



## Liquid Scintillation Counting Standards

Eckert & Ziegler Analytix manufactures a complete range of NIST traceable Standards for the calibration of Liquid Scintillation Counters (LSC). Our LSC Standards are calibrated in an ISO9001 certified and ISO17025 accredited laboratory using state of the art equipment, operated by experienced, professional staff.

We offer unquenched Tritium and Carbon-14 Standards and a wide

range of quenched Standards for the verification and calibration of LSC instruments from all major manufacturers.

Providing the LSC community with customized, NIST traceable, quenched LSC Standards is one of our core strengths. For counting efficiency calibration by internal standardization we provide all common nuclides in form of NIST traceable standardized solutions.



# Unquenched LSC Standard Sets

This unquenched Liquid Scintillation Counting Set of 3 Standards contains 1 Carbon-14, 1 Tritium (H-3) and 1 Background Standard.

The set is designed for establishing the optimum LSC operating settings and verify long term stability. It can be used with all common LSC instruments. Each source is calibrated, measurement uncertainty <4% (k=2).

The standards are available in 20 ml and 7 ml Argon purged, flame sealed borosilicate glass LSC vials.

## Chemical Form

C-14 or H-3 labeled toluene in toluene based scintillator, PPO/bis-MSB in scintillation grade toluene.



## Technical Data

| Product Code  | SET-H3C14-LSC-20FST<br>20 ml unquenched LSC Standard Set | SET-H3C14-LSC-7FST<br>7 ml unquenched LSC Standard Set   |
|---------------|--|--|
| Nuclides      | Carbon-14 and Tritium (H-3)                              | Carbon-14 and Tritium (H-3)                              |
| C-14 Activity | 1667 Bq (100 000 dpm) +/-10%, calibrated, NIST traceable | 1667 Bq (100 000 dpm) +/-10%, calibrated, NIST traceable |
| Active Volume | 15 ml C-14 labeled toluene in toluene based scintillator | 5 ml C-14 labeled toluene in toluene based scintillator  |
| H-3 Activity  | 4167 Bq (250 000 dpm) +/- 10%                            | 4167 Bq (250 000 dpm) +/- 10%                            |
| Active Volume | 15 ml H-3 labeled toluene in toluene based scintillator  | 5 ml H-3 labeled toluene in toluene based scintillator   |
| BKG-Standard  | Background Standard, 15ml toluene based scintillator     | Background Standard, 5ml toluene based scintillator      |

## Technical Data / Unquenched C-14/H-3 Standards for Beckman Coulter LSC

| Product Code  | LSCBC566321<br>20 ml unquenched LSC Standard Set<br>Recommended for Beckman Coulter LSC Instruments | LSCBC594946<br>7 ml unquenched LSC Standard Set<br>Recommended for Beckman Coulter LSC Instruments |
|---------------|---|--|
| Nuclides      | Carbon-14 and Tritium (H-3)   | Carbon-14 and Tritium (H-3)  |
| C-14 Activity | 1667 Bq +/-10% (100 000 dpm) calibrated, NIST traceable   | 750 Bq +/-10% (45 000 dpm) - calibrated, NIST traceable  |
| Active Volume | 15 ml C-14 labeled toluene in toluene based scintillator  | 5 ml C-14 labeled toluene in toluene based scintillator  |
| H-3 Activity  | 1667 Bq +/-10% (100 000 dpm) calibrated, NIST traceable   | 1667 Bq +/-10% (100 000 dpm) calibrated, NIST traceable  |
| Active Volume | 15ml, H-3 labeled toluene in toluene based scintillator   | 5ml H-3 labeled toluene in toluene based scintillator  |
| BKG-Standard  | Background Standard, 15ml toluene based scintillator  | Background Standard, 5ml toluene based scintillator  |

# Quenched LSC Standard Sets–Toluene

Quenched Liquid Scintillation Counting Sets contain 10 Standards. Each standard contains the same amount of radioactivity but with progressively higher levels of quenching agent nitromethane.

