

ECISS
EUROPEAN COMMITTEE FOR IRON AND STEEL STANDARDIZATION
EUROPÄISCHES KOMITEE FÜR EISEN- UND STAHLNORMUNG
COMITE EUROPEEN DE NORMALISATION DU FER ET DE L'ACIER

Certified European Reference Material (EURONORM CRM)
Certificate of chemical analysis

EURONORM-CRM No. 478-2 (Hematite - pig iron)

Laboratory means (4 values), mass content in %

Line No.	C	Si	Mn	P	S	Cr	Ni	B	Cu	N	Ti	V	As
1	-----	2.3235	0.3004	0.1845	0.0420	-----	0.1350	0.0004	0.1195	0.0020	0.0306	-----	<i>0.0016</i>
2	3.9652	2.3440	0.3115	0.1845	0.0431	0.2369	0.1353	0.0005	0.1210	0.0021	0.0308	0.0108	<i>0.0016</i>
3	3.9670	-----	0.3125	0.1907	0.0433	0.2375	0.1369	0.0005	0.1225	0.0021	0.0317	0.0108	<i>0.0017</i>
4	3.9796	2.3678	0.3147	0.1932	0.0438	0.2399	0.1392	0.0005	0.1246	0.0022	0.0317	0.0108	<i>0.0017</i>
5	3.9807	2.3804	0.3156	0.1969	0.0442	0.2445	0.1406	0.0006	0.1262	0.0022	0.0326	0.0112	<i>0.0017</i>
6	3.9838	2.3868	0.3171	0.1988	0.0448	0.2463	0.1422	0.0006	0.1267	0.0023	0.0328	0.0113	<i>0.0019</i>
7	3.9928	2.3889	0.3194	0.1988	0.0454	0.2463	0.1422	0.0006	0.1277	0.0023	0.0329	0.0114	<i>0.0019</i>
8	3.9932	2.3968	0.3196	0.2001	0.0455	0.2471	0.1456	0.0006	0.1278	0.0024	0.0330	0.0114	<i>0.0020</i>
9	4.0002	2.4135	0.3196	0.2017	-----	0.2492	0.1465	0.0006	0.1280	0.0025	0.0331	0.0115	-----
10	4.0085	2.4199	0.3205	0.2043	0.0460	0.2521	0.1472	0.0007	0.1284	0.0025	0.0339	0.0115	<i>0.0021</i>
11	4.0095	2.4213	0.3219	0.2084	0.0464	0.2534	0.1475	0.0007	0.1287	0.0026	0.0339	0.0117	<i>0.0023</i>
12	4.0105	2.4275	0.3242	0.2088	0.0474	0.2546	0.1546	0.0007	0.1290	0.0027	0.0341	0.0119	
13	4.0149	2.4288	0.3250	0.2090	0.0475	0.2555	0.1580		0.1291		0.0341	0.0119	
14	4.0157	2.4313	0.3255	0.2094	0.0475	0.2558	0.1589		0.1310		0.0343		
15	4.0292	2.4339	0.3285	0.2128	0.0483	0.2560	0.1607		0.1313				
16	4.0425	2.4413	0.3300	0.2220	0.0498	0.2595	0.1670		0.1314				
17	4.0477	2.4576	0.3318		0.0520	0.2610	0.1673		0.1316				
18		2.4586	0.3384			0.2611	0.1695		0.1317				
19		2.4783				0.2653	0.1790						
M(M)	4.0026	2.4111	0.3209	0.2015	0.0460	0.2512	0.1512	0.0006	0.1276	0.0023	0.0328	0.0113	
s(M)	0.0246	0.0405	0.0087	0.0103	0.0026	0.0083	0.0130	0.0001	0.0037	0.0002	0.0012	0.0004	
s(w)	0.0117	0.0121	0.0030	0.0031	0.0009	0.0022	0.0022	0.0001	0.0010	0.0001	0.0005	0.0003	

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 omitted by either the Cochran or Grubbs test. Values given in *italic type* are for information only.

