# CERTIFICATE OF ANALYSIS

# ACIRS-H7-2019-Lot #2

## Certified Reference Materials for

## Hardgrove Grindability Index

## (Set of 4)

| | |
|---|---|
| Certified: | 8 April 2020 |
| Valid to: | September 2021 |
| Report Number: | ACIRS-H7-Lot#2-CoA-rev0 |
| Previous ACIRS-H series: | Supersedes ACIRS-H7-2019-Lot#1 |

## 1. Introduction

ACIRS-H7-2019 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.

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-H7-2019-Lot#2 Certified Values***

| ACIRS-H7-2019 Lot#2 | Hardgrove Grindability Index[a] (HGI) | Standard Deviation[b] | No. of Samples | Uncertainty[c] (*k*=2) |
|---|---|---|---|---|
| Sample A | 30 | 0.3 | 19 | 0.1 |
| Sample B | 46 | 0.3 | 19 | 0.1 |
| Sample C | 63 | 0.4 | 19 | 0.2 |
| Sample D | 86 | 0.4 | 19 | 0.2 |

** This is an empirical method. All values are provided in HGI units which have no absolute value. Certified values are valid when tested according to ISO 5074 and equivalent methods. As stated in ISO 5074 the grindability characteristics of samples may be altered by conditions during drying and preparation. Table 3 reflects average sample moisture and relative humidity at the time of production testing.*

**NOTES**

a. *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.*
b. *Standard deviation (sd) is used to derive the likely range of results. For normally distributed data, the value for a measurand from a randomly chosen laboratory would be expected to lie within 2 standard deviations of HGI certified value with 95% probability.*
c. *Uncertainty is an expanded uncertainty and provides the user with information on the likely range of the true (but unknown) HGI value and has been estimated in accordance with the Guide to the Expression of Uncertainty in Measurement (GUM) with a coverage factor k=2, corresponding to a level of confidence of about 95%. It 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-H7-2019-Lot#2 are traceable to the certified (primary) reference material set from Penn State University ASTM (serial number: 2018-36-16) 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 must 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.

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

## 5. Source and Preparation

For the ACIRS-H7 production lot, bulk samples of > 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

192 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

Confirmation of satisfactory homogeneity of the full ACIRS-H7 production lot was conducted in 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: 2018-36-16. Values so generated are provided in Table 2[1].

**Table 2 Calibration of National Hardgrove Machine**

| ASTM certified reference material set (2018-36-16) | | |
|---|---|---|
| **HGI (units)** | **Mean mass - 75 µm (g)** | **Repeatability (units)** |
| 39 | 3.78 | 3 |
| 53 | 5.70 | 3 |
| 70 | 8.76 | 3 |
| 93 | 11.82 | 3 |
| Linear regression HGI = 6.5842x + 14.282 ($R^2$= 0.996) | | |

Nineteen samples from the production batch 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[2]. 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[3]. Therefore, the production lot for ACIRS-H7-2019 is satisfactorily homogenous.

[1] Continuity of calibration was confirmed by comparing calibration lines used for certification of ACIRS-H6-2017 (Lot #2).
[2] This represents 10% of the total production size for ACIRS-H7-2019
[3] As specified in ISO 5074 and Annex A3 of ASTM D409/D409M-16

**Table 3 ACIRS-H7-2019 homogeneity and original certification data***

| | SAMPLE A | | SAMPLE B | | SAMPLE C | | SAMPLE D | |
|---|---|---|---|---|---|---|---|---|
| | **-75 µm mass (g)** | **HGI** | **-75 µm mass (g)** | **HGI** | **-75 µm mass (g)** | **HGI** | **-75 µm mass (g)** | **HGI** |
| **Average** | 2.39 | 30.0 | 4.80 | 45.9 | 7.47 | 63.5 | 39.18 | 85.5 |
| **Standard Deviation** | 0.04 | 0.26 | 0.04 | 0.28 | 0.05 | 0.36 | 0.06 | 0.38 |
| **No. samples** | 19 | | 19 | | 19 | | 19 | |
| **% Yield, -1.18 x 0.6 mm** | 65.5 | | 64.2 | | 63.2 | | 57.6 | |
| **Environmental conditions during testing** | | | | | | | | |
| Relative Humidity (%) | Mean: 64<br>Range: 57 - 75 | | Mean: 62<br>Range: 53 - 74 | | Mean: 64<br>Range: 54 - 74 | | Mean: 56<br>Range: 47 - 63 | |
| Air dried moisture (%) | Mean: 5.24<br>Range: 5.05 – 5.42 | | Mean: 5.50<br>Range: 5.13 – 5.69 | | Mean: 2.43<br>Range: 2.04 – 2.66 | | Mean: 1.31<br>Range:1.18 – 1.39 | |

** Based on Regression Equation in Table 2*

## 7. Certification

The data in Table 3 represents homogeneity of the full production lot and initial certification conducted concurrently i.e. certification of ACIRS-H7-Lot#1.

In March 2020, further testing was conducted on eight random samples from each of lots A, B, C and D. Each sample was divided by RSD into two and then each sample tested in duplicate (n = 16 for each of A, B, C and D).

This testing confirmed that HGI values from the original Lot#1 certification were stable with no significant changes. Therefore, Lot#2 of ACIRS-H7-2019 maintain the same HGI values as for original certification (see Table 1).

## 8. Period of validity

When stored and used in accordance with this certificate, ACIRS-H7-Lot#2 is considered stable until September 2021. It is the responsibility of the user to obtain the most recent Certification Report for this reference material available at www.acirs.com.au/products/hardgrove-grindability/

## 9. Health and Safety

Samples shall be handled in accordance with the Safety Data Sheet available from www.acirs.com.au/products/hardgrove-grindability/

## 10. Legal Notice

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**Revision History**

| Document Number | Summary | Date |
|---|---|---|
| ACIRS-H7-Lot#2-CoA-rev0 | Original | 08/04/2020 |

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