

CERTIFICATE OF ANALYSIS

IMZ 183A

CERTIFIED REFERENCE MATERIAL NICKEL ALLOY

Analysis listed as percent by weight [% m/m]

	Certified value	Expanded Uncertainty		Certified value	Expanded Uncertainty
Al	3.45	± 0.06	Mo	1.63	± 0.01
B	0.0108	± 0.0008	Nb	0.747	± 0.006
C	0.107	± 0.003	Si	0.021	± 0.004
Co	8.23	± 0.10	Ta	1.56	± 0.05
Cr	15.99	± 0.15	Ti	3.39	± 0.03
Fe	0.063	± 0.004	W	2.62	± 0.05
Hf	0.020	± 0.003	Zr	0.033	± 0.002
			Mg	0.0013	± 0.0003

the expanded uncertainty bases on statistical evaluation of the contributions the interlaboratory certification analysis and the material homogeneity

Certificate Number: IMZ 183A-29072024
Certificate revision history on page 4

Analysis	Al	*	B	*	C	*	Co	*	Cr	*	Cu**	*	Fe	*	Hf	*
1	3.35	1	0.0097	5	0.1048	5	8.1359	7	15.507	7	0.0003	6	0.0593	7	0.016	7
2	3.3695	7	0.010	5	0.105	2	8.1565	7	15.77	7	0.0077	5	0.06	1	0.0192	5
3	3.3863	7	0.010	7	0.1063	2	8.20	7	15.91	1	0.0078	7	0.06	1	0.02	1
4	3.44	1	0.0106	7	0.1066	2	8.20	1	15.95	5	0.0092	7	0.0601	7	0.0218	7
5	3.445	7	0.0108	7	0.107	5	8.223	5	16.03	1	0.01	1	0.0612	7	0.0230	7
6	3.48	1	0.0112	5	0.108	2	8.234	7	16.0316	7	0.0110	7	0.0673	7		
7	3.487	7	0.0112	7	0.109	2	8.27	1	16.0809	10	0.0447	7	0.0691	7		
8	3.495	5	0.0120	19	0.110	2	8.328	7	16.18	1	< 0.01	1	0.071	1		
9	3.611	7	0.0120	7			8.33	1	16.234	7			0.0717	5		
Average ¹	3.4454		0.01084		0.1071		8.2305		15.9944		0.0091		0.0625		0.0200	
SD ²	0.0671		0.0009		0.0018		0.0678		0.1639		0.0022		0.0028		0.0027	
u characterization ³	0.02804		0.00036		0.0008		0.02831		0.06846				0.00119		0.00150	
u homogeneity ⁴	0.00119		0.00019		0.00109		0.043		0.030		0.00003		0.00133		0.00013	
Certified value ⁵	3.45		0.0108		0.107		8.23		15.99				0.063		0.020	
Expanded uncertainty ⁶	0.06		0.0008		0.003		0.10		0.15				0.004		0.003	

Analysis	Mn**	*	Mo	*	Nb	*	Ni**	*	P**	*	S**	*	Si	*	Ta	*
1	0.0015	7	1.6149	7	0.666	7	61.92	1	0.001	1	0.0002	2	0.013	1	1.4992	7
2	0.0018	7	1.6152	7	0.7117	7	62.32	1	0.0012	5	0.0003	2	0.0143	7	1.501	5
3	0.003	1	1.616	5	0.744	5	62.48	5	0.0020	7	0.00034	7	0.019	1	1.519	7
4	0.0031	1	1.62	1	0.745	7	62.603	7	0.002	1	0.0005	2	0.02	5	1.52	1
5	0.0082	5	1.622	7	0.7470	7			0.0024	5	0.00080	2	0.0218	7	1.54	7
6	0.0100	7	1.63	1	0.75	1			0.0024	7	0.0009	2	0.0232	7	1.62	1
7	0.01	1	1.635	7	0.75	1			0.0077	7	< 0.0005	2	0.0243	7	1.6239	7
8	0.0141	7	1.636	7	0.75	1							0.0272	7	1.649	7
9	0.0144	7	1.64	1	0.761	7									1.65	1
Average ¹	0.0073		1.6252		0.7467		62.372		0.0020		0.0005		0.0206		1.5641	
SD ²	0.0051		0.0095		0.0047		0.2236		0.0007		0.0003		0.0045		0.0587	
u characterization ³	0.00215		0.00397		0.0020								0.00198		0.02451	
u homogeneity ⁴	0.00005		0.0024		0.0023		0.086		0.00003		0.00005		0.00034		0.0077	
Certified value ⁵			1.63		0.747								0.021		1.56	
Expanded uncertainty ⁶			0.01		0.006								0.004		0.05	

Analysis	Ti	*	W	*	Zr	*	Ag		Bi		Mg		N		O	
1	3.251	5	2.3993	7	0.0275	7	0.000012	19	0.000003	19	0.00097	6	0.0001	3	0.0004	3
2	3.34	1	2.5897	7	0.0303	7	0.000021	7	0.000005	6	0.00111	7	0.0004	3	0.0013	3
3	3.37	1	2.592	7	0.0317	7	< 0.00001	6	< 0.00001	6	0.0012	7	0.0010	3	0.0015	3
4	3.3714	7	2.60	1	0.0324	5	< 0.00004	19	< 0.00003	19	0.0013	19	0.0014	3	0.0095	3
5	3.392	7	2.60	1	0.033	1	< 0.0001	6	< 0.00029	7	0.0015	19				
6	3.3949	7	2.64	1	0.034	1					0.0081	5				
7	3.40	1	2.662	7	0.035	7										
8	3.412	7	2.6960	5	0.0359	7										
9	3.486	7	2.726	7												
Average ¹	3.3854		2.6216		0.0326						0.00129					
SD ²	0.0300		0.0522		0.0024						0.00026					
u characterization ³	0.01251		0.02182		0.0011						0.00013					
u homogeneity ⁴	0.010		0.0084		0.00032											
Certified value ⁵	3.39		2.62		0.033						0.0013					
Expanded uncertainty ⁶	0.03		0.05		0.002						0.0003					

