Certified Reference Material

Certificate of Analysis

ISO 17034:2016 · **ISO/IEC 17025:2017** · **ISO 9001:2015**

Product ID: IARM-FE455-22

Revision No.: 000
Revision Date: 09/25/2023

Product Description: Stainless Steel, Martensitic, Custom 455 / S45500

Description and Intended Use: This **Certified Reference Material** is covered under the scope of accreditation to **ISO 17034** by LGC Standards - Manchester, NH. As an ISO 17034 certified reference material, appropriate use of this material will fulfill the certified reference material and traceability requirements for use in **ISO 17025** accredited laboratories. This CRM may come in the form of a solid disk, or chips. The intended use of this CRM may include, but is not limited to, the calibration of instruments and the validation of analytical methods.

Certified Values listed in wt.% with associated uncertainties

Al	0.073	±0.002	**As**	0.0028	±0.0005	**B**	0.0011	±0.0002	**C**	0.0037	±0.0005
Co	0.023	±0.002	**Cr**	11.5	±0.1	**Cu**	2.20	±0.04	**Mn**	0.036	±0.003
Mo	0.064	±0.003	**N**	0.0031	±0.0006	**Nb**	0.25	±0.01	**Ni**	8.21	±0.08
O	0.0014	±0.0004	**P**	0.006	±0.001	**S**	0.0010	±0.0003	**Si**	0.086	±0.009
Sn	0.0049	±0.0005	**Ti**	1.16	±0.02	**V**	0.070	±0.003			

Indicative Values listed in ppm

Fe	Balance	W	95	Zr	14

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.

$$1. N_{MIN} = \max\left(10, \sqrt[3]{N_{PROD}}\right) \qquad 2. U_{CRM} = \frac{\sqrt{H^2 + S^2}}{\sqrt{n}} * t$$

Certification Laboratories: Much of the analytical work performed to assess this material has been carried out by laboratories with proven competence, as indicated by their accreditation to ISO 17025. It is an implicit requirement for this accreditation that analytical work should be performed with due traceability, via an unbroken chain of comparisons, each with stated uncertainty, to primary standards such as the mole, or to nationally- or internationally-recognised reference materials. Of the individual results herein, some have traceability (to the mole) via primary analytical methods. Some are traceable to substances of known stoichiometry. Most have traceability via commercial solutions. Furthermore, some results have additional traceability to NIST standards, as part of the analytical calibration or process control.

- AnchorCert - Birmingham, England
- Applied Technical Services - Marietta, GA
- Avon Specialty Metals LTD - Gloucester, England
- Connecticut Metallurgical, Inc. - East Hartford, CT
- Dirats Laboratories - Westfield, MA
- Elemental Analysis Inc. - Lexington, KY
- Laboratory Testing, Inc. - Hatfield, PA
- LGC Standards - Manchester, NH
- Luvak Inc - Boylston, MA
- New Hampshire Materials Laboratory Inc - Somersworth, NH
- NSL Analytical Services - Cleveland, OH
- Scrooby's Laboratory Service Pty Ltd - Benoni, South Africa
- Sheffield Assay Office - Sheffield, England

Instructions for Use: 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. 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. The material should be stored in a cool, dry location when not in use.
Chips are not recommended for gas analysis.

Period of Validity: 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.

Chuck Goudreau, Certifying Officer

September 25, 2023
Certification Date

ISO 17034 Accredited: Reference Materials Producer, Certificate # 2848.02
ISO/IEC 17025 Accredited: Chemical Testing, Certificate # 2848.01

Conditions of Sale and Supply: All CRMs & RMs sold are subject to applicable LGC Standard Terms and Conditions of Sale.

