

CERTIFICATE OF ANALYSIS

IMZ 74B

CERTIFIED REFERENCE MATERIAL LOW ALLOY STEEL

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

	Certified value	Expanded uncertainty		Certified value	Expanded uncertainty
C	0.181	± 0.003	V	0.071	± 0.001
Si	0.316	± 0.005	Ti	0.021	± 0.001
Mn	1.15	± 0.01	Nb	0.041	± 0.001
P	0.019	± 0.001	Al	0.018	± 0.001
S	0.014	± 0.001	N	0.0048	± 0.0014
Cr	0.236	± 0.003	B	0.0009	± 0.0001
Ni	0.123	± 0.002	W	0.023	± 0.002
Mo	0.053	± 0.001	Sn	0.020	± 0.001
Co	0.026	± 0.001	As	0.013	± 0.001
Cu	0.245	± 0.004	Sb	0.013	± 0.001

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

Certificate Number: IMZ 74B-081223

Certificate revision history on page 4

Analysis	Al	*	As	*	B	*	C	*	Co	*	Cr	*	Cu	*	Mn	*
1	0,0157	7	0,010	5	0,00063	7	0,176	2	0,0233	7	0,226	7	0,23330	7	1,1104	7
2	0,0168	5	0,01129	7	0,0008	5	0,1769	2	0,024	1	0,23	17	0,2382	5	1,12	7
3	0,017	5	0,012	1	0,0009	7	0,1787	2	0,0247	5	0,23	10	0,24	5	1,13	1
4	0,0176	5	0,012	5	0,00090	5	0,1793	2	0,025	5	0,23	7	0,24	17	1,135	7
5	0,0179	5	0,012	5	0,0009	5	0,1797	2	0,025	5	0,2317	5	0,24	7	1,14	5
6	0,018	5	0,0121	5	0,0009	5	0,180	5	0,025	7	0,232	5	0,240	7	1,14	5
7	0,0180	5	0,0125	5	0,0009	7	0,180	5	0,0250	5	0,2321	5	0,241	7	1,140	5
8	0,0181	5	0,0128	7	0,0010	5	0,180	2	0,026	5	0,234	14	0,2437	7	1,1439	5
9	0,0184	7	0,0129	5	0,0010	5	0,1802	2	0,026	14	0,235	5	0,245	5	1,1442	5
10	0,01867	7	0,0130	5	0,0010	5	0,1807	5	0,0260	5	0,236	5	0,246	5	1,1461	7
11	0,019	14	0,0131	7	0,0013	5	0,1808	5	0,0265	5	0,2371	7	0,2468	5	1,150	14
12	0,019	5	0,0135	5			0,181	2	0,0268	5	0,238	5	0,2473	5	1,1501	5
13	0,0190	7	0,014	5			0,181	2	0,02682	7	0,238	1	0,250	1	1,1503	5
14	0,020	17	0,0144	7			0,182	5	0,0276	7	0,23836	7	0,2502	5	1,1513	5
15	0,02	7					0,1820	5	0,0296	7	0,24	5	0,251	14	1,167	1
16	0,021	5					0,183	2	0,030	5	0,24	5	0,252	1	1,17	5
17							0,1848	5			0,242	1	0,2543	5	1,18	17
18							0,19355	2			0,2430	5	0,26	5	1,2078	7
19											0,2471	7				
Average ¹	0,0184		0,0126		0,00092		0,1805		0,0259		0,2357		0,2454		1,1455	
SD ²	0,0011		0,0009		0,00009		0,0014		0,0014		0,0049		0,0059		0,0091	
u characterization ³	0,00033		0,00030		0,0000		0,00041		0,00043		0,0014		0,0017		0,0027	
u homogeneity ⁴	0,00025		0,00031		0,00001		0,0017		0,00024		0,0005		0,00065		0,003	
Certified value ⁵	0,018		0,013		0,0009		0,181		0,026		0,236		0,245		1,15	
Expanded uncertainty ⁶	0,001		0,001		0,0001		0,003		0,001		0,003		0,004		0,01	

