

CERTIFICATE OF ANALYSIS

IMZ 68

CERTIFIED REFERENCE MATERIAL LOW ALLOY STEEL

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

	Certified value	Expanded uncertainty		Certified value	Expanded uncertainty
C	0,102	± 0.007	Cu	0,166	± 0.004
Si	0,13	± 0.01	V	0,046	± 0.004
Mn	0,346	± 0.006	Ti	0,0033	± 0.0008
P	0,028	± 0.001	N	0,0086	± 0.0006
S	0,015	± 0.003	Sn	0,0066	± 0.0008
Cr	0,33	± 0.02	As	0,0057	± 0.0008
Ni	0,049	± 0.002	Sb	0,0020	± 0.0003
Co	0,008	± 0.001			

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

Certificate Number: IMZ 68-20082024

Certificate revision history on page 4

Analysis	C	*	Si	*	Mn	*	P	*	S	*	Cr	*	Ni	*	Mo**	*
1	0,0958	2	0,09	17	0,34	1	0,024	5	0,010	17	0,31	17	0,0401	5	0,00756	7
2	0,099	2	0,1017	6	0,34	17	0,0249	6	0,011	5	0,31241	7	0,043	1	0,009	7
3	0,099	13	0,1129	5	0,34	5	0,025	1	0,012	5	0,3153	5	0,048	7	0,00953	7
4	0,10	2	0,116	7	0,34	7	0,02687	7	0,013	1	0,319	7	0,048	5	0,010	7
5	0,10	5	0,1206	7	0,3401	5	0,027	5	0,013	5	0,32	1	0,048	5	0,010	7
6	0,101	5	0,1231	12	0,34239	7	0,027	7	0,0132	5	0,32	7	0,048	14	0,01003	6
7	0,10137	2	0,127	5	0,3426	12	0,02704	12	0,014	5	0,3258	5	0,04850	7	0,011	1
8	0,103	5	0,1283	5	0,343	5	0,0275	1	0,014	7	0,3268	12	0,04898	7	0,011	5
9	0,103	2	0,12960	7	0,3438	7	0,0278	5	0,0149	2	0,3269	7	0,049	5	0,011	17
10	0,104	2	0,13	5	0,346	5	0,028	5	0,0154	2	0,33	14	0,049	7	0,0124	5
11	0,104	2	0,13	7	0,346	7	0,028	7	0,01583	2	0,3308	6	0,0491	5	0,013	5
12	0,104	5	0,131	5	0,3470	14	0,0288	5	0,0159	2	0,3335	5	0,0493	6	0,014	5
13	0,1053	2	0,133	5	0,3481	5	0,0295	7	0,0160	2	0,335	5	0,050	5	0,0140	5
14			0,136	5	0,349	5	0,0299	5	0,016	2	0,337	5	0,050	7	0,014	5
15			0,136	5	0,35	1	0,030	5	0,0163	2	0,340	5	0,051	5	0,014	5
16			0,14	1	0,3526	6	0,031	10	0,01667	7	0,34	17	0,054	5		
17			0,141	7	0,354	7	0,031	17	0,01690	2	0,34	5				
18					0,355	5	0,03151	7	0,0181	13	0,340	5				
19					0,36	14	0,03570	18			0,341	7				
Average ¹	0,1016		0,1275		0,3460		0,0282		0,0147		0,3287		0,0488		0,0114	
SD ²	0,0024		0,0086		0,0053		0,0022		0,0018		0,0100		0,0012		0,0020	
u characterization ³	0,00084		0,00261		0,0015		0,00062		0,00053		0,00287		0,00039		0,00066	
u homogeneity ⁴	0,0036		0,006		0,0028		0,00014		0,0013		0,0085		0,0009		0,0022	
Certified value ⁵	0,102		0,13		0,346		0,028		0,015		0,33		0,049			
Expanded uncertainty ⁶	0,007		0,01		0,006		0,001		0,003		0,02		0,002			

