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Item Number	Quantities		Description	Unit Price	Total Price
	Quoted	Model No.			
600	1	747-2	<p><b>Gamma Spectroscopy System</b></p> <p>-Peak Area Background Subtract, Efficiency Correction, Nuclide Identification, Automatic Interference Correction, Cascade Summing Correction, Weighted Mean Activity Calculation, and Minimum Detectable Activity. -Requires S500C, S502C, or S504C.</p> <p>ANNULAR PLUG (FOR 7500SL ONLY)</p> <p>- 4.7" diameter, fits shield with 4.75" diameter hole</p> <p>- Consult factory on shield plugs for existing shields with 4.5" diameter holes</p>	\$ 593.00	\$593.00
Comments:				Sub Total	\$ 69,475
				Total Discounts	\$ (11,475)
				<b>Total</b>	<b>\$ 58,000</b>

Approved By:

\_\_\_\_\_

Taylor Haby  
Account Manager  
(979) 299-9217  
taylor.haby@canberra.com



### Features/Benefits

- Blind well approaches  $4\pi$  counting geometry yielding high absolute efficiency
- Large variety of models available allowing to select the optimum Well detector for your application
- Thin, ion-implanted contact inside Well allows spectroscopy from 20 keV up to 10 MeV

### Applications

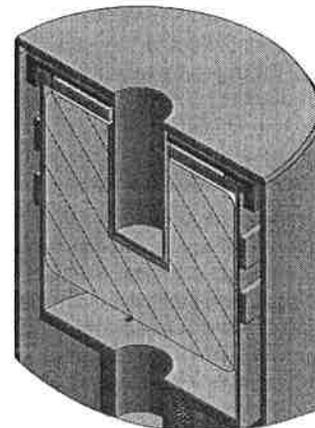
- Environmental samples
- Geology
- Oceanography
- Life sciences

## Germanium Well Detector (WELL)

### Description

The CANBERRA High-Purity Germanium (HPGe) Well Detector provides maximum efficiency for small samples because the sample is virtually surrounded by active detector material. The CANBERRA Well detector is fabricated with a blind hole rather than a through hole, leaving at least 15 mm of active detector thickness at the bottom of the well. The counting geometry therefore approaches  $4\pi$ .

The Well insert in the endcap is made of aluminum with a side-wall thickness of 0.5 mm and a 1 mm thick bottom. The ion implanted contact on the detector element is negligibly thin compared to 0.5 mm of aluminum so these detectors have intrinsically good low energy response, allowing spectroscopy down to 20 keV.



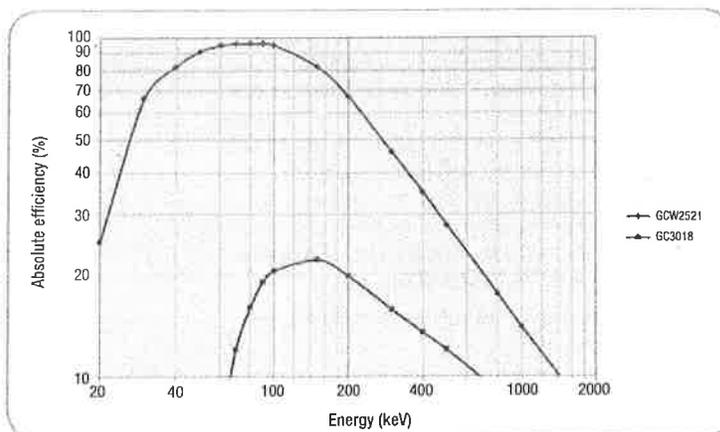
Ge Well Detector

### Advantages of Well Detectors

The advantages of well type detectors are based on the near  $4\pi$  counting geometry for a source placed inside the well.

This geometry assures a **high counting efficiency** as the full energy peak efficiency may be written as:  $\epsilon = \eta \cdot \epsilon_i$

Where  $\eta$  represents the geometrical efficiency given by  $\eta = \theta / 4\pi$ .  $\theta$  is the solid angle under which the detector "sees" the source and  $\epsilon_i$  is the intrinsic efficiency. For a well type detector,  $\eta \sim 1$  as  $\theta$  approaches  $4\pi$ . The absolute efficiency is thus mainly governed by the intrinsic efficiency. The figure below compares the absolute efficiency for a multi-gamma point source, once measure in the well of a Well detector and once at 1 cm distance from the window of a standard p-type coaxial detector.



Measured efficiency of a Model GCW2521 with a mixed point source standard located at the bottom of the 10 mm diameter Well, compared to a GC3018 with a source to endcap distance of 1 cm.

# Germanium Well Detector

For applications where small, low-activity samples must be measured, this high counting efficiency results into **lower detection limits** or **shorter counting times** to achieve a given detection limit.

