SUBSIDIARY DOCUMENT

HUB TECHNICAL SPECIFICATION

Data ingestion, integrity and access

Version 0.1 · Draft for public consultation

Lagos Carbon | In Partnership with LASEPA | 2026
lagoscarbon.com

SUMMARY

This document sets the technical parameters that the Lagos Standard requires but does not itself state: how often data must be captured and transmitted for each Grouping, how its integrity is evidenced, how anomalies are raised and resolved, how gaps are treated, and how the record is retained and made accessible.

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Parent document	The Lagos Standard — Principles & Requirements, Version 0.1
Gives effect to	LS 5.2, LS 8.2, LS 8.3, LS 8.7, LS 11.2 and LS 11.3
Status	Subsidiary. Amended under LS 13.2 without amendment of the Standard.
Contact	amelie@carbonmater.com

SECTION 1

Purpose, status and application

HTS 1.1 This Specification gives effect to the requirements of the Lagos Standard Principles & Requirements (the Standard) in respect of data ingestion, integrity, anomaly detection, retention and access.

HTS 1.2 It binds the Hub Operator and every Project Developer whose activity is registered on the Hub.

HTS 1.3 Where this Specification conflicts with the Standard, the Standard prevails.

HTS 1.4 A Sector Annex may impose a requirement more stringent than a requirement of this Specification. A Sector Annex shall not relax a requirement of this Specification.

HTS 1.5 The parameters in this Specification are minimum requirements. A Project Developer may capture or transmit data more frequently, and is encouraged to do so where the Recognised Underlying Standard or the buyer requires it.

HTS 1.6 This Specification is amended under LS 13.2. An amendment that tightens a parameter takes effect in accordance with LS 13.4 and attracts the Change Resolution Period at LS 13.5.

Parameters are expressed as maxima for intervals and minima for quality. A requirement that data be captured "at intervals not exceeding 15 minutes" is satisfied by capture every 5 minutes and breached by capture every 30.

SECTION 2

Data ingestion by Grouping

HTS 2.1 Data shall be captured and transmitted to the Hub at intervals not exceeding those in the table below. "Capture" is the interval at which a measurement is taken. "Transmission" is the period within which a captured measurement shall reach the Hub.

Grouping	Category family	Capture interval	Transmission	Primary source
G1	Solar, wind and waste-to-energy generation	15 minutes	24 hours	Revenue-grade meter, IEC 62053 class 0.5S or better
G2	Methane capture and destruction; industrial gas destruction	15 minutes	24 hours	Continuous flow and composition monitoring at the destruction point
G2	Energy efficiency and fuel switching	15 minutes	24 hours	Sub-metering at the measurement boundary
G2	Waste management and landfill gas capture	15 minutes	24 hours	Flow metering, plus weighbridge records per delivery
G2	Clean cooking and cookstoves	Hourly, aggregated daily	7 days	Stove use monitoring sensor
G2	Transport emissions reductions	Per trip, aggregated daily	7 days	Telematics unit or ticketing system
G3	Afforestation and reforestation	5 years (field); quarterly (remote)	30 days of capture	Permanent sample plots, plus remote sensing under Section 4
G3	Soil carbon and regenerative agriculture	5 years (field); quarterly (remote)	30 days of capture	Stratified soil sampling, plus remote sensing and management records
G3	Blue carbon	5 years (field); quarterly (remote); hourly (hydrology)	30 days; 7 days for hydrology	Sample plots, remote sensing, and water level and salinity loggers
G4	Biochar	Per production batch	7 days	Feedstock and output mass balance; laboratory characterisation per Section 2.4
G4	Direct air capture	15 minutes	24 hours	Continuous energy and CO_2 flow monitoring, plus storage confirmation
G4	Enhanced mineralisation	Per application event; annual field sampling	7 days; 30 days for sampling	Application records and weighbridge data; field sampling

HTS 2.2 Metering and sensor requirements.

(a) A meter relied upon for Grouping G1 shall be revenue-grade, of accuracy class 0.5S or better, sealed, and calibrated at intervals not exceeding two years by a body accredited for the purpose.

(b) A sensor relied upon for Grouping G2 shall be calibrated at intervals not exceeding twelve months, and the calibration certificate shall be uploaded to the Hub.

(c) Each meter and sensor shall carry a unique identifier registered on the Hub and linked to the activity and the measurement boundary it serves.

(d) Replacement of a meter or sensor shall be recorded on the Hub before the replacement unit is relied upon, with the final reading of the unit replaced.

HTS 2.3 Clock synchronisation. Every device transmitting to the Hub shall synchronise to a network time source not less than once in twenty-four hours. A clock drift exceeding sixty seconds shall raise an Anomaly.

HTS 2.4 Laboratory characterisation — Grouping G4.

(a) Biochar shall be characterised for carbon content, hydrogen to organic carbon ratio and moisture by an accredited laboratory, at intervals not exceeding the lesser of one thousand tonnes of production and three months.

