EUROPEAN CERTIFIED REFERENCE MATERIAL (EURONORM – CRM)

CERTIFICATE OF CHEMICAL ANALYSIS

EURONORM – CRM No. 880-1, BLAST FURNACE DUST

LABORATORY MEANS (4 values) - Mass content in % related to the dried (105°C) sample

Line No	Fe	Si	Ca	Mg	Al	Ti	Mn	P	S	Na	K	F
1	30.63	3.230	---	0.6905	1.178	0.0702	0.2061	0.0338	---	---	0.0880	---
2	30.67	3.270	3.067	0.6925	1.185	0.0705	0.2065	0.0339	0.3758	0.0350	0.0940	0.0250
3	30.71	3.275	3.088	0.6940	1.238	0.0723	0.2083	0.0347	0.3870	0.0380	0.0950	0.0275
4	30.79	3.292	3.090	0.6996	1.240	0.0760	0.2100	0.0348	0.4084	0.0382	0.0997	0.0277
5	30.82	3.300	3.090	0.7000	1.252	0.0775	0.2113	0.0355	0.4120	0.0390	0.1018	0.0315
6	30.94	3.306	3.096	0.7003	1.257	0.0783	0.2155	0.0359	0.4182	0.0393	0.1030	0.0325
7	30.95	3.310	3.102	0.7004	1.261	0.0786	0.2155	0.0369	0.4243	0.0397	0.1032	0.0333
8	30.99	3.319	3.103	0.7036	1.263	0.0788	0.2160	0.0372	0.4270	0.0400	0.1099	0.0342
9	31.02	3.320	3.105	0.7063	1.282	0.0790	0.2177	0.0375	0.4275	0.0403	0.1103	0.0350
10	31.05	3.326	3.105	0.7085	1.282	0.0797	0.2191	0.0376	0.4277	0.0404	0.1105	0.0353
11	31.05	3.328	3.124	0.7090	1.287	0.0800	0.2192	0.0380	0.4295	0.0410	0.1112	0.0360
12	31.06	3.332	3.142	0.7108	1.296	0.0809	0.2203	0.0390	0.4308	0.0413	0.1125	0.0370
13	31.13	3.355	3.148	0.7125	1.297	0.0810	0.2205	0.0390	0.4320	0.0417	0.1136	0.0388
14	31.16	3.364	3.171	0.7125	1.298	0.0844	0.2211	0.0393	0.4342	0.0424	0.1138	0.0397
15	31.20	3.367	3.172	0.7200	1.306	0.0844	0.2212	0.0397	0.4393	0.0432	0.1141	0.0446
16	31.25	3.373	3.196	0.7258	1.308	0.0852	0.2219	0.0399	0.4457	0.0452	0.1170	---
17	31.29	3.394	3.234	0.7361	1.314	0.0905	0.2225	0.0405	0.4493	0.0452	0.1175	
18	31.46	3.435	3.244	0.7527	1.375	0.0972	0.2298	0.0417	0.4498	0.0460	0.1205	
19	31.56	3.460	3.250	0.7530	1.376	0.0975	0.2317	---				
20	---		3.251	0.7614	---	---	0.2338					
21							---					
M_M	**31.04**	**3.335**	**3.146**	**0.7145**	**1.279**	**0.0812**	**0.2184**	**0.0375**	**0.4246**	**0.0409**	**0.1075**	**0.0342**
s_M	0.25	0.056	0.062	0.0210	0.051	0.0076	0.0077	0.0024	0.0200	0.0029	0.0090	0.0052
s_w	0.11	0.038	0.032	0.0111	0.017	0.0053	0.0043	0.0013	0.0070	0.0025	0.0031	0.0029

