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. 097-2 High Purity Iron

LABORATORY MEANS (4 Values)
mass content in %

Line No	Si	Mn	P	S	Cr	Mo	Ni	As	B	Co	Cu	N	Sn	V	W
1	0.00234	0.0108	—	0.00156	0.0196	—	—	0.00238	0.00004	0.0129	—	—	0.00030	0.00006	—
2	0.00245	0.0109	0.00414	0.00156	0.0198	0.00267	0.0206	0.00252	0.00005	0.0130	0.00729	0.00243	0.00032	0.00007	0.00311
3	0.00250	0.0111	0.00500	0.00160	0.0201	0.00348	0.0213	0.00253	0.00007	0.0131	0.00736	0.00273	0.00033	0.00007	0.00355
4	0.00251	0.0113	0.00507	0.00168	0.0202	0.00348	0.0229	0.00260	0.00008	0.0132	0.00738	0.00280	0.00035	0.00008	0.00367
5	0.00253	0.0114	0.00512	0.00170	0.0205	0.00350	0.0230	0.00263	0.00009	0.0132	0.00759	0.00283	0.00035	0.00009	0.00379
6	0.00260	0.0115	0.00513	0.00173	0.0206	0.00353	0.0232	0.00265	0.00010	0.0135	0.00769	0.00286	0.00038	0.00009	0.00380
7	0.00260	0.0115	0.00518	0.00173	0.0207	0.00358	0.0232	0.00265	0.00010	0.0136	0.00769	0.00288	0.00039	0.00010	0.00382
8	0.00263	0.0117	0.00519	0.00175	0.0207	0.00363	0.0237	0.00267	0.00012	0.0136	0.00770	0.00288	0.00040	—	0.00384
9	0.00268	0.0118	0.00522	0.00183	0.0207	0.00370	0.0239	0.00273	0.00013	0.0136	0.00776	0.00288	0.00040	0.00010	0.00385
10	0.00275	0.0119	0.00523	0.00185	0.0209	0.00370	0.0240	0.00273	0.00013	0.0137	0.00778	0.00289	0.00040	0.00010	0.00391
11	0.00283	0.0119	0.00523	0.00190	0.0210	0.00375	0.0240	0.00277	0.00015	0.0138	0.00779	0.00290	0.00040	0.00011	0.00398
12	0.00307	0.0120	0.00530	0.00195	0.0212	0.00375	0.0241	0.00284	0.00017	0.0138	0.00780	0.00303	0.00043	0.00013	0.00400
13	0.00322	0.0120	0.00531	0.00198	0.0212	0.00378	0.0242	0.00288	0.00017	0.0139	0.00781	0.00305	0.00050	0.00018	—
14	0.00323	0.0121	0.00547	0.00199	0.0215	0.00381	0.0242	0.00291	0.00018	0.0139	0.00783	0.00308	0.00051	0.00020	0.00400
15	0.00326	0.0121	0.00548	0.00200	0.0216	0.00382	0.0242	0.00292	0.00020	0.0140	0.00790	0.00314	0.00052	—	0.00408
16	0.00330	0.0121	0.00551	0.00207	0.0216	0.00383	0.0243	0.00292		0.0140	0.00793	0.00325	0.00053		0.00410
17	0.00333	0.0121	0.00559		0.0216	0.00383	0.0244	0.00292		0.0141	0.00794	0.00343	0.00053		0.00410
18	0.00350	0.0122	0.00568		0.0218	0.00383	0.0245	0.00313		0.0141	0.00808		0.00054		0.00413
19	—	0.0122	0.00585		0.0220	0.00384	0.0245	0.00315		0.0142	0.00815		0.00059		
20		0.0122	0.00593		0.0220	0.00386	0.0246	0.00319		0.0142	0.00818		—		
21		0.0124	0.00610		0.0220	0.00387	0.0246	0.00320		0.0142	0.00820				
22		0.0125	0.00623		0.0221	0.00400	0.0247			0.0146	0.00835				
23		0.0126			0.0222	0.00405	0.0255			0.0147	0.00838				
24		0.0127			0.0224		0.0255			0.0148	0.00844				
25		0.0127			0.0235		0.0257			0.0153	0.00853				
26		0.0133					0.0268				0.00867				
27		0.0133													
M_M	**0.00285**	**0.0120**	**0.00538**	**0.00181**	**0.0213**	**0.00370**	**0.0241**	**0.00281**	**0.00012**	**0.0139**	**0.00793**	**0.00294**	**0.00043**	**0.00011**	**0.00386**
s_M	0.00037	0.0007	0.00045	0.00017	0.0010	0.00028	0.0013	0.00024	0.00005	0.0006	0.00037	0.00023	0.00009	0.00005	0.00026
s_W	0.00033	0.0003	0.00024	0.00014	0.0003	0.00012	0.0004	0.00011	0.00002	0.0003	0.00011	0.00012	0.00004	0.00002	0.00013

