ECISS

EUROPEAN COMMITTEE FOR IRON AND STEEL STANDARDISATION
COMITÉ EUROPÉEN DE NORMALISATION DU FER ET DE L'ACIER
EUROPÄISCHES KOMITEE FÜR EISEN- UND STAHLNORMUNG

EUROPEAN CERTIFIED REFERENCE MATERIAL (EURONORM – CRM)

CERTIFICATE OF CHEMICAL ANALYSIS

EURONORM – CRM No. 055-2 0.5% Carbon Steel

LABORATORY MEANS (4 Values)
mass content in %

Line No	C	Si	Mn	P	S	Cr	Mo	Ni	As	Co	Cu	N
1	0.5146	—	0.6761	0.0092	0.0188	0.3127	0.0901	—	0.0164	0.0244	0.2013	0.00983
2	0.5152	0.2997	0.6772	0.0092	0.0190	0.3127	0.0904	0.3035	0.0174	0.0245	0.2021	0.00998
3	0.5161	0.3008	0.6774	0.0093	0.0192	0.3145	0.0906	0.3038	0.0176	—	0.2047	0.01038
4	0.5167	0.3030	0.6775	0.0095	0.0199	0.3165	0.0934	0.3052	0.0176	0.0246	0.2060	0.01040
5	0.5171	0.3050	—	0.0096	0.0201	0.3168	0.0938	0.3085	0.0178	0.0248	0.2063	0.01045
6	0.5184	0.3057	0.6807	0.0096	0.0202	0.3174	0.0945	0.3099	0.0185	0.0251	—	0.01074
7	0.5185	0.3081	0.6811	0.0097	0.0204	0.3181	0.0954	0.3102	0.0186	0.0254	0.2087	0.01074
8	0.5186	0.3084	0.6823	0.0099	0.0204	0.3211	0.0958	0.3109	0.0191	0.0256	0.2093	0.01078
9	0.5189	0.3089	0.6826	0.0100	0.0205	0.3214	0.0965	0.3122	0.0191	0.0256	0.2094	0.01081
10	0.5194	0.3095	0.6848	0.0102	0.0207	0.3230	0.0968	0.3124	0.0191	0.0257	0.2094	0.01084
11	0.5213	0.3111	0.6860	0.0102	0.0207	0.3236	0.0969	0.3130	0.0193	0.0259	0.2096	0.01095
12	0.5221	0.3115	0.6862	0.0102	0.0207	0.3246	0.0970	0.3134	0.0193	0.0260	0.2097	0.01097
13	0.5254	0.3123	0.6897	0.0102	0.0208	0.3259	0.0972	0.3146	0.0193	0.0262	0.2105	0.01098
14	0.5281	0.3127	0.6902	0.0106	0.0209	0.3273	0.0974	0.3150	0.0194	0.0263	0.2107	0.01111
15	0.5285	0.3132	0.6914	0.0108	0.0210	0.3276	0.0986	0.3173	0.0197	0.0263	0.2108	0.01139
16		0.3136	0.6955	0.0108	0.0213	0.3282	0.0988	0.3174	0.0198	0.0264	0.2114	
17		0.3168	0.6970	0.0112	0.0214	0.3282	0.0988	0.3257	0.0199	0.0267	0.2117	
18		0.3195	0.7015	0.0112	0.0214	0.3310	0.1001			0.0271	0.2133	
19		—	0.7024	0.0117	0.0217		0.1021			—	0.2157	
20			—				—			—		
M_M	**0.5199**	**0.3094**	**0.6866**	**0.0102**	**0.0205**	**0.3217**	**0.0960**	**0.3121**	**0.0187**	**0.0257**	**0.2089**	**0.01069**
s_M	0.0044	0.0054	0.0084	0.0008	0.0009	0.0058	0.0033	0.0057	0.0010	0.0008	0.0037	0.00042
s_W	0.0026	0.0023	0.0035	0.0004	0.0005	0.0019	0.0008	0.0020	0.0004	0.0005	0.0019	0.00019

