



FEDERACION  
ARGENTINA  
de ESPELEOLOGIA

DIRECCION RECURSOS NATURALES RENOVABLES	
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Malargüe, 6 de junio de 2011

DIRECCION DE RECURSOS NATURALES RENOVABLES							
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**Sr. Daniel Gómez,**  
**Dirección de Recursos Naturales Renovables**  
**MENDOZA**

**Asunto: Pedido de autorización para continuar estudios de gas radón en Caverna de Las Brujas**

De mi consideración:

Me dirijo a Ud. con referencia a estudios de gas radón en Caverna de Las Brujas llevados a cabo por técnicos de esta Federación y que motivaran el informe de la Dra. Miriam Kundt (CNEA) que se adjunta a la presente en copia simple, y que motivara un informe interno en la DRNR de fecha 16-3-2010 y del que estamos en conocimiento.

Sobre el particular, reiteramos ante Ud. la necesidad de darle continuidad a tales estudios, para lo cual comunicamos el aval de nuestra asociación a la propuesta de investigación presentada por el Dr. Ricardo Kanter, y que también adjuntamos a la presente.

Solicito que se extienda la autorización del caso según Resolución 410/02, vale decir, dentro de los próximos 7 días hábiles.

Saludo a Ud. muy atentamente

**Marta Brojan**  
**Presidenta FAdE**  
**02627 15673218**  
**[www.fade.org.ar](http://www.fade.org.ar)**



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## INFORME

### EVALUACIÓN DE RADIACIÓN NATURAL EN CAVERNA DE LAS BRUJAS (Malargüe, Mendoza)

Preparado por : Miriam S. Kundt  
Fecha de informe : octubre 2008

#### Objetivo

El informe que se detalla a continuación es el resultado de la Evaluación de Radiación Natural en Caverna de las Brujas solicitado por la Dirección de Recursos Naturales Renovables de Mendoza (DRNRM), por nota dirigida a la Comisión Nacional de Energía Atómica (CNEA), Expte: 1355 con fecha 12 de abril 2007. Dicha nota fue remitida por el Lic. Leopoldo León (Director de la DRNR). En la misma se invita a la CNEA a considerar la posibilidad de llevar adelante mediciones de gas radón en Caverna de Las Brujas como así también en otras cavidades kársticas turísticas de la provincia. Este trabajo se realizó como parte de las tareas de investigación llevadas adelante por CNEA.

#### Detalle del trabajo realizado:

El mismo se realizó siguiendo el plan de trabajo presentado por CNEA y aprobado por Resolución de la DRNR: Evaluación de Radiación Natural en Caverna de las Brujas

#### Detalle de las muestras y mediciones realizadas:

Durante los días 4 al 11 de febrero del 2008 se realizaron tareas radioambientales para establecer la concentración de gas radón y otros radionucleidos en la Reserva Natural Caverna de Las Brujas. Los participantes del grupo que ingresaron a la caverna para la toma de muestras y datos fueron: Didier Lanthelme, miembro de la Federación Espeleológica Francesa, Rubén Cepeda, miembro del INAE y Miriam Kundt miembro de CNEA. Cada ingreso a la caverna contó con el acompañamiento de un guarda parque. Esta investigación implicó la toma de muestras de suelo de 20 g cada una, agua y aire (mediante la colocación de detectores de carbón activado). Asimismo se tomaron datos de temperatura, humedad y tasa de dosis en cada punto monitoreado. Las muestras para medición de radionucleidos fueron llevadas a los laboratorios de la Autoridad Regulatoria Nuclear (ARN)



### Resultados

En las siguientes tablas se presenta el detalle de las muestras analizadas y los resultados obtenidos. En la Figura 1 se muestran los puntos de muestreo sobre el esquema de la caverna.

Punto de Muestreo	Sitio / Sala	Hora de toma de muestra	Temperatura °C	Humedad Relativa %	Tasa de dosis $\mu\text{Sv/h}$
X	Centro Operativo D/40 Base de guardaparaques	11	27.62	36.62	0.1
A	Entrada a la cueva	11.30	21.73	45.76	0.098
B	Sala de la Virgen	11.45	13.79	72	0.091
C		11.50	13.41	71.18	0.094
D		12	16.42	63.37	0.079
E		12.15	14.5	70.92	0.072
F		12.40	16.25	64.76	0.068
G	El pulpito	13	15.90	68.76	0.059
H	Final de sala de los encuentros	13.05	13.05	60.20	0.058
I	Sala de las flores	13.30	14.54	77.65	0.056
J	Sala de las arenas	14.15	12.62	73.69	0.059
K	Sala de los dioses/ NI	15.05	15.14	68.41	0.060
L	El pozo de la duda o salida de emergencia	15.30	16.37	64.78	0.059
M	Sala del aislamiento	15.45	12	68	0.059
N	Sala del aislamiento	16	12	68	0.059

### Determinaciones de radón ( $\text{Rn-222}$ ) en aire

Punto de muestreo	Número de vial	$\text{Rn-222}^1$ ( $\text{Bq/lm}^3$ )
A	1 - 2	$200 \pm 9^2$
B	3 - 4	$573 \pm 26^2$



