Analytical Reference Materials International

Certificate of Analysis
Certified Reference Material

Grade: **AISI 347 / UNS S34700**

Part Number (Q.A. NO.): **IARM 8H**

Certificate Date: **07/24/2017** Certificate No.: **8H-07242017-IARM-P** Revision Date: **07/24/2017**

Interpretation of Data

1. Certified values listed below reflect analysis results submitted by qualified analytical laboratories using a combination of methods and instrumentation that emulate actual methods and instrumental techniques currently utilized in the analytical community and are reported as % wt. unless otherwise noted.
2. Any data reported and enclosed by a **parentheses ( ) is a "best estimate" and is NOT CERTIFIED**. This data could not be quantified sufficiently for certification. It was however, reported by enough laboratories to be considered as potentially present in the matrix of the material being examined.
3. The "Inter laboratory Analysis Program" (ILAP) utilized in the establishment of the data are an ongoing program with permanent membership. Certain elements may be selected by a consensus of the members for more extensive testing. Therefore the data in **brackets [ ] indicates further testing is in process.**
   Chips are not certified for Oxygen analysis.
4. The "**±Estimated Uncertainty**" is enclosed by a **parentheses ( ) below** the individual **element's concentration** and is based on a Confidence Interval at 95%. Included in this estimated uncertainty, are the combined effects of method imprecision, material inhomogeneity, and any bias between methods.

Important: **A "User Registration Card" accompanies all shipments. This card should be completed immediately upon receipt of materials with the appropriate user information. This is the only way in which ARMI can guarantee customer updates or possible data modifications!**

Aluminum	Antimony	Arsenic	Boron	Calcium	Carbon	Chromium	Cobalt	Copper
0.005	(<0.002)	(<0.01)	(0.0002)	(<0.002)	0.049	17.14	0.083	0.192
(0.001)					(0.001)	(0.04)	(0.002)	(0.007)
Lead	**Magnesium**	**Manganese**	**Molybdenum**	**Nickel**	**Niobium**	**Nitrogen**	**Oxygen**	**Phosphorus**
(<0.03)	(<0.001)	1.81	0.237	9.08	0.48	0.027	(0.004)	0.0250
		(0.02)	(0.004)	(0.03)	(0.02)	(0.001)		(0.0007)
Selenium	**Silicon**	**Sulfur**	**Tantalum**	**Tin**	**Titanium**	**Tungsten**	**Vanadium**	**Zinc**
(<0.001)	0.40	0.002	(0.01)	0.008	0.0027	0.016	0.049	(<0.001)
	(0.01)	(0.001)		(0.002)	(0.0005)	(0.004)	(0.003)	
Zirconium								
(<0.002)								

The laboratories participating in the "Inter-Laboratory Analysis Program" (ILAP) and certification of this material are as follows:

Anderson Laboratories, Inc. - Greendale, WI
Carpenter Technology, Athens Operations - Tanner, AL
Chicago Spectro Service Laboratories - Chicago, IL
Crucible Industries - Syracuse, NY
Exova Burlington Lab - Burlington, ON
Kennametal Stellite, Inc. - Belleville, ON
Laboratory Testing, Inc. - Hatfield, PA
Latrobe Specialty Metals - Latrobe, PA
TimkenSteel Corporation - Canton, OH

Traceability: All members of the "Inter-Laboratory Analysis Program" (ILAP) listed above validate test methods and instrument performance utilizing SRMs produced by the National Institute of Standards and Technology, (NIST) as well as other CRMs and RMs produced by recognized Certifying Bodies from around the world. The specific SRMs, CRMs, and RMs applicable to the material covered by this certificate are:

