

# CERTIFICATE OF ANALYSIS

## IMZ 523

### CERTIFIED REFERENCE MATERIAL MARAGING STEEL

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

	Certified value	Uncertainty*		Certified value	Uncertainty*
C	0.010	± 0.001	Mo	6.67	± 0.14
Si	0.043	± 0.005	V	2.01	± 0.03
Mn	0.051	± 0.002	W	1.87	± 0.03
S	0.0039	± 0.0005	Cu	0.059	± 0.002
Co	14.44	± 0.13	Ti	0.70	± 0.02
Cr	0.048	± 0.004	N	0.0037	± 0.0006
Ni	15.94	± 0.18			

the uncertainty bases on 95% confidence limit and material inhomogeneity

Certificate Number: IMZ 523-280824  
Certificate revision history on page 4

Analysis	C	*	Si	*	Mn	*	P**	*	S	*	Co	*	Cr	*	Ni	*
1	0,0080	2	0,0373	7	0,045	1	0,002	6	0,0031	2	13,97	7	0,038	5	15,52	7
2	0,009	2	0,038	1	0,046	5	0,0022	7	0,0032	2	14,10	6	0,0428	7	15,6883	7
3	0,00994	5	0,03922	5	0,047	6	0,0023	12	0,00361	7	14,23	17	0,0443	7	15,69	8
4	0,0100	2	0,040	5	0,048	1	0,0030	7	0,004	2	14,30	7	0,047	7	15,77	7
5	0,0100	2	0,041	7	0,049	7	0,003	7	0,0042	2	14,33	7	0,050	7	15,79	7
6	0,0105	2	0,041	7	0,0498	7	0,00526	5	0,0044	2	14,42	11	0,05	7	15,89	1
7	0,011	13	0,048	1	0,051	7	0,00565	7	0,00458	5	14,46	7	0,05	6	15,90	7
8			0,050	6	0,051	7	0,006	7			14,49	7	0,05086	5	15,91	10
9			0,05474	7	0,051	1					14,4923	7	0,05	7	15,922	5
10					0,051	7					14,53	14	0,055	7	15,94	12
11					0,0517	7					14,55	1			15,97	14
12					0,0518	12					14,5878	7			16,00	17
13					0,052	7					14,60	12			16,07	6
14					0,05339	7					14,64	5			16,15	11
15					0,054	11					14,65	1			16,2379	7
16					0,0555	5					14,72	14			16,53	1
Average	0,0098		0,0433		0,0505				0,0039		14,442		0,0479		15,936	
SD	0,0010		0,0061		0,0029				0,0006		0,208		0,0049		0,240	
Certified value	<b>0,010</b>		<b>0,043</b>		<b>0,051</b>				<b>0,0039</b>		<b>14,44</b>		<b>0,048</b>		<b>15,94</b>	
C(95%)	0,0009		0,0047		0,0015				0,0005		0,1108		0,0035		0,1277	
RSD	10,1		14,2		5,7				15,0		1,4		10,3		1,5	
SD homogeneity	0,0002		0,002		0,0004						0,06		0,0004		0,12	
Uncertainty	<b>0,001</b>		<b>0,005</b>		<b>0,002</b>				<b>0,0005</b>		<b>0,13</b>		<b>0,004</b>		<b>0,18</b>	

Analysis	Mo	*	V	*	W	*	Ti	*	Cu	*	Al**	*	Nb**	*	N	*
1	6,348	5	1,92	9	1,81	7	0,660	7	0,052	7	0,004	7	0,00787	7	0,003	3
2	6,5	7	1,93	7	1,82	7	0,6740	7	0,054	6	0,016	1	0,008	6	0,0035	3
3	6,5	6	1,94	1	1,8285	7	0,6781	7	0,055	5	0,016	1	0,008	1	0,0038	3
4	6,53	1	1,967	9	1,83	7	0,68	1	0,056	1	0,030	6	0,009	1	0,004	3
5	6,5378	7	1,97	6	1,83	6	0,69	7	0,057	1	0,0314	7	< 0,005	7	0,0042	3
6	6,6	1	1,976	16	1,84	11	0,6948	5	0,0585	7	0,037	7				
7	6,65	7	1,99	7	1,87	1	0,698	11	0,0594	12	0,040	11				
8	6,67	1	1,9925	7	1,87	12	0,70	1	0,0597	14	0,0439	5				
9	6,6812	7	2,00	1	1,872	7	0,70	5	0,06	7	0,06850	7				
10	6,74	7	2,003	7	1,90	1	0,70	1	0,061	7	< 0,005	7				
11	6,856	7	2,01	1	1,90	1	0,70	6	0,062	7						
12	6,91	12	2,06	7	1,9113	7	0,7416	7	0,063	7						
13	7,13	11	2,08	7	1,93	7	0,742	7	0,06328	7						
14			2,080	7	1,988	5	0,76	7	0,0640	5						
15			2,08	11												
16			2,098	5												
17			2,1165	7												
Average	6,666		2,013		1,871		0,70132		0,0589						0,00370	
SD	0,207		0,062		0,050		0,02823		0,0037						0,00047	
Certified value	<b>6,67</b>		<b>2,01</b>		<b>1,87</b>		<b>0,70</b>		<b>0,059</b>						<b>0,0037</b>	
C(95%)	0,125		0,032		0,029	-	0,016		0,002						0,001	
RSD	3,1		3,1		2,7		4,0		6,3						12,7	
SD homogeneity	0,07		0,01		0,01		0,01		0,0005							
Uncertainty	<b>0,14</b>		<b>0,03</b>		<b>0,03</b>		<b>0,02</b>		<b>0,002</b>						<b>0,0006</b>	

