ACIRS-H10-2024-Lot #2

Certified Reference Material

for Hardgrove Grindability Index (Set of 4)

CERTIFICATE OF ANALYSIS

Table 1 ACIRS-H10-2024-Lot#2 Certified Values

ACIRS-H10-2024-Lot#2 CERTIFIED VALUES*					
	Hardgrove Grindability Index[a] (HGI)	**Standard Deviation[b]**	**Expanded Uncertainty[c] (*k*=2)**	**No. of Samples Tested**	**Repeatability**
Sample A	30	0.2	≤1.7	19	3 units
Sample B	48	0.2	≤1.7	19	3 units
Sample C	65	0.2	≤1.7	19	3 units
Sample D	84	0.3	≤1.7	19	3 units

** This is an empirical method. All values are provided in HGI units which have no absolute value. Certified values are valid when tested in accordance with ASTM D409/D409M-16 and equivalent methods. 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 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 tested by ASTM D409/D409M-16 with a primary certified reference material set supplied by Penn State University using the Australian National Hardgrove Machine.*

b. *Standard deviation (sd) is the standard deviation of sample means tested under repeatability conditions.*

c. *Expanded Uncertainty 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 deviations of the production process population means and includes contribution from sample inhomogeneity and instability.*

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Valid to: 31/01/2027
Report Number: ACIRS-H10-2024-Lot#2-CoA-rev0
Previous ACIRS-H series: Supersedes ACIRS-H10-2024-Lot#1

Accredited for compliance with ISO 17034
Accreditation Number 21027

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1. Introduction

This report describes the preparation and certification of ACIRS-H10-2024-Lot#2.

ACIRS-H10-2024-Lot#2 is a Certified Reference Material (CRM) comprising a set of four jars each having a different Hardgrove Grindability Index (HGI) value. Samples have a nominal mass of 1 kg prepared to -4.75+0.3 mm.

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

2. Description of the Samples and Preparation

For the ACIRS-H10-2024 production lot, bulk samples of mass greater than 450 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 subsamples for each of A, B, C and D were prepared to -4.75+0.3 mm top size by an AS ISO/IEC 17025 accredited facility tested to Annex A1-A2 of ASTM D409/D409M. Blending was conducted by multiple rotary sample division steps.

3. Instructions for Handling and Use

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

This set of CRMs **must** be thoroughly mixed by end-over-end rotation before subsampling. ACIRS cannot be held responsible for any changes that occur after the sample bottle has been opened.

Due to variation in the rank of these coal samples, it is critical that these samples have ample exposure time to ensure equilibration of the material, and it is stable before use. In some cases, additional equilibration time may be required.

Minimum sample mass, sample preparation and analysis should be in accordance with the most recent version of ASTM D409/D409M or equivalent test methods.

4. Homogeneity Assessment and Characterisation

Confirmation of satisfactory homogeneity was tested to Annex A3 of ASTM D409/D409M. The Australian National Hardgrove Machine was calibrated against primary certified reference materials as shown in Table 2. This data was used in the creation of the calibration graph used to certify for ACIRS-H10-2024[1].

19 samples[2] 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.

The HGI value 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 Annex A3 of ASTM D409/D409M-12, thereby passing homogeneity test criteria. The analysis conducted for the determination of satisfactory homogeneity is equivalent to certification of ACIRS-H10-2024. Certification data has been provided in Table 1.

[1] Continuity of calibration was confirmed by comparing calibration lines used for certification of ACIRS-H10-2024 (Lot #1).

[2] This represents 10% of the total production size for ACIRS-H10-2024.

In July 2025 further testing was conducted on four random samples from each of lots A, B, C and D. Each sample was tested in duplicate (n = 8 for each of A, B, C and D). Data was assessed using ACIRS-H10-2024-Lot#1 regression based on Penn State University (PSU) ASTM Primary HGI RM Set 2024-45-23 (Samples A, B, C, D) and ACIRS-H10-2024-Lot#2 regression based on PSU ASTM Primary HGI RMs Set 2024-45-23 (Samples A, B, C, D).

This testing and assessment confirmed that HGI values from the original (Lot#1) certification were stable with no significant changes. Therefore, Lot#2 of ACIRS-H10-2024 maintains the same HGI values as for original certification (see Table 1).

Table 2 Calibration of National Hardgrove Machine

PSU CRM set			
Serial number	**HGI (units)**	**Mean mass -75 µm (g)**	**Repeatability (units)**
2024-45-23 (Sample A)	44	4.19	3
2024-45-23 (Sample B)	58	7.17	3
2024-45-23 (Sample C)	74	9.15	3
2024-45-23 (Sample D)	91	11.40	3
Linear regression HGI = 6.5732x + 14.3165 (R^2= 0.984)*			

**Regression based on full dataset.*

Table 3 ACIRS-H10-2024 Homogeneity and 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	2.35	29.7	5.07	47.6	7.77	65.4	10.52	83.5
Standard Deviation	0.02	0.15	0.04	0.24	0.03	0.18	0.05	0.32
No. samples	19		19		19		19	
% Yield, -1.18 x 0.6 mm	66.4		66.3		65.3		61.1	
Environmental conditions during testing								
Relative Humidity (%)	Mean: 43 Range: 41 - 44		Mean: 50 Range: 48 - 52		Mean: 41 Range: 39 - 42		Mean: 60 Range: 54 - 65	
Air dried moisture (%)	Mean: 2.8 Range: 2.6 – 3.0		Mean: 2.5 Range: 2.4 – 2.7		Mean: 1.6 Range: 1.5 – 1.7		Mean: 1.5 Range: 1.4 – 1.6	

** Based on Regression Equation in Table 2*

5. Metrological Traceability

Empirical HGI values for ACIRS-H10-2024-Lot#2 are traceable to the primary set of CRMs produced by PSU, as listed in Table 2, when analysed by ASTM D409/D409M and equivalent methods.

6. Period of Validity

Property values are considered stable until January 2027. The stability of this sample will be monitored by ACIRS. It is the responsibility of the user to obtain the most recent Certificate of Analysis for this set of CRMs available at www.acirs.com.au/products/hardgrove-grindability/.

7. Health and Safety

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

8. Revision History

Document Number	Summary	Date
ACIRS-H10-2024-Lot#2-CoA-rev0	Original	31/07/2025

9. Legal Notice

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10. Authorisation

Approved by: Andrew Swanson (ACIRS Commercial Director)

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