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**Climate Action Reserve (CAR)**
**Argentina Livestock Protocol | Stakeholder Feedback**

This comment is intended to recommend the use of the carbon-14 testing method to determine the share of biogenic carbon content of biogas and subsequent fuels and emissions under this carbon credit protocol. Biogenic content measurements following methods such as ASTM D6866 Method B currently provide critical value to prominent clean fuel standard programs around the world for biogas, notably including the US Renewable Fuels Standard (RFS) and EU Renewable Energy Directive (RED) programs.

Included here you will find:



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## Recommendations for CAR's Argentina Livestock Protocol

Our recommendation is that CAR's Argentina Livestock Protocol should include direct biogenic content testing requirements following the ASTM D6866 Method B standard for any biogas seeking recognition of renewable (biogenic) content. Routine biogenic testing requirements currently play a critical role in the regulation of biogas upgraded to renewable natural gas (RNG) or biomethane fuels under the United States Renewable Fuels Standard (RFS) and the European Union's Renewable Energy Directive (RED), and biogas combusted for electricity production under the US Greenhouse Gas Reporting Program (GHGRP), Canada's Greenhouse Gas Reporting Program (GHGRP) and the EU Emissions Trading System (ETS).

While this protocol's GHG Assessment Boundary currently excludes biogenic CO2 emissions, it is impractical to exclude biogenic content from the protocol because of the sources, sinks and reservoirs (SSR)s which are included. It will specifically be critical to quantify biogenic content for SSR 11 on the use of biogas for upgrading to renewable natural gas (RNG) or biomethane fuels, SSR 13 on injection into

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pipelines or other end uses, and for SSR 10 on the use of biogas for electricity generation to require routine testing to verify biogenic content.

Introducing testing requirements to the protocol would bring this program in line with leading clean fuel programs' treatment of biogenic content in biogas, most significantly the US Renewable Fuels Standard (RFS) and EU Renewable Energy Directive (RED) programs. While Argentina does not have a national clean fuel standard in place yet, these programs have had decades of experience to develop best practices for crediting clean fuels production and use. Even further, if producers want to export fuels produced from biogas under this protocol to markets in the US or EU this documentation will be expected, and is very difficult to check retroactively. As an international certification body it is in Climate Action Reserve's best interest to meet the standard established by the US RFS and EU RED.

The US introduced biogenic testing requirements for fuels produced from biogas in the 2023 Set Rule update to the US Renewable Fuel Standard (RFS), in a section called the Biogas Regulatory Reform Rule (BRRR).[1] This update requires routine biogenic testing for any biogas or RNG fuels seeking to generate RINs under the RFS. Starting on July 1st, 2024 for new facilities and January 1st, 2025 for existing facilities, fuels produced from biogas will need to submit biogenic test results of the biogas at the point of production from the digester/landfill, at the point of upgrading, and after upgrading prior to pipeline injection. By testing the initial feedstock at the anaerobic digester (SSR 5), the biogas derived fuel at the point of upgrading (SSR 11) and the final blended fuel (SSR 13), there is a clear demonstration of biogenic content from the raw biogas from these livestock operations to the final energy product.

The EU introduced biogenic testing requirements for fuels produced from biogas in a June 2023 update to the EU Renewable Energy Directive (RED) titled, "Renewable energy- method for calculating the share of renewables in the case of co-processing."[2] This update was specifically issued in response to the discovery of a major case of fraud within the RED program stemming from biodiesel submissions from China which were approved by mass balance calculations.[3] The EU investigation into this issue is still ongoing, and the full extent of the damage is not yet known, but this was a significant setback for the program and quickly plummeted biodiesel prices in the EU. The EU tied biogas and biomethane into the update in order to address these concerns for any fuels containing a mixture of biogenic and fossil content.

The advantage of this framework is that the EU was able to continue to accept calculation based methodologies like mass and energy balance by requiring routine direct biogenic testing to validate the data. However, calculation based approaches are much more common for co-processing, where all

[1] 2023. "40 CFR Parts 80 and 1090– Renewable Fuel Standard (RFS) Program: Standards for 2023–2025 and Other Changes." *EPA*
[2] 2023. "Renewable energy- method for calculating the share of renewables in the case of co-processing." *European Commission*
[3] 2023. "ISCC Press Release July 27, 2023." *International Sustainability & Carbon Certification*

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inputs and outputs are concentrated in a single facility, as opposed to biomethane and RNG which are often produced, upgraded and blended at multiple facilities.