CERTIFIED VALUES, mass content in %

	C	Si	Mn	P	S	Cr	Ni	B	Cu	N	Ti	V
M(M)	4.003	2.411	0.321	0.201	0.0460	0.251	0.151	0.0006	0.1276	0.0023	0.0328	0.0113
C(95%)	0.013	0.021	0.005	0.006	0.0015	0.005	0.007	0.0001	0.0019	0.0002	0.0007	0.0003

C(95%) is the half-width confidence interval where t is the appropriate Student's t value and n is the number of acceptable laboratory means. For further information regarding the confidence interval for the certified value see ISO Guide 35:2006 sections 6.1 and 10.5.2.

$$C(95\%) = \frac{t \cdot s(M)}{\sqrt{n}}$$

English version November 2021
First issued July 1996

Description of the sample

The sample material has a grain size of < 0.250 mm. The samples are contained in glass bottles of 100 g. Part of the Si is present as SiC.

This reference material was prepared in accordance with the recommendations set out in ISO Guides 30 – 35 and issued by the German Iron and Steel CRM Working Group on behalf of the Iron and Steel Nomenclature Co-Ordinating Committee (COCOR) and the European Committee for Iron and Steel Standardization (ECISS), after approval by all the participating laboratories and all the producing organizations. (France – IRSID/CTIF, Germany – Iron and Steel CRM Working Group: Steel institute VDEh, BAM Bundesanstalt für Materialforschung und -prüfung & MPI für Eisenforschung, Nordic Countries – Nordic CRM Working Group, UK – BAS Ltd).

The German Iron and Steel CRM Working Group is composed of
 BAM Bundesanstalt für Materialforschung und -prüfung, Berlin
 Max-Planck-Institut für Eisenforschung GmbH (MPI), Düsseldorf
 Steel institute VDEh, Düsseldorf

Sale of the reference material: Bundesanstalt für Materialforschung und -prüfung (BAM), Richard-Willstätter-Straße 11, 12489 Berlin (www.webshop.bam.de).

Intended use & stability

This ECRM 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 stoichiometric metals or 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 and dry atmosphere. When the bottle has been opened the lid should be secured immediately after use. If the contents should become discoloured (eg. oxidised) due to atmospheric contamination they should be discarded.

Traceability

The assigned values for this reference material are achieved by inter-laboratory characterization, each laboratory using the method of their choice, details of which are given below. These methods are either stoichiometric analytical techniques or methods which are calibrated against pure metals or stoichiometric compounds.

Participating laboratories

AG der Dillinger Hüttenwerke, Dillingen-Saar (Germany)
 Böhler Edelstahl GmbH, Kapfenberg (Austria)
 Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin (Germany)
 The Castings Development Centre, Birmingham (United Kingdom)
 Centre de Recherches de Maitières, Pont-à-Mousson (France)
 CRM Centre de Recherches Métallurgiques, Liège (Belgium)
 CTIF Centre Technique des Industries de la Fonderie, Sèvres (France)
 Materialprüfungsamt Nordrhein-Westfalen (MPA NRW), Dortmund (Germany)
 Max-Planck-Institut für Eisenforschung GmbH, Düsseldorf (Germany)
 Ridsdale & Co. Ltd., Middlesbrough (United Kingdom)
 Rover Group, Longbridge (United Kingdom)
 SOLLAC, Florange (France)
 SOLLAC-Fos, Fos-sur-Mer (France)
 Stahlwerke Bremen GmbH, Bremen (Germany)
 Voest-Alpine Stahl Linz Ges.m.b.H., Linz (Austria)
 Weir Pumps Limited, Glasgow (United Kingdom)

Methods used

Element	Line No.	Method
C	2, 7, 13	Combustion, Coulometric
	3, 4, 8, 10, 11, 12, 15, 16	Combustion, Infrared absorption
	5, 9	Combustion, non-aqueous titration, acidimetric after absorption in organic solvent
	6, 14	Combustion, Conductimetry
	17	Combustion, Thermal conductivity

