

ECISS
EUROPEAN COMMITTEE FOR IRON AND STEEL STANDARDISATION
COMITÉ EUROPÉEN DE NORMALISATION DU FER ET DE L'ACIER
EUROPÄISCHES KOMITEE FÜR EISEN- UND STAHLNORMUNG

EUROPEAN CERTIFIED REFERENCE MATERIAL (EURONORM – CRM)
CERTIFICATE OF CHEMICAL ANALYSIS

EURONORM – CRM No. 281-1 Highly Alloyed Steel

LABORATORY MEANS (4 Values)
mass content in %

Line No	C	Si	Mn	P	S	Cr	Ni	Al (Total)	B	Co	Cu	N	Pb	Sn	Ti	As
1	0.0441	0.9158	—	0.0106	—	—	—	0.0140	0.0010	0.0200	0.0702	0.0212	0.0004	0.0082	0.2038	<i>0.0108</i>
2	0.0450	0.9175	0.7745	0.0107	0.0135	18.08	9.295	0.0142	0.0010	0.0206	0.0725	0.0217	0.0004	0.0084	0.2045	<i>0.0112</i>
3	0.0460	0.9178	0.7750	0.0110	0.0148	18.09	9.295	0.0142	0.0010	0.0211	0.0728	0.0218	0.0004	0.0090	0.2050	<i>0.0127</i>
4	0.0460	0.9228	0.7781	0.0112	0.0150	18.11	9.325	0.0145	0.0010	0.0212	0.0732	0.0220	0.0004	0.0092	0.2078	<i>0.0128</i>
5	0.0466	0.9234	0.7790	0.0112	0.0152	18.13	9.331	0.0148	0.0011	0.0214	0.0740	0.0224	0.0004	0.0094	0.0295	<i>0.0128</i>
6	0.0470	0.9250	0.7800	0.0112	0.0152	18.14	9.335	0.0151	0.0011	0.0215	0.0742	0.0226	0.0004	0.0094	0.2150	<i>0.0134</i>
7	0.0475	0.9265	0.7825	0.0115	0.0153	18.16	9.340	0.0152	0.0011	0.0216	0.0745	0.0226	0.0005	0.0095	0.2152	<i>0.0145</i>
8	0.0475	0.9272	0.7825	0.0115	0.0155	18.16	9.340	0.0154	0.0011	0.0216	0.0752	0.0227	0.0005	0.0095	0.2162	<i>0.0147</i>
9	0.0476	0.9274	0.7838	0.0115	0.0156	18.18	9.348	0.0155	0.0011	0.0218	0.0760	0.0228	0.0005	0.0095	0.2162	<i>0.0148</i>
10	0.0478	0.9275	0.7850	0.0117	0.0157	18.18	9.350	0.0156	0.0012	0.0229	0.0762	0.0228	0.0005	0.0096	0.2162	<i>0.0155</i>
11	0.0478	0.9300	0.7865	0.0121	0.0158	18.18	9.372	0.0159	0.0012	0.0232	0.0763	0.0230	0.0005	0.0097	0.2165	<i>0.0157</i>
12	0.0480	0.9300	0.7875	0.0122	0.0161	18.19	9.385	0.0160	0.0012	0.0250	0.0766	0.0230	0.0006	0.0098	0.2185	<i>0.0158</i>
13	0.0485	0.9325	0.7875	0.0122	0.0164	18.19	9.394	0.0163	0.0012	0.0250	0.0768	0.0231	0.0006	0.0100	0.2185	<i>0.0158</i>
14	0.0486	0.9338	0.7875	0.0124	0.0166	18.19	9.404	0.0172	0.0012	0.0250	0.0768	0.0232	0.0007	0.0100	0.2205	<i>0.0172</i>
15	0.0490	0.9365	0.7900	0.0125	0.0166	18.20	9.425	0.0176	0.0013	0.0260	0.0778	0.0234		0.0102	0.2220	<i>0.0172</i>
16	0.0502	0.9372	0.7902	0.0127	0.0166	18.20	9.428		0.0017	0.0260	0.0780	0.0234			0.2225	<i>0.0174</i>
17	0.0502	0.9395	0.7918	0.0127	0.0170	18.22	9.428		—		0.0797	0.0239			0.2250	<i>0.0182</i>
18	0.0510	0.9412	0.7952	0.0128	0.0174	18.25	9.438				0.0805	0.0241			0.2260	<i>0.0182</i>
19	0.0511	0.9475	0.8000	0.0130	0.0175	18.26	9.484				0.0820				0.2260	<i>0.0194</i>
20	0.0512	—	0.8000	0.0134	0.0182	—	—				—					
21				0.0138												
M_M	0.0480	0.9294	0.7861	0.0120	0.0160	18.17	9.373	0.0154	0.0012	0.0227	0.0760	0.0228	0.0005	0.0094	0.2160	<i>0.015</i>
s_M	0.0021	0.0085	0.0074	0.0009	0.0012	0.05	0.054	0.0011	0.0002	0.0021	0.0030	0.0008	0.0001	0.0006	0.0071	

Values given in italics are for information only.