Line No	Sn	Ti	V	W	Sb
1	0.0154	0.00075	0.00198	0.0141	0.00300
2	0.0155	0.00082	0.00218	0.0150	0.00338
3	0.0156	0.00087	0.00224	0.0158	0.00338
4	0.0158	0.00090	0.00228	0.0159	0.00338
5	0.0158	0.00092	0.00229	0.0160	0.00364
6	0.0158	0.00100	0.00229	0.0160	0.00369
7	0.0159	0.00104	—	0.0165	—
8	0.0159	0.00105	0.00238	0.0166	0.00380
9	0.0160	0.00106	0.00243	0.0168	0.00387
10	0.0161	0.00108	0.00245	0.0168	0.00388
11	0.0162	0.00108	0.00245	0.0169	0.00396
12	0.0162	0.00109	0.00247	0.0170	0.00398
13	0.0162	0.00110	0.00253	0.0173	0.00401
14	0.0164	0.00111	0.00258	0.0173	0.00426
15	0.0167	0.00113	0.00267	0.0177	0.00440
16	0.0172	0.00115	0.00277	0.0178	—
17	0.0174	0.00123	0.00280	0.0185	—
18	0.0175	0.00126	0.00285		
M_M	**0.0162**	**0.00104**	**0.00245**	**0.0166**	**0.00376**
s_M	0.0007	0.00014	0.00024	0.0011	0.00038
s_W	0.0003	0.00008	0.00009	0.0004	0.00011

Al	*Pb*	*Zr*	*Bi*	*Ca*	*Zn*
0.0008	*0.00001*	*0.00002*	*0.000002*	*0.0002*	*0.00002*
0.0025	*<0.0001*	*0.00002*	*0.000006*	*0.0002*	*0.00015*
0.0028	*0.00011*	*0.00002*	*<0.00001*	*0.0002*	*0.00020*
0.0031	*0.00012*	*0.00003*	*0.000010*	*0.0002*	*0.00020*
0.0032	*0.00012*	*0.00008*	*0.000010*	*0.0002*	*0.00029*
0.0037	*0.00014*	*0.00009*	*0.000015*	*0.0002*	*0.00042*
0.0037	*0.00018*	*<0.0001*	*0.000028*	*0.0006*	*0.00068*
0.0055	*0.00018*	*0.00010*	*0.000050*	*0.0007*	*0.00103*
0.0055	*0.00030*	*0.00018*	*<0.0002*	*0.0008*	*0.00108*
0.0055	*<0.0006*	*<0.0005*	*<0.0002*	*0.0008*	*0.00147*
0.0058	*<0.001*	*0.00055*	*<0.0005*	*0.0009*	*0.00154*
0.0060		*<0.001*		*0.0009*	*0.00162*
0.0060		*<0.005*		*0.0013*	*0.00168*
0.0065				*0.0017*	*0.00177*
<0.01				*0.0017*	*0.00185*
				<0.005	*0.00197*
					0.00239

Additional Information: *B: 0.0003%; Nb: <0.0002%, 0.0004%.*

M_M: Mean of the intralaboratory means, s_M: Standard deviation of the intralaboratory means, s_W: Intralaboratory standard deviation

The laboratory mean values have been examined statistically to eliminate outlying values. Where a "—" appears in the table it indicates that an outlying value has been eliminated by either the Cochran or Grubbs Test. Values reported as "less than" values by the participating laboratories have not been taken into account in the statistical calculations.

Values given in italics are for information only.

CERTIFIED VALUES

Mass content in %

	C	Si	Mn	P	S	Cr	Mo	Ni	As
M_M	**0.5199**	**0.3094**	**0.687**	**0.0102**	**0.0205**	**0.3217**	**0.0960**	**0.3121**	**0.0187**
C(95%)	0.0025	0.0028	0.005	0.0004	0.0004	0.0029	0.0016	0.0030	0.0006
	Co	**Cu**	**N**	**Sn**	**Ti**	**V**	**W**	**Sb**	
M_M	**0.0257**	**0.2089**	**0.01069**	**0.0162**	**0.00104**	**0.00245**	**0.0166**	**0.00376**	
C(95%)	0.0005	0.0019	0.00024	0.0004	0.00007	0.00013	0.0006	0.00022	

