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GIT

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CERTIFICATE OF ANALYSIS

IMZ 72A

CERTIFIED REFERENCE MATERIAL
LOW ALLOY STEEL

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

	Certified value	Expanded uncertainty		Certified value	Expanded uncertainty
C	0.076	± 0.007	V	0.011	± 0.001
Si	0.282	± 0.007	Ti	0.019	± 0.001
Mn	0.333	± 0.008	Al	0.021	± 0.001
P	0.081	± 0.006	N	0.0050	± 0.0012
S	0.012	± 0.001	B	0.0009	± 0.0001
Cr	0.530	± 0.007	W	0.023	± 0.001
Ni	0.050	± 0.002	Sn	0.014	± 0.001
Mo	0.021	± 0.001	As	0.013	± 0.001
Co	0.024	± 0.001	Sb	0.013	± 0.001
Cu	0.288	± 0.008			

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

Certificate Number: IMZ 72A-081223
Certificate revision history on page 4

Analysis	Al	*	As	*	B	*	C	*	Co	*	Cr	*	Cu	*	Mn	*
1	0,0193	5	0,010	5	0,0008	5	0,073	5	0,020	7	0,516	7	0,229	7	0,32022	7
2	0,0195	7	0,012	5	0,00080	5	0,0735	5	0,022	5	0,51678	7	0,2698	5	0,323	5
3	0,0195	7	0,0120	5	0,00083	7	0,0736	2	0,0231	5	0,52	17	0,27456	7	0,324	7
4	0,02	7	0,0122	7	0,0009	5	0,0738	2	0,0237	5	0,52	7	0,28	17	0,3258	5
5	0,0202	5	0,0124	5	0,0009	5	0,074	2	0,0239	7	0,5237	5	0,28	7	0,3295	5
6	0,0207	5	0,0125	5	0,0009	5	0,0741	5	0,024	14	0,5257	5	0,282	5	0,33	17
7	0,0208	7	0,0126	5	0,0010	7	0,0741	5	0,0240	5	0,53	1	0,285	7	0,3314	5
8	0,0212	5	0,0127	5	0,0010	5	0,0747	2	0,0240	5	0,53	5	0,287	14	0,332	7
9	0,0218	5	0,01277	7	0,0010	5	0,0753	2	0,0240	5	0,53	10	0,2886	7	0,332	1
10	0,0218	5	0,013	1	0,0010	7	0,0755	2	0,025	1	0,5300	5	0,29	5	0,3321	5
11	0,02261	7	0,014	5	0,0011	5	0,0769	2	0,025	5	0,530	5	0,2939	5	0,333	5
12	0,023	5	0,014	5			0,077	2	0,025	5	0,533	14	0,2942	5	0,3349	5
13	0,023	5	0,0141	7			0,078	2	0,0255	7	0,534	5	0,296	1	0,34	1
14	0,024	5	0,0152	7			0,0782	5	0,0265	7	0,534	1	0,297	5	0,34	5
15	0,025	17					0,07843	2	0,02659	7	0,537	5	0,2978	5	0,34	5
16							0,079	5	0,027	5	0,537	5	0,298	1	0,34	7
17							0,081	5			0,54	5	0,2980	5	0,3400	7
18							0,0845	2			0,5427	7	0,30	5	0,345	14
19											0,5667	7				
Average[1]	0,0214		0,0128		0,00093		0,0760		0,0244		0,5302		0,2881		0,3330	
SD[2]	0,0016		0,0008		0,00010		0,0022		0,0013		0,0081		0,0095		0,0067	
u characterization[3]	0,00053		0,00027		0,0000		0,00066		0,00041		0,0023		0,0028		0,0020	
u homogeneity[4]	0,00013		0,00054		0,00003		0,0032		0,00022		0,0025		0,0027		0,0032	
Certified value[5]	0,021		0,013		0,0009		0,076		0,024		0,530		0,288		0,333	
Expanded uncertainty[6]	0,001		0,001		0,0001		0,007		0,001		0,007		0,008		0,008	

