

**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. 285-2 MARAGING STEEL**

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

Line No.	C	Si	Mn	P	S	Cr	Mo	Ni	Total Al	B	Co	Cu	N	Ti	Zr	Sn
1	0.0012	0.0082	–	0.0040	0.0021	0.0178	4.8758	17.8841	0.1003	0.0006	7.5890	0.0076	0.0005	–	0.0047	0.0004
2	0.0013	0.0090	0.0156	0.0040	0.0022	0.0203	4.9123	17.9188	0.1015	0.0006	7.6500	0.0085	0.0005	0.5051	0.0047	0.0005
3	0.0014	0.0103	0.0158	0.0041	0.0022	0.0210	4.9293	17.9600	0.1021	0.0007	7.6780	0.0088	0.0005	0.5065	0.0049	0.0005
4	0.0016	0.0106	0.0158	0.0048	0.0023	0.0212	4.9355	17.9620	0.1025	0.0007	7.6850	0.0089	0.0006	0.5087	0.0050	0.0006
5	–	0.0107	0.0161	0.0048	0.0023	0.0214	4.9491	17.9746	0.1032	0.0007	7.6996	0.0089	0.0006	0.5113	0.0050	0.0006
6	0.0017	0.0110	0.0162	0.0049	0.0023	0.0215	4.9580	18.0478	0.1042	0.0008	7.7067	0.0090	0.0006	0.5133	0.0050	0.0008
7	0.0017	0.0116	0.0162	0.0049	0.0023	0.0219	4.9613	18.0588	0.1044	0.0008	7.7300	0.0090	0.0007	0.5168	0.0051	0.0009
8	0.0017	0.0117	0.0164	0.0050	0.0023	–	4.9725	18.0600	0.1051	0.0008	7.7425	0.0090	0.0007	0.5182	0.0051	0.0012
9	0.0018	0.0119	0.0165	0.0050	0.0023	0.0234	4.9800	18.0618	0.1055	0.0008	7.7477	0.0090	0.0008	0.5189	0.0051	0.0013
10	0.0018	0.0120	0.0165	0.0052	0.0024	0.0241	4.9887	18.0700	0.1061	0.0008	7.7700	0.0092	0.0008	0.5200	0.0051	0.0014
11	0.0019	0.0121	–	0.0052	0.0024	0.0242	4.9941	18.0843	0.1070	0.0008	7.7707	0.0092	0.0008	0.5228	0.0051	0.0018
12	0.0019	0.0125	0.0165	0.0052	0.0025	0.0244	4.9946	18.0911	0.1078	0.0009	7.7800	0.0093	0.0009	0.5230	0.0051	0.0020
13	0.0020	0.0130	0.0168	0.0058	0.0025	0.0244	4.9968	18.1000	0.1083	–	7.7813	0.0093	0.0009	0.5233	0.0052	–
14	0.0021	0.0135	0.0168	0.0058	0.0025	0.0245	5.0000	18.1050	0.1087	0.0010	7.7824	0.0093	0.0009	0.5239	0.0054	0.0022
15	0.0021	0.0140	0.0170	0.0060	0.0025	0.0246	5.0030	18.1100	0.1088	0.0010	7.7961	0.0095	0.0009	0.5239	–	
16	0.0023	–	0.0171	0.0060	0.0026	0.0250	5.0038	18.1198	0.1106	0.0011	7.8020	0.0098	0.0009	0.5242		
17		0.0148	0.0171	0.0069	0.0026	0.0250	5.0277	18.1359	0.1108	0.0012	7.8103	0.0101		0.5268		
18			0.0174	0.0069	0.0027	0.0250	5.0458	18.1525	0.1119	0.0012	7.8163	0.0101		0.5278		
19			0.0174	0.0073	0.0029	0.0259	5.0607	18.1531	0.1121		7.8325	0.0102		–		
20			0.0178		0.0030	0.0265	5.0656	18.1863	0.1125		7.8498	0.0102		0.5329		
21			0.0178		0.0031	0.0269	5.0750	18.2080			7.8725	0.0110		0.5355		
22			0.0186			0.0271					7.9105	0.0111				
M <sub>M</sub>	0.0018	0.0117	0.0168	0.0053	0.0025	0.0236	4.9869	18.0688	0.1067	0.0009	7.7638	0.0094	0.0007	0.5202	0.0050	0.0011
S <sub>M</sub>	0.0003	0.0017	0.0008	0.0010	0.0003	0.0024	0.0514	0.0862	0.0038	0.0002	0.0757	0.0008	0.0002	0.0084	0.0002	
S <sub>w</sub>	0.0002	0.0008	0.0004	0.0002	0.0002	0.0005	0.0232	0.0453	0.0014	0.0001	0.0314	0.0003	0.0001	0.0003	0.0001	