The US RFS model of testing at the point of production, at the point of blending with non-renewable components and at the point of injection into a pipeline provides a comprehensive chain of custody for the renewable content in these fuels, making it possible to report and trade only real biogenic content introduced to the grid. Similarly, the EU RED model demonstrates that tying calculation-based accounting approaches to routine direct testing requirements is the most secure way to access the benefits of a book-and-claim system without exposing the program to undue risk.

Introducing biogenic testing requirements to the protocol for biogas combustion used in electricity production would also bring this program in line with leading emissions reporting programs, including the US Greenhouse Gas Reporting Program (GHGRP), Canada's Greenhouse Gas Reporting Program (GHGRP), and the EU's Emissions Trading System (ETS). All of these programs require routine testing to verify the renewable portion of the electricity produced.

The US EPA's GHGRP is especially important to consider because it has successfully required mandatory quarterly testing and reporting of biogenic content using ASTM D6866 for over 12 years.[4] We also recommend reviewing the EPA's recent Standards for Greenhouse Gas Emissions from Fossil Fuel-Fired Electric Generating Units which applies the biogenic testing requirements of the GHGRP to facilities using biomass co-firing to decarbonize their electricity production.[5] Canada's GHGRP specifically requires quarterly testing following ASTM D6866 for electricity produced from renewable gaseous fuels derived from biogas.[6]

Similarly to its recent update establishing testing requirements to the RED, the EU has since introduced corresponding changes to their Emissions Trading System (ETS)'s Monitoring and Reporting Regulation which would require direct testing to verify any calculation-based reporting. This update is particularly relevant to consider for this protocol because it specifically states that direct testing verification is being added in order, "to avoid systematic underestimation of the total emissions in the mass balance system.[7]

Since this protocol's GHG Assessment Boundary includes the step from the anaerobic digester (SSR 5) to fuel upgrading (SSR 11) or electricity generation (SSR 10), biogenic content is necessary to include. Biogenic content measurements are the only reliable way to establish the renewable portion of

[4] 2016. "40 CFR Part 98 Subpart C– General Stationary Fuel Combustion Sources." *National Archives Code of Federal Regulations*
[5]2024. "40 CFR Part 60- New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units" *Environmental Protection Agency*
[6] 2020. "Canada's Greenhouse Gas Quantification Requirements." *Environment and Climate Change Canada*
[7] 2024. "Amending Implementing Regulation (EU) 2018/2066 as regards updating the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council." *European Commission*

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RNG/biomethane fuels and electricity produced from biogas combustion. Also, it is important to align this portion of the protocol with key regulatory requirements for biogas to have success in the market, including biogenic content measurements. This would create the most value for CAR's credits downstream, and would prepare biogas generated under the protocol for a smooth transition into use as fuels or electricity.

It is critically important that this program introduce biogenic content quantification through direct testing, rather than allow calculation based approaches such as mass balance, which make claims based on material inputs in production. These calculations allow producers to assume that all of their biomass inputs end up in their facilities' outputs, despite it being well understood in the industry that the input of renewable feedstocks is not the same as the output. Renewable feedstocks will often have different activity than their fossil counterparts and won't necessarily produce the same quantity of outputs.[8] By basing their calculations solely on production inputs rather than outputs these methods systematically over-report the renewable share of fuels.

This very important to consider for any protocol certifying biogas which is then upgraded to fuels or combusted for electricity production because biogas is often blended with non-renewable content in the process of biomethane/RNG production and is often co-fired with fossil fuels or coal when combusted for electricity production. If this protocol relies exclusively on calculations to determine the biogenic content of these blended fuels and co-generated electricity, producers will be able to intentionally claim credits for fossil content used in these energy products. The only reliable way to attribute credits exclusively to the biogenic content derived from biogas is through routine direct testing at the point of production, the point of blending with non-renewable content, and the point of pipeline injection or combustion.