D	7 - 8	1129 ± 52 <sup>2</sup>
E	9 - 10	1634 ± 75 <sup>2</sup>
F	11 - 12	2384 ± 109 <sup>2</sup>
H	15 - 16	3658 ± 168 <sup>2</sup>
I	17 - 18	4655 ± 213 <sup>2</sup>
J	19 - 20	1835 ± 84 <sup>2</sup>
K	21 - 22	568 ± 26 <sup>2</sup>
L	23 - 24	565 ± 26 <sup>2</sup>
M	25 - 26	1506 ± 69 <sup>2</sup>
N	27 - 28	294 ± 14 <sup>2</sup>
X	39 - 40	15 ± 2 <sup>2</sup>
G	13 - 14	2556 ± 117 <sup>2</sup>

<sup>1</sup> Adsorción sobre carbón activado y medición por centelleo líquido (1)

<sup>2</sup> Valor de concentración promedio del obtenido de ambos viales

#### Determinaciones de radón en agua

Cueva	Punto de muestreo	Rn-222 <sup>1</sup> (Bq/m <sup>3</sup> )
Cueva Las Brujas	I	<LD; LD=124

<sup>1</sup> Medición por centelleo líquido (2)

#### Determinaciones de Radio en suelo:

Punto de muestreo	Radio 226 l (mBq/g)
B	<LD; LD=17.9
C	<LD; LD=18.4
D	25 ± 12.4
E	30 ± 12.8
F	20.7 ± 12.1
G	29.4 ± 13.3
H	181.1 ± 20.5
I	28 ± 13.1
J	73.3 ± 15.9



### **Análisis y Conclusiones**

A continuación se detallan los valores máximos recomendados por diferentes organismos internacionales para los radionucleidos medidos, y se comparan con los valores obtenidos en las presentes mediciones:

Con relación a los valores determinados de radio-226 en muestras de suelo, los resultados obtenidos son compatibles con los valores encontrados habitualmente en la naturaleza. (1)

#### **- Límite de dosis:**

Valor guía recomendado por la Comisión Internacional de Protección Radiológica (ICRP) para el público en general es de 1 mSv/año oficial.

Los resultados obtenidos se encuentran por debajo de este valor.

#### **- Gas radón en aire:**

Rango de nivel de acción para intervención en lugares de trabajo recomendado por el BSS-115 (2): 1000 Bq/m<sup>3</sup>

Algunos resultados obtenidos se encuentran por encima de este valor.

#### **- Gas radón en agua:**

Valor guía recomendado por la OMS (3): 100 Bq/L (100.000 Bq/m<sup>3</sup>)

Los resultados obtenidos se encuentran por debajo de este valor.

Los valores de concentración de gas radón en aire, el ICRP 65 (4) define al nivel de acción como la concentración de radón por encima de la cual se recomienda la intervención para reducir la exposición en una vivienda o lugar de trabajo. La IAEA en su International Basic Safety Standards establece como nivel de acción en lugares de trabajo 1000 Bq/m<sup>3</sup> promedio en un año, considerando un factor de equilibrio (F) entre el gas radón y su progenie de período corto igual a 0,4. Por ende, en aquellos lugares donde las mediciones se encuentren por encima del nivel de acción, es recomendable adoptar medidas de mitigación a los fines de que la concentración de radón se reduzca a valores por debajo del mismo. En el caso de cavernas, debido a que no pueden ser ventiladas para eliminar gases, lo que se hace es limitar el tiempo de exposición de los trabajadores en dichas salas Ej: Cueva de Altamira - España (5).

A partir de las mediciones realizadas se observa que en los puntos E, F, H, I, J, M y G de la Cueva de las Brujas, los valores de gas radón medidos superan el nivel de acción citado.



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A fin de evaluar la necesidad de implementar medidas de intervención para disminuir el tiempo que los trabajadores permanecen en las cavidades, sería recomendable realizar nuevas mediciones con detectores de trazas nucleares para evaluar la concentración de radón en un año oficial.

**Bibliografía:**

1. United Nations, United Nations Scientific Committee on the Effects of Atomic Radiation, "Exposures of the Public and Workers to Various Sources of Radiation", A/AC.82/R-656, Fifty-fourth session, 2006.
2. International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series N° 115, International Atomic Energy Agency (IAEA), Vienna (1996).
3. WHO Drinking Water Guidelines, 2<sup>nd</sup> edition, 2004.
4. Protection Against Radon-222 at Home and at Work, ICRP 65, Vol. 23, N°2 (1993).
5. Radon continuous monitoring in Altamira Cave (Northern Spain) to assess user's annual effective dose. S.; CAÑAVERAS, J.C.; CUEZVA, S.; SOLER, V. Journal of Environmental Radioactivity, n° 80, p. 161174 (2005).