ALPHA AR 667	BAS 409/1	BS 189	CZECH 189A	IARM 8A	JSS 192-1	JSS ST04-5	NIST 1162	NIST 1263	NIST 345A	SU 304-1
ALPHA AR 874	BAS 410/2	BS 316	ECRM 0971	IARM 8B	JSS 193-1	JSS ST05-5	NIST 1163	NIST 1264	NIST 361	SU 304-2
ALPHA AR1652	BAS 421	BS 347C	ELTRA A1100-1004	IARM 8C	JSS 194-1	LECO 501-502	NIST 1164	NIST 1754	NIST 444	SU 304-3
ALPHA AR654	BAS 422	BS 3952	IARM 152A	IARM 8D	JSS 195-1	LECO 501-503	NIST 1171	NIST 1760	NIST C1151	SU 304-5
ALPHA AR871	BAS 465/1	BS 4142SE	IARM 152B	IARM 8E	JSS 650-11	LECO 501-645	NIST 1172	NIST 1761	NIST C1152	SU 304-7
BAS 401/1	BAS 466/1	BS 81N	IARM 154A	IARM 8F	JSS 651-11	LECO 502-328	NIST 1185	NIST 1762	NIST C1153	
BAS 401/2	BAS 467/1	BS 84J	IARM 16C	IARM 9A	JSS 652-11	LECO 502-459	NIST 121D	NIST 1763	NIST C1154	
BAS 402/1	BAS 65	BS 98	IARM 21A	IARM 9C	JSS 653-11	MBH 12X353	NIST 1230	NIST 1764	NIST C1173	
BAS 403/1	BCS 467-1	BS CA316-4	IARM 2C	JSS 172-4	JSS 654-11	NBS 1155	NIST 123B	NIST 1764A	NIST C1287	
BAS 404/1	BCS 474	CZECH 181A	IARM 302B	JSS 173-4	JSS 655-11	NIST 101G	NIST 1260	NIST 1765	NIST C1288	
BAS 405/1	BCS 475	CZECH 186A	IARM 327A	JSS 174-4	JSS ST01	NIST 1152	NIST 1261	NIST 1766	NIST C1289	
BAS 406/1	BNS 15B	CZECH 187A	IARM 4C	JSS 175-4	JSS ST01-5	NIST 1155	NIST 1261A	NIST 1767	NIST C2400	
BAS 407/2	BS 13B	CZECH 187B	IARM 5G	JSS 190-1	JSS ST02-5	NIST 1160	NIST 1262	NIST 2166	NIST C2401	
BAS 408/1	BS 156	CZECH 188A	IARM 6A	JSS 191-1	JSS ST03-5	NIST 1161	NIST 1262B	NIST 339	NIST D846	

A specific line of traceability is established to NIST and other Certifying Bodies for those elements that are noted as "Certified Values" on the Certificates of Analyses referenced above.

See Reverse Side for Statistical Data and Additional Information Regarding this Material.

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The following data and accompanying statements represent all pertinent information reported in the ILAP as it applies to the chemical characterization of this material as of 07/24/2017.

