

# Certificate of Analysis

BS 2992

Certified Reference Material<sup>1</sup> for AISI Steel Alloy Number 8620  
(UNS Number G86200)

	Certified Value <sup>2</sup>	Estimate of Uncertainty <sup>3</sup>	Certified Value <sup>2</sup>	Estimate of Uncertainty <sup>3</sup>
Analysis listed as percent by weight				
<b>C</b>	<b>0.195</b>	0.003	<b>O</b>	<b>0.0028</b> 0.0004
<b>Mn</b>	<b>0.72</b>	0.01	<b>Sn</b>	<b>0.0017</b> 0.0004
<b>P</b>	<b>0.008</b>	0.001	<b>V</b>	<b>0.001</b> 0.0005
<b>S</b>	<b>0.011</b>	0.001		
<b>Si</b>	<b>0.210</b>	0.006		
<b>Cu</b>	<b>0.026</b>	0.002		
<b>Ni</b>	<b>0.47</b>	0.01	<b>Information Values<sup>4</sup></b>	
<b>Cr</b>	<b>0.53</b>	0.007	<b>B</b>	0.0002
<b>Mo</b>	<b>0.164</b>	0.003	<b>Ca</b>	0.0005
<b>Al</b>	<b>0.036</b>	0.002	<b>Mg</b>	0.0001
<b>As</b>	<b>0.003</b>	0.001	<b>Ti</b>	0.0007
<b>Co</b>	<b>0.010</b>	0.001		
<b>N</b>	<b>0.0042</b>	0.0003		

<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 certified value listed is the present best estimate of the true value based on the results of an interlaboratory testing program.

<sup>3</sup> The uncertainties listed are based on value judgments of the material inhomogeneity and the 95% confidence interval. The half-width confidence interval C(95%) is shown on page 2.

<sup>4</sup> Information values are not certified and are provided for information only.

See the following pages for more information.