Toluene based LSC Standards are designed to establish counting efficiency correlation curves which are applicable to a wide range of scintillations cocktails and quenching agents. The standards are available in 20 ml and 7 ml Argon purged, flame sealed borosilicate glass LSC vials.

Each source is calibrated, measurement uncertainty <4% (k=2). The Transformed Spectral Index of the External Standard (tSIE) value is approx. 150 to 1000.



## Chemical Form

C-14 or H-3 labeled toluene in toluene based scintillator, PPO/bis-MSB in scintillation grade toluene, quenching agent nitromethane.

| Technical Data | C-14 Standards  | H-3 Standards   |
|----------------|---|---|
| Product Code   | SET-C14-LSC-20FST   | SET-H3-LSC-20FST  |
| Product        | Set of 10 quenched C-14 Standards - 20 ml vials                   | Set of 10 quenched H-3 Standards - 20 ml vials                    |
| Nuclide        | Carbon-14   | H-3 (Tritium)   |
| Activity       | 1667 Bq +/-10% (100 000 dpm) per vial, calibrated, NIST traceable | 4167 Bq +/-10% (250 000 dpm) per vial, calibrated, NIST traceable |
| Active Volume  | 15 ml C-14 labeled toluene in toluene based scintillator          | 15 ml H-3 labeled toluene in toluene based scintillator           |

|               |   |   |
|---------------|---|---|
| Product Code  | SET-C14-LSC-7FST  | SET-H3-LSC-7FST   |
| Product       | Set of 10 quenched C-14 Standards - 7 ml vials                    | Set of 10 quenched H-3 Standards - 7 ml vials                     |
| Nuclide       | Carbon-14   | H-3 (Tritium)   |
| Activity      | 1667 Bq +/-10% (100 000 dpm) per vial, calibrated, NIST traceable | 4167 Bq +/-10% (250 000 dpm) per vial, calibrated, NIST traceable |
| Active Volume | 5 ml C-14 labeled toluene in toluene based scintillator           | 5 ml H-3 labeled toluene in toluene based scintillator            |

| Technical Data | C-14 Standards for Low Level Counting                           | H-3 Standards Low Level Counting                                |
|----------------|---|---|
| Product Code   | SET-C14-LSC-20FST-LOW   | SET-H3-LSC-20FST-LOW  |
| Product        | Set of 10 quenched C-14 Standards - 20 ml vials                 | Set of 10 quenched H-3 Standards - 20 ml vials                  |
| Nuclide        | Carbon-14   | H-3 (Tritium)   |
| Activity       | 333 Bq +/-10% (20 000 dpm) per vial, calibrated, NIST traceable | 500 Bq +/-10% (30 000 dpm) per vial, calibrated, NIST traceable |
| Active Volume  | 15 ml C-14 labeled toluene in toluene based scintillator        | 15 ml H-3 labeled toluene in toluene based scintillator         |

**Technical Data**
**Quenched C-14/H-3 Standard Sets for Beckman Coulter LSC**

|                      |   |   |
|----------------------|---|---|
| <b>Product Code</b>  | <b>LSCBC566681</b>  | <b>LSCBC566680</b>  |
| <b>Product</b>       | <b>Set of 10 quenched C-14 Standards - 20 ml vials</b>            | <b>Set of 10 quenched H-3 Standards - 20 ml vials</b>             |
| <b>Nuclide</b>       | Carbon-14   | H-3 (Tritium)   |
| <b>Activity</b>      | 2500 Bq +/-10% (150 000 dpm) per vial, calibrated, NIST traceable | 8333 Bq +/-10% (500 000 dpm) per vial, calibrated, NIST traceable |
| <b>Active Volume</b> | 15 ml C-14 labeled toluene in toluene based scintillator          | 15 ml H-3 labeled toluene in toluene based scintillator           |
| <b>Product Code</b>  | <b>LSCBC566682</b>  | <b>LSCBC566683</b>  |
| <b>Product</b>       | <b>Set of 10 quenched C-14 Standards - 7 ml vials</b>             | <b>Set of 10 quenched H-3 Standards - 7 ml vials</b>              |
| <b>Nuclide</b>       | Carbon-14   | H-3 (Tritium)   |
| <b>Activity</b>      | 2250 Bq +/-10% (135000 dpm) per vial, calibrated, NIST traceable  | 8333 Bq +/-10% (500 000 dpm) per vial, calibrated, NIST traceable |
| <b>Active Volume</b> | 5 ml C-14 labeled toluene in toluene based scintillator           | 5 ml H-3 labeled toluene in toluene based scintillator            |