The half-width confidence interval $C(95\%) = \frac{t \times s_M}{\sqrt{n}}$ where "t" is the appropriate Student's t value and "n" is the number of acceptable mean values

For further information regarding the confidence interval for the certified value see ISO Guide 35:2006 sections 6.1 and 10.5.2

This Certified Reference Material was prepared in accordance with the principles and recommendations set out in ISO Guides 30 – 35 and issued by:

BUREAU OF ANALYSED SAMPLES LIMITED

Newham Hall, Middlesbrough, England TS8 9EA

On behalf of:- The Iron and Steel Nomenclature Co-ordinating Committee (COCOR) of the ECISS, after approval by all the participating laboratories and all the producing organizations. (France – IRSID/CTIF, Germany – Iron and Steel CRM Working Group: Stahlinstitut VDEh, BAM Bundesanstalt für Materialforschung und –prüfung & MPI für Eisenforschung, Nordic Countries – Nordic CRM Working Group, UK – BAS Ltd.)

UKAS REFERENCE MATERIALS

4004

EURONORM – CRM No. 055-2
METHODS USED

Element	Line Number	Methods
C	1-5-11	Combustion, gravimetry
	2	Combustion, non-aqueous titration in organic solvent
	3-4-6-8-9-10-12-13-14-15	Combustion, Infrared absorption
	7	Combustion, Coulometric titration
Si	2-3-5-7-8-9-10-11-12-13-15-17	Inductively Coupled Plasma-Optical Emission Spectrometry
	4-16	Spectrophotometry, molybdenum blue, without extraction
	6-14-18	Gravimetry, dehydration with perchloric acid
Mn	1-2-4-6-9-10-11-12-13-14-16-17-19	Inductively Coupled Plasma-Optical Emission Spectrometry
	3-7-8	Spectrophotometry, periodate oxidation
	15	Flame Atomic Absorption Spectrometry
	18	X-Ray Fluorescence Spectrometry, fused bead
P	1-2-4-5-6-10-11-12-13-16-17-19	Inductively Coupled Plasma-Optical Emission Spectrometry
	3-7-9-14-18	Spectrophotometry, phosphovanadomolydbate, extraction
	8	Inductively Coupled Plasma-Mass Spectrometry
	15	Spectrophotometry, molybdenum blue, extraction
S	1	Combustion, acidimetric titration, absorption in H_2O_2
	2-3-4-5-6-7-9-11-15-16-18-19	Combustion, Infrared absorption
	8-10	Gravimetric as $BaSO_4$ without separation
	12	Spectrophotometry, methylene blue evolution as H_2S in hypophosphoric acid and formic acid medium
	13-17	Inductively Coupled Plasma-Optical Emission Spectrometry
	14	Inductively Coupled Plasma-Mass Spectrometry
Cr	1-2-3-4-5-7-8-9-10-11-12-13-14-15-16-17	Inductively Coupled Plasma-Optical Emission Spectrometry
	6	Titration with Fe (II), oxidation with persulphate
	18	X-Ray Fluorescence Spectrometry, fused bead
Mo	1-3-4-5-6-8-9-10-11-12-13-14-15-16-17-18-19	Inductively Coupled Plasma-Optical Emission Spectrometry
	2	Inductively Coupled Plasma-Mass Spectrometry
	7	Spectrophotometry, thiocyanate in presence of Sn (II), extraction
Ni	2-3-5-6-7-8-9-10-11-12-13-14-15-16-17	Inductively Coupled Plasma-Optical Emission Spectrometry
	4	Flame Atomic Absorption Spectrometry
As	1-3-5-7-8-10-11-12-13-14-15-17	Inductively Coupled Plasma-Optical Emission Spectrometry
	2-9	Inductively Coupled Plasma-Mass Spectrometry
	4	Inductively Coupled Plasma-Optical Emission Spectrometry, evolution as arsine
	6	Spectrophotometry, diethyldithiocarbamate, separation as arsine
	16	Flame Atomic Absorption Spectrometry, evolution as arsine
Co	1-2-4-5-6-7-9-10-11-12-13-14-15-16-17-18	Inductively Coupled Plasma-Optical Emission Spectrometry
	8	Inductively Coupled Plasma-Mass Spectrometry
Cu	1	Inductively Coupled Plasma-Mass Spectrometry
	2-3-5-7-8-9-10-11-12-13-14-15-16-17-18	Inductively Coupled Plasma-Optical Emission Spectrometry
	4	Spectrophotometry, cuproine, without extraction
	19	Flame Atomic Absorption Spectrometry
N	1-3-4-5-6-7-9-10-11-12-13-15	Thermal conductivity, decomposition in graphite crucible
	2	Spectrophotometry, Nessler reagent, distillation
	8-14	Acidimetric titration after distillation, visual end point
Sn	1-8-15-18	Inductively Coupled Plasma-Mass Spectrometry
	2-3-4-5-6-7-10-11-12-13-14-16-17	Inductively Coupled Plasma-Optical Emission Spectrometry
	9	Flame Atomic Absorption Spectrometry, extraction with tri-octylphosphine oxide/KI/methylisobutylketone (4-methyl pentan-2-one)
Ti	1-16-18	Inductively Coupled Plasma-Mass Spectrometry
	2-3-4-5-6-7-8-9-10-11-12-13-14-15-17	Inductively Coupled Plasma-Optical Emission Spectrometry
V	1-2-3-4-5-8-9-10-11-12-13-14-15-16-17-18	Inductively Coupled Plasma-Optical Emission Spectrometry
	6	Inductively Coupled Plasma-Mass Spectrometry
W	1-3-5-6-7-8-9-10-11-12-13-15	Inductively Coupled Plasma-Optical Emission Spectrometry
	2-4-14-17	Inductively Coupled Plasma-Mass Spectrometry
	16	Spectrophotometry, thiocyanate formed in a strongly acid reducing solution
Sb	1-8-9-10	Inductively Coupled Plasma-Optical Emission Spectrometry
	2-3-4-5-6-14	Inductively Coupled Plasma-Mass Spectrometry
	11	Flame Atomic Absorption Spectrometry, hydride generation
	12	Flame Atomic Absorption Spectrometry, extraction with tri-octylphosphine oxide/KI/methylisobutylketone (4-methyl pentan-2-one)
	13	Inductively Coupled Plasma-Optical Emission Spectrometry, hydride generation
	15	Flame Atomic Absorption Spectrometry