Calculation-based approaches such as book and claim also allow producers to use a system of free allocation, meaning they do not have to guarantee that there is any renewable content in a given output. Producers prefer this because if 10% of their feedstocks are biogenic they can claim that 10% of their outputs are biogenic, even if that's not the case because biogenic content can go in different amounts to different end products. As a result, book and claim systems allow producers to claim that 10% of their outputs are 100% biogenic and the rest are 0%, even if all of the products should be 10% biogenic based on calculations (and would likely C14 test below that).[9] This allows producers to intentionally claim unfounded renewable content in the products which can maximize their incentives, without providing the decarbonization benefits those incentives are meant to promote. In the case of this protocol, this could mean that producers would be able to claim that 100% of their electricity generation is eligible to

[8] 2006. "Determining the modern carbon content of biobased products using radiocarbon analysis." *Bioresource Technology*, 97(16), 2084-2090.
[9] 2024. "The Mass Balance Approach." *International Sustainability & Carbon Certification*

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claim credits, even if much of the biogenic content from their biogas is used elsewhere and does not directly contribute to electricity generation.
We encourage CAR to review the recent mass balance fraud challenges faced by the EU Renewable Energy Directive (RED) program as an example of this risk.[10] In July 2023 the program discovered rampant fraudulent biodiesel submissions from China, which had been certified by ISCC mass balance. The discovery quickly "caused a dramatic fall in biodiesel prices in European markets."[11] In response to this situation the EU quickly updated the RED's rules to uniformly require routine direct testing, including for producers choosing calculation based approaches to verify their calculations.[12]

Routine testing requirements are a critical part of the verification process and should be used to verify the renewable content of biogas produced under this protocol and upgraded to fuel or combusted for electricity generation. Introducing testing requirements for biogas and biogas derived fuels is in line with the treatment of these fuels under the US Renewable Fuel Standard (RFS) and the EU Renewable Energy Directive.[13] Introducing testing requirements for biogas combustion for electricity production is also in line with the US Greenhouse Gas Reporting Program (GHGRP), Canada's Greenhouse Gas Reporting Program (GHGRP) and the EU Emissions Trading System (ETS).

**What is Biogenic Testing (Carbon-14)?**

Carbon-14 analysis is a reliable method used to distinguish the percentage of biobased carbon content in a given material. The radioactive isotope carbon-14 is present in all living organisms and recently expired material, whereas any fossil-based material that is more than 50,000 years old does not contain any carbon-14 content. Since Carbon-14 is radioactive, the amount of carbon-14 present in a given sample begins to gradually decay after the death of an organism until there is no carbon-14 left. Therefore, a radiocarbon dating laboratory can use carbon-14 analysis to quantify the carbon-14 content present in a sample, determining whether the sample is biomass-based, fossil fuel-derived, or a combination.

The analysis is based on standards such as ASTM D6866 and its international equivalents developed for specific end uses, such as ISO 21644. ASTM D6866 is an international standard developed for measuring the biobased carbon content of solid, liquid, and gaseous samples using radiocarbon dating.[14] There are also many specific international standards based on the use of direct Carbon-14 testing, such as ISO 21644, which is a European standard developed for measuring the biogenic carbon content of waste derived fuels as a fraction of total carbon content.[15]

[10] 2023. "ISCC Press Release July 27, 2023." *International Sustainability & Carbon Certification*
[11] 2023. "ISCC Press Release July 27, 2023." *International Sustainability & Carbon Certification*
[12] 2023. "Renewable energy- method for calculating the share of renewables in the case of co-processing." *European Commission*
[13] 2010. "40 CFR Part 80 Subpart M– Renewable Fuel Standard." *National Archives Code of Federal Regulations*
[14] 2021. "Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis." *ASTM International (D6866-21)*
[15] 2021. "ISO 21644:2021 Solid recovered fuels: Methods for the determination of biomass content." *International Standardization Organization*

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Carbon-14 analysis yields a result reported as % biobased carbon content. If the result is 100% biobased carbon, this indicates that the sample tested is completely sourced from biomass material such as plant or animal byproducts. A result of 0% biobased carbon means a sample is only fossil fuel-derived. A sample that is a mix of both biomass sources and fossil fuel sources will yield a result that ranges between 0% and 100% biobased carbon content. Carbon-14 testing has been incorporated into several regulations as the recommended or required method to quantify the biobased content of a given material.

**ASTM D6866 Method B - The Most Reliable Method**

Carbon-14 is a very well-established method which has been in use by many industries (including the fossil fuel industry) and academic researchers for several decades.

