

**Brammer Standard Company, Inc.**

# Certificate of Analysis

**BS 253**

**Grade 253MA Alloy Steel Reference Material**

|                                      | Certified Value <sup>1</sup> | Estimate of Uncertainty <sup>2</sup> |           | Certified Value <sup>1</sup> | Estimate of Uncertainty <sup>2</sup> |
|--------------------------------------|------------------------------|--------------------------------------|-----------|------------------------------|--------------------------------------|
| Analysis listed as percent by weight |                              |                                      |           |                              |                                      |
| <b>C</b>                             | <b>0.094</b>                 | 0.005                                | <b>Co</b> | <b>0.15</b>                  | 0.01                                 |
| <b>Mn</b>                            | <b>0.58</b>                  | 0.01                                 | <b>N</b>  | <b>0.146</b>                 | 0.004                                |
| <b>P</b>                             | <b>0.018</b>                 | 0.002                                | <b>Nb</b> | <b>0.017</b>                 | 0.002                                |
| <b>S</b>                             | <b>&lt;0.001</b>             |                                      | <b>Sn</b> | <b>0.006</b>                 | 0.001                                |
| <b>Si</b>                            | <b>1.81</b>                  | 0.03                                 | <b>Ti</b> | <b>0.005</b>                 | 0.001                                |
| <b>Cu</b>                            | <b>0.14</b>                  | 0.01                                 | <b>V</b>  | <b>0.050</b>                 | 0.004                                |
| <b>Ni</b>                            | <b>10.89</b>                 | 0.08                                 | <b>W</b>  | <b>0.03</b>                  | 0.01                                 |
| <b>Cr</b>                            | <b>20.68</b>                 | 0.06                                 |           |                              |                                      |
| <b>Mo</b>                            | <b>0.21</b>                  | 0.01                                 |           |                              |                                      |
| <b>Al</b>                            | <b>0.016</b>                 | 0.002                                |           |                              |                                      |
| <b>As</b>                            | <b>0.005</b>                 | 0.0015                               |           |                              |                                      |
| <b>Ce</b>                            | <b>0.044</b>                 | 0.003                                |           |                              |                                      |

<sup>1</sup> The certified value listed is the present best estimate of the true value based on the results of an interlaboratory testing program.

<sup>2</sup> The uncertainties listed are based on value judgments of the material inhomogeneity and the 95% confidence interval. The half-width confidence interval C(95%) is shown on page 2.

See reverse side for more information.

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| Analysis  | * | C      | *  | Mn     | *  | P      | * | S       | *  | Si    | *  | Cu     | *   | Ni     | *  | Cr     | *  | Mo     |
|-----------|---|--------|----|--------|----|--------|---|---------|----|-------|----|--------|-----|--------|----|--------|----|--------|
| 1         | 7 | 0.0888 | 2  | 0.546  | 1  | 0.015  | 7 | 0.0001  | 2  | 1.760 | 2A | 0.128  | 47  | 10.82  | 2  | 20.60  | 47 | 0.2046 |
| 2         | 2 | 0.091  | 47 | 0.5651 | 47 | 0.0166 | 7 | 0.0001  | 47 | 1.77  | 4  | 0.130  | 18A | 10.821 | 47 | 20.60  | 2  | 0.208  |
| 3         | 7 | 0.091  | 30 | 0.566  | 47 | 0.018  | 7 | 0.0001  | 10 | 1.795 | 2  | 0.137  | 18  | 10.836 | 1  | 20.62  | 2A | 0.208  |
| 4         | 7 | 0.0915 | 30 | 0.566  | 47 | 0.019  | 7 | 0.0003  | 1  | 1.80  | 47 | 0.1398 | 18  | 10.837 | 1  | 20.64  | 1  | 0.213  |
| 5         | 7 | 0.0919 | 30 | 0.567  | 1  | 0.0191 | 7 | 0.0003  | 10 | 1.80  | 47 | 0.14   | 1   | 10.85  | 47 | 20.68  | 1  | 0.215  |
| 6         | 7 | 0.0946 | 2A | 0.570  | 2  | 0.0192 | 7 | 0.0004  | 10 | 1.813 | 1  | 0.144  | 47  | 10.85  | 42 | 20.68  | 1  | 0.216  |
| 7         | 7 | 0.0946 | 47 | 0.57   | 2  | 0.0196 | 7 | 0.0005  | 47 | 1.815 | 47 | 0.145  | 18  | 10.88  | 42 | 20.694 | 47 | 0.22   |
| 8         | 7 | 0.095  | 1  | 0.579  | 47 | 0.020  |   |         | 10 | 1.821 | 1  | 0.146  | 1   | 10.88  | 1  | 20.70  | 47 | 0.22   |
| 9         | 7 | 0.096  | 1  | 0.580  |    |        |   |         | 2  | 1.828 | 1  | 0.149  | 47  | 10.93  | 42 | 20.701 |    |        |
| 10        | 7 | 0.098  | 7  | 0.58   |    |        |   |         | 10 | 1.83  | 47 | 0.15   | 1   | 10.94  | 47 | 20.72  |    |        |
| 11        | 7 | 0.099  | 1  | 0.588  |    |        |   |         | 10 | 1.84  |    |        | 18  | 10.99  | 2A | 20.78  |    |        |
| 12        |   |        | 30 | 0.596  |    |        |   |         | 47 | 1.842 |    |        | 47  | 11.00  | 47 | 20.78  |    |        |
| 13        |   |        | 47 | 0.60   |    |        |   |         |    |       |    |        |     |        |    |        |    |        |
| Average   |   | 0.0938 |    | 0.575  |    | 0.0183 |   | 0.00026 |    | 1.810 |    | 0.141  |     | 10.886 |    | 20.683 |    | 0.213  |
| Std Dev   |   | 0.0032 |    | 0.014  |    | 0.0017 |   | 0.00016 |    | 0.026 |    | 0.007  |     | 0.064  |    | 0.061  |    | 0.006  |
| Certified |   | 0.094  |    | 0.58   |    | 0.018  |   | <0.001  |    | 1.81  |    | 0.14   |     | 10.89  |    | 20.68  |    | 0.21   |
| t         |   | 2.2281 |    | 2.1788 |    | 2.3646 |   | 2.4469  |    | 2.201 |    | 2.2622 |     | 2.201  |    | 2.201  |    | 2.3646 |
| C(95%)    |   | 0.0021 |    | 0.009  |    | 0.0014 |   | 0.00015 |    | 0.016 |    | 0.005  |     | 0.041  |    | 0.039  |    | 0.005  |

