Analytical Reference Materials International

Provisional Certificate of Analysis

Certified Reference Material

Grade: **1-1/4Cr 1/2Mo / UNS K11572**

Part Number (Q.A. NO.): **IARM 35H**

Certificate Date: **01/11/2007** Certificate No.: **35H-01112007-IARM-P** Revision Date: **01/29/2008**

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.**
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	Arsenic	Boron	Carbon	Calcium	Cobalt	Chromium	Copper
[0.028]	[0.003]	[0.0004]	[0.14]	[(0.0004)]	[0.004]	[1.11]	[0.032]
[(0.001)]	[(0.0004)]	[(0.0001)]	[(0.002)]		[(0.001)]	[(0.01)]	[(0.001)]
Manganese	**Molybdenum**	**Nitrogen**	**Niobium**	**Nickel**	**Oxygen**	**Phosphorus**	**Lead**
[0.56]	[0.47]	[0.0076]	[0.002]	[0.071]	[0.0023]	[0.004]	[0.001]
[(0.004)]	[(0.003)]	[(0.0002)]	[(0.0003)]	[(0.001)]	[(0.0005)]	[(0.0005)]	[(0.0003)]
Sulfur	**Antimony**	**Silicon**	**Tin**	**Titanium**	**Vanadium**	**Tungsten**	**Zirconium**
[0.028]	[(0.002)]	[0.56]	[0.002]	[0.002]	[0.004]	[0.004]	[(0.001)]
[(0.001)]		[(0.01)]	[(0.0004)]	[(0.0003)]	[(0.0005)]	[(0.001)]	

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

AK Steel - Middletown, OH
Algoma Steel, Inc. - Sault Ste. Marie, ON
Anderson Laboratories, Inc. - Greendale, WI
ATI Allvac - Lockport, NY
Bodycote Materials Testing - Chicago, IL
Bodycote Materials Testing - Los Angeles, LA
Bodycote Materials Testing - Portland, OR
Cannon Muskegon Corp. - Muskegon, MI
Carpenter Technology Corporation - Reading, PA
Colonial Metals Co. - Columbia, PA
Crucible Research - Pittsburgh, PA
Crucible Specialty Metals - Syracuse, NY
Deloro Stellite, Inc. - Belleville, ON
Ellwood National Steel - Irvine, PA
Ellwood Quality Steel - New Castle, PA
IMR Test Labs - Lansing, NY
Jorgensen Forge Corp. - Seattle, WA
Kalco Metals, Inc - Farrell, PA
Koppel Steel - Koppel, PA
Laboratory Testing, Inc. - Hatfield, PA
Lockheed Martin Astronautics - Littleton, CO
MetalTek International, Inc. - Waukesha, WI
MSI Testing & Engineering, Inc. - Melrose Park, IL
Outokumpu Stainless OY - Tornio Finland
Special Metals IncoTest - Hereford, UK
Staveley Services Materials Testing - Gary, IN
Stork Materials Testing and Inspection - Huntington Beach, CA
Tensile Testing - Cuyahoga Hts., OH
The Timken Company - Canton, OH
Wheeling Pittsburgh Steel Corp. - Mingo Junction, 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: **IARM 35A, ALPHA AR872, NIST 1262A, 1264A, BS 60C, 61C, 68C, 1962, 2941, 4931, NIST 1263, 1264, BAS 410/1, 431/1, 458/1, IARM 30A, BS 57E, 61C, 68B, NIST 361, IARM 35C, BS 2-1, LECO 501-643, 501-644, BS 3941, IARM 35A, 35B, LECO 501-501, 501-510, 501-550, NIST 1261A, 1263A, ALPHA AR873, LECO 501-550, IARM 35A, 35B, 35C, 35D, LECO 501-503, 501-550, IARM 35C, LECO 501-643, BCS 409, 351, 454/1, 462/1, LECO 501-551, 502-102, R5657, NIST 1263A, 1763, BS 12D, 46, ALPHA AR872, AR890, LECO 501-550, IARM 27D, 35A, 35D, ES 0115A, LECO 502-188, 502-257, NIST 1761, 1762, 1763, 1764, 1765, 1766, 1767, NIST 8J, 345A, 1761, 1762, 1763, 1764, 1765, 1766, 1767, 2168, IARM 35B, 36B, AK597, A10, NIST 1217, 1225, 1763, NIST 1166, 1263, 1265, 1765, BCS SS456, BS 45, 61D, 3931, 4620, XCCS, 12X12749, ALPHA AR 1653, LECO 501-644, 501-676, IARM 35F, BS 4942, ALPHA AR660, AR872, NIST 293, 337A, 361, 1160, 1161, 1162, 1163, 1164, 1754, 1760, 1761, 1762, 1763, 1764, 1765, 1766, 1767, BAS 401/1, 402/1, 403/1, 404/1, 405/1, 406/1, 407/2, 408/1, 409/1, 410/2, JSS ST01, IARM 31D, LECO 501-510, 501-645,SUS INOX, RE 12/19, C/17, D/18, BS CSN-3, CSN-4, LECO 501-871, NIST 1286, IARM 30B, NIST 1762, 1766, BS 45, 46A, 47A, LECO 501-503, 501-505, 501-643, 501-644, VHG TALN-500, TCRN 43/04N, PCUN 41/04N, TMNN 33/04N, TMONF 502-300, PNIN 510-0663, PSNIF 510-0272, PSNNF 508-0467, PTINF 505-0227, PVN 44/05N, PWW 502-0244, 623-2702, LECO 501-501, 501-551, 501-553, 501-645, 501-674, 502-064, NIST 1261A, 1262A, 1263A, 1264A, 1265A, 1760, 1761, 1762, 1763, 1764, 1765, 1766, 1767, LECO 501-550, NIST 361, 362, 363, IARM 42B, LECO 501-644**

