

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. 276-2 5% Cr-Mo-V STEEL**

LABORATORY MEANS (4 Values)  
mass content in %

| Line No.             | C             | Si (Total)    | Mn            | P             | S             | Cr            | Mo            | Ni            | Cu            | N             | Sn            | V             |
|----------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| 1                    | 0.3933        | —             | —             | 0.0083        | 0.0168        | —             | 1.0802        | 0.1967        | 0.1761        | 0.0110        | —             | 0.2785        |
| 2                    | 0.3934        | 1.0159        | 0.3568        | 0.0084        | 0.0175        | 4.9325        | 1.0941        | 0.1968        | 0.1769        | 0.0110        | 0.0122        | 0.2790        |
| 3                    | 0.3937        | 1.0166        | 0.3570        | 0.0085        | 0.0176        | 4.9389        | 1.0948        | 0.1973        | —             | 0.0111        | 0.0125        | 0.2836        |
| 4                    | 0.3949        | 1.0204        | 0.3573        | 0.0085        | 0.0181        | 4.9445        | 1.1023        | 0.1999        | 0.1793        | 0.0113        | 0.0125        | 0.2863        |
| 5                    | 0.3953        | —             | 0.3591        | 0.0086        | 0.0182        | 4.9478        | 1.1130        | 0.1999        | 0.1795        | 0.0113        | 0.0127        | 0.2864        |
| 6                    | 0.3958        | 1.0273        | 0.3605        | 0.0086        | 0.0183        | 4.9496        | 1.1168        | 0.2003        | 0.1807        | 0.0114        | 0.0130        | 0.2886        |
| 7                    | 0.3963        | 1.0278        | 0.3608        | 0.0087        | 0.0184        | 4.9500        | 1.1198        | 0.2005        | 0.1808        | 0.0115        | 0.0130        | 0.2891        |
| 8                    | 0.3965        | 1.0293        | 0.3613        | 0.0088        | 0.0186        | 4.9525        | —             | 0.2009        | 0.1815        | 0.0115        | 0.0130        | 0.2894        |
| 9                    | 0.3978        | 1.0295        | 0.3617        | 0.0090        | 0.0187        | 4.9554        | 1.1256        | 0.2013        | 0.1818        | 0.0116        | 0.0131        | 0.2933        |
| 10                   | 0.3978        | 1.0311        | 0.3617        | 0.0091        | 0.0188        | 4.9628        | 1.1269        | 0.2015        | 0.1823        | 0.0116        | 0.0131        | 0.2935        |
| 11                   | 0.3983        | 1.0315        | 0.3618        | 0.0091        | 0.0192        | 4.9645        | 1.1272        | 0.2015        | 0.1823        | 0.0116        | 0.0133        | 0.2938        |
| 12                   | 0.3990        | 1.0334        | 0.3649        | 0.0092        | 0.0192        | 4.9695        | 1.1375        | 0.2025        | 0.1824        | 0.0116        | 0.0134        | 0.2952        |
| 13                   | 0.3993        | 1.0353        | 0.3653        | 0.0094        | 0.0193        | 4.9700        | 1.1380        | 0.2028        | 0.1828        | 0.0116        | 0.0134        | 0.2957        |
| 14                   | 0.3995        | 1.0361        | 0.3667        | 0.0095        | 0.0193        | 4.9750        | 1.1386        | 0.2036        | 0.1830        | 0.0117        | 0.0135        | 0.2974        |
| 15                   | 0.3995        | 1.0361        | 0.3672        | 0.0096        | 0.0193        | 4.9811        | 1.1405        | 0.2053        | 0.1839        | 0.0117        | 0.0135        | 0.2985        |
| 16                   | 0.3996        | 1.0363        | 0.3672        | 0.0097        | 0.0194        | 4.9811        | 1.1440        | 0.2053        | 0.1845        | 0.0118        | 0.0135        | 0.2999        |
| 17                   | 0.3996        | 1.0383        | 0.3700        | 0.0098        | 0.0194        | 4.9844        | 1.1501        | 0.2063        | 0.1846        | 0.0118        | 0.0136        | 0.3002        |
| 18                   | 0.3998        | 1.0410        | 0.3703        | 0.0098        | 0.0194        | 5.0024        | 1.1510        | 0.2065        | 0.1858        | 0.0118        | 0.0138        | 0.3013        |
| 19                   | 0.4002        | 1.0428        | 0.3707        | 0.0103        | 0.0195        | 5.0025        | 1.1595        | 0.2080        | 0.1865        | 0.0118        | 0.0139        | 0.3029        |
| 20                   | 0.4029        | 1.0435        | 0.3711        | 0.0103        | 0.0196        | 5.0098        | 1.1621        | 0.2083        | 0.1869        | 0.0120        | 0.0139        | 0.3118        |
| 21                   | 0.4059        | 1.0445        | 0.3720        | 0.0115        | 0.0199        | 5.0440        | 1.1658        | 0.2094        | 0.1890        | 0.0122        | 0.0140        | 0.3121        |
| 22                   | 0.4060        | 1.0495        | 0.3745        | —             | 0.0201        | 5.0520        | 1.1673        | 0.2112        | 0.1893        | 0.0124        | 0.0141        | 0.3245        |
| 23                   | 0.4075        | 1.0565        | 0.3750        | —             | 0.0205        | —             | 1.1868        | —             | 0.1898        | —             | —             | —             |
| <b>M<sub>M</sub></b> | <b>0.3988</b> | <b>1.0344</b> | <b>0.3651</b> | <b>0.0093</b> | <b>0.0189</b> | <b>4.9748</b> | <b>1.1337</b> | <b>0.2030</b> | <b>0.1832</b> | <b>0.0116</b> | <b>0.0133</b> | <b>0.2955</b> |
| <b>S<sub>M</sub></b> | 0.0039        | 0.0101        | 0.0057        | 0.0008        | 0.0009        | 0.0323        | 0.0269        | 0.0041        | 0.0037        | 0.0003        | 0.0005        | 0.0110        |
| <b>S<sub>w</sub></b> | 0.0022        | 0.0068        | 0.0026        | 0.0004        | 0.0004        | 0.0165        | 0.0099        | 0.0026        | 0.0015        | 0.0002        | 0.0004        | 0.0032        |