(b) Sample retention and chain of custody records shall be uploaded to the Hub with the result.

HTS 2.5 Manual entry. Where a measurement cannot be captured automatically, manual entry is permitted only where the applicable Sector Annex allows it, and shall be recorded with the identity of the person entering it, the time of entry and the supporting document.

Manual entry is the weakest evidence the Hub accepts and is treated as such in anomaly scoring under Section 3. Continuous capture is the design assumption of the Standard.

SECTION 3

Data integrity

HTS 3.1 Record contents. Each ingested record shall carry:

(a) the identifier of the device or source;

(b) the time of capture and the time of receipt, both in Coordinated Universal Time;

(c) the measured value and its unit;

(d) the quality flag returned by the device, where the device provides one; and

(e) the method of capture, being automatic or manual.

HTS 3.2 Hashing.

(a) The Hub shall compute a SHA-256 hash of each record on receipt and store it with the record.

(b) Records shall be chained such that each includes the hash of its predecessor for the same device.

(c) The Hub shall compute a root hash across all records received in each twenty-four hour period and publish it on the Register.

(d) Publication under subsection (c) allows any person to verify that a record produced later was present in the dataset at the time stated, without access to the dataset itself.

HTS 3.3 Immutability. An ingested record shall not be amended or deleted. A correction is made only under LS 8.7, by a new record that references the original, states the correction and the reasons for it, and leaves the original accessible.

HTS 3.4 Transmission security. Data shall be transmitted over an encrypted channel, and the transmitting device shall be authenticated to the Hub by a credential unique to it.

HTS 3.5 Duplicate detection. A record bearing a device identifier and capture time already present shall be rejected and shall raise an Anomaly.

SECTION 4

Remote sensing — Grouping G3

HTS 4.1 Acquisition. Imagery covering the full project area shall be acquired at intervals not exceeding three months.

HTS 4.2 Resolution and type.

(a) Optical imagery shall be of ground sample distance not exceeding ten metres.

(b) Synthetic aperture radar shall be acquired in addition to optical imagery for any project area subject to persistent cloud cover, and for all blue carbon activities.

(c) Where cloud cover obscures more than twenty per cent of the project area in an acquisition, a further acquisition shall be obtained within thirty days.

HTS 4.3 Change detection. The Hub shall apply automated change detection to each acquisition and shall raise an Anomaly where:

(a) canopy or vegetation loss exceeding two per cent of the project area is detected between acquisitions;

(b) any loss is detected within a permanent sample plot; or

(c) a change in land use inconsistent with the registered activity is detected.

HTS 4.4 Field measurement. Permanent sample plots shall be established at registration, georeferenced to within five metres, and re-measured at intervals not exceeding five years. Plot locations shall be withheld from publication where disclosure would create a risk to the plots or to the persons maintaining them.

HTS 4.5 Provenance. Each acquisition shall be recorded with its source, sensor, acquisition date, processing level and cloud cover percentage.

SECTION 5

Anomaly detection and resolution

HTS 5.1 Categories and thresholds. The Hub shall raise an Anomaly in each of the circumstances below.

Category	Trigger	Severity
Out of range	A value outside the registered operating range of the device	High
Flatline	An identical value across more than three consecutive capture intervals where variation is expected	High
Step deviation	A period-on-period change exceeding twenty per cent, or exceeding three standard deviations of the trailing ninety-day distribution	Medium
Missing data	More than one per cent of expected intervals absent in a monitoring period	Medium
Clock drift	Device time differing from network time by more than sixty seconds	Low
Duplicate	A record bearing a device identifier and capture time already present	Low
Calibration lapse	Reliance on a device whose calibration has expired	High
Manual entry density	Manual entries exceeding five per cent of records in a monitoring period	Medium
Remote sensing change	A trigger under HTS 4.3	High
Mass balance	Grouping G4: output inconsistent with feedstock input beyond the tolerance in the Sector Annex	High

HTS 5.2 Notification. An Anomaly shall be notified to the Project Developer within one Business Day of being raised.

HTS 5.3 Resolution.

(a) The Project Developer shall respond within ten Business Days of notification, stating the cause and the action taken.

(b) The response and its supporting evidence shall be recorded on the Hub and shall form part of the Lifecycle Record.

(c) An Anomaly of High severity that remains unresolved after twenty Business Days shall be escalated to LASEPA.

(d) An Anomaly is closed only when the Hub Operator records that the cause has been identified and the affected data corrected or excluded.

HTS 5.4 Effect on Attestation. An unresolved Anomaly affecting a monitoring period blocks confirmation of Qualifying Condition 2 under LS 7.2(b) in respect of any Issuance covering that period. Attestation shall not be applied until the Anomaly is closed.

This is the point at which the Standard's data requirements acquire consequence. An anomaly that is raised but never closed is not a reporting inconvenience; it prevents the Mark from being applied.