Analysis	Mo	*	N	*	Nb**	*	Ni	*	P	*	S	*	Sb	*	Si	*
1	0,0194	7	0,0045	5	0,00096	7	0,045	14	0,0760	5	0,009	17	0,0101	5	0,2689	5
2	0,020	5	0,00455	3	0,001	1	0,0451	7	0,0770	5	0,010	5	0,0103	7	0,2703	5
3	0,020	1	0,0046	3	0,0011	5	0,047	5	0,078	17	0,0100	5	0,011	5	0,2739	7
4	0,02	7	0,0048	5	0,0012	5	0,0486	5	0,078	5	0,01012	7	0,011	17	0,2777	5
5	0,02016	7	0,0048	5	0,0013	7	0,0488	5	0,0798	7	0,0105	2	0,011	5	0,279	5
6	0,0205	7	0,00506	3	0,002	5	0,0491	5	0,0799	5	0,011	1	0,011	5	0,280	7
7	0,0206	5	0,0051	5	0,009	17	0,0494	7	0,080	7	0,0110	5	0,0129	5	0,28	5
8	0,021	1	0,0051	3	< 0,0002	5	0,0498	5	0,0801	5	0,0112	2	0,013	5	0,28	8
9	0,021	17	0,0054	3	< 0,003	5	0,050	5	0,0810	7	0,0113	2	0,0130	5	0,28	7
10	0,0210	5	0,0054	5			0,05	7	0,08198	7	0,0114	2	0,0131	5	0,280	5
11	0,021	5	0,0068	5			0,0503	5	0,082	10	0,0117	2	0,01357	7	0,282	5
12	0,022	5					0,05041	7	0,083	5	0,012	5	0,0136	7	0,288	5
13	0,0221	7					0,0505	7	0,083	5	0,012	5	0,014	1	0,29	1
14	0,0223	5					0,053	1	0,085	5	0,0122	2	0,0143	5	0,29	5
15	0,0225	5					0,056	5	0,086	1	0,0122	2	0,0151	7	0,30	17
16	0,023	5					0,057	5	0,0866	7	0,0122	5			0,3035	7
17	0,0230	5					0,060	17	0,0899	5	0,0123	5			0,30417	7
18											0,0125	2				
19											0,0127	2				
20											0,013	2				
21											0,0136	2				
Average[1]	0,0212		0,0050		0,0013		0,0500		0,0813		0,0116		0,0125		0,2824	
SD[2]	0,0011		0,0004		0,0003		0,0019		0,0030		0,0010		0,0016		0,0078	
u characterization[3]	0,00034		0,00014		0,0001		0,00056		0,00091		0,00027		0,00051		0,0024	
u homogeneity[4]	0,00029		0,0006		0,00002		0,00064		0,0027		0,00038		0,00036		0,0025	
Certified value[5]	0,021		0,0050				0,050		0,081		0,012		0,013		0,282	
Expanded uncertainty[6]	0,001		0,0012				0,002		0,006		0,001		0,001		0,007	

Analysis	Sn	*	Ti	*	V	*	W	*
1	0,012	17	0,0178	5	0,009	5	0,0185	7
2	0,013	5	0,0178	5	0,0097	5	0,0188	5
3	0,0134	7	0,0178	5	0,010	5	0,019	1
4	0,01384	7	0,018	1	0,01004	7	0,020	5
5	0,014	1	0,0181	5	0,0101	5	0,021	5
6	0,0140	5	0,0184	7	0,0102	7	0,0220	7
7	0,0141	5	0,0184	7	0,011	5	0,0231	5
8	0,0143	5	0,01846	7	0,0106	7	0,0233	5
9	0,0143	5	0,0186	7	0,0108	7	0,02349	7
10	0,0144	7	0,019	5	0,0109	5	0,024	5
11	0,015	5	0,019	5	0,0109	5	0,024	5
12	0,015	5	0,019	5	0,0120	5	0,024	5
13	0,015	5	0,019	5	0,013	1	0,0241	7
14	0,0154	7	0,0191	5	0,013	5		
15	0,0156	5	0,020	17	0,020	17		
16			0,02	7				
Average[1]	0,0143		0,0186		0,0107		0,0225	
SD[2]	0,0008		0,0006		0,0008		0,0014	
u characterization[3]	0,00026		0,00019		0,0003		0,00049	
u homogeneity[4]	0,00034		0,00042		0,0001		0,00042	
Certified value[5]	0,014		0,019		0,011		0,023	
Expanded uncertainty[6]	0,001		0,001		0,001		0,001	

* - 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)
- Dunaferr 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)
- Vitkovice 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 645, AR 659, AR 1653, BS 14B, BS 33F, BS 316D, BS 316E, BS 316F, BS 700C, BS 1026A, BS 1762, BS 4340 A, BS 4820A, BCS 161/3, BCS 331, BCS 403, BCS/SS 403/2, BCS 432, BCS 433, BCS 435, BCS 451, BCS 456, ČKD163B, ČKD 164, ČKD 165A, ČKD 165B, ČKD 166, ČKD 166B, ČKD 168B, ČKD 171B, ČKD 180B, ČKD189A, E281-1, Eltra 92400-3040, Eltra 92400-3062, EURONORM 85, EURONORM 86, EURONORM 87, IMZ 1.5/3, IMZ 1.21/1, IMZ 1.74/1, IMZ 51/1, IMZ 55/1A, IMZ 68, IMZ 72, IMZ 74A, IMZ 75, IMZ 75A, IMZ 103A, IMZ 115, IMZ 116, IMZ 117, IMZ 124, IMZ 138, IPT 12A, IPT 39, Kladno 3-3-04, Kladno 3-3-13, Leco 501-501, Leco 501-502, Leco 501-510, Leco 502-893, MBH 12x353G, MBH 12x354B, MBH 12x356B, MBH 12x356C, MBH 12xLA3, MBH 12x357B, MBH 12x357D, NCS HS 11702-4, NCSHC 14213, NIST 1761, PT 5/2 ČMI, SPL CM-14A, SPL 184A, SPL 182A, SPL LA-3F, 3-1-31 ČSMU, 3-1-32 ČSMU, Vítkovice 3-1-33, pure reagents Merck Certipur, Na_2CO_3, K_2SO_4.

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 72A 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