

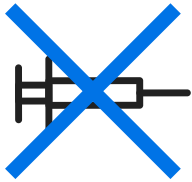


Reimagining Cold Chain Operations for Food and Pharmaceutical Goods

Gaining a Performance Edge in Challenging Cold Chain Conditions with Zebra Technologies



The cold chain is complex. Most vaccines need to be maintained at between 35°F and 46°F¹ / 2°C and 8°C, while approximately 40% of all food needs to be transported at set temperatures to prevent textural degradation, bruising, and microbial growth. And, despite best efforts, unexpected temperature fluctuations, inaccurate records, insufficient packaging, transit delays, and equipment failure are stubborn issues which can lead to temperature excursions.



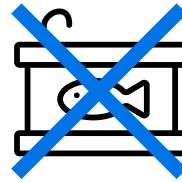
50%

of the world's vaccines are wasted due to temperature control, shipment, and supply chain issues²



40%

of all food is thrown away each year (around 2.5 billion tonnes)³



22%

of the food waste in the U.S every year happens after production and before consumption⁴

New technologies are combining to provide greater visibility over the cold chain. RFID and barcode labels make it easy to track items from the farm or plant to their end destinations. Easily deployed wireless electronic temperature sensors and loggers can stream data through vehicles, coolers, and containers, providing a real-time view over the progress and status of temperature-sensitive produce. Ready-to-use and printable indicators are providing innovative solutions too. They can monitor critical environmental exposures at item or shipment level, across sectors, including pharmaceutical, biotech, emergency medical services, and food distribution.

All data captured from our electronic sensors and bridges and via our mobile devices can be uploaded to the secure Zebra Cloud. From there, Zebra's application programming interfaces (APIs) enable trusted data exchange with your partners' supply chain systems. Also, intuitive developer tools streamline the integration of sensor data into systems of record, to enable data analytics that can help optimize supply chain performance.

And, wherever your people go, even in the freezer or chiller room, our rugged mobile devices can go with them. The devices make it easier for people to keep a constant eye on item status, with clear instructions to look after goods that pass through their care. The devices are part of an ecosystem which gives you visibility over a product's temperature status, location, and estimated time of arrival.

This insight, driven by data analytics, enables teams to sense, analyze, and act upon temperature excursions in real time.

