

CERTIFICATE OF ANALYSIS

IMZ 71A

CERTIFIED REFERENCE MATERIAL LOW ALLOY STEEL

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

	Certified value	Expanded uncertainty		Certified value	Expanded uncertainty
C	0.126	± 0.006	Ti	0.0041	± 0.0003
Si	0.494	± 0.007	Al	0.019	± 0.001
Mn	0.493	± 0.007	Nb	0.0100	± 0.0007
P	0.0126	± 0.0006	N	0.0065	± 0.0003
S	0.0075	± 0.0006	B	0.0009	± 0.0001
Cr	0.505	± 0.005	W	0.023	± 0.002
Ni	0.036	± 0.001	Sn	0.015	± 0.001
Mo	0.018	± 0.001	As	0.016	± 0.001
Co	0.025	± 0.001	Sb	0.013	± 0.001
Cu	0.90	± 0.02	Zr	0.0065	± 0.0007
V	0.055	± 0.001			

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

Certificate Number: IMZ 71A-240724

Certificate revision history on page 4

Analysis	C	*	Si	*	Mn	*	P	*	S	*	Cr	*	Ni	*	Mo	*
1	0.115	5	0.46121	7	0.480	7	0.0112	1	0.0064	1	0.489	5	0.03	1	0.0089	5
2	0.116	5	0.47	1	0.48	1	0.0114	7	0.0065	5	0.492	7	0.0305	7	0.01611	12
3	0.118	5	0.4722	1	0.481	5	0.0117	5	0.0065	2	0.4925	7	0.0337	7	0.0165	7
4	0.123	2	0.4773	5	0.482	1	0.01192	6	0.0068	5	0.493	5	0.0345	6	0.017	14
5	0.124	2	0.483	5	0.4820	7	0.01199	12	0.0069	1	0.497	5	0.0346	1	0.017	5
6	0.1247	5	0.484	5	0.4848	1	0.012	5	0.007	2	0.50	5	0.0346	7	0.01713	7
7	0.125	5	0.4855	5	0.485	5	0.0120	5	0.007	5	0.50	14	0.0347	5	0.0173	7
8	0.1253	2	0.49	12	0.4868	12	0.012	5	0.007	5	0.50	5	0.035	5	0.0174	7
9	0.126	5	0.49	5	0.489	5	0.012	5	0.0071	5	0.501	7	0.0350	1	0.0177	1
10	0.126	13	0.493	5	0.489	5	0.012	1	0.0072	5	0.501	5	0.0353	5	0.01784	7
11	0.127	5	0.494	5	0.4898	5	0.0123	5	0.0075	2	0.50152	7	0.03535	7	0.018	5
12	0.128	2	0.495	5	0.49	5	0.01239	7	0.0076	2	0.503	5	0.0354	7	0.018	5
13	0.1284	2	0.4960	8	0.49	12	0.0126	1	0.0079	2	0.504	5	0.036	1	0.0183	7
14	0.129	5	0.498	1	0.49	17	0.0126	5	0.008	5	0.505	1	0.036	17	0.0184	7
15	0.13	5	0.498	7	0.490	5	0.0127	5	0.00883	7	0.5052	5	0.036	14	0.0185	5
16	0.13	2	0.498	7	0.4912	7	0.0130	7	0.0089	13	0.50670	12	0.036	5	0.0185	1
17	0.1300	5	0.4988	5	0.4931	14	0.013	5	0.009	2	0.5067	7	0.0360	5	0.0186	1
18			0.50	5	0.498	14	0.013	12	0.010	5	0.508	7	0.0363	5	0.0188	5
19			0.50	17	0.4985	7	0.0130	1	0.0104	5	0.5083	1	0.037	5	0.019	5
20			0.50	12	0.500	5	0.0131	7			0.51	5	0.0378	7	0.0195	5
21			0.501	5	0.500	6	0.01320	7			0.51	9	0.038	5	0.020	5
22			0.519	5	0.50	5	0.0134	7			0.51	17	0.039	5	0.02	5
23			0.521	6	0.501	7	0.0135	5			0.5131	5	0.03988	7	0.02	17
24			0.525	7	0.503	5	0.0138	5			0.5146	7	0.040	5	0.02	1
25					0.5040	5	0.0161	7			0.5157	1	0.040	5	0.0201	6
26					0.506	7	0.021	12			0.519	6	0.05	9	0.023	5
27					0.5082	1					0.52	1			0.026	12
28					0.51476	7										
Average ¹	0.1258		0.4942		0.4928		0.01260		0.00754		0.5048		0.0361		0.0184	
SD ²	0.0032		0.0083		0.0087		0.0007		0.0009		0.0071		0.0019		0.0014	
u characterization ³	0.00099		0.00212		0.0021		0.00018		0.00025		0.00171		0.00046		0.00033	
u homogeneity ⁴	0.0027		0.0025		0.0029		0.00024		0.00020		0.0015		0.00014		0.00016	
Certified value ⁵	0.126		0.494		0.493		0.0126		0.0075		0.505		0.036		0.018	
Expanded uncertainty ⁶	0.006		0.007		0.007		0.0006		0.0006		0.005		0.001		0.001	

