

CERTIFICATE OF ANALYSIS

IMZ 112A

CERTIFIED REFERENCE MATERIAL LOW ALLOY STEEL

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

	Certified value	Expanded uncertainty		Certified value	Expanded uncertainty
C	0.212	± 0.004	Ti	0.0138	± 0.0005
Si	0.257	± 0.004	Al	0.017	± 0.001
Mn	0.471	± 0.005	Nb	0.0123	± 0.0007
P	0.0055	± 0.0004	N	0.0058	± 0.0002
S	0.0188	± 0.0008	B	0.0010	± 0.0001
Cr	0.099	± 0.001	W	0.072	± 0.002
Ni	0.055	± 0.001	Sn	0.162	± 0.005
Mo	0.054	± 0.002	As	0.023	± 0.002
Co	0.080	± 0.002	Sb	0.021	± 0.002
Cu	0.068	± 0.001	Pb	0.008	± 0.002
V	0.043	± 0.001	Zn	0.0020	± 0.0002

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

Certificate Number: IMZ 112A-040625
Certificate revision history on page 4

Analysis	C	*	Si	*	Mn	*	P	*	S	*	Cr	*	Ni	*	Mo	*
1	0.206	5	0.240	5	0.453	5	0.004	7	0.0165	5	0.0915	5	0.0335	5	0.0433	5
2	0.207	5	0.24	1	0.459	5	0.00466	6	0.0169	1	0.094	5	0.0408	7	0.05	12
3	0.208	5	0.245	7	0.459	5	0.005	7	0.01754	7	0.094	14	0.043	17	0.05	17
4	0.209	2	0.245	7	0.4592	7	0.005	5	0.0177	5	0.094	1	0.048	1	0.050	5
5	0.21	5	0.248	5	0.460	5	0.0050	1	0.0179	1	0.0957	7	0.05	9	0.05	1
6	0.21	2	0.25	12	0.46	1	0.005	5	0.018	5	0.09693	12	0.0536	7	0.0504	7
7	0.211	13	0.2526	5	0.462	1	0.005	5	0.018	5	0.097	1	0.05371	7	0.05075	7
8	0.2112	5	0.253	5	0.465	7	0.005	5	0.0186	5	0.097	5	0.054	5	0.0514	7
9	0.2125	5	0.253	5	0.4650	1	0.005	1	0.0188	2	0.09708	7	0.054	14	0.053	5
10	0.213	2	0.2545	5	0.466	5	0.00506	7	0.019	5	0.09797	7	0.0540	5	0.0530	7
11	0.2133	2	0.256	5	0.467	5	0.0052	5	0.019	2	0.0980	7	0.0540	5	0.053	5
12	0.214	2	0.2575	1	0.468	7	0.00534	12	0.0195	2	0.098	7	0.0542	5	0.0536	5
13	0.215	2	0.2576	5	0.47	5	0.0055	7	0.0195	2	0.098	5	0.055	5	0.0538	1
14	0.216	5	0.259	1	0.47444	7	0.0055	5	0.0195	5	0.099	5	0.0550	7	0.0541	5
15	0.218	5	0.2593	8	0.4745	7	0.0056	7	0.0197	2	0.099	7	0.055	5	0.05436	7
16	0.225	5	0.26	5	0.4746	5	0.0058	5	0.0198	5	0.0990	1	0.0555	7	0.0544	5
17	0.225	5	0.26	12	0.4750	7	0.0058	1	0.020	5	0.10	5	0.056	1	0.0545	7
18			0.260	5	0.475	5	0.006	5	0.0204	13	0.10	5	0.056	5	0.0547	7
19			0.26135	7	0.4751	12	0.006	12	0.0210	2	0.100	5	0.056	6	0.055	14
20			0.262	7	0.476	14	0.0061	5			0.100	5	0.0561	7	0.055	5
21			0.263	5	0.477	5	0.00615	7			0.1001	5	0.0562	1	0.0555	5
22			0.263	5	0.48	12	0.0064	1			0.1008	1	0.05650	7	0.0565	5
23			0.27	17	0.48	17	0.00657	7			0.102	6	0.0567	5	0.057	1
24			0.281	6	0.4806	5	0.0077	5			0.1027	5	0.057	5	0.057	5
25					0.483	7	0.013	12			0.104	7	0.059	5	0.05723	12
26					0.4836	1					0.11	17	0.061	5	0.0596	6
27					0.486	6					0.12	9			0.06	5
Average ¹	0.2124		0.2568		0.4708		0.00553		0.01881		0.0988		0.0548		0.0537	
SD ²	0.0037		0.0061		0.0087		0.00065		0.0011		0.0027		0.0017		0.0028	
u characterization ³	0.00114		0.00157		0.0021		0.00016		0.00033		0.00065		0.00061		0.00067	
u homogeneity ⁴	0.0016		0.0010		0.0014		0.000070		0.00026		0.00020		0.00030		0.00031	
Certified value ⁵	0.212		0.257		0.471		0.0055		0.0188		0.099		0.055		0.054	
Expanded uncertainty ⁶	0.004		0.004		0.005		0.0004		0.0008		0.001		0.001		0.002	