Certificate Number 2992-032201p1

Analysis	*	C	* Mn	* P	* S	* Si	* Cu	* Ni	* Cr	* Mo
1	C	0.190	MnP 0.7012	MPH 0.0062	C 0.009	AIC 0.196	MCT 0.024	MND 0.458	AAH 0.524	AIC 0.156
2	C	0.191	AIC 0.712	AIC 0.0065	C 0.010	AA 0.201	ECS 0.0242	AIC 0.462	AIC 0.525	AES 0.160
3	C	0.193	AIC 0.712	AIC 0.007	C 0.0101	AIC 0.202	MCB 0.0244	AIC 0.466	AES 0.526	AIC 0.161
4	C	0.193	AA 0.716	AIC 0.007	C 0.0105	AIC 0.203	AIC 0.025	GNi 0.4677	AIC 0.527	GMO 0.161
5	C	0.193	AES 0.716	AIC 0.0071	AES 0.0108	AIC 0.204	AIC 0.025	AIC 0.468	TCr 0.5285	AIC 0.163
6	C	0.193	MnP 0.719	AES 0.0072	AES 0.0110	GSi 0.205	IN 0.025	AIC 0.469	AIC 0.529	MMO 0.163
7	C	0.194	MnP 0.720	MPN 0.0072	C 0.0112	MSi 0.207	AAH 0.025	AES 0.469	AIC 0.529	AIC 0.163
8	C	0.195	MnP 0.720	AIC 0.0073	C 0.0113	GSi 0.207	AIC 0.0254	AIC 0.47	MDC 0.530	AGA 0.163
9	C	0.196	AGD 0.721	AIC 0.0075	C 0.0113	AIC 0.209	AIC 0.0258	AIC 0.470	AIC 0.530	AIC 0.163
10	C	0.1969	AIC 0.721	AIC 0.0076	AGA 0.0115	AES 0.209	MCB 0.026	AIC 0.47	AIC 0.530	AIC 0.164
11	C	0.197	AIC 0.722	AIC 0.0080	C 0.0115	GSi 0.211	AIC 0.026	AGA 0.472	AGA 0.530	AAH 0.164
12	C	0.197	AES 0.723	AGA 0.0080	CP 0.0115	AGA 0.211	AIC 0.026	AIC 0.475	TCr 0.531	AIC 0.165
13	C	0.1972	AIC 0.724	AES 0.008	C 0.012	GSi 0.214	AIC 0.0262	AA 0.475	AES 0.532	AA 0.165
14	C	0.198	AAH 0.725	AIC 0.008	C 0.0120	AIC 0.215	AGA 0.027	AES 0.477	AA 0.532	AIC 0.165
15	C	0.1983	AIC 0.727	AIC 0.0082	C 0.012	AIC 0.215	AIC 0.027	AA 0.477	AIC 0.532	AIC 0.165
16	CP	0.1987	AIC 0.728	AIC 0.0083	C 0.0121	AIC 0.215	AA 0.0273	AIC 0.477	AA 0.533	MMO 0.166
17	AGD	0.199	AIC 0.73	MPN 0.0083	C 0.0122	AES 0.216	AIC 0.0280	AIC 0.477	AIC 0.536	MMO 0.167
18			AIC 0.73	AIC 0.0084	C 0.0125	GSi 0.218	AIC 0.028	AIC 0.481	AIC 0.538	AIC 0.167
19			MnP 0.732	AIC 0.009	C 0.013	AIC 0.219	AES 0.028	AIC 0.484	AIC 0.54	AES 0.168
20			AIC 0.733			AIC 0.219	AES 0.0288	AAH 0.489	AIC 0.54	AIC 0.168
21			AIC 0.743				AIC 0.029	AA 0.49	AA 0.54	AIC 0.168
22			AA 0.751				MCT 0.030	MND 0.494	AIC 0.543	AA 0.169
Average		0.1953	0.724	0.0076	0.0113	0.2098	0.0264	0.474	0.532	0.1643
Std Dev		0.0028	0.011	0.0007	0.0010	0.0066	0.0017	0.009	0.005	0.0031
Certified		0.195	0.72	0.008	0.011	0.210	0.026	0.47	0.53	0.164
# Labs		17	22	19	19	20	22	22	22	22
t		2.1199	2.0796	2.1009	2.1009	2.093	2.0796	2.0796	2.0796	2.0796
C(95%)		0.0014	0.005	0.0003	0.0005	0.0031	0.0007	0.004	0.002	0.0014

Analysis	*	Al	* As	* Co	* N	* O	* Sn	* V
1	AIC	0.032	AIC 0.0018	AIC 0.0096	FU 0.0036	FU 0.0024	MSn 0.0012	AIC 0.001
2	AIC	0.0332	AAH 0.002	AIC 0.0096	FU 0.0039	FU 0.0025	AIC 0.0013	AIC 0.001
3	AIC	0.034	AIM 0.0022	AAA 0.0097	FU 0.0039	FU 0.0025	AIC 0.0013	AIC 0.001
4	AAA	0.0343	AIC 0.0024	AIC 0.0101	FU 0.0040	FU 0.0025	AAG 0.0015	AIC 0.0011
5	AIC	0.0346	MAD 0.0025	AES 0.0101	FU 0.0041	FU 0.0029	AIC 0.0016	AES 0.0011
6	AIC	0.035	AES 0.0026	AIC 0.0102	FU 0.0041	FU 0.0029	AIM 0.0016	AIC 0.0012
7	AIC	0.035	AIC 0.0028	AAG 0.0102	FU 0.0041	FU 0.0030	AAG 0.0019	IN 0.0012
8	AIC	0.035	AAH 0.0030	IN 0.0103	FU 0.0042	FU 0.0031	AGA 0.0019	AA 0.0012
9	AIC	0.0354	AIC 0.0033	AES 0.0106	FU 0.0043	FU 0.0034	AA 0.0021	AIC 0.0014
10	AIC	0.036	AAG 0.0033	AIH 0.0107	FU 0.0043		AES 0.0022	MVE 0.0014
11	AES	0.036	AIC 0.0033	AA 0.0109	FU 0.0044		AAG 0.0023	AIC 0.0016
12	AIC	0.0360	AES 0.0035	AIC 0.0110	FU 0.0044			AIC 0.0016
13	AIC	0.0363	AAG 0.0037	AIC 0.0111	FU 0.00449			AIC 0.0017
14	AGA	0.0364	AIH 0.0038	AIC 0.0111	FUP 0.0046			AIC 0.0020
15	AES	0.0365	AES 0.004	AIC 0.0115	FU 0.0047			AES 0.002
16	AIC	0.0366	IN 0.0043					AIC 0.0023
17	MCC	0.0370						
18	AIC	0.0373						
19	AA	0.0375						
Average		0.0355	0.0030	0.0104	0.00421	0.00280	0.00172	0.0014
Std Dev		0.0014	0.0007	0.0006	0.00029	0.00034	0.00038	0.0004
Certified		0.036	0.003	0.010	0.0042	0.0028	0.0017	0.001
# Labs		19	16	15	15	9	11	16
t		2.1009	2.1315	2.1448	2.1448	2.306	2.2281	2.1315
C(95%)		0.0007	0.0004	0.0003	0.00016	0.00026	0.00026	0.0002

