

Certified European Reference Material (EURONORM CRM)

Certificate of chemical analysis

EURONORM-CRM No. 082-1 (Free cutting steel)

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

Line No.	C	Si	Mn	P	S	Cr	Ni	Al	Cu	N	Pb	Te	As
1	0.4100	0.2267	0.7527	0.0110	0.0284	0.0154	0.0250	0.0300	0.0235	0.0040	0.1422	0.0276	<i>0.0232</i>
2	0.4110	0.2282	0.7572	0.0114	0.0285	0.0160	0.0252	0.0300	0.0237	0.0042	0.1425	0.0285	<i>0.0240</i>
3	0.4112	0.2295	0.7617	0.0115	0.0285	0.0168	0.0254	0.0302	0.0240	0.0044	0.1432	0.0285	<i>0.0244</i>
4	0.4115	0.2300	0.7622	0.0120	0.0287	0.0169	0.0257	0.0302	0.0244	0.0044	0.1450	0.0287	<i>0.0257</i>
5	0.4115	0.2307	0.7630	0.0121	0.0292	0.0172	0.0258	0.0305	0.0245	0.0045	0.1462	0.0295	<i>0.0260</i>
6	0.4120	0.2325	0.7642	0.0122	0.0292	0.0172	0.0260	0.0309	0.0245	0.0046	0.1480	0.0295	<i>0.0260</i>
7	0.4122	0.2327	0.7673	0.0124	0.0298	0.0176	0.0263	0.0317	0.0247	0.0046	0.1480	0.0298	<i>0.0266</i>
8	0.4140	0.2347	0.7675	0.0134	0.0299	0.0176	0.0263	0.0325	0.0247	0.0046	0.1485	0.0302	<i>0.0278</i>
9	0.4140	0.2350	0.7692	0.0135	0.0301	0.0182	0.0264	0.0325	0.0250	0.0046	0.1490	0.0305	<i>0.0278</i>
10	0.4147	0.2355	0.7695	0.0136	0.0305	0.0185	0.0270	0.0327	0.0250	0.0047	0.1495	0.0307	<i>0.0282</i>
11	0.4147	0.2360	0.7700	0.0136	0.0306	0.0190	0.0275	0.0330	0.0251	0.0048	0.1500	0.0307	<i>0.0285</i>
12	0.4150	0.2367	0.7700	0.0137	0.0307	0.0190	0.0280	0.0331	0.0252	0.0048	0.1505	0.0307	<i>0.0285</i>
13	0.4160	0.2370	0.7702	0.0139	0.0309	0.0190	0.0282	0.0332	0.0253	0.0048	0.1506	0.0315	<i>0.0290</i>
14	0.4162	0.2375	0.7725	0.0140	0.0310	0.0192	0.0284	0.0332	0.0254	0.0049	0.1507	0.0315	<i>0.0297</i>
15	0.4165	0.2375	0.7725	0.0140	0.0310	0.0192	0.0285	0.0335	0.0254	0.0050	0.1510	0.0318	<i>0.0306</i>
16	0.4170	0.2387	0.7727	0.0142	0.0313	0.0194	0.0285	0.0335	0.0262	0.0054	0.1515	0.0322	<i>0.0340</i>
17	0.4177	0.2407	0.7735	0.0142	0.0313	0.0195	0.0286	0.0340	0.0265		0.1527	0.0327	<i>0.0352</i>
18	0.4185	0.2415	0.7775	0.0150	0.0315	0.0201	0.0293	0.0344	0.0267		0.1535		<i>0.0355</i>
19	0.4185	0.2435	0.7817	0.0157	0.0315	0.0205	-----	0.0345	0.0267		0.1575		<i>0.0356</i>
20	0.4185	-----	0.7842	-----	0.0320	-----		0.0345	0.0268		-----		-----
M(M)	0.4145	0.2350	0.7690	0.0132	0.0302	0.0182	0.0270	0.0324	0.0252	0.0046	0.1490	0.0303	
s(M)	0.0028	0.0046	0.0076	0.0013	0.0011	0.0014	0.0014	0.0016	0.0010	0.0004	0.0039	0.0014	