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 01/29/2008.

35H	Al	As	B	C	Co	Cr	Cu	Mn	Mo	N	Nb	Ni	O	P	Pb	S	Si	Sn	Ti	V	W	Ca	Sb	Ta	Zn	Zr
1	0.029	0.002	0.001	0.134	0.0037	1.14	0.030	0.560	0.490	0.0074	0.0010	0.070	0.0013	0.006	0.0002	0.025	0.600	0.0020	0.001	0.003	0.0039	0.00055	0.0029	0.0003	0.0031	0.0011
2	0.031	0.0024	0.0002	0.144	0.0066	1.10	0.035	0.56	0.482	0.008	0.0020	0.072	0.0046	0.005	0.0007	0.029	0.54	0.004	0.0022	0.004	0.0051	0.0002	0.0010	0.0007	0.0027	0.0005
3	0.030	0.00295	0.0005	0.142	0.0036	1.108	0.031	0.564	0.4704	0.00735	0.002	0.076	0.0021	0.0055	0.001	0.026	0.545	0.0021	0.003	0.0045	0.0042	0.0009	0.0055	0.001	0.0010	0.001
4	0.029	0.0017	0.0001	0.1353	0.0073	1.089	0.035	0.566	0.470	0.00747	0.0019	0.0717	0.000758	0.004	0.0003	0.026	0.571	0.0031	0.0015	0.005	0.0068	0.00003	0.0008	0.001	0.0012	0.0010
5	0.0268	0.0039	0.00024	0.143	0.0040	1.104	0.0332	0.5521	0.4588	0.0074	0.0016	0.0729	0.0025	0.00565	0.0012	0.0290	0.5658	0.0019	0.0023	0.0056	0.005	0.0003	0.0014	0.0019	0.0026	0.001
6	0.0274	0.002	0.00013	0.1355	0.0026	1.075	0.0340	0.549	0.47	0.00733	0.0028	0.073	0.0041	0.0031	0.0009	0.0276	0.558	0.0026	0.0017	0.0046	0.0033	0.0004	0.0036	0.001	0.0019	0.0004
7	0.031	0.0023	0.0010	0.1346	0.005	1.091	0.034	0.571	0.474	0.0070	0.003	0.072	0.0022	0.0045	0.0014	0.0273	0.570	0.002	0.0021	0.0046	0.0021		0.0036	0.00015	0.002	0.0005
8	0.0293	0.0030	0.00026	0.130	0.004	1.162	0.026	0.571	0.484	0.0069	0.0025	0.0723	0.00127	0.003	0.0010	0.03037	0.518	0.0027	0.002	0.002	0.005		0.000542			0.0011
9	0.0269	0.0026	0.0002	0.134	0.002	1.120	0.027	0.569	0.466	0.00695	0.0015	0.070	0.0009	0.002	0.0008	0.027	0.551	0.0018	0.001	0.0050	0.001					0.0008
10	0.027	0.0038	0.0003	0.1318	0.0034	1.111	0.032	0.583	0.470	0.00747	0.003	0.076	0.00318	0.0048	0.00115	0.0302	0.565	0.001	0.0017	0.007	0.0040					0.0015
11	0.026	0.0027	0.0002	0.135	0.0061	1.098	0.0372	0.5749	0.4735	0.0079	0.001	0.071	0.0022	0.0051		0.0286	0.5729	0.0027	0.0017	0.0035	0.003					
12	0.0257	0.0035	0.00050	0.133	0.001	1.057	0.035	0.562	0.469	0.00766	0.002	0.0686	0.002	0.007		0.028835	0.547	0.0014	0.0013	0.004	0.0037					
13	0.0250	0.0035	0.00020	0.137	0.005	1.103	0.031	0.579	0.485	0.0080	0.0029	0.0695	0.00339	0.0016		0.0282	0.573	0.0016	0.001	0.0035	0.007					
14	0.0294	0.0022	0.0004	0.1337	0.004	1.102	0.0314	0.559	0.479	0.008	0.001	0.070	0.0022	0.0053		0.0262	0.543	0.001	0.003	0.0047	0.0031					
15	0.025	0.00245	0.0006	0.137	0.0030	1.120	0.0340	0.553	0.469	0.00847	0.0016	0.0715	0.0018	0.0041		0.0289	0.539	0.002	0.0017	0.005	0.0033					
16	0.031	0.0017	0.0002	0.135	0.0034	1.110	0.036	0.561	0.463	0.0082	0.0024	0.072	0.00096	0.0045		0.0274	0.552	0.0026	0.0010	0.005	0.001					
17	0.0252		0.00029	0.1355	0.0036	1.095	0.0305	0.554	0.485	0.0079	0.0032	0.071	0.0013	0.005		0.032	0.571	0.0010	0.0021	0.0048						
18	0.028			0.138	0.00143	1.112	0.0318	0.562	0.475	0.0076	0.0017	0.073	0.0040	0.005		0.02881	0.567	0.004	0.0021	0.0033						
19	0.030			0.137	0.0055	1.103	0.031	0.558	0.462	0.00730	0.0030	0.070	0.0029	0.0036		0.0272	0.550	0.0019	0.00135	0.0051						
20	0.0292			0.129	0.0037	1.098	0.032	0.550	0.465	0.0073	0.0035	0.0721		0.0047		0.0252	0.552	0.0017	0.0018	0.0040						
