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. 884-1 Furnace Dust

LABORATORY MEANS (4 Values)
mass content in %

Line No	Fe	Si	Ca	Mg	Al	Ti	Mn	P	Na	K	F	V	Cr	Ni
1	31.346	2.0143	4.9925	1.7743	0.3383	0.0198	—	0.0708	0.5268	—	0.3950	0.0250	1.7228	0.1771
2	31.369	2.0175	5.0665	1.7750	0.3447	0.0198	5.6599	0.0710	0.5475	0.9249	0.3960	0.0255	1.7608	0.1793
3	31.425	2.0225	5.0837	1.7775	0.3543	0.0204	5.6785	0.0734	0.5476	0.9309	0.4043	0.0274	1.7798	0.1849
4	31.434	2.0388	5.1040	1.7950	0.3574	0.0207	5.6855	0.0735	0.5580	0.9475	0.4058	0.0288	1.7950	0.1860
5	31.450	2.0475	5.1590	1.7953	0.3623	0.0210	5.7260	0.0737	0.5648	0.9500	0.4061	0.0290	1.7996	0.1863
6	31.464	2.0604	5.2000	1.8071	0.3643	0.0221	5.7557	0.0745	0.5687	0.9692	0.4072	0.0293	1.8074	0.1866
7	31.501	2.0785	5.2075	1.8284	0.3691	0.0226	5.7925	0.0754	0.5733	0.9733	0.4078	0.0297	1.8193	0.1882
8	31.547	2.0931	5.2228	1.8310	0.3743	0.0229	5.8000	0.0773	0.5810	0.9777	0.4104	0.0297	1.8333	0.1943
9	31.547	2.0943	5.2340	1.8452	0.3763	0.0231	5.8088	—	0.5815	0.9810	0.4125	0.0299	1.8358	0.1968
10	31.567	2.0972	5.2544	1.8478	0.3769	0.0231	5.8218	0.0780	0.5865	0.9815	0.4141	0.0301	1.8405	0.1972
11	31.572	2.0996	5.2595	1.8575	0.3777	0.0236	5.8475	0.0795	0.5934	0.9815	0.4148	0.0302	1.8438	0.1978
12	31.688	2.1182	5.2820	1.8630	0.3839	0.0238	5.8486	0.0817	0.5939	0.9848	0.4153	0.0304	1.8672	0.1984
13	31.818	2.1250	—	1.8658	0.3848	0.0244	5.8769	0.0848	0.5983	0.9898	0.4347	0.0310	1.8975	—
14	31.833	2.1278	5.2942	1.8778	0.3863	0.0245	5.8820	0.0849	0.6019	0.9925	0.4369	0.0310	1.8985	0.1998
15	31.853	2.1301	5.2993	1.8842	0.3961	0.0245	5.9120	0.0862	0.6022	0.9948		—	1.9132	0.2001
16	31.998	2.1350	5.3482	1.9003	0.3989	0.0250	5.9648	0.0875	0.6091	0.9992		0.0313	1.9265	0.2023
17	32.016	2.1404	5.4718	1.9245	0.4006	0.0252	5.9650	0.0933	—	1.0024		0.0333	1.9280	0.2048
18	32.065	2.1485		1.9261	0.4074	0.0255	5.9739		0.6282	1.0165		0.0335	1.9309	0.2089
19	32.150	2.1569		1.9387	0.4078	0.0258	6.0784		0.6302	1.0271		0.0349	1.9418	0.2120
20		2.1778			0.4193		6.1619		0.6305			0.0350	1.9748	0.2155
21		2.1874											—	0.2183
M_M	**31.665**	**2.1005**	**5.2175**	**1.8481**	**0.3790**	**0.0230**	**5.8547**	**0.0791**	**0.5854**	**0.9791**	**0.4115**	**0.0303**	**1.8558**	**0.1967**
s_M	0.256	0.0518	0.1184	0.0524	0.0219	0.0020	0.1337	0.0067	0.0291	0.0271	0.0121	0.0027	0.0684	0.0116
s_W	0.146	0.0175	0.0375	0.0207	0.0090	0.0008	0.0357	0.0013	0.0085	0.0097	0.0113	0.0006	0.0273	0.0026

