

SHIPPING & LOGISTICS MANUAL

2025 // Logistics Operations v1.5 // Multi-Modal Distribution

OPERATIONAL SCOPE

This manual defines the physical and digital movement protocols for fresh produce under the 2026 Industry Standards. Success is measured by the **integrity of the Cold Chain** and the **synchronization of the Digital Twin**.

1. Smart Cold Chain Protocols

Temperature management is the primary factor in shelf-life preservation. All carriers must maintain IoT-active reefers with real-time telemetry.

- ☐ Pre-cooling to commodity setpoint (T_{target}) before loading.
- ☐ Continuous data transmission (5-minute intervals) to the Secure Ledger.
- ☐ Humidity control maintained between 85%–95% for leafy greens/berries.

2. Transport & Emission Standards

In alignment with 2025 ESG mandates, carbon intensity must be logged for every leg of the journey.

$$\text{Total CO}_2e = \Sigma (\text{Leg Distance} \times \text{Transport Mode Factor})$$

3. Operational Responsibilities

Phase	Required Action	Data Output
Origin	Pre-cooling & Palletization	GS1-128 / QR Code Gen
Transit	Climate & GPS Tracking	IoT Telemetry Stream
Transfer	Cross-docking (<120 mins)	Timestamped Scan Out
Arrival	Seal Verification & QC Sync	Final Ledger Update

4. Emergency & Backup Protocols

In the event of **Digital Infrastructure Failure** (Cyber-attack or grid collapse), the following manual steps apply:

- Revert to physical Bill of Lading (BoL) and paper-based Temperature Logs.
- Manual verification of reefer settings every 4 hours.
- Local storage of data for batch-uploading once connectivity is restored.