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

	Al	As	B	C	Co	Cr	Cu	Fe	Mn	Mo	N	Nb	Ni
1	0.0680	0.0018	0.0005	0.0020	0.0115	10.90	2.040	75.83	0.0256	0.0550	0.0020	0.2120	7.733
2	0.0680	0.0025	0.0009	0.0030	0.0172	11.10	2.070	76.66	0.0290	0.0570	0.0020	0.2180	7.980
3	0.0689	0.0028	0.0009	0.0032	0.0199	11.17	2.123	76.82	0.0292	0.0586	0.0031	0.2190	8.008
4	0.0690	0.0029	0.0010	0.0037	0.0200	11.30	2.150		0.0305	0.0610	0.0034	0.2240	8.114
5	0.0690	0.0030	0.0010	0.0039	0.0200	11.32	2.170		0.0306	0.0620	0.0034	0.2459	8.178
6	0.0692	0.0032	0.0010	0.0039	0.0206	11.32	2.172		0.0330	0.0630	0.0035	0.2474	8.198
7	0.0701	0.0035	0.0012	0.0040	0.0220	11.34	2.181		0.0330	0.0630	0.0035	0.2486	8.200
8	0.0714	<0.005	0.0012	0.0043	0.0227	11.40	2.184		0.0347	0.0640	0.0036	0.2488	8.200
9	0.0727	<0.005	0.0012	0.0043	0.0227	11.43	2.196		0.0364	0.0660		0.2500	8.201
10	0.0730	<0.005	0.0013	0.0044	0.0228	11.44	2.208		0.0378	0.0669		0.2500	8.210
11	0.0731	<0.005	0.0016		0.0230	11.45	2.210		0.0381	0.0670		0.2506	8.225
12	0.0738	<0.01	<0.00005		0.0230	11.48	2.221		0.0390	0.0679		0.2550	8.242
13	0.0740	<0.01	<0.005		0.0230	11.50	2.225		0.0400	0.0688		0.2550	8.250
14	0.0750		<0.01		0.0244	11.51	2.236		0.0409	0.0728		0.2590	8.254
15	0.0770		<0.01		0.0260	11.53	2.244		0.0410	0.0730		0.2600	8.262
16	0.0791				0.0260	11.60	2.245		0.0430			0.2600	8.304
17	0.0858				0.0270	11.62	2.260		0.0430			0.2620	8.360
18					0.0271	11.90	2.291					0.2820	8.460
19					0.0300	11.98	2.370					0.2930	8.550
20						12.11							
Avg	0.0728	0.0028	0.0011	0.0037	0.0226	11.47	2.200	76.44	0.0356	0.0644	0.0031	0.2495	8.207
SD	0.0046	0.0005	0.0003	0.0007	0.0041	0.29	0.0747	0.53	0.0054	0.0053	0.0007	0.0204	0.175
Certified	**0.073**	**0.0028**	**0.0011**	**0.0037**	**0.023**	**11.5**	**2.20**	**(76.4382)**	**0.036**	**0.064**	**0.0031**	**0.25**	**8.21**
Uncertainty	0.002	0.0005	0.0002	0.0005	0.002	0.1	0.04		0.003	0.003	0.0006	0.01	0.08
Methods	I,X,O,G,IM	I,IM	I,O,IM	C	I,X,O,G,IM	I,X,O,G	I,X,O,G	X,I	I,X,O,G,IM	I,X,O,G,IM	F	I,X,O,G,IM	I,X,O,G

	O	P	S	Si	Sn	Ti	V	W	Zr
1	0.0009	0.0038	0.0006	0.0630	0.0033	1.088	0.0610	0.0006	0.0001
2	0.0011	0.0040	0.0006	0.0670	0.0040	1.095	0.0610	0.0030	0.0003
3	0.0011	0.0041	0.0007	0.0710	0.0042	1.128	0.0620	0.0250	0.0010
4	0.0015	0.0041	0.0010	0.0718	0.0045	1.141	0.0622	<0.005	0.0020
5	0.0018	0.0048	0.0011	0.0720	0.0046	1.142	0.0652		0.0020
6	0.0019	0.0050	0.0011	0.0762	0.0047	1.144	0.0660		0.0030
7		0.0050	0.0011	0.0820	0.0049	1.146	0.0680		<0.0005
8		0.0050	0.0012	0.0844	0.0050	1.160	0.0710		<0.001
9		0.0060	0.0018	0.0850	0.0050	1.173	0.0718		<0.002
10		0.0069	<0.0001	0.0919	0.0050	1.175	0.0726		<0.002
11		0.0070	<0.0005	0.0949	0.0054	1.175	0.0728		<0.005
12		0.0070		0.1005	0.0059	1.176	0.0730		<0.01
13		0.0080		0.1020	0.0060	1.180	0.0740		<0.01
14		0.0080		0.1053	0.0066	1.190	0.0749		
15		0.0090		0.1200	<0.001	1.216	0.0750		
16		0.0100			<0.005	1.220	0.0754		
17		<0.001			<0.005	1.240	0.0762		
18		<0.005			<0.005		0.0767		
19					<0.01		0.0779		
20					<0.01				
Avg	0.0014	0.0061	0.0010	0.0858	0.0049	1.164	0.0703	0.0095	0.0014
SD	0.0004	0.0019	0.0004	0.0163	0.0009	0.041	0.0058	0.0135	0.0011
Certified	**0.0014**	**0.006**	**0.0010**	**0.086**	**0.0049**	**1.16**	**0.070**	**(0.0095)**	**(0.0014)**
Uncertainty	0.0004	0.001	0.0003	0.009	0.0005	0.02	0.003		0.0003
Methods	F	X,O,I,G,IM	C	I,X,O,G,IM	I,O,IM,X	I,X,O,G	I,X,O,G,IM	O,I,X	I,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

LGC