Analysis	Co	*	V	*	W	*	Ti	*	Cu	*	Al	*	Nb	*	N	*
1	0.0704	7	0.040	7	0.0655	5	0.0117	5	0.060	7	0.015	5	0.009	5	0.0046	5
2	0.072	5	0.040	17	0.0664	1	0.0128	7	0.0609	6	0.0155	5	0.0105	7	0.0056	3
3	0.0728	7	0.04080	7	0.067	5	0.0129	1	0.064	5	0.0156	5	0.011	5	0.0056	5
4	0.073	5	0.0410	5	0.0673	5	0.0129	7	0.0649	7	0.016	5	0.011	17	0.0057	5
5	0.0749	7	0.041	5	0.06900	7	0.0130	5	0.0655	5	0.016	5	0.0114	5	0.0057	3
6	0.07719	7	0.042	5	0.070	5	0.013	5	0.066	5	0.0161	7	0.0116	7	0.0059	5
7	0.078	5	0.0422	1	0.07	1	0.0133	5	0.066	14	0.0163	5	0.01176	7	0.0059	5
8	0.080	1	0.0427	5	0.0701	5	0.01345	7	0.0666	1	0.0163	6	0.01195	7	0.0060	5
9	0.080	14	0.0428	5	0.0706	1	0.0137	7	0.067	1	0.0168	7	0.012	5	0.0061	3
10	0.080	5	0.0429	7	0.0710	7	0.01390	7	0.067	5	0.0171	7	0.012	5	0.0061	3
11	0.08071	7	0.043	5	0.071	5	0.014	5	0.067	5	0.01720	7	0.0122	7	0.0064	3
12	0.081	5	0.0431	5	0.072	5	0.014	5	0.067	5	0.0181	7	0.0124	5		
13	0.081	5	0.0432	5	0.0726	7	0.0140	5	0.068	5	0.0185	5	0.0126	1		
14	0.0810	5	0.0433	1	0.0747	7	0.014	5	0.0683	7	0.0187	5	0.013	5		
15	0.0811	7	0.04375	7	0.075	7	0.014	1	0.0687	5	0.01875	7	0.013	5		
16	0.08156	12	0.0439	7	0.075	5	0.0141	5	0.069	7	0.0191	5	0.0131	5		
17	0.082	5	0.044	5	0.075	7	0.0142	1	0.069	5	0.0195	5	0.0132	5		
18	0.0829	1	0.0440	7	0.075	5	0.01421	7	0.06963	12	0.0195	5	0.0132	6		
19	0.0833	5	0.044	5	0.077	5	0.0144	6	0.06966	7	0.0196	7	0.0136	1		
20	0.085	1	0.04447	7	0.0844	6	0.0145	5	0.0698	5	0.022	5	0.0137	5		
21	0.0868	6	0.0450	5			0.0147	5	0.06985	7			0.017	1		
22	0.0888	5	0.045	1			0.015	5	0.07	5						
23			0.0464	6			0.0168	7	0.07	17						
24			0.047	5					0.070	5						
25			0.0470	14					0.0707	7						
26									0.08	12						
27									0.10	1						
Average ¹	0.0803		0.0432		0.0716		0.01382		0.0680		0.017497		0.01227		0.0058	
SD ²	0.0032		0.0015		0.0036		0.0007		0.0022		0.0016		0.0010		0.0003	
u characterization ³	0.00086		0.00037		0.0010		0.00018		0.00054		0.00046		0.00028		0.00010	
u homogeneity ⁴	0.00038		0.00019		0.00055		0.00019		0.00029		0.00018		0.00020			
Certified value ⁵	0.080		0.043		0.072		0.0138		0.068		0.017		0.0123		0.0058	
Expanded uncertainty ⁶	0.002		0.001		0.002		0.0005		0.001		0.001		0.0007		0.0002	