Analysis	*	B	* Ca	* Mg	* Ti
1	AIC	0.00015	AES 0.00049	AES 0.00007	AES 0.0004
2	AES	0.0002	AA 0.00033	AIC 0.0001	AIC 0.0004
3			AIC 0.0002		AIC 0.0004
4			AIC 0.0006		AIC 0.0009
5			AIC 0.0007		AIC 0.0012
Average		0.00018	0.00046	0.00009	0.00066
Std Dev		0.00004	0.00020	0.00002	0.00037
Certified		(0.0002)	(0.0005)	(0.0001)	(0.0007)

\* Methods of analysis listed on page 3

Data in parentheses are not certified but are provided for information only.

$C(95\%) = (t \times sd) / n$  The half-width confidence interval, where  $t$  is the appropriate Student's  $t$  value,  $sd$  is the interlaboratory standard deviation, and  $n$  is the number of acceptable mean values. For further information regarding the confidence interval for the certified value see ISO Guide 35:1989 section 4.

## Methods of Analysis

Code	Element	Method
AA		Flame Atomic Absorption Spectrometry
AAA		Flame Atomic Absorption - standard addition method
AAG		Electro-thermal atomization (graphite furnace) Atomic Absorption Spectrometry
AAH		Flame Atomic Absorption Spectrometry with hydride generation
AES		AES - Spark Source Optical Emission Spectrometry
AGA		AES - Spark Source and Glow Discharge Spectrometry average
AGD		AES - GD - Glow Discharge Spectrometry
AIC		AES - ICP -Inductively Coupled Plasma Spectrometry
AIH		AES - ICP -Inductively Coupled Plasma Spectrometry after hydride generation
AIM		AES - ICP Mass Spectrometry addition method
C	C, S	Combustion-Infrared Absorption (ASTM E 1019) traceable to CRMs
CP	C, S	Combustion-Infrared Absorption traceable to pure substances
ECS	Cu	Sulphide precipitation, electro- deposition, gravimetric
FU	N, O	Inert gas Fusion Method (ASTM E 1019) traceable to CRMs
FUP	N	Inert gas Fusion Method traceable to pure substances
GMo	Mo	Gravimetry, Benzolnoxime
GNi	Ni	Dimethylglyoxime gravimetric
GSi	Si	Gravimetry with perchloric acid
IN		INAA - Neutron Activation Analysis
MAD	As	MAS - Molybdenum blue photometric after separation by distillation
MCB	Cu	MAS - Bicyclohexane oxalyldihydrazone photometric
MCC	Al	MAS - Chromazurol S photometric after separation with cupferron
MCT	Cu	MAS - Tetraethylthiuram disulphide
MDC	Cr	MAS - Diphenyl carbazide
MMo	Mo	MAS - Thiocyanate after extraction with butyl acetate
MND	Ni	MAS - Dimethylglyoxime photometric
MnP	Mn	MAS - Potassium periodate oxidation photometric
MPH	P	MAS - Heteropoly molybdenum blue spectrophotometry
MPN	P	MAS - n-butyl alcohol-trichloromethane extraction photometric
MSi	Si	MAS - Molybdenum blue photometric method (ASTM E350)
MSn	Sn	MAS - Phenylfluorone photometric
MVE	V	MAS - n-benzoyl phenylhydroxylamine extraction photometric
TCr	Cr	Perodisulphate oxidation titration