# Quenched Standard Sets – Ultima Gold

Quenched Liquid Scintillation Counting Sets contain 10 Standards. Each standard contains the same amount of radioactivity but with progressively higher levels of quenching agent nitromethane. These LSC Standards are designed to establish counting efficiency correlation curves which are applicable to Ultima Gold LSC cocktails. The Transformed Spectral Index of the External Standard (tSIE) value is approx. 150-650. The standards are available in 20ml and 7 ml, flame sealed borosilicate glass LSC vials.

Each source is calibrated, measurement uncertainty <4% (k=2).

## Chemical Form

C-14 labeled glucose or Tritium labeled water in Ultima Gold scintillation cocktail. Quenching agent nitromethane.

| Technical Data       | C-14 Standards   | H-3 Standards  |
|----------------------|--|--|
| <b>Product Code</b>  | <b>SET-C14-LSC-20FSUG</b>  | <b>SET-H3-LSC-20FSUG</b>   |
| <b>Product</b>       | Set of 10 quenched C-14 Standards - 20 ml vials                  | Set of 10 quenched H-3 Standards - 20 ml vials                     |
| <b>Nuclide</b>       | Carbon-14  | H-3 (Tritium)  |
| <b>Activity</b>      | 1667 Bq +/-10% (100000 dpm) per vial, calibrated, NIST traceable | 4167 Bq +/-10% (250000 dpm) per vial, calibrated, NIST traceable   |
| <b>Active Volume</b> | 15 ml C-14 labeled glucose in Ultima Gold scintillation cocktail | 15 ml Tritiated water (H-3) in Ultima Gold scintillation cocktail. |
| <b>Product Code</b>  | <b>SET-C14-LSC-7FSUG</b>   | <b>SET-H3-LSC-7FSUG</b>  |
| <b>Product</b>       | Set of 10 quenched C-14 Standards - 7 ml vials                   | Set of 10 quenched H-3 Standards - 7 ml vials                      |
| <b>Nuclide</b>       | Carbon-14  | H-3 (Tritium)  |
| <b>Activity</b>      | 1667 Bq +/-10% (100000 dpm) per vial, calibrated, NIST traceable | 4167 Bq +/-10% (250000 dpm) per vial, calibrated, NIST traceable   |
| <b>Active Volume</b> | 5 ml C-14 labeled glucose in Ultima Gold scintillation cocktail  | 5 ml Tritium labeled water in Ultima Gold scintillation cocktail.  |

## Standard Sets For Low Level Counting – Ultima Gold

| Technical Data       | C-14 Standards for Low Level Counting                            | H-3 Standards Low Level Counting                               |
|----------------------|--|--|
| <b>Product Code</b>  | <b>SET-C14-LSC-20FSUG-LOW</b>                                    | <b>SET-H3-LSC-20FSUG-LOW</b>                                   |
| <b>Product</b>       | Set of 10 quenched C-14 Standards - 20 ml vials                  | Set of 10 quenched H-3 Standards - 20 ml vials                 |
| <b>Nuclide</b>       | Carbon-14  | H-3 (Tritium)  |
| <b>Activity</b>      | 333 Bq +/-10% (20000 dpm) per vial, calibrated, NIST traceable   | 500 Bq +/-10% (30000 dpm) per vial, calibrated, NIST traceable |
| <b>Active Volume</b> | 15 ml C-14 labeled glucose in Ultima Gold scintillation cocktail | 15 ml Tritium labeled water in Ultima Gold based scintillator  |

