Metal and Quality, LLC

Certificate of Analysis

Reference Materials

DSZU C115 – DSZU C120

Set for Spectral Analysis of High Chromium Steels

INFORMATION

Reference Materials DSZU C115 – DSZU C120 is intended for calibration of measuring instruments at definition of chemical composition of High Chromium steels by using of Optical Emission Method

DEVELOPER AND MANUFACTURER

Metal and Quality, LLC

CERTIFIED VALUES (bold)

		Cr	Ni	C	Si	Mn	P	S	Mo	W	V	Ti	Cu	Al	Nb	Co	Sn	N
C115	Mass fraction in % M(M)	**11.73**	**1.66**	**0.145**	**0.389**	**0.341**	**0.0278**	**0.0026**	**0.368**	**1.98**	**0.250**	*0.0020*	**0.122**	**0.011**	**0.015**	**0.028**	**0.006**	**0.039**
	Uncertainty C(95%)	0.10	0.02	0.004	0.007	0.004	0.0012	0.0005	0.009	0.04	0.006	-	0.005	0.002	0.004	0.002	0.001	0.004
C116	Mass fraction in % M(M)	**12.71**	**0.209**	**0.286**	**0.295**	**0.464**	**0.0214**	**0.0118**	**0.029**	*0.01*	**0.029**	*0.002*	**0.082**	*0.006*	*0.01*	**0.021**	*0.005*	**0.022**
	Uncertainty C(95%)	0.10	0.007	0.005	0.007	0.006	0.0007	0.0007	0.006	-	0.004	-	0.004	-	-	0.003	-	0.002
C117	Mass fraction in % M(M)	**16.89**	**0.52**	**0.071**	**0.393**	**0.200**	**0.0240**	**0.0122**	**0.044**	*0.04*	**0.027**	**0.59**	**0.091**	**0.012**	*0.02*	**0.019**	*0.005*	**0.008**
	Uncertainty C(95%)	0.10	0.01	0.003	0.011	0.005	0.0010	0.0008	0.005	-	0.003	0.02	0.003	0.003	-	0.003	-	0.002
C118	Mass fraction in % M(M)	**19.69**	**3.45**	**0.018**	**0.142**	**1.23**	**0.0057**	**0.0098**	**0.337**	**0.32**	**0.109**	**0.117**	**0.344**	*0.004*	**0.116**	**0.093**	**0.026**	**0.028**
	Uncertainty C(95%)	0.08	0.04	0.002	0.008	0.02	0.0007	0.0007	0.008	0.01	0.004	0.003	0.010	-	0.007	0.006	0.002	0.002
C119	Mass fraction in % M(M)	**25.38**	**0.244**	**0.128**	**0.51**	**0.229**	**0.027**	**0.0068**	**0.084**	**0.046**	**0.052**	**1.02**	**0.069**	**0.017**	*0.02*	*0.01*	*0.006*	**0.010**
	Uncertainty C(95%)	0.12	0.010	0.003	0.02	0.005	0.001	0.0005	0.005	0.005	0.004	0.03	0.003	0.003	-	-	-	0.002
C120	Mass fraction in % M(M)	**30.8**	**8.46**	**0.078**	**0.35**	**0.158**	**0.0138**	**0.0030**	*0.03*	*0.01*	**0.041**	**0.005**	**0.122**	*0.02*	**0.015**	*0.03*	**0.004**	**0.042**
	Uncertainty C(95%)	0.2	0.07	0.002	0.01	0.004	0.0009	0.0005	-	-	0.005	0.001	0.003	-	0.003	-	0.001	0.002

Italics – indicative values

Uncertainty C(95%) estimated as the half-width confidence interval of Student's t-distribution, when n is the number of laboratory means (see pages 3, 4)

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

SPECIFICATION

Reference materials in the form of cylinders in diameter of 40 mm (C119 – 38 mm), height 20 mm are made of rolled (C115-C117, C119-C120) and forged (C118) steel.