Line No	Zn	Pb	Ag	As	Bi	Cd	Co	Cu	Mo	Sn	Cl
1	17.293	0.4238	0.0023	0.0040	0.0220	0.0036	0.0038	0.1494	0.1847	0.0161	0.9493
2	17.320	0.4260	0.0024	0.0042	0.0242	0.0040	0.0040	0.1513	0.1980	0.0165	0.9515
3	17.378	0.4268	0.0024	0.0047	—	0.0041	0.0041	0.1525	0.1983	0.0165	0.9525
4	17.383	0.4280	0.0024	0.0050	0.0262	0.0041	0.0042	0.1533	0.1984	0.0175	0.9629
5	17.403	0.4327	0.0025	0.0052	0.0264	0.0042	0.0042	0.1548	0.1993	0.0175	0.9660
6	17.443	0.4375	0.0026	0.0052	0.0267	0.0042	0.0042	0.1550	0.1995	0.0177	0.9723
7	17.463	0.4378	0.0026	0.0055	0.0274	0.0044	0.0044	0.1553	0.2011	0.0178	0.9724
8	17.498	0.4406	0.0026	0.0056	0.0276	0.0044	0.0044	0.1555	0.2065	0.0179	0.9740
9	17.515	—	0.0027	0.0056	0.0283	0.0045	0.0044	0.1563	0.2065	0.0181	0.9923
10	17.528	0.4414	0.0030	0.0057	0.0283	0.0046	0.0045	0.1569	0.2072	0.0182	0.9940
11	17.570	0.4416	0.0031	0.0058	0.0288	0.0049	0.0046	0.1573	0.2073	0.0190	1.0068
12	17.590	0.4433	0.0031	0.0059	0.0289	0.0049	0.0048	0.1575	0.2105	0.0191	1.0258
13	17.594	0.4462	0.0033	0.0059	0.0297	0.0049	0.0049	0.1580	0.2132	0.0195	1.0336
14	17.630	0.4465	0.0035	0.0065	0.0299	0.0049	0.0049	0.1582	0.2135	0.0200	1.0591
15	17.650	0.4493		0.0067	0.0303	—	0.0049	0.1596	0.2143	0.0205	1.0593
16	17.773	0.4498		—	0.0308	0.0051	0.0049	0.1604	0.2158	0.0205	
17	—	0.4506			0.0320	0.0052	0.0050	—	0.2158	0.0208	
18		0.4537					0.0050	0.1612	0.2172	0.0219	
19		0.4620					0.0051	0.1620	0.2174		
20		0.4642					0.0054	0.1660	0.2174		
21							0.0054		0.2188		
22									0.2207		
M_M	**17.502**	**0.4422**	**0.0028**	**0.0054**	**0.0280**	**0.0045**	**0.0046**	**0.1569**	**0.2082**	**0.0186**	**0.9915**
s_M	0.131	0.0116	0.0004	0.0008	0.0026	0.0005	0.0005	0.0040	0.0093	0.0017	0.0376
s_W	0.117	0.0055	0.0002	0.0004	0.0008	0.0002	0.0002	0.0017	0.0059	0.0009	0.0097