## LSC Alpha/Beta Standard Set – Ultima Gold AB

This quenched Liquid Scintillation Counting Set of 3 Standards contains 1 Americium-241, 1 Chlorine-36 and 1 Background Standard. The set is used to optimize the pulse discrimination parameter for alpha/beta separation. The standards are available in 20 ml, flame sealed borosilicate glass LSC vials.

### Technical Data      Alpha/Beta LSC Standard Set

|                  |   |
|------------------|---|
| Product Code     | SET-AM1CL6-LSC-20FSUGAB   |
| Am-241/Cl-36/BKG | Alpha/Beta Standard Set - 20 ml vials                             |
| Nuclide          | Am-241  |
| Am-241 Activity  | 1667 Bq +/-10% (100 000 dpm) per vial, calibrated, NIST traceable |
| Active Volume    | 15 ml   |
| Vial Type        | 20 ml flame sealed borosilicate glass ampoule                     |
| Chemical Form    | Americium Chloride in Ultima Gold AB scintillation cocktail.      |
| Nuclide          | Cl-36   |
| Cl-36 Activity   | 1667 Bq +/-10% (100 000 dpm) per vial, calibrated, NIST traceable |
| Active Volume    | 15 ml   |
| Vial Type        | 20 ml flame sealed borosilicate glass ampoule                     |
| Chemical Form    | Sodium Chloride in Ultima Gold AB scintillation cocktail          |
| BKG-Standard     | Background Standard   |
| Volume           | 15 ml   |
| Vial Type        | 20 ml flame sealed borosilicate glass ampoule                     |
| Chemical Form    | Ultima Gold AB scintillation cocktail                             |



# Single LSC Standards

Unquenched LSC Standards in flame sealed borosilicate glass ampoules.

All standards are calibrated, NIST traceable, measurement uncertainty <4% (k=2). Customized standards are available on request.

| Nuclide | Product Code         | Activity        | DPM     | Vial  | Active Volume | Chemical Form        |
|---------|----------------------|-----------------|---------|-------|---------------|----------------------|
| C-14    | C14-LSC-20FST-666BQ  | 666 Bq +/- 10%  | 40 000  | 20 ml | 15 ml         | C-14 labeled toluene |
| C-14    | C14-LSC-20FST-1666BQ | 1667 Bq +/- 10% | 100 000 | 20 ml | 15 ml         | C-14 labeled toluene |
| C-14    | C14-LSC-7FST-666BQ   | 666 Bq +/- 10%  | 40 000  | 7 ml  | 5 ml          | C-14 labeled toluene |
| C-14    | C14-LSC-7FST-1666BQ  | 1667 Bq +/- 10% | 100 000 | 7 ml  | 5 ml          | C-14 labeled toluene |

| Nuclide | Product Code        | Activity        | DPM     | Vial  | Active Volume | Chemical Form           |
|---------|---------------------|-----------------|---------|-------|---------------|-------------------------|
| H-3     | H3-LSC-20FST-1333BQ | 1333 Bq +/- 10% | 80 000  | 20 ml | 15 ml         | Tritium labeled toluene |
| H-3     | H3-LSC-20FST-1666BQ | 1667 Bq +/- 10% | 100 000 | 20 ml | 15 ml         | Tritium labeled toluene |
| H-3     | H3-LSC-7FST-1666BQ  | 1667 Bq +/- 10% | 100 000 | 7 ml  | 5 ml          | Tritium labeled toluene |
| H-3     | H3-LSC-20FST-4167BQ | 4167 Bq +/- 10% | 250 000 | 20 ml | 15 ml         | Tritium labeled toluene |
| H-3     | H3-LSC-7FST-4167BQ  | 4167 Bq +/- 10% | 250 000 | 7 ml  | 5 ml          | Tritium labeled toluene |



The vial caps are color-coded and laser engraved.

