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. 376-1 24% COBALT MAGNET ALLOY

**LABORATORY MEANS** (4 values)

**mass content in %**

| Line No. | C | Si | Mn | S | Ni | Al | Co | Cu | Nb | Ti | *Ta* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | — | 0.2950 | — | 0.0030 | 13.21 | 7.950 | 23.40 | 2.866 | — | 0.1480 | *0.0048* |
| 2 | 0.0223 | 0.2998 | 0.0400 | 0.0030 | 13.23 | 7.975 | 23.44 | 2.888 | 0.2800 | 0.1509 | *0.0072* |
| 3 | 0.0235 | 0.3025 | 0.0405 | 0.0032 | 13.26 | 8.000 | 23.45 | 2.893 | 0.2952 | 0.1512 | *0.0088* |
| 4 | 0.0240 | 0.3038 | 0.0426 | 0.0033 | 13.28 | 8.020 | 23.50 | 2.902 | 0.2992 | 0.1522 | *0.0100* |
| 5 | 0.0242 | 0.3062 | 0.0429 | 0.0034 | 13.33 | 8.082 | 23.54 | 2.920 | 0.2995 | 0.1532 | *0.0128* |
| 6 | 0.0245 | 0.3100 | 0.0435 | 0.0038 | 13.34 | 8.088 | 23.62 | 2.922 | 0.3000 | 0.1542 | *0.0140* |
| 7 | 0.0248 | 0.3114 | 0.0436 | 0.0038 | 13.37 | 8.090 | 23.67 | 2.934 | 0.3000 | 0.1550 | *0.0182* |
| 8 | 0.0248 | 0.3125 | 0.0441 | 0.0039 | 13.38 | 8.092 | 23.67 | 2.942 | 0.3000 | 0.1560 | *0.0184* |
| 9 | 0.0250 | 0.3125 | 0.0450 | 0.0041 | 13.38 | 8.095 | 23.67 | 2.950 | 0.3100 | 0.1575 | *0.0200* |
| 10 | 0.0250 | 0.3150 | 0.0458 | 0.0041 | 13.39 | 8.098 | 23.68 | 2.955 | 0.3112 | 0.1580 | *0.0208* |
| 11 | 0.0252 | 0.3150 | 0.0468 | 0.0042 | 13.39 | 8.100 | 23.71 | 2.955 | 0.3125 | 0.1585 | *0.0219* |
| 12 | 0.0252 | 0.3182 | 0.0470 | 0.0042 | 13.40 | 8.145 | 23.79 | 2.955 | 0.3172 | 0.1592 | *0.0220* |
| 13 | 0.0258 | 0.3195 | 0.0475 | 0.0042 | 13.42 | 8.190 | 23.80 | 2.958 | 0.3175 | 0.1600 | *0.0230* |
| 14 | 0.0260 | 0.3205 | 0.0485 | 0.0045 | 13.42 | 8.195 | 23.92 | 2.959 | 0.3180 | 0.1625 | |
| 15 | 0.0270 | 0.3208 | 0.0500 | 0.0047 | 13.42 | 8.198 | 23.94 | 2.970 | 0.3240 | 0.1625 | |
| 16 | 0.0270 | 0.3225 | 0.0501 | 0.0048 | 13.43 | 8.222 | 23.94 | 2.981 | 0.3250 | 0.1640 | |
| 17 | 0.0285 | 0.3230 | 0.0537 | 0.0050 | 13.46 | 8.242 | 23.95 | 3.002 | 0.3300 | 0.1650 | |
| 18 | 0.0288 | 0.3290 | 0.0550 | — | 13.49 | 8.304 | 23.99 | 3.030 | | 0.1675 | |
| 19 | 0.0289 | — | | | 13.51 | — | — | — | | 0.1680 | |
| **$M_M$** | **0.0256** | **0.3132** | **0.0463** | **0.0040** | **13.37** | **8.116** | **23.70** | **2.943** | **0.3087** | **0.1581** | *0.016-* |
| $s_M$ | 0.0018 | 0.0090 | 0.0042 | 0.0006 | 0.08 | 0.096 | 0.19 | 0.041 | 0.0132 | 0.0058 | |

$M_M$: Mean of the intralaboratory means  $s_M$: Standard deviation of the intralaboratory means

The laboratory mean values have been examined statistically to eliminate any outlying values. Where a "—" appears in the table it indicates that an outlying value has been omitted.