AES = Atomic Emission Spectrometry

MAS = Molecular Absorption Spectrometry (photometric, spectrophotometric methods)

**Co-operating Laboratories:** The co-operating laboratories were:

### Laboratory

AK Steel Research, Middletown, Ohio  
 Analytical Associates, Detroit, Michigan  
 ANAREM, Prague, Czech Republic  
 Brammer Standard Co., Inc., Houston, Texas  
 China National Analysis Center for Iron and Steel, Beijing, China  
 Crucible Specialty Steel, Syracuse, New York  
 J. Dirats and Co., Inc., Westfield, Massachusetts  
 Hoesch Stahl AG, Dortmund, Germany  
 IncoTest, Huntington, West Virginia  
 LECO Corporation, St. Joseph, Michigan  
 Shiva Technologies West, Morgan Hill, California  
 Shiva Analyticals (India) Ltd., Hoskote, Bangalore, India  
 VHG Laboratories, Inc., Manchester, New Hampshire

### Laboratory contact

Howard P. Vail  
 Charles Deak (retired)  
 Karel Bi ovsk  
 Richard P. Beaumont  
 Prof. Wang Haizhou  
 William Mastroe  
 Eric E. Dirats  
 Dr. Ohls  
 Melissa G. Staley  
 Dennis Lawrenz  
 Timothy A. West  
 Dr. T. V. Ramakrishna  
 Julie M. McIntosh

**Additional analytical data:** This material was used as an unknown test specimen in a nationally recognized Proficiency Testing Program (PTP) for low-alloy steel. Most of the participating laboratories used one or more of the ASTM Standard Test Methods E 322, E 415, E 1019, and E 1085. The PTP data was not used in calculating the certified values listed on pages 1 and 2. The data shown below are the results from the PTP.

Combustion Instrument Analysis using ASTM Standard Test Method E 1019

	C	S	N	O
Number of Labs	60	57	46	31
Grand Average	0.1970	0.0113	0.0040	0.0028
Standard Deviation	0.0053	0.0012	0.0004	0.0006

Optical Emission Spectrometric Analysis using ASTM Standard Test Method E 415

	C	Mn	P	S	Si	Cu	Ni	N
Number of Labs	74	83	84	82	85	74	79	12
Grand Average	0.1997	0.7168	0.0084	0.0123	0.2121	0.0264	0.4745	0.0043
Standard Deviation	0.0067	0.0124	0.0009	0.0013	0.0071	0.0024	0.0154	0.0004
	Cr	Mo	Al	Co	Sn	Ti	V	
Number of Labs	82	82	78	48	62	61	72	
Grand Average	0.5282	0.1662	0.0358	0.0104	0.0020	0.0014	0.0021	
Standard Deviation	0.0115	0.0058	0.0022	0.0007	0.0005	0.0006	0.0009	

X-ray Emission Spectrometric Analysis using ASTM Standard Test Method E 322

	Mn	Cu	Ni	Cr	Mo	V
Number of Labs	9	8	10	9	10	7
Grand Average	0.7194	0.0272	0.4610	0.5332	0.1639	0.0021
Standard Deviation	0.0155	0.0015	0.0066	0.0153	0.0031	0.0010

X-ray Emission Spectrometric Analysis using ASTM Standard Test Method E 1085

	Mn	P	Si	Cu	Ni	Cr	Mo	V	Co
Number of Labs	9	6	8	7	8	8	8	5	4
Grand Average	0.7134	0.0089	0.2133	0.0268	0.4650	0.5343	0.1626	0.0018	0.0111
Standard Deviation	0.0094	0.0016	0.0093	0.0019	0.0043	0.0073	0.0031	0.0011	0.0011

**Certification Process:** The requirements of ISO Guide 31, ISO Guide 34, ISO Guide 35, and ASTM Standard Guides E 1724 and E 1831 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.

