

Analytical Reference Materials International



Certificate of Analysis Certified Reference Material

Grade: **AISI 4140 / UNS G41400**

Part Number (Q.A. NO.): **IARM 30H**

Certificate Date: **07/19/2017**

Certificate No.: **30H-07192017-IARM-F**

Revision Date: **10/11/2017**

Interpretation of Data

- 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.
- 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.
- 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.
- 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	Bismuth	Boron	Calcium	Carbon	Chromium	Cobalt
0.020 (0.001)	0.0013 (0.0003)	0.0046 (0.0009)	(0.002)	0.0007 (0.0005)	(0.0009)	0.425 (0.005)	0.97 (0.01)	0.0071 (0.0006)
Copper	Hydrogen	Lead	Magnesium	Manganese	Molybdenum	Nickel	Niobium	Nitrogen
0.131 (0.002)	(<0.0001)	0.0005 (0.0003)	(0.001)	0.937 (0.009)	0.199 (0.004)	0.063 (0.002)	0.003 (0.002)	0.0081 (0.0006)
Oxygen	Phosphorus	Selenium	Silicon	Sulfur	Tantalum	Tin	Titanium	Tungsten
0.0016 (0.0008)	0.015 (0.001)	(<0.005)	0.253 (0.005)	0.022 (0.001)	(0.004)	0.008 (0.001)	0.0024 (0.0008)	0.007 (0.004)
Vanadium	Zinc	Zirconium						
0.0040 (0.0009)	(0.002)	0.002 (0.001)						

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

Anderson Laboratories, Inc. - Greendale, WI	Gerdau Longsteel North America - St. Paul, MN
ArcelorMittal Dofasco - Hamilton, ON	Laboratory Testing, Inc. - Hatfield, PA
Essar Steel Algoma, Inc. - Sault Ste. Marie, ON	PM Kalco, Inc - Wheatland, PA
Exova - Gary, IN	Special Metals IncoTest - Hereford, UK
Exova - Middlesbrough, UK	Timken Steel Corp. - Canton, OH
Exova - Portland, OR	

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 AR1648	BAS 407/2	BCS 459/2	BS CA3A	IARM 30B	JSS 173-4	LECO 501-551	NIST 1263A	NIST 1767
ALPHA AR657	BAS 408/1	BCS 460/1	BS CA-4	IARM 30C	JSS 174-4	LECO 501-644	NIST 1269	NIST 293
ALPHA AR660	BAS 409/1	BCS 462/1	BS CSN 2-1	IARM 30D	JSS 175-4	LECO 501-645	NIST 16F	NIST 361
ALPHA AR668	BAS 410/2	BCS 474	BS CSN2-2	IARM 30E	JSS ST01	LECO 502-060	NIST 1754	NIST 362
BAM 036-1	BCS 351	BS 3931	BS CSN3	IARM 30F	JSS ST02	LECO 502-102	NIST 1760	NIST 363
BAS 401/1	BCS 404	BS 59B	BS CSN4	IHS657	JSS ST03	NIST 1160	NIST 1761	NIST 365
BAS 402/1	BCS 410	BS 71A	BS XAAS	JSS 168-4	JSS ST04	NIST 1161	NIST 1762	NIST 368
BAS 403/1	BCS 454	BS CA-1	BS XCCS	JSS 169-4	JSS ST05	NIST 1162	NIST 1763	SS 456-1
BAS 404/1	BCS 454/1	BS CA1A	BS XCCV	JSS 170-4	JSS ST06	NIST 1163	NIST 1764	SS 460-1
BAS 405/1	BCS 455	BS CA-2	ES 096/1	JSS 171-4	LECO 501-504	NIST 1164	NIST 1765	SUS C17
BAS 406/1	BCS 456/2	BS CA-3	ES 481/1	JSS 172-4	LECO 501-510	NIST 1261A	NIST 1766	SUS D8

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 10/11/2017.