Dra. Miriam S. Kundt  
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Lab. 41 Centro Atómico Constituyentes  
Av. Gral Paz 1499 – CP: 1650. San Martín



Mendoza, 24 de abril de 2007

Resolución N°: 473

## ANEXO I

### Formulario de Solicitud Investigaciones

Solicitud de autorización para realizar investigaciones dentro de Áreas Naturales Protegidas

Fecha de solicitud

#### Datos del investigador principal (titular)

Nombre y Apellido: KANTER, Ricardo  
Profesión: Geólogo  
Nombre de la Institución para la cual trabaja: FEDERACIÓN ARGENTINA  
de ESPELEOLOGÍA (asesor externo)  
Dirección laboral: 25 de Mayo 1084 - 10 "3" - MENDOZA  
Teléfono: 0261-156006927 Fax: — Correo electrónico: kantar\_r@yahoo.com  
Dirección particular: —  
Teléfono particular: —

1. Nombre y apellidos de los investigadores secundarios y asistentes de campo  
Espeleólogos de la Federación Argentina de Espeleología
2. Título del proyecto  
Monitoreo de gas radón en ANP Caverna de las Brujas
3. Áreas Protegidas donde se realizarán las actividades  
ANP Las Brujas
4. Cronograma aproximado de trabajo (detalle el comienzo y finalización de cada campaña, así como la/s actividad/es en cada una de ellas)  
Muestras periódicas durante un año
5. Justificación

- 1) ¿Qué beneficios se obtendrán de su investigación?  
Conocer el contenido radiactivo de la caverna
- 2) ¿Cómo divulgará la información obtenida de su proyecto?  
IV Congreso Argentino de Espeleología  
Malargüe - Abril 2012

KANTER Ricardo



Mendoza, 24 de abril de 2007

Resolución N°: 473

3) Justifique por qué necesita realizar la investigación dentro de un área protegida

**6. Descripción de las actividades a realizar en las Áreas Protegidas**

Toma de muestras de aire, agua y suelo hipogeo

**7. Metodología**

Análisis de líquidos centelleo Tri-Carb 80TR/SL

**8. Sitios de muestreo**

Circuito turístico Las Brujas

**9. Colección de material**

SI  NO

Flora  Fauna  Arqueología  Otros (especificar)

individuos  partes de individuos  muestras (especificar)

**10. Especie/s**

no

**11. Número de especies**

no

**12. Número de ejemplares por especie**

no

**13. Método de transporte y destino**

CNEA - Comisión Nacional de Energía Atómica

**14. Justificativos para la colección o captura**

dar continuidad a trabajos anteriores de la CNEA

**15. Impactos Ambientales potenciales del proyecto**

NINGUNO

**16. Resultados esperados**

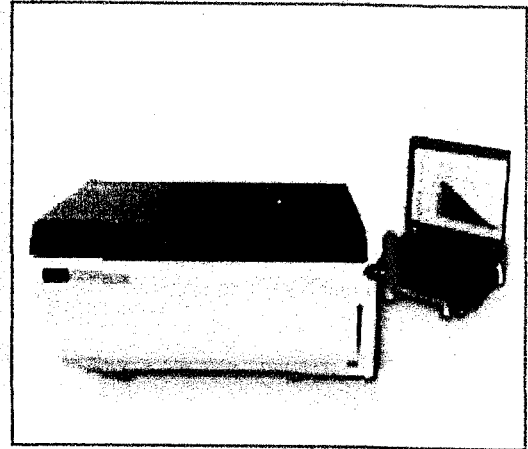
Medir el riesgo de gas radón en circuito turístico y correlacionar con movimientos sísmicos.

Ester Picardó



## Liquid Scintillation Analyzers

# Tri-Carb 3180TR/SL Low Activity Liquid Scintillation Analyzer



Tri-Carb 3180TR/SL

## Description

The Tri-Carb® 3180TR/SL is a computer-controlled benchtop liquid scintillation analyzer for detecting small amounts of alpha, beta and gamma radioactivity.

### Standard instrument features

- **Powerful computer system control on a dedicated ergonomic support arm with 2 GB (minimum) RAM and 80 GB hard disk (minimum) built-in DVD R/W and EtherNet support.**
- **Robust downloading sample changer mechanism with an electrostatic controller and a double light sealing shutter that allows the photomultiplier tube detectors to remain on for maximum stability even during sample changing.**
- **Patented TR-LSC® (Time-Resolved Liquid Scintillation Counting) is featured for high sensitivity, low background counting of LS samples. TR-LSC increases sample throughput and reduces cocktail consumption.**
- **Special proprietary "Surround TR-LSC" BGO (Bismuth Germanium Oxide) detector guard surrounds the sample in the counting chamber, enhances discrimination against background and yields the highest E<sup>2</sup>/B values available in a multipurpose liquid scintillation counting system. It is specially designed for counting extremely low activity samples in disposable glass and plastic vials.**
- **Super low level counting is available for extremely low activity beta samples, increasing system sensitivity (E<sup>2</sup>/B) to a factory test minimum of 880 for <sup>3</sup>H and 6,000 for <sup>14</sup>C.**
- **Temperature-controlled refrigeration establishes and maintains optimum counting conditions for a wide variety of sample types and assures reproducible BGO performance.**
- **Multi-parameter linear MCA (Multichannel Analyzer) with an effective resolution of 1/10 keV, offers an extended dynamic quench range and provides multi-parameter spectrum analysis to correct for luminescence, color quenching and background radiation.**
- **Live SpectraView™ Automatic spectrum display aids in optimizing counting conditions and helps evaluate complex sample situations. It allows setting temporary regions on the spectrum screen and enables the operator to monitor the effect of AEC (Automatic Efficiency Control) while the sample is counting.**