Line No	Sb	Ta	Zn
1	0.00010	0.00007	0.00003
2	0.00011	0.00008	0.00007
3	0.00011	0.00009	0.00007
4	0.00012	0.00014	0.00008
5	0.00012	0.00016	0.00011
6	0.00012	0.00017	0.00014
7	0.00012	0.00019	0.00015
8	0.00013	0.00019	0.00020
9	0.00013	0.00019	0.00024
10	0.00014	0.00022	0.00024
11	0.00016		0.00025
12	—		—
13	—		
14			
15			
16			
17			
18			
19			
20			
21			
M_M	**0.00012**	**0.00015**	**0.00014**
s_M	0.00002	0.00006	0.00008
s_W	0.00001	0.00002	0.00004

C	*Al_{Tot}*	*Nb*	*Pb*	*Ti*	*Zr*	*Bi*	*Ca*	*Mg*	*O*	*Ga*
0.00005	*0.0001*	*0.0007*	*<0.00001*	*0.00005*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*0.0040*	*0.00006*
<0.0001	*0.0002*	*0.0007*	*<0.00001*	*0.00037*	*<0.00001*	*<0.00001*	*0.00002*	*<0.00001*	*0.0043*	*0.00032*
<0.0002	*0.0002*	*0.0007*	*0.00001*	*0.00038*	*0.00001*	*<0.00001*	*0.00007*	*0.00004*	*0.0050*	*0.00047*
0.00024	*0.0002*	*0.0008*	*0.00001*	*0.00040*	*0.00001*	*0.00001*	*0.00010*	*0.00005*	*0.0052*	
0.00025	*0.0002*	*0.0008*	*0.00001*	*0.00046*	*0.00002*	*<0.00002*	*<0.0002*	*0.00005*	*0.0055*	
0.00037	*0.0003*	*0.0008*	*0.00001*	*0.00054*	*0.00004*	*<0.00002*	*<0.0002*	*<0.00010*	*0.0057*	
<0.0005	*<0.0004*	*0.0008*	*0.00002*	*0.00058*	*0.00005*	*0.00002*	*<0.0002*	*0.00010*		
0.00050	*0.0004*	*0.0009*	*<0.00005*	*0.00062*	*0.00005*	*0.00005*	*0.00040*	*0.00013*		
0.00076	*0.0006*	*0.0009*	*<0.0001*	*0.00065*	*<0.0001*	*0.00005*	*<0.0005*	*<0.0002*		
0.00181	*0.0007*	*0.0009*	*<0.0001*	*0.00076*	*≤0.0001*	*0.00008*	*<0.0005*	*0.00020*		
0.00195	*<0.001*	*0.0010*	*<0.0001*	*0.00078*	*0.00010*	*<0.0001*	*0.00058*	*0.00023*		
0.00203	*0.0010*	*0.0012*	*0.00011*	*0.00082*	*0.00010*	*<0.0001*		*0.00029*		
0.00208	*0.0011*	*0.0012*	*0.00018*	*0.00085*	*0.00010*	*0.00021*		*0.00034*		
0.00243	*0.0012*	*0.0012*	*0.00031*	*0.00090*	*0.00014*	*0.00080*		*<0.0005*		
	0.0013	*0.0015*	*0.00073*	*0.00095*	*0.00015*			*<0.0006*		
	0.0013	*0.0016*	*<0.0008*	*0.00096*	*<0.0005*					
	0.0014	*0.0016*	*<0.001*	*0.00097*	*<0.0006*					
	0.0015	*0.0016*	*0.00100*	*0.00101*	*<0.0016*					
		0.0017	*0.00100*	*0.00110*						
		0.0019		*0.00115*						
				0.00145						