Also Well Detectors have the advantage that **sample positioning is easy** and not very critical. Sample vials can easily be placed inside the well. The effect on the absolute efficiency of moving the sample inside the well is about an order of magnitude less than positioning a source inaccurately above a coaxial detector.

In making the choice for a Well type detector for a certain application, the above advantages have to be weighed against some potential disadvantages. The Well geometry only accommodates a small sample volume. If more sample material is available another measurement geometry using a coaxial or planar detector may yield a lower MDA per gram of sample. Secondly, due to the higher capacitance of the detector and the consequently higher electronic noise, the resolution performance of Well type detectors is worse than coaxial detectors, particularly at low energies. And thirdly, because the sample is very close to the detector and completely surrounded by it, a Well detector is more prone to summing effects, especially when isotopes with many coincident gammas are measured.

## Models and Options

A variety of detector sizes and well diameters are available. The standard well depth is 40 mm for all detectors. Consult the accompanying table for information on standard units. These models are available in most of CANBERRA's cryostat configurations. Consult the 'Cryostat and Cryostat Options' section in our product literature for more information.

HPGe Well Detectors are used to measure small samples, often with very low activity, sometimes leading to very long counting times. This type of detectors can therefore significantly benefit from adding the Ultra-Low Background (ULB) option. In this option CANBERRA uses a cryostat construction and select materials to reduce the background radiation on the detector, resulting in a shorter counting time to achieve a required detection limit. See the ULB section under 'Cryostats and Cryostat Options' for more details.

Well Detectors are equipped with resistive feedback preamplifiers.

## GERMANIUM WELL DETECTOR General Specifications and Information

Model Number	Rel. Eff. (%)	Well Dia.* (mm)	Active Volume (cc)	Resolution	
				FWHM (1332 keV)	FWHM (122 keV)**
GCW1521	15	10	90	2.1	1.1
GCW1522	15	16	100	2.2	1.3
GCW2021	20	10	110	2.1	1.1
GCW2022	20	16	120	2.2	1.3
GCW2521	25	10	130	2.1	1.2
GCW2523	25	16	140	2.3	1.4
GCW3021	30	10	150	2.1	1.2
GCW3023	30	16	160	2.3	1.4
GCW3521	35	10	170	2.1	1.2
GCW3523	35	16	180	2.3	1.4
GCW4021	40	10	190	2.1	1.2
GCW4023	40	16	200	2.3	1.4
GCW5021	50	10	260	2.1	1.2
GCW5023	50	16	260	2.3	1.4
GCW6021	60	10	300	2.1	1.3
GCW6023	60	16	300	2.3	1.5
GCW7021	70	10	320	2.1	1.3
GCW7023	70	16	320	2.3	1.5
GCW8022	80	10	350	2.2	1.3
GCW8023	80	16	350	2.3	1.5
GCW9022	90	10	380	2.2	1.3
GCW9023	90	16	380	2.3	1.5
GCW10022	100	10	450	2.2	1.3
GCW10023	100	16	450	2.3	1.5

\* Consult factory for other Well dimensions.

\*\* FWHM at 122 keV is a nominal value, not a specification limit.



# GWL Series Coaxial HPGe Detector Product Configuration Guide

## GWL Detector Dimensions

- Dimensions are for reference only and subject to change.
- If dimensional constraints are critical, contact the factory.