30H	Al	Sb	As	Bi	B	Ca	C	Cr	Co	Cu	H	Pb	Mg	Mn	Mo	Ni
1	0.015	0.0009	0.00299	0.000004	0.00015	0.0006	0.4134	0.9466	0.0056	0.125	<0.00003	0.00003	0.0001	0.902	0.1885	0.057
2	0.0187	0.001	0.0038	0.00002	0.00020	0.00071	0.418	0.948	0.0061	0.127		0.00005	0.0001	0.924	0.191	0.06
3	0.019	0.00101	0.00392	0.00006	0.0002	0.0008	0.418	0.9577	0.0066	0.127		0.0001	0.0003	0.926	0.1929	0.061
4	0.0196	0.00138	0.0042	0.0028	0.00025	0.00087	0.4206	0.9596	0.0068	0.1285		0.00037	0.0039	0.931	0.1935	0.061
5	0.020	0.0014	0.0042	0.0066	0.00026	0.0009	0.4217	0.964	0.0069	0.13		0.0008	<0.0010	0.9349	0.197	0.0616
6	0.0201	0.0017	0.0049	<0.0010	0.0004	0.0010	0.4218	0.966	0.007	0.131		0.0009		0.936	0.197	0.062
7	0.0203	0.0020	0.0054		0.00048	0.001	0.42365	0.967	0.0071	0.1320		0.001		0.938	0.19712	0.062
8	0.021		0.0071		0.0015	0.0012	0.424	0.969	0.0072	0.132				0.9399	0.198	0.06298
9	0.021				0.0025	<0.0010	0.425	0.975	0.0074	0.13362				0.94	0.1996	0.065
10	0.0217						0.425	0.9766	0.008	0.1343				0.943	0.200	0.0669
11	0.02172						0.4267	0.986	0.009	0.135				0.9442	0.206	0.068
12	0.0232						0.4337	0.9889		0.135				0.955	0.2064	0.0682
13	0.0234						0.448	1.01		0.1371				0.962	0.214	
14																
15																
Mean	0.020	0.0013	0.0046	0.002	0.0007	0.0009	0.425	0.97	0.0071	0.131		0.0005	0.001	0.937	0.199	0.063
STDV.	0.002	0.0004	0.0013	0.003	0.0008	0.0002	0.009	0.02	0.0009	0.004		0.0004	0.002	0.015	0.007	0.003
Certified	0.020	0.0013	0.0046	(0.002)	0.0007	(0.0009)	0.425	0.97	0.0071	0.131	(<0.0001)	0.0005	(0.001)	0.937	0.199	0.063
95% C.I.	0.001	0.0003	0.0009	0.0005	0.0005	0.005	0.005	0.01	0.0006	0.002		0.0003	0.003	0.009	0.004	0.002
Methods	O,I,A	X,O,IM,H	O,IM,I,H	O,IM,I,H	O,I	O,I	O,C	O,I	O,I	O,I		O,IM,I,H	O,IM,I,H	O,I	O,I	O,I

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

30H	Nb	N	O	P	Se	Si	S	Ta	Sn	Ti	W	V	Zn	Zr
1	0.0008	0.0068	0.0006	0.011	0.00007	0.240	0.0178	0.0002	0.0068	0.001	0.0014	0.0024	0.00032	0.00021
2	0.001	0.0073	0.0010	0.0140	0.0001	0.2421	0.0195	0.001	0.007	0.0016	0.003	0.0024	0.0011	0.00109
3	0.0012	0.00757	0.00105	0.014	0.005	0.244	0.0198	0.0054	0.007	0.0017	0.0033	0.00271	0.0017	0.0012
4	0.0015	0.0076	0.00138	0.01417		0.249	0.0221	0.0078	0.0072	0.0017	0.004	0.0032	0.0019	0.0017
5	0.0015	0.0076	0.00172	0.0145		0.25	0.0223	<0.0010	0.0072	0.00181	0.0053	0.0033	0.0024	0.002
6	0.0018	0.00776	0.0018	0.0145		0.251	0.02255		0.0075	0.0019	0.00581	0.0034		0.004
7	0.002	0.0078	0.0037	0.0150		0.2544	0.0226		0.0077	0.0020	0.009	0.0035		
8	0.00217	0.0078		0.015		0.255	0.0235		0.00799	0.002	0.011	0.0038		
9	0.0029	0.00793		0.0151		0.2583	0.02402		0.008	0.0022	0.0173	0.004		
10	0.0069	0.00796		0.0157		0.2585	0.0241		0.0082	0.0035		0.0045		
11	0.009	0.00906		0.016		0.259	0.02451		0.0084	0.0049		0.005		
12		0.0093		0.0164		0.25951	0.0250		0.011	0.005		0.0056		
13		0.0102		0.0182		0.2658			0.0124			0.008		
14														
15														
Mean	0.003	0.0081	0.0016	0.015	0.002	0.253	0.022	0.004	0.008	0.0024	0.007	0.0040	0.001	0.002
STDV.	0.003	0.0009	0.0010	0.002	0.003	0.008	0.002	0.004	0.002	0.0013	0.005	0.0015	0.001	0.001
Certified	0.003	0.0081	0.0016	0.015	(<0.005)	0.253	0.022	(0.004)	0.008	0.0024	0.007	0.0040	(0.002)	0.002
95% C.I.	0.002	0.0006	0.0008	0.001	0.005	0.005	0.001	0.001	0.0008	0.004	0.0009	0.0009	0.001	0.001
Methods	O,I	O,F	F	X,O,I	IM,H	O,I	O,C	X,O,IM,I	O,IM,I	O,I	X,O,IM,I	O,I	O,IM,I,H	O,IM,I

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.


 David Coler, General Manager
 Analytical Reference Materials International



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