***Additional Information**: Ag: <0.0001%, Al (sol): <0.0004%, 0.0010%, Cd: <0.0001%, Ge: 0.00043%, 0.00066%, Se: <0.0001%, Te: <0.0001%*

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 %

	Si	Mn	P	S	Cr	Mo	Ni	As	B
M_M	**0.00285**	**0.0120**	**0.00538**	**0.00181**	**0.0213**	**0.00370**	**0.0241**	**0.00281**	**0.00012**
C(95%)	0.00019	0.0003	0.00021	0.00009	0.0004	0.00013	0.0006	0.00011	0.00003
	Co	**Cu**	**N**	**Sn**	**V**	**W**	**Sb**	**Ta**	**Zn**
M_M	**0.0139**	**0.00793**	**0.00294**	**0.00043**	**0.00011**	**0.00386**	**0.00012**	**0.00015**	**0.00014**
C(95%)	0.0003	0.00016	0.00013	0.00005	0.00003	0.00014	0.00002	0.00004	0.00006

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 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

JANUARY 2013

EURONORM – CRM No. 097-2
METHODS USED

Element	Line Number	Methods
Si	1-4-5-6-7-10-12-14-15-16-18	Inductively Coupled Plasma-Optical Emission Spectrometry
	2-3-8-11-17	Spectrophotometry, molybdenum blue, without extraction
	9	Glow Discharge-Mass Spectrometry
	13	Inductively Coupled Plasma-Mass Spectrometry
Mn	1-3-4-5-6-10-11-14-15-16-17-19-21-22-23-24-25	Inductively Coupled Plasma-Optical Emission Spectrometry
	2-18-20-26-27	Inductively Coupled Plasma-Mass Spectrometry
	7-9	Spectrophotometry, periodate oxidation
	8	Glow Discharge-Mass Spectrometry
	12-13	Flame Atomic Absorption Spectrometry
P	2-3-4-5-6-7-8-10-12-13-14-19-20	Inductively Coupled Plasma-Optical Emission Spectrometry
	9-11-16-21-22	Spectrophotometry, phosphovanadomolybdate, extraction
	15	Spectrophotometry, molybdenum blue, without extraction
	17-18	Inductively Coupled Plasma-Mass Spectrometry
S	1-2-3-4-5-6-9-10-12-13-14-15-16	Combustion, infrared absorption
	7	Gravimetry as $BaSO_4$, without separation
	8	Glow Discharge-Mass Spectrometry
	11	Combustion, acidimetric titration, absorption in H_2O_2
Cr	1-2-3-5-6-9-10-11-13-14-15-16-17-18-19-20-21-22-23	Inductively Coupled Plasma-Optical Emission Spectrometry
	4	Glow Discharge-Mass Spectrometry
	7-8-12-24-25	Inductively Coupled Plasma-Mass Spectrometry
Mo	2	Spectrophotometry, thiocyanate in presence of Sn (II), extraction
	3-7-9-14-15-22	Inductively Coupled Plasma-Mass Spectrometry
	4-5-6-8-10-11-12-13-16-17-19-20-21-23	Inductively Coupled Plasma-Optical Emission Spectrometry
	18	Glow Discharge-Mass Spectrometry
Ni	2-4-5-6-7-9-10-11-13-14-15-16-17-18-19-22-23-25	Inductively Coupled Plasma-Optical Emission Spectrometry
	3-8-21-26	Inductively Coupled Plasma-Mass Spectrometry
	12-24	Flame Atomic Absorption Spectrometry
	20	Glow Discharge-Mass Spectrometry
As	1-3	Spectrophotometry, diethyldithiocarbamate, separation as arsine
	2-4-5-6-8-10-13-15-19-21	Inductively Coupled Plasma-Optical Emission Spectrometry
	7-9-11-14-17-18	Inductively Coupled Plasma-Mass Spectrometry
	12	Electrothermal Atomic Absorption Spectrometry
	16	Flame Atomic Absorption Spectrometry, evolution as arsine
	20	Flame Atomic Absorption Spectrometry
B	1-4-5-6-12	Inductively Coupled Plasma-Mass Spectrometry
	2-7-8-9-11	Inductively Coupled Plasma-Optical Emission Spectrometry
	3-10-13-14-15	Spectrophotometry, curcumin
Co	1-2-3-4-5-6-7-8-9-12-13-14-16-19-20-21-23-24-25	Inductively Coupled Plasma-Optical Emission Spectrometry
	10-15-17-18-22	Inductively Coupled Plasma-Mass Spectrometry
	11	Glow Discharge-Mass Spectrometry
Cu	2-6-10-16	Inductively Coupled Plasma-Mass Spectrometry
	3-4-5-7-8-9-11-12-13-14-15-17-19-20-22-23-24-25-26	Inductively Coupled Plasma-Optical Emission Spectrometry
	18-21	Flame Atomic Absorption Spectrometry
N	2-3-4-5-6-8-9-10-11-12-14-15-16-17	Thermal Conductivity, decomposition in graphite crucible
	7	Acidimetric titration after distillation, visual end point
	13	Spectrophotometry, Nessler reagent, distillation
Sn	1-2-4-7-8-10-17	Inductively Coupled Plasma-Mass Spectrometry
	3	Electrothermal Atomic Absorption Spectrometry
	5-9-11-12-13-16-18-19	Inductively Coupled Plasma-Optical Emission Spectrometry
	6	Glow Discharge-Mass Spectrometry
	14-15	Flame Atomic Absorption Spectrometry
V	1-2-4-6-7	Inductively Coupled Plasma-Mass Spectrometry
	3	Glow Discharge-Mass Spectrometry
	5-9-10-11-12-13-14	Inductively Coupled Plasma-Optical Emission Spectrometry
W	2-3-4-5-6-7-8-9-11-12-17	Inductively Coupled Plasma-Optical Emission Spectrometry
	10	Glow Discharge-Mass Spectrometry
	14-15-16-18	Inductively Coupled Plasma-Mass Spectrometry