M(M): mean of the intra-laboratory means
s(M): standard deviation of the intra-laboratory means

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	Al	Cu	N	Pb	Te
M(M)	0.415	0.235	0.769	0.013	0.030	0.018	0.027	0.032	0.025	0.0046	0.149	0.030
s(M)	0.003	0.005	0.008	0.001	0.001	0.001	0.001	0.002	0.001	0.0004	0.004	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.

Certificate editorially updated in June 2020 using the original data of the certificate of November 1976 and giving a certified value for nitrogen.

Description of the sample

The material is available in the form of chips. The samples are supplied in glass bottles containing 100 g.

Participating laboratories

ARBED, Division de Differdange, Differdange (Luxembourg)
 ARBED, Division d'Esch-Belval, Esch-sur-Alzette (Luxembourg)
 British Steel Corporation, Normanby Park Steel Works, Scunthorpe, Lincs (United Kingdom)
 British Steel Corporation, Special Steels Division, Rotherham Works (United Kingdom)
 Bundesanstalt für Materialprüfung (BAM), Berlin (Germany)
 Centro Sperimentale Metallurgico S.p.A., Roma Eur (Italy)
 CREUSOT-LOIRE, Centre de Recherches, Unieux (France)
 Eisenwerk-Gesellschaft Maximilianshütte mbH, Sulzbach-Rosenberg (Germany)
 Ford Motor Co. Ltd., Central Laboratory Services, Laindon, Basildon (United Kingdom)
 GKN Group Technological Centre, Wolverhampton (United Kingdom)
 Hoesch Hüttenwerke AG, Dortmund (Germany)
 Hoogovens IJmuiden BV, IJmuiden (The Netherlands)
 Institut de Recherches de la Sidérurgie Française (IRSID), Maizières-lès-Metz (France)
 Institut de Recherches de la Sidérurgie Française (IRSID), Saint-Germain-en-Laye (France)
 Neunkircher Eisenwerk AG, vormals Gebrüder Stumm, Neunkirchen (Saar) (Germany)
 N. V. Staalgieterwerk SMDK, Utrecht (The Netherlands)
 Ridsdale & Co. Ltd., Middlesbrough, Cleveland (United Kingdom)
 RNU Renault, Boulogne-Billancourt (France)
 SACILOR, Laboratoire Central Anal. Prod., Amnéville (France)
 S. A. Cockerill-Ougrée-Providence et Espérance-Longdoz, Seraing (Belgium)
 Sanderson Kayser Ltd., Attercliffe Steelworks, Sheffield (United Kingdom)
 Soc. Italsider, Laboratorio Centrale, Genova Cornigliano (Italy)
 Société Métallurgique Hainaut-Sambre, S. A., Couillet (Belgium)
 SOLLAC, Laboratoire Central Chimie, Florange (France)
 Stahlwerke Röchling-Burbach GmbH, Völklingen-Saar (Germany)
 Thyssen Niederrhein AG, Hütten- und Walzwerke, Werk Duisburg, Duisburg (Germany)
 Usinor, Usine de Longwy, Longwy (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, 8, 14, 16	Combustion, coulometric titration
	2, 7, 18, 19	Combustion, thermal conductivity
	3, 10	Combustion, infrared absorption
	4, 9, 12, 17, 20	Combustion, conductimetry
	5	Combustion, manometry after freezing out CO ₂
	6, 11, 13	Combustion, non-aqueous titration after absorption in organic solvent
	15	Combustion, gravimetry