S	*C*	*Hg*	*LOI*	*H_2O*
0.4393	*0.7438*	*0.00010*	*2.4080*	*0.2394*
0.4595	*0.7582*	*0.00010*	*2.4440*	*0.2770*
0.4601	*0.7697*	*0.00010*	*2.4768*	*0.3250*
0.4621	*0.7848*	*0.00010*	*2.4780*	*0.3766*
0.4674	*0.7880*	*0.00010*	*2.5268*	
0.4793	*0.7948*	*0.00012*	*2.5933*	
0.4801	*0.7962*	*0.00028*	*2.6502*	
0.4801	*0.8018*	*0.00030*	*2.6763*	
0.4867	*0.8024*	*0.00035*	*2.6775*	
0.4875	*0.8068*	*0.00035*	*2.6822*	
0.4882	*0.8188*	*0.00042*	*2.7126*	
0.4928	*0.8197*	*<0.0005*	*2.7700*	
0.4953	*0.8220*		*2.8945*	
0.5032	*0.8265*		*2.9832*	
0.5150	*0.8300*		*3.0110*	
0.5255	*0.8611*		*3.3215*	
0.5312	*0.8675*		*3.4616*	
0.5318	*0.8710*		*4.4300*	
0.5355	*0.8845*		*4.7005*	
	0.8868			

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 given in italics are for information only.

CERTIFIED VALUES
Mass content in %

	Fe	Si	Ca	Mg	Al	Ti	Mn	P	Na	K	F	V	Cr
M_M	**31.67**	**2.101**	**5.22**	**1.848**	**0.379**	**0.0230**	**5.85**	**0.079**	**0.585**	**0.979**	**0.411**	**0.0303**	**1.86**
C(95%)	0.13	0.024	0.07	0.026	0.011	0.0010	0.07	0.004	0.015	0.014	0.007	0.0013	0.04

	Ni	Zn	Pb	Ag	As	Bi	Cd	Co	Cu	Mo	Sn	Cl
M_M	**0.197**	**17.50**	**0.442**	**0.0028**	**0.0054**	**0.0280**	**0.0045**	**0.0046**	**0.1569**	**0.208**	**0.0186**	**0.991**
C(95%)	0.006	0.07	0.006	0.0003	0.0005	0.0014	0.0003	0.0003	0.0020	0.005	0.0009	0.021