Analysis	Co	*	V	*	W	*	Ti	*	Cu	*	Al	*	Nb	*	N	*
1	0.0207	1	0.050	7	0.0208	1	0.003	1	0.846	7	0.0160	7	0.008	5	0.0059	3
2	0.0220	7	0.050	17	0.021	5	0.0037	7	0.8549	1	0.0173	7	0.0087	7	0.0060	5
3	0.0229	7	0.052	5	0.021	5	0.0037	7	0.866	5	0.0177	7	0.009	5	0.0061	3
4	0.024	5	0.052	5	0.022	5	0.0037	5	0.869	5	0.01771	7	0.009	17	0.0062	5
5	0.0241	5	0.05	1	0.022	7	0.00375	7	0.87	5	0.018	5	0.0091	7	0.0063	3
6	0.0243	1	0.05212	7	0.022	5	0.0038	7	0.872	7	0.0181	5	0.0092	7	0.0065	3
7	0.02437	12	0.053	5	0.0223	7	0.0039	5	0.881	1	0.0185	6	0.0094	1	0.0066	3
8	0.0244	7	0.0536	5	0.0226	7	0.004	5	0.8818	7	0.0187	5	0.0094	5	0.0067	5
9	0.02441	7	0.054	5	0.02376	7	0.004	5	0.885	5	0.019	5	0.0095	7	0.0069	5
10	0.0245	1	0.054	5	0.0242	7	0.004	5	0.89	5	0.019	5	0.010	5	0.0070	5
11	0.0247	5	0.0548	1	0.0249	7	0.004	5	0.89	12	0.019	5	0.0100	5	0.0071	5
12	0.025	5	0.0549	7	0.025	5	0.00405	7	0.8945	1	0.0198	5	0.010	5		
13	0.025	5	0.0549	7	0.0253	1	0.00418	6	0.8968	7	0.020	5	0.01			
14	0.025	5	0.0550	5	0.0273	6	0.0042	5	0.89881	7	0.02	1	0.0105	1		
15	0.0252	6	0.0550	5	0.031	5	0.0044	1	0.8996	7	0.0202	5	0.01081	7		
16	0.0255	5	0.055	5			0.00464	7	0.90	17	0.02071	7	0.01082	6		
17	0.0255	5	0.0552	7			0.005	5	0.9048	5	0.0208	7	0.011	5		
18	0.026	14	0.0554	7			0.0051	7	0.9084	14	0.0215	7	0.0110	1		
19	0.02653	7	0.056	5			0.0051	5	0.913	7	0.0217	5	0.0113	5		
20	0.027	5	0.0562	1					0.913	5	0.022	5	0.0115	5		
21	0.0276	7	0.05659	7					0.92	14	0.024	5	0.0117	5		
22	0.03	1	0.057	5					0.92	1						
23			0.0575	5					0.9204	5						
24			0.0581	6					0.933	5						
25			0.05937	14					0.945	6						
26									0.964	5						
Average ¹	0.02488		0.0546		0.0233		0.00406		0.8968		0.0194		0.01001		0.0065	
SD ²	0.0010		0.0019		0.0019		0.0003		0.0226		0.0015		0.0010		0.0004	
u characterization ³	0.00026		0.00048		0.0006		0.00010		0.0056		0.00042		0.00027		0.00016	
u homogeneity ⁴	0.00027		0.0002		0.0005		0.000079		0.0090		0.000073		0.0002			
Certified value ⁵	0.025		0.055		0.023		0.0041		0.90		0.019		0.0100		0.0065	
Expanded uncertainty ⁶	0.001		0.001		0.001		0.0003		0.02		0.001		0.0007		0.0003	