Element	Line No.	Method
Si	1, 4 2, 6, 7, 8, 9, 12, 13, 14, 16, 17, 18 5 10, 11 15 19	Flame atomic absorption spectrometry Gravimetry, dehydration with perchloric acid Gravimetry, dehydration with nitric acid and sulfuric acid Plasma - optical emission spectrometry X-ray fluorescence spectrometry Gravimetry, dehydration with hydrochloric acid
Mn	1, 6, 7, 11, 13, 14, 17 2, 4, 9, 15 3, 8, 18 5, 12, 16 10	Plasma-Optical emission spectrometry Flame atomic absorption spectrometry Spectrophotometry, persulphate oxidation Spectrophotometry, periodate oxidation X-ray fluorescence spectrometry
P	1, 2, 7 3, 4, 5, 6, 10 8, 9, 11, 14 12 13, 15 16	Acidimetric titration of ammonium phosphomolybdate Spectrophotometry, phosphovanadomolybdate, extraction Plasma - optical emission spectrometry X-ray fluorescence spectrometry Spectrophotometry, molybdenum blue, without extraction Spectrophotometry, phosphovanadomolybdate, without extraction
S	1, 2, 3, 4, 5, 6, 8, 10, 11, 12, 14, 15 7 13, 17 16	Combustion, Infrared absorption Gravimetry as BaSO ₄ without separation Combustion, Conductimetry Combustion, acidimetric titration, absorption in H ₂ O ₂ or AgNO ₃
Cr	2, 3, 6, 9, 13, 14, 19 4, 5, 8, 10, 11, 12, 16, 18 7 15 17	Flame atomic absorption spectrometry Plasma - optical emission spectrometry Titration with Fe(II), oxidation with persulphate Titration with Fe(II), oxidation with perchloric acid X-ray fluorescence spectrometry
Ni	1, 3, 8, 11, 13, 14, 16, 18 2, 4, 5, 6, 7, 9, 10, 15, 17, 19 12	Flame atomic absorption spectrometry Plasma - optical emission spectrometry X-ray fluorescence spectrometry
B	1, 3, 4, 5, 7, 11, 12 2, 10 6, 9 8	Spectrophotometry, curcumin Plasma - optical emission spectrometry Spectrophotometry, 1,1-dianthrime, separation Spectrophotometry, methylene blue, extraction, separation of boron by ion exchange
Cu	1, 2, 7, 8, 9, 10, 12, 18 3, 4, 5, 6, 11, 13, 14, 15, 16, 17	Flame atomic absorption spectrometry Plasma - optical emission spectrometry
N	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12 11	Thermal conductivity, decomposition in graphite crucible Spectrophotometry, indophenol blue, distillation
Ti	1 2, 14 3, 4, 5, 6, 7, 8, 10, 11, 12, 13 9	Spectrophotometry, dianthylmethane Flame atomic absorption spectrometry Plasma - optical emission spectrometry Spectrophotometry, chromotropic acid, without separation
V	2 3 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	Flame atomic absorption spectrometry Spectrophotometry, N-benzoylphenylhydroxylamine, extraction Plasma - optical emission spectrometry
As	1, 10 2, 5 3, 6 4, 11 7 8	<i>Flameless atomic absorption spectrometry</i> <i>Spectrophotometry, DDC, separation as arsine</i> <i>Plasma - optical emission spectrometry</i> <i>Atomic absorption spectrometry, separation as arsine</i> <i>Spectrophotometry, molybdenum blue, halide extraction</i> <i>Flame atomic absorption spectrometry</i>

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 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 the German CRM working group may be obtained from the address above.

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 die Arbeitsgemeinschaft "Zertifiziertes Referenzmaterial Eisen und Stahl" hergestellten zertifizierten Referenzmaterialien oder Referenzmaterialien können unter der oben angegebenen Adresse erhalten werden.

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 produits par le Groupe de travail allemand pour les MRC sidérurgiques, peuvent être demandés en contactant l'adresse figurant plus haut dans ce Certificat.

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 den tyska arbetsgruppen för CRM, kan erhållas från angiven adress på certifikatet enligt ovan.

The German Iron and Steel CRM Working Group

The Working Group is composed of
Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin
Max-Planck-Institut für Eisenforschung GmbH (MPI), Düsseldorf
Steel institute VDEh, Düsseldorf

Dr. Sebastian Recknagel
Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin