

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 %, CO₂: ≈ 0.36 %, As: ≈ 40 µg/g, Ba: ≈ 150 µg/g, Cd: ≈ 1.7 µg/g, Co: ≈ 15 µg/g, Hg: ≈ 0.08 µg/g, Ti: ≈ 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 Française (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, 19	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, 12, 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

ARBED, Esch-sur-Alzette (Luxembourg)

ASCOMETAL, Dunkerque (France)

British Steel Corporation, Ravenscraig works (United Kingdom)

British Steel Corporation, Scunthorpe works (United Kingdom)

Bundesanstalt für Materialprüfung, Berlin (Germany)

Centre de Recherches Métallurgique, Liège (Belgium)

Centre de Recherches de Pont-à-Mousson, Pont-à-Mousson (France)

Cockerill - Sambre, Seraing (Belgium)

Dillinger Hüttenwerke AG, Dillingen (Germany)

Hoesch Stahl AG, Dortmund (Germany)

Hoogovens Groep B.V., IJmuiden (Netherlands)

Institut de Recherches de la Sidérurgie Française, Maizières-lès-Metz (France)

Ridsdale & Co Ltd, Middlesbrough (United Kingdom)

SOLLAC, Florange (France)

SOLMER, Fos-sur-Mer (France)

UNIMETAL, Gandrange (France)

USINOR, Dunkerque (France)

USINOR, Longwy (France)

FURTHER INFORMATION

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 et CEN/TR 10350. On peut se procurer ces deux documents auprès des organismes nationaux de normalisation.

D'autres informations et avis au sujet de ce Matériau de Référence Certifié, ou de tout autre Matériau de Référence Certifié ou Matériau de Référence produit par ArcelorMittal Maizières Research SAS, peuvent être demandés en contactant l'adresse figurant ci-dessous dans ce Certificat.

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 and CEN/TR 10350, both of which are available from the national standards body in your country. Further information and advice on this or other Certified Reference Materials or Reference Materials produced by ArcelorMittal Maizières Research SAS may be obtained from the address below.

Angaben über Herstellung, Zertifizierung und Bezugsmöglichkeiten dieser Europäischen Zertifizierten Referenzmaterialien (EURONORM-ZRM) sowie über die Anwendungen der in diesem Zertifikat enthaltenen statistischen Daten sind erhältlich beim Hersteller dieses zertifizierten Referenzmaterials, dessen Adresse auf diesem Zertifikat angegeben ist oder sie finden sich in den CEN-Reports CEN/TR 10317 und CEN/TR 10350, beide zu beziehen durch die nationalen Normenorganisationen.

Weitere Informationen und Hinweise zu diesem oder anderen durch ArcelorMittal Maizières Research SAS können unter der unten angegebenen Adresse erhalten werden.

För information angående tillverkning, certifiering och anskaffning av dessa europeiska certifierade referensmaterial (EURONORM CRM) och för användning av statistisk information, som angivits i detta certifikat, refereras antingen till producenten av detta certifierade referensmaterial eller till Teknisk Rapport CEN/TR 10317 och CEN/TR 10350 som kan erhållas från den nationella standardiseringsorganisationen.

Ytterligare information och rådfrågan om detta eller andra certifierade referensmaterial eller referensmaterial, producerade av ArcelorMittal Maizières Research SAS kan erhållas från nedanstående adress.

Laurence DAHERON
Responsible for certification

ArcelorMittal Maizières Research SAS
Voie Romaine
BP 30320
57283 Maizières-lès-Metz Cedex
France

E-mail: reference.materials@arcelormittal.com
Website: referencematerials.arcelormittal.com