

# CERTIFICATE OF ANALYSIS

## IMZ 524

### CERTIFIED REFERENCE MATERIAL MARAGING STEEL

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

	Certified value	Uncertainty*		Certified value	Uncertainty*
C	0.012	± 0.001	Mo	4.95	± 0.08
Si	0.13	± 0.01	V	3.02	± 0.05
Mn	0.68	± 0.01	W	1.85	± 0.03
S	0.004	± 0.001	Cu	0.024	± 0.002
Co	12.25	± 0.05	Ti	0.85	± 0.02
Cr	0.085	± 0.003	N	0.0038	± 0.0003
Ni	13.75	± 0.16			

the uncertainty bases on 95% confidence limit and material inhomogeneity

Certificate Number: IMZ 524-29072024

Certificate revision history on page 4

Analysis	C	*	Si	*	Mn	*	P**	*	S	*	Co	*	Cr	*	Ni	*
1	0,0103	2	0,097	1	0,673	7	0,002	6	0,00266	7	12,16	1	0,074	5	13,2	7
2	0,0109	2	0,1150	7	0,645	1	0,0028	12	0,0036	2	12,18	7	0,0810	7	13,59	7
3	0,0119	2	0,11540	5	0,65	1	0,0030	7	0,0038	2	12,2	7	0,0849	7	13,60	17
4	0,0123	2	0,12	5	0,650	5	0,0032	7	0,004	2	12,22	14	0,085	7	13,602	5
5	0,01232	5	0,130	1	0,658	6	0,004	7	0,0049	2	12,23	7	0,085	6	13,6173	7
6	0,013	13	0,139	7	0,668	7	0,00488	5	0,0049	2	12,23	1	0,08504	5	13,62	7
7	0,013	2	0,1395	7	0,670	7	0,00600	7	0,00588	5	12,2600	7	0,086	7	13,65	7
8			0,140	1	0,679	11	0,006	7			12,26	5	0,087	7	13,66	7
9			0,140	7	0,6840	7					12,27	12	0,088	7	13,72	1
10			0,140	6	0,687	7					12,28	1	0,09	7	13,74	11
11			0,153	7	0,693	7					12,29	14			13,83	12
12			0,170	7	0,697	1					12,29	11			13,89	10
13					0,7002	7					12,30	7			13,94	7
14					0,702	12					12,3031	7			13,98	6
15					0,703	7									14,01	14
16					0,7086	5									14,0423	7
17															14,10	1
Average	0,0120		0,1332		0,6792				0,0042		12,248		0,0846		13,752	
SD	0,0010		0,0193		0,0209				0,0011		0,046		0,0044		0,226	
Certified value	<b>0,012</b>		<b>0,13</b>		<b>0,68</b>				<b>0,004</b>		<b>12,25</b>		<b>0,085</b>		<b>13,75</b>	
C(95%)	0,0009		0,0123		0,0111				0,0010		0,0264		0,0031		0,1162	
RSD	8,6		14,5		3,1				24,9		0,4		5,2		1,6	
SD homogeneity	0,0003		0,002		0,004		0,0001				0,04		0,0004		0,11	
Uncertainty	<b>0,001</b>		<b>0,01</b>		<b>0,01</b>				<b>0,001</b>		<b>0,05</b>		<b>0,003</b>		<b>0,16</b>	

Analysis	Mo	*	V	*	W	*	Ti	*	Cu	*	Al**	*	Nb**	*	N	*
1	4,8	7	2,92	7	1,795	7	0,90	7	0,015	7	0,00788	7	0,006	1	0,0035	3
2	4,8	6	2,9256	7	1,80	7	0,790	7	0,020	5	0,012	7	0,007	6	0,0037	3
3	4,822	5	2,93	9	1,80	11	0,80	7	0,021	6	0,023	7	0,00784	7	0,004	3
4	4,8833	7	2,95	7	1,81	7	0,82	5	0,023	1	0,033	1	0,008	1	0,004	3
5	4,9	1	2,96	7	1,8275	7	0,8252	7	0,024	7	0,036	1	< 0,005	7	0,0040	3
6	4,93	1	2,99	1	1,83	1	0,83	1	0,0240	7	0,042	6				
7	4,9444	7	3,00	6	1,84	6	0,8388	5	0,025	1	0,0439	7				
8	4,95	7	3,00	1	1,85	7	0,85	1	0,03	7	0,051	7				
9	4,952	7	3,01	7	1,8727	7	0,85	6	0,026	7	0,0526	5				
10	4,97	7	3,013	7	1,89	1	0,852	11	0,0266	12	0,057	11				
11	5,03	1	3,014	5	1,90	7	0,859	7	0,0270	14						
12	5,18	12	3,015	9	1,90	12	0,87	7	0,02713	7						
13	5,21	11	3,048	7	1,90	1	0,88	1	0,028	7						
14			3,14	1			0,9108	7								
15			3,18	11												
16			3,1870	7												
Average	4,952		3,018		1,847		0,84827		0,0241						0,00384	
SD	0,128		0,084		0,041		0,03473		0,0036						0,00023	
Certified value	<b>4,95</b>		<b>3,02</b>		<b>1,85</b>		<b>0,85</b>		<b>0,024</b>						<b>0,0038</b>	
C(95%)	0,077		0,045		0,025		0,020		0,002						0,000	
RSD	2,6		2,8		2,2		4,1		15,1						6,0	
SD homogeneity	0,03		0,02		0,01		0,01		0,0002							
Uncertainty	<b>0,08</b>		<b>0,05</b>		<b>0,03</b>		<b>0,02</b>		<b>0,002</b>						<b>0,0003</b>	

Analysis	Sn**	*	As**	*	Sb**	*	B**	*
1	0,0006	7	0,0011	7	0,00040	7	0,0005	6
2	0,0010	6	0,0024	7	0,0007	15	0,00126	7
3	0,0016	7	0,0024	15	0,00091	4	0,0017	7
4	0,0024	15	0,0034	5	0,0010	6	0,003	5
5	0,00296	7	0,00363	7			0,0040	7
6	< 0,005	7	0,004	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 524 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)

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

December 2016 (Original certificate date)