

CERTIFICATE OF ANALYSIS

IMZ 114A

CERTIFIED REFERENCE MATERIAL LOW ALLOY STEEL

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

	Certified value	Expanded uncertainty		Certified value	Expanded uncertainty
C	0.358	± 0.005	V	0.096	± 0.001
Si	0.328	± 0.006	Ti	0.0088	± 0.0004
Mn	1.156	± 0.008	Al	0.027	± 0.001
P	0.0235	± 0.0006	Nb	0.015	± 0.001
S	0.0220	± 0.0007	N	0.0029	± 0.0005
Cr	0.423	± 0.005	Sn	0.014	± 0.001
Ni	0.098	± 0.004	As	0.0035	± 0.0009
Mo	0.112	± 0.003	Sb	0.018	± 0.002
Co	0.0057	± 0.0005	Pb	0.021	± 0.003
Cu	0.492	± 0.006	B	0.0019	± 0.0001

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

Certificate Number: IMZ114A-020625
Certificate revision history on page 4

Analysis	C	*	Si	*	Mn	*	P	*	S	*	Cr	*	Ni	*	Mo	*
1	0.3498	5	0.31	8	1.12	17	0.019	12	0.0200	2	0.41	5	0.088	7	0.098	12
2	0.35	5	0.3100	7	1.13	12	0.0205	7	0.0205	5	0.41	1	0.090	7	0.10	5
3	0.35	5	0.3193	8	1.134	7	0.022	7	0.021	1	0.41	5	0.090	6	0.10	7
4	0.351	5	0.32	5	1.14	5	0.023	1	0.021	2	0.418	5	0.09	7	0.109	7
5	0.355	5	0.32	17	1.1489	7	0.023	5	0.022	5	0.4194	7	0.0933	7	0.11	17
6	0.355	2	0.32	1	1.15	5	0.023	5	0.0219	5	0.42	5	0.0958	5	0.11	5
7	0.356	2	0.32	7	1.15	1	0.023	6	0.022	2	0.42	17	0.097	5	0.11	6
8	0.36	2	0.32	6	1.15	7	0.023	12	0.022	13	0.420	5	0.097	5	0.110	5
9	0.360	2	0.3260	5	1.15	7	0.0233	7	0.0220	1	0.42	7	0.098	1	0.111	5
10	0.36	5	0.327	12	1.155	12	0.0238	5	0.022	5	0.420	5	0.098	5	0.1118	7
11	0.3604	2	0.33	12	1.1550	5	0.0239	5	0.022	2	0.423	5	0.0990	7	0.1128	7
12	0.361	5	0.33	5	1.16	5	0.024	5	0.0221	2	0.4290	5	0.0993	5	0.113	5
13	0.362	2	0.33	7	1.16	5	0.024	5	0.0221	2	0.430	7	0.0994	5	0.114	1
14	0.364	5	0.336	1	1.16	5	0.024	1	0.0221	2	0.43	1	0.10	5	0.115	5
15	0.365	2	0.336	5	1.1636	7	0.024	5	0.023	5	0.43	5	0.10	5	0.1173	5
16	0.367	2	0.337	5	1.17	1	0.025	7	0.023	2	0.43	7	0.10	17	0.120	5
17	0.367	13	0.338	7	1.170	7	0.026	5	0.023	5	0.4311	7	0.10	9	0.12	5
18			0.338	5	1.17	5	0.0262	12	0.0240	7	0.44	9	0.10	1	0.12	1
19			0.34	5	1.19	5							0.11	5	0.12	7
20			0.341	5	1.19	5										
21			0.35	5												
Average ¹	0.3584		0.3284		1.1556		0.0235		0.0220		0.4226		0.0976		0.1122	
SD ²	0.0059		0.0100		0.0119		0.0008		0.0005		0.0079		0.0029		0.0043	
u characterization ³	0.00179		0.00273		0.00333		0.00024		0.00015		0.00233		0.00083		0.00124	
u homogeneity ⁴	0.0017		0.0007		0.0021		0.00018		0.00034		0.00062		0.0017		0.0006	
Certified value ⁵	0.358		0.328		1.156		0.0235		0.0220		0.423		0.098		0.112	
Expanded uncertainty ⁶	0.005		0.006		0.008		0.0006		0.0007		0.005		0.004		0.003	

