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Types of Thermometers Used in the Seafood Industry

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Introduction

Thermometers are an important tool for monitoring temperatures of seafood during transit, cooking, and storage. Thermometers can confirm if seafood has been cooked to a safe minimum internal temperature to destroy any harmful microorganisms such as *Listeria monocytogenes* and *Clostridium botulinum*, or that the product has been stored and maintained at safe temperatures. Temperature measurements taken during pasteurization, cooking, storage, and transportation of seafood also ensure compliance to regulations and implementation of Hazard Analysis and Critical Control Points (HACCP) and its prerequisite programs.

This publication describes the uses and limitations of thermometers commonly used by the seafood industry. This publication is part 1 of a three-part series. Part 2 will discuss accuracy and calibration activities, and part 3 will describe how to measure temperature of seafood products.

Selecting a Thermometer

Select a thermometer based on how it is going to be used. Some thermometers are designed to remain in the food while it is being cooked, while others should be used to check final cooking temperature, internal product temperature, or ambient temperature during refrigerated storage. Review the thermometer manufacturer's specifications for information on temperature range and accuracy, resolution, response time, the location of the sensing zone, and recommendations for calibration and accuracy checks. The probe diameter plays an important role when used for measuring the temperature of thin foods such as fish fillets and crab cakes.

Location of the Temperature-sensing Zone

Review the thermometer manufacturer's specifications for the location of the temperature-sensing zone and how far the thermometer must be inserted in a food to give an accurate reading, as well as its response time. Some thermometers may have the temperature-sensing zone at the tip of the probe. Others are marked with a dimple or indentation indicating that the temperature-sensing zone is from the tip of the thermometer to the dimple or indentation. To get an accurate temperature reading, the entire sensing zone must be in contact with the food being measured.

Types of Food Thermometers: Uses and Limitations

Note: All images depict just one example of the products represented. Similar products are also available for use.

Bimetallic Stemmed Thermometers

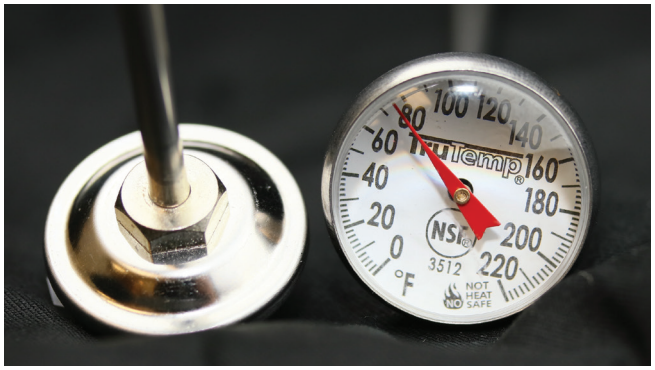

Figure 1: Bimetallic stem thermometer with analog display and calibration nut.

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- Commonly used for checking the internal temperature of foods such as cooked crabmeat and crab cakes, smoked fish, seafood salad, and oysters.
- Most common and inexpensive thermometer with analog display of temperature usually in the range of 0 F to 220 F (minus 17.8 C to 104 C) that does not require batteries.
- Probe may be marked with a dimple or indentation indicating the temperature-sensing zone.
- Accuracy can be adjusted if the thermometer has a calibration nut.
- Response time is about 11-16 seconds.

Figure 2: Two probes with dimples at different locations in the stem. The sensing zone is between the dimple and the tip of the probe.

Limitations:

- The temperature-sensing zone may be too long, making it hard to measure temperatures of thin foods.
- The small analog display scale is hard to read, leading to considerable errors by the reader.
- If a calibration nut is not available and the device is no longer accurate, it is not suitable for use.
- Has the longest response time compared with other types of thermometers.

Digital Thermometers

Figure 3: Digital thermometer with 0.1 F and C increments. Sensing zone located at the tip of the probe.