HOMOGENEITY

The homogeneity was evaluated according ISO Guide 35:2017 - Reference materials - Guidance for characterization and assessment of homogeneity and stability. This reference material was tested for homogeneity using OES method and found acceptable

TRACEABILITY

The characterization of material has been achieved by means interlaboratory experiment. At analyses used standardized methods of analysis and certified reference materials: IARM 205C, 205D, 327A; JK37; NCS HC 15313; HS 41749; BAS 462/1, 466/2; ICRM UNL1b, ICRM LG56-61, LG70-75, RG19-23, C37d, C44-2,C61; Brammer BS 9941; DSZU C015-C018

CRM VALIDITY

Shelf life of CRM: unlimited. 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

January 2022

SAFETY

A Safety Data Sheet (SDS) is not required for CA03. Reference material CA03 and packing does not contain hazardous chemical, explosives and radioactive substances and substances which might influence health and the environment

PARTICIPATING LABORATORIES (Ukraine)

ArcelorMittal Krivy Rig PJSC
Azovstal Iron & Steel Works PJSC
Azov Steel-Casting Company LLC
Dneprospetsstal (DSS) PJSC
Dnipropetrovsk Railway Switch Plant PJSC
Energomashspetsstal PJSC
Ilyich Iron and Steel Works of Mariupol PJSC
Kryvyi Rih Mechanical Repair Plant LLC
Zaporozhye Steel Works LLC

METHODS USED

Cr - Titrimetric, ICP-OES, OES
Ni – Gravimetric, AAS, ICP-OES, OES
C, S - Infrared absorption and Coulometric
Si - Photometric, ICP-OES, OES
Mn - Potentiometric, AAS, ICP-OES, OES
P - Photometric, ICP-OES, OES
Mo - Photometric, ICP-OES, OES
W, V, Ti, Cu, Al,Nb, Co, Sn - ICP-OES, OES
N - Inert gas fusion (O, N)