Analysis	Sn	*	As	*	Sb	*	Pb	*	B	*	Zn	*	O**	*	Zr**	*
1	0.149	7	0.017	5	0.015	5	0.00468	7	0.0006	5	0.0013	5	0.0183	3	0.0008	5
2	0.15175	7	0.0196	7	0.018	5	0.005	14	0.00078	6	0.00169	6			0.001	5
3	0.1562	5	0.02020	7	0.0182	5	0.0057	7	0.0008	5	0.0019	5			0.0013	1
4	0.157	7	0.0218	5	0.019	5	0.007	5	0.0009	5	0.0019	7			< 0.001	5
5	0.158	5	0.022	5	0.0193	5	0.0074	5	0.00096	5	0.002	5				
6	0.159	1	0.0223	7	0.0194	4	0.00745	7	0.00099	5	0.002	14				
7	0.1594	5	0.0225	5	0.0196	7	0.0079	7	0.0010	7	0.002	5				
8	0.160	5	0.0226	7	0.021	14	0.0080	4	0.0010	5	0.0022	5				
9	0.16	17	0.0226	1	0.02181	7	0.008	5	0.00104		0.0022	7				
10	0.1608	7	0.0227	5	0.022	5	0.0084	7	0.0011	5	0.00237	7				
11	0.164	5	0.02279	12	0.0223	7	0.0088	1	0.00111	7	0.0027	5				
12	0.1648	5	0.023	7	0.0228	7	0.009	5	0.00125	7						
13	0.165	5	0.023	5	0.023	1	0.00932	6	0.0013	5						
14	0.1650	5	0.023	5	0.0234	6	0.0097	5	0.0013	5						
15	0.1658	7	0.0238	6	0.0235	5	0.014	5								
16	0.167	5	0.0240	5												
17	0.17	14	0.0240	1												
18	0.179	6	0.0240	7												
19			0.0248	5												
20			0.0251	5												
21			0.0252	7												
22			0.0259	1												
Average ¹	0.1615		0.0230		0.0207		0.0079		0.00101		0.00203					
SD ²	0.0053		0.0014		0.0022		0.0014		0.0002		0.0003					
u characterization ³	0.00155		0.00037		0.0007		0.00046		0.00005		0.00010					
u homogeneity ⁴	0.0019		0.00063		0.00033		0.00094		0.000014		0.000026				0.000033	
Certified value ⁵	0.162		0.023		0.021		0.008		0.0010		0.0020					
Expanded uncertainty ⁶	0.005		0.002		0.002		0.002		0.0001		0.0002					

* - 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 – combustion and infra-red detection,
- 3 – high temperature extraction and thermo conductivity detection,
- 4 – graphite furnace atomic absorption spectrometry,
- 5 – spark atomic emission spectrometry,
- 6 – inductive coupled plasma mass spectrometry,
- 7 – inductive coupled plasma atomic emission spectrometry,
- 8 – gravimetry,
- 9 – potentiometric titration,
- 12 – spectrophotometry,
- 13 – coulometry,
- 14 – flame atomic emission spectrometry,
- 17 – energy dispersive x-ray fluorescence spectrometry.

