

**Brammer Standard Company, Inc.**  
**14603 Benfer Road**  
**Houston, Texas 77069 USA**

## **Certificate of Analysis**

**Reference Material for Carbon, Sulfur and Nitrogen  
in Low Alloy Steel**

Certified Values expressed as weight per cent

### **B.S. CSN-3**

|                 | <b>Certified<br/>Value</b> | <b>Estimate of<br/>Uncertainty</b> |
|-----------------|----------------------------|------------------------------------|
| <b>Carbon</b>   | <b>0.892</b>               | <b>±0.005</b>                      |
| <b>Sulfur</b>   | <b>0.0035</b>              | <b>±0.0002</b>                     |
| <b>Nitrogen</b> | <b>0.0047</b>              | <b>±0.0002</b>                     |

Owing to slight variations in pin weights, best precision and accuracy will be obtained by weighing each pin. See page 4 for a graph of pin weight distribution.

Certificate date: July 14, 1989

Certificate No. CSN3-071489

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## **PARTICIPATING LABORATORIES**

**Allegheny Ludlum Steel Corp., Brackenridge, PA**  
**Allegheny Ludlum Steel Corp., Lockport, NY**  
**Analytical Associates Inc., Detroit, MI**  
**Brammer Standard Company, Inc., Houston, TX**  
**Chicago Spectro Service Laboratory, Inc., Chicago, IL**  
**CyTemp Specialty Steel, Titusville, PA**  
**Jessop Steel Company, Washington, PA**  
**Midstates Analytical Laboratories, Inc., Tulsa, OK**  
**The Timken Company, Canton, OH**  
**VacAir Alloys Corp., Frewsburg, NY**

### **Cooperative Analysis**

Each participating laboratory received sets of test specimens identified only by random three-digit numbers. Each set consisted of the new Brammer Reference materials and Certified Reference Materials, as shown for the column headings in the following tables. The laboratories were requested to analyze the specimens in duplicate on two days. Each value shown in the bodies of the tables represents the arithmetic mean of all the results reported for that specimen by a particular laboratory.

### **Certificate Values**

The certified values were calculated after rejecting the highest and the lowest values reported for a given specimen and taking the arithmetic mean of the remaining values. The rejected values are not listed in the tables. NIST Standard Reference Materials and other Certified Reference Materials (CRMs) were analyzed as unknowns to validate this certification procedure.

Also included are the standard deviations of the results which are listed in the tables and an estimate of the 95% reliability intervals of the certified values. For a normal distribution, random error may be expected (on the average) to result in one measurement of twenty falling outside of the range defined by the mean plus or minus the 95% reliability interval.

### **Analytical Methods**

A superscript letter is used in the following tables to identify values found using alternative methods. Unless so indicated, all carbon and sulfur values were determined using the combustion/infra-red method and nitrogen was determined by inert gas fusion. The alternate methods were:

- a - Combustion/gas volumetric
- b - Combustion/titration (iodometric)

## Carbon

Summary for Carbon Analysis of CSN-3 and Certified Reference Materials

|                                 | CSN-3  | BAM 036-1 | BAM 126-1          | NBS 155 | NBS 363             |
|---------------------------------|--------|-----------|--------------------|---------|---------------------|
| 1                               | 0.8848 | 0.8460    | 0.8235             | 0.8915  | 0.6155              |
| 2                               | 0.8876 | 0.8470    | 0.8307             | 0.8958  | 0.6187              |
| 3                               | 0.8880 | 0.8528    | 0.8307             | 0.9008  | 0.6192              |
| 4                               | 0.8902 | 0.8553    | 0.8359             | 0.9018  | 0.6213              |
| 5                               | 0.8915 | 0.8625    | 0.8393             | 0.9047  | 0.6229              |
| 6                               | 0.9010 | 0.8628    | 0.8415             | 0.9065  | 0.6230 <sup>a</sup> |
| 7                               | 0.9010 | 0.8630    | 0.8415             | 0.9083  | 0.6300              |
| Average                         | 0.8920 | 0.8556    | 0.8347             | 0.9013  | 0.6215              |
| Standard Deviation <sup>b</sup> | 0.0060 | 0.0063    | 0.0067             | 0.0062  | 0.0054              |
| Uncertainty <sup>c</sup>        | 0.0053 | 0.0056    | 0.0059             | 0.0055  | 0.0048              |
| Certified Value                 |        | 0.858     | 0.841              | 0.905   | 0.62                |
| Uncertainty <sup>d</sup>        |        | 0.005     | 0.005 <sup>e</sup> | 0.002   | 0.01 <sup>e</sup>   |