- Displays in digital format the internal temperature of foods such as cooked crabmeat and crab cakes, seafood salad, smoked fish, and oysters.
- Has a larger temperature range (e.g., minus 58 F to 572 F, or minus 50 C to 300 C), compared with analog or dial types.
- Temperature-sensing zone is located at the tip of the thermometer, making it suitable for measuring the temperature of thin foods such as fish fillets and crab cakes.
- Accuracy can be adjusted if the thermometer has a zeroing screw.
- Response time is about 5-20 seconds.

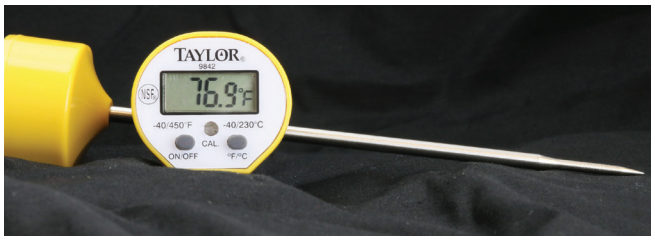

Figure 4: Digital thermometer with zeroing screw for calibration and accuracy adjustment. Sensing zone is located at the narrow tip of the probe.

Limitations:

- Requires batteries.
- If a zeroing screw is not available and the device is no longer accurate, it is not suitable for use.

Mercury-in-Glass (MIG) and Liquid-in-Glass Thermometers

Figure 5: Mercury-in-Glass thermometer encased in a shatterproof cover.

- Used in retort systems for thermal processing of low-acid canned foods and for cooking of crabs at temperatures above 212 F (100 C).
- When used, it is encased in a metal or glass stem with shatterproof coating.
- Commonly used as the reference against which processors calibrate or check the accuracy of thermometers used in-house.
- Electronic, bimetallic, and liquid-in-glass that contain no mercury are replacing mercury-in-glass thermometers in the food industry.
- Response time is about 2-3 minutes.

Limitations:

- Are hard to read and can break, creating a risk of broken glass and mercury contamination of the food and food processing areas.
- Can drift and lose accuracy with time.
- Cannot be adjusted if accuracy check fails.
- Response time is slow.

Infrared Thermometers

Figure 6: Infrared hand-held thermometer. Best used as a screening temperature tool.

- Does not need to touch the surface to measure temperature.
- Is best suited for taking surface temperatures of equipment such as skillets, griddles and grills, and surfaces that are hard to reach.
- Temperature range is from 0 F to approximately 600 F (32 C to 315 C).
- Accuracy is based on the distance-to-spot (D:S) ratio; D indicates the distance it should be from the target, and S is the diameter of the area being measured.
- Response time is fast; usually less than a second.

Limitations:

- Requires batteries.
- Cannot measure air temperature or internal temperature of food.
- Temperature reading is affected if taken through stainless steel or aluminum surfaces, glass, plastic food packaging material, fog or steam.