8H	Al	Sb	As	B	Ca	C	Cr	Co	Cu	Pb	Mg	Mn	Mo	Ni	Nb	N
1	0.0015	0.0013	0.0054	0.0001	0.0010	0.0457	17.033	0.080	0.1764	0.0005	0.0008	1.7537	0.2290	9.01	0.449	0.0251
2	0.0036		0.008	0.0001	0.00104	0.0457	17.05	0.08	0.1813	0.001		1.780	0.232	9.049	0.4516	0.02583
3	0.004			0.0001		0.046	17.0904	0.0805	0.185	0.0240		1.79	0.233	9.0502	0.4528	0.0265
4	0.0045			0.00018		0.0477	17.1174	0.0815	0.186			1.802	0.234	9.0526	0.4636	0.027
5	0.0045			0.0004		0.049	17.1342	0.0830	0.188			1.807	0.234	9.070	0.4647	0.0280
6	0.005			0.0005		0.0496	17.14	0.0838	0.1889			1.807	0.2355	9.082	0.465	0.0282
7	0.005			<0.0005		0.0499	17.153	0.085	0.1906			1.8131	0.2382	9.086	0.465	0.029
8	0.0060					0.050	17.154	0.085	0.195			1.8165	0.240	9.090	0.474	
9	0.006					0.0502	17.188	0.0863	0.196			1.823	0.242	9.1026	0.485	
10	0.0062					0.0505	17.217	0.089	0.207			1.8261	0.244	9.136	0.49	
11						0.0512	17.255		0.2123			1.83	0.2480	9.14	0.5107	
12						0.0520						1.841			0.5317	
13																
14																
15																
Mean	0.005	0.001	0.007	0.0002	0.0010	0.049	17.14	0.083	0.192	0.009	0.001	1.81	0.237	9.08	0.48	0.027
STDV.	0.001		0.002	0.0002	0.0000	0.002	0.07	0.003	0.011	0.013		0.02	0.006	0.04	0.03	0.001
Certified	**0.005**	**(<0.002)**	**(<0.01)**	**(0.0002)**	**(<0.002)**	**0.049**	**17.14**	**0.083**	**0.192**	**(<0.03)**	**(<0.001)**	**1.81**	**0.237**	**9.08**	**0.48**	**0.027**
95% C.I.	0.001					0.001	0.04	0.002	0.007			0.02	0.004	0.03	0.02	0.001
Methods	X,O,I	X	X,O	O,I	O	O,C	X,W,O,I	X,O,I	X,O,I	O		X,O,I	X,O,I	X,O,I	X,O,I	F

Legend: W = Classical, C = Combustion, F = Fusion, A = AA or GFAA, I = ICP or DCP, IM=ICP-MS, D = DC Arc, O = AES, X = XRF, G = GDAES or GDMS, H = Hollow Cathode AES

8H	O	P	Se	Si	S	Ta	Sn	Ti	W	V	Zn	Zr
1	0.003	0.0235	<0.001	0.384	0.0006	0.005	0.0051	0.0021	0.011	0.0407	0.0007	0.0015
2	0.00442	0.0240		0.386	0.00079	0.0054	0.007	0.0025	0.012	0.046		0.0015
3	0.0045	0.024		0.390	0.00082	0.021	0.008	0.003	0.0127	0.0465		0.006
4	0.0058	0.024		0.394	0.0009	<0.001	0.0089	0.003	0.0165	0.047		
5	<0.005	0.0249		0.3990	0.0010		0.0097	0.0031	0.0167	0.049		
6		0.025		0.401	0.0011		0.011		0.017	0.0491		
7		0.025		0.411	0.0014				0.0230	0.050		
8		0.0251		0.42	0.0050					0.05		
9		0.0253		0.4354	0.005					0.0515		
10		0.0255								0.0535		
11		0.0270								0.0598		
12		0.027										
13												
14												
15												
Mean	0.004	0.0250		0.40	0.002	0.010	0.008	0.0027	0.016	0.049	0.001	0.003
STDV.	0.001	0.0011		0.02	0.002	0.009	0.002	0.0004	0.004	0.005		0.003
Certified	**(0.004)**	**0.0250**	**(<0.001)**	**0.40**	**0.002**	**(0.01)**	**0.008**	**0.0027**	**0.016**	**0.049**	**(<0.001)**	**(<0.002)**
95% C.I.		0.0007		0.01	0.001		0.002	0.0005	0.004	0.003		
Methods	F	X,O,I	X	X,O,I	O,I,C	X,O	X,O,I	X,O,I	X,O,I	X,O,I	X	X,O

Legend: W = Classical, C = Combustion, F = Fusion, A = AA or GFAA, I = ICP or DCP, IM=ICP-MS, D = DC Arc, O = AES, X = XRF, G = GDAES or GDMS, H = Hollow Cathode AES

The International Standards Organization (ISO) definitions, expressed in ISO Guide 30–1992 list the following:

Certifying Body: Any technically competent body (organization or firm, public or private) that issues a reference material certificate, which provides the information, detailed in ISO Guide 31. The only generally accepted certifying body in the United States for primary standards - Standard Reference Materials (SRM) is the U. S. Department of Commerce, National Institute of Standards & Technology, (NIST), Gaithersburg, MD. All other certifying bodies in the United States produce Reference Materials (RM) or Certified Reference Materials (CRM).