The engraving includes:

- Product code
- Nuclide
- Measured activity in Bq and DPM
- Reference date
- Expiration date
- Serial number
- Radioactive labeling

## Quenched single LSC Standards – Ultima Gold cocktail in flame sealed borosilicate glass ampoules, Argon purged.

All standards are calibrated, NIST traceable, measurement uncertainty <4% (k=2). The tSIE quench value is approx.750.

| Nuclide | Product Code          | Activity        | DPM     | Vial  | Active Volume | Chemical Form      |
|---------|-----------------------|-----------------|---------|-------|---------------|--------------------|
| Am-241  | AM1-LSC-20FSUG-1666BQ | 1667 Bq +/- 10% | 100 000 | 20 ml | 15 ml         | Americium Chloride |
| Am-241  | AM1-LSC-7FSLUG-1666BQ | 1667 Bq +/- 10% | 100 000 | 7 ml  | 5 ml          | Americium Chloride |

| Nuclide | Product Code           | Activity        | DPM     | Vial  | Active Volume | Chemical Form        |
|---------|------------------------|-----------------|---------|-------|---------------|----------------------|
| C-14    | C14-LSC-20FSLUG-333BQ  | 333 Bq +/- 10%  | 20 000  | 20 ml | 15 ml         | C-14 labeled glucose |
| C-14    | C14-LSC-20FSLUG-1666BQ | 1667 Bq +/- 10% | 100 000 | 20 ml | 15 ml         | C-14 labeled glucose |
| C-14    | C14-LSC-7FSLUG-1666BQ  | 1667 Bq +/- 10% | 100 000 | 7 ml  | 5 ml          | C-14 labeled glucose |

| Nuclide | Product Code          | Activity        | DPM     | Vial  | Active Volume | Chemical Form   |
|---------|-----------------------|-----------------|---------|-------|---------------|-----------------|
| Cl-36   | CL6-LSC-20FSUG-1666BQ | 1667 Bq +/- 10% | 100 000 | 20 ml | 15 ml         | Sodium Chloride |
| Cl-36   | CL6-LSC-7FSUG-1666BQ  | 1667 Bq +/- 10% | 100 000 | 7 ml  | 5 ml          | Sodium Chloride |

| Nuclide | Product Code         | Activity        | DPM     | Vial  | Active Volume | Chemical Form         |
|---------|----------------------|-----------------|---------|-------|---------------|-----------------------|
| H-3     | H3-LSC-20FSUG-500BQ  | 500 Bq +/- 10%  | 30 000  | 20 ml | 15 ml         | Tritium labeled water |
| H-3     | H3-LSC-20FSUG-1666BQ | 1667 Bq +/- 10% | 100 000 | 20 ml | 15 ml         | Tritium labeled water |
| H-3     | H3-LSC-7FSUG-1666BQ  | 1667 Bq +/- 10% | 100 000 | 7 ml  | 5 ml          | Tritium labeled water |

| Nuclide | Product Code          | Activity        | DPM     | Vial  | Active Volume | Chemical Form   |
|---------|-----------------------|-----------------|---------|-------|---------------|-----------------|
| Ni-63   | NI3-LSC-20FSUG-1666BQ | 1667 Bq +/- 10% | 100 000 | 20 ml | 15 ml         | Nickel Chloride |
| Ni-63   | NI3-LSC-7FSUG-1666BQ  | 1667 Bq +/- 10% | 100 000 | 7 ml  | 5 ml          | Nickel Chloride |

| Nuclide | Product Code          | Activity        | DPM     | Vial  | Active Volume | Chemical Form      |
|---------|-----------------------|-----------------|---------|-------|---------------|--------------------|
| Sr-90   | SR0-LSC-20FSUG-1666BQ | 1667 Bq +/- 10% | 100 000 | 20 ml | 15 ml         | Strontium Chloride |
| Sr-90   | SR0-LSC-7FSUG-1666BQ  | 1667 Bq +/- 10% | 100 000 | 7 ml  | 5 ml          | Strontium Chloride |



