

Certified European Reference Material (EURONORM CRM)

Certificate of chemical analysis

EURONORM-CRM No. 480-1 (Cast iron)

Laboratory mean values (4 determinations), mass content in %

Line No.	C	Si	Mn	P	S	Ni	Al	Mg	Cr	Cu
1	2,998	2,358	0,1417	0,0016	-----	0,4700	0,0137	0,0158	<i>0,0139</i>	<i>0,0039</i>
2	3,003	2,372	0,1450	0,0016	0,0070	0,4716	0,0147	0,0159	<i>0,0140</i>	<i>0,0042</i>
3	3,010	2,375	0,1465	0,0018	0,0077	0,4727	0,0150	0,0164	<i>0,0145</i>	<i>0,0042</i>
4	3,010	2,380	0,1470	0,0018	0,0077	0,4775	0,0151	0,0165	<i>0,0152</i>	<i>0,0045</i>
5	3,016	2,388	0,1481	0,0018	0,0078	0,4780	0,0153	0,0166	<i>0,0157</i>	<i>0,0046</i>
6	3,023	2,392	0,1482	0,0018	0,0083	0,4787	0,0155	0,0167	<i>0,0159</i>	<i>0,0046</i>
7	3,024	2,402	0,1499	0,0018	0,0083	0,4810	0,0155	0,0168	<i>0,0161</i>	<i>0,0049</i>
8	3,025	2,405	0,1500	0,0019	0,0083	0,4820	0,0156	0,0171	<i>0,0167</i>	<i>0,0050</i>
9	3,030	2,405	0,1517	0,0019	0,0085	0,4827	0,0160	0,0172	<i>0,0171</i>	<i>0,0050</i>
10	3,030	2,412	0,1520	0,0020	0,0085	0,4842	0,0162	0,0173	<i>0,0171</i>	<i>0,0050</i>
11	3,032	2,413	0,1532	0,0020	0,0085	0,4850	0,0167	0,0174	<i>0,0172</i>	<i>0,0052</i>
12	3,035	2,416	0,1535	0,0021	0,0086	0,4875	0,0168	0,0176	<i>0,0172</i>	<i>0,0059</i>
13	3,035	2,417	0,1541	0,0022	0,0086	0,4880	0,0170	0,0178	<i>0,0195</i>	<i>0,0062</i>
14	3,048	2,420	0,1545	0,0023	0,0087	0,4881	0,0172	0,0179	<i>0,0196</i>	<i>0,0090</i>
15	3,048	2,422	0,1550	0,0023	0,0088	0,4892	0,0175	0,0184		
16	3,058	2,430	0,1572	0,0024	0,0100	0,4897	0,0180	0,0190		
17	3,063	2,434	0,1575	0,0029	0,0104	0,4900	0,0182	-----		
18	-----	2,440	0,1590	0,0029	0,0106	0,4900	0,0192	-----		
19		2,453		0,0032	-----			-----		
M(M)	3,029	2,407	0,1513	0,0021	0,0086	0,4826	0,0163	0,0172		
s(M)	0,018	0,025	0,0047	0,0005	0,0010	0,0066	0,0014	0,0009		
s(w)				0,0002						

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 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	Ni	Al	Mg
M(M)	3,03	2,41	0,151	0,0021	0,0086	0,483	0,016	0,017
s(M)	0,02	0,02	0,005	0,0005	0,0010	0,007	0,001	0,001

This certified reference material was prepared and issued by:

The German Iron and Steel CRM Working Group

consisting of Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Max-Planck-Institut für Eisenforschung GmbH (MPI), Düsseldorf, Steel institute VDEh, Düsseldorf

after approval by all the participating laboratories and all the producing organisations: France: Institut de Recherches de la Sidérurgie Française (IRSID) and Centre Technique des Industries de la Fonderie (CTIF), UK: Bureau of Analysed Samples Ltd. (BAS), Germany: Iron and Steel CRM Working Group: Steel institute VDEh, Bundesanstalt für Materialforschung und -prüfung (BAM) & MPI für Eisenforschung.

Description of the sample

The material is available in the form of powder and was produced by atomization of the melt. The particle size is between 60 µm and 200 µm. The samples are supplied in glass bottles containing 100 g.

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

Participating laboratories in certification 1979

ARBED, Division de Differdange, Differdange (Luxembourg)
 ARBED, Division d'Esch-Belval, Esch-sur-Alzette (Luxembourg)
 British Cast Iron Research Association (BCIRA), Alvechurch, Birmingham (United Kingdom)
 British Steel Corporation, Stanton and Staveley Works, Nottingham (United Kingdom)
 Bundesanstalt für Materialprüfung, Berlin (Germany)
 Centre de Recherches de Pont-à-Mousson, Pont-à-Mousson (France)
 Centre Technique des Industries de la Fonderie, Sèvres (France)
 Centro Sperimentale Metallurgico S.p.A., Roma Eur (Italy)
 COCKERILL, Cockerill-Ougrée-Providence et Espérance-Longdoz, Seraing (Belgium)
 Creusot-Loire, Centre de Recherches d'Unieux, Unieux (France)
 GKN Group Technological Centre, Wolverhampton (United Kingdom)
 Hoogovens - ESTEL, IJmuiden (The Netherlands)
 N. V. Staalgieterij SMDK, Utrecht (The Netherlands)
 Ridsdale & Co. Ltd., Middlesbrough, Cleveland (United Kingdom)
 RNU Renault, Laboratoire d'Analyses et d'Essais, Boulogne Billancourt (France)
 Soc. Italsider, Laboratorio Centrale, Genova (Italy)
 Soc. Italsider, Tubi Ghisa, Genova (Italy)
 Stahlwerke Peine-Salzgitter AG, Werk Salzgitter, Peine (Germany)
 Thyssen Niederrhein AG, Hütten- und Walzwerke, Oberhausen (Germany)
 Thyssen Schalker Verein GmbH, Gelsenkirchen (Germany)