## CERTIFIED VALUES

**mass content in %**

| | C | Si | Mn | S | Ni | Al | Co | Cu | Nb | Ti |
|---|---|---|---|---|---|---|---|---|---|---|
| **$M_M$** | **0.0256** | **0.313** | **0.046** | **0.0040** | **13.37** | **8.12** | **23.70** | **2.94** | **0.309** | **0.158** |
| $C_{(95\%)}$ | 0.0009 | 0.005 | 0.002 | 0.0003 | 0.04 | 0.05 | 0.10 | 0.02 | 0.007 | 0.003 |

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 laboratories

## DESCRIPTION OF THE SAMPLE

This sample consists of material passing a 250 µm aperture sieve from which the fines passing a 53 µm aperture sieve have been removed. It is supplied only in bottles of 100g.

## PARTICIPATING LABORATORIES

Aubert et Duval, Les Ancizes (France)
Böhler AG, Düsseldorf-Oberkassel (Germany)
Breda Siderurgica, Milan (Italy)
Bundesanstalt für Materialforschung und-prüfung (BAM), Berlin (Germany)
Centro Sperimentale Metallurgico (CSM), Rome (Italy)
Cockerill, Seraing (Belgium)
Darwins Magnets International, Sheffield (UK)
Eclipse Tools Ltd., Sheffield (UK)
Hoesch Stahl AG, Dortmund (Germany)
Imphy s.a., Imphy (France)
Institut de Recherches de la Sidérurgie Francaise (IRSID), Maizieres-les-Metz (France)
Institut de Recherches de la Sidérurgie Francaise (IRSID), Saint Germain-en-Laye (France)
Laborlux s.a. Esch-sur-Alzette (Luxembourg)
London and Scandinavian Metallurgical Co. Ltd., Rotherham, (UK)
Murex Ltd., Rainham (UK)
Ridsdale and Co. Ltd., Middlesbrough (UK)
Ross and Catherall Ltd., Sheffield (UK)
SNIAS, Suresnes (France)
Société Metallurgique Hainaut Sambre, Couillet (Belgium)
Sollac, Florange (France)
Stahlwerke Röchling-Burbach GmbH, Völklingen-Saar (Germany)
Thyssen Edelstahlwerke AG, Krefeld (Germany)

**This reference material 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; German Federal Republic—Iron and Steel CRM Working Group; UK—BAS Ltd.)

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(First issued in July 1980 before re-certification of Ti)

