

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. 481-1 DUCTILE (NODULAR) IRON

LABORATORY MEANS (4 Values)
mass content in %

Line No	C	Si	Mn	P	S	Cr	Mo	Ni	Al	As	Cu	Mg
1	3.865	2.240	0.4325	0.0176	0.0020	0.0538	0.0100	—	0.0188	0.0075	—	0.0472
2	3.882	2.249	0.4330	0.0177	0.0027	0.0560	0.0100	—	0.0195	0.0075	0.1418	0.0482
3	3.885	2.262	0.4338	0.0177	0.0030	0.0566	0.0100	1.162	0.0202	0.0080	0.1428	0.0490
4	3.891	2.275	0.4350	0.0180	0.0030	0.0570	0.0100	1.168	0.0205	0.0081	0.1460	0.0495
5	3.900	2.276	0.4352	0.0184	0.0031	0.0572	0.0104	1.172	0.0215	0.0085	0.1472	0.0499
6	3.900	2.282	0.4375	0.0185	0.0031	0.0577	0.0104	1.178	0.0217	0.0086	0.1478	0.0500
7	3.902	2.286	0.4380	0.0185	0.0032	0.0581	0.0105	1.178	0.0222	0.0087	0.1482	0.0500
8	3.907	2.288	0.4385	0.0186	0.0035	0.0595	0.0108	1.180	0.0225	0.0090	0.1486	0.0501
9	3.909	2.289	0.4428	0.0188	0.0035	0.0610	0.0112	1.184	0.0227	0.0092	0.1487	0.0502
10	3.910	2.290	0.4448	0.0190	0.0038	0.0640	0.0115	1.185	0.0228	0.0094	0.1489	0.0502
11	3.910	2.291	0.4450	0.0196	0.0039	0.0644	0.0118	1.190	0.0230	0.0095	0.1490	0.0505
12	3.912	2.292	0.4472	0.0197	0.0040	0.0645	0.0124	1.192	0.0230	0.0100	0.1490	0.0510
13	3.914	2.293	0.4475	0.0198	0.0040	0.0658	0.0125	1.192	0.0234	0.0102	0.1492	0.0518
14	3.920	2.295	0.4500	0.0200	0.0040	0.0658	0.0130	1.195	0.0235	0.0105	0.1500	0.0520
15	3.922	2.297	0.4540	0.0201	0.0041	0.0668		1.195	0.0238	0.0110	0.1500	0.0520
16	3.923	2.298	0.4563	0.0201	0.0045	0.0684		1.196	0.0242	0.0110	0.1518	0.0528
17	3.925	2.298	0.4600	0.0202	0.0045	0.0707		1.198	0.0244	0.0126	0.1524	0.0538
18	3.932	2.301	0.4650	0.0206	0.0047	0.0722		1.203	0.0246	0.0128	0.1542	0.0548
19	3.932	2.304	0.4780	0.0208	0.0048	0.0740		1.206	0.0248		0.1547	—
20	—	2.310	0.4800	0.0210	0.0048	0.0744		1.208	0.0260		0.1552	—
21	—	2.323	—	—	0.0049	—		1.225	0.0270		0.1555	—
22					0.0050							
23					0.0055							
24					0.0059							
M_M	3.907	2.288	0.4477	0.0192	0.0040	0.0634	0.0110	1.190	0.0229	0.0096	0.1496	0.0507
S_M	0.018	0.019	0.0142	0.0011	0.0010	0.0064	0.0011	0.015	0.0021	0.0016	0.0037	0.0019
S_W	0.010	0.015	0.0040	0.0007	0.0004	0.0014	0.0005	0.010	0.0008	0.0006	0.0017	0.0008

M_M : Mean of the intralaboratory means, s_M : Standard Deviation of the intralaboratory means.

s_W : Intralaboratory standard deviation, s_b : Interlaboratory standard deviation, $s_b = \sqrt{s_M^2 - (s_W^2 \div 4)}$

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	Mo	Ni	Al	As	Cu	Mg
M_M	3.907	2.288	0.448	0.0192	0.0040	0.063	0.0110	1.190	0.0229	0.0096	0.150	0.0507
C(95%)	0.009	0.009	0.007	0.0005	0.0004	0.003	0.0007	0.007	0.0010	0.0008	0.002	0.0010

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

This 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: VDEh, BAM & MPI für Eisenforschung, Nordic Countries – Nordic CRM Working Group, UK – BAS Ltd.)



