

Analytical Reference Materials International

Certificate of Analysis Certified Reference Material



Grade: **AISI 1018 / UNS G10180**

Part Number (Q.A. NO.): **IARM 28G**

Certification Date: **11/14/2005**

Certificate No.: **28G-11142005-IARM-F**

Revision Date: **11/14/2005**

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!

<u>Aluminum</u> 0.002 (0.001)	<u>Antimony</u> (0.002)	<u>Arsenic</u> 0.0031 (0.0005)	<u>Boron</u> 0.0001 (0.00004)	<u>Calcium</u> 0.0012 (0.0003)	<u>Carbon</u> 0.189 (0.004)	<u>Chromium</u> 0.049 (0.001)	<u>Cobalt</u> 0.003 (0.001)
<u>Copper</u> 0.178 (0.003)	<u>Lead</u> <0.001	<u>Manganese</u> 0.79 (0.004)	<u>Molybdenum</u> 0.009 (0.001)	<u>Nickel</u> 0.044 (0.001)	<u>Niobium</u> 0.0013 (0.0003)	<u>Nitrogen</u> 0.0089 (0.0003)	<u>Oxygen</u> 0.003 (0.001)
<u>Phosphorus</u> 0.021 (0.001)	<u>Sulfur</u> 0.023 (0.001)	<u>Silicon</u> 0.252 (0.003)	<u>Tin</u> 0.016 (0.0003)	<u>Titanium</u> 0.0011 (0.0003)	<u>Tungsten</u> 0.0032 (0.0004)	<u>Vanadium</u> 0.0014 (0.0002)	<u>Zirconium</u> 0.001 (0.0005)

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

Algoma Steel, Inc. - Sault Ste. Marie, ON
Bodycote Materials Testing - Portland, OR
Crucible Specialty Metals - Syracuse, NY
Koppel Steel - Koppel, PA
Mittal Steel - East Chicago, IN
Staveley Services Materials Testing - Gary, IN

Anderson Laboratories, Inc. - Greendale, WI
Carpenter Technology Corporation - Reading, PA
IMR Test Labs - Lansing, NY
Laboratory Testing, Inc. - Hatfield, PA
Republic Engineered Products - Canton, OH
The Timken Company - 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: NIST 11H, 32E, 33E, 50C, 73E, 105, 125B, 129, 133A, 170, 344, 361, 362, 363, 364, 365, 885, 1261A, 1263A, 1754, 1762, 1763, 1765, 1766, 3128, NIST 1160, 1161, 1162, 1163, 1164, 1261, 1262, 1263, 1264, 1265, 1761, 1762, 1763, 1764, 1765, 1766, 1767, 35a, 337a, 361, 362, 363, 1754, JSS ST01, ST02, ST03, ST04, ST05, ST06, 168-4, 169-4, 170-4, 171-4, 172-4, 173-4, 174-4, 175-4, BAS 401/1, 402/1, 403/1, 404/1, 405/1, 406/1, 407/1, 408/2, 409/2, 410/2, 452-1, JA-NR-3B, JK-2D, BS XAAS, XCCV, XCCS, CA-1, CA-2, CA-3, CA-4, CA1A, CA2A, CA3A, LECO 501-510, 501-645, NIST 100B, 361, 1763, 1766, NIST 293, 2166, LECO 501-645, BS 3941, BS 2942, NIST 1261A, 1262A, 1263A, 1264A, 1265A, 1761, 1762, 1763, 1764, 1765, 1766, 1767, IARM 196A, LECO 501-550, IARM 28E, NIST 362, 363, 364, IARM 28C, 28D, 28E, NIST 55E, 1265, 1765, BS 3961, 3962, LECO 501-501, IARM 28A, BS 2931, ES 0115A, LECO 501-679, 501-645, NIST 1761, 1762, 1763, 1764, 1765, 1766, 1767, SUS RE12/2, D/8, C/8, INOX, CA1, ALPHA A871, BS CSN 2-1, CSN-3, CSN-4, LECO 501-503, 501-678, IARM 28D, 28F

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.

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 11/14/2005.

