Brammer Standard Company, Inc.

Certificate of Analysis

B.S. 4150 MOD

Reference Material for Modified AISI Steel Grade 4150 with Bismuth and Sulfur addition

	Certified Value[1]	Estimate of Uncertainty[2]		Certified Value[1]	Estimate of Uncertainty[2]
		Analysis listed as percent by weight			
C	**0.47**	0.008	**As**	**0.005**	0.001
Mn	**0.90**	0.015	**Ca**	**0.0010**	0.0002
P	**0.024**	0.001	**Co**	**0.012**	0.001
S	**0.079**	0.002	**N**	**0.0087**	0.0004
Si	**0.21**	0.01	**Pb**	**0.0010**	0.0003
Cu	**0.19**	0.01	**Sn**	**0.013**	0.002
Ni	**0.15**	0.01	**V**	**0.008**	0.002
Cr	**1.01**	0.01			
Mo	**0.21**	0.01	Informational values[3]		
Al	**0.012**	0.002	O	(0.003)	
Bi	**0.070**	0.004	Ti	(0.002)	

[1] The certified value listed is the present best estimate of the true value based on the results of an interlaboratory testing program.

[2] The uncertainties listed are based on value judgments of the material inhomogeneity and possible bias in the determined analytical values. No attempt is made to derive exact statistical measurements of imprecision because several methods were used in the determination of most constituents.

[3] Data in parentheses are not certified and are provided for information only.

The requirements of ISO Guide 31 and ISO Guide 35 were generally followed for the preparation of this reference material and certificate of analysis. This is a reference material as defined by ISO Guide 30.

See reverse side for more information.

Certificate Number 4150MOD-020195

Brammer Standard Company, Inc., 14603 Benfer Road, Houston, TX 77069-2895
Telephone (281) 440-9396 Fax (281) 440-4432

BS 4150 MOD Certificate Number 4150MOD-020195

Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al	Bi
1	0.462	0.88	0.0229	0.077	0.198	0.178	0.143	1.00	0.209	0.0105	0.066
2	0.463	0.885	0.023	0.0772	0.20	0.18	0.148	1.002	0.209	0.012	0.068
3	0.467	0.888	0.0235	0.0775	0.20	0.185	0.15	1.002	0.21	0.0122	0.069
4	0.471	0.893	0.0235	0.0778	0.202	0.186	0.15	1.005	0.21	0.0127	0.070
5	0.472	0.894	0.024	0.0780	0.203	0.188	0.152	1.006	0.211	0.013	0.0703
6	0.472	0.91	0.0240	0.079	0.204	0.189	0.152	1.008	0.214	0.0135	0.071
7	0.474	0.915	0.0245	0.079	0.209	0.190	0.154	1.009	0.220		0.0715
8	0.475		0.026	0.0794	0.21	0.20	0.154	1.01	0.22		0.0719
9	0.476		0.026	0.0798	0.212	0.20	0.157	1.014	0.22		0.0733
10	0.476			0.080	0.218		0.160	1.019	0.221		0.074
11	0.477			0.0805	0.22		0.16				
12				0.081	0.22		0.16				
13					0.230						
Average	0.4714	0.895	0.0242	0.0789	0.210	0.188	0.153	1.008	0.214	0.0123	0.0705
Std Dev	0.0052	0.013	0.0012	0.0013	0.010	0.008	0.005	0.006	0.005	0.0010	0.0024
Certified	0.471	0.90	0.024	0.079	0.21	0.19	0.15	1.01	0.21	0.012	0.070

