

# 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. 088-2 HIGH PURITY IRON

LABORATORY MEANS (4 Values)

mass content in %

| Line No.             | C*             | Si            | Mn            | P             | S             | Cr            | Ni            | Co            | Cu            | V              | Ca             | N      | Al     | Mo     |
|----------------------|----------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|----------------|----------------|--------|--------|--------|
| 1                    | 0.00026        | 0.0039        | –             | 0.0040        | 0.0059        | –             | –             | 0.0056        | 0.0147        | 0.00015        | 0.00040        | 0.0006 | 0.0002 | 0.0024 |
| 2                    | 0.00032        | 0.0039        | 0.0734        | 0.0042        | 0.0059        | 0.0204        | 0.0245        | 0.0057        | –             | 0.00015        | 0.00045        | 0.0007 | 0.0002 | 0.0026 |
| 3                    | 0.00032        | 0.0043        | 0.0750        | 0.0043        | 0.0061        | 0.0221        | 0.0254        | 0.0057        | 0.0153        | 0.00020        | 0.00052        | 0.0007 | 0.0003 | 0.0026 |
| 4                    | 0.00035        | 0.0046        | 0.0756        | 0.0044        | 0.0061        | 0.0228        | 0.0261        | 0.0057        | 0.0155        | 0.00028        | 0.00060        | 0.0008 | 0.0003 | 0.0026 |
| 5                    | 0.00040        | 0.0047        | 0.0762        | 0.0044        | 0.0063        | 0.0231        | 0.0262        | 0.0058        | 0.0156        | 0.00028        | 0.00060        | 0.0008 | 0.0003 |        |
| 6                    | 0.00043        | 0.0050        | 0.0767        | 0.0044        | 0.0067        | 0.0231        | 0.0265        | 0.0058        | 0.0158        | 0.00030        | 0.00062        | 0.0009 | 0.0003 |        |
| 7                    | 0.00052        | 0.0050        | 0.0783        | 0.0045        | 0.0067        | 0.0234        | 0.0267        | 0.0060        | 0.0160        | 0.00030        | 0.00065        | 0.0009 | 0.0004 |        |
| 8                    | 0.00068        | 0.0051        | 0.0783        | 0.0045        | 0.0069        | 0.0235        | 0.0270        | 0.0060        | 0.0163        | 0.00030        | 0.00068        | 0.0010 | 0.0004 |        |
| 9                    | 0.00075        | 0.0051        | 0.0803        | 0.0045        | 0.0070        | 0.0236        | 0.0271        | 0.0061        | 0.0164        | 0.00030        | 0.00068        | 0.0010 | 0.0005 |        |
| 10                   | 0.00075        | 0.0055        | 0.0806        | 0.0045        | 0.0071        | 0.0237        | 0.0271        | 0.0061        | 0.0164        | 0.00030        | 0.00072        | 0.0010 | 0.0005 |        |
| 11                   | 0.00076        | 0.0056        | 0.0811        | 0.0047        | 0.0071        | 0.0239        | 0.0274        | 0.0061        | 0.0165        | 0.00031        | 0.00075        | 0.0010 | 0.0009 |        |
| 12                   | 0.00077        | 0.0060        | 0.0815        | 0.0047        | 0.0072        | 0.0240        | 0.0275        | 0.0061        | 0.0165        | 0.00032        | 0.00078        | 0.0011 | 0.0009 |        |
| 13                   | 0.00085        | 0.0061        | 0.0821        | 0.0047        | 0.0074        | 0.0240        | 0.0276        | 0.0061        | 0.0165        | 0.00040        | 0.00080        | 0.0011 | 0.0009 |        |
| 14                   | 0.00102        | 0.0066        | 0.0825        | 0.0047        | 0.0075        | 0.0248        | 0.0277        | 0.0062        | 0.0165        | 0.00045        | 0.00080        | 0.0011 | 0.0011 |        |
| 15                   | –              | 0.0069        | 0.0827        | 0.0048        | 0.0076        | 0.0253        | 0.0280        | 0.0062        | 0.0165        |                | 0.00080        | 0.0011 | 0.0011 |        |
| 16                   | 0.00103        |               | 0.0829        | 0.0048        | 0.0076        | 0.0256        | 0.0280        | 0.0062        | 0.0166        |                | 0.00088        | 0.0011 |        |        |
| 17                   | –              |               | 0.0832        | 0.0049        | 0.0076        | 0.0256        | 0.0280        | 0.0062        | 0.0166        |                | 0.00090        | 0.0012 |        |        |
| 18                   |                |               | 0.0834        | 0.0050        | 0.0076        | 0.0262        | –             | 0.0063        | 0.0166        |                | 0.00090        | 0.0014 |        |        |
| 19                   |                |               | 0.0843        | 0.0051        | 0.0077        | 0.0269        | 0.0285        | 0.0063        | 0.0167        |                | 0.00090        | 0.0014 |        |        |
| 20                   |                |               | 0.0843        | 0.0053        | 0.0081        | 0.0269        | 0.0294        | 0.0063        | 0.0167        |                | 0.00095        | 0.0016 |        |        |
| 21                   |                |               | 0.0852        | 0.0055        |               | 0.0269        | 0.0296        | 0.0064        | 0.0168        |                | –              |        |        |        |
| 22                   |                |               | 0.0854        | 0.0056        |               | 0.0272        | 0.0296        | 0.0064        | 0.0170        |                | –              |        |        |        |
| 23                   |                |               | 0.0861        | 0.0059        |               |               | 0.0297        | 0.0064        | 0.0178        |                |                |        |        |        |
| <b>M<sub>M</sub></b> | <b>0.00062</b> | <b>0.0052</b> | <b>0.0809</b> | <b>0.0048</b> | <b>0.0070</b> | <b>0.0244</b> | <b>0.0275</b> | <b>0.0061</b> | <b>0.0163</b> | <b>0.00029</b> | <b>0.00072</b> |        |        |        |
| <b>s<sub>M</sub></b> | 0.00026        | 0.0009        | 0.0037        | 0.0005        | 0.0007        | 0.0018        | 0.0014        | 0.0003        | 0.0007        | 0.00008        | 0.00016        |        |        |        |
| <b>s<sub>w</sub></b> | 0.00011        | 0.0003        | 0.0006        | 0.0002        | 0.0002        | 0.0005        | 0.0004        | 0.0001        | 0.0003        | 0.00004        | 0.00007        |        |        |        |