Element	Line number	Method
Si	1, 5, 8, 15, 17 2, 3, 4, 10, 12, 13, 14, 19 6, 7, 11 9 16	Gravimetry, dehydration with perchloric acid MAS, molybdenum blue, without extraction FAAS MAS, silicovanadomolybdate, extraction MAS, silicovanadomolybdate, without extraction
Mn	1, 15, 16, 20 2, 3, 5, 6, 7, 9, 10, 11, 12, 14, 17, 19 4, 18 8 13	FAAS MAS, oxidation with periodate MAS, oxidation with persulfate and silver nitrate Titration with Mn(VII), zinc oxide separation Titration with arsenite, oxidation with persulfate and silver nitrate
P	1, 2, 5, 9, 10, 11, 16, 17 3, 4, 6, 8, 12, 15, 18 7, 13, 14, 19	MAS, molybdenum blue, without extraction MAS, phosphovanadomolybdate, extraction MAS, molybdenum blue, extraction
S	1, 2, 5, 6, 9, 16 3, 17, 20 4 7, 8, 12, 14, 15, 19 10, 11, 18 13	Combustion, acidimetric titration Combustion, conductimetry Gravimetry as barium sulphate without separation Combustion, infrared absorption Combustion, iodometry Combustion, coulometric titration
Cr	1, 4, 5, 10, 12, 13, 15, 17, 18, 19 2 3, 6, 8, 9, 11, 16 14	MAS, diphenylcarbazide Titration with Fe(II), oxidation with persulfate FAAS Titration with Fe(II), oxidation with perchloric acid
Ni	1, 4, 5, 8, 9, 10, 11, 17 2, 3, 6, 13, 15, 16, 18 7, 12, 14	FAAS MAS, dimethylglyoxime, without extraction MAS, dimethylglyoxime, extraction
Al	1, 7, 11 2, 8, 9, 10, 12, 13, 14, 17, 18, 19, 20 3, 15, 16 4 5 6	MAS, eriochrome cyanine FAAS, without extraction of iron MAS, eriochrome cyanine, electrolytic separation FAAS, extraction of iron MAS, chrome azurol-S MAS, hydroxychinolate, ion exchange separation
Cu	1, 2, 5, 11 3, 4, 9, 13, 14, 15, 16, 17, 19 6, 20 7 8 10 12 18	MAS, biscyclohexanone-oxalyldihydrazone (BCO) FAAS MAS, 2,2'-Dichinoly, without extraction MAS, diethyldithiocarbamate, without extraction MAS, 2,2'-Dichinoly, extraction MAS, lead diethyldithiocarbamate, extraction MAS, diethyldithiocarbamate, extraction MAS, oxalyldihydrazide
N	1, 2, 7, 8, 10, 11, 12, 13 3, 6, 15 4, 14 5 9, 16	Thermal conductivity, decomposition in graphite crucible Acidimetric titration Gas volumetry, oxidising fusion, CO ₂ as carrier gas MAS, indophenol blue Vacuum extraction, decomposition in graphite crucible
Pb	1 2, 5, 11 3 4, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18, 19	Polarography MAS, dithizone XRF FAAS
Te	2, 14 3, 6, 10, 12, 15 4, 5, 7, 9 8, 11, 13 16	Gravimetry as Cu ₂ Te MAS, reduction with Sn(II) FAAS Turbidimetry, reduction with Sn(II) MAS, thiourea

Element	Line number	Method
As	1, 4, 5, 8, 9, 10, 12, 15, 16	MAS, molybdenum blue, extraction
	2	Polarography, halide distillation
	3, 14	MAS, silver diethyldithiocarbamate
	6, 7	MAS, molybdenum blue, separation as AsH ₃
	11, 13, 17	Titration with bromate, potentiometric end point, halide distillation
	18, 19	Titration with iodine, separation as sulphide

Abbreviations:

MAS	Spectrophotometry
FAAS	Flame atomic absorption spectrometry
XRF	X-ray fluorescence 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.

The German Iron and Steel CRM Working Group

The Working Group is composed of
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 Max-Planck-Institut für Eisenforschung GmbH (MPI), Düsseldorf
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