

Improving Quality Assurance in the Meat and Seafood Cold Chain Product Section



## Introduction

According to the Centers for Disease Control (CDC) approximately one in six Americans is sickened each year by food borne illnesses. That's nearly 48 million preventable illnesses. Worse, incident rates for the six most common pathogen are increasing. The best prevention, according to the FDA, is to properly treat or cook the food and then to chill it to temperatures that prevent the growth of pathogen and the formation of toxins.

Although the optimum temperatures differ, meats and seafoods all must maintain exact temperatures throughout shipping to ensure quality, palatability, and safety through the journey from origination to the ultimate customer. For these products, it's not enough to ensure they are frozen or refrigerated. Here, the exact temperature matters.

For example, fresh beef and scallops should be maintained at 0° to 1°C, while cured farm-style bacon is stable at 16°-18°C\*\*.

Optimal frozen temperatures vary, too, depending upon the product. Frozen fish should be kept between -29° and -23°C, while frozen lamb and pork may be as warm as -18°C. However, most cold storage retailers and shippers specify that frozen meat be stored at -24°C. Excursions outside those parameters may affect the texture, flavor, and safety of these foods.

## Regulations and associated monitoring requirements

The Food Safety Modernization Act (FSMA), which was signed into law in 2011 and phased in gradually, remains one of the most recent attempts to improve food safety for American consumers.

Although the FSMA is the most significant change to food safety regulations in the past 70 years, it is expected to have little impact upon facilities already in compliance with Hazard Analysis Critical Control Point (HACCP) guidelines for seafood and meat. (Under HACCP, plants develop plans based upon their own risks and conditions, leaving them free to innovate.)

Overall, the FSMA requires food facilities to develop written

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plans to prevent unsafe and unsanitary conditions based upon hazards for the food it handles. The plan must specify preventive controls, identify monitoring strategies, maintain monitoring records, and stipulate actions to correct any problems.

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This freedom, however, undoubtedly will cause some confusion among importers and small and medium-sized food companies as they attempt to interpret and comply with the regulation and the massive record-keeping it demands. This increase in regulation will inevitably increase costs to business that will be passed on to the consumer.

## The proper handling and storage of seafood

Despite the FSMA and HACCP guidelines, food safety remains an issue. Nearly one third of the 504 warning letters issued by the FDA in 2017 were for food or dietary supplements, and almost 10 percent of those were issued to seafood companies. There were a variety of issues, but infractions in good manufacturing practices comprised a large group – 19 percent – of the letters.

Some of the problems were simple, like the 2018 case in which apples were stored outside without temperature controls. Other issues involved failure to adhere to companies' own HACCP plans. For example, in 2018, a fish



processing plant in Kentucky received a warning letter from the FDA citing improper temperature monitoring. Although the plant used a temperature recorder, management failed to use it throughout production and didn't know what the critical temperature limit was in Celsius – the unit of measurement used by the recorder.

The challenge for seafood is exacerbated by a long, sometimes complicated, supply chain that more than 90 percent – nearly \$20 billion of edible fishery products – is international. A GAO analysis shows that of that 90 percent, 21 percent of US seafood is imported from China. Canada is the next largest contributor, at 12 percent.

The FDA, already stretched thin with US pharmaceutical inspections, devotes only a small percentage of its resources to food. Although it requires seafood producers to adhere to certain safety standards, in 2015 it inspected slightly more than two percent of the products.

Multiple handoffs further complicate the process. Even though one supplier may handle fishery products properly, it's difficult to know whether handlers upstream or downstream took similar precautions to guarantee the cold chain. According to the FDA, time and temperature abuse at a single step may not make a product unsafe, but abuse in successive processing steps may allow pathogens to grow and produce toxins. Tuna scrape is a good example. Burgeoning numbers of fish processors along the tuna-rich Indian Ocean extract as much value as possible from their catches by scraping the bones for back meat, which is combined with that of many fish and sold for sushi and similar products. Tuna scrape should be kept at sub-freezing temperatures, but it's easy for mistakes to be made, particularly when the product comes from multiple small processing facilities. That difficulty, among others, contributed to the Salmonella Nchanga outbreak in 2012 and the recall of nearly 59,000 pounds of yellow fin tuna.



The FDA's Enforcement website shows letters sent to seafood companies. Specific issues varied by company, but a look at several reveals calls for monitoring temperature in transit, continuous temperature monitoring, daily temperature and equipment checks, secondary control strategies to prevent toxin formation, and monitoring temperatures while thawing. One firm a few years ago failed to record refrigeration temperatures when the recording pen ran out of ink, among other violations. Companies typically are given 15 days to correct the issue before products are seized or they are closed down. For importers, fish may not be allowed to enter the country. Minimizing the risk of receiving an FDA warning letter and the subsequent disruption to business involves not only controlling temperature in your own operations, but also ensuring that incoming fish were handled and transported properly by the previous processor to minimize pathogen growth rates.