Carbon-14 measurements done by commercial third party testing is robust, consistent, and with quantifiable accuracy/precision of the carbon-14 amount under **ASTM D6866 method B**. The EN 16785 is the only standard that allows a variant of the Mass Balance (MB) method of 'carbon counting' under EN 16785-2. The EN 16785-1 requires that the biocarbon fraction be determined by the carbon-14 method. However, when incorporating this EN 16785 method, certification schemes like the "Single European Bio-based Content Certification" **only** allow the use of EN 16785-1 due to its reliability and the value of a third-party certification. http://www.biobasedcontent.eu/en/about-us/

In ASTM D6866 method B, the carbon-14 result is provided as a single numerical result of carbon-14 activity, with graphical representation that is easily understood by regulators, policy makers, corporate officers, and more importantly, the public. The overwhelming advantage of carbon-14 is that it is an independent and standardized laboratory measurement of any carbon containing substance that produces highly accurate and precise values. In that regard, it can stand alone as a quantitative indicator of the presence of biobased vs. petroleum feedstocks. When carbon-14 test results are challenged, samples can be rapidly remeasured to verify the original reported values (unlike mass balance).

The quantification of the biobased content of a given product can be as low as 0.1% to 0.5% (1 relative standard deviation – RSD) based on Instrumental error for Method B (AMS). This error is exclusive of indeterminate sources of error in the origin of the biobased content, and manufacturing processes. As such a total error of +/-3% (absolute) has been assigned to the reported Biobased Content to account for determinate and indeterminate factors.[16]

[16]2021. Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis. *ASTM International (D6866-21).* pp 1-19. doi: 10.1520/D6866-21.

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It is also important that the program should always require ASTM D6866 Method B, rather than allow Method C for any use. Where ASTM D6866 Method B uses the AMS Instrument to measure $^{14}C$, Method C uses Liquid Scintillation Counting (LSC). In Method B, the AMS Instrument directly measures the $^{14}C$ isotopes. However, in Method C, scintillation molecules indirectly absorb the beta molecules that release with the decay of $^{14}C$ and convert the energy into photons which are measured proportionally to the amount of $^{14}C$ in the sample. Since Method B directly measures the $^{14}C$ isotopes and Method C measures them indirectly, Method B is significantly more precise and should be prioritized in regulations.[17] LSC measurements, like those used in Method C, are commonly used as an internal testing tool when samples are limited and accuracy does not need to be extremely high.

**About Beta Analytic**

Beta Analytic was among the originators of the use of Accelerator Mass Spectrometry (AMS) for the ASTM D6866 biobased / biogenic testing standard using Carbon-14 to distinguish renewable carbon sources from petroleum sources. Beta began testing renewable content in 2003 at the request of United States Department of Agriculture (USDA) representatives who were interested in Beta's Carbon-14 capabilities for their BioPreferred® Program (www.biopreferred.gov). At their request, Beta joined ASTM under subcommittee D20.96. Beta's previous president, Darden Hood, was positioned as a technical contact for the USDA and within 3 months completed the ASTM D6866-04 standard. The Carbon-14 technique is now standardized in a host of international standards including ASTM D6866, CEN 16137, EN 16640, ISO 16620, ISO 19984, BS EN ISO 21644:2021, ISO 13833 and EN 16785. Carbon-14 analysis can be used on various types of samples (gas, liquids and solids). Beta Analytic continues to be a technical contact for ASTM D6866 with current president Ron Hatfield and is involved with all their latest ASTM D6866 versions.

The Carbon-14 standardized method is also incorporated in a variety of regulatory programs including the California AB32 program, US EPA GHG Protocol, US EPA Renewable Fuels Standard, United Nations Carbon Development Mechanism, Western Climate Initiative, Climate Registry's Greenhouse Gas Reporting Protocol and EU Emissions Trading Scheme.

We are currently technical experts on Carbon-14 in the following committees:

ASTM D6866 (D20.96) Plastics and Biobased Products (Technical Advisor)
ASTM (D02.04) Petroleum Products, Liquid Fuels and Lubricants (Technical Advisor)
ASTM (061) US TAG to ISO/TC 61 Plastics (Technical Expert)
USDA BioPreferred Program TAC (Technical Advisor)
ISO/TC 61/SC14/WG1 Terminology, classifications, and general guidance (Technical Expert)

[17]2022. "Testing the methods for determination of radiocarbon content in liquid fuels in the Gliwice Radiocarbon and Mass Spectrometry Laboratory." *Radiocarbon*

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CEN/TC 411 Biobased Products
CEN/TC 411/WG 3 Biobased content
CEN/TC 61/SC 14/WG 1 Terminology, classifications, and general guidance (Technical Expert)

**ISO/IEC 17025:2017 Accredited Laboratory**

To ensure the highest level of quality, laboratories performing ASTM D6866 testing should be ISO/IEC 17025:2017 accredited or higher. This accreditation is unbiased, third party awarded and supervised. It is unique to laboratories that not only have a quality management program conformant to the ISO 9001:2008 standard, but more importantly, have demonstrated to an outside third-party laboratory accreditation body that Beta Analytic has the technical competency necessary to consistently deliver technically valid test results. The ISO 17025 accreditation is specifically for natural level radiocarbon activity measurements including biobased analysis of consumer products and fuels, and for radiocarbon dating.