CONTACTS

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MEAN VALUES OF LABORATORIES

C115	Cr	Ni	C	Si	Mn	P	S	Mo	W	V	Ti	Cu	Al	Nb	Co	Sn	N
1	11.570	1.610	0.1349	0.3740	0.3280	0.0252	0.0015	0.3401	1.883	0.2313	*0.0010*	0.1100	0.0071	0.0088	0.0240	0.0047	0.0307
2	11.570	1.630	0.1370	0.3770	0.3360	0.0255	0.0020	0.3404	1.930	0.2370	*0.0010*	0.1150	0.0090	0.0092	0.0248	0.0052	0.0357
3	11.596	1.633	0.1390	0.3810	0.3360	0.0258	0.0020	0.3610	1.940	0.2400	*0.0016*	0.1175	0.0100	0.0123	0.0263	0.0052	0.0380
4	11.603	1.650	0.1408	0.3820	0.3370	0.0262	0.0025	0.3657	1.959	0.2431	*0.0022*	0.1205	0.0113	0.0171	0.0265	0.0057	0.0402
5	11.678	1.655	0.1440	0.3850	0.3380	0.0264	0.0026	0.3660	1.962	0.2490	*0.0024*	0.1210	0.0113	0.0177	0.0286	0.0062	0.0408
6	11.689	1.657	0.1440	0.3862	0.3398	0.0273	0.0027	0.3667	1.979	0.2510	*0.0028*	0.1230	0.0119	0.0180	0.0289	0.0070	0.0420
7	11.695	1.658	0.1481	0.3863	0.3406	0.0280	0.0033	0.3670	1.990	0.2520	*0.0031*	0.1230	0.0129	0.0181	0.0309	0.0079	0.0443
8	11.710	1.662	0.1490	0.3864	0.3410	0.0280	0.0035	0.3700	1.990	0.2540		0.1233	0.0132		0.0314		
9	11.760	1.668	0.1510	0.3950	0.3450	0.0289	0.0035	0.3710	2.060	0.2560		0.1249					
10	11.930	1.701	0.1530	0.3970	0.3460	0.0295		0.3750	2.060	0.2580		0.1305					
11	11.963	1.744	0.1540	0.4070	0.3480	0.0295		0.3830		0.2630		0.1351					
12	11.980			0.4070	0.3514	0.0306		0.3870		0.2640							
13						0.0310		0.3930									
M(M)	**11.729**	**1.661**	**0.1450**	**0.3887**	**0.3406**	**0.0278**	**0.0026**	**0.3681**	**1.9753**	**0.2499**	*0.0020*	**0.1222**	**0.0108**	**0.0145**	**0.0277**	**0.0060**	**0.0388**
s(M)	0.150	0.036	0.0065	0.0107	0.0063	0.0020	0.0007	0.0155	0.0549	0.0102	*0.0008*	0.0069	0.0021	0.0042	0.0027	0.0011	0.0045
C116	**Cr**	**Ni**	**C**	**Si**	**Mn**	**P**	**S**	**Mo**	**W**	**V**	**Ti**	**Cu**	**Al**	**Nb**	**Co**	**Sn**	**N**
1	12.480	0.197	0.2728	0.2817	0.4500	0.0200	0.0100	0.0211	*0.0033*	0.0205	*0.0010*	0.0720	*0.0010*	*0.0041*	*0.0157*	*0.0040*	0.0204
2	12.563	0.200	0.2780	0.2850	0.4550	0.0200	0.0110	0.0214	*0.0050*	0.0240	*0.0010*	0.0725	*0.0020*	*0.0045*	0.0177	*0.0044*	0.0209
3	12.568	0.200	0.2790	0.2870	0.4589	0.0202	0.0118	0.0240	*0.0070*	0.0240	*0.0015*	0.0780	*0.0058*	*0.0050*	0.0180	*0.0049*	0.0218
4	12.583	0.201	0.2800	0.2900	0.4600	0.0205	0.0118	0.0242	*0.0080*	0.0250	*0.0024*	0.0807	*0.0090*	*0.0097*	0.0185	*0.0060*	0.0220
5	12.590	0.201	0.2830	0.2900	0.4604	0.0205	0.0120	0.0295	*0.0112*	0.0258	*0.0031*	0.0824	*0.0090*	*0.0116*	0.0208	*0.0065*	0.0237
6	12.645	0.205	0.2850	0.2924	0.4630	0.0206	0.0120	0.0309	*0.0146*	0.0279	*0.0037*	0.0829	*0.0093*	*0.0190*	0.0222		0.0250
