Brammer Standard Company, Inc.

Certified Reference Material[1]

BS TRM-1A

	Certified[1]	Estimate of Material Uncertainty (U_M)[2]	Estimate of Measurement Uncertainty (U_m) [3]
Tensile Strength, ksi	**83.9**	**0.3**	**1.7**
Yield Strength, ksi	**70.2**	**0.2**	**1.5**
Total Elongation, %	**18.8**	**0.3**	**1.8**
Reduction, %	**56.9**	**0.5**	**3.2**

[1] 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)

[2] The estimate of material uncertainty, U_M, is calculated based on the results of an interlaboratory testing program. See formula listed on page 2.

[3] The estimate of measurement process uncertainty, U_m, is based on the results of an interlaboratory testing program. See formula listed on page 2.

Co-operating Laboratories:	**Laboratory accreditation, certificate number**
Analytical Process Laboratories, Milwaukee, Wisconsin	A2LA 0431.02
Bowser Morner, Inc., Dayton, Ohio	A2LA 0071.04
Inco Test, Huntington, West Virginia	NADCAP 00072-E
Laboratory Testing Inc., Hatfield, Pennsylvania	A2LA 177.02, NADCAP 0013-F
Materials Technology Inc., Birmingham, Alabama	A2LA 878.01
Metallurgical Services, Inc., Maywood, Illinois	A2LA 0510.01
Sherry Laboratories, Muncie, Indiana	A2LA 0174.02, NADCAP 0009
Stavley Services Materials Testing, Glendale Heights, Illinois	A2LA 0188.01
Stork-Herron, Cleveland, Ohio	A2LA 0100.01
Stork-MMA Testing Labs, Inc., Newtown, Pennsylvania	A2LA 0478.01
Tensile Testing Metallurgical Laboratory, Cleveland, Ohio	A2LA 0161.02, NADCAP 104684
US Inspection Services, Cleveland, Ohio	A2LA 1704.06, NADCAP 0156
Wah Chang, Albany, Oregon	TUV CERT 74 100 7665A

See the following pages for more information. **Certificate Number TRM1A-082003-p1**

Brammer Standard Company, Inc., 14603 Benfer Road, Houston, TX 77069-2895
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Tensile Strength, ksi

Lab*	1st	2nd	3rd	4th	A_L	A_G-A_L	S_L
1	83.11	82.87	83.04	82.84	82.96	-0.91	0.13
2	83.70	83.50	82.70	82.40	83.07	-0.80	0.62
3	83.50	82.97	83.04	82.98	83.12	-0.75	0.25
4	84.82	83.92	82.19	82.47	83.35	-0.52	1.24
5	83.69	83.53	83.51	83.31	83.51	-0.36	0.16
6	83.35	83.48	83.91	83.87	83.65	-0.22	0.28
7	84.79	83.95	84.35	84.13	84.30	0.43	0.37
8	84.53	84.44	84.58	84.48	84.51	0.64	0.06
9	84.77	84.60	84.26	84.60	84.56	0.69	0.21
10	85.67	84.59	83.50	84.86	84.66	0.79	0.89
11	84.86	85.25	84.82	84.45	84.85	0.98	0.33

A_G = 83.87 S_G = 0.84 N = 44 t(95) = 2.02 U_m = 1.69 U_M = 0.25

Yield Strength, ksi

Lab*	1st	2nd	3rd	4th	A_L	A_G-A_L	S_L
1	69.70	69.54	68.71	69.30	69.31	-0.94	0.43
2	69.87	70.14	69.49	69.40	69.72	-0.53	0.34
3	69.58	69.82	69.60	69.90	69.73	-0.52	0.16
4	69.60	69.37	69.82	70.54	69.83	-0.42	0.51
5	70.79	70.34	69.58	69.12	69.96	-0.29	0.75
6	69.88	70.22	70.24	70.11	70.11	-0.14	0.17
7	70.32	70.17	70.59	70.37	70.36	0.11	0.18
8	70.15	70.19	70.50	71.21	70.51	0.26	0.49
9	71.18	71.02	70.36	70.32	70.72	0.47	0.44
10	71.06	70.95	70.45	71.14	70.90	0.65	0.31
11	71.56	72.21	71.34	71.27	71.59	1.34	0.43

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

A_G = 70.25 S_G = 0.73 N = 44 t(95) = 2.02 U_m = 1.47 U_M = 0.22

A_L = the lab average. A_L is calculated for each lab by summing the results and dividing by the number of determinations (4).

