

ECISS
 EUROPÄISCHES KOMITEE FÜR EISEN- UND STAHLNORMUNG
 COMITE EUROPEEN DE NORMALISATION DU FER ET DE L'ACIER
 EUROPEAN COMMITTEE FOR IRON AND STEEL STANDARDIZATION

European Certified Reference Material (EURONORM-CRM)
 Certificate of Chemical Analysis

EURONORM-CRM No. 083-1
(unalloyed steel)

Laboratory means (4 values), mass content in %

| Line No. | C | N | Line No. | Mn | P | S | Ni | Cu | Cr | Al | As |
|----------|--------|---------|----------|--------|--------|--------|--------|--------|---------------|---------------|---------------|
| 1 | 0,0251 | 0,00151 | 1 | 0,2817 | 0,0063 | 0,0092 | ----- | ----- | <i>0,0085</i> | <i>0,0025</i> | <i>0,0023</i> |
| 2 | 0,0254 | 0,00154 | 2 | 0,2827 | 0,0064 | 0,0092 | 0,0116 | 0,0147 | <i>0,0103</i> | <i>0,0030</i> | <i>0,0030</i> |
| 3 | 0,0257 | 0,00165 | 3 | 0,2829 | 0,0065 | 0,0092 | 0,0118 | 0,0147 | <i>0,0107</i> | <i>0,0035</i> | <i>0,0031</i> |
| 4 | 0,0257 | 0,00172 | 4 | 0,2832 | 0,0067 | 0,0095 | 0,0132 | 0,0149 | <i>0,0107</i> | <i>0,0035</i> | <i>0,0032</i> |
| 5 | 0,0258 | 0,00173 | 5 | 0,2875 | 0,0070 | 0,0095 | 0,0133 | 0,0150 | <i>0,0109</i> | <i>0,0036</i> | <i>0,0032</i> |
| 6 | 0,0259 | 0,00177 | 6 | 0,2877 | 0,0071 | 0,0096 | 0,0135 | 0,0154 | <i>0,0110</i> | <i>0,0039</i> | <i>0,0034</i> |
| 7 | 0,0259 | 0,00183 | 7 | 0,2882 | 0,0073 | 0,0097 | 0,0135 | 0,0154 | <i>0,0117</i> | <i>0,0040</i> | <i>0,0044</i> |
| 8 | 0,0259 | 0,00189 | 8 | 0,2890 | 0,0074 | 0,0099 | 0,0135 | 0,0155 | <i>0,0121</i> | <i>0,0042</i> | <i>0,0045</i> |
| 9 | 0,0261 | 0,00190 | 9 | 0,2900 | 0,0076 | 0,0100 | 0,0140 | 0,0160 | <i>0,0127</i> | <i>0,0043</i> | <i>0,0045</i> |
| 10 | 0,0261 | 0,00190 | 10 | 0,2900 | 0,0077 | 0,0100 | 0,0140 | 0,0161 | <i>0,0130</i> | <i>0,0043</i> | <i>0,0046</i> |
| 11 | 0,0263 | 0,00190 | 11 | 0,2907 | 0,0077 | 0,0100 | 0,0140 | 0,0162 | <i>0,0134</i> | <i>0,0045</i> | <i>0,0046</i> |
| 12 | 0,0264 | 0,00199 | 12 | 0,2910 | 0,0077 | 0,0102 | 0,0142 | 0,0165 | <i>0,0140</i> | <i>0,0047</i> | <i>0,0049</i> |
| 13 | 0,0266 | 0,00200 | 13 | 0,2925 | 0,0078 | 0,0102 | 0,0142 | 0,0165 | <i>0,0142</i> | <i>0,0048</i> | <i>0,0055</i> |
| 14 | 0,0268 | 0,00205 | 14 | 0,2930 | 0,0081 | 0,0103 | 0,0150 | 0,0165 | <i>0,0146</i> | <i>0,0048</i> | <i>0,0055</i> |
| 15 | 0,0269 | 0,00206 | 15 | 0,2950 | 0,0083 | 0,0103 | 0,0152 | 0,0166 | <i>0,0154</i> | <i>0,0049</i> | <i>0,0056</i> |
| 16 | 0,0270 | 0,00215 | 16 | 0,2955 | 0,0090 | 0,0104 | 0,0155 | 0,0167 | <i>0,0155</i> | <i>0,0049</i> | <i>0,0060</i> |
| 17 | 0,0271 | 0,00215 | 17 | 0,2955 | 0,0094 | 0,0105 | 0,0158 | 0,0170 | <i>0,0162</i> | <i>0,0050</i> | |
| 18 | 0,0275 | 0,00225 | 18 | ----- | 0,0095 | 0,0105 | 0,0169 | 0,0177 | <i>0,0172</i> | <i>0,0056</i> | |
| 19 | | | 19 | | | 0,0110 | | | | <i>0,0061</i> | |
| 20 | | | 20 | | | | | | | <i>0,0063</i> | |
| M(M) | 0,0262 | 0,00189 | M(M) | 0,2892 | 0,0076 | 0,0100 | 0,0141 | 0,0160 | | | |
| s(M) | 0,0007 | 0,00021 | s(M) | 0,0045 | 0,0010 | 0,0004 | 0,0013 | 0,0008 | | | |
| s(w) | 0,0003 | 0,00011 | | | | | | | | | |