The laboratories participating in certification analysis:

- Cognor S.A.Oddział HSJ w Stalowej Woli, Zakładowe Laboratorium Badawczo-Doświadczalne; Poland, UDT LB-032/22-16,
- Deutsche Edelstahlwerke GmbH; Abteilung PP-CH, Witten, Germany - accreditation DakkS D-PL-19654-01-00, DIN EN ISO/IEC 17025,

- Dunafer Labor Nonprofit Kft., Dunaújváros, Hungary, accreditation ISO/IEC 17025; NAH-2-0330/2016,
- Inco Test Ltd Hereford, UK, accreditation UKAS 0281,
- Institute for Certified Reference Materials, Jekaterinburg, Russia, accreditation RU.0001.510008,
- Lithea, Ltd. Brno, The Czech Republic,
- OnderzoeksCentrum voor de Aanwending van Staal, Zelzate, Belgium,
- PJSC "Electrometallurgical works "Dneprospetsstal", Zaporozhye, Ukraine,
- Sieć Badawcza Łukasiewicz - Instytut Metalurgii Żelaza – Gliwice, Poland, PCA 17025 - AB554,
- TECHLAB, St Julien-les-Metz, France,
- Vitkovice Testing Center, Ostrava, The Czech Republic, Testing Laboratory Nr 1036; Accreditation Certificate No. 531/2018 by the Czech Accreditation Institute; ČSN EN ISO/IEC 17025:2005.

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: B2764, B2762, B2406-certificate618A, BCS 405/2, BCS 458/2, BCS 459/2, BCS-SS 462/1, BS14, BS1020, BS75 G BS2513, BS 239/3, BS 452, BS 459/2, C5/4, UNL5/3, C19/5, C2/5, C44-2, C7/6, CKD 167B, CKD181A, CKD186D, EURONORM 096-1, EURO191-2, EUR0181-1, EURO 187-1, EURO 042-1, EZRM 064-1, EZRM 197-1EZRM 077-1, EZRM 079-1, , EZRM 178-1, EZRM 231-2, IMZ 1.19/2, IMZ 1.71/1, IMZ 1.5/3, IMZ 1.13/1, IMZ 1.72, IMZ 1.18, IMZ 1.85, IMZ 1.3/2,IMZ 1.33, IMZ 1.3/7, IMZ 1.82. IMZ 1,19/1, IMZ 1.11/2, IMZ 1.32, IMZ 75, IMZ 76, IMZ110, IMZ 111, IMZ 114, IMZ114A, IMZ 117, IMZ 137, IMZ 138, IMZ 112, IMZ 71, IMZ 140, IMZ 55/1A, IMZ 57, IMZ 171, JSS175-6, MBH 12x355(C), MBH 12x10180(C), NBS1261a, NBS1263a, NBS1767, NIST SRM 362, NIST SRM 363, NIST SRM 2165, NIST SRM 2167, SS50, SS51 SS52, SS53, SS54, SS55, SS59, SS 431, SS432, SS433, SS456/1, SS457/1, SS459/1, SS458, SS460, UNL12/3, UNL5/3, C9/4, UNL17, UNL3/4.

Production of melt: This material was manufactured by Sieć Badawcza Łukasiewicz - Instytut Metalurgii Żelaza, Gliwice, Poland.

Available form: Discs 38 mm in diameter and 20 mm high.

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

Note: In optical emission spectrometry with spark excitation it is recommended to avoid using the central part of the surface (diameter approx. 5 mm) due to possible segregation of material.

Validity of certification: The certification of IMZ 112A 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: 4 June 2025

Certificate revision history:

4 June 2025 (editorial changes) 9 September 2021 (adjustment of uncertainty values); 9 March 2021 (Original certificate date)