

BRAMMER STANDARD COMPANY, INC.

CERTIFICATE OF ANALYSIS

BASIC OXYGEN FURNACE SLAGS

analysis listed as percent by weight

| BS No. | 101/1 | uc* | 101/2 | uc* | 101/3 | uc* | 101/5 | uc* |
|--------------------------------|-------|-------|---------|-------|---------|------|---------|------|
| CaO | 52.9 | 0.1 | 47.0 | 0.6 | 53.7 | 0.4 | 46.0 | 0.4 |
| SiO ₂ | 23.3 | 0.4 | 16.8 | 0.5 | 18.8 | 0.4 | 14.9 | 0.2 |
| Al ₂ O ₃ | 0.70 | 0.09 | 0.9 | 0.2 | 1.47 | 0.04 | 0.57 | 0.05 |
| MgO | 8.7 | 0.6 | 8.1 | 0.2 | 3.1 | 0.1 | 5.5 | 0.2 |
| TiO ₂ | 0.8 | 0.1 | 0.8 | 0.1 | 0.92 | 0.05 | 1.1 | 0.1 |
| T. Fe | 5.8 | 0.4 | 15.2 | 0.1 | 11.0 | 0.2 | 19.2 | 0.2 |
| MnO | 3.47 | 0.09 | 4.8 | 0.1 | 5.2 | 0.2 | 5.7 | 0.3 |
| P ₂ O ₅ | 0.76 | 0.06 | 0.70 | 0.05 | 0.77 | 0.08 | 0.71 | 0.03 |
| S | 0.19 | 0.01 | 0.23 | 0.04 | 0.19 | 0.02 | 0.12 | 0.01 |
| Na ₂ O | 0.013 | 0.008 | 0.031 | 0.008 | (0.028) | | (0.043) | |
| K ₂ O | 0.008 | 0.003 | (0.006) | | (0.006) | | (0.005) | |

The certificate values for these reference materials are the average results of chemical analyses. Several major steel companies provided the data and checked them by instrumental methods. The values shown as oxides have been calculated by converting the concentrations of the elements to the equivalent oxide forms. The oxide forms chosen are those normal to the steel industry for slag chemistry.

uc* The uncertainties listed are based on value judgments of the material inhomogeneity and the 95% confidence interval.

Dry the material for one hour at 105°C and mix well before using. The material has been pulverized to pass a #100 sieve.

Original Certificate of Analysis issued in September, 1976 with Certificate number CC976.

Revisions: Sodium and potassium oxide analyses were added on April 20, 1989 with Certificate number CC976-REV042089.

Uncertainties were added on February 02, 2009 with Certificate number 020209-101-SLAGS. Some values were updated to reflect the calculated uncertainties. Data in parentheses are not certified but provided for information only.

Stability was demonstrated with this revision for BS 101/1 only with additional laboratory testing from an ISO 17025 accredited laboratory on this **Certificate number 050616-101-SLAGS** . Revised values for all elements are presented and K₂O is now certified. The new revised values all fall within the previous uncertainties, proving stability. BS 101/4 was removed from this certificate as it was revised May 07, 2013 and upgraded to a Certified Reference Material. BS 101/2, 101/3, and 101/5 are currently being analyzed for stability.

Validity statement: ISO Guide 31 states that the certification should contain an expiration date for all materials where instability has been demonstrated or is considered possible, after which the certified value is no longer guaranteed by the certifying body. The certification of BS 101/1 is valid for at least 20 years at which time stability is verified and a new certificate will be issued. The material needs to be stored in cool, dry conditions to avoid any moisture contamination. The certification is nullified if this CRM is damaged, contaminated, or otherwise modified.

Certificate Number: The unique identification number for this certificate of analysis is 050616-101-SLAGS. You may obtain information on revisions of certificates from the internet at www.brammerstandard.com

Certified by: _____ on May 6, 2016.
Beau R. Brammer