**Analysis:** Chemical analyses were made on chips prepared by a lathe from the certified portion of the discs in accordance with ASTM Standard Practice E 1806. The laboratories participating in the testing normally followed the requirements of ISO Guide 25 and/or ISO Standard 17025. Individual values listed on page 2 are the average of each analyst's results. Methods of analysis used were a combination of ASTM Standard Test Method E 1019 and E 415 plus additional ICP and AA spectrometric methods.

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

**Traceability:** The following Certified Reference Materials were used to validate the analytical data listed on page 2: SRM 19h, 30f, 32b, 33c, 33d, 36a, 36b, 73 c, 100b, 106b, 131e, 132a, 135, 139b, 166b, 293, 343a, 361, 362, 1754, 1762, 1764, 2166, 2167; ECRM 061-1, 088-1; CKD 180, 181, 186, 188.

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**Homogeneity:** This Reference Material was tested for homogeneity using ASTM Standard Method E 826 and found acceptable. It was also examined by optical emission spectrometry using ASTM Standard Test Method E 415 and found to be compatible with the following Reference Materials: SRM: C1173, 1261a, 1262a, 1263a, 1264a, 1265a, 1761, 1762, 1763, 1764, 1765, 1766, 1767; ECRM 186-1, 191-1; SS 457/1, 458/1; JSS 169-4, 170-6, 171-4.

**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.

**Source:** This material was produced by North Star Steel, Monroe, Michigan. It was melted by an electric arc furnace, aluminum killed, bottom poured into ingots, hot rolled, and finished with a normalized heat treatment.

**Form:** This Reference Material is in the form of a disc, approximately 38 mm in diameter and 19 mm thick.

**Use:** This Reference Material is intended for use in optical emission and x-ray spectrometric methods of analysis. Refer to ISO Guide 33 for information about the use of Reference Materials.

**Certified area:** The entire depth of the disc may be used.

**Caution:** As with any bar material, avoid optical emission spectrometric burns in the center of the disc (5 mm radius), as some segregation may be present.

**Sample Preparation:** For best analytical results, use the same method for preparing the analytical surface on all reference materials as you use for production specimens. Avoid overheating the disc during surface preparation.

**Certificate Number:** The unique identification number for this certificate of analysis is 2992-032201-px, where x indicates the page number. Refer to future Brammer Standard Company catalogs for information on any revisions to this or other Brammer Standard reference materials. You may also obtain information on revisions of certificates from the internet at [brammerstandard.com](http://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 Reference Material 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:bramstan@netropolis.net">bramstan@netropolis.net</a>
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Certified by: \_\_\_\_\_ on March 22, 2001.  
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.**

**Brammer Standard Company's Chemical Laboratory is accredited to ISO Guide 25 by A2LA. (Certificate Number 656.01)**

## **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 322 - 96 Standard Test Method for X-Ray Emission Spectrometric Analysis of Low-Alloy Steels and Cast Irons

E 415 - 85 (Reapproved 1999) Standard Test Method for Optical Emission Vacuum Spectrometric Analysis of Carbon and Low-Alloy Steel

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

E 1019 - 2000 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys

E 1085 - 95 Standard Test Method for X-Ray Emission Spectrometric Analysis of Low-Alloy Steels

E 1724 - 95 Standard Guide for Testing and Certification of Metal and Metal-Related Reference Materials

E 1806 - 96 Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition

E 1831 - 96 Standard Guide for Preparing Certificates for Reference Materials Relating to Chemical Composition of Metals, Ores, and Related Materials.

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

ISO Standard 17025 (First edition, 1999), General requirements for the competence of calibration and testing laboratories.

ISO Guide 25 (Third edition, 1990), General requirements for the competence of calibration and testing laboratories.

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 33 (Second edition, 2000), Uses of certified reference materials.

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.

*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

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