Analysis	Mo	*	N	*	Nb	*	Ni	*	P	*	S	*	Sb	*	Si	*
1	0,0495	7	0,0037	5	0,0397	7	0,1176	7	0,0166	7	0,0097	2	0,012	5	0,3063	7
2	0,050	5	0,0040	5	0,0399	5	0,118	14	0,0169	5	0,01031	7	0,012	5	0,308	5
3	0,050	1	0,0045	3	0,040	1	0,119	7	0,017	5	0,012	1	0,0124	7	0,309	7
4	0,05	7	0,0045	5	0,040	5	0,1196	7	0,0172	5	0,012	17	0,0126	5	0,3094	5
5	0,0511	7	0,0045	5	0,0401	7	0,12	7	0,0177	5	0,0129	2	0,0127	5	0,31	5
6	0,05228	7	0,00483	3	0,041	5	0,122	5	0,018	1	0,013	5	0,013	5	0,31	17
7	0,053	5	0,00483	3	0,041	5	0,12270	7	0,018	10	0,0131	2	0,013	17	0,31	8
8	0,053	17	0,0049	3	0,0412	5	0,1230	5	0,0180	5	0,0131	5	0,0130	5	0,3153	5
9	0,053	5	0,0052	5	0,042	5	0,1235	5	0,018	7	0,0132	2	0,01325	7	0,3193	5
10	0,0538	5	0,0053	3	0,042	17	0,1235	5	0,019	5	0,0135	2	0,0137	7	0,32	1
11	0,054	1	0,0065	5	0,0420	5	0,124	1	0,0195	5	0,014	5	0,0138	7	0,32	5
12	0,054	5			0,04210	7	0,1248	5	0,0196	5	0,014	5	0,014	1	0,321	5
13	0,0543	5			0,0440	5	0,125	5	0,0198	7	0,014	2	0,0146	5	0,322	5
14	0,0549	5			0,044	5	0,1255	5	0,020	5	0,0140	2	0,0147	5	0,322	5
15	0,0551	5					0,127	5	0,02095	7	0,0140	2			0,32661	7
16	0,0560	7					0,128	5	0,0224	7	0,0140	5			0,3388	7
17	0,0562	5					0,13	17	0,023	17	0,0142	2				
18	0,058	14									0,0143	5				
19											0,0150	5				
20											0,0152	2				
21											0,0154	2				
Average ¹	0,0532		0,0048		0,0413		0,1232		0,0186		0,0136		0,0132		0,3161	
SD ²	0,0023		0,0005		0,0012		0,0030		0,0014		0,0010		0,0008		0,0071	
u characterization ³	0,00067		0,00018		0,0004		0,00092		0,00041		0,00028		0,00027		0,0022	
u homogeneity ⁴	0,00029		0,0007		0,00045		0,0004		0,00021		0,00025		0,00024		0,0009	
Certified value ⁵	0,053		0,0048		0,041		0,123		0,019		0,014		0,013		0,316	
Expanded uncertainty ⁶	0,001		0,0014		0,001		0,002		0,001		0,001		0,001		0,005	

Analysis	Sn	*	Ti	*	V	*	W	*
1	0,019	1	0,01	7	0,0682	5	0,0208	5
2	0,0190	5	0,01762	7	0,0687	7	0,021	5
3	0,01908	7	0,020	1	0,069	5	0,021	5
4	0,0194	5	0,020	17	0,0697	7	0,0210	7
5	0,0195	7	0,0204	7	0,070	1	0,022	1
6	0,0196	7	0,021	5	0,070	5	0,0222	7
7	0,020	5	0,021	5	0,07	10	0,0226	7
8	0,020	17	0,0216	5	0,0701	5	0,024	5
9	0,021	5	0,0218	5	0,0703	5	0,024	5
10	0,021	5	0,0219	7	0,071	17	0,025	5
11	0,021	5	0,022	5	0,071	5	0,02624	7
12	0,0211	7	0,0220	5	0,072	5	0,0272	5
13	0,0211	5	0,0220	5	0,07203	7	0,0291	5
14	0,0215	5	0,0221	5	0,0721	5		
15	0,022	5	0,0227	7	0,0722	7		
16			0,023	5	0,0728	5		
17					0,073	14		
Average ¹	0,0203		0,0214		0,0707		0,0232	
SD ²	0,0010		0,0010		0,0014		0,0021	
u characterization ³	0,00032		0,00030		0,0004		0,00074	
u homogeneity ⁴	0,00018		0,0002		0,00021		0,00043	
Certified value ⁵	0,020		0,021		0,071		0,023	
Expanded uncertainty ⁶	0,001		0,001		0,001		0,002	

