

BRAMMER STANDARD COMPANY, INC.

Certificate of Analysis

BS TRM-4

Certified Reference Material for Aluminum Grade 5052 - UNS Number A95052

	Certified Value ¹	Estimate of Material Uncertainty (U_M) ²	Estimate of Measurement Uncertainty (U_m) ³
Tenile Strength, ksi	36.0	0.1	0.8
Yield Strength, ksi	28.4	0.1	0.7
Total Elongation, %	11.4	0.1	1.1
Reduction, %⁴	(37.0)	---	---
Hardness, HR15T⁵	71.9	0.6	5.4

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 3.

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

⁴ Values in parentheses are not certified and are provided for information only.

⁵ Hardness determined by the Rockwell 15T scale; 15 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	35.4	28.18	11.22	30.43	73.575
2	35.44	28.29	11.62	30.88	73.275
3	35.45	28.48	10.97	30.38	73.625
4	35.48	28.56	11.78	29.24	74.15
5	35.48	28.33	10.82	27.46	73.875
6	35.5	28.42	10.87	27.83	73.825
7	35.5	28.55	11.40	30.33	74.775
8	35.51	28.33	10.85	30.68	73.825
9	35.54	28.2	12.15	29.86	73.675
10	35.56	28.41	11.87	29.00	73.925
11	35.57	28.38	11.10	30.91	74.225
12	35.59	28.56	11.72	32.36	74.6
13	35.609	28.187	10.8	19.4	67.5
14	35.61	28.41	11.57	28.73	73.95
15	35.63	28.41	12.12	32.43	73.725
16	35.63	28.5	11.75	30.36	73.675
17	35.64	28.31	12.35	30.14	73.9
18	35.64	28.3	10.78	31.76	74.025
19	35.64	28.49	11.07	31.75	73.3
20	35.64	28.27	11.40	30.34	73.95
21	35.66	28.177	12.1	19.4	67.3
22	35.66	28.4	11.32	26.57	73.35
23	35.67	28.49	11.37	30.51	73.525
24	35.683	28.551	10.8	18.5	67.6
25	35.71	28.2	12.43	33.20	73.85
26	35.71	28.22	11.78	29.82	73.55
27	35.71	28.73	11.53	29.87	73.875
28	35.72	28.58	10.85	28.54	73.8
29	35.72	28.27	12.20	31.35	73.85
30	35.74	28.56	11.25	31.01	73.8
31	35.74	28.39	11.20	30.61	73.625
32	35.748	28.291	11.6	14.2	67.4
33	35.75	28.35	11.35	30.43	73.225
34	35.75	28.78	11.10	29.28	73.75
35	35.75	28.65	11.72	30.43	73.95
36	35.78	28.76	11.25	28.95	73.475
37	35.78	28.76	11.60	29.87	73.925
38	35.789	28.769	10.2	14.5	67.5
39	35.818	28.485	10.4	21.8	67.3
40	35.84	28.61	12.55	31.95	73.625

Analysis	Tensile	Yield	Elongation	RofA	Hardness
41	35.85	28.56	10.75	30.19	73.75
42	35.867	28.769	10.2	18	67.4
43	35.87	28.335	12.6	24.4	67.1
44	35.87	29.04	10.75	28.26	73.95
45	35.89	28.82	11.53	30.13	74.275
46	35.894	28.566	12.0	14.7	67.3
47	35.899	28.668	11.4	20.3	67.4
48	35.9	28.38	11.82	31.92	74.025
49	35.968	28.584	11.8	18.2	67.3
50	35.978	28.715	11.4	17.1	67.3
51	35.987	28.456	11.2	14.6	67.2
52	36.027	28.786	10.8	16.4	67.5
53	36.04	28.77	11.53	31.1	74
54	36.052	28.831	10.4	16.7	67.2
55	36.064	28.351	11.4	17.2	67.2
56	36.07	28.76	11.30	30.83	73.6
57	36.073	28.688	10.5	43.6	67.5
58	36.115	28.755	11.4	16.2	67.5
59	36.143	28.494	12.0	43.6	67.2
60	36.236	28.611	11.8	17.9	67.4
61	36.4	28.6	11.0	67.5	72
62	36.4	27.9	10.5	67.7	72.8
63	36.5	28.6	11.0	66.2	72.6
64	36.5	28	11.5	66.9	72.6
65	36.5	27.7	12.0	66.6	72.8
66	36.5	28.3	11.5	67	72.6
67	36.6	28.1	11.5	66.7	73
68	36.6	28.3	11.0	67.6	72.8
69	36.6	27	12.0	66.7	73
70	36.6	28.1	12.0	67.8	72.8
71	36.6	28.7	11.5	67.8	72.8
72	36.6	28.4	11.5	67.9	73
73	36.7	27.5	10.0	67.4	72
74	36.7	28.8	12.0	68.1	73
75	36.7	28.5	11.5	67.2	73.4
76	36.7	27.2	11.5	66.3	72.2
77	36.7	28	11.0	66.7	73
78	36.8	28.8	11.5	68.2	73.2
79	36.8	29.1	11.5	67.4	72.8
80	37	27.9	11.5	67.4	73

	Tensile	Yield	Elongation	RofA	Hardness
Average	35.98	28.43	11.39	37.02	71.94
Std Dev	0.42	0.35	0.55	18.52	2.71
t(95)	1.99	1.99	1.99	1.99	1.99
Cert	36.0	28.4	11.4	(37.0)	71.9
U_M	0.1	0.1	0.1		0.6
U_m	0.8	0.7	1.1		5.4

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 E826 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-4-021315 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-4-021315. You may obtain information on revisions of certificates from the internet at 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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Phone: (281) 440-9396 Web: www.brammerstandard.com
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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

References:

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

E826 Standard Practice for Testing Homogeneity of a Metal Lot or Batch in Solid Form by Spark Atomic Emission Spectrometry

E8/E8M 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

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 February 13, 2015.

Beau R. Brammer