- **<sup>133</sup>Ba low energy external standard source and tSIE (transformed Spectral Index of External standard) calculations** eliminate the effects of vial glow, plastic wall and cocktail changes on the DPM results. The use of integral spectrum counts eliminates the need for repeat counting of the external standard and negates the effect of isotope half-life on quench monitoring accuracy and precision. The <sup>133</sup>Ba external standard is centered under the sample vial which eliminates the effects of volume variations and assures reproducible quench monitoring for the life of the instrument.
- **A cassette-loaded bi-directional sample conveyor mechanism** is standard with a sample capacity of either 408 standard 20 mL vials, or 720 small 4 or 7 mL vials.
- **Varisette™ sample changer** enables intermixing and counting of both large and small sample vials without special adapters. Includes both large vial (12-position) and small vial (18-position) cassettes.
- **Positive sample identification** provides protocol number, cassette number, sample number, and user-selectable printout and data file storage of the counting time and date for each sample.
- **Quick-Count sample loading** for 60 independent protocols (with unlimited assays) provides unrestricted access to sample changer and protocol selection plugs. Sample batches are processed by simply activating the Quick-Count protocol plugs, thus minimizing any user programming.
- **Anti-jam recovery** of the sample changer mechanism protects samples, vials and the counting system from damage if obstructions occur.
- **Automatic power-fail recovery** restarts counting when power is restored and the instrument has reinitialized itself.
- **Date and time clock** provides real time display and time-stamped printouts; battery supported.
- **Enhanced IPA™ (Instrument Performance Assessment) database** for monitoring efficiencies, backgrounds, E/B and Chi-square values for <sup>3</sup>H and <sup>14</sup>C over the life of the instrument. IPA flags impending problems and provides both running mean and fixed baseline charts and associated tables for retrospective quality control and proactive system maintenance. Baseline acquisition is programmable for increased flexibility. IPA data may also be transmitted to an external computer via RS-232 or saved to disk for archiving instrument performance. The most recent IPA time and date stamped data are available on demand for reporting purposes. Each IPA printout includes instrument model, serial number, software version number and calibration standard information.
- **Dynamic color-corrected single and dual label DPM** is based on tSIE with AEC. It includes DPM based on SIS, constant quench DPM, and full spectrum DPM based on spectrum unfolding. AEC corrects for differential quenching effects in multi-label samples. The low energy spectrum of the external standard ensures accurate tracking of <sup>3</sup>H, <sup>14</sup>C and other low energy sample spectra over a very wide quench range. Includes factory stored quench standards for <sup>3</sup>H and <sup>14</sup>C in classical and ULTIMA Gold™ cocktails with **On-screen editing** of quench correction curves and recording of date last modified.
- **SpectraWorks™ spectrum analysis software** for the Windows® operating system analyzes beta, alpha, and gamma spectra and provides simultaneous display for up to four spectra in stacked or overlaid mode. It features zooming to any part of the spectrum; six regions of interest; display of counts or CPM and linear or log spectra; provides automatic and manual scaling; calculates E/B, MDA, peak resolution; allows adding and subtracting of spectra and multiplication and division by constants.
- **Enhanced Direct DPM** technique determines the DPM of any single label pure beta or beta/gamma radionuclide in any cocktail without the use of quench standards.

#### Standard software features

- **QuantaSmart™ software** with comprehensive on-line context sensitive help for the Windows® XP operating system is a 32-bit operating system software that provides a robust multitasking, easy networking environment and unlimited assays in a secure multiuser environment.
- **SpectraBase counting and data management system** provides regionless counting and storing of complete spectra for all samples and standards. Features include automatic recall of spectra stored in the quench library for region-independent quench correction and postprocessing of sample data with the **Replay™** feature.
- **Enhanced Replay sample post-processing** provides complete recall and post-processing of historical count data to eliminate sample recounting. It enables changes to count conditions and reports as well as execution of user application software for optimization of data analysis.
- **Triple-Label DPM** is based on tSIE/AEC for accurate spill correction.
- **Chemiluminescence correction with response normalization** corrects for luminescence interference to speed up sample counting. Response normalization of the correction circuits eliminates the effect of component drift on the corrected results.
- **Sample worklist** enables entry, editing and review of worklists for each assay. Automatic creation of worklists is possible with the 2D barcode option, which allows sample identification with user-specified codes for sample printouts and data files.
- **Group PrioStat™ interrupt mode** gives priority counting status to a batch of samples counted according to any stored protocol conditions. It automatically restores the interrupted protocol upon completion and stores PrioStat data for immediate viewing. Data is printed at protocol termination.