1 www.cdc.gov/index.htm

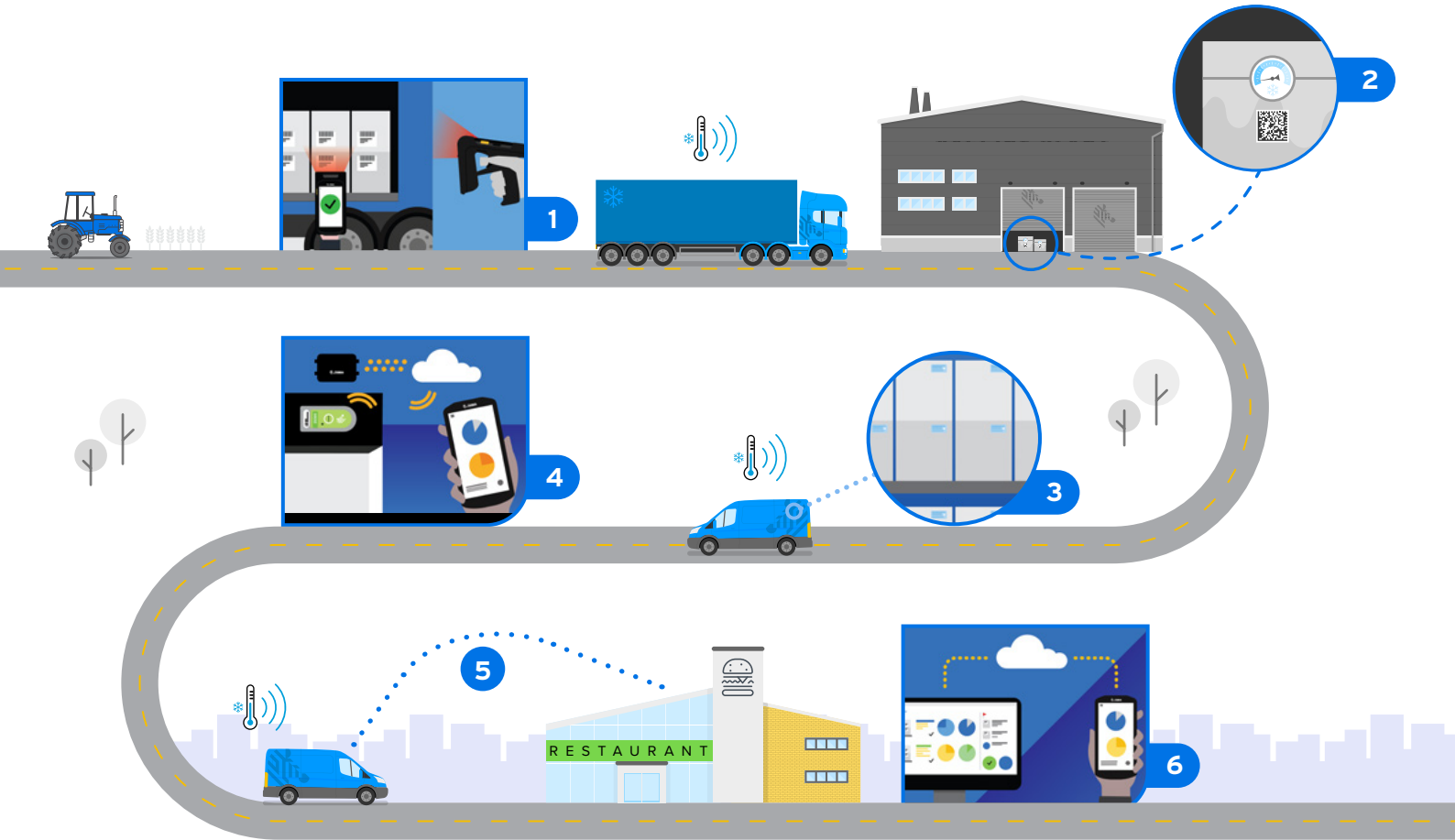
2 WHO

3 Foodlogistics.com

4 <https://progressivegrocer.com/how-grocers-can-lead-charge-reduce-food-waste-save-energy>

A New Perspective Across the Cold Chain

Food, biologics, and vaccines require strict control of environmental parameters including temperature ranges, humidity levels, light exposure, and more. Our devices and solutions monitor environmental exposures critical to maintaining the quality of your products, as illustrated below, involving a shipment of produce from farm to fork.



1. Farm gate

- Produce is tracked and traced using RFID labels
- APIs and Zebra's Secure Cloud enable data to be shared with warehouse and transport management systems (including, for example, critical tracking events⁵, defined by legislation such as FSMA 204)
- Electronic temperature sensors are added to containers as the produce makes its way to manufacturing

2. At the factory: Quality optimization and defeating counterfeiters

- Unique ID labeling (2D barcodes / RFID) enable simple tracing across production
- Accurate, easy scanning for traceability
- Machine vision cameras automatically check products for quality and packing benches for compliance with quality processes

3. Transport: Visibility across journeys

- RFID labels attached to pallets, cases, or items for track and trace
- Mobile devices check item status and handling instructions, and accurately capture data
- Electronic temperature sensors can complement existing refrigerated truck systems by, for example, providing validation that temperatures were within range through the entire hold space (such as by the door or for a specific pallet) and providing continuous visibility into temperature and location data, raising alerts if an item goes out of the appropriate temperature range
- Temperature indicators and temperature-sensitive labels can be added to packaging or individual items to visually alert teams to any temperature excursions
- Mobile device-based paperwork boosts productivity for drivers and recipients

4. Monitoring and tracking goods in the distribution and fulfillment center

- Auto-register goods-in (fixed RFID) for consignment ID
- Monitor goods continuously, including temperature exposure
- Handheld devices and vehicle-mount computers withstand various levels of condensing environments as goods are stored and moved

5. Last mile delivery to restaurant

- Electronic temperature sensors and indicators can monitor for excursions at truck, pallet, pack, and item level
- Goods are quickly registered into the final destination (e.g., supermarkets, restaurants) using fixed or handheld RFID readers

6. Visibility in the cloud

- REST-based APIs connect data collected from the field and electronic sensors into Zebra Secure Cloud
- Cloud-based ledgers can be used to create a single, secure version of consignment progress, accessible by all parties in the supply chain

⁵FSMA legislation defines the type of key data elements (KDEs) which must be captured during critical tracking events (CTEs). CTEs include the harvesting and cooling of food, the packing of foodstuffs, the shipping and handovers between parties in the supply chain, and more. See here for more.

Environmental Sensing Solutions

Our range of electronic sensors and ready-to-use and printable temperature indicators reimagine the supply chain, helping you to see and know more.

Zebra Electronic ZS300 Sensor and the ZB200 Bridge

The ZS300 Sensor is fixed via a self-adhesive label (or optional magnet) to pretty much any material including pallets, packaging, and the interior of shipping containers. It can collect and store data between -40°F and +185°F (-40°C and +85°C), and share this wirelessly to the ZB200 bridge or Android™ mobile device. With the bridge's Wi-Fi and Ethernet connections, the temperature data, which is authenticated and encrypted, can be streamed via REST-based APIs into your warehouse and supply chain management systems. Additionally, with the Zebra ZSFinder Android Sensor Discovery App, people handling goods gain a real-time view over the shipment's temperature status and share the temperature data via their Android mobile device.

The sensor's powerful yet simple enterprise software toolkit eases integrations and, with IP67 certification, the sensor is built tough for life in the supply chain. The solution provides timely and accurate data for confident decision-making. Furthermore, with Zebra's end-of-life recycling service, it supports your net zero or environmental goals.

Ready-to-Use Temperature Indicators for Shipping

Zebra ready-to-use indicators provide clear visual warnings for products such as food, biologics, and pharmaceuticals when temperature limits have been exceeded during transit, storage, and utilization. Single use, requiring no activation, irreversible, easy to understand, and customizable with branding and instructions for consumers, the indicators help extend quality management from harvest or production through to use.

Find the Right Sensor and Selector for You

A range of factors may impact your assets from manufacturing, processing, storage and transportation to their final destination. With our interactive selector tool, answer a simple set of questions to discover the ideal sensors that provide the environmental condition visibility you need throughout your assets' journeys.

Click [here](#) to learn more.



Ready-to-Use Food Temperature Indicators

Our Fresh-Check indicator is an intelligent companion to use-by dates on packaging. It contains a reactive material which changes color irreversibly, faster at higher temperatures and slower at lower ones, so it's easy to see when the specified time and temperature limit for a product has been reached. The affordable indicators are specially formulated for your product's life requirements, such as 8 days at 40°F, or 23 days at 40°F. The indicators promote quality and can help influence consumer buying decisions in-store.

ZeOn-Demand Printable Temperature Indicators

Our customizable, printable indicators add an extra layer of critical information on a thermal printable label, combining asset identification for tracking and tracing across the supply chain with environmental insights into a single solution. With direct thermal printing, paper labels, and tag options, indicators are available to provide a clear visual sign of irreversible and reversible temperature exposures, irreversible humidity, and exposure to steam sterilization.

To assist in advancing the efficiency and productivity of your cold chain operations, our certified printer and labels supplies program produces the highest-quality, pre-tested labeling: from ensuring labels withstand harsh environmental conditions that include freezing temperatures and moisture, to providing excellent print quality with each command. And, through our Zebra ZipShip service, we ensure the fast dispatch of your desired consumables, off the shelf, with a minimum order quantity of only one box.