M(M) : Mean of the intralaboratory means
 s(M) : Standard deviation of the intralaboratory means
 s(w) : Intralaboratory standard deviation

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 in *italic* type are for information only.

CERTIFIED VALUES, mass content in %

| | C | N | | Mn | P | S | Ni | Cu |
|---------------|--------|---------|-------------|-------|--------|--------|-------|-------|
| M(M) | 0,0262 | 0,00189 | M(M) | 0,289 | 0,0076 | 0,0100 | 0,014 | 0,016 |
| C(95%) | 0,0004 | 0,00011 | s(M) | 0,004 | 0,0010 | 0,0005 | 0,001 | 0,001 |

C(95%) is the half-width confidence interval where t is the appropriate Student's t value and n is the number of acceptable laboratory means. For further information regarding the confidence interval for the certified value see ISO Guide 35:2006 sections 6.1 and 10.5.2.

$$C(95\%) = \frac{t \cdot s(M)}{\sqrt{n}}$$

Revised August 2009 with new values for Nitrogen.
 Revised March 2006 with new values for Carbon.
 Values for Phosphorus recalculated with original data. (First issued in August 1978)

Description of the sample

The sample is available in the form of chips. It is supplied in glass bottles containing 100 g.

This reference material was prepared in accordance with the recommendations set out in ISO Guides 30 – 35 and issued by the German Iron and Steel CRM Working Group on behalf of the Iron and Steel Nomenclature Co-Ordinating Committee (COCOR) and the European Committee for Iron and Steel Standardization (ECISS).

The German Iron and Steel CRM Working Group is composed of
 BAM Bundesanstalt für Materialforschung und -prüfung, Berlin
 Max-Planck-Institut für Eisenforschung GmbH (MPI), Düsseldorf
 Stahlindustrie VDEh (Committee of chemists), Düsseldorf (management for the working group)

The certification was carried out by the association of European Certified Reference Material Producers (EURONORM-CRM) after approval of its members: Institut de Recherches de la Sidérurgie Française (IRSID), Centre de Développement des Industries de Mise en Forme des Matériaux (CTIF), France, Bureau of Analysed Samples Ltd. (BAS), UK, Jernkontoret, Swerea KIMAB (Nordic CRM Working Group) and the above mentioned German Iron and Steel CRM Working Group and all participating laboratories.

Sale of the reference material: BAM Bundesanstalt für Materialforschung und -prüfung, Richard-Willstätter-Straße 11, 12489 Berlin (www.webshop.bam.de).

Intended use & stability

ECRM 083-1 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 and 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 primary substances (pure stoichiometric metals or compounds).

Laboratories participating in the original certification 1978

ARBED, Division de Differdange, Differdange (Luxembourg)
 ARBED, Division d'Esch-Belval, Esch-sur-Alzette (Luxembourg)
 British Steel Corporation, Orb Works, Newport (UK)
 British Steel Corporation, Rotherham Works,
 Rotherham (UK)
 Brown-Firth Research Laboratories, Sheffield (UK)
 Bundesanstalt für Materialprüfung (BAM), Berlin (Germany)
 Centro Sperimentale Metallurgico S.p.A., Rom (Italy)
 COCKERILL, Cockerill-Ougrée-Providence et Espérance-
 Longdoz, Seraing (Belgium)
 Creusot-Loire, Usine de Dunes, Dunkerque (France)
 Hoesch Hüttenwerke AG, Dortmund (Germany)
 Hoogovens – ESTEL, IJmuiden (Netherlands)
 Institut de Recherches de la Sidérurgie Française (IRSID),
 Maizières-lès-Metz (France)