- **Sample PrioStat™ interrupt mode** allows special function priority counting of individual samples, with manual control over counting conditions.
- **Heterogeneity monitor** determines sample quality and flags non-homogeneous sample results.
- **Automatic spectrum plot** (on demand) per sample allows spectral documentation of samples.
- **SIS (Spectral Index of Sample) quench indicating parameter** determines counting efficiency by analysis of sample spectrum.
- **Luminescence detection and correction** with percent luminescence is flagged on printout to alert user of possible sample problems.
- **Sample screening** allows screening numeric fields such as activity based on several criteria including background levels, a hard number or within a range of activities or values. Hits can easily be identified in reports with optional highlighting and custom hit flags.
- **Printed header** contains instrument serial number, user ID, and drive and path of all electronic stored data. Each printed page or RTF (Rich Text Format) file report is numbered and dated for GLP compliance.
- **Password protection** prevents unwanted changes to saved assays.
- **Assay-specific, user selectable, coincidence resolving time** enables optimized counting of any fast or slow, liquid or solid scintillator, for SPAs (Scintillation Proximity Assays), solid scintillation filters and the newer liquid scintillation cocktails.
- **Automatic processing of count data to final results** provides automatic, protocol specific data processing for all user applications, including commercial or user generated software. No exporting of data to off-board storage devices or computers is required.
- **Spectral unfolding** separates and displays in color the individual radionuclide spectra of dual label samples.
- **3D (three-dimensional) spectral mapping** displays in color the quench standard spectra together with the spectrum of the unknown for single label DPM counting.
- **Half-life correction to any date and time** is available for up to three radionuclides.
- **Activity reporting** is provided in Becquerels, micro-Curies, or picoCuries.
- **Independent output formatting to printer, RS-232 and disk storage** for each protocol provides almost unlimited flexibility in data reporting. Electronic data can be saved to disk in ASCII, RTF, Lotus® or Microsoft® Excel® compatible formats. Reports can be customized for data content and protocol information.
- **User-definable calculations** are available for custom data reporting.
- **Background subtraction** can be nominated via sample, entered value, or stored IPA background spectrum.
- **Programmable single photon counting** enables luminescence assay counting with optimized signal-to-background ratios. It overcomes problems associated with excessive luminescence.
- **Preset time (up to 9,999.99 minutes) and preset error coincidence termination** optimizes counting accuracy in the three counting regions.
- **Percent of standard calculations** is present for single, dual and triple label samples.
- **User adjustable assay-specific sample precount delay** permits dark adaptation of samples before counting.
- **Computer-aided diagnostics** are used to verify all system functions.
- **Decay computations** automatically calculate decay corrected DPM values for commonly used radionuclide standards.

#### Hardware options

- **Automatic 2D barcode reader** reads 2D barcodes (factory default setup) or properly sized linear bar codes placed on the vial cap. Barcode readings can be used to create the sample worklist and optionally save to a file or validate an existing worklist. Barcodes are enabled on individual assays giving the user maximum flexibility in barcode usage. Bar code configuration software program provided for custom setup.
- **Printer** (ink jet or laser jet).

#### Software options

- **Enhanced security option (ES)** provides 21 CFR part 11 compatible software that includes instrument access security, electronic data security and audit logs.
- **Alpha/beta discrimination** using automatic PDA (Pulse Decay Analysis) separates alpha and beta radionuclides including automatic and manual optimization of minimum spillover settings applied to each protocol. It includes automatic determination, display, plotting and storage of alpha-in-beta and beta-in-alpha spillover curves. It also enables further optimization or fine tuning of minimum spillover settings for each protocol and library storage of PDD (Pulse Decay Discriminator) setting for recall.

#### Accessories

- **Instrument utility cart** functionally designed general purpose laboratory cart. Supports any PerkinElmer bench-top system.
- **See the Equipment, Chemicals & Supplies section** in the PerkinElmer catalog.

## Physical data

### Dimensions:

Height:	18.5 in.	(47 cm)
Width:	40.5 in.	(103 cm)
Depth:	44 in.	(111.76 cm)

### Weight:

523 lb (238 kg)

Shipping weight: approximately 700 lb (318 kg)

### Electrical Requirements:

100-240 Vac 50/60 Hz

3-prong grounded plug

Power Consumption: <800 VA

### Environmental:

Operating ambient temperature 15–35 °C (59–90 °F)

Operating relative humidity 30%–85%

## Typical performance data

(As measured in factory at Downers Grove, Illinois)

Energy Range: 0–2,000 keV

Efficiency, Normal Count Mode:

		Minimum Acceptable
<sup>3</sup> H	0–18.6 keV	60%
<sup>14</sup> C	0–156 keV	95%

Figure of Merit (E<sup>2</sup>/B), Normal Count Mode (NCM):

<sup>3</sup> H	1–18.6 keV	400
<sup>14</sup> C	4–156 keV	1,000

Figure of Merit (E<sup>2</sup>/B), Super Low Level Count Mode:

