

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. **295-1** HIGHLY ALLOYED STEEL  
LABORATORY MEANS (4 Values)  
mass content in %

Line No.	C	Si	Mn	P	S	Cr	Mo	Ni	Total Al	As
1	0.0149	0.3975	1.7264	0.0146	0.0001	19.3455	3.8750	—	—	0.0035
2	0.0149	0.3977	1.7340	0.0153	0.0001	19.3584	3.9070	—	0.0190	0.0036
3	0.0156	0.3979	1.7375	0.0153	0.0002	19.3703	3.9459	24.2491	0.0191	0.0037
4	0.0159	0.3999	1.7391	0.0156	0.0003	19.3885	3.9525	24.2871	0.0193	0.0039
5	0.0160	0.4015	1.7395	0.0159	0.0003	19.3930	3.9584	24.3212	0.0195	0.0040
6	0.0161	0.4033	1.7420	0.0159	0.0003	19.3942	3.9642	24.3307	0.0196	0.0040
7	0.0162	0.4062	1.7425	0.0163	0.0003	19.4075	3.9678	24.3360	0.0198	0.0040
8	0.0163	0.4066	1.7495	0.0164	0.0003	19.4100	3.9758	24.3400	0.0198	0.0042
9	0.0163	0.4072	1.7503	0.0165	0.0003	19.4409	3.9795	24.3669	0.0199	0.0042
10	0.0163	0.4119	1.7520	0.0165	0.0003	19.4857	3.9900	—	0.0200	0.0042
11	0.0165	0.4133	1.7534	0.0166	0.0003	19.5050	3.9914	24.3733	0.0200	0.0043
12	0.0165	0.4145	1.7619	0.0167	0.0003	19.5080	3.9958	24.3850	—	0.0043
13	0.0165	0.4189	1.7635	0.0168	0.0004	19.5150	3.9992	24.3984	0.0207	0.0043
14	0.0168	0.4200	1.7639	0.0169	0.0004	19.5225	4.0042	24.3989	0.0207	—
15	0.0168	0.4221	1.7650	0.0172	0.0004	19.5335	4.0125	24.4109	0.0208	0.0047
16	0.0169	0.4240	1.7654	0.0176	0.0004	19.5678	4.0233	24.4236	0.0211	0.0049
17	0.0170	0.4268	1.7655	0.0176	0.0004	19.6165	4.0342	24.4385	0.0215	—
18	0.0171	0.4269	1.7716	0.0178	0.0005	19.6350	4.0353	24.4750	0.0220	—
19	0.0175	0.4384	1.7853	0.0179	0.0005	19.6412	4.0565	24.4925	0.0227	—
20	0.0180	0.4400	1.7900	0.0182	0.0006	19.7626	4.0635	24.4955	—	—
21	0.0181	0.4518	1.7932	0.0191	—	19.8071	4.0753	24.5035	—	—
22	0.0182	0.4585	1.7940	—	—	—	4.1031	24.5150	—	—
M <sub>M</sub>	0.0166	0.4175	1.7584	0.0167	0.0003	19.5051	3.9959	24.3969	0.0203	0.0041
S <sub>M</sub>	0.0009	0.0175	0.0196	0.0011	0.0001	0.1298	0.0539	0.0765	0.0010	0.0004
S <sub>w</sub>	0.0005	0.0065	0.0083	0.0005	0.0001	0.0366	0.0231	0.0472	0.0005	0.0002