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.

Values given above in italic type are for information only

### CERTIFIED VALUES

mass content in %

|                      | C*            | Si            | Mn            | P             | S             | Cr            | Ni            | Co            | Cu            | V              | Ca             |
|----------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|----------------|----------------|
| <b>M<sub>M</sub></b> | <b>0.0006</b> | <b>0.0052</b> | <b>0.0809</b> | <b>0.0048</b> | <b>0.0070</b> | <b>0.0244</b> | <b>0.0275</b> | <b>0.0061</b> | <b>0.0163</b> | <b>0.00029</b> | <b>0.00072</b> |
| C(95%)               | 0.0002        | 0.0005        | 0.0017        | 0.0002        | 0.0004        | 0.0008        | 0.0007        | 0.0002        | 0.0003        | 0.00005        | 0.00008        |

### IMPORTANT NOTE

\* The ECRM Producers are aware that the determination of low carbon contents should preferably be carried out on compact samples (after pretreatment). In this special case, the powdered sample ECRM 088-2, satisfactory carbon values have been obtained after pre-heating at 420°C ± 10°C in air for 5-10 minutes in accordance with ISO 15349-2. Determination of low carbon in unalloyed steels by HF/IR. See further information under “Methods Used” for carbon.

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

JANUARY 2001

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



Certificate No. Q3993

**METHODS USED**  
**EURONORM – CRM No. 088-2**

| Element   | Line Number  | Methods   |
|---|--|---|
| <b>C*</b>   | 1-2-3-4-5-6-7-8-9-10-11-12-13-16<br>14                               | High frequency combustion-infrared absorption<br>Combustion, non-aqueous titration  |
| NOTE: Extensive work has shown that this finely divided material adsorbs carbon on the surface but this can be removed by pre-heating in air immediately before combustion. (This may be carried out in a muffle furnace with thermostatic temperature control). It is therefore vitally important to carry out this pre-treatment of the sample. |  |   |
| <b>Si</b>   | 1-2-3-4-5-6-7-9-11<br>8-10<br>12-13<br>14<br>15                      | ICP-OES<br>Photometric as molybdenum blue with extraction<br>Photometric as molybdenum blue without extraction<br>Gravimetric, dehydration with perchloric acid<br>FAAS |
| <b>Mn</b>   | 2-6-8-10-11-12-13-14-15-17-20-21-22-23<br>3-4-5-7-16-18<br>9-19      | ICP-OES<br>FAAS<br>Photometric, oxidation with periodate  |
| <b>P</b>  | 1-11-12-19-20<br>2-3-10-13-15-22-23<br>4-5-6-7-8-14-16-17-18-21<br>9 | Photometric as phosphovanadomolybdate with extraction<br>Photometric as molybdenum blue without extraction<br>ICP-OES<br>ICP-MS   |
| <b>S</b>  | 1<br>2-3-4-5-6-7-9-10-11-12-13-14-15-16-17-18-19-20<br>8             | Gravimetric as BaSO <sub>4</sub> , after chromatographic separation on alumina<br>High frequency combustion, infrared absorption<br>Coulometric titration               |
| <b>Cr</b>   | 2-3-7-13-14-19-20-21-22<br>4-5-6-8-9-10-11-12-15-16-17-18            | FAAS<br>ICP-OES   |
| <b>Ni</b>   | 2-3-4-9-13-14-21<br>5-6-7-8-11-12-15-16-17-19-20-22-23<br>10         | FAAS<br>ICP-OES<br>Photometric with dimethylglyoxime with extraction  |
| <b>Co</b>   | 1-2-3-6-7-8-9-10-12-13-14-15-16-20<br>4-11-19-21-22-23<br>5-17-18    | ICP-OES<br>FAAS<br>ICP-MS   |
| <b>Cu</b>   | 1-4-5-7-10-18-19-21<br>3-6-8-9-13-14-15-16-17-20-22-23<br>11<br>12   | FAAS<br>ICP-OES<br>ICP-MS<br>Photometric with diethyldithiocarbamate with extraction  |