**Required tracer-free facility for Carbon-14**

For carbon-14 measurement to work, be accurate, and repeatable, the facility needs to be a tracer-free facility, which means artificial/labeled carbon-14 is not and has never been handled in that lab. Facilities that handle artificial carbon-14 use enormous levels relative to natural levels and it becomes ubiquitous in the facility and cross contamination within the facility, equipment and chemistry lines is unavoidable. Results from a facility that handles artificial carbon-14 would show elevated renewable contents (higher pMC, % Biobased / Biogenic values), making those results invalid. Because of this, Federal contracts and agency programs (such as the USDA BioPreferred Program) require that AMS laboratories must be 14C tracer-free facilities in order to be considered for participation in solicitations.

To learn more about the risks associated with testing natural levels Carbon-14 samples in a facility handling artificially enhanced isotopes please see the additional information provided after this comment.

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2024. "The Mass Balance Approach." *International Sustainability & Carbon Certification* https://www.iscc-system.org/certification/chain-of-custody/mass-balance/

# Demand a Tracer-Free Laboratory for Radiocarbon Dating

As part of its commitment to provide high-quality results to its clients, ISO/IEC 17025-accredited Beta Analytic does not accept pharmaceutical samples with "tracer Carbon-14" or any other material containing artificial Carbon-14 (14C) to eliminate the risk of cross-contamination. Moreover, the lab does not engage in "satellite dating" – the practice of preparing individual sample graphite in a remote chemistry lab and then subcontracting an AMS facility for the result.

## High Risk of Cross-Contamination

Pharmaceutical companies evaluate drug metabolism by using a radiolabeled version of the drug under investigation. AMS biomedical laboratories use 14C as a tracer because it can easily substitute 12C atoms in the drug molecule, and it is relatively safe to handle. Tracer 14C is a well-known transmittable contaminant to radiocarbon samples, both within the AMS equipment and within the chemistry lab.

Since the artificial 14C used in these studies is phenomenally high (enormous) relative to natural levels, once used in an AMS laboratory it becomes ubiquitous. Cross-contamination within the AMS and the chemistry lines cannot be avoided. Although the levels of contamination are acceptable in a biomedical AMS facility, it is not acceptable in a radiocarbon dating facility.

Biomedical AMS facilities routinely measure tracer-level, labeled (Hot) 14C samples that are hundreds to tens of thousands of times above the natural 14C levels found in archaeological, geological, and hydrological samples. Because the 14C content from the biomedical samples is so high, even sharing personnel will pose a contamination risk; "Persons from hot labs should not enter the natural labs and vice versa" (Zermeño et al. 2004, pg. 294). These two operations should be absolutely separate. Sharing personnel, machines, or chemistry lines run the risk of contaminating natural level 14C archaeological, geological, and hydrological samples.

## Avoid the Risks

Find out from the lab that you are planning to use that they have never in the past and will never in the future:

- accept, handle, graphitize or AMS count samples containing Tracer or Labeled (Hot) 14C.

- share any laboratory space, equipment, or personnel with anyone preparing (pretreating, combusting, acidifying, or graphitizing) samples that contain Tracer or Labeled (Hot) 14C.

- use AMS Counting Systems (including any and all beam-line components) for the measurement of samples that contain Tracer or Labeled (Hot) 14C.

## Tracer-Free Lab Required

Recently, federal contracts are beginning to specify that AMS laboratories must be 14C tracer-free facilities in order to be considered for participation in solicitations.