Line No.	B	Co	Cu	N	Sn	V	Sb	Fe	Mg
1	0.0017	0.0404	1.4325	—	0.0015	0.0410	0.0005	47.9675	0.0002
2	0.0017	0.0413	1.4360	0.0590	0.0015	0.0417	0.0006	48.1109	0.0002
3	0.0017	0.0428	1.4370	0.0595	0.0020	0.0423	0.0006	48.1150	0.0002
4	0.0017	0.0429	1.4540	0.0596	0.0020	0.0425	0.0006	48.1815	0.0002
5	0.0018	0.0430	1.4560	0.0600	0.0020	0.0425	0.0006	48.1931	0.0002
6	0.0018	0.0437	1.4607	0.0601	0.0021	0.0426	0.0007	48.2625	0.0003
7	0.0018	0.0440	1.4753	0.0603	0.0023	0.0431	0.0007	48.2625	0.0003
8	0.0019	0.0442	1.4759	0.0607	—	0.0432	0.0007	48.2835	0.0003
9	0.0019	0.0446	1.4805	0.0611	0.0025	0.0433	0.0008	48.3700	0.0003
10	0.0019	0.0454	1.4857	0.0616	0.0029	0.0436	0.0008	48.3856	0.0003
11	0.0019	0.0456	1.4857	0.0616	0.0029	0.0458	0.0008	48.4329	0.0003
12	0.0019	0.0456	1.4869	0.0617	0.0029	0.0462	0.0008	48.5000	0.0003
13	0.0019	0.0460	1.4879	0.0624	0.0030	0.0466	0.0010	48.5058	—
14	0.0020	0.0461	1.4924	0.0625	0.0031	0.0473	0.0010	48.5843	—
15	0.0020	0.0462	1.4946	0.0626	0.0032	0.0484	0.0010	48.5925	—
16	—	0.0463	1.4960	0.0627	0.0032	0.0485	—	48.6125	—
17	—	0.0465	1.4975	0.0633	0.0033	0.0489	—	48.7225	—
18	—	0.0466	1.5000	0.0640	—	0.0493	—	—	—
19	—	0.0467	1.5056	0.0644	—	0.0494	—	—	—
20	—	0.0470	1.5073	—	—	0.0500	—	—	—
21	—	0.0470	1.5133	—	—	0.0523	—	—	—
22	—	0.0485	1.5305	—	—	—	—	—	—
M <sub>M</sub>	0.0018	0.0450	1.4814	0.0615	0.0025	0.0456	0.0007	48.3578	0.0003
S <sub>M</sub>	0.0001	0.0020	0.0260	0.0016	0.0006	0.0033	0.0002	0.2102	—
S <sub>w</sub>	0.0001	0.0007	0.0089	0.0007	0.0002	0.0007	0.0001	0.0776	—

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 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	As	B	Co	Cu	N	Sn	V	Sb	Fe
M <sub>M</sub>	0.0166	0.418	1.758	0.0167	0.0003	19.51	3.996	24.40	0.0203	0.0041	0.0018	0.0450	1.481	0.0615	0.0025	0.0456	0.0007	48.36
C(95%)	0.0004	0.008	0.009	0.0005	0.0001	0.06	0.024	0.04	0.0005	0.0002	0.0001	0.0011	0.012	0.0008	0.0003	0.0015	0.0001	0.11

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.



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, UK—BAS Ltd.)



## PARTICIPATING LABORATORIES

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Aubert et Duval, Les Ancizes (France)	Luxcontrol S.A., Esch-sur-Alzette (Luxembourg)
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Creusot-Loire Industrie, Le Creusot (France)	Ugine Savoie, Ugine (France)
Höganäs AB, Höganäs (Sweden)	Uddeholm Tooling AB, Hagfors (Sweden)
Hoogovens Groep BV, IJmuiden (Netherlands)	Voest Alpine Linz Stahl GmbH., Linz (Austria)
Imphy SA, Imphy (France)	

## 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 295-1(C). It is also supplied in the form of 38mm dia discs ...ref 295-1(D).