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>p</sub>: Interlaboratory standard deviation

$$S_M = \sqrt{S_D^2 + S_W^2/4}$$

The laboratory mean values have been examined statistically to eliminate outstanding 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	Mo	Ni	Al	B	Co	Cu	N	Ti	Zr
M <sub>M</sub>	0.0018	0.0117	0.0168	0.0053	0.0025	0.0236	4.99	18.07	0.1067	0.0009	7.76	0.0094	0.0007	0.520	0.0050
C(95%)	0.0002	0.0008	0.0004	0.0005	0.0002	0.0011	0.02	0.04	0.0018	0.0001	0.04	0.0004	0.0001	0.004	0.0001

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. 94/3993

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  
Germany–Iron and Steel CRM Working Group, UK–BAS Ltd.)

MAY 1997

## PARTICIPATING LABORATORIES

Acerinox S.A., Algeciras (Spain)  
 Aubert & Duval, Les Ancizes (France)  
 Alfred H. Knight International Ltd. St. Helens (UK)  
 British Steel Engineering Steels, Sheffield (UK)  
 British Steel Strip Products, Llanwern (UK)  
 British Steel Technical, Middlesbrough (UK)  
 Böhler Edelstahl GmbH, Kapfenberg (Austria)  
 Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin (Germany)  
 Centro Nacional de Investigaciones Metalúrgicas (CENIM), Madrid (Spain)  
 Cockerill Sambre S.A., Couillet (Belgium)  
 Defence Research Agency, Ministry of Defence, Farnborough (UK)  
 EWK Edelstahl Witten-Krefeld GmbH, Witten (Germany)  
 Hoogovens Staal BV, IJmuiden (Netherlands)  
 Howmet Alloys International Ltd., (UK)

Imphy S.A., Imphy (France)  
 Institut de Recherches de la Sidérurgie Française (IRSID),  
 Maizières-lès-Metz (France)  
 Luxcontrol S.A., Esch-sur-Alzette (Luxembourg)  
 Materialprüfungsamt Nordrhein-Westfalen (MPA-NRW), Dortmund  
 (Germany)  
 Max-Planck Institut für Eisenforschung GmbH., Düsseldorf (Germany)  
 Rautaruukki Oy, Raahе (Finland)  
 Ridsdale & Co. Ltd., Middlesbrough (UK)  
 Sheffield Testing Laboratories Ltd., Sheffield (UK)  
 SINTEF Molab as., Mo (Norway)  
 Ugine SA, Isbergues (France)  
 Voest Alpine Stahl Linz GmbH., Linz (Austria)

## DESCRIPTION OF THE SAMPLE

This sample is available in the form of chips passing a 1700µm aperture sieve from which the dust passing a 250µm aperture sieve has been removed.  
 It is supplied in bottles containing 100g ...ref 285-2(C). It is also supplied in the form of 38mm dia discs ...ref 285-2(D).

