

CERTIFICATE OF ANALYSIS

ACIRS-H8-2021-Lot #2

Certified Reference Materials for

Hardgrove Grindability Index

(Set of 4)

Certified: October 2022
Valid to: January 2024
Report Number: ACIRS-H8-Lot#2-CoA-rev0
Previous ACIRS-H series: Supersedes ACIRS-H8-2021-Lot#1



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1. Introduction

ACIRS-H8-2021-Lot#2 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 general accordance with ASTM D409/D409M-16.

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-H8-2021-Lot#2 Certified Values*

ACIRS-H8-2021 Lot#1	Hardgrove Grindability Index ^a (HGI)	Standard Deviation ^b	Uncertainty ^c (k=2)	No. of Samples Tested	Repeatability
Sample A	27	0.2	1.7	10	3 units
Sample B	44	0.2	1.7	10	3 units
Sample C	59	0.3	1.7	10	3 units
Sample D	83	0.4	1.7	10	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 according to 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

- 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 ASTM D409/D409M-16 with a primary certified reference material set supplied by Penn State University using the Australian national Hardgrove machine.
- Standard deviation (sd) is the standard deviation of sample means tested under repeatability conditions.
- 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 deviations of the production process population means and includes contribution from sample inhomogeneity and instability.

3. Metrological Traceability

Empirical HGI values for ACIRS-H8-2021-Lot#2 are traceable to the primary certified reference materials produced by Penn State University, as listed in Table 2, when analysed by 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 of ASTM D409/D409M or equivalent test methods (as above).

Minimum sample size is in accordance with ASTM D409/D409M or equivalent test methods.
The Safety Data Sheet is available from www.acirs.com.au/products/hardgrove-grindability/.

5. Source and Preparation

For the ACIRS-H8 production lot, bulk 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

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

6. Homogeneity Assessment

Confirmation of satisfactory homogeneity was conducted in strict accordance with Annex A3 of ASTM D409/D409M. The Australian national HGI 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-H8-2021¹.

Table 2 Calibration of National Hardgrove Machine

ASTM certified reference material set			
Serial number	HGI (units)	Mean mass - 75 µm (g)	Repeatability (units)
2021-40-04 (A)	42	4.16	3
2021-40-05R* (B)	59	6.96	3
2021-40-04 (C)	68	8.34	3
2021-40-04 (D)	92	11.31	3
Linear regression HGI = 6.982x + 11.532 (R ² = 0.993)			

*Sample B from the 2021-40-04 set was recalled by Penn State University and replaced by 2021-40-05R

19 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.

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 Annex A3 of ASTM D409/D409M-12. ACIRS-H8-2021 therefore passed homogeneity test criteria.

¹ Continuity of calibration was confirmed by comparing calibration lines used for certification of ACIRS- H7-2019 (Lot #2).

² This represents 10% of the total production size for ACIRS-H8-2021

Table 3 ACIRS-H8-2021 Homogeneity and Certification Data*

	SAMPLE A		SAMPLE B		SAMPLE C		SAMPLE D	
	-75 µm mass (g)	HGI						
Average	2.22	27.0	4.64	43.9	6.85	59.3	10.23	83.0
Standard Deviation	0.02	0.17	0.03	0.23	0.04	0.28	0.06	0.41
No. samples	19		19		19		19	
% Yield, -1.18 x 0.6 mm	67.1		67.1		67.1		62.8	
Environmental conditions during testing								
Relative Humidity (%)	Mean: 47 Range: 46 - 50		Mean: 37 Range: 35 - 38		Mean: 46 Range: 44 - 48		Mean: 52 Range: 51 - 55	
Air dried moisture (%)	Mean: 4.12 Range: 4.00 – 4.20		Mean: 3.13 Range: 3.07 – 3.18		Mean: 2.51 Range: 2.41 – 2.57		Mean: 1.11 Range: 1.09 – 1.14	

* 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-H8-Lot#1.

In September 2022 further testing was conducted on five random samples from each of lots A, B, C and D. Each sample was divided by rotary sample division into two and then each sample tested in duplicate (n = 10 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-H8-2021 maintain the same HGI values as for original certification (see Table 1).

----- Revision History

Document Number	Summary	Date
ACIRS-H8-Lot#2-CoA-rev0	Original	20/10/2022

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