M_M: Mean of the intralaboratory means, s_M: Standard deviation of the intralaboratory 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 eliminated by either the Cochran or Grubbs Test.

CERTIFIED VALUES

Mass content in %

	C	Si	Mn	P	S	Cr	Ni	Al	B	Co	Cu	N	Pb	Sn	Ti
M_M	0.048	0.929	0.786	0.012	0.016	18.17	9.37	0.015	0.0012	0.023	0.076	0.023	0.0005	0.009	0.216
C(95%)	0.001	0.005	0.004	0.001	0.001	0.03	0.03	0.001	0.0001	0.002	0.002	0.001	0.0001	0.001	0.004

The half-width confidence interval C(95%) = $\frac{t \times s_M}{\sqrt{n}}$ where "t" is the appropriate Student's t value and "n" is the number of acceptable mean values. For further

information regarding the confidence interval for the certified value see ISO Guide 35:2006 sections 6.1 and 10.5.2

PARTICIPATING LABORATORIES

Acieries de Champagnole, Champagnole, France
 Arbed, Division d'Esch-Belval, Esch-sur-Alzette Luxembourg
 Automobiles Peugeot, Voujeaucourt, France
 British Steel Corporation, Rotherham Works, UK
 British Steel Corporation, Stocksbridge and Tinsley Park Works, UK
 Brown Firth Research Laboratories, Sheffield, UK
 Bundesanstalt für Materialprüfung (BAM), Berlin-Dahlem, Germany
 Centro Sperimentale Metallurgico (CSM), Rome, Italy
 Cockerill, Seraing, Belgium
 Hoogovens-ESTEL, IJmuiden, Holland
 Institut de Recherches de la Sidérurgie Française (IRSID), St Germain-en-Laye, France

Ridsdale & Co Ltd., Middlesbrough, UK
 Societa Terni, Terni, Italy
 Société Metallurgique Hainut Sambre, Couillet, Belgium
 Société Nouvelle Acieries de Pompey, Pompey, France
 Staatliches Materialprüfungsamt Nordrhein-Westfalen, Dortmund, Germany
 Stahlwerke Röchling-Burbach GmbH, Völklingen-Saar, Germany
 Thyssen Edelstahlwerke AG, Witten, Germany
 Ugine Aciers, Ugine, France
 Usinor, Longwy, France
 Wiggin Steel and Alloys, Birmingham, UK

This certified reference material was prepared in accordance with the recommendations
 set out in ISO Guides 30 – 35 and issued by:

BUREAU OF ANALYSED SAMPLES LIMITED

Newham Hall, Middlesbrough, England TS8 9EA

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 organizations. (France – IRSID/CTIF, Germany – Iron and Steel CRM Working Group: Stahlinstitut VDEh, BAM Bundesanstalt für Materialforschung und –prüfung & MPI für Eisenforschung, Nordic Countries – Nordic CRM Working Group, UK – BAS Ltd.)