METHODS USED
EURONORM – CRM No. 481-1

Element	Line Number	Methods
C	1-2-9-14	Thermal Conductivity
	3-10-12-17	Infrared absorption after combustion
	4-7-11-18	Coulometric titration after combustion
	5-13-15-19	Gravimetric after combustion
	6	Conductimetric after combustion
	8-16	Non-aqueous titration after combustion
Si	1-3-4-5-6-7-8-9-11-12-13-14-15-16-17-18-19-20	Gravimetric, dehydration with perchloric acid
	2-10	Photometric as molybdenum blue
	21	Flame atomic absorption spectrometry
Mn	1-7-10	Titrimetric with arsenite, oxidation with persulphate
	2-5-11-12-14-19-20	Photometric, periodate oxidation
	3-6-7-8-9-13-16-17-18	Flame atomic absorption spectrometry
	4-15	Photometric, persulphate oxidation
P	1-4-8-11-14-17	Photometric, as phosphovanadomolybdate
	2-3-5-6-7-9-12-15-16-18-19	Photometric, as molybdenum blue
	10-13-20	Titrimetric, as phosphomolybdate
S	1-4-8	Conductimetric after combustion
	2-12-14-18-19	Coulometric titration after combustion
	3-9-15	Gravimetric as BaSO ₄
	5-10-11-13-21-22-23	Infrared absorption after combustion
	6-16-17-20-24	Acidimetric titration after combustion
	7	Combustion, spectrophotometric with para-rosaniline
Cr	1-13-15	Photometric, with diphenylcarbazide
	2-3-5-7-8-9-10-11-12-14-16-18-19-20	Flame atomic absorption spectrometry
	4-6-17	Titrimetric with Fe(II), oxidation with persulphate
Mo	1-3-4-5-7-8-11-13	Flame atomic absorption spectrometry
	2-6-9-10-12-14	Photometric, with thiocyanate
Ni	3-8-20	Gravimetric, with dimethylglyoxime
	4-5-6-7-9-10-11-12-14-17-18	Flame atomic absorption spectrometry
	13-15-21	Photometric, with dimethylglyoxime
	16	Complexometric titration, precipitation with dimethylglyoxime
	19	Titration with dichromate, precipitation with dimethylglyoxime
Al	1-17	Photometric, with Chrome Azurol S
	2-13-20	Photometric, with Eriochrome Cyanine
	3-4-5-6-7-8-10-11-12-15-16-18-19-21	Flame atomic absorption spectrometry
	9	Photometric, with 8-Hydroxyquinoline
	14	Titration of hydroxyquinolate with bromine
As	1-8-14-16-17	Photometric, with silver diethyldithiocarbamate
	2-6-7-9	Photometric, as molybdenum blue
	3-4-13-18	Titration with iodine, reduction with hypophosphite
	5-12	Titration with bromate after distillation
	10-11-15	Flame atomic absorption spectrometry
Cu	2-3-5-6-8-9-10-11-12-13-14-16-17-18-20	Flame atomic absorption spectrometry
	4-21	Photometric, with 2,2' diquinolyl
	7	Photometric, with neocuproine
	15-19	Photometric, with bis-oxalyldihydrazone
Mg	1-2-3-4-5-7-8-9-10-11-12-13-14-15-16-18	Flame atomic absorption spectrometry
	6-17	Titration with EDTA

DESCRIPTION OF THE SAMPLE

The sample is available in the form of a powder passing a nominal 1700µm aperture from which the dust passing a nominal 250µm aperture has been removed. It is supplied in bottles containing 100 g.

TRACEABILITY

The traceability of ECRM 481-1 has been established in accordance with the principles of ISO Guides 30 – 35 and the International Vocabulary of Basic and General Terms in Metrology (VIM).

The characterisation of this material has been achieved by inter-laboratory study, each laboratory using the method of its 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.

PARTICIPATING LABORATORIES

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Société Cockerill, Seraing, Belgium
Stahlwerke Röchling-Burbach GmbH, Völklingen-Saar, Germany
Usinor, Dunkerque, France

INTENDED USE & STABILITY

The sample, ECRM 481-1, 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 the 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.

It can be demonstrated statistically that there is no significant contribution to the uncertainty of the certified values from any changes in composition throughout the bulk of the material.

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 to CEN Report CR 10317 and ECISS Information Circular No. 5, both of which are available from the national standards body in your country or from CEN in Brussels. (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.

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REVISION HISTORY

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Revised with C(95%) values for the certified elements
Revised with editorial amendments

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