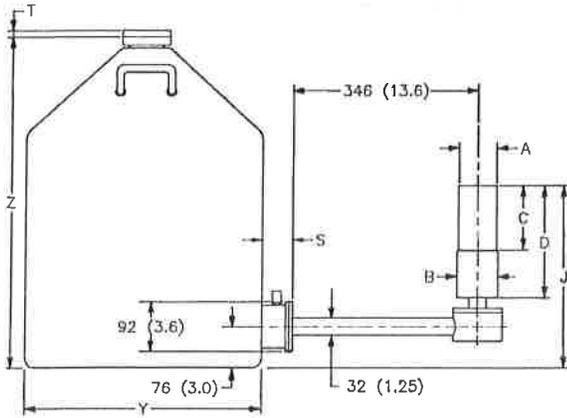
Endcap Model (dia. mm)			Standard or LB				XLB			
			-70	-83	-95	-108	-70	-83	-95	-108
Dim.	Unit	Tol.								
A	mm (in)	0.3 (0.01)	70 (2.75)	83 (3.25)	95 (3.75)	108 (1.25)	70 (2.75)	83 (3.25)	95 (3.75)	108 (1.25)
B	mm (in)	0.3 (0.01)	75 (2.95)	88 (3.45)	100 (3.95)	113 (4.45)	75 (2.95)	88 (3.45)	100 (3.95)	113 (4.45)
C	mm (in)	5 (0.2)	134 (5.3)	122 (4.8)	134 (5.3)	134 (5.3)	160 (6.3)	147 (5.8)	160 (6.3)	160 (6.3)
D	mm (in)	8 (0.3)	246 (9.7)	246 (9.7)	258 (10.2)	258 (10.2)	272 (10.7)	272 (10.7)	284 (11.2)	284 (11.2)
E	mm (in)	18 (0.7)	916 (36.1)	919 (36.2)	932 (36.7)	932 (36.7)	941 (37.1)	945 (37.2)	957 (37.7)	957 (37.7)
EM	mm (in)	19 (0.75)	917 (36.1)	920 (36.2)	933 (36.7)	933 (36.7)	942 (37.1)	946 (37.2)	958 (37.7)	958 (37.7)
H	mm (in)	18 (0.7)	352 (13.8)	352 (13.8)	364 (14.3)	364 (14.3)	X X	X X	X X	X X
HB	mm (in)	0.3 (0.1)	73 (2.9)	85 (3.3)	99 (3.9)	111 (4.4)	X X	X X	X X	X X
HC	mm (in)	5 (0.2)	134 (5.3)	122 (4.8)	135 (5.3)	135 (5.3)	X X	X X	X X	X X
HD	mm (in)	10 (0.4)	162 (6.4)	162 (6.4)	175 (6.9)	175 (6.9)	X X	X X	X X	X X
J	mm (in)	10 (0.4)	380 (15)	380 (15)	393 (15.5)	393 (15.5)	405 (16)	405 (16)	418 (16.5)	418 (16.5)
L	mm (in)	10 (0.4)	338 (13.3)	338 (13.3)	350 (13.8)	350 (13.8)	363 (14.3)	363 (14.3)	376 (14.8)	376 (14.8)

## Example Model Numbers

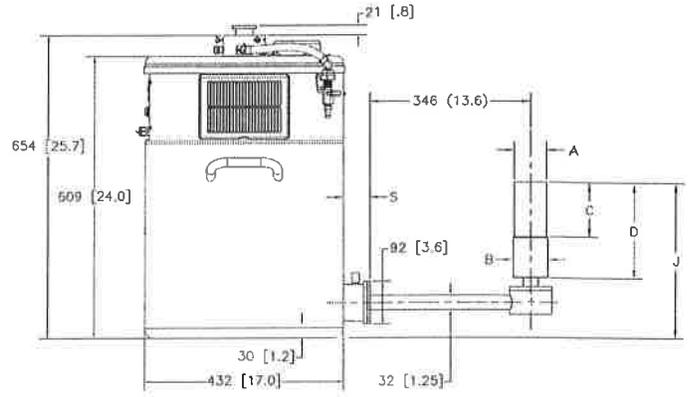
GWL-120-10	120 cc active volume GWL detector with 10-mm diameter well tube and 70-mm diameter endcap.
CFG-SV-70	Vertical "dipstick" style cryostat to fit 70-mm diameter endcap.
DWR-30	30 liter top port dewar that accepts "dipstick" style cryostats.
GWL-300-15-LB-AWT	300 cc active volume GWL detector with 15-mm diameter high purity Al (low-background) well tube and 95-mm diameter Cu endcap.
CFG-SL-LB-95	Sidelooking cryostat and dewar to fit 95-mm diameter endcap with low background charcoal pumping agent.
DWR-13B	13 liter sidelooking dewar.
GWL-450-10-XLB-AWT	450 cc active volume GWL detector with 10-mm diameter high purity Al (low-background) well tube with 108-mm diameter Cu endcap.
CFG-SJ-XLB	"J" type cryostat with lead shield and low-background charcoal pumping agent.
DWR-30B	30 liter side looking dewar.
GWL-170-15	170 cc active volume GWL detector with 15-mm diameter well tube and 83-mm diameter endcap.
CFG-SV-83	Vertical "dipstick" style cryostat to fit 70-mm diameter endcap.
MOBIUS-ST	Möbius Recycler.

# GWL Series Coaxial HPGe Detector Product Configuration Guide

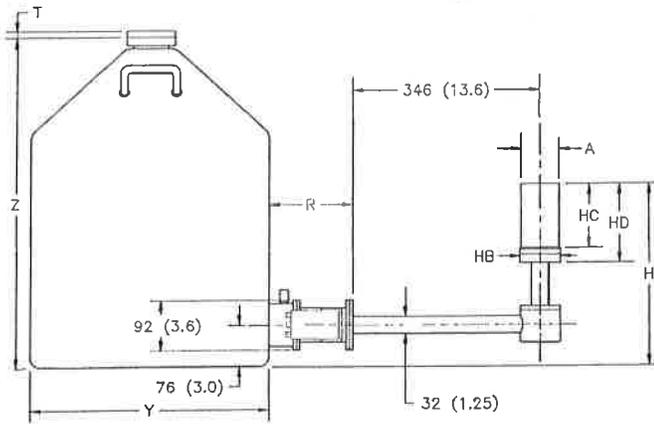
**Note: Cryostat/Dewar drawings are NOT to scale, see tables that follow for complete dimensions.  
Dimensions are for reference only and subject to change, if dimensional constraints are critical, contact the factory.**