EURONORM – CRM No. 097-2
METHODS USED

Element	Line Number	Methods
Sb	1-2-3-7-9-10-11	Inductively Coupled Plasma-Mass Spectrometry
	4	Electrothermal Atomic Absorption Spectrometry
	5	Flame Atomic Absorption Spectrometry, hydride generation
	6	Flame Atomic Absorption Spectrometry
	8	Glow Discharge-Mass Spectrometry
Ta	1-2-3-4-6-8-10	Inductively Coupled Plasma-Mass Spectrometry
	5-7-9	Inductively Coupled Plasma-Optical Emission Spectrometry
Zn	1-3-4-9-11	Inductively Coupled Plasma-Mass Spectrometry
	2-6-10	Flame Atomic Absorption Spectrometry
	5-7-8	Inductively Coupled Plasma-Optical Emission Spectrometry
C	*1-2-3-4-5-6-7-8-9-10-11-12*	*Combustion, infrared absorption*
	13	*Combustion, non-aqueous titration after absorption in organic solvent*
	14	*Combustion, coulometric titration*
Al_{Tot}	*1-10-18*	*Inductively Coupled Plasma-Mass Spectrometry*
	2-4-5-6-7-8-9-11-12-13-14-15-16-17	*Inductively Coupled Plasma-Optical Emission Spectrometry*
	3	*Electrothermal Atomic Absorption Spectrometry*
Nb	*1-3-5-7-11-20*	*Inductively Coupled Plasma-Mass Spectrometry*
	2-4-6-8-9-10-12-13-14-15-16-17-18	*Inductively Coupled Plasma-Optical Emission Spectrometry*
	19	*Glow Discharge-Mass Spectrometry*
Pb	*1-4-5-6-9-10-11*	*Inductively Coupled Plasma-Mass Spectrometry*
	2	*Glow Discharge-Mass Spectrometry*
	3-12-15	*Flame Atomic Absorption Spectrometry*
	7-8	*Electrothermal Atomic Absorption Spectrometry*
	13-14-16-17-18-19	*Inductively Coupled Plasma-Optical Emission Spectrometry*
Ti	*1-5-9-20-21*	*Inductively Coupled Plasma-Mass Spectrometry*
	2-3-4-6-7-8-10-11-12-13-14-15-16-18-19	*Inductively Coupled Plasma-Optical Emission Spectrometry*
	17	*Glow Discharge-Mass Spectrometry*
Zr	*1*	*Glow Discharge-Mass Spectrometry*
	2-3-5-7-8-9-15	*Inductively Coupled Plasma-Mass Spectrometry*
	4-6-10-11-12-13-14-16-17-18	*Inductively Coupled Plasma-Optical Emission Spectrometry*
Bi	*1-3-7-11-12*	*Inductively Coupled Plasma-Mass Spectrometry*
	2	*Glow Discharge-Mass Spectrometry*
	4-8	*Flame Atomic Absorption Spectrometry, hydride generation*
	5	*Flame Atomic Absorption Spectrometry*
	6-9	*Electrothermal Atomic Absorption Spectrometry*
	10-13-14	*Inductively Coupled Plasma-Optical Emission Spectrometry*
Ca	*1*	*Glow Discharge-Mass Spectrometry*
	2-4-8-9-10-11	*Inductively Coupled Plasma-Optical Emission Spectrometry*
	3-6-7	*Flame Atomic Absorption Spectrometry*
	5	*Inductively Coupled Plasma-Mass Spectrometry*
Mg	*1*	*Glow Discharge-Mass Spectrometry*
	2-7-11-13	*Inductively Coupled Plasma-Mass Spectrometry*
	3-5-10-12-14-15	*Inductively Coupled Plasma-Optical Emission Spectrometry*
	4-6-8-9	*Flame Atomic Absorption Spectrometry*
O	*1-2-3-6*	*Infrared absorption measurement, reduction fusion under helium*
	4-5	*Infrared absorption measurement, reduction fusion under vacuum*
Ga	*1*	*Inductively Coupled Plasma-Optical Emission Spectrometry*
	2	*Inductively Coupled Plasma-Mass Spectrometry*
	3	*Glow Discharge-Mass Spectrometry*