7	12.688	0.207	0.2860	0.2985	0.4646	0.0210	0.0121	0.0320	*0.0160*	0.0313	*0.0040*	0.0840		*0.0220*	0.0233		
8	12.729	0.208	0.2930	0.3020	0.4676	0.0215	0.0123	0.0390	*0.0186*	0.0330		0.0849			0.0247		
9	12.760	0.208	0.2950	0.3050	0.4690	0.0221	0.0134	0.0420	*0.0200*	0.0341		0.0868			0.0270		
10	12.790	0.212	0.2952	0.3144	0.4780	0.0222				0.0350		0.0870					
11	12.940	0.213	0.2970		0.4780	0.0230				0.0356		0.0894					
12	12.950	0.214				0.0233											
13	12.982	0.220				0.0233											
14		0.246															
M(M)	**12.713**	**0.209**	**0.2858**	**0.2946**	**0.4640**	**0.0214**	**0.0118**	**0.0293**	*0.0115*	**0.0287**	*0.0024*	**0.0819**	*0.0060*	*0.0108*	**0.0209**	*0.0052*	**0.0223**
s(M)	0.164	0.012	0.0082	0.0102	0.0087	0.0012	0.0009	0.0075	*0.0061*	0.0053	*0.0013*	0.0057	*0.0037*	*0.0072*	0.0037	*0.0011*	0.0017
C117	**Cr**	**Ni**	**C**	**Si**	**Mn**	**P**	**S**	**Mo**	**W**	**V**	**Ti**	**Cu**	**Al**	**Nb**	**Co**	**Sn**	**N**
1	16.681	0.493	0.0620	0.3720	0.1920	0.0218	0.0106	0.0358	*0.0218*	0.0220	0.5600	0.0830	*0.0068*	*0.0098*	0.0137	*0.0033*	0.0072
2	16.691	0.493	0.0640	0.3720	0.1920	0.0223	0.0107	0.0390	*0.0273*	0.0220	0.5650	0.0830	*0.0073*	*0.0151*	0.0163	*0.0043*	0.0076
3	16.735	0.502	0.0640	0.3776	0.1928	0.0226	0.0108	0.0393	*0.0300*	0.0225	0.5720	0.0880	*0.0109*	*0.0181*	0.0165	*0.0044*	0.0077
4	16.750	0.505	0.0687	0.3790	0.1930	0.0226	0.0110	0.0400	*0.0388*	0.0229	0.5720	0.0900	*0.0119*	*0.0199*	0.0174	*0.0066*	0.0077
5	16.808	0.506	0.0700	0.3810	0.1960	0.0226	0.0120	0.0406	*0.0500*	0.0240	0.5770	0.0903	*0.0121*	*0.0209*	0.0179	*0.0073*	0.0085
6	16.830	0.506	0.0720	0.3830	0.1966	0.0227	0.0124	0.0407	*0.0510*	0.0245	0.5800	0.0908	*0.0127*	*0.0230*	0.0208	*0.0080*	0.0119
7	16.890	0.510	0.0725	0.3908	0.1980	0.0240	0.0131	0.0455	*0.0510*	0.0290	0.6000	0.0933	*0.0150*	*0.0230*	0.0212	*0.0080*	
8	16.905	0.522	0.0732	0.3933	0.1993	0.0242	0.0131	0.0510	*0.0590*	0.0296	0.6037	0.0940	*0.0150*	*0.0240*	0.0233		
9	16.960	0.524	0.0750	0.4090	0.2000	0.0244	0.0134	0.0510		0.0318	0.6100	0.0942	*0.0170*	*0.0290*	0.0240		
10	17.000	0.526	0.0760	0.4100	0.2036	0.0250	0.0134	0.0550		0.0322	0.6120	0.0962					
11	17.090	0.533	0.0776	0.4112	0.2120	0.0252	0.0135			0.0330	0.6340	0.0970					
12	17.095	0.539	0.0789	0.4140	0.2190	0.0253					0.6358						
13	17.190	0.540		0.4210		0.0254											
14		0.548				0.0280											
15		0.552															
M(M)	**16.894**	**0.520**	**0.0712**	**0.3934**	**0.1995**	**0.0240**	**0.0122**	**0.0438**	*0.0411*	**0.0267**	**0.5935**	**0.0909**	*0.0121*	*0.0203*	**0.0190**	*0.0060*	**0.0084**
s(M)	0.165	0.019	0.0056	0.0175	0.0084	0.0017	0.0012	0.0064	*0.0136*	0.0045	0.0261	0.0048	*0.0034*	*0.0056*	0.0035	*0.0019*	0.0018