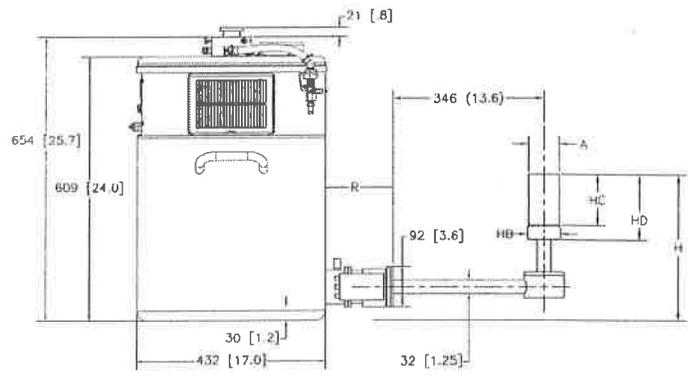
**CFG-SJ, DWR-30B (or -13B or -7.5B)**



**CFG-SJ, MOBIUS-B**



**CFG-HJ, DWR-30B (or -13B or -7.5B)**



**CFG-HJ, MOBIUS-B**

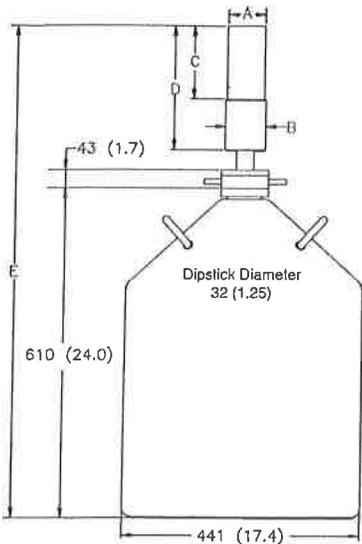
# GWL Series Coaxial HPGe Detector Product Configuration Guide

## Streamline Dimensional Data

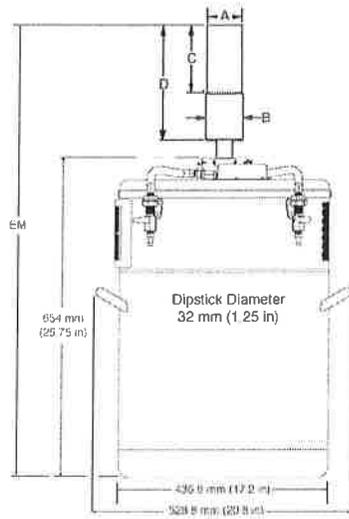
Streamline systems (detector capsule and cryostat) share the same vacuum, requiring a cryostat or cryostat/dewar selection with the cryostat having a matching diameter to the capsule endcap. A cryostat must be ordered with a Streamline capsule.

The cryostat and dewar drawings that follow are to be used in conjunction with the accompanying tables of dimensions.

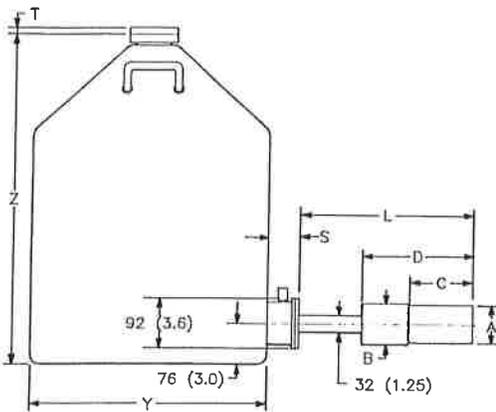
**Note: Cryostat/Dewar drawings are NOT to scale, see tables that follow for complete dimensions.**  
Dimensions are for reference only and subject to change, if dimensional constraints are critical, contact the factory.



