

ECISS  
**EUROPEAN COMMITTEE FOR IRON AND STEEL STANDARDIZATION**  
**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. 451-2 AUSTENITIC CAST IRON**

**LABORATORY MEANS (4 Values)**  
 mass content in %

Line No.	C	Si	Mn	P	S	Cr	Ni	Cu
1	2.0288	2.0713	1.0567	0.0553	—	1.0543	—	6.1714
2	2.0348	2.0761	1.0574	0.0565	0.0292	1.0671	13.8623	6.2147
3	2.0352	2.0798	1.0579	0.0565	0.0298	1.0737	13.8850	6.2200
4	2.0405	2.0800	1.0630	0.0568	0.0299	1.0785	13.9125	6.2248
5	2.0479	2.0807	1.0636	0.0573	0.0299	1.0803	13.9365	6.2310
6	2.0500	2.0808	1.0650	0.0580	0.0301	1.0888	13.9440	6.2341
7	2.0510	2.0825	1.0693	0.0580	0.0302	1.0901	13.9746	6.2353
8	2.0525	2.0831	1.0720	0.0582	0.0303	1.0911	13.9800	6.2375
9	2.0531	2.0856	1.0725	0.0582	0.0304	1.0960	13.9905	6.2487
10	2.0545	2.0863	1.0729	0.0587	0.0307	1.0968	14.0099	6.2625
11	2.0610	2.0880	1.0734	0.0587	0.0310	1.0978	14.0328	6.2708
12	2.0664	2.0890	1.0748	0.0587	0.0315	1.0978	14.0364	6.2712
13	2.0666	2.0910	1.0803	0.0591	0.0318	—	14.0457	6.2758
14	2.0678	2.0944	1.0816	0.0599	0.0322	1.0999	14.0470	6.2825
15	2.0685	2.0954	1.0840	0.0600	0.0327	1.1053	14.0475	6.2969
16	2.0695	2.1000	1.0882	0.0606	0.0327	1.1164	14.0675	6.3105
17	2.0735	2.1022	1.0892	0.0611	0.0328	1.1170	14.0700	6.3218
18	2.0761	2.1038	1.0915	0.0627	0.0338	1.1173	14.0774	6.3268
19	2.0775	2.1084	1.0997	0.0633	0.0346	1.1179	14.0854	6.3275
20	2.0790	—	1.1040	0.0635	0.0351	1.1186	14.0988	—
21	2.0855	2.1202	1.1050	0.0646	—	1.1375	14.1573	—
22	—	2.1244	1.1168	—	—	—	—	—
<b>M<sub>M</sub></b>	<b>2.0590</b>	<b>2.0916</b>	<b>1.0790</b>	<b>0.0593</b>	<b>0.0315</b>	<b>1.0971</b>	<b>14.0131</b>	<b>6.2613</b>
<b>s<sub>M</sub></b>	0.0160	0.0140	0.0168	0.0025	0.0017	0.0203	0.0764	0.0430
<b>s<sub>w</sub></b>	0.0068	0.0106	0.0070	0.0010	0.0007	0.0095	0.0395	0.0243

**M<sub>M</sub>**: Mean of the laboratory means **s<sub>M</sub>**: Standard deviation of the laboratory means  
**s<sub>w</sub>**: Intralaboratory standard deviation **s<sub>b</sub>**: Interlaboratory standard deviation

$$s_M = \sqrt{s_b^2 + s_w^2/4}$$

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 omitted by either the Cochran or Grubbs Test.

**CERTIFIED VALUES**  
 mass content in %

	C	Si	Mn	P	S	Cr	Ni	Cu
<b>M<sub>M</sub></b>	<b>2.059</b>	<b>2.092</b>	<b>1.079</b>	<b>0.0593</b>	<b>0.0315</b>	<b>1.097</b>	<b>14.01</b>	<b>6.26</b>
<b>C(95%)</b>	0.007	0.007	0.008	0.0011	0.0008	0.010	0.04	0.02

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 35:1989 section 4.



Certificate No. Q3993

This reference material was prepared and issued by:  
**BUREAU OF ANALYSED SAMPLES LIMITED**

Newham Hall, Middlesbrough, England

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.)

JANUARY 1999

## PARTICIPATING LABORATORIES

AB Sandvik Steel, Sandviken (Sweden) Acerinox S.A., Algeciras (Spain) AG der Dillinger Hüttenwerke, Dillingen-Saar (Germany) Aubert et Duval, Les Ancizes (France) Böhler Edelstahl GmbH, Kapfenberg (Austria) Bundesanstalt für Materialforschung und-prüfung (BAM), Berlin (Germany) Castings Development Centre, Birmingham (UK) Centro Nacional de Investigaciones Metalúrgicas (CENIM), Madrid (Spain) Centre de Recherches de Maitières - DDP, Pont-à-Mousson (France) Cockerill Sambre, Couillet (Belgium) Centre Technique des Industries de la Fonderie (CTIF), Charleville (France) Centre Technique des Industries de la Fonderie (CTIF), Sèvres (France)	Force Institutet, Copenhagen (Denmark) Hoogovens Staal BV, IJmuiden (Netherlands) Institutet för Metallforskning, Stockholm (Sweden) Luxcontrol S.A., Esch-sur-Alzette (Luxembourg) Materialprüfungsamt Nordrhein-Westfalen (MPA-NRW), Dortmund (Germany) Max Planck Institut für Eisenforschung GmbH, Dusseldorf (Germany) Ridsdale & Co. Ltd., Middlesbrough (UK) Stahlwerke Bremen GmbH, Bremen (Germany) Weir Pumps Ltd., Glasgow (UK) Voest-Alpine Stahl Linz GmbH, Linz (Austria)
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## DESCRIPTION OF THE SAMPLE