Analysis	Pb**	*	Pd**	*	Pt**	*	Re**	*	Se**	*	Te**	*	Ti**	*	V**	*
1	0.000009	19	0.0013	7	0.0074	7	0.0144	7	0.00015	7	< 0.00001	6	0.000007	6	0.0021	7
2	0.000015	19					0.055	5	0.0002	6	< 0.00001	6	< 0.000005	19	0.0029	7
3	0.000019	6							< 0.00005	19	< 0.00001	7	< 0.00001	6	0.0048	6
4	0.000028	7							< 0.0005	6	< 0.00005	6	< 0.00001	7	0.006	1
5	< 0.00005	6													0.0071	7
6															0.0122	5
7															0.026	7
8															< 0.03	1
Average ¹															0.00711	
SD ²															0.00481	
u characterization ³																
u homogeneity ⁴							0.000075								0.00020	
Certified value ⁵																
Expanded uncertainty ⁶																

Analysis	Sn**	*	Zn**	*
1	0.00036	19	0.00003	19
2				
Average ¹				
SD ²				
u characterization ³				
u homogeneity ⁴				
Certified value ⁵				
Expanded uncertainty ⁶				

* - analytical method used

** informative value

All values are based on recommendations of the ISO GUIDE 35:2017(E) standard:

1. **Average** is calculated according to Algorithm A (Guide clause A.2.3.4: Robust statistics)
2. **Standard deviation** is calculated according to Algorithm A (Guide clause A.2.3.4: Robust statistics)
3. **Uncertainty of material characterization** is based on the data obtained from the analysis performer by Network of competent labs (Guide clause 9.5) and calculated according to Guide clause B.5.2.
4. **Uncertainty associated with homogeneity** of material is calculated in agreement with Guide clause 7.11 (Uncertainty evaluation from homogeneity studies)
5. **Certified value** is the average value rounded to one or two significant digits of expanded uncertainty
6. **Expanded uncertainty** is an geometric average of u characterization and u homogeneity multiplied by coverage factor $k = 2$.

Certification Process: Both preparation of this Reference Material and certification process were prepared according to requirements PN-EN 17034 and ISO GUIDE 35:2017(E).

Chemical Analysis: Chemical analyses were carried out on chips prepared by milling and also for bulk samples. Single values in the above table are the means obtained by individual laboratories. The following methods were used for analysis:

- 1 – wavelength dispersive x-ray fluorescence spectrometry,
- 2 – high frequency infra red absorption,
- 5 – spark atomic emission spectrometry,
- 6 – inductive coupled plasma mass spectrometry,
- 7 – inductive coupled plasma atomic emission spectrometry,
- 19 – glow discharge mass spectrometry.

The laboratories participating in certification analysis:

- Consolidated Precision Products, Rzeszów, Poland, accreditation Nadcap no. 15554182566
- Dirats Laboratories, Westfield, MA, USA, accreditation ANAB, ISO/IEC 17025, no. AT-1546
- Genitest Inc Montreal, Canada, accreditation P RI 123077
- Inco Test Ltd Hereford, UK, accreditation UKAS 0281
- Sieć Badawcza Łukasiewicz Instytut Metalurgii Żelaza – Gliwice, Poland; accred. PCA 17025 - AB554
- Laboratory Testing Inc., Hatfield, PA. USA, accreditation A2LA, ISO/IEC 17025, no. 0117.05
- Lithea, Ltd., Brno, The Czech Republic.

Homogeneity: The homogeneity of this Reference Material was evaluated in accordance with guidelines of ISO GUIDE 35:2017(E). Optical emission spectrometry with spark excitation method was used.

Traceability: This Reference Material was found traceable to the following CRMs: Alpha Aesar 708917409, Alpha Aesar 911A, Alpha Aesar 612B, , Alpha AR 882, Alpha AR 654, IARM 190a, IARM 332a, IARM 333A, IARM277A, , IARM57A, IMZ180, IMZ181, IMZ183, IMZ 187, IMZ202, IMZ 205, IMZ 206, IPT 37C, Leco 0586, MBH 1867a, MS CalA 070920, MS CalB 070920, MS CalD 070920, Ni16Cr8Co 101020, SRM 3114, SRM 3131A, SRM 3138, SRM 3140, SRM3143, Tramps2000 022520, pure standards from SCP Science and VHGlabs.

Production of melt: This material was manufactured by Certified Alloy Products Inc., USA.

Available form: 1/4 section of 88 mm cylinder and 20 mm high.

Intended use: This Reference Material is intended for use in spark atomic emission and X-ray spectrometric methods.

Validity of certification: The certification of IMZ 183A is valid indefinitely within the uncertainty specified provided this Reference Material is stored in dry place and in environment free from chemical or other aggressive vapours. Periodic recertification is not required. The certification is nullified if this Reference Material is damaged, contaminated or otherwise modified.

Safety: This Reference Material and packing does not contain substances which can directly influence health.

Storage: This Reference Material should be stored in dry place and in environment free from chemical or other aggressive vapours.

Inquiries regarding this Reference Material should be directed to:
rm@git.lukasiewicz.gov.pl

Approved by
Director of the Institute

Prof. Dr. Hab. Eng. Adam Zieliński

Certificate issue date: 29 July 2024

Certificate revision history:

29 July 2024 (editorial changes)

9 September 2021 (adjustment of uncertainty values); 10 March 2021 (Original certificate date)