Analysis	Sn**	*	As**	*	Sb**	*	B**	*
1	0,0009	6	0,0006	7	0,00017	4	0,0011	6
2	0,0009	7	0,0014	15	0,0003	15	0,00182	7
3	0,0011	15	0,0016	7	0,00041	7	0,0021	7
4	0,0015	7	0,0033	5	0,0011	6	0,003	5
5	< 0,005	7	0,00452	7			< 0,001	7
6			0,005	6				
7			< 0,005	7				
Average								
SD								
Certified value								
C(95%)								
RSD								
SD homogeneity							0,0001	
Uncertainty								

\* - analytical method used

\*\* - informative values

$C(95\%) = (t \cdot SD) / \sqrt{n - 1}$  - The half-width confidence interval calculated for the 95 % confidence level where  $t$  is the appropriate Student's  $t$  value,  $sd$  is the interlaboratory standard deviation and  $n$  is the number of acceptable mean values

**Homogeneity:** The homogeneity of this Reference Material was evaluated with the use of statistic parameters obtained during interlaboratory tests in 1996 and found acceptable. Optical emission spectrometry with spark excitation method was used.

**Certification Process:** Both preparation of this Reference Material and certification process were prepared according to requirements of ISO Guide 31. ISO Guide 34 and ISO Guide 35. This reference material is in agreement with ISO Guide 30.

**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 – high frequency infra red absorption,
- 3 – high temperature extraction,
- 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.

**The laboratories participating in certification analysis:**

- ArcelorMittal Eisenhüttenstadt, Forschungs- und Qualitätszentrum GmbH, Germany - accreditation DakkS D-PL-17148-01-00, DIN EN ISO/IEC 17025;

- Deutsche Edelstahlwerke GmbH; Abteilung PP-CH, Witten, Germany - accreditation DakkS D-PL-19654-01-00, DIN EN ISO/IEC 17025;
- Genitest Inc Montreal, Canada, accreditation P RI 123077;
- Inco Test Ltd Hereford, England, accreditation UKAS 0281;
- Institute for Certified Reference Materials, Jekatierinburg, Russia, accreditation RU.0001.510008;
- Institute for Ferrous Metallurgy – Gliwice, Poland; PCA 17025 - AB554;
- Leco Instrumente Plzen, Czech Republic;
- Lithea, Ltd. Czech Republic;
- OnderzoeksCentrum voor de Aanwending van Staal, Zelzate, Belgium;
- PJSC “Electrometallurgical works “Dneprospetsstal”, Zaporozhye, Ukraine.

**Traceability:** This Reference Material was tested with the use of optical emission spectrometry with spark excitation and was found compatible to the following CRMs: MBH 14933(R), MBH 14933(S).

**Production of melt:** This material was manufactured by Instytut Metalurgii Żelaza, Gliwice, Poland.

**Available form:** Discs 38 mm in diameter and 20 mm high.

**Intended use:** This Reference Material is intended for use in optical emission and X-ray spectrometric methods. Caution: In optical emission spectrometry with spark excitation the central part of the surface (approximately 5 mm) should be avoided because of possible segregation of the material.

**Validity of certification:** The certification of IMZ 523 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](mailto:rm@git.lukasiewicz.gov.pl)

Approved by  
 Director of the Institute

Prof. Dr. Hab. Eng. Adam Zieliński

Certificate issue date: 28 August 2024

Certificate revision history:

28 August 2024 (editorial changes)

1 March 2021 (change of information regarding validity of certification, editorial changes);

December 2016 (Original certificate date)