EURONORM – CRM No. 281-1

METHODS USED

Element	Line Number	Methods
C	1-8	Combustion, conductimetric
	2	Combustion, thermal conductivity
	3-6	Combustion, low pressure
	4-15	Combustion, non-aqueous titration
	5-7-9-10-11-12-13-14-16-18-19-20	Combustion, infrared absorption
	17	Combustion, coulometric
Si	1-3-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19	Gravimetric, dehydration with perchloric acid
	2	Gravimetric, dehydration with hydrochloric acid
	4	Photometric, as molybdenum blue
Mn	2-3-4-5-6-9-11-12-13-16-17-19	Photometric, oxidation with periodate
	7	Photometric, oxidation with persulphate/silver nitrate
	8-10-15-18	Atomic absorption spectrometry
	14	Titrimetric with ammonium ferrous sulphate, oxidation with persulphate/silver nitrate
	20	Titrimetric with arsenite, oxidation with persulphate/silver nitrate
P	1-8-9-10-11-13-16-19-20	Photometric as molybdenum blue
	2-3-4-6-7-15-17-18-21	Photometric as phosphovanadomolybdate with extraction
	5-12-14	Photometric as molybdenum blue with extraction
S	2-5-6-8-10-11-13-14-16-17-18-19-20	Combustion, infrared absorption
	3-4-9	Combustion, acidimetric titration
	7	Combustion, coulometric
	12	Combustion, conductimetric
	15	Combustion, oxidation/reduction titration
Cr	2	Titrimetric with ammonium ferrous sulphate, oxidation with perchloric acid, potentiometric end point
	3-13-14-15-16	Titrimetric with ammonium ferrous sulphate, oxidation with persulphate/silver nitrate, potentiometric end point
	4-5	Titrimetric with ammonium ferrous sulphate, oxidation with perchloric acid, visual end point
	6-7-9-10-11-12-17-18-19	Titrimetric with ammonium ferrous sulphate, oxidation with persulphate/silver nitrate, visual end point
	8	Atomic absorption spectrometry
Ni	2-7-9-11-12-13-16-19	Dimethylglyoxime precipitation, gravimetric
	3-4-6	Dimethylglyoxime precipitation, titration with cyanide
	5	Dimethylglyoxime precipitation, titration with EDTA
	8	Photometric with dimethylglyoxime
	10-15-18	Atomic absorption spectrometry
	14	Dimethylglyoxime precipitation, titration with dichromate
	17	Photometric with dimethylglyoxime with extraction
Al (Total)	1-3-4-5-7-8-9-11-12-13-14	Atomic absorption spectrometry
	2-6-15	Photometric with eriochrome cyanine, mercury cathode separation
	10	Photometric with chrome azurol S
B	1	Photometric with dianthrimide
	2-5-6-9-10-13-14-16	Photometric with curcumin
	3-7	Photometric with curcumin, separation by distillation
	4	Plasma emission spectrometry
	8	Photometric with carmine, separation by distillation
	11-12	Photometric with methylene blue, separation by extraction
	15	Photometric with dianthrimide after mercury cathode and ion exchange separations
Co	1-2-6-8-9-11-13-14-15-16	Atomic absorption spectrometry
	3-12	Photometric with nitroso-R salt
	4-5-7-10	Photometric with nitroso-R salt, separation with 1-nitroso-2-naphthol
Cu	1-3-4-5-6-12-16-17-18	Atomic absorption spectrometry
	2-8-10-14-15	Photometric with 2,2' diquinolyl with extraction
	7-9-19	Photometric with 2, 2' diquinolyl
	11	Photometric with diethyldithiocarbamate with extraction
	13	Photometric with diethyldithiocarbamate
N	1	Vacuum fusion, pressure measurement
	2-9-12-17	Titrimetric with hydrochloric acid, separation by distillation
	3	Photometric with indophenol blue, separation by distillation
	4-5-6-7-8-10-11-13-14-15-16-18	Carrier gas fusion, thermal conductivity
Pb	1-6-8-13-14	Photometric with dithizone with extraction
	2-3-4-5-7-9-10-11-12	Atomic absorption spectrometry
Sn	1-3-6-10-12-14	Atomic absorption spectrometry
	2	Photometric as 3-pyridyl complex with extraction
	5-8-11	Photometric with phenylfluorone
	4-7-9	Titrimetric with iodate, reduction with aluminium, sulphide separation
	13-15	Photometric with catechol violet with extraction
Ti	1-7-9-17-18-19	Photometric with chromotropic acid
	2-8	Photometric with hydrogen peroxide, cupferron separation
	3-15-16	Photometric with hydrogen peroxide
	4-11-13-14	Atomic absorption spectrometry
	5-6-12	Photometric with diantipyrylmethane
	10	X-ray fluorescence spectrometry
As	1-9-12-13-17-18-19	Photometric as molybdenum blue with extraction
	2	Atomic absorption spectrometry
	3-7-8-11-16	Photometric with silver diethyldithiocarbamate
	4-15	Titrimetric with bromate, separation by distillation potentiometric end point
	5	Titrimetric with iodine, hypophosphite reduction
	6	Titrimetric with iodine, separation as sulphide
	10	Photometric as molybdenum blue, separation as arsine
14	X-ray fluorescence spectrometry	

EURONORM – CRM No. 281-1

DESCRIPTION OF THE SAMPLE

ERM 281-1 is sold in the form of chips passing a nominal 1700µm aperture sieve from which the fines passing a nominal 250µm sieve have been removed. It is supplied in bottles containing 100g.

INTENDED USE & STABILITY

ECRM 281-1 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 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 contents should become discoloured (e.g. oxidised) by atmospheric contamination they should be discarded.

TRACEABILITY

The traceability of ECRM 281-1 has been established in accordance with principles of ISO Guides 30 – 35 and the International Vocabulary of Basic and General Terms In Metrology.

The characterisation of this material has been achieved by inter-laboratory study, 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.

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 Bureau of Analysed Samples Ltd. may be obtained from the address below.

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 10317:2014 et CEN/TR 10350:2013. On peut se procurer ces deux documents auprès des organismes nationaux de normalisation. (Pour la France: AFNOR, 11 Avenue Francis de Pressensé, 93571 – St Denis la Plaine Cedex).

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