

QOTHO CERTIFIED REFERENCE MATERIAL (QCRM)

QCRM-2-177

FERROMANGANESE ALLOY

CERTIFICATE OF ANALYSIS

CERTIFIED VALUES			
ANALYTES	UNITS	CONCENTRATIONS	EXPANDED UNCERTAINTY
Mn	%	79.32	±0.24
ASSIGNED VALUES (FOR INFORMATION ONLY)			
ANALYTES	UNITS	CONCENTRATIONS	EXPANDED UNCERTAINTY
C	%	7.10	±0.06
Cr	%	0.031	±0.003
Fe	%	12.24	±0.23
Ni	%	0.009	±0.005
P	%	0.07	±0.01
S	%	0.011	±0.005
Si	%	0.61	±0.06

1. Use:

QCRM-2-177 is a certified reference material which is suitable for use as random control samples in routine analytical laboratory quality control, when inserted within a batch of samples and measured in parallel to the unknown. The QCRM can also be used as a control sample in the analysis of samples of a similar type, verification of analytical methods for Manganese Alloy and as a calibration standard for the calibration of equipment used for analysing similar materials.

2. Origin of Material:

This standard was sponsored by Transalloy.

3. Mineral and Chemical Composition:

This high carbon ferromanganese was produced via a pyrometallurgical process, utilizing chrome and manganese concentrates from South Africa.

4. Date of Initial Issue:

29 April 2022.

5. Packaging & Handling instructions:

The material was packaged as 100g unit sizes, placed in geo-envelopes, within a vacuum sealed aluminium foil bag. Open the seal of the foil with care and shake or otherwise agitate prior to use. Normal safety precautions for handling fine particulate matter are recommended, such as the use of safety glasses, breathing protection, gloves, and a laboratory coat. Once opened, material must be stored in a cool, dry environment. Results on page 1 is presented on dry basis. Analysis should therefore be done on dry basis, after drying to constant mass, at 105 degrees Celsius.

6. Method of Preparation:

The material was sieved through a 75-micron screen and the oversize was re-milled to ensure 100% passing through the screen. It was then blended, systematically divided, and packaged into 100-gram zip-lock bags. Randomly selected samples, from the bags, were tested in-house via XRF, to confirm homogeneity. Once confirmed and certification completed, the items were placed in geo-envelopes and vacuum sealed in aluminium foil bags.

7. Methods of Analysis used:

- Sodium peroxide fusion with ICP-OES finish
- Sodium peroxide fusion with Potentiometric Titration
- Iron and Manganese by multi-acid digestion and potentiometric finish
- Silica by multi-acid digestion and gravimetric finish
- Fused beads with XRF finish
- Carbon & Sulphur by combustion analysis.

8. Analysis required:

An instruction letter was sent to all participants. The analysis required was noted in the instruction letter and reporting template, including but not limited to Ba, C, Cr, Fe, Mn, Ni, P, S and Si.

9. Participating Laboratories:

NO	LABORATORY	COUNTRY
1.	Assmang Cato Ridge	South Africa
2.	Mitra SK India	India
3.	Mitra SK South Africa	South Africa
4.	SGS Malaysia	Malaysia
5.	UIS Analytical Services ICP	South Africa

10. Assay Data:

Data used for Assigning Values and Certification.

LABORATORY	Ba	C	Cr	Fe	Mn	Ni	P	S	Si
UNIT	%	%	%	%	%	%	%	%	%
LAB001	0.007	7.275	0.031	12.36	79.77	0.005	0.067	0.026	0.66
LAB002	0.032	7.06	0.031	11.22	78.735	0.022	0.058	0.009	0.6
LAB003					78.82				
LAB004		7.098		12.265	78.854		0.063	0.015	0.434
LAB005					79.705				
LAB006		7.075		12.31	79.8		0.072	0.009	0.617
LAB007			0.034	12.135	79.165	0.007	0.082		0.595
LAB008		7.057		12.09	79.765		0.072	0.009	0.802
LAB009			0.034	12.2	79.23	0.007	0.081		0.615
LAB010	0.023	7.085	0.031	11.19	79.31	0.02	0.057	0.009	0.615
LAB011					79.25				
LAB012		7.119		12.685	78.95		0.129	0.006	0.49
LAB013					79.745				
LAB014	0.006	6.805	0.031	12.33	79.385	0.005	0.067	0.014	0.65

11. Method of Certification:

QM is a SANAS Accredited Proficiency Testing Scheme Provider, No. PTS0012

This material was distributed as test items, in the Qotho Manganese PT Round 1 of 2022. The participating laboratories were each given two randomly selected samples (blind duplicates) from the batch, to analyse and report on in duplicate. Some laboratories reported results via more than one analytical method. Obvious blunders were resolved with the laboratories (if any), after which the data was processed using Robust Statistics, through PROLab Plus.