Temperature Data Loggers – Continuous Temperature-recording Devices

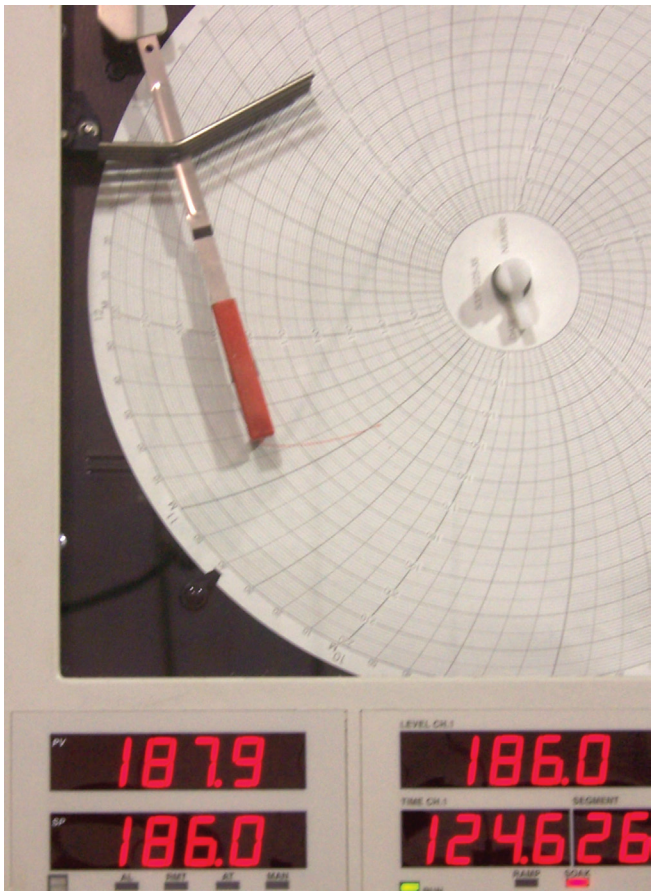

Figure 7: Analog continuous time and temperature data logger with chart and digital readout used for batch pasteurization.

- With an attached probe, can measure or continuously monitor and record the ambient or internal temperature of seafood during transit, storage, and cooking.
- Reusable and programmable to record specific time parameters, temperature, and alarm settings; can be either portable or fixed.
- Some can generate a permanent chart or printout that can be visually checked and evaluated to check if parameters have been met.
- Can be linked to smartphones or software for a computerized view of the collected data.
- Should be checked once a day to make sure they are operational regardless of whether units have an alarm system.

Limitations:

- Battery operated but most have long battery life or backup to prevent data loss.

The following three thermometers are probes that can be connected to data loggers or recorders to measure the temperature of a seafood product during transit, storage, or cooking processes.

Thermocouple Probe Thermometer

Figure 8: Data logger with two thermocouple probes of different sizes and diameters.

- Used for measuring temperature of a food after it is cooked and removed from the cooking device.
- Can read and display temperature very fast, depending on the probe diameter, length, and application.
- Temperature-sensing zone located at the tip of the thin probe can measure thin as well as thick foods.
- Can be purchased with software for computerized

record keeping and can be calibrated for accuracy as well.

- Response time is between 2-5 seconds, making it ideal for quickly checking temperatures of foods in more than one place.

Limitations:

- Requires batteries.
- Wires must be checked for damage or kinks, which can affect the accuracy of the sensing device.

Thermistor Probes

Figure 9. Button-sized thermistor logger with USB interface cable used for monitoring seafood in transit.

- Used for continuously monitoring water temperature during harvest of oysters and temperature of seafood products during transportation, processing, and storage.
- Also used for measuring temperatures of frozen products, soup, and brine solutions.
- Available with different types of probes, including button-shaped probes, that can measure specific temperature ranges.
- Temperature-sensing zone located at the tip of the thin probe can measure thin as well as thick foods.
- Response time is about 10 seconds.

Limitations:

- Temperature range is limited to a few hundred degrees.
- More than one thermistor may need to be purchased for all temperature-measurement needs.
- Probes are fragile and hard to calibrate.

Resistance Temperature Detectors (RTDs)

Figure 10. Data logger with attached RTD probe.

- Used for continuously monitoring temperatures of seafood products during cooking, refrigeration, blast freezing, individual quick freezing (IQF), and water bath used during cooling of pasteurized products.
- Can also measure ambient temperatures of cold or

freezer storage units.

- Can measure a wide range of temperatures, between minus 328 F to 1,202 F (minus 200 C to 650 C).
- Readings are more accurate and more repeatable than thermocouples.
- Response time depends on the probe diameter, length, and application.

Limitations:

- Response time is slower than thermocouple.
- More expensive than thermocouples and thermistors.
- Work best when measuring narrow temperature ranges as compared with measuring sporadic ranges of extreme temperatures over time.
- Difficult to calibrate.

Resources

Snyder, O. Peter. 2005. "Choosing the Right Thermometer to Verify Food Temperature." Hospitality Institute of Technology and Management. http://www.hi-tm.com/Documents2006/choose-right-therm.pdf.

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