

# Temperature Monitoring Solutions for HACCP Compliance for the Meat Processor

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## Temperature Monitoring Solutions for HACCP Compliance

MadgeTech has been a key resource for the food and beverage industry for over 20 years, offering a wide range of temperature monitoring solutions. We have a deep commitment to facilitating regulatory compliance and promoting best practice in food safety. MadgeTech data loggers and monitoring systems have become synonymous with HACCP compliance and process verification throughout the food industry, both domestically and internationally.

Most importantly, the MadgeTech name is widely known for both quality and reliability.

As a provider of leading-edge technology, MadgeTech offers a diverse line of wireless data logging systems for environmental and facility monitoring. This allow FSQA personnel to see both product and process temperatures in real time. From refrigerators to freezers and blast chillers, from the production floor to packaging and storage, MadgeTech provides an easily scalable temperature and humidity monitoring solution for even the most challenging environments.

Our goal is to continue to provide the tools needed to help food safety professionals perform their jobs more effectively and efficiently.

When you think of food safety, think of MadgeTech.

Norman E. Carlson,

Founder & President

# An Introduction to HACCP Compliance

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## Introduction to HACCP Compliance

What does it mean to be HACCP compliant?

A good place to start is to look closely at the term "HACCP." The acronym HACCP stands for Hazard Analysis and Critical Control Points. It is an approach to maximizing food safety through identifying biological, chemical, and physical hazards that may occur during the various production processes that could render the food product unsafe, and designing measures to reduce these hazards to an acceptable threshold.

The Food Safety and Inspection Service (FSIS) of the United States Department of Agriculture lists the following seven principles that guide HACCP.



# Seven Principles that Guide HACCP



Reference the FSIS website<sup>1</sup>.

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# Overview of the Seven Principles of HACCP

most common critical limits in meat processing relate to time and temperature.



**Conduct a Hazard Analysis** - In conducting a hazard analysis, the processing plant's team in charge of HACCP must consider each step in the production process and determine the food safety hazards that exist. Measures can then be designed to enable the plant to limit these hazards.



**Identify Critical Control Points -** The FSIS defines a "critical control point" as "A point, step, or procedure in a food process at which control can be applied and, as a result, a food safety hazard can be prevented, eliminated, or reduced to acceptable levels<sup>2</sup>." The plant's HACCP team should determine and list every such CCP in the plant's production process.



**Establish Critical Limits for each Critical Control Point** - The FSIS defines a "critical limit" as "the maximum or minimum value to which a physical, biological, or chemical hazard must be controlled at a critical control point to prevent, eliminate, or reduce to an acceptable level<sup>3</sup>." Critical limits are quantifiable values; some of the



**Establish Critical Control Point Monitoring Requirements** - The plant's HACCP team must determine what monitoring procedures it will put in place for the purpose of measuring each critical limit of each critical control point. Sufficient monitoring procedures will specify "how the measurement will be taken, when the measurement is taken, who is responsible for the measurement and how frequently the measurement is taken during production."



**Establish Corrective Actions** - Corrective actions are those procedures that the processing plant will follow when there is deviation from a critical limit. In putting together its HACCP plan, the plant's HACCP team must determine what actions will be taken in the case of any such deviation from a critical limit.



**Establish Record Keeping Procedures -** Record keeping is a critical element of an HACCP compliant plant. HACCP compliant recordkeeping will include such things as the plant's written HACCP plan, information about the plant's HACCP team, the plant's hazard analysis, the identified critical control points, the critical limits established, monitoring and verification procedures, recordkeeping procedures, flow charts, and corrective actions that will be implemented for deviations.

**Establish Procedures for Verifying the HACCP System is Working** - Verification of the plant's HACCP plan will ensure that the HACCP works and provides product safety as intended. A description of the food product, its intended use, and who its intended consumers are should also be included in a complete HACCP plan.

## Critical Control Point

"A point, step, or procedure in a food process at which control can be applied and, as a result, a food safety hazard can be prevented, eliminated, or reduced to acceptable levels<sup>2</sup>."

# Data Logging Technology

There are various measurement methods that can be used to establish and monitor critical limits to maintain an accurate record keeping system. For example: strip chart recorders rely on moving parts and thermometers rely on employee diligence, but data loggers do not rely on moving parts or constant employee attentiveness.

