

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

European Certified Reference Material (EURONORM-CRM)

Certificate of Chemical Analysis

EURONORM-CRM No. 194-2
(High-strength Steel grade 1.8928)

Laboratory means (4 values), mass content in %

Line No.	C	Si	Mn	P	S	Cr	Mo	Ni	Al _{tot}	As	B
1	0.1661	0.2863	1.2584	0.0126	0.00032	0.7442	0.3930	0.3235	0.0631	0.00183	-----
2	0.1670	0.2865	-----	0.0127	0.00038	0.7495	0.3930	0.3240	-----	-----	-----
3	0.1671	0.2885	1.2610	0.0130	0.00038	0.7495	0.3933	0.3242	0.0652	0.00189	0.00093
4	0.1680	0.2910	1.2613	0.0131	0.00040	0.7507	0.3940	0.3248	0.0655	0.00190	0.00123
5	0.1690	0.2936	1.2613	0.0132	0.00043	0.7509	0.3970	0.3253	0.0657	0.00198	0.00125
6	0.1694	0.2938	1.2643	0.0133	0.00045	0.7511	0.3976	0.3292	0.0662	0.00198	0.00135
7	0.1697	0.2962	1.2663	0.0135	0.00048	0.7522	0.3980	0.3295	0.0663	0.00200	0.00141
8	0.1697	0.2974	1.2676	0.0136	0.00060	0.7531	0.4020	0.3297	0.0664	0.00203	0.00150
9	0.1700	0.2993	1.2708	0.0136	0.00060	0.7534	0.4025	0.3298	0.0665	0.00205	0.00150
10	0.1702	0.2995	1.2755	0.0137	0.00061	0.7553	0.4029	0.3331	0.0667	0.00207	0.00160
11	0.1704	0.2995	1.2785	0.0137	0.00069	0.7615	0.4034	0.3334	0.0670	0.00210	0.00165
12	0.1708	0.2999	1.2866	0.0138	-----	0.7630	0.4052	0.3338	0.0673	0.00213	0.00173
13	0.1709	0.2999	1.2868	0.0140	-----	0.7633	0.4059	0.3343	0.0674	0.00228	0.00175
14	0.1715	-----	1.2910	0.0140	-----	0.7640	0.4069	0.3344	0.0676	0.00238	0.00180
15	0.1719	0.3005	1.2930	0.0141	-----	0.7663	0.4089	0.3346	0.0686	0.00243	0.00180
16	-----	0.3023	1.3009	-----	-----	0.7689	0.4090	0.3349	0.0689	-----	0.00180
17	-----	0.3032	1.3013	0.0143	-----	0.7720	0.4093	0.3353	0.0690	-----	0.00188
18	-----	0.3042	1.3022	0.0144	-----	0.7725	0.4100	0.3355	0.0704	-----	-----
19	-----	0.3043	1.3070	0.0145	-----	0.7772	0.4104	0.3369	-----	-----	-----
20	-----	0.3047	1.3170	0.0147	-----	0.7868	-----	0.3377	-----	-----	-----
21	-----	-----	-----	-----	-----	-----	-----	0.3390	-----	-----	-----
M(M)	0.1694	0.2974	1.2816	0.0137	0.00049	0.7603	0.4022	0.3316	0.0669	0.00208	0.00155
s(M)	0.0018	0.0060	0.0184	0.0006	0.00012	0.0112	0.0063	0.0049	0.0018	0.00018	0.00028
s(w)	0.0011	0.0028	0.0071	0.0003	0.00004	0.0052	0.0032	0.0026	0.0007	0.00007	0.00008

Line No.	Co	Cu	N	Nb	Ti	V
1	-----	0.0299	0.00290	-----	0.00275	0.00128
2	0.00290	0.0301	0.00290	0.0273	0.00283	-----
3	0.00305	0.0303	0.00298	0.0276	0.00288	0.00140
4	0.00310	0.0306	0.00303	0.0278	0.00290	0.00150
5	0.00310	0.0306	0.00305	0.0279	0.00295	0.00150
6	0.00310	0.0307	0.00308	0.0279	0.00303	0.00155
7	0.00313	0.0310	0.00310	0.0282	0.00303	0.00156
8	0.00316	0.0310	0.00312	0.0284	0.00308	0.00156
9	0.00328	0.0311	0.00318	0.0285	0.00310	0.00160
10	0.00333	0.0313	0.00323	0.0287	0.00318	0.00163
11	0.00333	0.0314	0.00323	0.0293	0.00323	0.00165
12	0.00338	0.0316	0.00345	0.0293	0.00323	0.00165
13	0.00343	0.0316	0.00350	0.0300	0.00335	0.00170
14	0.00343	0.0316	0.00353	0.0303	0.00335	0.00175
15	0.00343	0.0316	0.00363	0.0304	0.00340	0.00180
16	0.00347	0.0316	-----	0.0310	0.00350	0.00203
17	0.00348	0.0321	-----	0.0310	0.00353	-----
18	0.00368	0.0322	-----	-----	0.00365	-----
19	-----	0.0323	-----	-----	0.00368	-----
20	-----	0.0323	-----	-----	0.00370	-----
21	-----	0.0324	-----	-----	-----	-----
M(M)	0.00328	0.0313	0.00319	0.0290	0.00322	0.00161
s(M)	0.00021	0.0008	0.00024	0.0013	0.00030	0.00018
s(w)	0.00006	0.0004	0.00013	0.0004	0.00011	0.00004

