



QUALITY ASSURANCE RESOURCES, LLC

8455 River King Drive, Freeburg, IL 62243, 618-539-5838

QAR-RM-1 Coal Reference Material

Part No.: QAR-RM-1 Lot No.:07331

Rank: High Volatile C Bituminous Coal Illinois USA

QAR-RM Reference Materials packaged in +50 gram bottles are produced by Quality Assurance Resources, LLC for use as Reference Materials in the Analysis of Coal. Homogeneity is verified in accordance with accepted IUPAC principles through the analysis of a random selection of bottled material. Assigned values and uncertainties for these materials are confirmed and validated by distributing the materials through the Quality Associates International, Ltd. (Canada) Proficiency Testing Program (CANSPEX™), which includes 132 coal testing laboratories from around the world. The QAR-RM Sample provides a range of values and test limits for Ash, Volatile, BTU, Carbon, Hydrogen, Nitrogen, Sulfur Forms, Chlorine, Fluorine, Mercury, Selenium, and FSI.

| QAR RM-1 hvCb Coal Illinois USA | | | | | | |
|--|--------------------------|---|---------------------------|-----------------------|-----------------------|-----------------------|
| Parameter | Most Likely Value | 99 % Confidence Interval Most Likely Value | Degrees of Freedom | 1S Test Limits | 2S Test Limits | 3S Test Limits |
| Moisture wt % | 7.62 | 0.04 | 108 | 0.17 | 0.34 | 0.51 |
| Ash wt % db | 6.94 | 0.01 | 112 | 0.07 | 0.14 | 0.21 |
| Volatile wt % db | 35.15 | 0.17 | 87 | 0.65 | 1.31 | 1.96 |
| Btu/lb db | 13093 | 7 | 107 | 40 | 80 | 121 |
| Carbon wt % db | 74.61 | 0.28 | 48 | 0.81 | 1.62 | 2.43 |
| Hydrogen wt % db | 4.79 | 0.05 | 43 | 0.14 | 0.27 | 0.41 |
| Nitrogen wt % db | 1.70 | 0.01 | 43 | 0.05 | 0.09 | 0.14 |
| Total Sulfur wt % db | 1.50 | 0.01 | 107 | 0.04 | 0.08 | 0.12 |
| Pyritic Sulfur wt % db | 0.288 | 0.023 | 17 | 0.036 | 0.072 | 0.107 |
| Sulfate Sulfur wt % db | 0.378 | 0.006 | 16 | 0.015 | 0.030 | 0.045 |
| Chlorine µg/g db | 3537 | 110 | 39 | 285 | 569 | 854 |
| Fluorine µg/g db | 45 | 3 | 24 | 7 | 13 | 20 |
| Mercury ng/g db | 121 | 3 | 23 | 7 | 15 | 22 |
| Selenium µg/g db | 1.3 | 0.3 | 8 | 0.2 | 0.5 | 0.7 |
| FSI | 1.5 | 0.1 | 48 | 0.5 | 1.0 | 1.5 |



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The composition of all coal samples changes with time through a variety of complex oxidation routes. To minimize changes in composition, QAR uses amber bottles with integral sealing and shrink seals on the caps. Composition change can be further minimized by keeping the material tightly sealed in a cool, dark place. QAR selects coals which demonstrate stability within the shelf life specified in this certificate. Ash, Total Sulfur, Hydrogen, Nitrogen, Chlorine, Fluorine, and Mercury have historically demonstrated stability for at least ten years. QAR will continue to monitor Gross Calorific Value Carbon and Volatile Matter.

THIS SAMPLE MEETS TRACEABILITY REQUIREMENTS OUTLINED IN *INTERNATIONAL STANDARD ISO 17025 GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES*.