# Internal standards for LSC counting efficiency calibration

Eckert & Ziegler Analytics offers a wide range of NIST traceable, calibrated solutions for the determination of the counting efficiency by internal standardization. They are provided in a 10 ml flame sealed glass ampoule with an active volume of 10 ml. Customized solutions are available on request. Activity tolerance +/-20%.

| Nuclide       | Product Code       | Activity Conc. [kBq/g] | Total Activity [kBq] | Activity Conc. [DPM/g] | Measurement Uncertainty (k=2) | Chemical Form  |
|---------------|--------------------|------------------------|----------------------|------------------------|-------------------------------|--|
| H-3 (Tritium) | 8003-10FSAH-400KBQ | 40                     | 400                  | $2.4 \times 10^6$      | <3.5%                         | Tritium labeled water  |
| H-3 (Tritium) | 8003-10FSAT-400KBQ | 40                     | 400                  | $2.4 \times 10^6$      | <3.5%                         | Tritium labeled Toluene  |
| C-14          | 8014-10FSAT-100KBQ | 10                     | 100                  | $6 \times 10^5$        | <4%                           | C-14 labeled Toluene   |
| C-14          | 8014-10FSAG-100KBQ | 10                     | 100                  | $6 \times 10^5$        | <4%                           | C-14 labeled glucose (50µg/g) + formaldehyde (1µg/g) in H <sub>2</sub> O         |
| C-14          | 8014-10FSAC-100KBQ | 10                     | 100                  | $6 \times 10^5$        | <4%                           | Na <sub>2</sub> CO <sub>3</sub> in 0.001M NaOH, 30µg/g C                         |
| Am-241        | 8241-10FSA-100KBQ  | 10                     | 100                  | $6 \times 10^5$        | <2%                           | Americium Chloride in 1M HCl, no carrier added                                   |
| Ca-45         | 8045-10FSA-100KBQ  | 10                     | 100                  | $6 \times 10^5$        | <6%                           | Calcium Chloride in 0.1 M HCl, 30 µg/g Ca  |
| Cd-109        | 8109-10FSA-100KBQ  | 10                     | 100                  | $6 \times 10^5$        | <2%                           | Cadmium Chloride in 0.1 M HCl, 30 µg/g Cd  |
| Cl-36         | 8036-10FSA-100KBQ  | 10                     | 100                  | $6 \times 10^5$        | <4%                           | Sodium Chloride in 0.0005M NaOH, 30 µg/g Cl                                      |
| Co-60         | 8060-10FSA-100KBQ  | 10                     | 100                  | $6 \times 10^5$        | <1.5%                         | Cobalt Chloride in 0.1 M HCl, 30 µg/g Co   |
| Cr-51         | 8051-10FSA-100KBQ  | 10                     | 100                  | $6 \times 10^5$        | <2%                           | Chromium Chloride in 0.1 M HCl, 30 µg/g Cr                                       |
| Cs-137        | 8137-10FSA-100KBQ  | 10                     | 100                  | $6 \times 10^5$        | <2%                           | Cesium Chloride in 0.1 M HCl, 30 µg/g Cs   |
| Fe-55         | 8055-10FSA-100KBQ  | 10                     | 100                  | $6 \times 10^5$        | <4%                           | Ferric Chloride in 0.1 M HCl, 30 µg/g Fe   |
| I-125         | 8125-10FSA-100KBQ  | 10                     | 100                  | $6 \times 10^5$        | <3.5%                         | Sodium Iodide in 0.1 M NaOH + 0.006M Na <sub>2</sub> SO <sub>3</sub> , 30 µg/g I |
| I-129         | 8129-10FSA-100KBQ  | 10                     | 100                  | $6 \times 10^5$        | <3.5%                         | Sodium Iodide in 0.1 M NaOH + 0.006M Na <sub>2</sub> SO <sub>3</sub> , 30 µg/g I |
| Ni-63         | 8063-10FSA-100KBQ  | 10                     | 100                  | $6 \times 10^5$        | <3%                           | Nickel Chloride in 0.1 M HCl, 30 µg/g Ni   |
| S-35          | 8035-10FSA-100KBQ  | 10                     | 100                  | $6 \times 10^5$        | <3.5%                         | Sodium Sulfate in H <sub>2</sub> O, 30 µg/g S                                    |
| Sr-90         | 8090-10FSA-100KBQ  | 10                     | 100                  | $6 \times 10^5$        | <2%                           | Strontium Chloride in 0.1 M HCl, 30 µg/g Sr + 30 µg/g Y                          |
| Tc-99         | 8099-10FSA-100KBQ  | 10                     | 100                  | $6 \times 10^5$        | <3%                           | Sodium pertechnetate in 0.001M NaOH, no carrier added                            |