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.

Additional values for information:
Sb: 0.00030; 0.00030
Sn: 0.00030; 0.00043

CERTIFIED VALUES, mass content in %

	C	Si	Mn	P	S	Cr	Mo	Ni	Al _{tot}	As	B
M(M)	0.1694	0.2974	1.282	0.0137	0.00049	0.760	0.402	0.3316	0.0669	0.00208	0.00155
C(95%)	0.0010	0.0029	0.009	0.0003	0.00009	0.006	0.004	0.0023	0.0009	0.00011	0.00016

	Co	Cu	N	Nb	Ti	V
M(M)	0.00328	0.0313	0.00319	0.0290	0.00322	0.00161
C(95%)	0.00011	0.0004	0.00014	0.0007	0.00015	0.00010

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.

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

Düsseldorf, September 2015

This certified 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

comprising of Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Max-Planck-Institut für Eisenforschung GmbH (MPI), Düsseldorf
Steel institute VDEh (Committee of chemists), Düsseldorf (management for the working group)

On behalf of: The Iron and Steel Nomenclature Co-ordinating Committee (COCOR) of the ECISS,
after approval by all the participating laboratories and all the producing organisations. (France- ArcelorMittal Maizières/CTIF; Germany-Iron and Steel
CRM Working Group: Steel institute VDEh, Bundesanstalt für Materialforschung und -prüfung (BAM) & MPI für Eisenforschung;
Nordic Countries-Nordic CRM Working Group)

Description of the sample

The sample is available in the form of fine steel chips (approx. 150 pieces per g) from which the fines passing a 0,5 mm sieve have been removed. It is supplied in glass bottles containing 100 g. It is also supplied in the form of 39 mm dia discs (28 mm thick).

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

Intended use & stability

ECRM 194-2 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.

The solid (disc) sample is intended for establishing and checking the calibration of optical emission and X-ray spectrometers for the analysis of samples of similar materials. The "as received" working surface of the sample should be finished before use to remove any protective coating. It will remain stable provided that it is not subjected to excessive heat (eg, during preparation of the working surface).

Traceability

The traceability of ECRM 194-2 has been established in accordance with principles of ISO Guides 30 – 35 and the International vocabulary of basic and general terms in metrology.

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.

Participating laboratories

AB Sandvik Materials Technology, Sandviken (Sweden)
 AG der Dillinger Hüttenwerke, Dillingen/Saar (Germany)
 ALS Scandinavia laboratory, Luleå (Sweden)
 ArcelorMittal Atlantique et Lorraine, Dunkerque (France)
 ArcelorMittal Eisenhüttenstadt Forschungs- und Qualitätszentrum GmbH, Eisenhüttenstadt (Germany)
 ArcelorMittal Atlantique et Lorraine, Florange (France)
 ArcelorMittal Maizières Research SA, Maizières-lès-Metz (France)
 AUBERT & DUVAL, Les Ancizes (France)
 Böhler Edelstahl GmbH & Co KG, Kapfenberg (Austria)
 Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin (Germany)
 DCNS RESEARCH, La Montagne (France)
 Deutsche Edelstahlwerke GmbH, Witten (Germany)
 ELTRA GmbH Applikationslabor, Haan (Germany)
 Höganäs AB, Höganäs (Sweden)
 ICRM, Yekaterinburg (Russia)
 IfG Service GmbH, Düsseldorf (Germany)
 Leibniz-Institut für Festkörper- und Werkstoffforschung IFW, Dresden, (Germany)
 Max-Planck Institut für Eisenforschung GmbH, Düsseldorf (Germany)
 Saarstahl AG, Völklingen (Germany)
 Salzgitter Flachstahl GmbH, Salzgitter (Germany)
 SSAB, Borlänge, (Sweden)
 ThyssenKrupp Steel Europe AG, Duisburg (Germany)
 voestalpine Stahl GmbH, Linz (Austria)