A_G = the grand average. A_G is calculated by summing the results for all determinations and all labs and dividing by the total number of determinations (44).

S_L = the lab standard deviation. S_L 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 minus1and taking the square root of the resulting term.

S_G = the grand standard deviation which is calculated similarly to S_L 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_m is a measure of how well the user can expect his system to perform. $U_m = t(95) * S_G$

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

Percent Elongation

Lab*	1st	2nd	3rd	4th	A_L	A_G-A_L	S_L
1	17.70	17.35	17.25	17.30	17.40	-1.36	0.20
2	16.50	17.50	18.50	18.50	17.75	-1.01	0.96
3	18.90	18.80	16.70	19.20	18.40	-0.36	1.15
4	19.00	19.00	18.50	18.00	18.63	-0.13	0.48
5	19.00	19.00	19.00	18.00	18.75	-0.01	0.50
6	18.50	19.00	18.50	19.00	18.75	-0.01	0.29
7	20.00	19.00	19.50	17.00	18.88	0.12	1.31
8	18.65	19.10	18.65	19.10	18.88	0.12	0.26
9	19.00	19.05	18.85	18.80	18.92	0.16	0.12
10	19.00	20.00	19.00	19.00	19.25	0.49	0.50
11	19.47	19.22	19.07	19.22	19.25	0.49	0.17
12	20.18	20.30	17.07	20.32	19.47	0.71	1.60
13	19.50	19.00	20.00	19.50	19.50	0.74	0.41

$A_G = 18.76$ $S_G = 0.90$ $N = 52$ $t(95) = 2.01$ $U_m = 1.81$ $U_M = 0.25$

Percent Reduction In Area

Lab*	1st	2nd	3rd	4th	A_L	A_G-A_L	S_L
1	55.38	55.20	53.51	55.38	54.87	-2.07	0.91
2	55.01	55.46	55.01	54.55	55.01	-1.93	0.37
3	57.00	56.00	56.00	55.00	56.00	-0.94	0.82
4	56.61	56.08	55.38	57.13	56.30	-0.64	0.75
5	56.65	57.33	57.35	57.19	57.13	0.19	0.33
6	57.47	57.04	57.04	57.21	57.19	0.25	0.20
7	56.06	57.46	56.75	58.80	57.27	0.33	1.17
8	59.65	61.03	55.64	55.02	57.84	0.90	2.96
9	58.65	59.71	56.90	56.63	57.97	1.03	1.47
10	58.56	58.51	56.71	58.47	58.06	1.12	0.90
11	58.53	59.11	58.60	58.53	58.69	1.75	0.28

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

$A_G = 56.94$ $S_G = 1.59$ $N = 44$ $t(95) = 2.02$ $U_m = 3.21$ $U_M = 0.48$

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

Homogeneity: A group of 22 twelve foot bars from the same production heat were sampled at the four foot and eight foot length of each bar producing 44 test samples. The 44 samples were obtained by Tensile Testing Laboratories in Cleveland, Ohio 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 16 bars were found acceptable for use as a Certified Reference Material (CRM). The 6 nonconforming bars have been tagged and stored in a separate area from the 16 acceptable bars.

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. Also available are commercially machined 0.505 inch specimens fabricated in accordance to the specifications of ASTM E08-01, Figure 9, Specimen 1. Fabrication was performed at an ISO and NADCAP approved facility.

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 TRM1A-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

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. Phone: (281) 440-9396 web brammerstandard.com
14603 Benfer Road
Houston, Texas 77069-2895 USA Fax: (281) 440-4432 e-mail contact@brammerstandard.com

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

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 Website: 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

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.