PARTICIPATING LABORATORIES

Acerinox S.A., Algeciras, Spain
AG der Dillinger Hüttenwerke, Dillingen, Germany
Alcoa Howmet, Exeter, UK
ALS Scandinavia, Luleå, Sweden
ArcelorMittal Dunkerque, Dunkerque, France
ArcelorMittal Florange, Florange, France
ArcelorMittal Research, Maizières-lès-Metz, France
ATI-Allvac Ltd, Sheffield, UK
Aubert & Duval, Les Ancizes, France
BAM Bundesanstalt für Materialforschung und -prüfung, Berlin, Germany
Böhler Edelstahl GmbH, Kapfenberg, Austria
CTIF, Sèvres, France
DCNS, La Montagne, France
Heraeus Materials Technology GmbH, Hanau, Germany
Höganäs AB, Höganäs, Sweden
IFW, Dresden, Germany
IncoTest, Hereford, UK
Pattinson & Stead (2005) Ltd, Middlesbrough, UK
Ridsdale & Co Ltd., Middlesbrough, UK
Rautaruukki Oyj, Raahe, Finland
Saarstahl AG, Völklingen, Germany
Sandvik Materials Technology, Sandviken, Sweden
Shiva Technologies, Tournefeuille, France
Swerea Kimab, Stockholm, Sweden
Tata Steel IJmuiden, IJmuiden, The Netherlands
Tata Steel, Port Talbot, UK
Tata Steel, Stocksbridge, UK
Tata Steel, Scunthorpe, UK
ThyssenKrupp Steel Europe AG, Duisburg, Germany
Thyssen Krupp VDM GmbH, Werdohl, Germany
voestalpine Stahl Linz GmbH, Linz, Austria

EURONORM – CRM No. 097-2

DESCRIPTION OF THE SAMPLE

The sample consists of chips passing a nominal 1700µm aperture sieve from which the fines passing a nominal 250µm sieve has been removed. It is supplied in bottles containing 100g, ref ECRM 097-2(C). It is also supplied in the form of 38mm dia. discs, ref ECRM 097-2(D)

INTENDED USE & STABILITY

ECRM 097-2 (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 097-2 (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).

TRACEABILITY

The traceability of ECRM 097-2 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 10317:2009 and CEN/TR 10350:2009, 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 10317:2009 et CEN/TR 10350:2009. 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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