

Certified Reference Material (CRM)
Certificate of Chemical Analysis

CRM Steel-H2
(Alloyed Steel, 1.4546.9)

Laboratory means (4 values), mass content in mg/kg

| No. | H |
|------|------|
| 1 | 1.03 |
| 2 | 1.04 |
| 3 | 1.06 |
| 4 | 1.10 |
| 5 | 1.12 |
| 6 | 1.13 |
| 7 | 1.15 |
| 8 | 1.19 |
| 9 | 1.21 |
| 10 | 1.21 |
| 11 | 1.21 |
| 12 | 1.22 |
| 13 | 1.28 |
| 14 | 1.29 |
| 15 | 1.34 |
| 16 | 1.35 |
| 17 | 1.39 |
| 18 | 1.40 |
| 19 | 1.40 |
| 20 | 1.47 |
| 21 | 1.53 |
| 22 | 1.58 |
| M(M) | 1.26 |
| s(M) | 0.16 |
| s(w) | 0.09 |

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.

CERTIFIED VALUE (mass fraction in mg/kg)

| | H |
|---------------|------|
| M(M) | 1.26 |
| C(95%) | 0.07 |

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.

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

Berlin, July 2022

This certified reference material was produced and issued by Bundesanstalt für Materialforschung und -prüfung (BAM), after approval by all laboratories involved.

Description of the sample

The sample is available in the form of 1 g pins with a diameter of 6 mm. It is supplied in glass bottles containing 100 pins. The material has to be stored at $4\text{ °C} \pm 2\text{ °C}$ in a refrigerator.

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

Intended use & stability

This CRM 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.

It will remain stable, provided that the bottle remains sealed and is stored in a cool and dry atmosphere. The storage temperature has to be $4\text{ °C} \pm 2\text{ °C}$ (refrigerator). Before opening the bottle, it has to be warmed up to room temperature in a desiccator. After opening the bottle, the lid should be closed immediately after removal. Cleaning of the pins before analysis is strongly recommended. For this purpose, the pins are washed three times with isopropanol/acetone and then dried. Pre-cleaned tweezers should be used to handle the pins.

The certificate is valid until 31.12.2026.

Homogeneity

The homogeneity of the reference material was tested on 60 samples taken from the total batch.

Traceability

The traceability of CRM Steel-H2 has been established in accordance with principles of ISO Guides 30 – 35 and the international vocabulary of basic and general terms in metrology (VIM).

The characterisation of this material has been achieved by inter-laboratory study, each laboratory using the method of their choice, details of which are given above. These methods were either stoichiometric analytical techniques or methods calibrated with primary substances or with certified reference materials selected to be similar in composition to the CRM Steel-H2 (e.g., CRM Steel-H1).

Participating laboratories

AB Sandvik Materials Technology, Sandviken (Sweden)
 AG der Dillinger Hüttenwerke, Dillingen / Saar (Germany)
 Bruker AXS GmbH, Karlsruhe (Germany)
 Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin (Germany)
 Dirats Laboratories, Westfield, MA, (United States of America)
 Elementar Analysensysteme GmbH, Langenselbold (Germany)
 ESAB AB, Göteborg (Sweden)
 Evonik Operations GmbH, Hanau (Germany)
 Horn & Co. Analytics GmbH, Witten (Germany)
 Horn & Co. Analytics GmbH, Wetzlar (Germany)
 Horn & Co. Analytics GmbH, Siegen (Germany)
 Karlsruher Institut für Technologie (KIT), Eggenstein-Leopoldshafen (Germany)
 Plansee SE, Reutte (Austria)
 revierlabor, Essen (Germany)
 Saarstahl AG, Völklingen (Germany)
 SSAB, Raabe (Finland)
 ThyssenKrupp Steel AG, Duisburg (Germany)
 voestalpine Böhler Edelstahl GmbH & Co KG, Kapfenberg (Austria)
 voestalpine Stahl GmbH, Linz (Austria)

Methods used

| Element | Line number | Method/detection |
|---------|----------------------|--|
| H | 1, 4, 12, 18, 20 | Fusion / thermal conductivity Calibration with CRM Steel-H1 |
| | 2, 3, 10, 11, 13, 17 | Fusion / thermal conductivity Calibration with H ₂ /N ₂ |
| | 5, 6, 22 | Fusion / thermal conductivity Calibration with He |
| | 7, 14, 15, 19 | Fusion / thermal conductivity Calibration with CRM |
| | 8 | Fusion / thermal conductivity Calibration with TiH ₂ |
| | 9, 16 | Fusion / mass spectrometry Calibration with H ₂ /N ₂ |
| | 21 | Fusion / mass spectrometry Calibration with He |

Further information

Information and guidance on this or other certified reference materials or reference materials can be obtained at the address given above.

Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin



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