

Metal and Quality, LLC
CERTIFICATE OF ANALYSIS
DSZU C020 – DSZU C024
High Manganese Steel



INFORMATION Certified Reference Materials of High Manganese Steel DSZU C020 - DSZU C024 are intended for calibration of measuring instruments at definition of chemical composition of high manganese steels by using of Optical Emission and X-ray Spectrometry methods

MANUFACTURER Metal and Quality, LLC

CERTIFIED VALUES (BOLD) AND UNCERTAINTIES

Mass fraction in %	C	Si	Mn	P	S	Cr	Mo	Ni	Cu	V
C020	0.97 0.01	0.094 0.007	8.85 0.09	0.024 0.001	<i>0.015</i> -	0.96 0.02	0.13 0.02	1.36 0.03	0.53 0.02	0.155 0.003
C021	1.33 0.01	0.103 0.009	11.23 0.08	0.035 0.001	0.010 0.002	0.62 0.01	0.096 0.007	0.36 0.01	0.32 0.01	0.124 0.005
C022	1.16 0.01	0.35 0.01	12.89 0.07	0.087 0.002	0.0054 0.0008	0.192 0.007	<i>0.03</i> -	0.122 0.008	0.103 0.003	<i>0.03</i> -
C023	0.79 0.01	0.291 0.008	13.09 0.08	0.052 0.002	0.0062 0.0009	0.313 0.007	<i>0.04</i> -	3.15 0.04	0.111 0.006	<i>0.02</i> -
C024	0.88 0.01	0.531 0.015	16.93 0.09	0.068 0.002	0.0100 0.0009	1.62 0.06	0.29 0.02	0.66 0.03	0.72 0.005	0.29 0.02

Uncertainty C(95%) estimated as the half-width confidence interval of Student's t-distribution, when n is the number of laboratory means (see next pages)

$$C(95\%) = \frac{t \cdot s(M)}{\sqrt{n}}$$

Italics - approximate values

Indicative content

Mass fraction, %	Al	Nb	N	B	Ti
C020	<i>0,004</i>	<i>0,016</i>	<i>0,019</i>	<i>0,0016</i>	<i>0,003</i>
C021	<i>0,003</i>	<i>0,029</i>	<i>0,013</i>	<i>0,0019</i>	<i>0,005</i>
C022	<i>0,007</i>	<i>0,014</i>	<i>0,013</i>	<i>0,0012</i>	<i>0,007</i>
C023	<i>0,006</i>	<i>0,015</i>	<i>0,018</i>	<i>0,0014</i>	<i>0,003</i>
C024	<i>0,004</i>	<i>0,10</i>	<i>0,021</i>	<i>0,0033</i>	<i>0,005</i>

SPECIFICATION CRMs are made from forged and heat-treated steels in cylinders form, 38-42 mm in diameter and 20-25 mm thick

HOMOGENEITY The homogeneity was evaluated according to ISO Guide 35:2006 (7.7 Evaluating a homogeneity study) and DSTU GOST 8.531:2002 "Reference materials of composition of solid and disperse materials. Ways of homogeneity assessment"

TRACEABILITY The traceability of CRMs DSZU C020 – DSZU C024 established in accordance with ISO Guide 30-35. The characterization of CRMs was achieved through an interlaboratory experiment. Average results of chemical methods have been obtained by two analysts, from 3 to 6 measurements by each. Average results of spectral methods have been obtained from 10 measurements. At analyses used standardized and certified methods of analysis: combustion coulometric and infrared, potentiometric, titrimetric, photometric, ICP-OES, F-AAS, Spark-OES, JDS-OES, XRF. At analysis reference materials were used: ICRM CRM C51g, BAM ECRM 235-1, BAS SS-CRM 491/2, BAS SS-CRM 491/2, SS-CRM 493/2, BAS SS-CRM 494/2, BAS SS-CRM 495/3, BAS SS-CRM 495/4, MBH CRM 14XMN1 – 14XMN5, Brammer BS18A

CRM VALIDITY The shelf life of samples is unlimited subject to the conditions of storage and use. The working surface of the sample should be purified before use. Reference material will remain stable provided that it is not subjected to excessive heat (e.g. during preparation of the working surface)

DATE OF ISSUE August 2010

DELIVERY CRM, packed into a box and a certificate of analysis

SAFETY A Safety Data Sheet (SDS) is not required for CRMs C010 - C013. Material and packing does not contain hazardous chemical, explosives and radioactive substances and substances which might influence health and the environment

PARTICIPATING LABORATORIES

OJSC "Dneprospetsstal", Ukraine; OJSC "Ilyich Iron and Steel Works", Ukraine; "Kerch Switch Plant Ltd.", Ukraine; OJSC "Dnepropetrovsk Pointer Factory", Ukraine; State enterprise "Ukrainian Special Steels Institute"; OJSC "MECHEL", RU; OJSC "UralSteel", Metalloinvest, RU; OJSC "Alchevsk Iron & Steel Works", Ukraine; OJSC "REGOM", Ukraine; CJSC "KZGO" Mountain Equipment Works, Ukraine; "SPL-Bohumin", Czech Republic; "Federal Institute for Materials Research and Testing (BAM)", Germany