Not all the participating laboratories were accredited. Historical performance in Qotho PT Schemes, as well as an evaluation of the CRM QA/QC data generated by the laboratories, during the analysis of this QRM, were considered, to evaluate the competence of laboratories. Where competence could not be confirmed, the affected data was deselected from the dataset. Certification of analytes was then done, provided that a minimum of 10 qualifying datapoints remained available.

Where analytes could not be certified, estimate concentrations were assigned, using all the data in the dataset.

12. Measurement of Uncertainty:

Standard uncertainty, u_{CRM} , was calculated according to ISO 13528:2015 (equation 6), and it includes the effects of uncertainty due to inhomogeneity, transport, potential instability, and laboratory uncertainty. Because of all the uncertainties under consideration, QM further applies an expanded uncertainty, for certification purposes. The measurement uncertainty of the certified value is therefore calculated as follows: $U_{CRM} = k u_{CRM}$, where k is a coverage factor, which is determined from the Student's t -distribution, based on the degrees of freedom, per analyte.

This presents a certified value, as follows: $x_{CRM} \pm U_{CRM}$.

Measurement uncertainty for Assigned values, are calculated in the same manner.

Laboratories which prefer to use the 95% measurement uncertainty, rather than the expanded uncertainty, all available information relating to measurement uncertainty of the certified/assigned values, are given below:

Analyte	Unit of measure	s (Standard Deviation of Dataset)	v (Degrees of Freedom)	k (Coverage Factor)	u (Standard Uncertainty)	95% Measurement Uncertainty	Expanded Uncertainty
C	%	0.065	7	2.365	0.024	± 0.05	± 0.06
Cr	%	0.001	5	2.571	0.001	± 0.002	± 0.003
Fe	%	0.28	9	2.262	0.099	± 0.20	± 0.23
Mn	%	0.513	13	2.160	0.109	± 0.22	± 0.24
Ni	%	0.004	5	2.571	0.002	± 0.004	± 0.005
P	%	0.015	9	2.262	0.005	± 0.01	± 0.01
S	%	0.005	7	2.365	0.002	± 0.004	± 0.005
Si	%	0.063	9	2.262	0.027	± 0.05	± 0.06

13. Metrological Traceability:

The values quoted herein are based on the consensus values derived from statistical analysis of the data from an inter laboratory measurement program. Traceability to SI units is via the accredited laboratories, as ISO 17025 requires laboratories to use CRM's traceable to the SI units, during the calibration of their equipment. Not all laboratories were accredited.

Fortunately, most laboratories reported on the QA/QC CRMs used during the analysis of this QRM and reported the values obtained during the sample run. Evaluation of their QA/QC performance serves as further evidence of metrological traceability.

Equivalence tests were performed on all analytes to determine whether the metrologically traceable data and those for which traceability evidence was not available, could be treated as equal (at a level of significance of $\alpha = 0.05$). Where equivalent, all the data was used. Where not equivalent, only the metrologically traceable data was considered.

14. Minimum sample size:

The recommended minimum sample size for the use of this material is as per the participants method validation criteria.

15. Period of validity:

The certified values are valid for this product, while still sealed in its original packaging, for a minimum period of 5 years from date of Initial Certification. Stability monitoring of inventory will be done at regular intervals. Any concerns regarding potential instability of the material, will immediately be communicated to all consumers.

16. Legal:

This certificate and the reference material described in it were prepared with due care and attention. The requirements of ISO Guide 31, ISO 17043 and ISO 17034 were followed in the preparation of this reference material and certificate of analysis.

Qotho Minerals, however, accepts no liability for any decisions or actions taken following the use of the reference material. The company has a complaints procedure, which will be made available upon request, should there be any dissatisfaction with either the product or the COA.

Certifying & Technical Signatory	
Qotho Managing Director	29 April 2022

This Certificate of Analysis (CoA) has been electronically signed using an Advanced Electronic Signature (AES) in terms of the Electronic Communications and Transactions Act No. 15, 2002 (ECT Act). Any amendments to the CoA can be detected by reference to the Signature Panel displayed in the electronic pdf version of the CoA.

END