| Analysis  | *  | Al     | *  | As     | *  | Ce     | *  | Co     | *  | N      | *  | Nb     | *  | Sn     | *  | Ti     | *  | V      | *  | W      |
|-----------|----|--------|----|--------|----|--------|----|--------|----|--------|----|--------|----|--------|----|--------|----|--------|----|--------|
| 1         | 1  | 0.013  | 1  | 0.0038 | 48 | 0.042  | 32 | 0.138  | 11 | 0.1400 | 1  | 0.015  | 1  | 0.0049 | 2A | 0.0030 | 2A | 0.0426 | 47 | 0.026  |
| 2         | 1  | 0.014  | 8  | 0.0052 | 1  | 0.042  | 4  | 0.14   | 11 | 0.1447 | 36 | 0.015  | 1  | 0.005  | 2  | 0.0030 | 4  | 0.0426 | 1  | 0.026  |
| 3         | 2  | 0.014  | 2  | 0.0054 | 6  | 0.0439 | 2  | 0.144  | 11 | 0.146  | 1  | 0.0160 | 31 | 0.0053 | 1  | 0.005  | 47 | 0.048  | 47 | 0.0269 |
| 4         | 16 | 0.015  | 23 | 0.0054 | 1  | 0.0443 | 47 | 0.15   | 11 | 0.148  | 1  | 0.016  | 8  | 0.0054 | 1  | 0.005  | 47 | 0.049  | 1  | 0.027  |
| 5         | 1  | 0.015  | 1  | 0.007  | 1  | 0.046  | 1  | 0.153  | 11 | 0.148  | 2  | 0.0160 | 1  | 0.0054 | 1  | 0.005  | 2  | 0.0491 | 1  | 0.0271 |
| 6         | 1  | 0.0153 |    |        |    |        | 2A | 0.1542 | 11 | 0.1487 | 1  | 0.016  | 1  | 0.006  | 1  | 0.005  | 1  | 0.0497 | 47 | 0.028  |
| 7         | 1  | 0.016  |    |        |    |        | 1  | 0.156  | 11 | 0.149  | 2  | 0.0165 | 2  | 0.0060 | 1  | 0.0053 | 1  | 0.050  | 39 | 0.032  |
| 8         | 1  | 0.0163 |    |        |    |        | 1  | 0.158  | 1  | 0.017  | 2A | 0.0060 | 47 | 0.0055 | 1  | 0.0055 | 1  | 0.052  | 1  | 0.032  |
| 9         | 1  | 0.017  |    |        |    |        | 47 | 0.16   |    |        | 1  | 0.0174 | 1  | 0.006  | 1  | 0.0058 | 1  | 0.053  | 2  | 0.0401 |
| 10        | 2  | 0.0198 |    |        |    |        | 47 | 0.1719 |    |        | 1  | 0.0175 | 2  | 0.0078 | 1  | 0.0060 | 47 | 0.0556 |    |        |
| 11        |    |        |    |        |    |        |    |        |    |        | 47 | 0.019  | 8  | 0.0089 | 17 | 0.0062 | 27 | 0.056  |    |        |
| 12        |    |        |    |        |    |        |    |        |    |        | 1  | 0.020  |    |        | 2  | 0.007  |    |        |    |        |
| Average   |    | 0.0155 |    | 0.0054 |    | 0.0436 |    | 0.153  |    | 0.1463 |    | 0.0168 |    | 0.0061 |    | 0.0052 |    | 0.0498 |    | 0.0295 |
| Std Dev   |    | 0.0019 |    | 0.0011 |    | 0.0017 |    | 0.010  |    | 0.0032 |    | 0.0015 |    | 0.0012 |    | 0.0012 |    | 0.0044 |    | 0.0046 |
| Certified |    | 0.016  |    | 0.005  |    | 0.044  |    | 0.15   |    | 0.146  |    | 0.017  |    | 0.006  |    | 0.005  |    | 0.050  |    | 0.03   |
| t         |    | 2.2622 |    | 2.7764 |    | 2.7764 |    | 2.2622 |    | 2.4469 |    | 2.201  |    | 2.2281 |    | 2.201  |    | 2.2281 |    | 2.306  |
| C(95%)    |    | 0.0014 |    | 0.0014 |    | 0.0021 |    | 0.007  |    | 0.0030 |    | 0.0010 |    | 0.0008 |    | 0.0007 |    | 0.0030 |    | 0.0035 |