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LABORATORY MEANS, mass fraction in % by weight

C020

n	C	Si	Mn	P	S	Cr	Mo	Ni	Cu	V	B	Ti	Nb	Al	N
1	0.940	0.080	8.53	0.0218	0.0080	0.934	0.100	1.307	0.495	0.150	0.0010	0.0016	0.009	0.0010	0.0165
2	0.944	0.088	8.65	0.0220	0.0101	0.938	0.100	1.315	0.502	0.151	0.0012	0.0017	0.012	0.0010	0.0176
3	0.945	0.089	8.67	0.0228	0.0102	0.941	0.110	1.315	0.506	0.153	0.0014	0.0020	0.012	0.0030	0.0177
4	0.945	0.090	8.70	0.0230	0.0120	0.941	0.120	1.339	0.512	0.155	0.0016	0.0021	0.022	0.0053	0.0200
5	0.955	0.091	8.73	0.0235	0.0150	0.963	0.130	1.350	0.530	0.155	0.0020	0.0040	0.024	0.0060	0.0253
6	0.966	0.094	8.80	0.0238	0.0158	0.968	0.150	1.371	0.530	0.158	0.0024	0.0082		0.0068	
7	0.968	0.096	8.83	0.0242	0.0172	0.972	0.160	1.386	0.547	0.158					
8	0.972	0.098	8.86	0.0248	0.0180	0.979	0.160	1.390	0.561	0.158					
9	0.976	0.102	8.89	0.0255	0.0188	0.985		1.406	0.563						
10	0.980	0.112	8.91	0.0255	0.0191	0.991		1.420	0.565						
11	0.981		8.92		0.0210										
12	0.985		8.94												
13	0.995		8.97												
14			9.05												
15			9.07												
16			9.08												
M(M)	0.966	0.094	8.85	0.0237	0.0150	0.961	0.129	1.360	0.531	0.155	0.0016	0.0033	0.016	0.0039	0.0194
s(M)	0.018	0.009	0.16	0.0013	0.0043	0.021	0.025	0.041	0.027	0.003	0.0005	0.0026	0.007	0.0025	0.004

C021

n	C	Si	Mn	P	S	Cr	Mo	Ni	Cu	V	B	Ti	Nb	Al	N
1	1.295	0.086	11.00	0.0309	0.0048	0.565	0.089	0.337	0.296	0.115	0.0013	0.0020	0.022	0.0010	0.0100
2	1.300	0.090	11.01	0.0320	0.0060	0.592	0.091	0.340	0.299	0.120	0.0016	0.0030	0.023	0.0010	0.0123
3	1.300	0.096	11.05	0.0337	0.0074	0.600	0.091	0.346	0.301	0.122	0.0017	0.0031	0.026	0.0028	0.0131
4	1.310	0.098	11.05	0.0349	0.0098	0.618	0.095	0.347	0.301	0.123	0.0019	0.0035	0.030	0.0030	0.0132
5	1.329	0.103	11.09	0.0350	0.0100	0.619	0.096	0.358	0.314	0.123	0.0022	0.0070	0.037	0.0045	0.0150
6	1.330	0.107	11.18	0.0360	0.0115	0.625	0.103	0.358	0.316	0.128	0.0024	0.0088	0.038	0.0054	0.0162
7	1.333	0.110	11.22	0.0365	0.0119	0.626	0.110	0.373	0.320	0.131				0.0060	
8	1.339	0.116	11.23	0.0368	0.0128	0.627		0.378	0.328	0.133					
9	1.343	0.119	11.27	0.0370	0.0140	0.628		0.385	0.332						
10	1.345		11.27	0.0385	0.0142	0.633			0.338						
11	1.347		11.28			0.637			0.340						
12	1.349		11.30												
13	1.360		11.35												
14			11.36												
15			11.46												
16			11.51												
M(M)	1.329	0.103	11.23	0.0351	0.0102	0.615	0.096	0.358	0.317	0.124	0.0019	0.0046	0.029	0.0034	0.0133
s(M)	0.021	0.011	0.16	0.0024	0.0033	0.021	0.008	0.017	0.016	0.006	0.0004	0.0027	0.007	0.0020	0.0022