EURONORM – CRM No. 055-2
METHODS USED

Element	Line Number	Methods
Al	*1*	*Inductively Coupled Plasma-Mass Spectrometry*
	2-3-4-5-6-7-8-9-10-11-12-13-14-15	*Inductively Coupled Plasma-Optical Emission Spectrometry*
Pb	*1-3-5-6-8-9*	*Inductively Coupled Plasma-Mass Spectrometry*
	2-11	*Flame Atomic Absorption Spectrometry*
	4-7-10	*Inductively Coupled Plasma-Optical Emission Spectrometry*
Zr	*1-3-4-5-6*	*Inductively Coupled Plasma-Mass Spectrometry*
	2-7-8-9-10-11-12-13	*Inductively Coupled Plasma-Optical Emission Spectrometry*
Bi	*1-2-3-4-5-8*	*Inductively Coupled Plasma-Mass Spectrometry*
	6-7-11	*Inductively Coupled Plasma-Optical Emission Spectrometry*
	9-10	*Flame Atomic Absorption Spectrometry*
Ca	*1*	*Flame Atomic Absorption Spectrometry*
	2-10-13	*Inductively Coupled Plasma-Mass Spectrometry*
	3-4-5-6-7-8-9-11-12-14-15-16	*Inductively Coupled Plasma-Optical Emission Spectrometry*
Zn	*1-2-7*	*Flame Atomic Absorption Spectrometry*
	3-4-16	*Inductively Coupled Plasma-Mass Spectrometry*
	5-6-8-9-10-11-12-13-14-15-17	*Inductively Coupled Plasma-Optical Emission Spectrometry*