Mannesmann AG Hüttenwerke, Duisburg-Huckingen
 (Germany)
 Materials Quality Assurance Directorate, Ministry of Defence,
 Bragg Laboratory, Sheffield (UK)
 N. V. Staalgieterij SMDK, Utrecht (Netherlands)
 Ridsdale & Co Ltd, Middlesbrough (UK)
 Soc. Italsider, Laboratorio Centrale Prodotti, Genua (Italy)
 Société Nationale de Chemins de Fer Français (S.N.C.F.),
 Laboratoire Central, Levallois Perret (France)
 Staatliches Materialprüfungsamt Nordrhein-Westfalen,
 Dortmund (Germany)
 Thyssen AG, vorm. August Thyssen-Hütte, Duisburg-Ruhrort
 (Germany)
 USINOR, Usine de Longwy, Longwy (France)

Laboratories participating in the re-certification of carbon 2005

Arcelor Research, Maizières-lès-Metz (France)
 Böhler Edelstahl GmbH, Kapfenberg, Steiermark (Austria)
 Bundesanstalt für Materialforschung und -prüfung (BAM),
 Berlin (Germany)
 Corus Llanwern, Llanwern (UK)
 Corus Stocksbridge, Stocksbridge (UK)
 Corus Testing Solutions, Scunthorpe (UK)
 Edelstahlwerke Südwestfalen GmbH, Siegen (Germany)
 EWK Edelstahl Witten-Krefeld GmbH, Witten (Germany)
 Hüttenwerke Krupp Mannesmann GmbH, Duisburg
 (Germany)

Kanthal AB, Hallstahammar (Sweden)
 Korrosions- och Metallforskningsinstitutet AB, Stockholm
 (Sweden)
 Ovako Steel AB, Hofors (Sweden)
 Ridsdale & Co Ltd, Middlesbrough (UK)
 SOLLAC-Dunkerque, Dunkerque (France)
 SOLLAC-Florange, Florange (France)
 SOLLAC, Usine de Fos, Fos-sur-Mer (France)
 ThyssenKrupp Steel AG, Duisburg (Germany)
 voestalpine Stahl GmbH, Linz (Austria)

Laboratories participating in the re-certification of nitrogen 2008

AG der Dillinger Hüttenwerke, Dillingen/Saar (Germany)
 ArcelorMittal Research, Maizières-lès-Metz (France)
 Aubert & Duval, Lez Ancizes (France)
 BAM Bundesanstalt für Materialforschung und -prüfung, Berlin (Germany)
 BÖHLER Edelstahl GmbH, Kapfenberg, (Steiermark) (Austria)
 C.T.I.F. Centre de Développement des Industries de Mise en Forme des Matériaux, Sèvres (France)
 Corus Strip Products, Llanwern (UK)
 Deutsche Edelstahlwerke GmbH, Witten (Germany)
 Forschungs- und Qualitätszentrum Brandenburg GmbH (FGZ), Eisenhüttenstadt (Germany)

Institute for Certified Reference Materials, Ekaterinburg (Russia)
 Max-Planck Institut für Eisenforschung GmbH, Düsseldorf (Germany)
 Swerea KIMAB, Stockholm (Sweden)
 Pattinson & Stead (2005) Ltd, Middlesbrough (UK)
 Ridsdale & Co Ltd, Middlesbrough (UK)
 Salzgitter Flachstahl GmbH, Salzgitter (Germany)
 ThyssenKrupp Steel AG, Duisburg (Germany)
 voestalpine Stahl GmbH, Linz (Austria)