Line No	Cr	Ni	Zn	Pb	Cu	Cl	C_{Total}
1	---	0.0125	0.0620	0.0147	---	0.0815	*35.94*
2	0.0225	0.0125	0.0625	0.0148	0.0033	0.0815	*36.42*
3	0.0244	0.0126	0.0625	0.0153	0.0039	0.0826	*36.95*
4	0.0249	0.0130	0.0633	0.0154	0.0040	0.0830	*37.11*
5	0.0250	0.0136	0.0635	0.0158	0.0043	0.0833	*37.23*
6	0.0251	0.0139	0.0636	0.0160	0.0044	0.0838	*37.33*
7	0.0260	0.0139	0.0637	0.0160	0.0044	0.0851	*37.71*
8	0.0268	0.0140	0.0637	0.0160	0.0044	0.0855	*37.77*
9	0.0270	0.0142	0.0640	0.0160	0.0047	0.0856	*37.87*
10	0.0270	0.0145	0.0641	0.0164	0.0048	0.0868	*37.96*
11	0.0273	0.0145	0.0646	0.0166	0.0052	0.0875	*38.01*
12	0.0278	0.0146	0.0648	0.0170	0.0052	0.0887	*38.08*
13	0.0278	0.0150	0.0650	0.0180	0.0052	0.0903	*38.18*
14	0.0278	0.0150	0.0653	0.0186	0.0054	0.0905	*38.22*
15	0.0280	0.0151	0.0667	0.0188	0.0055	0.0913	*38.38*
16	0.0280	0.0156	0.0668	0.0202	0.0055		*38.61*
17	0.0280	0.0160	0.0672	---	0.0065		*38.85*
18	0.0285	0.0178	---		0.0065		*39.22*
19		---			---		
20		---					
21							
M_M	**0.0266**	**0.0144**	**0.0643**	**0.0166**	**0.0049**	**0.0858**	*37.77*
s_M	0.0017	0.0013	0.0015	0.0016	0.0009	0.0033	
s_w	0.0015	0.0008	0.0013	0.0008	0.0004	0.0033	

M_M: Mean of the intra-laboratory means

s_M: Standard deviation of the intra-laboratory means

s_w: Intra-laboratory 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.

Additional values for information: Fe_m: ≈ 0.33 %, Fe^{++}: ≈ 3.8 %, CO_2: ≈ 0.36 %, As: ≈ 40 µg/g, Ba: ≈ 150 µg/g, Cd: ≈ 1.7 µg/g, Co: ≈ 15 µg/g, Hg: ≈ 0.08 µg/g, Tl: ≈ 0.4 µg/g, Ag: < 2 µg/g, Mo: < 20 µg/g, Sb: < 10 µg/g, Sn: < 10 µg/g, V: < 20 µg/g
(with Fe_m = metallic iron)

CERTIFIED VALUES - Mass content in % related to the dried (105°C) sample

	Fe	Si	Ca	Mg	Al	Ti	Mn	P	S
M_M	**31.0**	**3.34**	**3.15**	**0.714**	**1.28**	**0.081**	**0.218**	**0.038**	**0.425**
s_M	0.3	0.06	0.06	0.021	0.05	0.008	0.008	0.003	0.020

	Na	K	F	Cr	Ni	Zn	Pb	Cu	Cl
M_M	**0.041**	**0.108**	**0.034**	**0.027**	**0.014**	**0.064**	**0.017**	**0.005**	**0.086**
s_M	0.003	0.009	0.005	0.002	0.001	0.002	0.002	0.001	0.004

This certified reference material was prepared and issued by:

ArcelorMittal Maizières Research SAS (formerly "IRSID")
Voie Romaine, BP 30320, F-57283 Maizières-lès-Metz Cedex

after approval by all the participating laboratories and all the producing organisations (France: Institut de Recherches de la Sidérurgie Francaise (IRSID); Germany: Iron and Steel CRM Working Group; United Kingdom: Bureau of Analysed Samples Ltd. (BAS)).

Certificate editorially updated July 2023, using the original data of the certificate of April 1986.