* - 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,
- 5 – spark atomic emission spectrometry,
- 7 – inductive coupled plasma atomic emission spectrometry,
- 8 – gravimetry,
- 10 – titrimetry,
- 12 – spectrophotometry,
- 14 – flame atomic emission spectrometry,
- 17 – energy dispersive x-ray fluorescence spectrometry.

Participating Laboratories:

- ArcelorMittal, Dąbrowa Górnicza, PCA accreditation AB 1449, ISO 17025, (Poland)
- Bundesanstalt für Materialforschung und -prüfung (BAM), DAKKs accreditation D-PL-11075-14-00, ISO 17025, (Germany)
- Cognor S.A. Oddział HSJ, Stalowa Wola, Zakładowe Laboratorium Badawczo-Doświadczalne, UDT LBU-301/22-22, (Poland)
- Dunaiferr Labor Nonprofit Kft., Dunaújváros, NAH accreditation NAH-1-1798/2021, ISO 17025, (Hungary)
- Enviform a.s., Třinec, Testing Laboratory Nr 1371, CAI accreditation, ISO 17025, (Czech Republic)
- Lithea, Ltd., (Czech Republic)
- OnderzoeksCentrum voor de Aanwending van Staal, Zelzate, (Belgium),
- Sieć Badawcza Łukasiewicz - Górnośląski Instytut Technologiczny, Gliwice, PCA accreditation AB 554, ISO 17025, (Poland)
- Sieć Badawcza Łukasiewicz - Instytut Metali Nieżelaznych, Gliwice, PCA accreditation AB 274, ISO 17025, (Poland)
- TECHLAB, St Julien-les-Metz, (France)
- Vítkovice Testing Center, Ostrava, Testing Laboratory Nr 1036, CAI accreditation, ISO 17025, (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:

AR 659, BAS 087-1, BS 14B, BS 33F, BS 316D, BS 316E, BS 316F, BS 700C, BS 1018, BS 1026A, BS 1762, BS 4340 A, BS 4820A, BCS 161/3, BCS 331, BCS/SS 431, BCS 451, ČKD 164, ČKD 165B, ČKD 166, ČKD 166B, ČKD 171B, ČKD 180B, ČKD 189A, CMI 185D, DDR Nr.85, Eltra 92400-3062, EURONORM 85, EURONORM 86, EURONORM 87, IMZ 1.19/2, IMZ 1.21/1, IMZ 1.74/1, IMZ 51/1, IMZ 68, IMZ 72, IMZ 74, IMZ 74A, IMZ 75, IMZ 103A, IMZ 112A, IMZ 114A, IMZ 115, IMZ 116, IMZ 117, IMZ 122, IMZ 124, IMZ 137, IMZ 138, IPT 12A, IPT 31, Kladno 3-3-09, Leco 501-502, Leco 501-503, Leco 501-510, Leco 501-676, Leco 501-677, MBH 12x353G, MBH 12x354B, MBH 12x356B, MBH12x356C, MBH 12xLA3, MBH 12x357D, NCSHC 1112, NCS HS 11702-4, NIST 1261, NIST 1269, NIST 1761, NIST 1763, PT 5/2 ČMI, SPL 184A, SPL 182A, SPL LA-3F, 3-1-31 ČSMU, 3-1-32 ČSMU, Vítkovice 3-1-33, pure reagents Merck Certipur, Na₂CO₃, K₂SO₄.

Production of melt: This material was manufactured by Łukasiewicz Research Network - Upper Silesian Institute of Technology (Poland)

Available form: Discs approximately 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 74B 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: 8 December 2023