# Low-Background (dead) Water

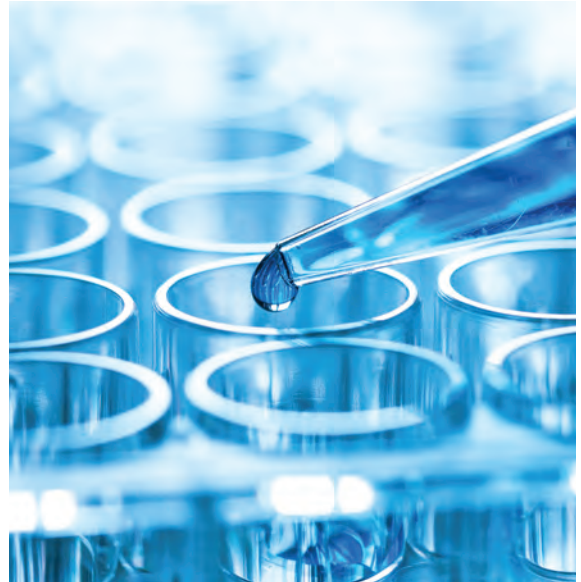
This freshwater is collected from an artesian well that is screened at a depth of >100 m below the water table. Based upon hydraulic conductivity this water has not been in contact with the atmosphere for several thousand years and should therefore contain undetectable amounts of tritium. Analysis of this water by the University of Miami Tritium Laboratory indicates that the tritium levels are below their detection limit (< 0.1 TU). This water is suitable for use as analytical instrument, field and equipment blanks. The water will be delivered in 1 liter polyethylene bottles. A copy of the batch analysis will be provided.

**Product Code: BGW-1LB**

1 Liter Low-Background Water

Tritium (H-3) activity less than 0.006 Bq/kg (6 pBq/g)

Batch Analysis Certificate provided

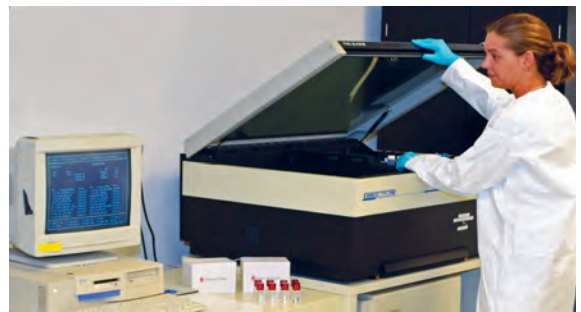


# Customized LSC standards and calibrated solutions

Eckert & Ziegler Analytics provides customized, NIST traceable LSC Standards for most applications. Please contact us with your requirements.

**We will need the following information for a quotation:**

- Set of sources or single standard
- Nuclide(s)
- Activity per nuclide
- Scintillation cocktail
- Active volume
- Vial type (volume)
- Quench tSIE value/range



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