<sup>3</sup> H	1–12.5 keV	880
<sup>14</sup> C	14.5–97.5 keV	6,000

Observed <sup>3</sup>H Performance with 11 mL H<sub>2</sub>O in 9 mL  
ULTIMA Gold LLT and Plastic Vials:

E<sup>2</sup>V<sup>2</sup>/B > 41,000

Observed <sup>14</sup>C Performance for Benzene Samples in Glass Vials  
with Pico-SL Vial Holders:

E<sup>2</sup>V<sup>2</sup>/B > 325,000

**Note:** The efficiencies, backgrounds, and E<sup>2</sup>/B values for the Normal Count Mode were determined using PerkinElmer scaled large vial glass standards set P.N. 6008500 verified with NIST standard activity. Super Low Level Count Mode Values are determined using low level scaled large glass standards P.N. 6018914 verified with NIST standard activity. No maximum is specified for background.

**Safety, Radiated Emissions and Immunity:** The Tri-Carb 3180TR/SL has been tested and approved for safety, radiated emissions and immunity according to the standards of CSA, TUV, IEC1010 and CE93.

In the U.S.A. the CSA approval satisfies the requirements of 29 CFR

PerkinElmer, Inc.  
940 Winter Street  
Waltham, MA 02451 USA  
P. (800) 762-4000 or  
(+1) 203-925-4602  
[www.perkinelmer.com](http://www.perkinelmer.com)



For a complete listing of our global offices, visit [www.perkinelmer.com/ContactUs](http://www.perkinelmer.com/ContactUs)

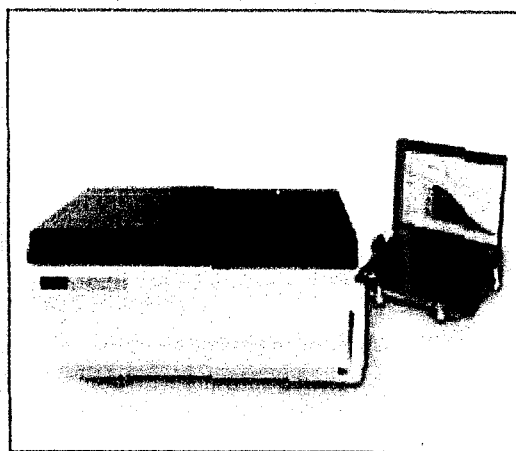
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## Liquid Scintillation Analyzers

# Tri-Carb 3110TR

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Tri-Carb 3110TR

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- **Patented TR-LSC® (Time-Resolved Liquid Scintillation Counting)** is featured for high sensitivity, low background counting of LS samples. TR-LSC increases sample throughput and reduces cocktail consumption.
- **Multi-parameter linear MCA (Multichannel Analyzer)** with an effective resolution of 1/10 keV, offers an extended dynamic quench range and provides multi-parameter spectrum analysis to correct for luminescence, color quenching and background radiation.
- **Live SpectraView™ Automatic spectrum display** aids in optimizing counting conditions and helps evaluate complex sample situations. It allows setting temporary regions on the spectrum screen and enables the operator to monitor the effect of AEC (Automatic Efficiency Control) while the sample is counting.
- **<sup>133</sup>Ba low energy external standard source and tSIE (transformed Spectral Index of External standard) calculations** eliminate the effects of vial glow, plastic wall and cocktail changes on the DPM results. The use of integral spectrum counts eliminates the need for repeat counting of the external standard and negates the effect of isotope half-life on quench monitoring accuracy and precision. The <sup>133</sup>Ba external standard is centered under the sample vial which eliminates the effects of volume variations and assures reproducible quench monitoring for the life of the instrument.
- **A cassette-loaded bi-directional sample conveyor mechanism** is standard with a sample capacity of either 408 standard 20 mL vials, or 720 small 4 or 7 mL vials.
- **Varisette™ sample changer** enables intermixing and counting of both large and small sample vials without special adapters. Includes both large vial (12-position) and small vial (18-position) cassettes.
- **Positive sample identification** provides protocol number, cassette number, sample number, and user-selectable printout and data file storage of the counting time and date for each sample.

- **Quick-Count sample loading** for 60 independent protocols (with unlimited assays) provides unrestricted access to sample changer and protocol selection plugs. Sample batches are processed by simply activating the Quick-Count protocol plugs, thus minimizing any user programming.
- **Anti-jam recovery** of the sample changer mechanism protects samples, vials and the counting system from damage if obstructions occur.
- **Automatic power-fail recovery** restarts counting when power is restored and the instrument has reinitialized itself.
- **Date and time clock** provides real time display and time-stamped printouts; battery supported.