Analysis	As	Ca	Co	N	Pb	Sn	V	O	Ti
1	0.0035	0.00087	0.011	0.0083	0.00086	0.0118	0.006	0.0018	0.0017
2	0.0042	0.0009	0.012	0.0085	0.0009	0.012	0.0065	0.0020	0.0022
3	0.0052	0.00111	0.0122	0.0085	0.00094	0.0120	0.007	0.0024	0.0026
4	0.006	0.00116	0.0126	0.0088	0.0012	0.0126	0.007	0.0035	0.003
5	0.0060		0.013	0.0089		0.0128	0.0078	0.0036	
6			0.013	0.0090		0.0135	0.0078		
7			0.013			0.0145	0.009		
8						0.015	0.010		
Average	0.0050	0.00101	0.0124	0.00867	0.0010	0.0130	0.0076	0.0027	0.0024
Std Dev	0.0011	0.00015	0.0007	0.00027	0.0002	0.0012	0.0013	0.0008	0.0006
Certified	0.005	0.0010	0.012	0.0087	0.0010	0.013	0.008	(0.003)	(0.002)

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

Analysis: Chemical analyses were made on chips prepared by a lathe from the certified portion of the discs. The laboratories participating in the testing normally followed the requirements of ISO Guide 25. The individual values listed above are the average of each analyst's results. Methods of analysis used were a combination of ASTM Standard Methods E 350, E 415, and E 1019, plus additional ICP and AA spectrometric methods.

Co-operating Laboratories: Some of the co-operating laboratories were:

Analytical Associates, Inc., Detroit, Michigan
ANAREM, Prague, Czech Republic
Brammer Standard Co., Inc., Houston, Texas
Coleman Testing Laboratories, Riverside, New Jersey
Copperweld Steel Company, Warren, Ohio
Crucible Specialty Steel, Syracuse, New York
J. Dirats and Co., Inc., Westfield, Massachusetts
Laboratory Testing Inc., Dublin, Pennsylvania
LECO Corporation, St. Joseph, Michigan
Ledoux & Company, Teaneck, New Jersey
Andrew S. McCreath & Son, Inc., Harrisburg, Pennsylvania
Shiva Technologies, Inc., Cicero, New York
Spectrochemical Laboratories, Inc., Pittsburgh, Pennsylvania
VHG Laboratories, Inc., Manchester, New Hampshire

Homogeneity: This Reference Material was tested for homogeneity using ASTM Standard Practice E 826 and found acceptable.

Traceability: This Reference Material was also examined by optical emission spectrometry and found to be compatible with the following Certified Reference Materials: NIST SRM C1273, 1261A to 1265A, 1761 to 1767. The following Certified Reference Materials were used to validate the analytical data listed on page 2: NIST SRM 13g, 30f, 32e, 125b, 291, 361 to 365; BAM 039-2, 044-1; BCS 455/1, 456/1, 458/1; ECRM 085-1, 088-1, 096-1, 097-1, 184-1; GBW 01402; IMZ 1.22/3.

Source: This material was produced by Copperweld Steel Company, Warren, Ohio. The material was made in an electric arc furnace and cast into ingots. The bar stock was hot rolled and annealed.

Available Form: This Reference Material is available in the form of a disc, approximately 38 mm (1.50") in diameter and 12 mm (0.50") thick. It is also available in a special set of 7 mm thick discs.

Use: This Reference Material is intended for use in optical emission and x-ray spectrometric methods of analysis. 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.

Because this Reference Material contains bismuth, care must be taken in its application. Several bismuth measurements may be required to calculate an accurate average concentration.

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.

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

Certified by: _____ on February 1, 1995.
G. R. Brammer

Certificate Number 4150MOD-020195

References:

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

E 322 - 67 (Reapproved 1990) Standard Method for X-Ray Emission Spectrometric Analysis of Low-Alloy Steels and Cast Irons

E 350 - 90 Standard Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

E 415 - 85 (Reapproved 1995) Standard Test Method for Optical Emission Vacuum Spectrometric Analysis of Carbon and Low-Alloy Steel

E 826 - 85 (Reapproved 1990) Standard Practice for Testing Homogeneity of Materials for the Development of Reference Materials

E 1019-93 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys

ISO Guides available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

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 (First edition, 1981), Contents of certificates of reference materials.

ISO Guide 33 (First edition, 1989), Uses of certified reference materials.

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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