

Measurement results for 60Co Assay baskets H5, H9, H14, H15, A4, and B3 (C003, C001, C005, C022, C021, C020, C032, C033, C038, C035, C036, C039, C053, C054, C055, C065, C066, & C067)

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August 2020

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**Prepared for the
U.S. Department of Energy**

**Under DOE Idaho Operations Office
Contract DE-ST6001032**

INTEROFFICE MEMORANDUM

Date: August 6, 2020

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Subject: Measurement results for ^{60}Co Assay baskets H5, H9, H14, H15, A4, and B3
(C003, C001, C005, C022, C021, C020, C032, C033, C038, C035, C036, C039, C053,
C054, C055, C065, C066, & C067)

Eighteen cobalt targets (C003, C001, C005, C022, C021, C020, C032, C033, C038, C035, C036, C039, C053, C054, C055, C065, C066, & C067) were assayed on July 28-29, 2020, following irradiation in ATR cycle 168A. The average specific activity of each target was determined by using the cobalt assay system located in the ATR canal following procedure ACMM-3610 [1].

A Victoreen 550-4-T ionization chamber was used along with a Standard Imaging SuperMAX electrometer to measure the dose rate from each target as it was raised past the collimator of the cobalt assay system.

The ^{60}Co standard basket containing 3 capsules of known activities were measured to determine the sensitivity factor from integrated dose rate to target activity (Ci). In accordance with ACMM-3610, the standards were measured at the beginning and at the end of the procedure each day to ensure that no physical changes occurred that would affect the ionization chamber sensitivity. The sensitivity factor was determined using six standard basket measurements, yielding an average sensitivity factor for the 18 measurements of 0.0302 ± 0.0022 ([R-in./min.]/Ci). This calculation was performed by integrating the dose-rate data over the range of the source, subtracting the baseline, and dividing by the decay-corrected activity of the standard. Measured data for the standard measurements can be provided upon request.

The average specific activity of each ^{60}Co target was determined following procedure ACMM-3610 and taking into account mass values from ECAR-3872 [2].

A geometric correction of 0.935 ± 0.005 was applied, as required in ACMM-3610, according to ECAR-4947 [3].

Sources of measurement uncertainty include:

- Activity of ^{60}Co standards: 5%
- Calibration of Ionization Chamber: 3.4%
- Ion-collection Efficiency of Ionization Chamber: 0.5%
- Geometric Correction Factor: 0.5%

The standard deviation of the sensitivity factor accounts for the first three of these as well as other systemic uncertainties. The total measurement uncertainty was 7.4%.

The assayed values and associated measurement uncertainties (68% confidence interval) are shown below.

Table 1. Assay results

Target Information				Specific Activity (Ci/g)	
ATR Position	Capsule Stack Position	Capsule ID	Mass (g)	Assay	Measurement Uncertainty (σ)
H5	top	C003	46.44	146.1	10.8
	middle	C001	46.734	30.8	2.3
	bottom	C005	46.65	121.4	9.0
H9	top	C022	46.86	123.3	9.1
	middle	C021	46.64	207.2	15.3
	bottom	C020	46.61	131.3	9.7
H14	top	C032	46.758	106.2	7.9
	middle	C033	46.758	166.7	12.3
	bottom	C038	46.753	120.5	8.9
H15	top	C035	46.653	91.0	6.7
	middle	C036	46.806	142.9	10.6
	bottom	C039	46.742	101.8	7.5
A4	top	C053	46.832	82.9	6.1
	middle	C054	46.742	156.3	11.6
	bottom	C055	46.726	100.0	7.4
B3	top	C065	46.695	112.6	8.3
	middle	C066	46.701	202.8	15.0
	bottom	C067	46.706	135.3	10.0

Assay results from 2017-2020 can be found in ECAR-4925 [4]. Raw data and calculations can be found in digital lab notebook LAB-E-347. Further clarification can be provided upon request.

References

- [1] Idaho National Laboratory, "ACMM-3610: ATR Dry Tube Measurements and ATR Capsule Assay," Idaho National Laboratory, Idaho Falls, ID, 2020.
- [2] B. Gross, "ECAR-3872: As-Run Physics Analysis of the HSA Cobalt Targets in the ATR H and Inner A-Positions for Cycles 157C through 166B," Idaho National Laboratory, Idaho Falls, ID, 2020.
- [3] J. Brookman, "ECAR-4947: Geometry Correction Factor for the HSA Cobalt Target," Idaho National Laboratory, Idaho Falls, 2020.
- [4] J. Urban-Klaehn, "ECAR-4925: RML Cobalt Assay Results and Analysis," Idaho National Laboratory, Idaho Falls, 2020.

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