

CERTIFICATE OF ANALYSIS

ACIRS-H6-2017-Lot #1

**Certified Reference Materials for
Hardgrove Grindability Index**

(Set of 4)

| | |
|--------------------------|--------------------------|
| Certified: | August, 2017 |
| Valid to: | February, 2019 |
| Report Number: | ACIRS-H6-Lot#1-CoA-01 |
| Previous ACIRS-H series: | Supersedes ACIRS-H5-2016 |

1. Introduction

ACIRS-H6-2017-Lot#1 is a Certified Reference Material comprising a set of four jars each having a different Hardgrove Grindability Index (HGI) value. Samples have a nominal mass of 1 kg and top-size of 4.75 mm.

Sample preparation, homogeneity assessment and certification have been conducted by an AS ISO/IEC 17025 accredited facility in accordance with ISO 5074 and ASTM D409/D409M.

Production and certification was conducted in accordance with the technical and production requirements of ISO 17034 and overseen by ACIRS personnel representing Australian Coal Research Limited and the Australian Coal Preparation Society.

The intended use of these samples is as a quality control tool and for calibration of Hardgrove grindability machines.

2. Certified Values

Table 1 ACIRS-H6-2017-Lot#1 Certified Values*

| ACIRS-H6-2017 Lot#1 | Hardgrove Grindability Index ^a (HGI) | Standard Deviation ^b | No. of Samples | Uncertainty ^c (k=2) |
|---------------------|---|---------------------------------|----------------|--------------------------------|
| Sample A | 32 | 0.4 | 13 | 0.2 |
| Sample B | 44 | 0.2 | 13 | 0.1 |
| Sample C | 61 | 0.2 | 13 | 0.1 |
| Sample D | 87 | 0.6 | 9 | 0.4 |

* This is an empirical method. All values are provided in HGI units which have no absolute value.

NOTES

- HGI property values are the best estimate of the true HGI value and are based on the unweighted mean of means. Characterisation was conducted by ISO 5074 (direct comparison method) with a primary certified reference material supplied by Penn State University using the Australian national Hardgrove machine.
- Standard deviation (sd) is used to derive the likely range of results. The value for a measurand from a randomly chosen laboratory would be expected to lie within 2 x sd of property values with 95% probability.
- The certified uncertainty of this value is the expanded uncertainty with a coverage factor k=2 corresponding to a level of confidence of about 95%. Expanded uncertainty provides the user with information on the likely range of the true (but unknown) HGI value for the reference material. This corresponds to a 95% confidence interval and has been derived from the observed standard deviation of the population mean plus contribution from sample inhomogeneity. The contribution from instability is considered negligible.

3. Traceability

Empirical HGI values for ACIRS-H6-2017-Lot#1 are traceable to the certified (primary) reference materials Penn State University ASTM set serial number: 2017-33-13 when analysed by ISO 5074, ASTM D409/D409M and equivalent methods.

4. Instructions for Handling and Use

Sample bottles should be kept tightly sealed and stored in a cool, dark place. Do not freeze.

The reference material should be thoroughly mixed by end-over-end rotation before sub-sampling. Samples should be prepared and analysed in accordance with the most recent version ISO 5074, ASTM D409/D409M or equivalent. Minimum sample size is in accordance with ISO 5074 and ASTM D409/D409M.

ACIRS-H6D certified values are guaranteed in the range 35 to 60% relative humidity.

The Safety Data Sheet for this product is available from
www.acirs.com.au/products/hardgrove-grindability/

5. Source and Preparation

Samples of mass greater than 250 kg of each of 4 coals were obtained:

Sample A: High volatile thermal coal, South-East Qld

Sample B: High volatile thermal coal, Hunter Valley, NSW

Sample C: High rank bituminous thermal coal, Central Qld

Sample D: High rank bituminous coking coal, Central Qld

128 x 1kg sub-samples for each of A, B, C and D were prepared in strict accordance with ISO 5074 and Annex A1-A2 of ASTM D409/D409M. Blending was conducted by multiple rotary sample division steps.

6. Homogeneity Assessment and Certification

Confirmation of satisfactory homogeneity was conducted in strict accordance with ISO 5074 and Annex A3 of ASTM D409/D409M. The Australian national HGI machine was calibrated against primary certified reference material i.e. Penn State University ASTM set serial number: 2017-33-13. Values so generated are provided in Table 2 and were used in the creation of the calibration graph used to certify for ACIRS-H6-2017.¹

Table 2 Calibration of National Hardgrove Machine
ASTM certified reference material set (2017-33-13)

| HGI (units) | Mean mass - 75 µm (g) | Repeatability (units) |
|---|-----------------------|-----------------------|
| 41 | 3.79 | 3 |
| 59 | 6.86 | 3 |
| 76 | 9.30 | 3 |
| 97 | 12.14 | 3 |
| Linear regression HGI = 6.7213x + 14.341 (R ² = 0.997) | | |

13 samples² were selected from each of Lots A, B, C and D by a process of random systematic sampling and analysed in duplicate against this calibration line.

¹ Continuity of calibration was confirmed by comparing calibration lines used for certification of ACIRS-ACIRS-H5-2016 (Lot #1 and Lot #2).

² This represents 10% of the total production size for ACIRS-H6-2017

The HGI values and standard deviation of each sample is provided in Table 3. Samples A, B, C and D met the criteria for satisfactory homogeneity as specified in ISO 5074 cross referencing Annex A3 of ASTM D409/D409M-12. ACIRS-H6-2017 therefore passed homogeneity test criteria.

Table 3 ACIRS-H6-2017 homogeneity and certification data*

| | SAMPLE A | | SAMPLE B | | SAMPLE C | | SAMPLE D | |
|-----------------------------|----------------------------|------|----------------------------|------|----------------------------|------|----------------------------|------|
| | Mean mass (g of -75 µm) | HGI | Mean mass (g of -75 µm) | HGI | Mean mass (g of -75 µm) | HGI | Mean mass (g of -75 µm) | HGI |
| Average | 2.68 | 32.4 | 4.46 | 44.3 | 6.87 | 60.5 | 10.41 | 87.9 |
| Std. Dev. | | 0.36 | | 0.24 | | 0.24 | | 0.62 |
| No. samples | 13 | | 13 | | 13 | | 9 | |
| Yield, %⁺ | 69.3 | | 69.7 | | 68.1 | | 61.8 | |

* Based on Regression Equation in Table 2

⁺ Yield of -1.18 + 0.60mm size fraction

The analysis conducted for the determination of satisfactory homogeneity is equivalent to certification of Lot #1 comprising up to 24 sample sets. Certification data has been provided in Table 1.

Revision History

| Document Number | Summary | Date |
|-----------------------|----------|-------------|
| ACIRS-H6-Lot#1-CoA-01 | Original | 30/09/21017 |

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Approved by: Mark Bennetts
Australian Coal Industry Reference Samples (ACIRS)

PO Box 2315, DANGAR NSW 2309, AUSTRALIA

Phone +61 (2) 4926 4870

Fax +61 (2) 4926 4902

Email acirs@acps.com.au