Data listed as mass fraction expressed as percent.

$C(95\%) = (t \times sd) / \sqrt{n}$  The half-width confidence interval, where  $t$  is the appropriate Student's  $t$  value,  $sd$  is the interlaboratory standard deviation, 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.

**Certification Process:** The requirements of ISO Guide 31, ISO Guide 34, ISO Guide 35, and ASTM Standard Guides E 1724 and E 1831 were followed for the preparation of this reference material and certificate of analysis. This is a reference material as defined by ISO Guide 30.

**Analysis:** Chemical analyses were made on chips prepared by a lathe from the certified portion of the bars in accordance with ASTM Standard Practice E 1806. The laboratories participating in the testing normally followed the requirements of ISO Guide 25. The individual values listed above are the average of each analyst's results. Methods of analysis used were a combination of ASTM Standard Methods E 350, E 353, and 1019 plus additional ICP and AA spectrometric methods.

**Outliers:** Some outlying data was excluded from the data listed above due to technical assessment of the cooperating laboratories and statistical evaluation.

**Homogeneity:** This Reference Material was tested for homogeneity using ASTM Standard Practice E 826 and found acceptable.

**Methods of Analysis**

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| Method Nr | Description.   |
|-----------|--|
| 1         | AES - ICP -Inductively Coupled Plasma  |
| 2         | AES - OES - Optical Emission   |
| 2A        | Average from XRF and AES-OES   |
| 4         | FAS - Atomic Absorption Spectrometry   |
| 6         | AES - DCP - Direct Current Plasma  |
| 7         | Combustion-Infrared Absorption   |
| 8         | Graphite Furnace Atomic Absorption Spectrometry                                  |
| 10        | Gravimetry with perchloric acid  |
| 11        | Inert gas Fusion Method  |
| 16        | MAS - Chromazurol S photometric after separation with cupferron                  |
| 18        | Dimethylglyoxime gravimetric   |
| 18A       | Average from EDTA, dimethylglyoxime gravimetric                                  |
| 23        | MAS - Molybdate test photometric method  |
| 27        | MAS - N-benzoyl phenylhydroxylamine-trichloromethane extraction photometric      |
| 30        | MAS - Periodate  |
| 31        | MAS - Phenylfluorone photometric   |
| 32        | MAS - Photometric with nitroso-R-sale  |
| 36        | MAS - Sulphochlorophenol S photometric   |
| 39        | MAS - Thiocyanate-chlorpromazine hydrochloride-chloroform extraction photometric |
| 42        | Peroxydisulfate oxidation titrimetric  |
| 47        | XRF spectrometric  |
| 48        | MAS - Chlorophosphonago mA photometric   |

AES = Atomic Emission Spectrometry

MAS = Molecular Absorption Spectrometry (photometric, spectrophotometric methods)

**Traceability:** This Reference Material was also examined by optical emission spectrometry and found to be compatible with the following Certified Reference Material: NIST SRM C1151, C1152, C1153, S 1154; SS 468/1.

The following Certified Reference Materials were used to validate the analytical data listed on page 2: NIST SRM 15h, 101e, 101f, 101g, 136e, 160b, 339, 341, 348a, 361, 367, 865, 1754; BCS 338; ECRM 284-1.