C118	Cr	Ni	C	Si	Mn	P	S	Mo	W	V	Ti	Cu	Al	Nb	Co	Sn	N
1	19.459	3.374	0.0147	0.1250	1.1600	0.0040	0.0088	0.3163	0.2975	0.0979	0.1088	0.3180	*0.0023*	0.1008	0.0846	0.0230	0.0253
2	19.510	3.383	0.0161	0.1259	1.1900	0.0050	0.0090	0.3266	0.3010	0.1000	0.1118	0.3230	*0.0038*	0.1040	0.0872	0.0247	0.0267
3	19.580	3.385	0.0163	0.1280	1.1900	0.0052	0.0090	0.3290	0.3162	0.1037	0.1160	0.3359	*0.0040*	0.1070	0.0880	0.0250	0.0274
4	19.629	3.390	0.0170	0.1280	1.2040	0.0052	0.0090	0.3298	0.3170	0.1040	0.1160	0.3400	*0.0044*	0.1090	0.0893	0.0254	0.0280
5	19.649	3.413	0.0195	0.1325	1.2200	0.0056	0.0090	0.3310	0.3180	0.1090	0.1173	0.3440	*0.0048*	0.1120	0.0912	0.0282	0.0300
6	19.653	3.446	0.0210	0.1380	1.2200	0.0056	0.0099	0.3320	0.3200	0.1100	0.1190	0.3441	*0.0059*	0.1140	0.0930	0.0289	0.0302
7	19.655	3.460	0.0210	0.1400	1.2330	0.0060	0.0101	0.3425	0.3230	0.1105	0.1190	0.3470		0.1199	0.0990		
8	19.695	3.468		0.1457	1.2330	0.0060	0.0102	0.3430	0.3302	0.1120	0.1190	0.3496		0.1230	0.0995		
9	19.720	3.510		0.1467	1.2350	0.0069	0.0110	0.3510	0.3350	0.1133	0.1210	0.3500		0.1240	0.1090		
10	19.778	3.520		0.1505	1.2490	0.0073	0.0118	0.3520	0.3357	0.1140	0.1210	0.3670		0.1276			
11	19.780	3.530		0.1518	1.2600			0.3530	0.3370	0.1190	0.1211	0.3690		0.1344			
12	19.810	3.534		0.1632	1.2600				0.3404								
13	19.990			0.1640	1.2730												
M(M)	**19.685**	**3.451**	**0.0179**	**0.1415**	**1.2252**	**0.0057**	**0.0098**	**0.3369**	**0.3226**	**0.1085**	**0.1173**	**0.3443**	*0.0042*	**0.1160**	**0.0934**	**0.0259**	**0.0279**
s(M)	0.137	0.062	0.0025	0.0135	0.0326	0.0009	0.0010	0.0121	0.0138	0.0064	0.0040	0.0156	*0.0012*	0.0106	0.0077	0.0022	0.0019
C119	**Cr**	**Ni**	**C**	**Si**	**Mn**	**P**	**S**	**Mo**	**W**	**V**	**Ti**	**Cu**	**Al**	**Nb**	**Co**	**Sn**	**N**
1	25.070	0.223	0.1158	0.4620	0.2205	0.0243	0.0060	0.0714	0.0375	0.0424	0.9420	0.0625	0.0100	*0.0131*	*0.0070*	*0.0029*	0.0077
2	25.220	0.224	0.1220	0.4659	0.2225	0.0251	0.0060	0.0790	0.0380	0.0435	0.9475	0.0634	0.0140	*0.0133*	*0.0080*	*0.0055*	0.0085
3	25.250	0.233	0.1237	0.4882	0.2228	0.0252	0.0061	0.0800	0.0410	0.0443	0.9700	0.0640	0.0155	*0.0218*	*0.0097*	*0.0060*	0.0095
4	25.275	0.238	0.1260	0.5000	0.2230	0.0253	0.0064	0.0807	0.0414	0.0520	0.9900	0.0656	0.0166	*0.0219*	*0.0105*	*0.0060*	0.0115
5	25.310	0.240	0.1260	0.5024	0.2255	0.0259	0.0067	0.0828	0.0473	0.0529	1.0250	0.0661	0.0184	*0.0280*	*0.0110*	*0.0086*	0.0119
6	25.380	0.241	0.1260	0.5040	0.2300	0.0260	0.0068	0.0841	0.0475	0.0530	1.0300	0.0700	0.0190	*0.0380*	*0.0132*		0.0121
7	25.470	0.244	0.1275	0.5064	0.2306	0.0272	0.0068	0.0850	0.0500	0.0536	1.0325	0.0700	0.0200		*0.0147*		