## METHODS USED EURONORM – CRM No. 295-1

Element	Line Number	Methods
<b>C</b>	1-15	Combustion, conductimetry
	2-3-4-5-6-7-8-9-10-12-13-14-16-17-18-19-21-22	Combustion, infrared absorption
	11	Combustion, coulometric titration
	20	Combustion, non-aqueous titration
<b>Si</b>	1-3-4-6-8-9-11-12-13-15-16-18-20-22	Gravimetric, dehydration with perchloric acid
	2-5-7-10-17	PES
	19-21	Photometric, as molybdenum blue, without extraction
	14	FAAS
<b>Mn</b>	1-6-7-15-20-21	FAAS
	2-3-9-10-11-16-17-22	Photometric, oxidation with periodate
	4-5-8-12-13-14-18	PES
	19	Photometric - persulphate oxidation
<b>P</b>	1-3-5-13-21	Photometric, as molybdenum blue, without extraction
	2-6-7-9-10-11-15	PES
	4	Photometric, as phosphovanadomolybdate, without extraction
	8-12-14-16-17-18-19-20	Photometric, as phosphovanadomolybdate, with extraction
<b>S</b>	1-2-3-4-5-6-7-9-10-11-12-14-15-16-17-18-19-20	Combustion, infrared absorption
	8	Combustion, conductimetry
	13	Gravimetric, after chromatographic separation on alumina
<b>Cr</b>	1-2-3-6-9-10-11-12-14-15-16-17-20-21	Titration with Fe(II), oxidation with persulphate
	4-5-13	Titration with Fe(II), oxidation with perchloric acid
	7-8-18-19	PES
<b>Mo</b>	1-5-10	FAAS
	2-22	Photometric, thiocyanate in presence of Sn(II), without extraction
	3	Photometric in presence of ascorbic acid, without extraction
	4	Gravimetry, with benzoin oxime
	6-7-8-11-13-14-16-17-18-19-21	PES
	9-12-15-20	Photometric, thiocyanate in presence of Sn(II), with extraction
<b>Ni</b>	3-14-16-18-19	PES
	4	Cyanometric titration
	5	Titration with dichromate after separation with dimethylglyoxime
	6-17	Photometric, dimethylglyoxime, without extraction
	7-9-11-12-15-21-22	Gravimetry, dimethylglyoxime
	8-13	Complexometric titration, visual end-point
<b>Al</b>	20	Photometric, dimethylglyoxime, with extraction
	2-4-7-9-10-13-14-15-18-19	FAAS, without separation
	3-6-8-16-17	PES
	5	Photometric, eriochrome cyanine, separation of iron with NaOH
	11	AAS, graphite furnace
<b>As</b>	1-2-3-8-12-16	PES
	4-5-9-10-13	AAS, graphite furnace
	6-7	Photometric, as molybdenum blue, halide extraction
	11	Photometric, with silver diethyldithiocarbamate, separation as arsine
	15	FAAS, separation as arsine
<b>B</b>	1-2-4-12-14-15	Photometric, with curcumin
	3-5-6-7-8-9-10-13	PES
	11	ICP-MS
<b>Co</b>	1-3-4-5-7-8-11-14-16-17-18-20-22	FAAS
	2-9-10-12-13-15-19-21	PES
	6	Photometric, with 2-nitroso-1-naphthol, with extraction
<b>Cu</b>	1-2-3-4-5-13-14-16-17-18-19-20-22	FAAS
	6-7-8-9-10-12-15-21	PES
	11	Photometric, with cuproine, with extraction
<b>N</b>	2-3-4-6-7-8-9-10-11-12-13-14-15-16-17-19	Thermal conductivity, decomposition in graphite crucible
	5	Acidimetric titration after distillation
	18	Photometric, with Nessler reagent after distillation

**METHODS USED**  
**EURONORM – CRM No. 295-1**

Element	Line Number	Methods
<b>Sn</b>	1-5-12-15	FAAS
	2-3-7-10-11-13-14	AAS, graphite furnace
	4-6-9-16-17	PES
<b>V</b>	1-4-7-8-9-10-12-13-17-19-21	PES
	2-3-6-11-14-16-20	FAAS
	5-18	Titration with Fe(II), oxidation with Mn(VII)
<b>Sb</b>	15	AAS, graphite furnace
	1	PES
	2-3-4-5-7-9-10-11-12-15	AAS, graphite furnace
<b>Fe</b>	6	Photometric, with rhodamine B, with extraction
	8	ICP-MS
	13-14	FAAS
<b>Mg</b>	1-7-9-10-11-12-16-17	Titration with Cr(VI), after reduction with Sn(II)
	2-4-6-13	Titration with Mn(VII), after reduction with Sn(II)
	3-8-14-15	PES
	5	
	1-5-6-7-8-9-10	FAAS
	2-11-12	PES
	3	AAS, graphite furnace
	4	ICP-MS

**Abbreviations:**

AAS: Atomic Absorption Spectrometry  
FAAS: Flame 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).