LGC ARMI

Certificate of Analysis
IARM Ni690-18
Nickel Alloy 690 / UNS N06690
Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	0.25 ± 0.01	**C**	0.025 ± 0.002	**Co**	0.013 ± 0.005	**Cr**	29.1 ± 0.8
Cu	0.012 ± 0.003	**Fe**	10.0 ± 0.3	**Mg**	0.0030 ± 0.0007	**Mn**	0.154 ± 0.006
Mo	0.013 ± 0.006	**N**	0.012 ± 0.001	**Nb**	0.007 ± 0.005	**Ni**	59.8 ± 0.5
P	0.004 ± 0.001	**S**	0.0007 ± 0.0002	**Si**	0.049 ± 0.006	**Ti**	0.324 ± 0.008
V	0.048 ± 0.004	**W**	0.003 ± 0.002				

Indicative Values listed in ppm

As (<10)	B (<300)	Bi (<1)	Ca (<10)	Hf (<700)	O (20)	Pb (10)
Re (<100)	Sb (<1)	Sn (<30)	Ta (<60)	Zr (20)		

Description and Intended Use

This CRM may come in the form of a solid disk, chips, or powder. The intended use of this CRM may include, but is not limited to, the calibration of instruments and the validation of analytical methods.

Instructions for Use

1. The test surface is on the opposite side of the labeled surface, which includes the material identification. 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.
2. The minimum sample size for chips should be individually evaluated based on the analytical technique used; this would typically be greater than 0.1 grams.
3. The material should be stored in a cool, dry location when not in use.
4. Chips are not certified for Oxygen analysis.

LGC ARMI ISO 9001:2008

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IARM-Ni690-18-F
6/18/2018   1 / 2

The following data represents all pertinent information reported as it applies to the chemical characterization of this material.

	Al	As	B	Bi	C	Ca	Co	Cr	Cu	Fe	Hf	Mg	Mn	Mo	N	Nb
1	0.21	0.001	0.00023	<0.00001	0.0196	0.0003	0.0052	26.50	0.0057	9.08333	0.0619	0.002	0.145	0.004	0.0108	0.00245
2	0.227	0.0008			0.0227	0.001	0.0079	26.69	0.00663	9.3111		0.0024	0.1465	0.0061	0.0109	0.004
3	0.24		0.027		0.025	<0.0005	0.0081	28.79	0.0079	9.804		0.003	0.1478	0.00753	0.011	0.004
4	0.24		<0.0001		0.0252		0.0089	29.25	0.01	9.865		0.0031	0.15	0.0085	0.0114	0.004
5	0.2433	<0.001	<0.001		0.0255		0.01	29.549	0.0105	9.96		0.0033	0.15	0.01	0.0116	0.0042
6	0.245				0.0257		0.01	29.56	0.012	9.969		0.004	0.15	0.01	0.012	0.01051
7	0.246				0.0264		0.0135	29.62	0.0148	9.98			0.1525	0.0105	0.0145	0.019
8	0.25				0.0266		0.02	29.668	0.015	9.99			0.158	0.022		
9	0.25				0.027		0.022	29.74	0.016	10.0425			0.163	0.022		
10	0.2504				0.0278		0.023	29.9316	0.017	10.225			0.1722	0.03		
11	0.278				0.028			29.962	0.02	10.46						
12	0.281							30.123		10.847						
13																
14																
15																
Mean	0.25				0.025		0.013	29.1	0.012	10.0		0.003	0.154	0.013	0.012	0.007
STDV.	0.02				0.002		0.006	1.0	0.005	0.5		0.0007	0.009	0.009	0.001	0.006
Certified	**0.25**	**(<0.001)**	**(<0.03)**	**(<0.0001)**	**0.025**	**(<0.001)**	**0.013**	**29.1**	**0.012**	**10.0**	**(<0.07)**	**0.0030**	**0.154**	**0.013**	**0.012**	**0.007**
U_CRM	0.01				0.002		0.005	0.8	0.003	0.3		0.0007	0.006	0.006	0.001	0.005
Methods	X,O,IM,I	IM	O,IM	IM	O,C	O,IM	X,O,IM,I,A	X,W,O,I	X,O,IM,I	X,O,I	O	X,O,IM	X,O,IM,I	X,O,IM,I	O,F	X,O,IM,I