**Co-operating Laboratories:** Some of the co-operating laboratories were:

**Laboratory**

Allegheny Ludlum Corporation, Works Laboratory, Brackenridge, Pennsylvania  
Allegheny Ludlum Corporation, Analytical Services, Brackenridge, Pennsylvania  
Allavc, Lockport, New York  
ARMCO Inc, Research & Technology, Middletown, Ohio  
Brammer Standard Co., Inc., Houston, Texas  
China National Analysis Center for Iron and Steel, Beijing, China  
Crucible Specialty Steel, Syracuse, New York  
J. Dirats and Co., Inc., Westfield, Massachusetts  
IncoTest, Huntington, West Virginia  
Laboratory Testing, Inc., Dublin, Pennsylvania  
LECO Corporation, St. Joseph, Michigan  
Shiva Analyticals (India) Ltd., Hoskote, Bangalore, India  
The Timken Company, Canton, Ohio  
VHG Laboratories, Inc., Manchester, New Hampshire

**Laboratory contact**

Shawn Cooper  
Sally Bissell-Seymour  
Thomas Herdlein  
Howard Vail  
Richard Beaumont  
Prof. Wang Haizhou  
William Mastroe  
Eric C. Dirats  
R. E. Jackson  
Lee Dilks  
Dennis Lawrenz  
Dr. T. V. Ramakrishna  
Douglas Gapen  
Julie M. McIntosh

**Validity statement:** ISO Guide 31 requires that a validity period statement be included in the certificate of analysis. This Reference Material is valid indefinitely. The certification is nullified if this Reference Material is damaged, contaminated, or otherwise modified.

**Source:** This material was produced by Avesta Sheffield Bar Company, Richburg, South Carolina. The material was made in an electric arc furnace and cast into ingots. The bar stock was hot rolled and annealed.

**Available Form:** This Reference Material is available in the form of a disc, approximately 38 mm (1.50") in diameter and 12 mm (0.50") thick.

**Use:** This Reference Material is intended for use in optical emission and x-ray spectrometric methods of analysis. The entire depth of the disc may be used.

**Caution:** As with any bar material, avoid optical emission spectrometric burns in the center of the disc (5 mm radius), as some segregation may be present.

**Sample Preparation:** For best analytical results, use the same method for preparing the analytical surface on all reference materials as you use for production specimens. Avoid overheating the disc during surface preparation.

**Safety Notice:** A Material Safety Data Sheet (MSDS) is not required for this material. This material will not release or otherwise result in exposure to a hazardous chemical, under normal conditions of use. Inquiries concerning this Reference Material should be directed to:

Brammer Standard Co., Inc.  
14603 Benfer Road  
Houston, Texas 77069-2895 USA

Phone: (281) 440-9396

Fax: (281) 440-4432

Certified by: \_\_\_\_\_ on June 14, 2021.  
Beau R. Brammer

**Certificate Number 253-061421R1p4**

**By Certificate Number R-021, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9002 by the American Association for Laboratory Accreditation (A2LA).**

**Brammer Standard Company's Chemical Laboratory is accredited to ISO Guide 25 by A2LA.  
(Certificate Number 656.01)**

## **References:**

*ASTM documents available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959,  
Telephone: 610-832-9500 Fax: 610-832-9555 e-mail: service@astm.org Website: www.astm.org*

E 350 - 90 Standard Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

E 353-93 Standard Test Methods for Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

E 826 - 85 (Reapproved 1990) Standard Practice for Testing Homogeneity of Materials for the Development of Reference Materials

E 1019 - 93 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys

E 1724 - 95 Standard Guide for Testing and Certification of Metal and Metal-Related Reference Materials

E 1806 - 96 Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition

E 1831 - 96 Standard Guide for Preparing Certificates for Reference Materials Relating to Chemical Composition of Metals, Ores, and Related Materials.

*ISO Guides available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.*

ISO Guide 25 (Third edition, 1990), General requirements for the competence of calibration and testing laboratories.

ISO Guide 30 (Second edition, 1991), Terms and definitions used in connection with reference materials.

ISO Guide 31 (First edition, 1981), Contents of certificates of reference materials.

ISO Guide 33 (First edition, 1989), Uses of certified reference materials.

ISO Guide 34 (First edition, 1996), Quality system guidelines for the production of reference materials.

ISO Guide 35 (Second edition, 1989), Certification of reference materials - General and statistical principles.

*Other useful documents available from NIST, U.S. Department of Commerce, Gaithersburg, MD 20899.*

NIST Special Publication 260-100, Handbook for SRM Users

NIST Special Publication 829, Use of NIST Standard Reference Materials for Decisions on Performance of Analytical Chemical Methods and Laboratories

**Certificate Number 253-061421R1p5**