

# BRAMMER STANDARD COMPANY, INC.

## Certificate of Analysis

### BS TRM-3

Certified Reference Material for Stainless Steel Grade 304 - UNS Number S30400

	Certified Value <sup>1</sup>	Estimate of Material Uncertainty ( $U_M$ ) <sup>2</sup>	Estimate of Measurement Uncertainty ( $U_m$ ) <sup>3</sup>
<b>Tensile Strength, ksi</b>	<b>98.2</b>	<b>0.6</b>	<b>5.5</b>
<b>Yield Strength, ksi</b>	<b>44.7</b>	<b>0.3</b>	<b>3.1</b>
<b>Total Elongation, %</b>	<b>52.0</b>	<b>1.2</b>	<b>10.8</b>
<b>Reduction, %</b>	<b>57.1</b>	<b>1.9</b>	<b>17.3</b>
<b>Hardness, HRB<sup>4</sup></b>	<b>86.3</b>	<b>0.7</b>	<b>6.3</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,  $U_M$ , is calculated based on the results of an interlaboratory testing program. See formula listed on page 3.

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

<sup>4</sup> Hardness determined by the Rockwell B scale; 100 kgf 1/16" diameter.

The requirements of ISO Guides 31, 34, and 35 were followed for the preparation of this Certified Reference Material and certificate of analysis. This is a Certified Reference Material as defined by ISO Guide 30.

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Analysis	Tensile	Yield	Elongation	RofA	Hardness
1	94.86	45.252	48.8	49.4	92.2
2	94.871	44.376	47.6	45.8	90.3
3	95.037	44.452	49.6	49	92
4	95.046	44.984	49.0	45.9	92
5	95.052	44.635	49.2	51	90
6	95.695	44.541	49.6	47.9	92.5
7	95.75	46.2	49.00	55.72	83.525
8	95.853	44.744	47.0	45.7	90.9
9	95.873	44.78	47.8	43.5	92.8
10	96.003	45.323	47.8	46.7	90
11	96.078	45.2	47.6	49.2	92.6
12	96.12	44.76	50.23	56.55	84.475
13	96.195	45.218	47.2	43	89.3
14	96.257	44.639	48.2	53.1	92.1
15	96.29	45.39	48.75	54.62	83.975
16	96.376	45.206	48.3	50.6	91.3
17	96.47	44.82	48.2	50.3	92.2
18	96.54	46	48.27	53.86	84.475
19	96.55	44.41	51.10	55.88	83.725
20	96.58	46.78	49.08	55.24	84.425
21	96.66	46.27	50.15	56.92	84
22	96.781	45.201	49.2	49.6	92.6
23	96.83	46.29	48.75	56.34	84.2
24	96.859	44.819	48.6	43.9	91.5
25	96.9	45.87	49.65	55.93	83.775
26	96.91	46.51	49.45	55.76	84.3
27	96.94	45.16	49.02	55.64	84.375
28	96.953	46.653	48.6	46.5	91.2
29	96.97	44.73	48.35	54.62	84.375
30	96.99	44.94	49.35	54.29	83.975
31	97	46.16	47.67	55.01	84.25
32	97.004	44.91	48.4	43.8	92.7
33	97.01	44.99	49.60	55.19	84.375
34	97.03	44.26	48.83	55.76	83.9
35	97.04	46	48.20	57.76	83.45
36	97.04	45.43	49.65	54.21	84.2
37	97.1	46.74	48.15	54.56	84.15
38	97.1	46.55	49.87	55.21	84.35
39	97.103	45.426	48.6	43.3	91.3
40	97.12	46.05	47.83	56.42	84.4

Analysis	Tensile	Yield	Elongation	RofA	Hardness
41	97.15	44.96	49.12	55.76	84.475
42	97.16	46.64	48.50	54.4	83.375
43	97.16	45.09	49.73	56.62	84
44	97.16	44.75	49.20	55.31	83.65
45	97.19	44.69	49.80	57.51	84.2
46	97.21	45.26	49.20	54.07	83.975
47	97.24	44.85	49.45	57.28	83.125
48	97.25	45.07	48.42	56.35	83.6
49	97.27	45.8	48.60	54.88	84.4
50	97.281	45.259	49.2	45.4	92.5
51	97.3	46.22	49.87	54.97	83.675
52	97.34	44.77	49.37	54.83	84.125
53	97.36	46.48	48.95	57.58	84.45
54	97.37	46.64	49.62	55.10	84.175
55	97.39	44.78	49.02	55.53	84.475
56	97.48	45.21	48.25	54.58	84.05
57	97.5	47.9	48.50	55.24	84.55
58	97.52	44.97	49.25	55.13	84.4
59	97.53	46.36	49.37	55.76	84.275
60	97.57	46.54	49.12	56.55	84.425
61	101.3	42.5	60.5	71.3	85
62	101.7	42.6	60.5	68.4	86
63	101.7	41.9	62.0	70.9	85.2
64	101.9	41.4	62.0	78.5	85
65	102.1	41.7	61.5	68.8	85
66	102.1	42.9	61.5	70.3	85
67	102.6	42.9	61.5	65.8	86
68	102.6	39.3	60.5	70.4	86
69	102.6	40.9	60.5	70.2	85.4
70	102.7	42.8	60.5	65.4	86
71	102.9	42.5	61.0	73.9	85.6
72	103	42.6	61.5	63.7	85.4
73	103.2	43.2	61.0	71.4	86
74	103.4	43.4	62.0	67.5	85.6
75	103.4	42.6	62.0	69	86
76	103.5	43.2	61.5	68.9	85.6
77	103.6	42.7	61.0	75.4	86
78	103.6	42.1	61.0	69.1	85.4
79	103.8	43.4	62.0	71.7	86
80	104.2	44.3	61.5	75.2	85.6