Analysis	Co	*	V	*	W**	*	Ti	*	Cu	*	Al**	*	Nb**	*	N	*
1	0,005	5	0,039	7	0,006	5	0,002	1	0,148	7	0,00239	7	0,00100	6	0,0067	5
2	0,00731	7	0,0419	5	0,00781	7	0,003	5	0,1568	5	0,0024	6	0,001	5	0,0081	3
3	0,0076	5	0,04203	7	0,00880	6	0,003	5	0,16	17	0,003	7	0,00142	7	0,0083	5
4	0,0078	5	0,044	17	0,009	5	0,003	5	0,16	17	0,0041	5	0,004	7	0,00858	2
5	0,00795	6	0,045	7	0,010	5	0,003	7	0,16039	7	0,005	5	0,0047	7	0,0086	3
6	0,008	1	0,04521	7	0,010	7	0,0031	7	0,161	1	0,0050	5	< 0,002	5	0,0086	5
7	0,008	5	0,0455	6	0,012	5	0,00326	7	0,162	5	0,005	5	< 0,003	5	0,0087	3
8	0,008	7	0,047	1	0,024	7	0,0034	5	0,162	14	0,00507	12			0,0088	3
9	0,008	5	0,047	5	< 0,010	5	0,00345	7	0,165	5	0,0052	5			0,00897	12
10	0,00844	7	0,047	7	< 0,02	5	0,0035	5	0,1662	12	0,006	5			0,0094	3
11	0,00870	12	0,0473	5			0,0037	5	0,1663	7	0,007	5		5	0,0098	3
12	0,009	5	0,0477	5			0,0037	5	0,170	5						
13	0,009	7	0,048	5			0,0039	6	0,17	5						
14	0,011	7	0,048	5			0,0039	5	0,17	7						
15	< 0,01	5	0,050	5			< 0,01	7	0,171	5						
16			0,050	5					0,1716	5						
17									0,174	5						
18									0,1741	6						
19									0,175	7						
Average ¹	0,0081		0,0464		0,0096		0,0033		0,1658		0,0046		0,0016		0,0086	
SD ²	0,0006		0,0022		0,0019		0,0004		0,0061		0,0013		0,0007		0,0004	
u characterization ³	0,00020		0,00069		0,0008		0,00013		0,00176		0,00047		0,00038		0,00016	
u homogeneity ⁴	0,0007		0,0019		0,00087		0,00037		0,00084		0,0008		0,0000			
Certified value ⁵	0,008		0,046				0,0033		0,166						0,0086	
Expanded uncertainty ⁶	0,001		0,004				0,0008		0,004						0,0006	

Analysis	Sn	*	As	*	Sb	*	Pb**	*	B**	*	Zn**	*	Zr**	*
1	0,0056	5	0,00456	7	0,001	5	0,00312	7	0,0001	5	0,00217	7	0,001	5
2	0,00581	7	0,005	5	0,00129	7	< 0,001	5	0,0003	5			0,002	7
3	0,0060	7	0,005	5	0,002	1			0,0005	5			0,00250	7
4	0,006	5	0,0052	7	0,002	5			0,00073	7			0,00313	6
5	0,006	7	0,0053	5	0,002	5			0,001	7			< 0,001	5
6	0,0062	5	0,006	1	0,0021	6			< 0,0001	5			< 0,002	5
7	0,007	5	0,006	5	0,008	7			< 0,0003	5				
8	0,00721	6	0,0061	5	< 0,002	5								
9	0,008	5	0,0065	6										
10	0,008	5	0,008	7										
11	0,009	1												
Average ¹	0,0066		0,0057		0,0020				0,0005				0,0022	
SD ²	0,0008		0,0007		0,0002				0,0004				0,0009	
u characterization ³	0,00029		0,00030		0,0001				0,00020				0,00056	
u homogeneity ⁴	0,0003		0,0003		0,00001		0,00003						0,00003	
Certified value ⁵	0,0066		0,0057		0,0020									
Expanded uncertainty ⁶	0,0008		0,0008		0,0003									

* - 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 performed 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,
- 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.
- 18 – colorimetry.

The laboratories participating in certification analysis:

- ArcelorMittal, Dąbrowa Górnicza, Poland, PCA 17025 – AB 1449,
- Cognor S.A.Oddział HSJ w Stalowej Woli, Poland, Zakładowe Laboratorium Badawczo-Doświadczalne; UDT LB-032/22-16,
- Dunaiferr Labor Nonprofit Ltd, Dunaújváros Environmental and Chemical Analytical Material Testing Department and Spectrometric Material Testing Department, Hungary, Accreditation ISO/IEC 17025; NAH-2-0330/2016,
- Enviform a.s., Třinec, The Czech Republic; Testing Laboratory Nr 1371; Accreditation Certificate No, 219/2016 by the Czech Accreditation Institute; ČSN EN ISO/IEC 17025:2005,
- 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, Poland, Gliwice, PCA 17025 - AB554,

- 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: B2752, B2764, BCS SS433, BCS SS435, MBH 12x356(C), BCS SS53, BCS SS 434, BCS-CRM No.113, BS 8620E, BS 160A, BS2931A, BS 1048, BS 56H, BS 55G, BS 61G, C5/4, C7/6, C9/4, C15/5, CKD167B, CKD186D, ECRM 077-3, ECRM 083-1, ECRM 055-2, , Euro 042-1, Euro 059-2, IMZ73, IMZ74A, IMZ76, IMZ111, IMZ112, IMZ112A, IMZ113, IMZ114, IMZ115, IMZ114A, IMZ117, IMZ137, IMZ138, IMZ140, IMZ1.5/3, IMZ1.77, IMZ1.84, IMZ1.10/1, IMZ 1.9/2, IMZ1.5/2, NIST 362, NIST 2165, NIST 2167, UNL18, C61, , UNL1/2, UNL2/5, UNL10/3, UG1/10, UNL8/3, UNL13/3, TL1001, pure chemicals.

Production of melt: This material was manufactured by Baildon steel plant, Katowice, Poland.

Available form: Discs approx. 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 68 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: 20 August 2024

Certificate revision history:

20 August 2024 (editorial changes)

20 December 2021 (Original certificate date)