

**Brammer Standard Company, Inc.**  
**Certified Reference Material<sup>1</sup>**

**BS TRM-1**

	<b>Certified<sup>1</sup></b>	<b>Estimate of Material Uncertainty (U<sub>m</sub>)<sup>2</sup></b>	<b>Estimate of Measurement Uncertainty (U<sub>m</sub>)<sup>3</sup></b>
<b>Tensile Strength, ksi</b>	<b>93.3</b>	<b>0.3</b>	<b>2.1</b>
<b>Yield Strength, ksi</b>	<b>89.3</b>	<b>0.5</b>	<b>3.2</b>
<b>Total Elongation, %</b>	<b>15.6</b>	<b>0.2</b>	<b>1.6</b>
<b>Reduction, %</b>	<b>55.0</b>	<b>0.4</b>	<b>2.7</b>

<sup>1</sup> Brammer Standard Company, Inc., is accredited to ISO Guide 34 as a Reference Material Producer to produce Certified Reference Materials by A2LA (Certificate Number 656.02)

<sup>2</sup> The estimate of material uncertainty, U<sub>m</sub>, is calculated based on the results of an interlaboratory testing program. See formula listed on page 2.

<sup>3</sup> The estimate of measurement process uncertainty, U<sub>m</sub>, is based on the results of an interlaboratory testing program. See formula listed on page 2.

**Co-operating Laboratories:**

Analytical Process Laboratories, Milwaukee, Wisconsin  
 Bowser Morner, Inc., Dayton, Ohio  
 Inco Test, Huntington, West Virginia  
 Laboratory Testing Inc., Hatfield, Pennsylvania  
 Materials Technology Inc., Birmingham, Alabama  
 Metallurgical Services, Inc., Maywood, Illinois  
 Sherry Laboratories, Muncie, Indiana  
 Staveley Services Materials Testing, Glendale Heights, Illinois  
 Stork-Herron, Cleveland, Ohio  
 Stork-MMA Testing Labs, Inc., Newtown, Pennsylvania  
 Tensile Testing Metallurgical Laboratory, Cleveland, Ohio  
 US Inspection Services, Cleveland, Ohio  
 Wah Chang, Albany, Oregon

**Laboratory accreditation, certificate number**

A2LA 0431.02  
 A2LA 0071.04  
 NADCAP 00072-E  
 A2LA 177.02, NADCAP 0013-F  
 A2LA 878.01  
 A2LA 0510.01  
 A2LA 0174.02, NADCAP 0009  
 A2LA 0188.01  
 A2LA 0100.01  
 A2LA 0478.01  
 A2LA 0161.02, NADCAP 104682  
 A2LA 1704.06, NADCAP 0156  
 TUV CERT 74 100 7665A

See the following pages for more information.

Certificate Number TRM1-082003-p1

**Brammer Standard Company, Inc., 14603 Benfer Road, Houston, TX 77069-2895**  
**Telephone (281) 440-9396 Fax (281) 440-4432 [brammerstandard.com](http://brammerstandard.com)**

### Tensile Strength, ksi

Lab*	1st	2nd	3rd	4th	A <sub>L</sub>	A <sub>G</sub> -A <sub>L</sub>	S <sub>L</sub>
1	91.74	91.67	91.90	92.08	91.85	-1.46	0.18
2	93.18	92.64	91.91	90.07	91.95	-1.36	1.36
3	92.23	92.05	92.35	92.27	92.23	-1.08	0.13
4	93.83	93.80	93.47	92.32	93.36	0.05	0.71
5	93.47	93.48	93.67	92.95	93.39	0.08	0.31
6	94.62	94.19	93.54	91.80	93.54	0.23	1.24
7	94.27	93.83	93.64	93.59	93.83	0.52	0.31
8	93.31	93.58	94.11	94.63	93.91	0.60	0.58
9	94.36	93.91	94.00	93.50	93.94	0.63	0.35
10	93.08	93.21	94.86	94.76	93.98	0.67	0.96
11	94.27	94.66	94.11	94.66	94.42	1.11	0.28