Reference Material (RM): Material or substance one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Certified Reference Material (CRM): Reference material, accompanied by a certificate, one or more of whose property values are certified by a procedure, which establishes its traceability to an accurate realization of the unit in which the property values are expressed, and for which each certified value is accompanied by an uncertainty at a stated level of confidence.

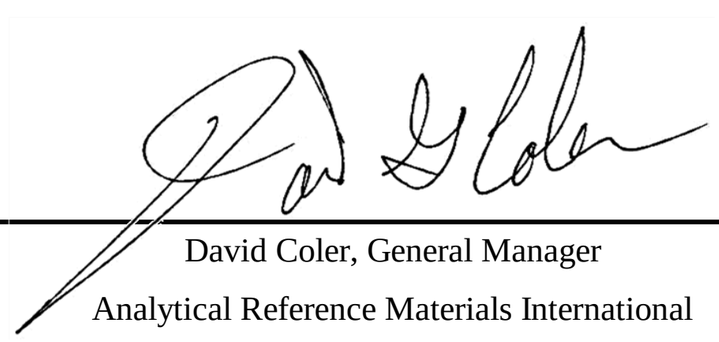
Inter-Laboratory Analysis Program (ILAP): Although ASTM Standard E691-87 applies to inter-laboratory studies to "Determine the Precision of a Single Test Method", it is also a well thought out and logical plan for conducting an inter laboratory program involving multiple techniques. Therefore, the planning, conducting, analyzing, protocol, and treatment of data resulting from this inter laboratory program were performed utilizing the guidelines established in ASTM E691-87.

Methods of Analysis: In view of the fact, that the "Inter Laboratory Analysis Program" entails a wide variety of materials, no single analytical method would provide optimum data results. Therefore, the methods utilized were a combination of ASTM Standard Methods for classical wet chemistry, ICP, AA, Optical Emission, and X-Ray spectrometric methods. The determinations for Carbon, Sulfur, Nitrogen, and Oxygen are the result of combustion and OE instrument procedures.

Expiration of Certification: The certification of this IARM is valid indefinitely, within the uncertainty specified, provided the IARM is handled and stored in accordance with the instructions stated on this certificate. The certification is nullified if the IARM is damaged, contaminated, otherwise modified, or used in a manner for which it was not intended.

Instructions for Use: The test surface is the side opposite to the labeled surface, which includes the IARM number. The entire thickness of the unit is certified. However, the user is cautioned not to measure disks less than 2 mm thick when using X-ray fluorescence spectrometry. Each packaged disk has been prepared by finishing the test surface using a lathe. The user must determine the correct surface preparation procedure for each analytical technique. The user is cautioned to use care when either resurfacing the disk or performing additional polishing as these processes may contaminate the surface. When not in use, the material should be stored in a cool, dry location. This material was tested using both the solid disks and chips prepared from the disks. The certified values are considered representative of the overall average composition of the material. Chips are not to be used for Oxygen analysis.

Selection of Materials: A "batch" or "series" is defined as a single bar of one continuous length and heat. The majority of materials are in wrought condition; other methods of manufacture are utilized as a less desirable resort. ILAP samples are taken by removing a section, a minimum of, every one-twelfth of total length from the entire bar. A portion of the section is converted to chips and thin (pin) disk for analysis by classical wet chemistry, ICP, AA, and combustion procedures, and the balance remains as a thick disk for OES and X-Ray analysis. This systematic sampling procedure results in the homogeneity being reflected as a product of the overall statistics and certified data. This method of homogeneity testing is in accordance with ISO Guide 34, regarding the systematic selection and testing of a representative number of units for the assessment of homogeneity.



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