## Sulfur

Summary for Sulfur Analysis of CSN-3 and Certified Reference Materials

|                                 | CSN-3(1st)          | CSN-3(2nd)          | EURO 184-1          | BAM 230-1           | NBS 363             |
|---------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| 1                               | 0.0031              | 0.0031              | 0.0025              | 0.0071              | 0.0062              |
| 2                               | 0.0031              | 0.0033              | 0.0029              | 0.0073 <sup>f</sup> | 0.0062 <sup>f</sup> |
| 3                               | 0.0033              | 0.0034              | 0.0030              | 0.0074              | 0.0062              |
| 4                               | 0.0034              | 0.0034              | 0.0031              | 0.0076              | 0.0067              |
| 5                               | 0.0036 <sup>f</sup> | 0.0036              | 0.0031              | 0.0076              | 0.0067              |
| 6                               | 0.0036              | 0.0040 <sup>f</sup> | 0.0033              | 0.0077              | 0.0070              |
| 7                               |                     | 0.0041              | 0.0040 <sup>f</sup> | 0.0081              | 0.0070              |
| 8                               |                     | 0.0045 <sup>f</sup> | 0.0041              | 0.0085 <sup>f</sup> | 0.0072              |
| Average                         |                     | 0.0035 <sup>g</sup> | 0.0033              | 0.0077              | 0.0067              |
| Standard Deviation <sup>b</sup> |                     | 0.0004 <sup>g</sup> | 0.0006              | 0.0005              | 0.0004              |
| Uncertainty <sup>c</sup>        |                     | 0.0002 <sup>g</sup> | 0.0005              | 0.0004              | 0.0003              |
| Certified Value                 |                     |                     | 0.0032              | 0.0072              | 0.0068              |
| Uncertainty <sup>d</sup>        |                     |                     | 0.0003              | 0.0009 <sup>c</sup> | 0.0002 <sup>e</sup> |

## Nitrogen

Summary for Nitrogen Analysis of CSN-3 and Certified Reference Materials

|                                 | CSN-3   | BAM 036-1 | BAM 039-2 |
|---------------------------------|---------|-----------|-----------|
| 1                               | 0.00450 | 0.01008   | 0.01140   |
| 2                               | 0.00460 | 0.01015   | 0.01140   |
| 3                               | 0.00467 | 0.01030   | 0.01150   |
| 4                               | 0.00473 | 0.01047   | 0.01162   |
| 5                               | 0.00478 | 0.01080   | 0.01200   |
| 6                               | 0.00493 | 0.01098   | 0.01200   |
| Average                         | 0.0047  | 0.0105    | 0.0117    |
| Standard Deviation <sup>b</sup> | 0.0002  | 0.0004    | 0.0002    |
| Uncertainty <sup>c</sup>        | 0.0002  | 0.0004    | 0.0002    |
| Certified Value                 |         | 0.0095    | 0.0113    |
| Uncertainty <sup>d</sup>        |         | 0.0007    | 0.0003    |

## Footnotes to Analysis Summary

- a) Analysis by combustion/gas volumetric instrument.
- b) Standard deviations were calculated by the method of Dean & Dixon, Anal. Chem 23, 636 (1951).
- c) Uncertainty is the 95% reliability interval calculated by the method of Dean & Dixon.
- d) Unless otherwise indicated, uncertainty is the 95% reliability interval calculated by the method of Dean & Dixon from data provided on the CRM Certificate.
- e) Uncertainty as stated on the CRM Certificate.
- f) Analysis by combustion/tritration (iodometric) instrument.
- g) This is the overall average of two sets of samples analyzed several months apart. The standard deviation is the usual estimate of the sample standard deviation. The uncertainty was calculated for the 95% level using the Student distribution (t), the estimated standard deviation (s), and the number of results (n), as  $ts/n^{0.5}$ .

### CSN-3 Pin Weight Distribution