To easily select and order Zebra Certified Supplies, visit [here](#).

Mobile Devices for Cold Chain Environments

The cold chain is hard on technology. When teams move their mobile devices between ambient, chilled, and freezer environments, condensation often results. It can ruin sensitive electronics. Ice may freeze onto keyboards. Foggy displays can be hard to read. The cold can also lead to sluggish app performance. Batteries often drain faster too. What's more, your teams may be working inside and outside, in all weathers and variable light conditions, and many will be wearing gloves.

To overcome these issues, our experienced human factors design team spends time working alongside and observing personnel operating in demanding environments to create intuitive, ergonomic, and highly dependable mobile devices. The lineup includes rugged mobile computers, printers, scanners and rugged scanners, tablets, vehicle-mounted computers, and wearables, which help your teams to:

- **Streamline cold storage handling:** With special cold chain features, such as heated scan windows, touchscreens, and keyboards, along with freezer-rated batteries and internal heaters, your workers' devices go where they go, ensuring constant connectivity to business-critical apps and data.
- **Increase accuracy and productivity:** Your teams are sure to be continually entering and retrieving data. Choosing the best device for this job means identifying the conditions it needs to withstand and selecting the form factor which enables the freedom of movement across environments. A wide range of device configurations and accessories enable you to tailor devices to people's roles, creating a solution for every type of worker, with access to the accurate, reliable, and fast applications and features they need to power through tasks from the freezer, to the yard, and beyond.
- **Make informed decisions:** Your teams working at the edge of your business can quickly reference proper handling instructions and temperature requirements, to confidently make their next best moves.

Zebra Device Software

Our powerful software lineup extends our devices' performance and life cycles. The embedded utilities, developer tools, and apps make it easier to deploy, secure, remotely manage, and diagnose our technology including RFID readers, printers, scanners, and mobile devices. For example, our mobile computers include ready-to-go and powerful productivity- and collaboration-enhancing apps, enhanced connectivity, and a service to prolong their operation with patches and software updates way beyond the typical three years provided by Android.

For peace of mind, we also provide a range of enterprise service and support with top-to-bottom, inside-out preventive care for your mobile devices and the workflows they empower. Choose a "right-for-you" maintenance plan that's tailored to your needs, with a range of response levels.

Enterprise-Class Applications

Our global network of independent software vendors (ISVs) can help you identify the best existing applications to meet your needs or provide customized solution development to address bespoke requirements.

Our robust, proven cloud platforms make it easy to collect, store and secure data from the location, state, and sense of your tagged enterprise resources. And with our analytics you gain actionable insights. Shared through your applications, the insights can be accessed by your teams with solutions to simplify operations, digitize workflows and enhance performance. Drivers and handlers can more easily and accurately monitor item temperatures, logistics managers can view order progress in real-time and plan accordingly, depot leaders can manage operatives and adjust tasking on-the-fly, and teams across the supply chain can better anticipate their next moves with insight into the location and status of vehicles and shipments.

You can also make operational data available to partners across the supply chain. This enhances collaboration, and improves transparency when it comes to tracking, tracing, and validating the status of temperature-sensitive items.

Deep Expertise, Knowledge, and Experience

As a long-standing leader in enterprise mobility solutions, we can help improve real-time visibility across your supply chain, to see and understand more about the status of materials and products as they travel from harvest and manufacture to the end user.

Our devices and electronic sensors are made for rugged supply chain environments and to be simple to deploy, integrate, secure, manage, and maintain. And our range of temperature indicators and labels are easy to use, needing only to be placed in with, or adhered to, packaging and consignments to provide trusted visual alerts for any unexpected temperature events.

Our solutions give you the confidence to make informed decisions about the products in your care, while the data and insights collated can help identify and smooth supply chain issues to optimize processes.

For more information, please visit [here](#).



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