QAR RM-1 WAS RUN THROUGH THE SAME CONTROLLED PROFICIENCY TEST PROGRAM (PTP) FOR THE SAME TEST PARAMETERS AS THE FOLLOWING CERTIFIED REFERENCE MATERIAL COALS: ISGS IBC105, ISGS IBC110, NIST1632C, NIST 2383B, NIST 2684B, NIST 2685B, NIST 2692B, NIST 2693, SABS SARM 18, USGS CLB-1, USGS CWE-1.

THE **MOST LIKELY VALUE (MLV)** CAN BE USED FOR MEASUREMENT CONTROL¹. THE CERTIFICATE INCLUDES THE 99 % CONFIDENCE INTERVAL OF THE MOST LIKELY VALUE, PLUS THE FOLLOWING TEST LIMITS: **1 STANDARD DEVIATION (1S)**, **2 STANDARD DEVIATION (2S)** AND **3 STANDARD DEVIATION (3S)** FOR A SINGLE CALIBRATION OR CONTROL MEASUREMENT. THESE TEST LIMITS TAKE INTO ACCOUNT THE CONFIDENCE INTERVAL OF THE MLV, WHICH INCLUDES SAMPLE INHOMOGENEITY AND THE PRECISION OF A STABLE UNBIASED MEASUREMENT PROCESS EMPLOYED TO DETERMINE THE CALIBRATION OR CONTROL VALUE.

A LABORATORY SHOULD INVESTIGATE AND RECTIFY CALIBRATION OR CONTROL CONDITIONS FOR ANY VALUE IN EXCESS OF THE **3 STANDARD DEVIATION (3S)** TEST LIMITS. A LABORATORY SHOULD IMPLEMENT PRACTICES TO VERIFY THE STABILITY OF CALIBRATION AND CONTROL CONDITIONS FOR ANY VALUE BETWEEN **2 STANDARD DEVIATION (2S)** TEST LIMITS AND **3 STANDARD DEVIATION (3S)** TEST LIMITS. A SINGLE CALIBRATION OR CONTROL VALUE WITHIN **1 STANDARD DEVIATION (1S)** OR **2 STANDARD DEVIATION (2S)** TEST LIMITS CAN BE CONSIDERED ACCEPTABLE.

THE FOLLOWING INFORMATION CONCERNING **TRACEABILITY TO RECOGNIZED CERTIFIED REFERENCE MATERIALS (CRMS) OR REFERENCE MATERIALS (RMS)** ARE INCLUDED IN THIS CERTIFICATE FOR INTERNAL AND EXTERNAL AUDIT PURPOSES.

¹ The RM sample bottle should be marked with a red line approximately ¼ of the height of the bottle from the bottom. When the level of the RM sample reaches the red line, a new bottle of control sample should be tested as an unknown to verify that the new control sample meets quality specifications stated on the control sample certificate. Prior to taking a test portion for analysis, all samples should be mixed by rotating the bottle end over end not less than 30 times in a figure eight fashion. As the sample in the bottle is depleted, the residual moisture content can change. A change of 0.1 wt % in the residual moisture can affect the dry heating value by as much as 14 BTU/lb. Check measurements of the residual moisture content whenever the laboratory relative humidity changes by more than 10 %.



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QAR SHALL NOT BE LIABLE FOR COSTS OF PROCUREMENT OF SUBSTITUTE PRODUCTS OR SERVICES, FOR ANY LOSS OF BUSINESS, LOSS OF USE OR OF DATA, INTERRUPTION OF BUSINESS, LOST PROFITS OR GOODWILL, OR OTHER INDIRECT, SPECIAL, INCIDENTAL, EXEMPLARY OR CONSEQUENTIAL DAMAGES OF ANY KIND ARISING OUT OF THIS AGREEMENT, EVEN IF QAR HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH LOSS, AND NOTWITHSTANDING ANY FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY. QAR'S TOTAL LIABILITY UNDER THIS AGREEMENT WITH RESPECT TO ANY PRODUCT AND/OR SERVICE SOLD HEREUNDER SHALL IN NO EVENT EXCEED THE PRICE PAID BY CUSTOMER FOR SUCH PRODUCT AND/OR SERVICE.

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