

The following data represents all pertinent information reported as it applies to the chemical characterization of this material.

	Ag	As	Bi	Cd	Cu	Ni	S	Sb	Se	Sn	Te	Zn				
1	0.0006	0.1057	0.0325	0.0013	0.1383	0.0014	0.0007	9.747	0.0012	0.1272	0.0011	0.0105				
2	0.0013	0.1100	0.0387	0.0014	0.1410	0.0016	0.0013	9.876	0.0015	0.1280	0.0028	0.0112				
3	0.0016	0.1120	0.0391	0.0014	0.1430	0.0018	0.0038	9.895	0.0016	0.1310	0.0038	0.0115				
4	0.0019	0.1140	0.0396	0.0015	0.1453	0.0018		10.038	0.0020	0.1330	0.0040	0.0120				
5	0.0020	0.1140	0.0402	0.0015	0.1470	0.0018		10.049	0.0022	0.1348	0.0043	0.0124				
6	0.0020	0.1141	0.0411	0.0016	0.1492	0.0018		10.087	0.0023	0.1425	0.0054	0.0126				
7	0.0021	0.1152	0.0418	0.0016	0.1510	0.0022		10.140	0.0023	0.1440		0.0127				
8	0.0024	0.1158	0.0437	0.0018	0.1510	0.0023		10.230				0.0129				
9	0.0025		0.0470		0.1533			10.250				0.0141				
10					0.1535											
11																
12																
13																
14																
15																
Mean	0.0018	0.1126	0.0404	0.0015	0.1473	0.0018	0.0019	10.035	0.0019	0.1344	0.0036	0.0122				
STDV.	0.0006	0.0033	0.0039	0.0001	0.0053	0.0003	0.0016	0.168	0.0004	0.0066	0.0015	0.0011				
Certified	0.0018	0.113	0.040	0.0015	0.147	0.0018	(0.002)	10.0	0.0019	0.134	0.004	0.0122				
U _{CRM}	0.0004	0.003	0.003	0.0001	0.004	0.0002		0.1	0.0004	0.006	0.002	0.0008				
Methods	A,I	A,I	A,I,W	A,I	A,I,W	A,I	C	A,I,W	A,I	A,I,W	A,I	A,I				

Legend: W = Classical, C = Combustion, F = Fusion, A = AA or GFAA, I = ICP or DCP, IM=ICP-MS, D = DC Arc, O = AES, X = XRF, G = GDAES or GDMS, H = Hollow Cathode AES

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Sheffield Analytical Services
Mineral & Metallurgical Laboratories
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AMG Superalloys UK Ltd.

NSW, Australia
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Montreal, QC

Much of the analytical work performed to assess this material has been carried out by laboratories with proven competence, as indicated by their accreditation to ISO 17025. It is an implicit requirement for this accreditation that analytical work should be performed with due traceability, via an unbroken chain of comparisons, each with stated uncertainty, to primary standards such as the mole, or to nationally- or internationally-recognised reference materials. Of the individual results herein, some have traceability (to the mole) via primary analytical methods. Some are traceable to substances of known stoichiometry. Most have traceability via commercial solutions. Furthermore, some results have additional traceability to NIST standards, as part of the analytical calibration or process control.

Homogeneity and Uncertainty

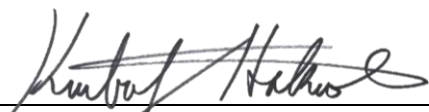
"Uncertainty" values, as reported adjacent to certified concentration values, are based on a 95% Confidence Interval. These estimated uncertainties include the combined effects of method imprecision, material inhomogeneity, and any bias between methods. Homogeneity data from experimental spark OES results are reflected in both the overall statistics and certified data. Homogeneity samples are selected by a systematic sampling procedure. The number of samples may be determined by equation 1, where N_{prod} is the number of units produced and N_{min} is the number of samples used for homogeneity testing. These samples are arranged in a simple randomized design such that each sample is analyzed multiple times by spark OES. Homogeneity may also be determined within sample using an applied version of ASTM E826. A single factor ANOVA is used to calculate uncertainty due to inhomogeneity (U_{hom}). Uncertainty of the material is calculated by equation 2, where H=U_{hom}, S= Standard deviation, t= t-value at 95% CI, and n= number of observations.

$$1. N_{min} = \max(10, \sqrt[3]{N_{prod}})$$

$$2. U_{CRM} = \frac{\sqrt{H^2 + S^2}}{\sqrt{n}} * t$$

Expiration

The certification of this material is valid indefinitely, within the uncertainty specified, provided the material is handled and stored in accordance with the instructions stated on this certificate. The certification is nullified if the material is damaged, contaminated, otherwise modified, or used in a manner for which it was not intended.


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