

CERTIFICATE OF ANALYSIS

13X 30300 (batch A)

Certified Reference Material Information

Type: FREE-MACHINING STAINLESS STEEL (WROUGHT)
Form and Size: Disc, 40mm diameter
Manufactured by: Stock Bar
Certified and Supplied by: MBH Analytical Ltd

Assigned Values

Percentage element by weight

Element	C	Si	S	P	Mn	Ni	Cr
Value ¹	0.041	0.424	0.312	0.0199	1.84	8.55	17.59
Uncertainty ²	0.002	0.006	0.005	0.0010	0.02	0.05	0.08

Element	Mo	Cu	Co	V	B	N
Value ¹	0.333	0.0252	0.0259	0.092	0.0035	0.0350
Uncertainty ²	0.005	0.0011	0.0010	0.003	0.0003	0.0013

Definitions

- ¹ The certified values are the present best estimates of the true content for each element. Each value is a panel consensus, based on the averaged results of an interlaboratory testing programme, detailed on page 3.
- ² The uncertainty values are generated from the 95% confidence interval derived from the wet analysis results, in combination with a statistical assessment of the homogeneity data, as described on page 2.

Certified by:

MBH ANALYTICAL LIMITED _____ on 5th March 2012

C Eveleigh

Method of Preparation

This reference material was produced from commercial barstock to UNS S30300. The metallurgical history is unknown.

Sampling

Samples for chemical analysis were taken from various positions throughout the bar. At least 10% of all discs were selected for non-destructive homogeneity testing.

Homogeneity

The discs were checked for lateral segregation, and for local and batch homogeneity using an optical emission spectrometer.

Using the combined data from each surface, standard deviation values were derived for each element as an indicator of any non-homogeneity (as determined for the specific sample size taken by the spectrometer).

Chemical Analysis

Analysis was carried out on millings taken from samples representative of the product. It was performed by a panel of laboratories operating within the terms of EN ISO/IEC 17025 - 2005, using documented standard reference methods and validated by appropriate reference materials.

The individual values listed overpage are the average of each analyst's results.

Estimation of Uncertainties

Each element certified has been analysed by several laboratories, and 95% half-width confidence intervals ($C_{(95\%)}$) for the resultant mean values have been derived by the method shown on page 3.

As a separate exercise, the degree of non-homogeneity of the batch for each element has been quantified by a programme of non-destructive application testing, discussed above.

The final certified uncertainty for each element has been derived by combining these two factors, using the square-root of the summed squares.

Traceability

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. In addition, some of the results derived as part of this testing programme have traceability to NIST standards, as part of the analytical calibration or process control.

Usage

Intended use: With optical emission and X-ray fluorescence spectrometers.

Recommended method of use: Steels are generally prepared by finishing, grinding, turning or milling. However, users are recommended to follow the calibration and sample preparation procedures specified by the relevant instrument manufacturer.

Preparation should be the same for reference materials and the samples for test.

The recommended sample size is at least five replicate analyses. Users are advised to check against possible bias between reference materials and production samples due to differences in metallurgical history, and be aware of possible inter-element effects.

Analytical Data

Percentage element by weight

Sample	C	Si	S	P	Mn	Ni	Cr
1	0.0383	0.412	0.300	0.0167	1.795	8.464	17.45
2	0.0387	0.413	0.301	0.0185	1.807	8.469	17.48
3	0.0394	0.420	0.305	0.0186	1.816	8.503	17.48
4	0.0400	0.421	0.310	0.0190	1.821	8.511	17.50
5	0.0400	0.425	0.310	0.0194	1.828	8.520	17.55
6	0.0400	0.426	0.310	0.0198	1.833	8.532	17.59
7	0.0410	0.427	0.310	0.0200	1.842	8.533	17.64
8	0.0420	0.433	0.312	0.0202	1.856	8.604	17.68
9	0.0427	0.433	0.318	0.0205	1.864	8.611	17.68
10	0.0431	0.434	0.322	0.0207	1.876	8.624	17.69
11	0.0433		0.322	0.0213	1.879	8.642	17.70
12	0.0445		0.323	0.0220	1.894		
13	0.0459			0.0221			
Mean	0.0414	0.424	0.312	0.0199	1.843	8.547	17.59
Std Dev	0.0023	0.008	0.008	0.0015	0.031	0.063	0.10
C (95%)	0.0014	0.006	0.005	0.0009	0.020	0.042	0.07