Participating laboratories in certification of phosphorus 1988

British Steel Corporation, Corby (United Kingdom)
 British Steel Corporation, Port Talbot (United Kingdom)
 Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin (Germany)
 Centre Technique des Industries de la Fonderie (CTIF), Sèvres (France)
 Eisenwerk-Gesellschaft Maximilianshütte mbH Sulzbach-Rosenberg (Germany)
 Hoesch Stahl AG, Dortmund (Germany)
 Institut de Recherches de la Siderurgie Française, Maizieres les Metz und Saint-Germain en Laye (France)
 Klöckner Stahl GmbH, Bremen (Germany)
 Klöckner Stahl GmbH, Georgsmarienerwerke, Osnabrück (Germany)
 Krupp Stahl AG, Bochum (Germany)
 Krupp Stahl AG, Siegen (Germany)
 Mannesmann Röhren-Werke AG, Duisburg (Germany)
 Max-Planck-Institut für Eisenforschung GmbH, Düsseldorf (Germany)
 Ridsdale & Co. Ltd., Middlesbrough (United Kingdom)
 Rotherham Engineering Steels, Rotherham (United Kingdom)
 Sollac, Florange (France)
 Stahlwerke Peine-Salzgitter, Salzgitter (Germany)
 Thyssen Stahl AG, Duisburg (Germany)
 Usinor Aciers, Dunkerque (France)

Intended use and 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 each 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. Most methods used were either international or national standard methods or methods which are technically equivalent.

Methods used

Element	Line number	Method
C	1, 2, 6, 10	Combustion, coulometric titration
	3, 8, 16, 17	Combustion, thermal conductivity
	4, 11, 13	Combustion, gravimetry
	5, 12	Combustion, gas volumetry
	7	Combustion, infrared absorption
	9, 14, 15	Combustion, Non-aqueous titration after absorption in organic solvent
Si	1	Gravimetry, dehydration with hydrochloric acid
	2	MAS, molybdenum blue, without extraction
	3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 18, 19	Gravimetry, dehydration with perchloric acid
	10	Method not reported
	17	FAAS
Mn	1, 2, 6, 9, 12, 15, 16, 17	MAS, oxidation with periodate
	3, 18	MAS, oxidation with persulfate and silver nitrate
	4, 8, 10, 11, 13, 14	FAAS
	5, 7	Titration with arsenite, oxidation with persulfate and silver nitrate
P	1, 2, 12, 13	MAS, molybdenum blue, extraction
	3, 4, 5, 6, 7, 8, 9, 10, 11, 15, 16, 18, 19	MAS, phosphomolybdovanadate, extraction
	14	MAS, molybdenum blue, without extraction
	17	ICP-OES
S	2	Gravimetry, separation by adsorption on alumina
	3, 9, 11, 14, 16	Combustion, acidimetric titration
	4, 6, 7, 12	Combustion, infrared absorption
	5, 10, 17	Combustion, coulometric titration
	8, 15	Combustion, iodometry
	13, 18	Combustion, conductometry
Ni	1, 5, 7, 8, 9, 10, 12, 13, 15, 17	FAAS
	2, 11, 16, 18	MAS, dimethylglyoxime, without extraction
	3	Method not reported
	4	Gravimetry, dimethylglyoxime
	6	Cyanometric titration
	14	MAS, dimethylglyoxime, with extraction
Al	1, 2, 3, 8, 12, 15, 17	FAAS, without extraction of iron
	4, 5, 10	MAS, Eriochrome cyanine, electrolytic separation
	6	MAS, Chrome azurol S, ion exchange separation
	7	MAS, hydroxyquinolate, ion exchange separation
	9, 11, 13, 14	FAAS, extraction of iron
	16	MAS, hydroxyquinoline, with extraction
	18	MAS, Eriochrome cyanine, extraction of iron with MIBK
Mg	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16	FAAS
Cr	1, 2, 5, 6, 8, 11, 14	FAAS
	3	Method not reported
	4, 7, 9, 12	MAS, diphenylcarbazide
	10	Titration (electrometric), oxidation with persulfate
	13	Titration (electrometric), oxidation with perchloric acid
Cu	1, 5, 6, 7, 8, 9, 11, 12, 13, 14	FAAS
	2	MAS, dithiooxamide, without extraction
	3	MAS, bis(cyclohexanone-oxalyl)dihydrazone (BCO)
	4	MAS, lead diethyl dithiocarbamate, extraction
	10	Method not reported

Abbreviations:

ICP-OES	Inductively coupled plasma - optical emission spectrometry
MAS	Spectrophotometry
FAAS	Flame atomic absorption spectrometry

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.

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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.

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