



## Certificate of Analysis

Relates to products: AR 208, AR 208C, AR 208V, AR 1790, AR 1790C, AR 1790V, AR 3403

### BENZOIC ACID CALORIMETRIC CRM

LOT # 2204

The intended use of this reference material is for the calibration and or continued quality verification of combustion calorimetric methods. The quantity of energy evolved by combustion of Alpha Resources LLC's benzoic acid, when burned using a PARR 6200EA calorimeter [1] is given below, where the mass is against brass weights in air [2]

**26454 J/g  $\pm$  61 J/g**  
**6318 I.T. cal/g  $\pm$  15 I.T. cal/g**  
**11373 Btu/lb  $\pm$  26 Btu/lb**

This value is the average of the combustion of 67 benzoic acid samples (Lot 2204). The material used in production of this standard was identified in accordance with ARI-LAB-041. The samples for round robin testing were selected in accordance with ARI-LAB-625. The precision values represent the mean value and expanded uncertainty at a 95% confidence limit ( $k=2$ ) derived from analysis. This was determined by utilizing ANOVA and The Guide to Uncertainty Measurement. The calorimeter was calibrated with NIST Standard Reference Material (SRM) 39j benzoic acid. The results of the tests indicated no significant difference between the heat of combustion values of NIST SRM 39j and Alpha Resources LLC benzoic acid (Lot 2204). Metrological traceability is to the SI derived unit of mass fraction expressed as J/g, BTU/lb., and I.T. cal/g. This reference was produced in accordance with ISO17034. The above values relate only to the material used to produce this standard. Minimum and or alternative sample size may be used per your test method or instrument manufacturer.

**Handling and Storage:** Benzoic acid will not absorb moisture from the atmosphere if the relative humidity does not exceed 90%. The heat of combustion of the sample will not change with time if adequate precautions are taken to avoid the introduction of impurities.

**Expiration of Certification:** This reference material is stable while kept stored and sealed properly under normal laboratory conditions. Reported values are valid for 10 years from the date of certification.

#### [1] Combustion vessel Conditions

- Measuring mode isoparabolic (ISO 1928)
- Oxygen operating pressure charged to 450psi.
- Combustion reaction is between 25-27 °C
- Approximately 1-gram sample of benzoic acid is combusted.

[2] The reduction of weight in air to weight in vacuum results in a heat of combustion value of 26434 J/g for benzoic acid. This value uses the following assumptions:

- The density of benzoic acid at 25 °C is 1.320 g/cc.
- The density of dry air (1 atm and 20 °C) is 0.0012 g/cc.
- The density of brass is 8.4 g/cc.

***In routine fuel testing with the combustion vessel calorimeter, where an accuracy of not better than 0.1% is required, this buoyancy correction is generally not used. HP Benzoic Acid contains no Sulfur or Nitrogen, no correction is needed.***

This is a certified reference material CRM. The testing and production of this reference material is accredited and meets the requirements of ISO/IEC17025 and ISO17034 as verified by the ANSI-ANAB. **Refer to certificate and scope of accreditation(s) AT-1200 and AR-1920 for details.** Remedies for any claimed defect in this product will be limited to product replacement or refund of the purchase price. In no event shall Alpha Resources be liable for incidental or consequential damages. This certificate cannot be reproduced except in full.

**Certification Date: April 17, 2023**

**Dustin Jenkins, Ph.D., Global Technical Director**