C022

n	C	Si	Mn	P	S	Cr	Mo	Ni	Cu	V	B	Ti	Nb	Al	N
1	1.120	0.315	12.63	0.0815	0.0044	0.180	0.009	0.108	0.091	0.007	0.0007	0.0041	0.010	0.0040	0.0091
2	1.121	0.340	12.65	0.0850	0.0048	0.180	0.010	0.110	0.095	0.010	0.0010	0.0046	0.010	0.0050	0.0114
3	1.143	0.340	12.70	0.0859	0.0052	0.182	0.010	0.112	0.098	0.015	0.0011	0.0048	0.013	0.0051	0.0122
4	1.155	0.349	12.75	0.0878	0.0054	0.184	0.012	0.113	0.100	0.032	0.0012	0.0050	0.014	0.0070	0.0128
5	1.158	0.349	12.85	0.0880	0.0055	0.187	0.015	0.113	0.100	0.040	0.0019	0.0100	0.021	0.0095	0.0150
6	1.160	0.354	12.86	0.0883	0.0058	0.190	0.067	0.114	0.103	0.047		0.0115		0.0100	0.0156
7	1.161	0.357	12.87	0.0888	0.0060	0.193	0.076	0.120	0.105						
8	1.163	0.365	12.88	0.0900	0.0061	0.197		0.128	0.106						
9	1.170	0.367	12.90	0.0910		0.199		0.136	0.107						
10	1.172	0.373	12.91			0.200		0.144	0.111						
11	1.173		12.92			0.203		0.147	0.114						
12	1.179		12.95			0.208									
13	1.186		13.00												
14			13.00												
15			13.02												
16			13.12												
17			13.17												
M(M)	1.159	0.351	12.89	0.0874	0.0054	0.192	0.028	0.122	0.103	0.025	0.0012	0.0067	0.014	0.0068	0.0127
s(M)	0.020	0.017	0.15	0.0029	0.0006	0.010	0.030	0.014	0.007	0.017	0.0004	0.0032	0.005	0.0025	0.0024

C023

n	C	Si	Mn	P	S	Cr	Mo	Ni	Cu	V	B	Ti	Nb	Al	N
1	0.750	0.270	12.84	0.0495	0.0057	0.300	0.018	3.080	0.095	0.010	0.0008	0.0018	0.008	0.0045	0.0137
2	0.772	0.271	12.90	0.0507	0.0059	0.301	0.020	3.120	0.100	0.016	0.0011	0.0020	0.009	0.0050	0.0175
3	0.775	0.274	12.95	0.0508	0.0059	0.301	0.022	3.120	0.102	0.018	0.0012	0.0021	0.016	0.0050	0.0187
4	0.778	0.289	12.96	0.0510	0.0060	0.305	0.030	3.165	0.105	0.019	0.0019	0.0027	0.019	0.0053	0.0200
5	0.786	0.295	13.00	0.0513	0.0061	0.310	0.070	3.170	0.110	0.026	0.0020	0.0070	0.023	0.0068	0.0200
6	0.789	0.296	13.00	0.0533	0.0065	0.310	0.085	3.180	0.111	0.043				0.0070	0.0200
7	0.789	0.298	13.07	0.0540	0.0073	0.317		3.210	0.111						
8	0.792	0.300	13.14	0.0540		0.320			0.114						
9	0.797	0.302	13.15	0.0549		0.321			0.116						
10	0.798	0.303	13.16			0.328			0.120						
11	0.806	0.308	13.17			0.331			0.120						
12	0.833		13.19						0.126						
13			13.22												
14			13.27												
15			13.30												
M(M)	0.789	0.291	13.09	0.0522	0.0062	0.313	0.041	3.149	0.111	0.022	0.0014	0.0031	0.015	0.0056	0.0183
s(M)	0.020	0.014	0.14	0.0019	0.0005	0.011	0.029	0.044	0.009	0.012	0.0005	0.0022	0.006	0.0010	0.0025

C024

n	C	Si	Mn	P	S	Cr	Mo	Ni	Cu	V	B	Ti	Nb	Al	N
1	0.854	0.495	16.59	0.0652	0.0083	1.505	0.267	0.587	0.650	0.256	0.0020	0.0033	0.080	0.0010	0.0118
2	0.863	0.505	16.65	0.0663	0.0094	1.540	0.270	0.597	0.667	0.260	0.0027	0.0042	0.092	0.0030	0.0194
3	0.870	0.513	16.77	0.0678	0.0095	1.587	0.279	0.635	0.670	0.277	0.0032	0.0052	0.102	0.0035	0.0207
4	0.870	0.520	16.79	0.0680	0.0096	1.590	0.281	0.644	0.685	0.301	0.0035	0.0060	0.104	0.0045	0.0220
5	0.873	0.533	16.87	0.0690	0.0097	1.603	0.282	0.658	0.689	0.309	0.0037	0.0070	0.106	0.0055	0.0290
6	0.873	0.535	16.90	0.0693	0.0106	1.624	0.293	0.660	0.776	0.311	0.0048	0.0072	0.120	0.0080	
7	0.875	0.539	16.91	0.0711	0.0110	1.663	0.314	0.680	0.793	0.317					
8	0.888	0.552	16.92	0.0712	0.0120	1.748	0.330	0.690	0.810						
9	0.896	0.553	16.92			1.755		0.699							
10	0.897	0.561	16.95					0.720							
11	0.898	0.566	17.01					0.734							
12	0.922		17.05												
13			17.06												
14			17.08												
15			17.19												
16			17.20												
M(M)	0.882	0.534	16.93	0.0685	0.0100	1.624	0.290	0.664	0.718	0.290	0.0033	0.0055	0.101	0.0043	0.0206
s(M)	0.019	0.023	0.16	0.0021	0.0011	0.085	0.022	0.047	0.064	0.025	0.0009	0.0015	0.014	0.0024	0.0062

M(M) - Mean of intralaboratory means

s(M) - Standard deviation of the mean values of laboratories