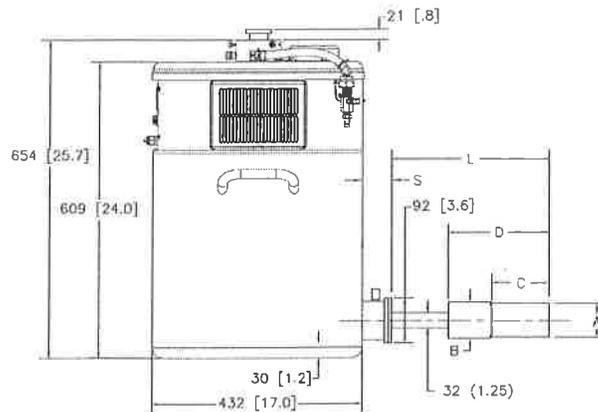
CFG-SV, DWR-30



CFG-SV, MOBIUS-ST



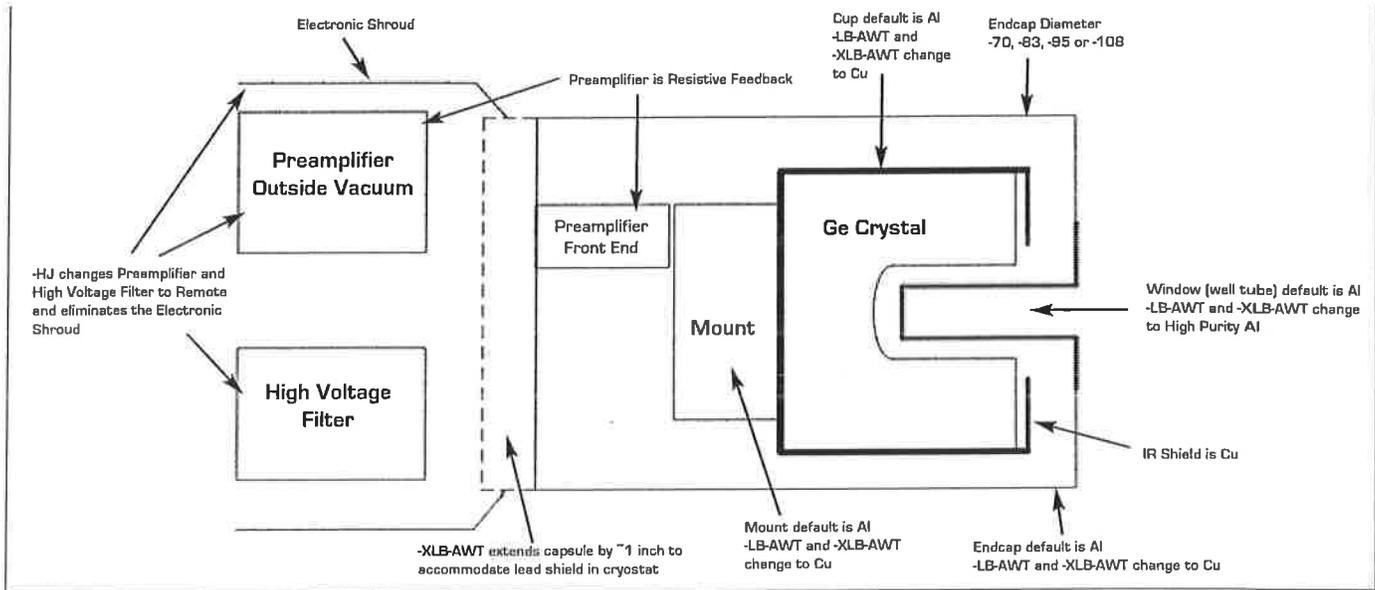
CFG-SL, DWR-30B (or -13B or -7.5B)