Analysis	Sn	*	As	*	Sb	*	Pb**	*	B	*	Zn**	*	O**	*	Zr	*
1	0.013	14	0.012	5	0.0092	5	0.002	5	0.0006	5	0.001	5	0.0132	3	0.0050	1
2	0.0130	5	0.013	5	0.011	5	0.0025	5	0.00077	6	0.0011	5			0.0053	7
3	0.0137	5	0.0145	7	0.0117	5	0.0038	1	0.0008	5	0.0013	5			0.0054	5
4	0.014	5	0.01477	7	0.0119	4	0.011	5	0.0008	5					0.0055	5
5	0.0140	7	0.0148	5	0.012	5			0.00087	5					0.006	5
6	0.0142	5	0.015	5	0.0128	5			0.00089	7					0.0060	7
7	0.0144	5	0.015	5	0.013	1			0.0009	5					0.0064	7
8	0.0145	7	0.0155	5	0.013	14			0.0009	5					0.0068	5
9	0.0145	7	0.01557	12	0.013	5			0.0010	5					0.0068	5
10	0.0145	5	0.0156	5	0.01328	7			0.0010	7					0.00687	6
11	0.015	5	0.0156	1	0.014	5			0.0011	5					0.007	5
12	0.015	5	0.0157	7	0.0145	7			0.0011	5					0.007	5
13	0.0151	1	0.016	5	0.0146	7			0.0011	5					0.007	5
14	0.0152	5	0.0161	7	0.01508	6			0.00133	5					0.0074	5
15	0.01532	6	0.0161	1	0.0182	5									0.00751	7
16	0.01542	7	0.0163	1	0.0212	7									0.0077	1
17	0.016	5	0.0164	7	0.0258	5										
18	0.016	5	0.0166	7												
19	0.0166	7	0.01683	6												
20	0.023	17	0.0173	7												
21			0.018	5												
22			0.0248	5												
Average ¹	0.0148		0.0157		0.0134				0.00093						0.00650	
SD ²	0.0009		0.0010		0.0017				0.0001						0.0008	
u characterization ³	0.00025		0.00026		0.0005				0.00005						0.00025	
u homogeneity ⁴	0.00029		0.00061		0.0002		0.00018		0.000017		0.000031				0.00025	
Certified value ⁵	0.015		0.016		0.013				0.0009						0.0065	
Expanded uncertainty ⁶	0.001		0.001		0.001				0.0001						0.0007	

* - 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,

- Dunaferr 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, Jekatierinburg, 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-SS 462/1, SS50BCS 405/2, BCS 458/2, BCS 459/2, BS14, BS 239/3, BS 452, BS 459/2, BS2513, , C5/4, C19/5, UNL10/3, C44-2, U3/9, C7/6, C9/4, CKD164A, CKD165A, CKD 167B, CKD186D, EURONORM 096-1, Euro191-2, , EUR0181-1, EURO 187-1, EURO 042-1, EZRM 064-1, EZRM 197-1, EZRM 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 55/1A, IMZ71, IMZ 57, IMZ72, IMZ 75, IMZ 76, IMZ110, IMZ 111, IMZ 112, IMZ 114, IMZ 117, IMZ 137, IMZ 138, IMZ 140, IMZ 171, JSS175-6, MBH 12x3539(E), MBH 12x353(F), NBS1261a, NBS1263a, NIST 1264, NBS1767, NIST SRM 362, NIST SRM 363, NIST SRM 2165, NIST SRM 2167, SS51 SS52, SS53, SS55, SS59, SS 431, SS432, SS433, SS435, SS456/1, SS457/1, SS459/1, SS458, SS460, UNL17, UNL7/3, UNL6/3.

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

Available form: Discs 35 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 71A 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); 9 March 2021 (Original certificate date)