$$A_G = 93.31$$

$$S_G = 1.06$$

$$N = 44$$

$$t(95) = 2.02$$

$$U_m = 2.14$$

$$U_M = 0.32$$

### Yield Strength, ksi

Lab*	1st	2nd	3rd	4th	A <sub>L</sub>	A <sub>G</sub> -A <sub>L</sub>	S <sub>L</sub>
1	86.88	86.74	86.62	88.41	87.16	-2.11	0.84
2	88.76	87.24	87.01	85.75	87.19	-2.08	1.24
3	90.19	89.53	87.46	87.24	88.61	-0.66	1.48
4	89.45	88.29	88.69	88.74	88.79	-0.48	0.48
5	90.79	89.92	88.78	86.25	88.94	-0.33	1.97
6	88.69	89.09	90.22	90.41	89.60	0.33	0.84
7	91.59	90.29	88.52	88.84	89.81	0.54	1.42
8	91.35	90.00	90.13	88.97	90.11	0.84	0.97
9	90.68	90.64	89.99	90.04	90.34	1.07	0.37
10	91.34	90.47	90.61	89.53	90.49	1.22	0.74
11	91.46	91.15	91.01	90.22	90.96	1.69	0.53

\* Lab number does not correspond with the list of cooperating labs on page 1.

$$A_G = 89.27$$

$$S_G = 1.56$$

$$N = 44$$

$$t(95) = 2.02$$

$$U_m = 3.15$$

$$U_M = 0.47$$

A<sub>L</sub> = the lab average. A<sub>L</sub> is calculated for each lab by summing the results and dividing by the number of determinations (4).

A<sub>G</sub> = the grand average. A<sub>G</sub> is calculated by summing the results for all determinations and all labs and dividing by the total number of determinations (44).

S<sub>L</sub> = the lab standard deviation. S<sub>L</sub> is calculated by taking the square of each determination's difference from the lab mean, summing these terms, and dividing by the number of determinations minus 1 and taking the square root of the resulting term.

S<sub>G</sub> = the grand standard deviation which is calculated similarly to S<sub>L</sub> except that all 44 data points are used.

N = number of measurements, 4 x 11 = 44, and N-1 = 43, t(95) = the t-statistic (coverage factor) for 95% confidence.

U<sub>m</sub> is a measure of how well the user can expect his system to perform.  $U_m = t(95) * S_G$

U<sub>M</sub> is a measure of how well this CRM is defined.  $U_M = U_m / \sqrt{N}$

**Percent Elongation**

Lab*	1st	2nd	3rd	4th	A <sub>L</sub>	A <sub>G</sub> -A <sub>L</sub>	S <sub>L</sub>
1	14.00	14.00	14.00	15.00	14.25	-1.00	0.50
2	14.10	15.40	15.40	13.40	14.57	-0.68	0.99
3	15.00	15.50	14.50	15.00	15.00	-0.25	0.41
4	15.00	15.50	14.50	15.00	15.00	-0.25	0.41
5	14.50	15.50	15.50	15.00	15.13	-0.12	0.48
6	15.50	14.00	15.50	15.50	15.13	-0.12	0.75
7	15.50	15.60	15.70	14.60	15.35	0.10	0.51
8	15.50	15.35	15.40	15.55	15.45	0.20	0.09
9	15.00	16.00	15.00	17.50	15.88	0.63	1.18
10	14.84	16.19	15.84	16.93	15.95	0.70	0.87
11	16.00	16.00	16.00	16.00	16.00	0.75	0.00

$$A_G = 15.55 \quad S_G = 0.80 \quad N = 44 \quad t(95) = 2.02 \quad U_m = 1.61 \quad U_M = 0.24$$

**Percent Reduction In Area**

Lab*	1st	2nd	3rd	4th	A <sub>L</sub>	A <sub>G</sub> -A <sub>L</sub>	S <sub>L</sub>
1	52.75	53.20	54.38	54.40	53.68	-1.36	0.83
2	54.47	53.20	52.18	56.10	53.99	-1.05	1.69
3	54.93	54.40	53.72	53.59	54.16	-0.88	0.63
4	52.87	54.85	55.33	54.17	54.30	-0.74	1.07
5	55.38	54.22	54.05	54.85	54.63	-0.41	0.61
6	53.00	56.00	54.00	56.00	54.75	-0.29	1.50
7	54.12	54.84	55.02	56.35	55.08	0.04	0.93
8	55.38	55.82	55.47	54.58	55.31	0.27	0.52
9	55.59	54.94	55.64	56.09	55.56	0.52	0.47
10	57.01	57.13	55.12	55.54	56.20	1.16	1.02
11	56.53	55.34	56.65	56.44	56.24	1.20	0.61
12	55.56	55.56	56.01	59.25	56.59	1.55	1.79

\* Lab number does not correspond with the list of cooperating labs on page 1.

$$A_G = 55.04 \quad S_G = 1.32 \quad N = 48 \quad t(95) = 2.01 \quad U_m = 2.66 \quad U_M = 0.38$$

Shaded results are those where insufficient raw data was supplied. Results are those reported by labs.