CFG-SL, MOBIUS-B

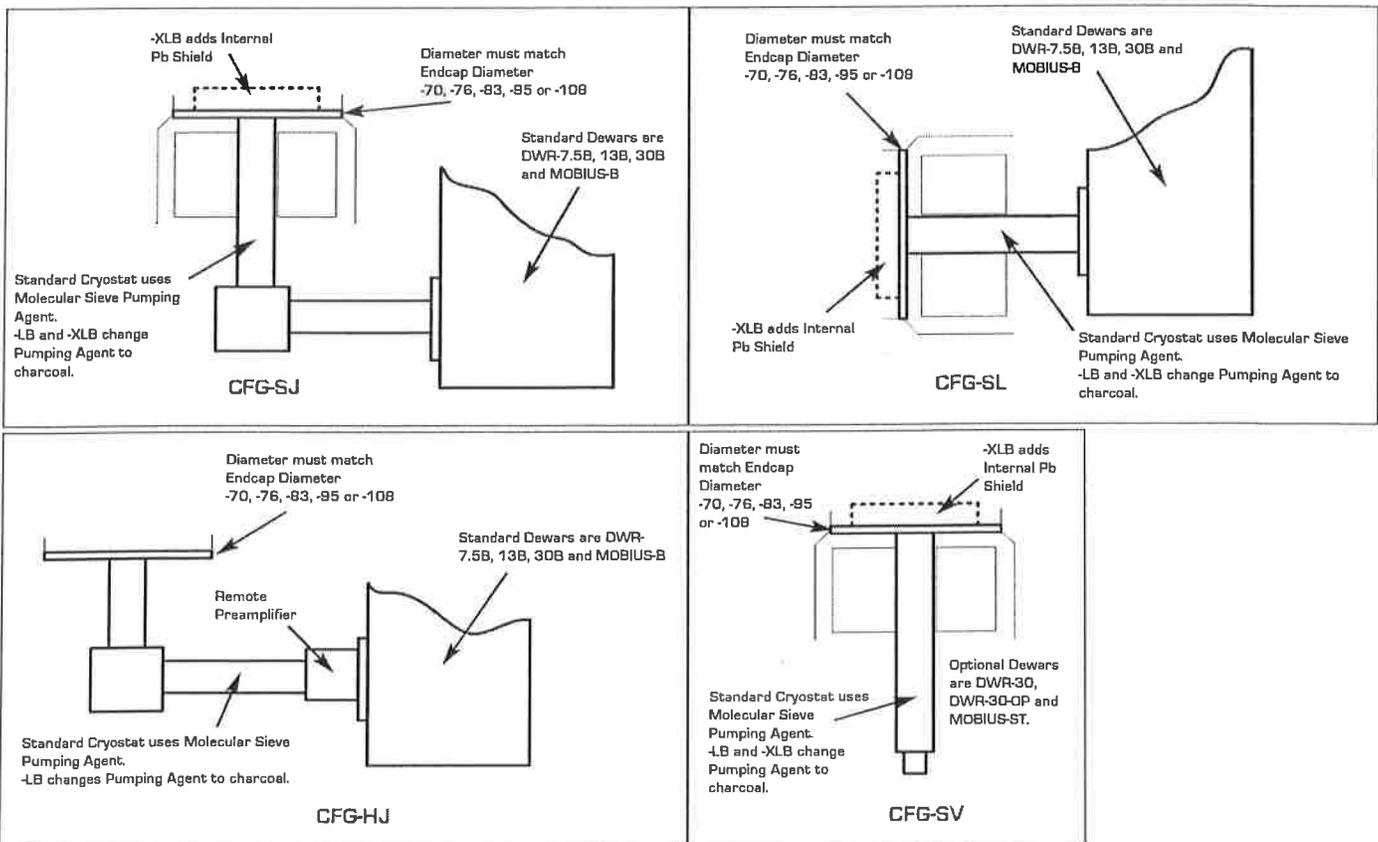
# GWL Series Coaxial HPGe Detector Product Configuration Guide

## Streamline Detector Capsule



## Streamline Cryostat and Cryostat/Dewar Assemblies

Streamline systems (detector capsule and cryostat) share the same vacuum, requiring a cryostat or cryostat/dewar selection with the cryostat having a matching diameter to the capsule endcap.



# GWL Series Coaxial HPGe Detector Product Configuration Guide

## Steps to Configure Your ORTEC HPGe Detector

### 1) Configure the Detector Model

- Ge Crystal active volume and well tube diameter
- Endcap and window
- Mount
- Preamplifier
- High Voltage Filter
- Cable Package

Options are available for the detector model that can change specific materials used in the construction of the detector endcap, cup, and mount. Preamplifier options are also available.

### 2) Configure the Cryostat/Dewar Model

- Vertical Dipstick style (separate Dewar or Mobius Recycler)
- Sidelooking designed to be oriented with the detector horizontal at the bottom of the dewar
- "J" configurations designed with the detector attached near the bottom of the dewar and a right angle bend in the cryostat orienting the detector to look up.

A cryostat and dewar or other cooling device are required for operation.

You must choose a cryostat or cryostat/dewar model for the detector to be mounted on and vacuum sealed. The cryostat or cryostat/dewar combination diameter must match the endcap diameter of the selected detector.

## Detector Options

### Remote Preamplifier Option [-HJ]

This option allows all the preamplifier and high voltage connections to be outside a shield and removes the preamplifier and high voltage filter from the "line-of-sight" to the Ge crystal. For low background applications, this option eliminates any possible preamplifier or high voltage filter components that may add to the background inside a shield.

### Low-Background Options [-LB-AWT, and -XLB-AWT]

Low-background GWL detectors are supplied with oxygen-free high conductivity (OFHC) copper endcaps with low-background high purity aluminum well tubes of 0.02 inch wall thickness.

## Defining the Detector Model

- See ordering information for option compatibility.