$M_M$ : Mean of the laboratory means  $S_M$ : Standard deviation of the laboratory means  
 $S_w$ : Intralaboratory standard deviation  $S_b$ : 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 (Total)   | Mn           | P             | S             | Cr           | Mo           | Ni           | Cu           | N             | Sn            | V            |
|----------------------|--------------|--------------|--------------|---------------|---------------|--------------|--------------|--------------|--------------|---------------|---------------|--------------|
| <b>M<sub>M</sub></b> | <b>0.399</b> | <b>1.034</b> | <b>0.365</b> | <b>0.0093</b> | <b>0.0189</b> | <b>4.975</b> | <b>1.134</b> | <b>0.203</b> | <b>0.183</b> | <b>0.0116</b> | <b>0.0133</b> | <b>0.296</b> |
| <b>C(95%)</b>        | 0.002        | 0.004        | 0.002        | 0.0003        | 0.0003        | 0.012        | 0.010        | 0.002        | 0.002        | 0.0001        | 0.0002        | 0.005        |

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.

**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 276-2(C). It is also supplied in the form of 38mm dia discs ...ref 276-2(D).

This reference material was prepared and issued by:

**BUREAU OF ANALYSED SAMPLES LIMITED**

Newham Hall, Middlesbrough, England

FEBRUARY 1993

On behalf of:- The Iron and Steel Nomenclature Co-ordinating Committee (COCOR) of the ECIS, 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

|  |  |
|--|--|
| AB Sandvik Steel, Sandviken (Sweden)                                     | Klöckner Stahl GmbH., Bremen (Germany)   |
| Acerinox S.A., Algeciras (Spain)   | Laborlux S.A., Esch-sur-Alzette (Luxembourg)   |
| Ascometal, Dunkerque (France)  | Rautaruukki Oy, Raahе (Finland)  |
| Aubert et Duval, Les Ancizes (France)                                    | Ridsdale & Co. Ltd., Middlesbrough (UK)  |
| Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin (Germany) | Staatliches Materialprüfungsamt, Nordrhein-Westfalen (MPA NW),<br>Dortmund-Aplerbeck (Germany) |
| Centro Nacional de Investigaciones Metalurgicas (CENIM), Madrid (Spain)  | Stocksbridge Engineering Steels, Sheffield (UK)  |
| Cockerill Sambre S.A., Couillet (Belgium)                                | Thyssen Edelstahlwerke AG, Krefeld (Germany)   |
| Creusot-Loire Industrie, Le Creusot (France)                             | Thyssen Edelstahlwerke AG, Witten (Germany)  |
| Defence Research Agency, Woolwich (UK)                                   | Uddeholm Tooling AB, Hagfors (Sweden)  |
| Hoogovens Groep BV, IJmuiden (Netherlands)                               | Ugine S.A., Isbergues (France)   |
| Howmet Alloys International Ltd., Exeter (UK)                            | Voest Alpine Stahl Linz GmbH., Linz (Austria)  |
| Institutet för Metallforskning, Stockholm (Sweden)                       |  |