#### Standard software features

- **QuantaSmart™ software with comprehensive on-line context sensitive help for the Windows® XP operating system** is a 32-bit operating system software that provides a robust multitasking, easy networking environment and unlimited assays in a secure multiuser environment.
- **SpectraBase counting and data management system** provides regionless counting and storing of complete spectra for all samples and standards. Features include automatic recall of spectra stored in the quench library for region-independent quench correction and post-processing of sample data with the Replay™ feature.
- **HSCM (High Sensitivity Count Mode)** increases system sensitivity by implementing additional electronic background reduction via TR-LSC. It includes assay specific, user-selectable delay before burst settings for optimization of TR-LSC. Not available with ULLCM.
- **Enhanced Replay sample post-processing** provides complete recall and post-processing of historical count data to eliminate sample recounting. It enables changes to count conditions and reports as well as execution of user application software for optimization of data analysis.
- **Enhanced IPAT™ (Instrument Performance Assessment) database** for monitoring efficiencies, backgrounds, E<sup>2</sup>/B and Chi-square values for <sup>3</sup>H and <sup>14</sup>C over the life of the instrument. IPA flags impending problems and provides both running mean and fixed baseline charts and associated tables for retrospective quality control and pro-active system maintenance. Baseline acquisition is programmable for increased flexibility. IPA data may also be transmitted to an external computer via RS-232 or saved to disk for archiving instrument performance. The most recent IPA time and date stamped data are available on demand for reporting purposes. Each IPA printout includes instrument model, serial number, software version number and calibration standard information.
- **Dynamic color-corrected single and dual label DPM** is based on tSIE with AEC. It includes DPM based on SIS, constant quench DPM, and full spectrum DPM based on spectrum unfolding. AEC corrects for differential quenching effects in multi-label samples. The low energy spectrum of the external standard ensures accurate tracking of <sup>3</sup>H, <sup>14</sup>C and other low energy sample spectra over a very wide quench range. Includes factory stored quench standards for <sup>3</sup>H and <sup>14</sup>C in classical and ULTIMA Gold™ cocktails with **On-screen editing** of quench correction curves and recording of date last modified.
- **Enhanced Direct DPM** technique determines the DPM of any single label pure beta or beta/gamma radionuclide in any cocktail without the use of quench standards.
- **Triple-Label DPM** is based on tSIE/AEC for accurate spill correction.
- **Chemiluminescence correction with response normalization** corrects for luminescence interference to speed up sample counting. Response normalization of the correction circuits eliminates the effect of component drift on the corrected results.
- **Sample worklist** enables entry, editing and review of worklists for each assay. Automatic creation of worklists is possible with the 2D barcode option, which allows sample identification with user-specified codes for sample printouts and data files.
- **Group PrioStat™ interrupt mode** gives priority counting status to a batch of samples counted according to any stored protocol conditions. It automatically restores the interrupted protocol upon completion and stores PrioStat data for immediate viewing. Data is printed at protocol termination.
- **Sample PrioStat™ interrupt mode** allows special function priority counting of individual samples, with manual control over counting conditions.
- **Heterogeneity monitor** determines sample quality and flags non-homogeneous sample results.
- **Automatic spectrum plot** (on demand) per sample allows spectral documentation of samples.
- **SIS (Spectral Index of Sample) quench indicating parameter** determines counting efficiency by analysis of sample spectrum.
- **Luminescence detection and correction** with percent luminescence is flagged on printout to alert user of possible sample problems.
- **Sample screening** allows screening numeric fields such as activity based on several criteria including background levels, a hard number or within a range of activities or values. Hits can easily be identified in reports with optional highlighting and custom hit flags.

- **Printed header** contains instrument serial number, user ID, and drive and path of all electronic stored data. Each printed page or RTF (Rich Text Format) file report is numbered and dated for GLP compliance.
- **Password protection** prevents unwanted changes to saved assays.
- **Assay-specific, user selectable, coincidence resolving time** enables optimized counting of any fast or slow, liquid or solid scintillator, for SPAs (Scintillation Proximity Assays), solid scintillation filters and the newer liquid scintillation cocktails.
- **Automatic processing of count data to final results** provides automatic, protocol specific data processing for all user applications, including commercial or user-generated software. No exporting of data to offboard storage devices or computers is required.
- **Spectral unfolding** separates and displays in color the individual radionuclide spectra of dual label samples.
- **3-D (three-dimensional) spectral mapping** displays in color the quench standard spectra together with the spectrum of the unknown for single label DPM counting.
- **Half-life correction to any date and time** is available for up to three radionuclides.
- **Activity reporting** is provided in Becquerels, micro-Curies, or picoCuries.
- **Independent output formatting to printer, RS-232 and disk storage** for each protocol provides almost unlimited flexibility in data reporting. Electronic data can be saved to disk in ASCII, RTF, Lotus® or Microsoft® Excel® compatible formats. Reports can be customized for data content and protocol information.
- **User-definable calculations** are available for custom data reporting.
- **Background subtraction** can be nominated via sample, entered value, or stored IPA background spectrum.
- **Programmable single photon counting** enables luminescence assay counting with optimized signal-to-background ratios. It overcomes problems associated with excessive luminescence.
- **Preset time (up to 9,999.99 minutes) and preset error coincidence termination** optimizes counting accuracy in the three counting regions.
- **Percent of standard calculations** is present for single, dual and triple label samples.
- **User adjustable assay-specific sample precount delay** permits dark adaptation of samples before counting.
- **Computer-aided diagnostics** are used to verify all system functions.