Base Model (example)	Well Option (if required)	Preamplifier Option (if required)
GWL-90-15	-LB-AWT -XLB-AWT	-HJ

### For Analysis of Small, Low-Activity Samples

- High absolute counting efficiency for small samples
- Active Volumes to 400 cc
- Unique ion-implanted blind well
- Resolution specified with source inside the well
- Spectroscopy from 10 keV to 10 MeV
- Near  $4\pi$  geometry
- Extra-large well (1.55 x 4.0 cm) standard

ORTEC's High-Purity Germanium (HPGe) Well Detectors offer high absolute counting efficiency for radiochemical analysis and low-level gamma-ray spectroscopy. The unique ion-implanted detector well has an ultra-thin dead layer (only 0.3  $\mu\text{m}$  thick), and therefore provides the most extensive useful energy range (10 keV to 10 MeV). Unlike other Well detectors that have a hole all the way through the germanium crystal, ORTEC's Well Detectors have a "blind hole" with at least 5 mm of active germanium at the bottom of the hole (Fig. 1). This near  $4\pi$  geometry provides the maximum absolute counting efficiency available. The large well (1.55-cm-diameter and 4.0-cm-long) accommodates an extensive range of sample sizes. Like all of ORTEC's HPGe photon detectors, the HPGe Well detector may be stored or cycled repeatedly to room temperature without performance degradation.

As specified in ANSI/IEEE Std. 325-1996, the resolution is measured with a point source inside the well, 1 cm from the bottom. Measurements of resolution outside the well can be deceiving.

A typical curve of absolute efficiency in the well vs. photon energy is shown in Fig. 2.

### The Following Specifications are Provided for Each Model GWL Detector

- Energy resolution at 1.33-MeV photons from  $^{60}\text{Co}$  at optimum shaping time.
- Active Ge volume and well tube diameter.
- Energy resolution at 122 keV photons from  $^{57}\text{Co}$  at optimum shaping time.

### Configuration Guidelines

#### Streamline (non-PopTop) Configuration

In so called Streamline systems, the detector capsule is NOT demountable. Detector capsule and cryostat share the same vacuum. In configuration terms, this requires a cryostat or cryostat/dewar selection with the cryostat having a matching diameter to the capsule endcap. A cryostat must always be ordered with a Streamline capsule, because they are integral.

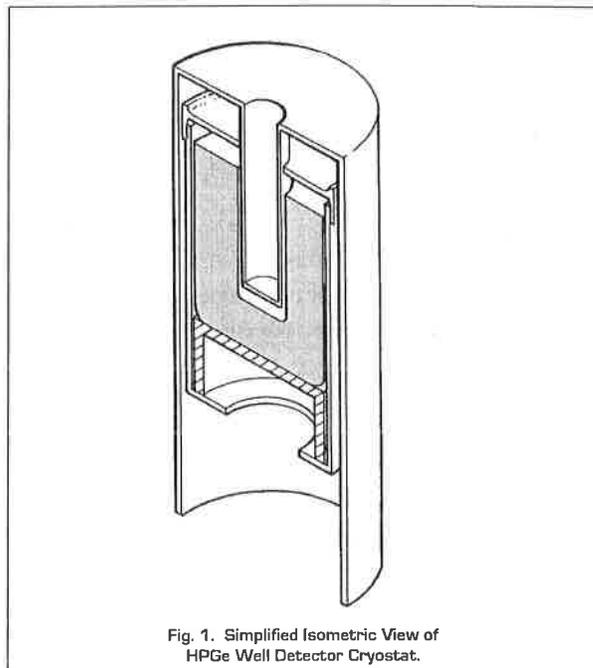


Fig. 1. Simplified Isometric View of HPGe Well Detector Cryostat.

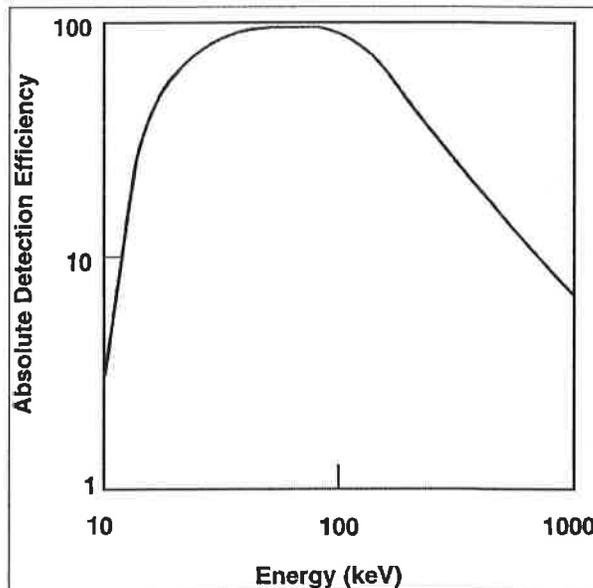


Fig. 2. Absolute Detection Efficiency in the Well vs. Photon Energy. [If a well detector is used as a general-purpose coaxial detector (a use not recommended by ORTEC), its relative efficiency at 25 cm can be determined from the equation on page 58.]