**Homogeneity:** A group of 32 twelve foot bars from the same production heat were sampled at the four foot and eight foot length of each bar producing 64 test samples. The 64 samples were sent to Staveley Services Materials Testing, in Glendale Heights, Illinois for machining and testing according to ASTM E 08-01. The data produced for tensile strength, yield strength, elongation, and reduction in area was processed using a modified version of ASTM Standard Method E 826 and all bars were found acceptable for use as a Certified Reference Material (CRM).

**Certification Process:** The requirements of ISO Guides 34 and 35 were followed for the preparation of this reference material and certificate of analysis. This is a Certified Reference Material as defined by ISO Guide 30.

**Testing Procedure:** A set of four 1.0 inch round by 6.25 inch long rods were sent to each of thirteen laboratories. The laboratories were instructed to machine the rods and test them using ASTM Standard Test Method E 08-01 and to report the yield strength, tensile strength, elongation, and reduction in area. The laboratories were asked to provide the raw data used in their calculations. The raw data was used to calculate table values unless otherwise noted.

**Outliers:** Some outlying data was excluded from the data listed on pages 2 and 3 due to technical assessment of the cooperating laboratories through statistical evaluation.

**Source:** This 1018 grade carbon steel CRM was produced by Republic Technologies International, Canton, Ohio. The material was melted by an electric arc furnace, aluminum killed, and processed with a cold drawn finish.

**Form:** This CRM is in the form of a rod, approximately 25.4 mm (1.0") diameter x 158 mm (6.25") long.

**Use:** This CRM is intended for use in tensile machine calibration verification and control charting.

**Sample Preparation:** Prepare using your normal procedure.

**Validity statement:** ISO Guide 31 states that the certification should contain an expiration date for all materials where instability has been demonstrated or is considered possible, after which the certified value is no longer guaranteed by the certifying body. Whereas this material is in a solid form and stable, no expiration date is specified.

**Certificate Number:** The unique identification number for this certificate of analysis is TRM1-082003-px, where x indicates the page number. You may also obtain information on revisions to this or other Brammer Standard materials from the internet at: [www.brammerstandard.com](http://www.brammerstandard.com)

**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 CRM should be directed to:

Brammer Standard Co., Inc. 14603 Benfer Road Houston, Texas 77069-2895 USA	Phone: (281) 440-9396 Fax: (281) 440-4432	web <a href="http://brammerstandard.com">brammerstandard.com</a> e-mail <a href="mailto:contact@brammerstandard.com">contact@brammerstandard.com</a>
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Prepared by: \_\_\_\_\_ on August 20, 2003.  
G. R. Brammer

**Brammer Standard Company, Inc., is accredited to ISO Guide 34 as a Reference Material Producer for the production of Certified Reference Materials and Reference Materials by A2LA (Certificate Number 656.02)  
The scope of accreditation is listed on the website: [www.brammerstandard.com](http://www.brammerstandard.com)**

**By Certificate Number 10539, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9002:1994 by National Quality Assurance, U.S.A.**

## 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](mailto:service@astm.org) Website: [www.astm.org](http://www.astm.org)*

E 8-01 Standard Test Methods for Tension Testing of Metallic Materials

E 826 - 85 (Reapproved 1996) Standard Practice for Testing Homogeneity of Materials for the Development of Reference Materials

*ISO Guides available from Global Engineering - [www.global.ihs.com](http://www.global.ihs.com)*

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

ISO Guide 31 (Second edition, 2000), Reference materials -Contents of certificates and labels.

ISO Guide 34 (Second edition, 2000), General requirements for the competence of reference material producers.

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

**Certificate Number TRM1-082003-p4**