Sample	Mo	Cu	Co	V	B	N
1	0.322	0.0222	0.0240	0.0860	0.0028	0.0323
2	0.323	0.0238	0.0242	0.0876	0.0029	0.0328
3	0.327	0.0242	0.0249	0.0889	0.0032	0.0334
4	0.327	0.0242	0.0252	0.0895	0.0034	0.0336
5	0.328	0.0249	0.0254	0.0906	0.0034	0.0342
6	0.333	0.0252	0.0260	0.0908	0.0035	0.0351
7	0.334	0.0253	0.0266	0.0909	0.0035	0.0357
8	0.334	0.0255	0.0268	0.0946	0.0037	0.0360
9	0.337	0.0265	0.0278	0.0958	0.0040	0.0368
10	0.341	0.0270	0.0280	0.0963	0.0042	0.0371
11	0.342	0.0279		0.0984		0.0380
12	0.346					
Mean	0.333	0.0252	0.0259	0.0918	0.0035	0.0350
Std Dev	0.008	0.0016	0.0014	0.0039	0.0004	0.0019
C (95%)	0.005	0.0011	0.0010	0.0027	0.0003	0.0013

Note: $C_{(95\%)}$ is the 95% half-width confidence interval derived from the equation:

$$C_{(95\%)} = (t \times SD) / \sqrt{n}$$

where n is the number of available values, t is the Student's t value for n-1 degrees of freedom, and SD is the standard deviation of the test results.

Participating Laboratories

Exova Materials Testing
Metals Technology (Testing) Ltd
Sheffield Assay Office
Universal Scientific Laboratory
Laboratory Testing, Inc
Genitest, Inc
Institute of Iron and Steel Technology
Luo Yang Copper Co
Sargam Metals Pvt Ltd
TCR Engineering Services Ltd
Raghavendra Spectrometallurgical Lab.
De Bruyn Spectroscopic Solutions Ltd
Coleshill Laboratories Ltd
London & Scandinavian Met. Co Ltd
LECO Corporation

Middlesbrough, England
Sheffield, England
Sheffield, England
Milperra, NSW, Australia
Hatfield, PA, USA
Montreal, Canada
Shanghai, China
Luo Yang, He Nan, China
Chennai, India
Mumbai, India
Bangalore, India
Johannesburg, South Africa
Birmingham, England
Rotherham, England
St Joseph, MI, USA

UKAS accreditation 0239
UKAS accreditation 0963
UKAS accreditation 0012
NATA accreditation 0492
A2LA accreditation 0117
PRI accreditation 123077
CNAL accreditation 0783
CNAL accreditation 0173
NABL accreditation 0025
NABL accreditation 0367
NABL accreditation 0371

Note: to achieve the above-noted accreditation (eg UKAS, NATA, etc), test houses must demonstrate conformity to the general requirements of EN ISO/IEC 17025.

Analytical Methods Used

ELEMENT	RESULT No. & METHOD				
	ICP-AES	FAAS	GD-AES	OTHER	
Carbon	-	-	-	all	combustion (IR or volumetric detection)
Silicon	2, 4, 6	-	-	1, 3, 8	photometric (molybdenum blue)
Sulfur	4	-	-	5, 7, 9, 10	gravimetric (perchloric acid)
Phosphorus	1-3, 5, 6, 9, 12	-	7	1-3, 5-12	combustion (IR or volumetric detection)
Manganese	1, 3, 5, 7, 9, 10	4	12	8, 11	volumetric (alkalimetric)
Nickel	6-9, 11	-	1	4, 10, 13	photometric (molybdenum blue)
Chromium	1-4, 6, 7	-	10	6, 8	photometric (periodate)
Molybdenum	1, 3-5, 9, 10, 12	7	11	2, 11	volumetric (ferrous ammonium sulfate)
Copper	1-3, 5-8, 11	4, 9	10	2, 5, 10	gravimetric (dimethyl glyoxime)
Cobalt	1, 3, 4, 6-8	2, 5	10	3, 4	volumetric (dimethyl glyoxime/EDTA)
Vanadium	2-5, 7, 9-11	6, 8	1	5, 8, 9, 11	volumetric (ferrous ammonium sulfate)
Boron	2-4, 6-10	-	5	2	ICP-MS
Nitrogen	-	-	-	6, 8	photometric (thiocyanate)
				9	photometric (5-chloro PADAB)
				1	ICP-MS
				2, 4, 10	volumetric (hydrochloric acid)
				1, 3, 5-9, 11	inert gas fusion (thermal conductivity)

Notes

This Certified Reference Material has been produced and certified in accordance with the requirements of ISO Guide 34-2009, ISO Guide 31-2000 and ISO Guide 35-2006, taking into account the requirements of the ISO Guide to the Expression of Uncertainty in Measurement (GUM).

This certification is applicable to the whole of the disc. However, in accordance with normal practice for OES, it is appropriate to avoid usage of the central portion of approx 6mm diameter.

This material will remain stable indefinitely, provided adequate precautions are taken to protect it from cross-contamination, extremes of temperature and atmospheric moisture. All production records will be retained for a period of 20 years from the date of this certificate. This certification will therefore expire in March 2032, although we reserve the right to make changes as issue revisions, in the intervening period.

This sample is also available in the form of chippings.

The manufacture, analysis and certification of this product were supervised by C Eveleigh, PhD, Technical Director, MBH Analytical Ltd.

The material to which this certificate of analysis refers is supplied subject to our general conditions of sale.