# GWL Series Coaxial HPGe Detector Product Configuration Guide

## GWL Streamline Cryostats

- Dewar required. Select dewar from GWL Streamline Dewars.
- Append matching Detector Endcap Size designation to cryostat model: -70, -83, -95, -108 [e.g., CFG-SJ-95 for GWL-280-15 or CFG-SL-XLB-83 for GWL-170-10-XLB-AWT]

Model No.	Description
CFG-HJ	J-type Cryostat with Remote Preamp (for -HJ option only)
CFG-SJ	J-type Cryostat
CFG-SL	Side-Looking Cryostat
CFG-SV	Vertical Cryostat (Dipstick type)
<b>LOW-BACKGROUND</b>	
CFG-HJ-LB	Low-Background J-type Cryostat with Remote Preamp (for -HJ option only)
CFG-SJ-LB	Low-Background J-type Cryostat
CFG-SL-LB	Low-Background Side-Looking Cryostat
CFG-SV-LB	Low-Background Vertical Cryostat (Dipstick type)
CFG-SJ-XLB	Extra-Low-Background J-type Cryostat
CFG-SL-XLB	Extra-Low-Background Side-Looking Cryostat
CFG-SV-XLB	Extra-Low-Background Vertical Cryostat (Dipstick type)

## GWL Streamline Dewars

For Cryostat	Choose	Description
CFG-HJ, SJ, SL	DWR-7.5B	7.5-liter Side-Looking Dewar
	DWR-13B	13-liter Side-Looking Dewar
	DWR-30B	30-liter Side-Looking Dewar
	MOBIUS-B	Möbius Recycler 28-liter Side-Looking Dewar
CFG-SV	DWR-30-OP	30-liter Offset-Port Dewar
	DWR-30	30-liter Dewar
	MOBIUS-ST	Möbius Recycler 28-liter Dewar for purchase stand alone
	MOBIUS-ST-DET	Möbius Recycler 28-liter Dewar for purchase in combination with Detector

Specifications subject to change  
080515

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For International Office Locations, Visit Our Website

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ADVANCED MEASUREMENT TECHNOLOGY

## GWL Series Coaxial HPGe Detector Product Configuration Guide

### Ordering Information

- GWL-120 is standard order and delivery, all others are special order only.
- If dimensional considerations are critical, contact factory.
- Cryostat and dewar or other cooling device are not included with detector and are required for operation.
- A cryostat must be ordered with a Streamline detector.

Model No.	Volume Nominal [cc]	Well Tube		Energy Resolution FWHM		Endcap Diameter (mm)
		Diameter (mm)	Depth (mm)	@1.33 MeV (keV)	@122 keV (keV)	
GWL-90-10	90	10	40	2.10	1.2	70
GWL-90-15	90	15.5	40	2.30	1.4	70
GWL-110-10	110	10	40	2.10	1.2	70
GWL-110-15	110	15.5	40	2.30	1.4	70
<b>GWL-120-10</b>	120	10	40	2.10	1.2	70
<b>GWL-120-15</b>	120	15.5	40	2.30	1.4	70
GWL-130-10	130	10	40	2.10	1.2	70
GWL-130-15	130	15.5	40	2.30	1.4	70
GWL-150-10	150	10	40	2.10	1.2	83
GWL-150-15	150	15.5	40	2.30	1.4	83
GWL-170-10	170	10	40	2.10	1.2	83
GWL-170-15	170	15.5	40	2.30	1.4	83
GWL-190-10	190	10	40	2.10	1.2	83
GWL-190-15	190	15.5	40	2.30	1.4	83
GWL-220-10	220	10	40	2.10	1.2	95
GWL-220-15	220	15.5	40	2.30	1.4	95
GWL-250-10	250	10	40	2.10	1.2	95
GWL-250-15	250	15.5	40	2.30	1.4	95
GWL-280-10	280	10	40	2.15	1.2	95
GWL-280-15	280	15.5	40	2.30	1.4	95
GWL-300-10	300	10	40	2.15	1.2	95
GWL-300-15	300	15.5	40	2.30	1.4	95
GWL-350-10	350	10	40	2.15	1.2	95
GWL-350-15	350	15.5	40	2.30	1.4	95
GWL-400-10	400	10	40	2.15	1.2	108
GWL-400-15	400	15.5	40	2.30	1.4	108
GWL-450-10	450	10	40	2.15	1.2	108
GWL-450-15	450	15.5	40	2.30	1.4	108

### GWL Detector Options

- LB-AWT Low-Background Detector with OFHC Cu Endcap and High Purity Al Well Tube, add "-LB-AWT" to the model number. Requires selection of a Low-Background LB cryostat.
- XLB-AWT Extra-Low-Background Detector with OFHC Cu Endcap and High Purity Al Well Tube, add "-XLB-AWT" to the model number. Requires selection of a Low-Background XLB cryostat. Not compatible with -HJ option.
- HJ Remote preamplifier and high voltage filter for use with HJ type cryostat, add "-HJ" to the model number. Requires selection of HJ cryostat. Not compatible with -XLB-AWT option.