Methods used

| Element | Line number | Method |
|------------------------------|---|--|
| Re-certification 2005 | | |
| C | 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 15, 16, 18 7, 14 17 | Combustion, infrared absorption Combustion, thermal conductivity Non aqueous titration after absorption in organic solution |
| Re-certification 2008 | | |
| N | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16 13 14, 17 18 | Thermal conductivity, decomposition in a graphite crucible Coulometry, NH ₄ ⁺ after distillation Acidimetric titration after distillation, visual detection Spectrophotometry; Nessler reagent |
| Certification 1978 | | |
| Mn | 1, 6, 8 2 3, 4, 5, 7, 10, 11, 12, 13, 16, 17 9, 14, 15 | Flame atomic absorption spectrometry Titration with arsenite, persulphate oxidation Spectrophotometry, periodate oxidation Spectrophotometry, persulphate oxidation |
| P | 1, 2, 9, 13, 17, 18 3, 4, 5, 6, 7, 10, 11, 12, 14, 15 8 16 | Spectrophotometry, molybdenum blue, without extraction Spectrophotometry, phosphovanadomolybdate, extraction Spectrophotometry, molybdenum blue, extraction Spectrophotometry, phosphovanadomolybdate, without extraction |
| S | 1, 5, 11, 17, 18, 19 2, 6, 7, 8, 13 3, 16 4, 15 9, 12, 14 10 | Combustion, conductimetry Combustion, infrared absorption Combustion, oxidation reduction titration Combustion, acidimetric titration Combustion coulometric titration Gravimetric as BaSO ₄ after chromatographic separation of SO ₄ ²⁻ on alumina |
| Ni | 2, 5, 9, 16 3, 10, 12 4, 6, 7, 8, 11, 13, 14, 15, 17, 18 | Spectrophotometry, dimethylglyoxime, without extraction Spectrophotometry, dimethylglyoxime, extraction Flame atomic absorption spectrometry |
| Cu | 2, 4, 5, 7, 9, 12, 13, 14, 15, 16 3, 18 6 8 10, 11 17 | Flame atomic absorption spectrometry Spectrophotometry, dithiooxamide, without extraction Spectrophotometry, bicyclohexanone-oxalyldihydrazone Spectrophotometry, diethyldithiocarbamate, extraction Spectrophotometry; 2,2'-diquinolyl, extraction Spectrophotometry; oxalyldihydrazide |
| Cr | 1, 3, 5, 6, 8, 11, 14, 15 2, 4, 7, 9, 10, 12, 13, 17, 18 16 | Flame atomic absorption spectrometry Spectrophotometry; diphenylcarbazide Titration with Mn(VII); oxidation with persulphate |
| Al | 1, 3, 6, 8, 9, 11, 12, 14, 19 2, 7, 13, 17 4 5 10, 18 15, 16, 20 | Flame atomic absorption spectrometry, without extraction of iron Flame atomic absorption spectrometry, after extraction of iron Spectrophotometry; eriochrome cyanine Spectrophotometry; chrome azurole-S Spectrophotometry; hydroxyquinoline, ion exchange separation Spectrophotometry; eriochrome cyanine, electrolytic separation |

| Element | Line number | Method |
|---------|---------------------------|---|
| As | 1, 2, 4, 5, 12 3, 6, 8 | <i>Spectrophotometry; molybdenum blue extraction</i> <i>Spectrophotometry; Ag-diethyldithiocarbamate, separation as arsine</i> |
| | 7 | <i>Titration with Ce(IV); precipitation of elemental As</i> |
| | 9, 15 | <i>Titration with bromate; halide distillation</i> |
| | 10, 11, 14 | <i>Titration with bromate (potentiometric end point); halide distillation</i> |
| | 13 | <i>Flame atomic absorption spectrometry</i> |
| | 16 | <i>Titration with iodine, sulphide extraction</i> |

Further information

Angaben über Herstellung, Zertifizierung und Bezugsmöglichkeiten dieser Europäischen Zertifizierten Referenzmaterialien (EURONORM-ZRM) sowie über die Anwendungen der in diesem Zertifikat enthaltenen statistischen Daten sind erhältlich beim Hersteller dieses zertifizierten Referenzmaterials, dessen Adresse auf diesem Zertifikat angegeben ist oder sie finden sich im CEN-Report CR 10317 und in der Mitteilung Nr. 5 (ECISS), beide zu beziehen durch die nationalen Normenorganisationen oder direkt von CEN, Brüssel (in Deutschland bei der Vertriebsstelle des DIN: Beuth-Verlag GmbH, Burggrafenstraße 4-10, 10787 Berlin).

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D'autres informations et avis au sujet de ce Matériau de Référence Certifié, ou de tout autre Matériau de Référence Certifié ou Matériau de Référence produits par le Groupe de travail pour les MRC sidérurgiques, peuvent être demandés en contactant l'adresse figurant plus haut dans ce Certificat.

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 either to the producer of this Certified Reference Material at the address given on this Certificate or to CEN-Report CR 10317 and Information Circular No. 5 (ECISS), both of which are available from the national standards body in your country or from CEN, Brussels (in the UK this is the BSI, 389 Chiswick High Road, London W4 4AL).

Further information and advice on this or other Certified Reference Materials or Reference Materials produced by the German CRM working group may be obtained from the address above.

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The German Iron and Steel CRM Working Group

The Working Group is composed of
 BAM Bundesanstalt für Materialforschung und -prüfung, Berlin
 Max-Planck-Institut für Eisenforschung GmbH (MPI), Düsseldorf
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