METHODS USED

Element	Line Number	Methods
Fe	1, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18	Titration with Cr (VI)
	2	XRF
	4	Titration with Mn (VII) after silvercolumn reduction
	16, 19	ICP-OES
Si	1, 2, 3, 4, 8, 10, 11, 13, 15, 17, 19	Gravimetry, dehydration with perchloric acid
	5, 6, 7	ICP-OES
	9, 14, 18	XRF
	12	MAS, molybdenum blue, without extraction
	16	Gravimetry, dehydration with hydrochloric acid
Ca	2, 6, 7, 9, 11, 12, 13, 18, 19, 20	AAS
	3, 5, 17	XRF
	4, 10, 15	ICP-OES
	8, 14, 16	Complexometric titration, visual end point
Mg	1, 4, 5, 6, 7, 8, 10, 12, 14, 15, 17, 18, 19, 20	AAS
	2, 3, 11, 16	ICP-OES
	9, 13	XRF
Al	1	MAS, hydroxyquinolate, ion exchange
	2, 3, 6, 8, 9, 10, 11, 13, 15, 18, 1 9	AAS
	4, 5, 7, 16	ICP-OES
	12, 14	XRF
	17	Complexometric titration, without separation
Ti	1, 11, 12, 15	AAS
	2, 9, 13, 17	ICP-OES
	3, 6, 8, 10, 14, 16	MAS, chromotropic acid, without separation
	4	MAS, hydrogen peroxide, after separation
	5, 18, 19	XRF
	7	MAS, diantipyrylmethane, without separation
Mn	1, 14, 18	MAS, periodate oxidation
	2, 3, 6, 7, 10, 11, 12, 16	AAS
	4	MAS, bismuthate oxidation
	5, 13, 15, 19	ICP-OES
	8, 9	XRF
	17	Titration with arsenite, oxidation with persulphate
	20	MAS, persulphate oxidation
P	1, 3, 6, 7, 10, 11, 1 2, 13	MAS, molybdenum blue, without extraction
	2, 8, 14, 17	MAS, phosphovanadomolybdate, extraction
	4, 16	MAS, phosphovanadomolybdate, without extraction
	5, 9	XRF
	15, 18	ICP-OES
S	2, 9, 11	Combustion, oxidation reduction titration
	3	Combustion, conductimetry
	4	Combustion, coulometric titration
	5, 6, 7, 8, 10, 12, 13, 14, 15, 16, 17, 18	Combustion, infrared absorption
Na	2, 8, 16, 17	ICP-OES
	3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 18	AAS
K	1, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 18	AAS
	2, 3, 12, 17	ICP-OES
F	2, 7	MAS, alizarin, after distillation
	3, 4, 5, 8, 9, 10, 14	Specific ion electrode, alkaline fusion, separation of hydroxides
	6, 15	Titration with Th (IV), visual end point, separation of interfering ions
	11	Amperometry, separation of interfering ions
	12	MAS, alizarin, pyrohydrolysis
	13	ETAAS (aluminium fluoride)
Cr	2, 3, 4, 6, 7, 9, 10, 11, 12, 14, 15, 16, 17, 18	AAS
	5	ICP-OES
	8	XRF
	13	MAS, chromate
Ni	1, 2, 3, 4, 5, 6, 9, 11, 12, 13, 14, 15, 16, 17, 18	AAS
	7	MAS, dimethylglyoxime, extraction
	8	ICP-OES
	10	XRF
Zn	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 13, 14, 15, 16, 17	AAS
	7, 12	ICP-OES
Pb	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16	AAS
	13	ICP-OES
Cu	2, 3, 4, 5, 6, 7, 10, 11, 13, 14, 15, 16, 17, 18	AAS
	8	MAS, diethyldithiocarbamate, extraction
	9, 12	ICP-OES
Cl	1, 4, 5, 6, 7, 9, 10, 12, 14, 15	Titration with Ag+, potentiometric end point
	2	Precipitation with Ag+, titration of excess Ag+ with SCN-, visual end point
	3	Titration with Hg (II), visual end point
	8	Gravimetry as AgCl
	11, 13	Titration with Ag+, visual end point
C_T	1, 5, 6, 7, 14, 16, 17, 18	Combustion, infrared absorption
	2, 8, 9, 10, 11, 15	Combustion, coulometric titration
	3, 12	Combustion, gravimetry
	4	Combustion, conductimetry
	13	Combustion, acidimetric titration in non aqueous medium

Abbreviations:

AAS Atomic Absorption Spectrometry
ETAAS Electrothermal Atomic Absorption Spectrometry
ICP-OES Inductively Coupled Plasma – Optical Emission Spectrometry
MAS Molecular Absorption Spectrophotometry
XRF X-Ray Fluorescence spectrometry

DESCRIPTION OF THE SAMPLE

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

INTENDED USE & STABILITY

ECRM 880-1 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 the 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 content should become discoloured (e.g. oxidised) due to atmospheric contamination it should be discarded.

TRACEABILITY

The assigned values for each material are achieved by inter-laboratory characterization, 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.

PARTICIPATING LABORATORIES

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FURTHER INFORMATION

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