## METHODS USED EURONORM – CRM No. 276-2

| Element      | Line Number  | Methods   |
|--------------|--|---|
| <b>C</b>     | 1-2-3-4-6-7-8-9-10-11-12-14-15-16-17-18-19-20-23<br>5-22<br>13<br>21 | Combustion, infrared absorption<br>Combustion, non-aqueous titration<br>Combustion, conductimetry<br>Combustion, coulometry   |
| <b>Si</b>    | 2-4-6-7-9-10-12-13-16-17-19-20-22                                    | Gravimetric, dehydration with perchloric acid   |
| <b>Total</b> | 3-11-14-18<br>8-15-23<br>21  | Photometric as molybdenum blue with extraction<br>Plasma Emission Spectrometry<br>Atomic Absorption Spectrometry  |
| <b>Mn</b>    | 2-3-12-14-15-18-21-22<br>4-9-13-17-19<br>5-6-7-10-16-20<br>8-11-23   | Plasma Emission Spectrometry<br>Atomic Absorption Spectrometry<br>Photometric - Periodate oxidation<br>Photometric - Persulphate oxidation  |
| <b>P</b>     | 1-3-14-17<br>2<br>4-5-6-8-9-11-12-13-15-19-20-21<br>7-10-16-18       | Photometric as molybdenum blue<br>Photometric as molybdenum blue with extraction<br>Photometric as phosphovanado-molybdate with extraction<br>Plasma Emission Spectrometry  |
| <b>S</b>     | 1-2-3-4-5-6-7-9-10-11-12-13-14-15-16-19-20-21-22-23<br>8<br>17<br>18 | Combustion, infrared absorption<br>Combustion, acidimetric titration<br>Gravimetric as BaSO <sub>4</sub><br>Combustion, conductimetry   |
| <b>Cr</b>    | 2-3-9-11-18-20-22<br>4<br>5-6-7-8-10-12-13-14-15-16-17-19-21         | Plasma Emission Spectrometry<br>Titration with Fe(II), oxidation with perchloric acid<br>Titration with Fe(II), oxidation with persulphate  |
| <b>Mo</b>    | 1-3-4-11-14-15-17-19-22-23<br>2-9-12-21<br>5-6-10-13-16-18-20<br>7   | Plasma Emission Spectrometry<br>Photometric with thiocyanate in presence of Sn(II)<br>Photometric with thiocyanate in presence of Sn(II), extraction<br>Atomic Absorption Spectrometry                              |
| <b>Ni</b>    | 1-13-15-22<br>2-4-8-9-10-16-21<br>3-6-7-11-12-14-17-18-19-20<br>5    | Photometric with dimethylglyoxime<br>Plasma Emission Spectrometry<br>Atomic Absorption Spectrometry<br>Titration with potassium dichromate after separation with dimethylglyoxime                                   |
| <b>Cu</b>    | 1-4-7-8-13-14-16-19-20-23<br>2-5-9-10-11-12-15-17-21<br>6-22<br>18   | Atomic Absorption Spectrometry<br>Plasma Emission Spectrometry<br>Photometric with cuproine, without extraction<br>Photometric as oxalyldihydrazone   |
| <b>N</b>     | 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-19-22<br>18<br>20<br>21    | Thermal conductivity, decomposition in graphite crucible<br>Gas Volumetry, oxidising fusion, CO <sub>2</sub> as carrier gas<br>Acidimetric titration, distillation<br>Photometric with indophenol blue distillation |
| <b>Sn</b>    | 2-4-7-8-9-15-18-19-21<br>3-6-11-12-13-14-20<br>5-17-22<br>10<br>16   | Plasma Emission Spectrometry<br>Graphite Furnace AAS<br>Atomic Absorption Spectrometry<br>Plasma Emission Mass Spectrometry<br>Photometric with substituted fluorone, halide separation                             |
| <b>V</b>     | 1-6-7-8-10-12-14-16-17-21<br>2-4-9-18-22<br>3-5-13-19-20<br>11-15    | Plasma Emission Spectrometry<br>Atomic Absorption Spectrometry<br>Titration with Fe(II), oxidation with Mn(VII)<br>Photometric with N-benzoylphenyl-hydroxylamine, with extraction                                  |

## 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 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, 1000 Berlin 30).