## METHODS USED EURONORM – CRM No. 285-2

Element	Line Number	Methods
<b>C</b>	1-2-3-4-7-8-9-10-11-12-13-15-16	Combustion, infrared absorption
	6	Combustion, conductimetry
	14	Combustion, non-aqueous titration
		<b>NOTE:</b> All results for carbon were obtained after pretreatment of sample (by preheating or acid etching) to remove any surface contamination.
<b>Si</b>	1-2-5-8-15-17	PES
	3	ICP-MS
	4-6-7-10-13-14	Photometric as molybdenum blue, without extraction
	9-11	Photometric as molybdenum blue, with extraction
<b>Mn</b>	12	Gravimetric, dehydration with perchloric acid
	2-3-6-9-10-12-13-15-17-22	PES
	4-5-7-8-14-16-18-20-21	FAAS
	19	Photometric, periodate oxidation
<b>P</b>	1-7-8-9-10-15-16-19	Photometric as phosphovanadomolybdate, extraction
	2-3-12-18	Photometric as molybdenum blue, without extraction
	4-5	Photometric as molybdenum blue, with extraction
	6-11-13-14	PES
<b>S</b>	17	Acidimetric titration of ammonium phosphomolybdate
	1-2-3-5-7-9-10-11-12-13-14-15-16-17-19-20-21	Combustion, infrared absorption
	4	Combustion coulometric titration
	6-18	Combustion, conductimetry
<b>Cr</b>	8	Photometric as molybdenum blue, separation as sulphide
	1-2-5-6-10-11-14-19-20-22	FAAS
	3-4-7-9-12-13-15-16-17-18-21	PES
<b>Mo</b>	1-3-5-7-8-9-10-11-12-14-15-16-17-21	PES
	2	Gravimetric with bezoinoxime
	4-6-18-19-20	Photometric with thiocyanate in presence of Sn(II), extraction
	13	FAAS
<b>Ni</b>	1-7-10-14-16	PES
	2-5-6-8-13-18	Gravimetric, dimethylglyoxime
	3-19	Complexometric titration, visual end-point
	4-17-21	Photometric with dimethylglyoxime, with extraction
	9-15-20	Photometric, dimethylglyoxime, without extraction
	11	Titration with dichromate after separation with dimethylglyoxime
<b>Al</b>	12	Cyanometric titration
	1-2-3-4-5-6-9-10-13	PES
	7-8-11-12-14-15-16-18-19-20	FAAS
	17	Photometric with eriochrome cyanine, NaOH separation of iron
<b>B</b>	1-3-6-7-10-11-12-14-15	Photometric with curcumin
	2	ICP-MS
	4-5-8-9-16-17-18	PES

**METHODS USED**  
**EURONORM – CRM No. 285-2**

Element	Line Number	Methods
Co	1-2-9-10-12-14-16-18-19-20	PES
	3-8-15-22	Titration with ferricyanide, potentiometric end-point
	4-5-6-11-13	FAAS
	7	Photometric with thiocyanate
	17-21	Photometric with nitroso-R-salt
Cu	1-3-4-5-9-10-13-15-18-19-20	FAAS
	2-6-7-8-11-12-14-16-17-22	PES
	21	Photometric with diethyldithiocarbamate, extraction
N	1-2-3-4-5-6-7-8-9-10-11-13-15-16	Thermal conductivity, decomposition in graphite crucible
	12	Gas volumetry, oxidising fusion, CO <sub>2</sub> carrier gas
	14	Photometric with indophenol blue after distillation
Ti	2-3-6-9-10-11-12-16-17-18-20-21	PES
	4-5-8	FAAS
	7	Photometric with hydrogen peroxide, after separation
	13-14-15	Photometric with diantipyrylmethane
Zr	1-2-3-4-5-6-9-10-11-12-13-14	PES
	7	ICP-MS
	8	Photometric with arsenazo III
Sn	1-2-3-4-5-12	GF-AAS
	6-8-11-14	FAAS
	7	ICP-MS
	9-10	PES

**Abbreviations:**

FAAS: Flame Atomic Absorption Spectrometry  
 GF-AAS: Graphite Furnace-Atomic Absorption Spectrometry  
 ICP-MS: Inductively Coupled Plasma - Mass Spectrometry  
 PES: Plasma Emission 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 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 Zertifizierten Europäischen Referenzmaterialien (EURONORM-ZRM) sowie über die Anwendung 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 30).