SECTION 6

Data gaps and conservative treatment

HTS 6.1 A gap is a capture interval for which no valid record exists, whether because none was received or because the record failed an integrity check.

HTS 6.2 Gaps shall be treated as follows, by reference to the proportion of expected intervals missing in the monitoring period.

Proportion missing	Treatment	Evidence required
1% or less	Interpolation permitted using the mean of the adjacent valid intervals	Record of the interpolation and the intervals used
More than 1% and not more than 5%	Substitution at the tenth percentile of the trailing ninety-day distribution for that device	Record of the substituted value and its derivation
More than 5% and not more than 15%	The affected intervals are excluded from the quantified output	Root cause analysis and corrective action plan
More than 15%	The monitoring period is not eligible for Attestation	Report to LASEPA under LS 12.1

HTS 6.3 Where the Recognised Underlying Standard prescribes a treatment for missing data that is more conservative than this Section, that treatment applies.

HTS 6.4 Every gap and its treatment shall be recorded on the Hub and shall be visible in the Lifecycle Record.

HTS 6.5 Repeated gaps arising from the same cause in consecutive monitoring periods shall raise an Anomaly of High severity irrespective of proportion.

SECTION 7

Retention, resilience and access

HTS 7.1 Retention. Records shall be retained for not less than fifteen years after the Retirement or Cancellation of the credit to which they relate, in accordance with LS 11.3.

HTS 7.2 Resilience.

(a) Records shall be replicated to a facility geographically separate from the primary facility.

(b) The recovery point objective shall not exceed one hour and the recovery time objective shall not exceed four hours.

(c) Restoration from backup shall be tested not less than twice in each year and the result recorded.

HTS 7.3 Access provisioning under LS 11.2.

(a) The Hub shall provide a read-only interface through which a person with a Legitimate Interest may obtain the Lifecycle Record of an Attested Credit.

(b) Access shall be granted on verification of identity alone, and shall not be referred to the Project Developer, the Hub Operator or the Issuer for approval.

(c) A request shall be answered within five Business Days.

(d) Where access is refused, the refusal and its reasons shall be recorded and reported to LASEPA within one Business Day.

(e) LASEPA shall hold standing access, not subject to request or to any condition.

Subsection (b) is the operative provision behind LS 11.2. If a request for a Lifecycle Record can be routed to the party with an interest in the answer, the Standard's independence claim fails in implementation whatever the text says.

HTS 7.4 Logging. Every access to a Lifecycle Record shall be logged with the identity of the person, the time and the records accessed. Access logs shall be available to LASEPA.

HTS 7.5 Personal data. Personal data shall be minimised in anything exposed through the interface at HTS 7.3, in accordance with LS 11.4.

SECTION 8

Change control

HTS 8.1 This Specification is amended under LS 13.2. A change to a parameter in Section 2, Section 5 or Section 6 is an Ordinary Change and requires consultation under LS 13.3.

HTS 8.2 A change to Section 3, Section 4 or Section 7 that does not affect the rights or obligations of a Project Developer may be determined as a Housekeeping Change.

HTS 8.3 Where an amendment tightens a parameter, the Change Resolution Period at LS 13.5 applies, and activities registered before the effective date shall have not less than twelve months to comply.

HTS 8.4 The Hub Operator shall maintain a public record of the version of this Specification against which each monitoring period was assessed.

Annex — Parameter summary

For reference. The operative requirements are in the sections indicated.

Parameter	Value	Clause
Capture interval, G1 and continuous G2	15 minutes	HTS 2.1
Transmission, continuous sources	24 hours	HTS 2.1
Transmission, intermittent sources	7 days	HTS 2.1
Field re-measurement, G3	5 years	HTS 2.1, HTS 4.4
Remote sensing acquisition, G3	3 months	HTS 4.1
Optical ground sample distance	10 metres	HTS 4.2(a)
Meter calibration, G1	2 years	HTS 2.2(a)
Sensor calibration, G2	12 months	HTS 2.2(b)
Biochar characterisation	1,000 tonnes or 3 months	HTS 2.4(a)
Clock drift tolerance	60 seconds	HTS 2.3
Root hash publication	24 hours	HTS 3.2(c)
Anomaly notification	1 Business Day	HTS 5.2
Anomaly response	10 Business Days	HTS 5.3(a)
Escalation, High severity	20 Business Days	HTS 5.3(c)
Gap threshold, interpolation permitted	1%	HTS 6.2
Gap threshold, period ineligible	15%	HTS 6.2
Retention	15 years after retirement	HTS 7.1

Parameter	Value	Clause
Recovery point / recovery time objective	1 hour / 4 hours	HTS 7.2(b)
Access request response	5 Business Days	HTS 7.3(c)

Document history

Version	Date	Summary
0.1	25 August 2026	First draft issued alongside Version 0.1 of the Standard.