# METHODS USED
# EURONORM-CRM 376-1

| Element | Line Number | Methods |
|---|---|---|
| **C** | 2-13-15 | Combustion, gravimetric |
| | 3- 4- 5- 7- 9-10-16-17-18 | Combustion, infrared absorption |
| | 6- 8-19 | Combustion, conductimetric |
| | 11 | Combustion, non aqueous titration |
| | 12 | Combustion, thermal conductivity |
| | 14 | Combustion, coulometric |
| **Si** | 1- 4- 5- 6- 8- 9-10-11-12-13-14-15-16-17-18 | Gravimetric, dehydration with perchloric acid |
| | 2 | Gravimetric, dehydration with hydrochloric acid |
| | 3 | Atomic absorption spectrometry |
| | 7 | Photometric as molybdenum blue |
| **Mn** | 2- 5- 6- 8- 9-10-13-14-17-18 | Photometric, oxidation with periodate |
| | 3- 4- 7-11-12-16 | Atomic absorption spectrometry |
| | 15 | Photometric, oxidation with persulphate/silver nitrate |
| **S** | 1- 2-16 | Combustion, oxidation/reduction titration |
| | 3- 5- 6- 7- 8- 9-10-11-12-13-15-17 | Combustion, infrared absorption |
| | 4 | Gravimetric as $BaSO_4$ after chromatographic separation on alumina |
| | 14 | Combustion, conductimetric |
| **Ni** | 1-16 | Dimethylglyoxime precipitation, titration with EDTA |
| | 2- 8-13-18 | Photometric with dimethylglyoxime |
| | 3- 4- 5- 6-12-15 | Dimethylglyoxime precipitation, gravimetric |
| | 7- 9-14-19 | Atomic absorption spectrometry |
| | 10 | Dimethylglyoxime precipitation, titration with dichromate |
| | 11 | Photometric with dimethylglyoxime with extraction |
| | 17 | Dimethylglyoxime precipitation, titration with cyanide |
| **Al** | 1- 3- 9 | Complexometric |
| | 2- 8-10-11-12-13-14-15-18 | Atomic absorption spectrometry |
| | 4- 6- 7-16 | Gravimetric with 8-hydroxyquinoline |
| | 5 | Gravimetric as oxide |
| | 17 | Photometric with eriochrome cyanine |
| **Co** | 1 | Photometric with thiocyanate |
| | 2- 6-11-14-16 | Atomic absorption spectrometry |
| | 3- 7-10-12-18 | Titration with ferricyanide, potentiometric end point |
| | 4- 5 | Photometric with nitroso-R-salt |
| | 8 | Photometric with isonitrosomalonylguanidine |
| | 9 | Photometric with stannous chloride |
| | 13-17 | Photometric with ferricyanide |
| | 15 | Precipitation with 1-nitroso-2-naphthol, gravimetric |
| **Cu** | 1- 2- 4- 8- 9-13-14-16-17 | Atomic absorption spectrometry |
| | 3 | Electrogravimetric |
| | 5-15 | Photometric with biscyclohexanone oxalyldihydrazone |
| | 6 | Photometric with cuproine |
| | 7 | Photometric with diethyldithiocarbamate |
| | 10 | Iodimetric titration after separation as sulphide |
| | 11-12 | Precipitation with salicylaldoxime, gravimetric |
| | 18 | Photometric with 2, 2' diquinolyl |
| **Nb** | 2- 9-12 | Gravimetric after separation by hydrolysis |
| | 3 | Photometric with PAR after ion exchange separation |
| | 4- 6-11 | Photometric with PAR after precipitation with phenylarsonic acid |
| | 5 | Photometric with thiocyanate after ion exchange separation |
| | 7- 8 | Photometric with PAN |
| | 10 | Photometric with PAR |
| | 13 | Photometric with PAN with extraction |
| | 14 | Photometric with pyrogallol |
| | 15-16-17 | Atomic absorption spectrometry |
| **Ti** | 1-16 | Photometric with chromotropic acid |
| | 2- 7 | Photometric with chromotropic acid after ion exchange separation |
| | 3-18 | Photometric with hydrogen peroxide after cupferron separation |
| | 4- 5- 6- 9-12 | Plasma Emission Spectrometry |
| | 8-14-15 | Atomic absorption spectrometry |
| | 10-11-13-17-19 | Photometric with diantipyrylmethane |
| **Ta** | 1 | X-ray fluorescence spectrometry |
| | 2 | Photometric with phenylfluorone after ion exchange separation |
| | 3 | Photometric with malachite green |
| | 4 | Photometric with hydrogen peroxide |
| | 5- 9-10-11-12 | Photometric with pyrogallol after precipitation with phenylarsonic acid |
| | 6 | Photometric with nile blue |
| | 7 | Photometric with PAR |
| | 8 | Photometric with methyl violet with extraction |
| | 13 | Atomic absorption 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, 2 Park Street, London W1A 2BS).

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 Mitteilung en 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, 1000 Berlin 30).