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

March 2011

EURONORM – CRM No. 884-1
METHODS USED

Element	Line Number	Methods
Fe	1-18	Titration with Cr(VI) after reduction with Ti(III)
	2-8-12	Titration with Cr(VI) after reduction with Sn(II)
	3-4-6-10-13-17-19	Inductively coupled plasma-optical emission spectrometry
	5-16	Flame atomic absorption spectrometry
	7-11-14-15	X-ray fluorescence spectrometry
	9	Titration with Mn (VII) after reduction with Ti (III)
Si	1-10-14-15	Gravimetry, dehydration with perchloric acid
	2-18-21	X-ray fluorescence spectrometry
	3-5-8-9-13-16-17-19-20	Inductively coupled plasma-optical emission spectrometry
	4-12	Flame atomic absorption spectrometry
	6-7	Gravimetry, dehydration with sulphuric acid
	11	Spectrophotometry, molybdenum blue, without extraction
Ca	1-3-6	Flame atomic absorption spectrometry
	2-4-5-9-10-11-12-16-17	Inductively coupled plasma-optical emission spectrometry
	7-8-14-15	X-ray fluorescence spectrometry
Mg	1-4-6-7-8-9-12-13-14-17-18	Inductively coupled plasma-optical emission spectrometry
	2-3-5	Flame atomic absorption spectrometry
	10-11-15-16	X-ray fluorescence spectrometry
	19	Inductively coupled plasma-mass spectrometry
Al	1-2-3-4-5-7-9-10-11-13-14-15-17-18	Inductively coupled plasma-optical emission spectrometry
	6-16	Flame atomic absorption spectrometry
	8-19-20	X-ray fluorescence spectrometry
	12	Inductively coupled plasma-mass spectrometry
Ti	1-2-3-4-5-7-8-10-11-12-13-15-16-17-18-19	Inductively coupled plasma-optical emission spectrometry
	6-9	Inductively coupled plasma-mass spectrometry
	14	X-ray fluorescence spectrometry
Mn	2-3-5-7-9-10-14-15-16-19-20	Inductively coupled plasma-optical emission spectrometry
	4	Inductively coupled plasma-mass spectrometry
	6-18	Spectrophotometry, periodate oxidation
	8-11	Flame atomic absorption spectrometry
	12-13-17	X-ray fluorescence spectrometry
P	1-2-3-5-6-7-8-11-12-13-14	Inductively coupled plasma-optical emission spectrometry
	4-17	X-ray fluorescence spectrometry
	10	Spectrophotometry, molybdenum blue after separation of interfering elements
	15-16	Spectrophotometry, phosphovanadomolybdate, extraction
Na	1-5-7-9-10-12-14-15-16-18-20	Inductively coupled plasma-optical emission spectrometry
	2-3-4-8-13	Flame atomic absorption spectrometry
	6	Neutron activation analysis
	11-19	Inductively coupled plasma-mass spectrometry
K	2-6-7-9-10-11-12-14-16-18	Inductively coupled plasma-optical emission spectrometry
	3-4-8-13-15	Flame atomic absorption spectrometry
	5	Neutron activation analysis
	17	Inductively coupled plasma-mass spectrometry
	19	X-ray fluorescence spectrometry
F	1-4-14	Specific ion electrode, steam distillation
	2-3-7	Ion Chromatography
	5-8-10-11-12-13	Specific ion electrode, alkaline fusion, separation of hydroxides
	6	Specific ion electrode, pyrohydrolysis
	9	Titration with Th (IV), visual end point, separation of interfering ions
V	1-2-3-4-5-6-8-9-10-11-12-13-14-16-17-18-19	Inductively coupled plasma-optical emission spectrometry
	7	Inductively coupled plasma-mass spectrometry
	20	X-ray fluorescence spectrometry
Cr	1	Inductively coupled plasma-mass spectrometry
	2-3-4-6-8-10-11-12-13-14-15-17-18-19	Inductively coupled plasma-optical emission spectrometry
	5	Flame atomic absorption spectrometry
	7	Neutron activation analysis
	9-16-20	X-ray fluorescence spectrometry
Ni	1-2-3-4-5-6-7-10-11-12-15-18-19-20-21	Inductively coupled plasma-optical emission spectrometry
	8-16	X-ray fluorescence spectrometry
	9	Inductively coupled plasma-mass spectrometry
	14-17	Flame atomic absorption spectrometry
Zn	1-2-4-5-8-9-11-13	Inductively coupled plasma-optical emission spectrometry
	3-16	Complexometric titration, visual end point
	6-10-12-14	X-ray fluorescence spectrometry
	7-15	Flame atomic absorption spectrometry