PARTICIPATING LABORATORIES

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AG der Dillinger Hüttenwerke, Dillingen, Germany
ALS Scandinavia, Luleå, Sweden
ArcelorMittal Dunkerque, Dunkerque, France
ArcelorMittal Florange, Florange, France
BAM Bundesanstalt für Materialforschung und -prüfung, Berlin, Germany
Böhler Edelstahl GmbH, Kapfenberg, Austria
CTIF, Sèvres, France
DCNS, La Montagne, France
Element Materials Technology, Sheffield, UK
Exova Teesside, Middlesbrough, UK
HC Starck GmbH & Co KG, Goslar, Germany
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Institute of Certified Reference Materials, Yekaterinburg, Russia
Leibniz Institute for Solid State and Materials Research, Dresden, Germany
Pattinson & Stead (2005) Ltd, Middlesbrough, UK
Ridsdale & Co Ltd., Middlesbrough, UK
Shiva Technologies, Tournefeuille, France
SSAB EMEA, Oxelösund, Sweden
Swerea KIMAB AB, Kista, Sweden
Tata Steel IJmuiden, IJmuiden, The Netherlands
Tata Steel, Port Talbot, UK
Tata Steel, Stocksbridge, UK
ThyssenKrupp Steel Europe AG, Duisburg, Germany
voestalpine Stahl Linz GmbH, Linz, Austria

EURONORM – CRM No. 055-2

DESCRIPTION OF THE SAMPLE

The sample consists of chips passing a nominal 1700µm aperture sieve from which the fines passing a nominal 250µm sieve have been removed. It is supplied in bottles containing 100g, ref ECRM 055-2(C). It is also supplied in the form of 38mm dia. discs, ref ECRM 055-2(D).

INTENDED USE & STABILITY

ECRM 055-2 (C) is intended for the verification of analytical methods, such as those used by the participating laboratories, for the calibration of analytical instruments in cases where calibration with primary substances (pure metals or stoichiometric compounds) is not possible and for establishing values for secondary reference materials.
It will remain stable provided that the bottle remains sealed and is stored in a cool, dry atmosphere. When the bottle has been opened the lid should be secured immediately after use. If the contents should become discoloured (e.g. oxidised) by atmospheric contamination they should be discarded.

ECRM 055-2 (D) is intended for establishing and checking the calibration of Optical Emission and X-Ray Spectrometers for the analysis of similar materials. The "as received" working surface of the sample should be linished before use to remove any protective coating. It will remain stable provided that it is not subjected to excessive heat (e.g. during preparation of the working surface).

NB: An area 6mm in diameter in the centre of the discs should be avoided for optical emission spectrometry.

TRACEABILITY

The traceability of ECRM 055-2 has been established in accordance with principles of ISO Guides 30 – 35 and the International Vocabulary of Basic and General Terms In Metrology.
The characterisation of this material has been achieved by inter-laboratory study, each laboratory using the method of their choice, details of which are given above. These methods are either stoichiometric analytical techniques or methods which are calibrated against pure metals or stoichiometric compounds. Most methods used were either international or national standard methods or methods which are technically equivalent.

FURTHER INFORMATION

For information regarding the preparation, certification and supply of these European Certified Reference Materials (EURONORM-CRMs) and the use of the statistical information given on this certificate, please refer either to the producer of this Certified Reference Material or to Technical Reports CEN/TR 10317:2013 and CEN/TR 10350:2013, both of which are available from the national standards body in your country. (In the UK this is the BSI, 389 Chiswick High Road, London W4 4AL).

Further information and advice on this or other Certified Reference Materials or Reference Materials produced by Bureau of Analysed Samples Ltd. may be obtained from the address below.

Pour disposer d'informations sur la fabrication, la certification et la distribution des Matériaux de Référence Certifiés Européens (EURONORM-MRC) ainsi que sur l'utilisation des informations statistiques données sur ce certificat, se reporter soit au producteur de ce Matériau de Référence Certifié, soit aux Rapports Techniques CEN/TR 10317:2013 et CEN/TR 10350:2013. On peut se procurer ces deux documents auprès des organismes nationaux de normalisation. (Pour la France: AFNOR, 11 Avenue Francis de Pressensé, 93571 – St Denis la Plaine Cedex).

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