- **Decay computations** automatically calculate decay corrected DPM values for commonly used radionuclide standards.

#### Hardware options

- **Automatic 2D barcode reader** (factory default setup) or properly sized linear bar codes reads 2D barcodes placed on the vial cap. Barcode readings can be used to create the sample worklist and optionally save to a file or validate an existing worklist. Barcodes are enabled on individual assays giving the user maximum flexibility in barcode usage. Bar code configuration software program provided for custom setup.
- **Printer** (ink jet or laser jet).
- **Temperature-controlled refrigeration** establishes and maintains optimum counting conditions for a wide variety of sample types.

#### Software options

- **Enhanced security option (ES)** provides 21 CFR part 11 compatible software that includes instrument access security, electronic data security and audit logs.
- **ULLCM (Ultra Low Level Count Mode) option kit**, for low activity level beta samples increases system sensitivity ( $E^2/B$ ) to a factory test minimum of 500 for  $^3H$  and 1,400 for  $^{14}C$ . ULLCM may be used to provide optimal conditions in either the normal LS mode or alpha/beta mode for extra low level beta samples. Includes low level discrimination over the entire energy range of 0-2,000 keV. It includes SpectraWorks™ spectrum analysis software for the Windows® operating system and assay specific, user-selectable delay before burst settings for optimization of TR-LSC.
- **Alpha/beta discrimination** using automatic PDA (Pulse Decay Analysis) separates alpha and beta radionuclides including automatic and manual optimization of minimum spillover settings applied to each protocol. It includes automatic determination, display, plotting and storage of alpha-in-beta and beta-in-alpha spillover curves. It also enables further optimization or fine tuning of minimum spillover settings for each protocol and library storage of PDD (Pulse Decay Discriminator) setting for recall.
- **SpectraWorks™ spectrum analysis software** for the Windows® operating system analyzes beta, alpha, and gamma spectra and provides simultaneous display for up to four spectra in stacked or overlaid mode. It features zooming to any part of the spectrum; six regions of interest; display of counts or CPM and linear or log spectra; provides automatic and manual scaling; calculates  $E^2/B$ , MDA, peak resolution; allows adding and subtracting of spectra and multiplication and division by constants.

## Accessories

- **Instrument utility cart** functionally designed general purpose laboratory cart. Supports any PerkinElmer benchtop system.
- **See the Equipment, Chemicals & Supplies** section in the PerkinElmer catalog.

## Physical data

### Dimensions:

Height:	18.5 in.	(47 cm)
Width:	40.5 in.	(103 cm)
Depth:	32 in.	(81 cm)
Depth with refrigeration:	44 in.	(112 cm)

### Weight:

477 lb (217 kg)

523 lb (238 kg) with refrigeration

Shipping weight: approximately 700 lb (318 kg)

### Electrical Requirements:

100-240 Vac 50/60 Hz

3-prong grounded plug

### Power Consumption:

<200 VA; <800 VA with temperature control option

### Environmental:

Operating ambient temperature 15–35 °C (59–90 °F)

Operating relative humidity 30%–85%

## Typical performance data

(As measured in factory at Downers Grove, Illinois)

Energy Range: 0–2,000 keV

Efficiency, Normal Count Mode:

		Minimum	Acceptable
<sup>3</sup> H	0–18.6 keV	60%	
<sup>14</sup> C	0–156 keV	95%	

Figure of Merit (E<sup>2</sup>/B), Normal Count Mode (NCM):

<sup>3</sup> H	1–18.6 keV	180
<sup>14</sup> C	4–156 keV	380

Figure of Merit (E<sup>2</sup>/B), Low Activity/High Sensitivity Count Mode:

<sup>3</sup> H	1–12.5 keV	300
<sup>14</sup> C	14.5–97.5 keV	950

Figure of Merit (E<sup>2</sup>/B), Ultra Low Level Count Mode (ULLCM):

<sup>3</sup> H	1–12.5 keV	500
<sup>14</sup> C	14.5–97.5 keV	1,400

Observed Background, NCM:

		Average
<sup>3</sup> H	0–18.6 keV	17.3 CPM
<sup>14</sup> C	0–156 keV	24.3 CPM

**Note:** The efficiencies, backgrounds, and E<sup>2</sup>/B values for the Normal Count Mode were determined using PerkinElmer sealed large vial glass standards set P.N. 6008500 verified with NIST standard activity. The HSCM and ULLCM values are determined using PerkinElmer low level sealed large glass vial standards set P.N. 6018914 verified with NIST standard activity. No maximum is specified for background.

### Safety, Radiated Emissions and Immunity:

The Tri-Carb 3110TR has been tested and approved for safety, radiated emissions and immunity according to the standards of CSA, TUV, IEC1010 and CE93.

In the U.S.A. the CSA approval satisfies the requirements of 29CFR 1910.399.

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