

DIN EN ISO 17034:2017



Certified Reference Material FLX-4001 – Black Mass NMC

Certified Values

Parameter	Mass fraction in % ¹⁾	Uncertainty in % ²⁾	Traceable to
Al	1,22	0,10	IV CGAL1 LOT: V2-AL742224
Co	3,24	0,12	IV CGCO10 LOT: W2-CO750984
Mn	0,800	0,061	IV CGMN10 LOT: V2-MN747403
Ni	28,27	0,54	AC18.10664
P	0,595	0,050	IV CGP1 LOT: V2-P747083
Si	1,04	0,10	IV CGSI1 LOT: V2-SI744713

Table1) Certified Values

1) Certified value traceable to SI unit kg/kg based on dried sample (105°C until constant mass)

2) Total expanded uncertainty U_{CRM} calculated for a confidence interval of 95% ($k=2$).

This certificate is valid, within the uncertainty specified, **until 31.08.2036**, provided the CRM is handled in accordance with instructions given in this certificate. The certification is nullified if the CRM is damaged, contaminated, or otherwise modified.

Bedburg-Hau, **01.09.2026**

Responsible Reference Materials

Dr. Rainer Schramm

Quality Management

Ch. Winkels-Herding

Description of the CRM

This reference material is an industrial product. The complete batch was sealed into 30 g bottles. This material is normally going into the refineries to recover the valuable metals from the battery material.

Intended use

Calibration and control sample for x-ray fluorescence (XRF) analysis.

Informational Values

Parameter	Mass Fraction in % ³⁾	Uncertainty ⁴⁾
LOI ³⁾	41,60	
Cu ⁵⁾	1,07	0,06
Fe ⁵⁾	0,336	0,031
Li ⁵⁾	3,96	0,07
C ⁵⁾	35,40	0,70
S ⁵⁾	0,104	0,016
O ⁵⁾	20,41	1,20
N ⁵⁾	0,071	0,011
F ⁵⁾	1,91	0,27

Table2) Informational Values

3) Based on calcination at 950°C until constant mass.

4) Total expanded uncertainty U_{s*} calculated for a confidence interval of 95% ($k=2$), if present.

5) Based on dried material (1h 105 °C). Values taken from PT FXRV-2025-03

Instructions for the correct use of the CRM

The minimum sample quantity for analysis should be 0.2g. For XRF use, samples should be prepared as loose powder, pressed pellet or fused bead.

Storage Information

The material has to be stored in a dry and clean environment.

Hazardous situation

For this material an actual MSDS is available.

Level of homogeneity

In accordance with ISO 33405:2024 a homogeneity study was performed. A one-way ANOVA was used to calculate the batch inhomogeneity.

Stability

In accordance with ISO 33405:2024 a stability study was performed. As a result, the stability of the material was considered as fit for purpose. The uncertainty of long term stability was calculated

Total expanded uncertainty

The total expanded uncertainty U_{CRM} for a confidence interval of 95% ($k=2$) was calculated by taking into account the uncertainty of characterization u_{char} , of inhomogeneity u_{bb} and long-term stability u_{lts} .

$$U_{CRM} = k \times \sqrt{u_{char}^2 + u_{bb}^2 + u_{lts}^2}$$

Traceability

All of the certified values derived as part of this testing program have traceability to the reference materials stated in table 1.

Methods used

The analytical work performed to assess this material was carried out by the FLUXANA laboratory, which works according to ISO/IEC 17025:2018.

In accordance with ISO 17034:2017 and ISO 33405:2024, we use the approach stated in ISO 17034:2017 Chapter 7.12.3. d) value transfer from an RM to a closely matched candidate RM performed using a single measurement procedure performed by one laboratory.

An example for this approach is found in DIN ISO 13528:2025 E.5. Using this approach, samples of the test material that is to be the new reference material are tested along with matching and/or synthetic RMs using a suitable method. The assigned values X_{CRM} and their uncertainties U_{CRM} are then derived from a calibration against the certified reference values of the compared RMs. Synthetic RMs are made from pure chemicals by weighing.

Measurement method used: XRF with fusion as sample preparation technique.

This certificate is in conformance with ISO 33401:2024.



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