Analysis	Co	*	V	*	W**	*	Ti	*	Cu	*	Al	*	Nb	*	N	*
1	0.0047	7	0.088	6	0.0039	1	0.007	17	0.47	17	0.024	1	0.0061	7	0.0020	3
2	0.0048	7	0.093	7	0.006	7	0.0074	1	0.480	7	0.024	5	0.0085	7	0.0021	5
3	0.005	7	0.093	5	0.0061	7	0.0079	6	0.48	12	0.0245	5	0.013	5	0.0022	5
4	0.005	6	0.0935	7	0.0068	7	0.0080	7	0.48	5	0.0247	7	0.013	5	0.0022	3
5	0.0055	5	0.0946	5	0.0070	5	0.0084	5	0.483	1	0.025	7	0.0139	5	0.0027	3
6	0.0056	5	0.095	1	0.008	6	0.0085	7	0.4868	7	0.026	6	0.014	1	0.0027	3
7	0.0058	7	0.095	7	0.010	5	0.0086	5	0.487	5	0.026	5	0.0141	7	0.0029	3
8	0.0059	5	0.095	7	0.012	7	0.0087	7	0.49	5	0.0266	7	0.015	1	0.0030	5
9	0.0059	5	0.095	5	0.02	5	0.0088	7	0.49	5	0.0272	5	0.015	17	0.0032	3
10	0.0060	5	0.096	5			0.009	5	0.490	1	0.0275	5	0.015	5	0.0032	5
11	0.006	5	0.0965	7			0.009	5	0.493	5	0.028	5	0.015	5	0.0035	3
12	0.006	5	0.097	5			0.009	5	0.4965	5	0.028	5	0.016	7	0.004	5
13	0.0061	1	0.097	5			0.009	5	0.497	7	0.0285	5	0.016	5	0.0048	5
14	0.01	5	0.0978	5			0.009	5	0.499	5	0.0291	7	0.0167	5		
15			0.098	5			0.0096	12	0.500	5	0.032	5	0.017	5		
16			0.10	1			0.0098	5	0.50	7			0.017	6		
17			0.100	16			0.010	5	0.5003	2			0.017	5		
18			0.10	5			0.0106	7	0.503	12						
19									0.51	7						
Average ¹	0.0057		0.0959		0.0074		0.0088		0.4915		0.0266		0.0149		0.0029	
SD ²	0.0004		0.0023		0.0016		0.0007		0.0090		0.0019		0.0016		0.0007	
u characterization ³	0.00013		0.00068		0.00067		0.00021		0.00259		0.00061		0.00049		0.00024	
u homogeneity ⁴	0.0002		0.0002		0.0002		0.00008		0.0014		0.0002		0.00015		nd	
Certified value ⁵	0.0057		0.096				0.0088		0.492		0.027		0.015		0.0029	
Expanded uncertainty ⁶	0.0005		0.001				0.0004		0.006		0.001		0.001		0.0005	

Analysis	Sn	*	As	*	Sb	*	Pb	*	B	*	Zn**	*
1	0.011	6	0.0025	4	0.014	4	0.018	6	0.0016	5	0.004	7
2	0.0117	4	0.0028	1	0.016	7	0.019	5	0.0017	7	0.0054	7
3	0.012	1	0.003	5	0.016	5	0.019	5	0.0018	5	0.009	7
4	0.012	7	0.0031	5	0.0166	7	0.019	7	0.0018	5		
5	0.013	5	0.0031	7	0.017	5	0.020	1	0.0018	5		
6	0.0137	5	0.0033	5	0.0179	5	0.020	5	0.0019	5		
7	0.0139	7	0.0034	7	0.018	5	0.020	7	0.0019	6		
8	0.014	5	0.0037	5	0.018	6	0.0208	5	0.0020	5		
9	0.0147	7	0.0037	7	0.019	5	0.0212	7	0.0020	5		
10	0.0148	5	0.004	6	0.020	1	0.022	7	0.0020	5		
11	0.015	7	0.004	7	0.020	7	0.023	5	0.0020	5		
12	0.015	1	0.004	5	0.024	5	0.023	5	0.00225	7		
13	0.015	5	0.0042	5			0.024	5				
14	0.015	5	0.0042	5			0.026	5				
15	0.015	5					0.028	4				
16	0.016	17										
Average ¹	0.0142		0.0035		0.0179		0.0212		0.00189		0.0060	
SD ²	0.0010		0.0005		0.0020		0.0022		0.00014		0.0023	
u characterization ³	0.00031		0.00017		0.00072		0.00071		0.00005		0.00166	
u homogeneity ⁴	0.0001		0.0004		0.0006		0.0014		0.000014		0.00003	
Certified value ⁵	0.014		0.0035		0.018		0.021		0.0019			
Expanded uncertainty ⁶	0.001		0.0009		0.002		0.003		0.0001			