According to the FDA Fisheries Guidance, CHAPTER 12: Pathogenic Bacteria Growth and Toxin Formation (Other Than *Clostridium botulinum*) as a Result of Time and Temperature Abuse, "Growth rates of pathogens are highly temperature dependent. Ordinarily, pathogenic bacteria growth is relatively slow at temperatures below 70°F (21.1°C). In most cases, growth is very slow below 50°F (10°C), and 40°F (4.4°C) is below the minimum growth temperature of *eria*, although there are some exceptions."

### Temperature management of meat

Perfect temperature management is just as critical to maximize the shelf-life of case-ready meats as it is for fresh or frozen products. Case-ready meats are packed in a central facility, and shipped to the customer ready to be placed in a refrigerated case. To prolong shelf life, oxygen absorbers are placed into the packaging. The process is most effective when low temperatures are maintained.

Seafood Type	Ideal Storage Temperature	Ideal Transit Temperature
Live lobster	5° to 10° C	0° to 4.5° C
Halibut	-1° to 4° C	-0.6° to 1.1° C
Haddock, cod, perch, salmon	-1 to 1° C	0° C
Frozen crab	-18° C	-18° to -23° C

  

Meat Type	Ideal Storage Temperature	Ideal Transit Temperature
Beef, fresh	0° to 1° C	0.0 °to 1.1° C
Bacon, Packer Style	1° to 4° C	1° to 4° C
Poultry, fresh	-2.2 to 0.0	-2.2 to 0.0
Meat, mechanically separated	-29° to -18° C	-29° to -18° C

Temperature studies and lane mapping on a seasonal and geographic basis are required for shipping and storage. In addition, placing multiple [temperature loggers](#) inside reefer trailers containing frozen meat or seafood confirms that the refrigeration is functioning properly and that there is good airflow through the container, or alerts carriers and shippers of potential problems. Without loggers, shippers may never become aware of malfunctions and cannot provide an audit trail for traceability.

*“As markets become increasingly distant, maintaining the cold chain – and proving it – becomes increasingly important.” USDA from the FDA*



### Determining cold chain gaps through monitoring and analysis

The requirement for tracking and recalls is consistent for meat and seafood. Ensuring the safety of meat and seafood comes down, largely, to temperature monitoring solutions that are both flexible and standards based. The Fisheries Guidance, for example, provides monitoring recommendations. The most basic is to monitor fishery products when there are variances between the surface or ambient temperatures and the product’s internal

temperature. The location of the product also is a factor, because items in the center of a shipment or, as the FDA says, “a pile of fish,” have greater thermal stability than items exposed to air circulation.

“During transportation and storage, the challenge is to... keep the “cold-chain” from breaking.” USDA Food Safety and Inspection Service.

A comprehensive environmental monitoring program for refrigerated facilities and shipments can help processors comply with some aspects of those regulations. A variety of solutions are available to help ensure that meat and seafood maintain safe temperatures as they move through the supply chain. Simple, [low cost temperature indicators](#) may be affixed to cases, letting handlers know at a glance whether the package was exposed to unsafe ambient temperatures in transit. When these indicators are serialized, shippers have one more product identifier at their disposal to aid in traceability. For more detailed information, shippers can deploy data monitors or loggers to document the extent and duration of any temperature excursions. Some devices include probes that monitor the internal temperature of the shipment and can be accessed without opening the package.

Food processors and their clients can use temperature information to determine whether the product should be accepted, rejected, or refrigerated and held for evaluation, adding assurance that products exposed to unsafe temperatures can be identified as early as possible – ideally, before they are combined with other products or shipped to customers.

A robust monitoring program also provides valuable insight into the supply chain, alerting shippers and carriers

to problems, often before they escalate. For example, routinely monitoring reefer refrigeration equipment assures carriers that it is working properly or, if it fails, that it can be repaired before multiple shipments are damaged. Likewise, monitoring loads can signal failures with a trailer's ability to

maintain the designated temperature from front to back, and whether temperature spikes correlate with loading or unloading operations. This insight helps pinpoint the most critical problems and remedy them, helping to ensure that products are maintained at safe temperatures.



### SpotBot BLE

The device was created in partnership with Bosch to make the supply chain transparent. Once attached to the shipment, the SpotBot BLE measures and records temperature, humidity, tilt, and shock, with the data visualized through the SpotBot BLE app. The limits of each parameter can be individually configured, and any violation is traceable and assignable.



### Logic Temperature Recorder

Designed to be low-cost and help optimize the cold chain by alerting manufacturers, handlers and shippers when a product has been exposed to temperature conditions beyond a specified threshold. All LOGIC units are water resistant (NEMA 4) recorders with USB in addition to integrated wireless capability that allows for fast data downloads.



### WarmMark

Single-use, ascending time-temperature indicator which alerts users of exposure to unacceptable temperature conditions.



### ColdMark

A single-use descending temperature indicator, is designed to help shippers identify and correct gaps in their cold chain. The ColdMark turns from clear to violet when the temperature goes below a predetermined threshold.

To learn more about how temperature monitoring enhances meat and seafood quality assurance, [contact SpotSee](#).

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