This sample is available in the form of chips passing a 710µm aperture sieve from which the fines passing a 180µm aperture sieve have been removed. It is supplied in bottles containing 100g. N.B. a significant proportion of the carbon content is in the graphitic form.

## INTENDED USE & 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, 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 traceability of this ECRM is ensured by the use of either stoichiometric analytical techniques or methods which are calibrated against pure stoichiometric metals or compounds.

## METHODS USED EURONORM – CRM No. 451-2

Element	Line Number	Methods
<b>C</b>	1-2-3-4-6-8-10-12-14-15-16-17-18-19-20-21	Combustion, infrared absorption
	5	Coulometric titration
	7-9	Combustion, conductimetry
	11-13	Combustion, non-aqueous titration
<b>Si</b>	1-2-3-5-6-7-9-10-13-16-18-19-21	Gravimetric, dehydration with perchloric acid
	4-8-11	Photometric as molybdenum blue, without extraction
	12	Gravimetric, dehydration with hydrochloric acid in presence of gelatine
	14-15-17	Inductively Coupled Plasma-Optical Emission Spectrometry
	22	Gravimetric, dehydration with hydrochloric acid
<b>Mn</b>	1-3-4-6-15-19	Photometric, periodate oxidation
	2-5-7-13-16-21-22	Inductively Coupled Plasma-Optical Emission Spectrometry
	8-9-10-11-12-14-17-18	Flame Atomic Absorption Spectrometry
	20	Photometric, persulphate oxidation
<b>P</b>	1-5-10-12-14-15-17	Photometric as phosphovanadomolybdate, with extraction
	2-4-16-18	Photometric as molybdenum blue, without extraction
	3-6-9-13-19-21	Inductively Coupled Plasma-Optical Emission Spectrometry
	7	Acidimetric titration of ammonium phosphomolybdate
	8-11	Photometric as molybdenum blue, with extraction
<b>S</b>	20	Inductively Coupled Plasma-Mass Spectrometry
	2-3-4-5-7-8-9-10-11-12-13-15-16-20	Combustion, infrared absorption
	6	Photometric as methylene blue, separation as hydrogen sulphide
	14	Inductively Coupled Plasma-Optical Emission Spectrometry
	17	Combustion, oxidation reduction titration
<b>Cr</b>	18	Gravimetric as barium sulphate, without separation
	19	Combustion, conductimetry
	1-2-8-16-17	Flame Atomic Absorption Spectrometry
	3-5-7-9-11-15-19-20-21	Inductively Coupled Plasma-Optical Emission Spectrometry
	4-6-12-14-18	Titration with Fe(II), oxidation with persulphate
<b>Ni</b>	10	Titration with Fe(II), oxidation with perchloric acid
	2-3-6-7-9-14-16-17-19	Gravimetric, dimethylglyoxime
	4-5-10-12-20	Inductively Coupled Plasma-Optical Emission Spectrometry
	8-21	Photometric, dimethylglyoxime, without extraction
	11-15	Complexometric titration
<b>Cu</b>	13	Photometric, dimethylglyoxime, with extraction
	18	Titration with dichromate, separation with dimethylglyoxime
	1-3-11-12-13-15-19	Inductively Coupled Plasma-Optical Emission Spectrometry
	2-6-7-8-9-10-14-16-17	Flame Atomic Absorption Spectrometry
	4	Photometric with oxalyldihydrazide
<b></b>	5	Electrogravimetry
	18	Photometric, dibenzoyldithiocarbamate

## 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 Information Circulars No. 1 (ECISS) and No. 5 (ECSC), 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).

Des informations complémentaires 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 le certificat se trouvent dans les circulaires d'information No. 1 (ECISS) et No. 5 (CECA). On peut se procurer ces deux circulaires auprès des organismes nationaux de normalisation. (Pour la France: AFNOR, Tour Europe - Cedex 7, 92080 Paris La Défense).

Angaben über Herstellung, Zertifizierung und Bezugsmöglichkeiten dieser Europäischen Zertifizierten Referenzmaterialien (EURONORM-ZRM) sowie über die Anwendungen der in diesem Zertifikat enthaltenen statistischen Daten finden sich in den Mitteilungen Nr. 1 (ECISS) und Nr. 5 (EGKS), beide zu beziehen durch die nationalen Normenorganisationen. (In Deutschland bei der Vertriebsstelle des DIN: Beuth-Verlag GmbH, Burggrafenstrasse 4-10, 10787 Berlin).