Methods used

Element	Line number	Method
C	1, 2, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15 3 7	Combustion, Infrared absorption Combustion, Coulometric titration Combustion, Thermal conductivity
Si	1, 2, 3, 4, 5, 6, 8, 12, 13, 15, 17, 18 7, 9, 11, 19 10 16, 20	ICP-OES Gravimetry, dehydration with perchloric acid Gravimetry, dehydration with sulfuric acid MAS, molybdenum blue, without extraction
Mn	1, 3, 4, 5, 6, 7, 9, 10, 11, 12, 14, 15, 16, 17, 18, 20 8, 13 19	ICP-OES MAS, periodate oxidation ICP-MS
P	1, 9, 12 2, 3, 4, 6, 7, 8, 11, 13, 14, 19, 20 5, 18 10, 15, 17	MAS, molybdenum blue, without extraction ICP-OES ICP-MS MAS, phosphovanadomolybdate, extraction
S	1, 2, 3, 4, 5, 6, 7, 9, 11 8, 10	Combustion, Infrared absorption MAS, methylene blue, evolution as H ₂ S in hypophosphoric and formic acid
Cr	1, 20 2 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19	ICP-MS MAS, diphenylcarbazide, iron separation ICP-OES
Mo	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 5	ICP-OES ICP-MS
Ni	1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20 5, 21 6 15	ICP-OES ICP-MS MAS, dimethylglyoxime, without extraction MAS, dimethylglyoxime, extraction
Al _{tot}	1, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18 10	ICP-OES ICP-MS
As	1, 5, 6, 8, 10 3, 7, 11 4 9 12, 13, 14, 15	ICP-MS ETAAS AAS, evolution as AsH ₃ ICP-OES, evolution as AsH ₃ ICP-OES
B	3, 4, 8, 10, 11, 12, 14, 17 5, 6, 7, 9, 13 15, 16	ICP-OES MAS, curcumin ICP-MS
Co	2, 3, 4, 5, 6, 7, 10, 11, 13, 14, 15, 16, 17, 18 8, 12 9	ICP-OES ICP-MS FAAS
Cu	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 19, 20 6, 15 18 21	ICP-OES MAS, diethyldithiocarbamate, extraction ICP-MS FAAS
N	1, 3, 4, 5, 7, 8, 9, 11, 12, 13, 14, 15 2, 6 10	Thermal conductivity, decomposition in a graphite crucible Acidimetric titration after distillation, visual detection MAS, Bispyrazolone, distillation
Nb	2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17 9	ICP-OES ICP-MS
Ti	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 14, 15, 16, 17, 18, 19, 20 10, 13	ICP-OES ICP-MS
V	1, 3, 4, 5, 7, 10, 11, 13, 14, 15, 16 6, 8, 9, 12	ICP-OES ICP-MS

Abbreviations:

AAS Atomic Absorption Spectrometry
 FAAS Flame Atomic Absorption Spectrometry
 ICP-OES Inductively Coupled Plasma - Optical Emission Spectrometry

ICP-MS Inductively Coupled Plasma - Mass Spectrometry
 ETAAS Electrothermal Atomic Absorption Spectrometry
 MAS Molecular 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 10317:2014 and CEN/TR 10350:2013, both of which are available from the national standards body in your country. (In the UK this is the BSI, 389 Chiswick High Road, London W4 4AL). 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 10317:2014 und CEN/TR 10350:2013, beide zu beziehen durch die nationalen Normenorganisationen (in Deutschland bei der Vertriebsstelle des DIN: Beuth-Verlag GmbH, Burggrafenstraße 4-10, 10787 Berlin). 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.

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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 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 10317:2014 och CEN/TR 10350:2013 som kan erhållas från den nationella standardiseringsorganisationen. (Sverige: SIS, S:t Paulsgatan 6, SE-118 80 Stockholm, Finland: SFS, PL. 116, FIN-002 41, Helsingfors, Danmark: DS, Kollegievej 6, DK-Charlottenlund 2920, Norge: NSF, Drammensveien, 145 A, Postboks 353 Skøyen, NO-0213 Oslo, Island: STRI, Holtagardar, IS-104 Reykjavik).

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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 (Committee of chemists), Düsseldorf (management for the working group)

Dr. Bernd - Josef Schlothmann
 Steel institute VDEh (Committee of chemists), management for the working group