A solicitation for the National Oceanic and Atmospheric Administration (NOAA) has indicated that "the AMS Facility utilized by the Contractor for the analysis of the micro-samples specified must be a 14C tracer-level-free facility." (Solicitation Number: WE-133F-14-RQ-0827 - Agency: Department of Commerce)

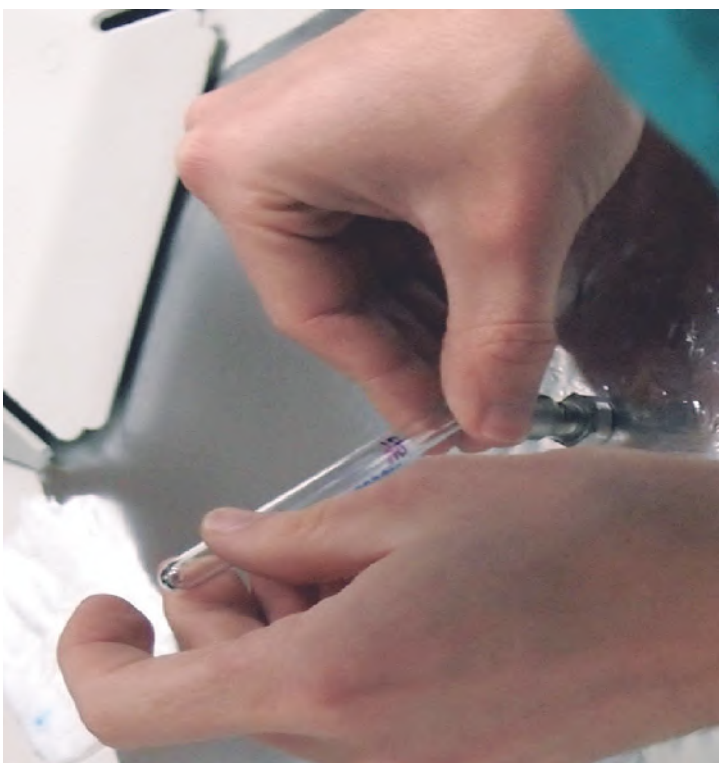
As a natural level radiocarbon laboratory, we highly recommend that researchers require the AMS lab processing their samples to be Tracer-free.

## No Exposure to Artificial Carbon-14

According to ASTM International, the ASTM D6866 standard is applicable to laboratories working without exposure to artificial carbon-14 routinely used in biomedical studies. Artificial carbon-14 can exist within the laboratory at levels 1,000 times or more than 100 % biobased materials and 100,000 times more than 1% biobased materials. Once in the laboratory, artificial 14C can become undetectably ubiquitous on materials and other surfaces but which may randomly contaminate an unknown sample producing inaccurately high biobased results. Despite vigorous attempts to clean up contaminating artificial 14C from a laboratory, isolation has proven to be the only successful method of avoidance. Completely separate chemical laboratories and extreme measures for detection validation are required from laboratories exposed to artificial 14C. Accepted requirements are:

(1) disclosure to clients that the laboratory working with their products and materials also works with artificial 14C
(2) chemical laboratories in separate buildings for the handling of artificial 14C and biobased samples
(3) separate personnel who do not enter the buildings of the other
(4) no sharing of common areas such as lunch rooms and offices
(5) no sharing of supplies or chemicals between the two
(6) quasi-simultaneous quality assurance measurements within the detector validating the absence of contamination within the detector itself.

**ASTM D6866-22** – Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis.



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"... we certainly do not advocate processing both labeled and natural samples in the same chemical laboratory." "The long term consequences are likely to be disastrous."

2. Recovery from tracer contamination in AMS sample preparation. A. J. T. Jull, D. J. Donahue, L. J. Toolin. Radiocarbon, Vol. 32, No.1, 1990, p. 84-85 doi:10.2458/azu_js_rc.32.1253 (Open Access)

"... tracer 14C should not be allowed in a radiocarbon laboratory." "Despite vigorous recent efforts to clean up the room, the "blanks" we measured had 14C contents equivalent to modern or even post -bomb levels."

3. Prevention and removal of elevated radiocarbon contamination in the LLNL/CAMS natural radiocarbon sample preparation laboratory. Zermeño, et. al. Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms
Vol. 223-224, 2004, p. 293-297
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"The presence of elevated 14C contamination in a laboratory preparing samples for natural radiocarbon analysis is detrimental to the laboratory workspace as well as the research being conducted."

4. High level 14C contamination and recovery at XI'AN AMS center. Zhou, et. al. Radiocarbon, Vol 54, No. 2, 2012, p. 187-193
doi:10.2458/azu_js_rc.54.16045

"Samples that contain high concentrations of radiocarbon ("hot" samples) are a catastrophe for low background AMS laboratories." "In our case the ion source system was seriously contaminated, as were the preparation lines."


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