| <b>V</b>  | 1-2-3-5-6-7-8-11-12-14<br>4<br>9-10-13                               | ICP-OES<br>FAAS<br>ICP-MS   |
| <b>Ca</b>   | 1-3-4-5-6-7-14-15-16<br>2-8-9-10-11-12-13-17-18-19-20                | FAAS<br>ICP-OES   |
| <b>N</b>  | 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-17-18-19-20<br>16                | Thermal conductivity, decomposition in graphite crucible<br>Photometric with indophenol blue after distillation   |
| <b>Al</b>   | 1-4-5-6-9-10-11-12-15<br>2-3-13-14<br>7<br>8                         | ICP-OES<br>FAAS<br>ICP-MS<br>Photometric with chrome azural S, ion exchange separation  |
| <b>Mo</b>   | 1-2<br>3<br>4  | ICP-OES<br>ICP-MS<br>FAAS   |

**Abbreviations:-**

FAAS: Flame Atomic Absorption Spectrometry  
ICP-MS: Inductively Coupled Plasma - Mass Spectrometry  
ICP-OES: Inductively Coupled Plasma-Optical Emission Spectrometry

## EURONORM – CRM No. 088-2

### PARTICIPATING LABORATORIES

|  |   |
|--|---|
| AB Sandvik Steel, Sandviken (Sweden)                                     | Keighley Laboratories Ltd., Keighley (UK)                         |
| Acerinox S.A., Algeciras (Spain)   | Luxcontrol S.A., Esch-sur-Alzette (Luxembourg)                    |
| Ascometal Usine de Fos, Fos-sur-Mer (France)                             | Max-Planck-Institut für Eisenforschung GmbH, Düsseldorf (Germany) |
| AG der Dillinger Hüttenwerke, Dillingen-Saar (Germany)                   | NILAB, Avesta (Sweden)  |
| Böhler Edelstahl GmbH & Co KG, Kapfenberg (Austria)                      | Ovako Steel AB, Hofors (Sweden)                                   |
| Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin (Germany) | Ridsdale & Co. Ltd., Middlesbrough (UK)                           |
| Castings Development Centre, Birmingham (UK)                             | Serma Technologies, Belfort (France)                              |
| Centro Nacional de Investigaciones Metalúrgicas (CENIM), Madrid (Spain)  | SOLLAC, Florange (France)   |
|  | SOLLAC, Fos-sur-Mer (France)                                      |
| Cockerill Sambre S.A., Couillet (Belgium)                                | Swedish Institute for Metals Research (SIMR), Stockholm (Sweden)  |
| Corus, Llanwern (UK)   |   |
| Corus, IJmuiden (Netherlands)  | Thyssen Krupp Stahl AG, Dortmund (Germany)                        |
| IRSID, Maizières-lès-Metz (France)                                       | Voest-Alpine Stahl Linz GmbH, Linz (Austria)                      |

### DESCRIPTION OF THE SAMPLE

The sample is available in the form of powder passing a 180µm aperture sieve from which the dust passing a 53µm aperture sieve has been removed. It is supplied in bottles containing 100g.

### INTENDED USE & STABILITY

This sample 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.

### 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).

För information angående tillverkning, certifiering och distribuering av dessa europeiska certifierade referensmaterial (EURONORM CRM) och för användning av statistisk information, som angivits i detta certifikat, refereras till informationscirkulär Nr 1 (ECISS) och Nr 5 (ECSC) från de nationella standardiseringsorganisationerna. (I Sverige är det SIS, Box 6455, SE-113 82 Stockholm, i Finland är det SFS, PL 116, FIN-002 41, Helsinki, i Danmark är det DS, Kollegievej 6, DK-Charlottenlund 2920, i Norge är det NSF, Drammensveien 145 A, Postboks 353 Skøyen, NO-0213 Oslo, på Island är det STRI, Holtagarðar, IS-104 Reykjavík).