28G	Al	As	B	C	Co	Cr	Cu	Mn	Mo	N	Nb	Ni	O	P	Pb
1	0.001	0.0040	0.0001	0.180	0.0033	0.0507	0.170	0.790	0.011	0.0080	0.0015	0.040	0.00330	0.022	0.0002
2	0.0035	0.0027	0.00014	0.1866	0.003	0.049	0.179	0.7875	0.0094	0.00961	0.0010	0.0450	0.00228	0.0188	<0.0001
3	0.0012	0.0023	0.0001	0.183	0.0035	0.047	0.181	0.791	0.0081	0.00922	0.0007	0.044	0.0031	0.0202	0.0001
4	0.0035	0.0034	0.00020	0.183	0.0039	0.0496	0.172	0.791	0.009	0.0092	0.00093	0.044	0.00239	0.023	0.001
5	0.0016	0.0035	0.0001	0.2023	0.004	0.0497	0.1827	0.7851	0.0079	0.0085	0.0010	0.0424	0.0033	0.0201	0.0008
6	0.0019	0.0032	0.00019	0.189	0.0030	0.049	0.173	0.774	0.0075	0.00882	0.0019	0.0442	0.0050	0.0209	0.0004
7	0.0015	0.00266	0.00015	0.197	0.005	0.0458	0.184	0.794	0.010	0.0084	0.0020	0.047	0.00445	0.023	
8	0.0015	0.0033	0.00015	0.196	0.0039	0.049	0.177	0.789	0.0086	0.00903	0.0018	0.0450	0.0020	0.0222	
9	0.001		0.00003	0.195	0.0025	0.052	0.181	0.781	0.008	0.0089	0.0011	0.046		0.022	
10	0.00025		0.0002	0.188	0.0033	0.0472	0.178	0.800	0.012	0.0093	0.0016	0.0447		0.0210	
11	0.0026			0.1876	0.0021	0.0483	0.1837	0.7839	0.0052	0.00947	0.00071	0.0450		0.0211	
12	0.00195			0.184		0.05084	0.180	0.790	0.0104	0.0093	0.0016	0.04397		0.0214	
13	0.0011			0.18708		0.0485	0.17745	0.79748	0.00848	0.00863		0.0391		0.02246	
14				0.1894			0.1752	0.799		0.0089				0.0208	
Mean	0.0017	0.0031	0.0001	0.1891	0.0034	0.0490	0.1781	0.7895	0.0089	0.0089	0.0013	0.0439	0.0032	0.0214	0.0005
STDV.	0.0010	0.0005	0.0001	0.0063	0.0008	0.0017	0.0044	0.0071	0.0017	0.0004	0.0005	0.0022	0.0011	0.0012	0.0004
Certified	0.002	0.0031	0.0001	0.189	0.003	0.049	0.178	0.79	0.009	0.0089	0.0013	0.044	0.003	0.021	<0.001
95% C.I.	0.001	0.0005	0.00003	0.004	0.001	0.001	0.003	0.004	0.001	0.0003	0.0003	0.001	0.001	0.001	
Methods	A,I,O	I,O	O	C,O	X,I,O	X,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	I,O

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

28G	S	Si	Sn	Ti	V	W	Bi	Ca	Cd	Mg	Sb	Se	Ta	Zn	Zr
1	0.023	0.260	0.0165	0.00180	0.00180	0.0032	0.0009	0.00050		0.0007	0.0026	<0.0001	0.0027	0.00210	0.0020
2	0.0230	0.254	0.0161	0.0009	0.0012	0.0034	<0.001	0.00143		<0.001	0.0020	0.004	0.0020	0.0008	0.0002
3	0.0234	0.249	0.016	0.0010	0.0014	0.0028		0.0014			0.0021	<0.001	0.0010	0.0009	0.0004
4	0.0210	0.264	0.0165	0.0008	0.0013	0.0030		0.0016			0.0030		0.0010	0.0005	0.0006
5	0.0241	0.246	0.0155	0.0017	0.0015	0.00275		0.0009			0.0019			<0.001	0.0010
6	0.0235	0.2472	0.0153	0.0010	0.0011	0.0038		0.0011							0.0010
7	0.022	0.255	0.016	0.0006	0.0015			0.0010							0.0014
8	0.0251	0.251	0.0157	0.0010	0.0015			0.0015							0.0009
9	0.0239	0.252	0.0157	0.0013	0.00093			0.00168							
10	0.0212	0.245	0.0151	0.0004	0.0017			0.0013							
11	0.025	0.2475	0.01531	0.0018											
12	0.0237	0.247	0.0151	0.00066											
13	0.02321	0.25133		0.0012											
14		0.2579													
Mean	0.0232	0.2519	0.0157	0.0011	0.0014	0.0032	0.0009	0.0012		0.0007	0.0023	0.0040	0.0017	0.0011	0.0009
STDV.	0.0013	0.0057	0.0005	0.0003	0.0003	0.0004		0.0004			0.0005		0.0008	0.0007	0.0006
Certified	0.023	0.252	0.016	0.0011	0.0014	0.0032		0.0012			(0.002)		(0.002)	(0.001)	0.001
95% C.I.	0.001	0.003	0.0003	0.0003	0.0002	0.0004		0.0003							0.0005
Methods	C,O	X,W,A,O	X,O	X,I,O	X,A,I,O	X,I,O		I,O			X,I,O		I,O	I,O	X,I,O

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

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.

Certified by: 
 William D. Britt, President/General Manager
 Analytical Reference Materials International

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