8	25.488	0.244	0.1280	0.5100	0.2340	0.0275	0.0077	0.0860	0.0540	0.0550	1.0400	0.0720	0.0205		*0.0175*		
9	25.490	0.246	0.1290	0.5200	0.2353	0.0280	0.0078	0.0944	0.0562	0.0575	1.0500	0.0727	0.0220		*0.0179*		
10	25.620	0.248	0.1321	0.5397	0.2370	0.0283	0.0079	0.0960		0.0580	1.0570	0.0733					
11	25.621	0.271	0.1330	0.5530	0.2420	0.0284				0.0580	1.0700	0.0736					
12		0.280	0.1333	0.5550		0.0285					1.1082	0.0738					
13			0.1354			0.0285											
14			0.1360			0.0290											
M(M)	**25.381**	**0.244**	**0.1281**	**0.5089**	**0.2294**	**0.0269**	**0.0068**	**0.0839**	**0.0459**	**0.0518**	**1.0219**	**0.0689**	**0.0173**	*0.0227*	*0.0122*	*0.0058*	**0.0102**
s(M)	0.174	0.017	0.0056	0.0298	0.0071	0.0016	0.0007	0.0072	0.0068	0.0058	0.0504	0.0043	0.0037	*0.0094*	*0.0039*	*0.0020*	0.0019
C120	**Cr**	**Ni**	**C**	**Si**	**Mn**	**P**	**S**	**Mo**	**W**	**V**	**Ti**	**Cu**	**Al**	**Nb**	**Co**	**Sn**	**N**
1	30.370	8.320	0.0732	0.3300	0.1500	0.0107	0.0020	*0.0170*	*0.0050*	0.0320	0.0028	0.1164	*0.0132*	0.0093	0.0234	0.0025	0.0401
2	30.460	8.339	0.0750	0.3350	0.1529	0.0125	0.0021	*0.0200*	*0.0050*	0.0360	0.0030	0.1170	*0.0170*	0.0126	0.0245	0.0040	0.0420
3	30.595	8.353	0.0770	0.3360	0.1530	0.0134	0.0025	*0.0225*	*0.0081*	0.0369	0.0030	0.1180	*0.0172*	0.0140	0.0288	0.0042	0.0430
4	30.674	8.377	0.0770	0.3501	0.1573	0.0134	0.0028	*0.0263*	*0.0083*	0.0372	0.0038	0.1200	*0.0175*	0.0153	0.0300	0.0050	0.0438
5	30.710	8.390	0.0770	0.3525	0.1584	0.0135	0.0029	*0.0264*	*0.0100*	0.0400	0.0040	0.1200	*0.0210*	0.0160	0.0317	0.0050	0.0445
6	30.800	8.425	0.0790	0.3526	0.1584	0.0136	0.0031	*0.0318*	*0.0140*	0.0430	0.0043	0.1230	*0.0212*	0.0166	0.0337	0.0053	0.0448
7	30.930	8.488	0.0800	0.3540	0.1600	0.0137	0.0031	*0.0336*	*0.0149*	0.0460	0.0052	0.1240	*0.0220*	0.0189	0.0387		0.0490
8	30.970	8.529	0.0802	0.3584	0.1618	0.0140	0.0032	*0.0345*	*0.0149*	0.0480	0.0060	0.1240	*0.0263*				
9	31.113	8.540	0.0805	0.3590	0.1657	0.0150	0.0037	*0.0430*	*0.0187*	0.0520	0.0066	0.1244	*0.0290*				
10	31.118	8.550	0.0834	0.3612		0.0151	0.0046		*0.0189*		0.0068	0.1280					
11	31.120	8.620		0.3650		0.0152						0.1283					
12		8.620		0.3780		0.0159											
M(M)	**30.805**	**8.463**	**0.0782**	**0.3527**	**0.1575**	**0.0138**	**0.0030**	*0.0283*	*0.0118*	**0.0412**	**0.0046**	**0.1221**	*0.0205*	**0.0147**	**0.0301**	**0.0043**	**0.0439**
s(M)	0.267	0.109	0.0030	0.0137	0.0049	0.0014	0.0008	*0.0082*	*0.0052*	0.0065	0.0015	0.0041	*0.0049*	0.0031	0.0053	0.0010	0.0028

M(M) - Mean of intralaboratory means

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