	Tensile	Yield	Elongation	RofA	Hardness
<b>Average</b>	98.24	44.70	51.98	57.15	86.35
<b>Std Dev</b>	2.75	1.57	5.45	8.71	3.17
<b>t(95)</b>	1.99	1.99	1.99	1.99	1.99
<b>Cert</b>	<b>98.2</b>	<b>44.7</b>	<b>52.0</b>	<b>57.1</b>	<b>86.3</b>
<b>U<sub>M</sub></b>	0.6	0.3	1.2	1.9	0.7
<b>U<sub>m</sub></b>	5.5	3.1	10.8	17.3	6.3

Average = is calculated by summing the results for all determinations and dividing by the total number of determinations.

Std Dev = standard deviation is calculated by taking the square of each determination, summing these terms, and dividing by the number of determinations minus 1 and taking the square root of the resulting term.

N = number of measurements.

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.  $U_m = t(95) * \text{Std Dev}$

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

<u>Laboratory</u>	<u>Location</u>	<u>Registrar</u>	<u>Accreditation</u>
Exova	Glenadale Heights, IL	A2LA	17025
Laboratory Testing, Inc.	Hatfield, PA	PRI/Nadcap	17025
Tensile Testing Metallurgical Laboratory	Cleveland, OH	A2LA	17025

A2LA = American Association for Laboratory Accreditation

Nadcap = National Aerospace and Defense Contractors Accreditation Program

PRI = Performance Review Institute

**Analysis:** Tensile testing was performed on samples prepared by machining from representative samples of the certified portion of the lot in accordance with ASTM Standard Test Method E8/E8M. The laboratories participating in the testing followed the requirements of ISO Standard 17025.

**Traceability:** No Certified Reference Materials were used to validate the analytical data listed on page 2. Traceability is to the calibration of the testing equipment, which meets ISO 17025 requirements.

**Homogeneity:** This Certified Reference Material (CRM) was tested for homogeneity using a modified version of ASTM Standard Method E 826 and found acceptable.

**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. The certification of BS TRM-3-012715 is valid indefinitely. The certification is nullified if this CRM is damaged, contaminated, or otherwise modified.

**Source:** The sheet stock for this CRM was produced by Dependable Stamping Company, Cleveland, OH.

**Form:** This CRM is machined in the form of a sheet, approximately 30 cm by 30 cm by Dependable Stamping Company.

**Use:** This CRM is intended for use in tensile testing methods of analysis. Refer to ISO Guide 33 for information about the use of Certified Reference Materials.

**Certified Area:** The entirety of the CRM may be used.

**Sample Preparation:** For best analytical results, use the same method for preparing CRMs as you use for production specimens. Avoid overheating the sample during preparation as this can cause a change in the measured properties.

**Certificate Number:** The unique identification number for this certificate of analysis is TRM-3-012715. You may obtain information on revisions of certificates 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 CRM 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:

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Houston, Texas 77069-2895 USA

Phone: (281) 440-9396    Web: [www.brammerstandard.com](http://www.brammerstandard.com)  
Fax: (281) 440-4432    Email: [contact@brammerstandard.com](mailto:contact@brammerstandard.com)

**Brammer Standard Company, Inc., is accredited by the American Association For Laboratory Accreditation (A2LA) to ISO Guide 34 as a Reference Material Producer for the production of Certified Reference Materials and Reference Materials (Certificate Number 656.02)**

**Brammer Standard Company's Chemical Laboratory is accredited by A2LA to ISO Standard 17025. (Certificate Number 656.01)**

**By Certificate Number 10539, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9001:2008 by National Quality Assurance (NQA), U.S.A.**

The scopes of accreditation are listed on the website: [www.brammerstandard.com](http://www.brammerstandard.com)

### **References:**

Versions used were those available at the time of testing and characterization

E 826            Standard Practice for Testing Homogeneity of a Metal Lot or Batch in Solid Form by Spark Atomic Emission Spectrometry

E 8/E 8M        Standard Test Methods for Tension Testing of Metallic Materials

ISO Standard 17025:2005    General requirements for the competence of testing and calibration laboratories

ISO Standard 9001:2008    Quality Management Systems - Requirements

ISO Guide 30:1992    Terms and definitions used in connection with reference materials + 2008 amendment

ISO Guide 31:2000    Reference materials - Contents of certificates and labels

ISO Guide 33:2000    Uses of certified reference materials

ISO Guide 34:2009    General requirements for the competence of reference material producers

ISO Guide 35:2006    Reference Materials - General and statistical principles for certification

*ASTM documents available from ASTM, 1916 Race Street, Philadelphia, PA, 19103.*

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

*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

Certified by: \_\_\_\_\_ on January 23, 2015.

Beau R. Brammer