EURONORM – CRM No. 884-1
METHODS USED

Element	Line Number	Methods
Pb	1-3-4-5-7-8-10-11-13-15-17-18-19	Inductively coupled plasma-optical emission spectrometry
	2-20	Inductively coupled plasma-mass spectrometry
	6-14-16	X-ray fluorescence spectrometry
	12	Flame atomic absorption spectrometry
Ag	1-3-4-8-10-11	Inductively coupled plasma-optical emission spectrometry
	2-5-9-12-13	Flame atomic absorption spectrometry
	6-7-14	Inductively coupled plasma-mass spectrometry
As	1	X-ray fluorescence spectrometry
	2-3-4-7-8-14	Inductively coupled plasma-optical emission spectrometry
	5-9-11-12-13	Inductively coupled plasma-mass spectrometry
	6	Inductively coupled plasma-optical emission spectrometry, evolution as arsine
	10	Neutron activation analysis
	15	Electrothermal atomic absorption spectrometry
Bi	1-8-10	Electrothermal atomic absorption spectrometry
	2-6-7-9-11-13-14-15-17	Inductively coupled plasma-optical emission spectrometry
	4-5-16	Inductively coupled plasma-mass spectrometry
	12	Flame atomic absorption spectrometry
Cd	1-2-3-5-6-8-10-13-14	Inductively coupled plasma-optical emission spectrometry
	4-7	Flame atomic absorption spectrometry
	9-11-12-16-17	Inductively coupled plasma-mass spectrometry
Co	1-2-3-4-5-6-7-9-10-13-15-18-19-20-21	Inductively coupled plasma-optical emission spectrometry
	8	Electrothermal atomic absorption spectrometry
	11-12-14-16	Inductively coupled plasma-mass spectrometry
	17	Neutron activation analysis
Cu	1-2-4-5-6-7-8-9-10-13-15-16-18-19	Inductively coupled plasma-optical emission spectrometry
	3-20	X-ray fluorescence spectrometry
	11-14	Inductively coupled plasma-mass spectrometry
	12	Flame atomic absorption spectrometry
Mo	1	Neutron activation analysis
	2-7-15	Inductively coupled plasma-mass spectrometry
	3-4-5-6-8-9-11-12-13-14-17-18-19-20-21-22	Inductively coupled plasma-optical emission spectrometry
	10	X-ray fluorescence spectrometry
	16	Flame atomic absorption spectrometry
Sn	1-5-6-7-8-9-10-11-12-13-14-15-17-18	Inductively coupled plasma-optical emission spectrometry
	2	X-ray fluorescence spectrometry
	3-16	Inductively coupled plasma-mass spectrometry
	4	Electrothermal atomic absorption spectrometry
Cl	1-2-3-6-7-8-12-13	Ion chromatography
	4	Precipitation with Ag^+, titration of excess Ag^+ with SCN^-, visual end point
	5-9-11	Titration with Ag^+, potentiometric end point
	10	Titration with Ag^+, visual end point
	14	Gravimetry as AgCl
	15	Neutron activation analysis
S	*1-2-3-4-6-7-8-10-12-13-14-15-16-17-18-19*	*Combustion, infrared absorption*
	5	*Gravimetry as $BaSO_4$, without separation*
	9	*Combustion, oxidation reduction titration*
	11	*Inductively coupled plasma-optical emission spectrometry*
C	*1-2-3-4-5-6-7-8-9-10-11-13-15-16-17-18-19-20*	*Combustion, infrared absorption*
	12	*Combustion, gravimetry*
	14	*Combustion, non-aqueous titration after absorption in organic solvent*
Hg	*1-3-4-5-6-7-11*	*Atomic absorption spectrometry, cold vapour*
	2-8-10	*Inductively coupled plasma-mass spectrometry*
	9	*Inductively coupled plasma-optical emission spectrometry*
	12	*Flame atomic absorption spectrometry*
LOI	*1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19*	*Ignition at 1000°C ± 25°C*
H_2O	*1-2-3*	*Gravimetry, weight loss*

Note re Loss On Ignition (LOI): The material contains many metallic species and, after the initial combustion of volatile constituents and consequent weight loss, these species start to oxidise and hence the material begins to gain weight. For this reason it is not possible to certify the Loss On Ignition.

EURONORM – CRM No. 884-1

PARTICIPATING LABORATORIES

Acerinox S.A., Algeciras, Spain
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Ridsdale & Co Ltd., Middlesbrough, UK
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Tata Steel, Port Talbot, UK
Tata Steel RD & T, Rotherham, UK
ThyssenKrupp Steel AG, Duisburg, Germany
Umicore Precious Metals Refining, Hoboken, Belgium
Weser-Metall GmbH Nordenham, Germany

DESCRIPTION OF THE SAMPLE

The sample is available in the form of a powder passing a nominal 150 µm aperture. It is supplied in bottles containing 100 g.

INTENDED USE & STABILITY

ECRM 884-1 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.

TRACEABILITY

The traceability of ECRM 884-1 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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