* - 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 a 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,
- 10 – titrimetry,
- 11 – glow discharge atomic emission spectrometry,
- 12 – spectrophotometry,
- 13 – coulometry,
- 14 – flame atomic emission spectrometry,
- 15 – hollow cathode atomic emission spectrometry,
- 16 – amperometry,
- 17 – energy dispersive x-ray fluorescence spectrometry,
- 18 – visual colorimetry.

The laboratories participating in certification analysis:

- Deutsche Edelstahlwerke GmbH; Abteilung PP-CH, Witten, Germany - accreditation DakkS D-PL-19654-01-00, DIN EN ISO/IEC 17025;
- Enviform a.s., Třinec, Czech Republic; Testing laboratory Nr. 1371; Accreditation Certificate No. 219/2016 by the Czech Accreditation Institute; ČSN EN ISO/IEC 17025:2005;

- Huta Stali Jakościowych Stalowa Wola, Zakładowe Laboratorium Badawczo-Doświadczalne; UDT LB-032/22-16;
- Institute for Certified Reference Materials, Jekatierinburg, Russia, accreditation RU.0001.510008;
- Institute for Ferrous Metallurgy – Gliwice, Poland; PCA 17025 - AB554;
- ISD Huta Częstochowa, Laboratorium Badań Chemicznych i Metalograficznych, Poland,
- Lithea, Ltd. Czech Republic;
- OnderzoeksCentrum voor de Aanwending van Staal, Zelzate, Belgium,
- PJSC “Electrometallurgical works “Dneprospetsstal”, Zaporozhye, Ukraine.

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: 1C5/1, 7-2/21, 7-3/2, 16C2/2, BA 14B, BAS 276-2, BCS 320, BCS 323, BCS 335, BCS 337, BCS433, BCS 434, BCS435, BCS456/1, BCS 459, BCS 451, BCS-CRM67A, BRA 39-48, BS 50F, C2/5, C7/6, C31/4, CKD162-171, CKD165B, CKD166B, CKD180B-189A, CRM AR 1653, CRM 502-016, CRM 502-416, CRM 502-328, EZRM 194-2, EZRM 289-1, EZRM 297-1, EZRM 274-1, EURO 85, EURO 86, EURO 87, ICRM UG07-UG9/7, ICRM UG87-UG97, ICRM UG108-UG114, IMZ1.6/2, IMZ1.9/2, IMZ1.19/1, IMZ1.21/1, IMZ1.32, IMZ1.33, IMZ1.71, IMZ1.71/1, IMZ1.73, IMZ1.77, IMZ1.83, IMZ1.85, IMZ57, IMZ76, IMZ112, IMZ114, IMZ115, IMZ117, IMZ122, JS 190-195, MBH 12x41300(A), MBH 12xLA3(B), MBH 12xLA5, MBH 12 353(F), MBH 12xLA2(D), MBH 12x15260(W), MBH 12x 353(F), MBH 12x14072(A), MBH 12x356(B), MBH 13x14211, MBH 13x17005(D), MBH 13x32154, MBH 13x12853(K), MBH 13x14713(A), MBH 13xNSC3(Y), MBH 13x14212(R), MBH 12x15252(S) MBH 12x353(E), NIST 1763-1767, NIST 1264a, NIST1764a, SPL RM 2003, SPL RM 2005, SPL RM 2006, SPL RM2014, SPL RM N100, SS460/2, UNL5/3UNL10/3, UNL8/4, U11/5.

Production of melt: This material was manufactured by Institute for Ferrous Metallurgy, 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 IMZ114A 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:
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Approved by
 Director of the Institute

Prof. Dr. Hab. Eng. Adam Zieliński

Certificate issue date: 02 June 2025

Certificate revision history:

02 June 2025 (editorial changes)

26 May 2020 (change of information regarding validity of certification, editorial changes;

6th of December 2018 (Original certificate date)