

# CERTIFICATE OF ANALYSIS

## IMZ 164

### REFERENCE MATERIAL FERRITIC-AUSTENITIC STEEL

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

C	0.100	V	0.053
Si	0.82	Nb	0.049
Mn	1.77	Co	0.035
P	0.019	N	0.249
S	0.002	W	(0.025)
Cr	20.96	Ti	(0.003)
Ni	6.75	Sn	(0.003)
Mo	3.48	As	(0.005)
Cu	0.26	Pb	(0.002)
Al	0.040		

Values in brackets are informative

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Analysis	C	Si	Mn	P	S	Cr	Ni	Mo
1	0.0910	0.780	1.710	0.0166	0.0017	20.667	6.540	3.377
2	0.0943	0.784	1.710	0.0168	0.0019	20.820	6.560	3.410
3	0.0970	0.791	1.737	0.0190	0.0020	20.850	6.593	3.431
4	0.0975	0.800	1.760	0.0191	0.0023	20.875	6.700	3.433
5	0.0976	0.808	1.770	0.0195	0.0023	20.980	6.740	3.444
6	0.0985	0.819	1.778	0.0197	0.0026	20.980	6.762	3.453
7	0.1000	0.830	1.780	0.0200	0.0026	21.020	6.820	3.461
8	0.1005	0.840	1.799	0.0200	0.0031	21.046	6.837	3.498
9	0.1006	0.850	1.800		0.0033	21.067	6.850	3.526
10	0.1017	0.855	1.807			21.110	6.850	3.538
11	0.1029	0.870	1.810			21.118	6.868	3.560
12	0.1040		1.819				6.877	3.577
13	0.1053							
14	0.1057							
Average	0.0998	0.821	1.773	0.0188	0.0024	20.958	6.750	3.476
SD	0.0042	0.031	0.038	0.0014	0.0005	0.140	0.124	0.063
Certified	<b>0.100</b>	<b>0.82</b>	<b>1.77</b>	<b>0.019</b>	<b>0.002</b>	<b>20.96</b>	<b>6.75</b>	<b>3.48</b>
C(95%)	0.0025	0.022	0.025	0.0012	0.0004	0.099	0.082	0.042

Analysis	Cu	Al	V	Sn*	W*	Nb	Co	N
1	0.254	0.0295	0.0487	0.0019	0.021	0.0476	0.0330	0.2394
2	0.261	0.0357	0.0500	0.0031	0.023	0.0483	0.0347	0.2500
3	0.262	0.0433	0.0515	0.0033	0.033	0.0490	0.0357	0.2510
4	0.264	0.0455	0.0528	0.0043		0.0500	0.0381	0.2523
5	0.268	0.0470	0.0531			0.0500		0.2536
6	0.268		0.0560			0.0517		
7	0.269		0.0571					
8	0.269							
Average	0.264	0.0402	0.0527	0.0032	0.025	0.0494	0.0354	0.2493
SD	0.005	0.0074	0.0030	0.0010	0.006	0.0015	0.0021	0.0057
Certified	<b>0.26</b>	<b>0.040</b>	<b>0.053</b>			<b>0.049</b>	<b>0.035</b>	<b>0.249</b>
C(95%)	0.005	0.0103	0.0030			0.0017	0.0039	0.0079

Analysis	Ti*	As*	Pb*	Sb	Hg	Bi	Zr	Al(sol)
1	0.0020	0.0045	0.0004	0.0008	< 0.0001	< 0.0001	0.0072	0.029
2	0.0032	0.0046	0.0020	0.0010				
3	0.0032	0.0053	0.0023					
4	0.0040		0.0033					
Average	0.0031	0.0048	0.0020					
SD	0.0008	0.0004	0.0012					

\* - 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. For further

information regarding the confidence interval for the certified value see ISO Guide 35:1989 section 4.

**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 of the certified portion of the bars and also for some solid samples. Single values in the above table are the means obtained by individual laboratories. The following methods were used for analysis:

<b>C and S</b>	- high frequency infra-red absorption (HFIR), AES spark;
<b>Mn</b>	- flame AAS, AES spark, XRF, ICP-AES, photometric, titrimetric;
<b>Si</b>	- ICP-AES, AES spark, XRF, ICP-AES, photometric, gravimetric;
<b>P</b>	- ICP-AES, AES spark, XRF, photometric, titrimetric;
<b>Cr</b>	- flame AAS, AES spark, XRF, ICP-AES, photometric, titrimetric;
<b>Ni</b>	- flame AAS, AES spark, XRF, ICP-AES, photometric, gravimetric;
<b>Cu, Mo</b>	- flame AAS, AES spark, XRF, ICP-AES, photometric;
<b>V, W</b>	- flame AAS, AES spark, XRF, ICP-AES, photometric;
<b>Ti</b>	- GF AAS, AES spark, ICP-AES;
<b>Al</b>	- flame AAS, AES spark, ICP-AES, photometric;
<b>Co, Nb</b>	- lame AAS, AES spark, XRF, ICP-AES;
<b>As, Sn, Pb</b>	- GF AAS, AES spark, ICP-AES;
<b>Sb, Bi, Hg</b>	- GF AAS;
<b>N</b>	- high temperature extraction;
<b>Zr</b>	- AES spark;
<b>Al (sol)</b>	- ICP-AES, AES spark.

**The laboratories participating in the testing of this Reference Material were:**

- Alstom Power, Elbląg, Poland
- Ferrostał, Gliwice, Poland
- Huta Lucchini, Warszawa, Poland
- Huta Małapanew, Ozimek, Poland
- Huta Trzyniec, Czech Republic
- Instytut Metalurgii Żelaza, Gliwice, Poland
- ISH Ołomuniec, Czech Republic
- Laboratorium Aplikacyjne firmy GNR, Italy
- Laboratorium Aplikacyjne firmy LECO, Praga, Czech Republic
- Laboratorium Aplikacyjne firmy Thermo-ARL, Switzerland
- Magnesy Baildon, Katowice, Poland
- Mittal Steel Poland, Oddział Dąbrowa Górnicza, Poland
- Mittal Steel Poland, Oddział Kraków, Poland
- US Steel - Labortest, Koszyce, Slovakia

**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.

**Traceability:** This Reference Material was tested with the use of optical emission spectrometry with spark excitation and was found compatible to the following CRMs: BCS SS460/1-468/1, BS SS 3951, BS CA 316-2, BS 316A, MW13-37.

**Production of melt:** This material was produced by Huta Baildon, Katowice. The melt was made in an open induction furnace.

**Available form:** Discs: 40 mm in diameter and 40 mm thick; chips: bottles 100g.

**Intended use:** This Reference Material is intended for use in optical emission and X-ray spectrometric methods (bulks sample) and also in classical wet methods, UV-Vis spectrometry, AAS, ICP-AES, C,S- and N- analyzers and other wet methods (chips).

Caution: In optical emission spectrometry with spark excitation the central part of the surface of discs (approximately 5 mm) should be avoided because of possible segregation of the material.

**Validity of certification:** The certification of IMZ 164 is valid indefinitely 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.

Chips: if the contents of the bottle becomes changed (for example oxidized) or contaminated, the whole contents of bottle should be discarded.

**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: 23 July 2024

Certificate revision history:

23 July 2024 (editorial changes)

21 January 2021 (change of information regarding validity of certification, editorial changes);

November 2003 (Original certificate date)