21	0.0268			0.133	0.003	1.121	0.035	0.558	0.471	0.0072	0.0022	0.0694		0.0031		0.028	0.576	0.0011	0.0014	0.00472						
22	0.0245			0.12538		1.108	0.034	0.571	0.48012	0.00728	0.0020	0.0681		0.005		0.030	0.548	0.000316		0.0042						
23	0.025			0.134		1.13218	0.0318	0.55192	0.477	0.0076		0.071		0.00416		0.02612	0.551	0.0024		0.0046						
24	0.0244			0.1316		1.105	0.0345	0.566	0.4740	0.00788		0.070		0.0038		0.0286	0.5586	0.0019		0.0035						
25	0.0269			0.1331		1.0855	0.0251	0.5638	0.4969	0.0083		0.0705		0.0045		0.0287	0.593			0.0032						
26	0.028			0.1319		1.107	0.031	0.591	0.47305			0.073		0.0038		0.0263	0.538			0.0017						
27				0.1437		1.1207	0.0287	0.5903	0.472					0.00195		0.02745	0.573			0.0014						
28				0.142		1.114	0.0321	0.557	0.4805					0.0048		0.0280	0.5724			0.0041						
29				0.147		1.113	0.0310	0.5662	0.482					0.0058		0.0283	0.565			0.003						
30						1.114		0.571	0.463					0.0057		0.0283	0.569									
31						1.162		0.557						0.005		0.0293										
Mean	0.0276	0.0027	0.0004	0.1357	0.0039	1.1090	0.0321	0.5646	0.4743	0.0076	0.0022	0.0714	0.0023	0.0044	0.0009	0.0280	0.5598	0.0020	0.0018	0.0041	0.0038	0.0004	0.0024	0.0009	0.0021	0.0009
STDV.	0.0021	0.0007	0.0003	0.0049	0.0016	0.0212	0.0029	0.0108	0.0088	0.0004	0.0007	0.0019	0.0011	0.0012	0.0004	0.0016	0.0171	0.0009	0.0006	0.0012	0.0017	0.0003	0.0018	0.0006	0.0008	0.0003
Certified	0.028	0.003	0.0004	0.14	0.004	1.11	0.032	0.56	0.47	0.0076	0.002	0.071	0.0023	0.004	0.001	0.028	0.56	0.002	0.002	0.004	0.004	(0.0004)	(0.002)	(0.001)	(0.002)	(0.001)
95% C.I.	0.001	0.0004	0.0001	0.002	0.001	0.01	0.001	0.004	0.003	0.0002	0.0003	0.001	0.0005	0.0005	0.0003	0.001	0.01	0.0004	0.0003	0.0005	0.001					
Methods	X,A,I,O	H,I,O	I,O	C,O	X,I,O	X,W,A,I,O	X,A,I,O	X,A,I,O	X,A,I,O	F,O	X,I,O	X,A,I,O	F	X,I,O	X,H,A,I,O	C,I,O	X,W,A,I,O	X,I,O	X,I,O	X,I,O	X,I,O	I,O	H,I,O	X,I,O	H,I,O	X,I,O

The International Standards Organization (ISO) definitions, expressed in ISO Guide 30-1981-(E) list the following:

Certifying Body: A technically competent body (organization or firm, public or private) that issues a Reference Material Certificate. The only generally accepted certifying body in the United States is the U. S. Department of Commerce, National Institute of Standards & Technology, (NIST), Gaithersburg, MD.

Reference Material (RM): A material or substance with one or more properties which are sufficiently well established to be used for calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Certified Reference Material (CRM): A reference material with one or more properties whose values are certified by a technically valid procedure accompanied by or traceable to a certificate or other documentation, which is issued by a Certifying Body.

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 instrument procedures.

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. Each member of the ILAP is furnished a sample pack from a specific location on the batch bar. 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.

William D. Britt, President & General Manager
Analytical Reference Materials International

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