	Ni	O	P	Pb	Re	S	Sb	Si	Sn	Ta	Ti	V	W	Zr		
1	58.918	0.0009	0.002	0.0001	0.01	0.00035	<0.00005	0.04	0.00015	0.00012	0.2967	0.04	0.00056	0.001		
2	59.25	0.001	0.003	0.00014		0.0005		0.0412	0.001	0.002	0.312	0.0422	0.001	0.002		
3	59.307	0.0012	0.0032	0.001		0.0005		0.045	0.0021	0.003	0.315	0.0452	0.0019	0.002		
4	59.544	0.00137	0.0037	0.0019		0.00065		0.04504		0.006	0.316	0.047	0.0029	0.003		
5	59.77	0.006	0.004			0.0008		0.0465	<0.001	<0.0025	0.32	0.05	0.003			
6	59.7935		0.004			0.00081		0.05			0.32	0.05	0.006			
7	60.138		0.00466			0.001		0.055			0.3292	0.05035				
8	60.51		0.005			0.001		0.057			0.33	0.053				
9	61.051		0.007			0.0011		0.065			0.333	0.055				
10											0.3351					
11											0.34					
12											0.3407					
13																
14																
15																
Mean	59.8	0.002	0.004	0.0010		0.0007		0.049			0.324	0.048	0.003	0.0020		
STDV.	0.7	0.002	0.001	0.0009				0.008			0.01	0.005	0.002	0.0008		
Certified	**59.8**	**(0.002)**	**0.004**	**(0.001)**	**(<0.01)**	**0.0007**	**(<0.0001)**	**0.049**	**(<0.003)**	**(<0.006)**	**0.324**	**0.048**	**0.003**	**(0.002)**		
U_CRM	0.5		0.001			0.0002		0.006			0.008	0.004	0.002			
Methods	X,O,I	F	X,O,IM,I	O,IM	X	X,O,C	IM	X,O,IM,I	O,IM	X,O,IM	X,O,IM,I	X,O,IM	X,O,IM	X,O,IM		

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

Certification Laboratories

Huntington Alloys Corporation	Huntington, WV	Oxford Instruments Analytical GmbH	Uedem, Germany
Exova - Gary	Gary, IN	Laboratory Testing, Inc.	Hatfield, PA
ATI Specialty Materials, Monroe	Monroe, NC	ATI Specialty Materials, Lockport	Lockport, NY
Huntington Alloys Corporation	Huntington, WV	Anderson Laboratories, Inc.	Greendale, WI
Cannon-Muskegon	Muskegon, MI	Oerlikon Metco	Fort Saskatchewan, AB
EAG Laboratories	Liverpool, NY	VHG Labs	Manchester, NH

Certification laboratories have demonstrated performance and traceability by utilizing test methods under the scope of ISO 17025 or have shown competence through a proficiency testing program. Some of the specific CRMs and SRMs used in the analysis of the material covered by this certificate are:

NIST 126C   NIST 343A   NIST 867   NIST 3106   NIST 3128   NIST 865   NIST 3113   NIST 3131A   NIST 864   IARM 52B   IARM 53D

Homogeneity and Uncertainty

"Uncertainty" values, as reported adjacent to certified concentration values, are based on a 95% Confidence Interval. These estimated uncertainties include the combined effects of method imprecision, material inhomogeneity, and any bias between methods. Homogeneity data from experimental XRF results are reflected in both the overall statistics and certified data. Homogeneity samples are selected by a systematic sampling procedure. The number of samples may be determined by equation 1, where N_{prod} is the number of units produced and N_{min} is the number of samples used for homogeneity testing. These samples are arranged in a simple randomized design such that each sample is analyzed multiple times by XRF. Homogeneity may also be determined within sample using an applied version of ASTM E826. A single factor ANOVA is used to calculated uncertainty due to inhomogeneity (U_{hom}). Uncertainty of the material is calculated by equation 2, where H=U_{hom}, S= Standard deviation, t= t-value at 95% CI, and n= number of observations.

$$1. \quad N_{min} = \max(10, \sqrt[3]{N_{prod}})$$

$$2. \quad U_{CRM} = \frac{\sqrt{H^2 + S^2}}{\sqrt{n}} * t$$

Expiration

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

David Coler, General Manager

Analytical Reference Materials International