A data logger is an electronic measurement instrument that records environmental parameters such as temperature, humidity, pressure, pH and much more. The data is then retrieved through a wireless connection or download directly to a PC. From there the data is available in graphical and tabular formats, which are date and time stamped. These records can be saved electronically or printed to provide to regulatory agencies.

Temperature monitoring is especially critical for regulatory compliance of USDA and FDA regulations. Data loggers can be designed into HACCP plans to easily maintain compliance with such regulations. As each HACCP plan is unique to each plant, the data logging solution is dependent upon the end users application and requirements.

#### Take into consideration:

- What environmental parameter needs to be measured? (Examples, Temperature, Humidity, pH, etc.)
- What temperature range does the data logger need to measure? (Examples: Smokehouse temperatures, refrigerators, coolers, etc.)
- Does it need to be waterproof?

Designed for a wide variety of uses, data loggers can have internal sensors for measuring ambient environmental parameters, while others have external sensors for measuring the internal temperature of a product. Keep in mind, data loggers have different operating environments. While one model is built to withstand the harsh conditions within an oven, it may not be waterproof and cannot be exposed to any condensing environment.

#### Some additional data logger features include:

- Alarms and text/email notifications
- LCD screens to see current readings & statistics
- LED Status Indicators
- Password Protection
- Push button start
- Wireless Data Transmission





TransiTempll Shipping Temperature Data Logger

HiTemp140 High Temperature Data Loggers (with optional thermal shield)

**RFOT** Wireless Meat Temperature Data Logger

## Software and Maintenance

As precision measurement instruments, data loggers do require maintenance. This typically includes battery replacement, O-ring replacement and at least annual recalibration to a traceable source. To provide accurate data, the data logger being used should always be certified and calibrated to a known standard.

When using data loggers, in most cases there will be software required to allow for further analysis of the data collected. Certain software programs include customizable features that can help easily analyze the data.

To read more about how software can be used to streamline required documentation and recordkeeping processes see <u>page 17</u>.



## Calibration and Recordkeeping

A critical piece of any HACCP plan is monitoring and recordkeeping of critical limits, which makes reliable calibration and maintenance of devices crucial.

Standard thermometers for measurements of temperature and hygrometers to measure humidity require a much more intensive regimen by designated plant personnel, with a greater likelihood of deviation. Data loggers provide a cost-effective means of extremely accurate data collection and recordkeeping over long periods of time and under harsh conditions, with far less requirements for human supervision and involvement.

To ensure data accuracy, most data logging companies provide services to maintain the correct and consistent calibration of its devices. A calibration certificate indicates the date and condition of the services, providing the documentation required by most regulatory agencies to prove proper periodic calibration.

In the United States, the USDA has control over the slaughter and processing regulations in regard to the meat industry. Whether a facility is federally or state inspected, they are required to adhere to strict guidelines for the processing and storage of commercial meat. As outlined in 9 C.F.R. Part 417, inspections require the implementation of HACCP plans.

As per section 417.2, when a HACCP plan is created, it must be signed and dated by the designated, HACCP trained individual. The plan must be signed again upon acceptance into the company, as well as each time any modification is made. Annually, the plan must be reassessed to validate its adequacy in controlling food safety hazards and its effective implementation. Failure to take corrective actions needed for compliance may render products as adulterated.

To assist meat processing establishments meet HACCP requirements, FSIS created generic models for each of the processes where hazards are likely to occur. FSIS has indicated that the generic models can be used as a

starting point for putting together plant-specific HACCP plans. The diagrams and forms FSIS includes in the generic models include lists of references to assist an establishment ensure its hazard analysis is complete as required by 9 C.F.R. Part 417. Anyone faced with creating a HACCP plan is urged to use the FSIS generic models located on the agency's website to help guide the process.

Section 417.5 states an important element of any HACCP plan is the collection, monitoring, verification, and recording of data to determine whether the processes in place are succeeding in meeting critical limits, and to detect when any deviation has occurred that will require corrective action. Modern data loggers are an excellent way to meet the requirements of a HACCP plan. Some of the quantitatively measurable data that may need to be collected and recorded per the HACCP plan include temperatures, time, and pH, and data loggers represent the state of the art manner in such data collection, monitoring, verification, and recording.

# Slaughter



#### Regulation

The FSIS requires a strict testing regimen to test for the presence of E. coli in slaughtered meat, "Each official establishment that slaughters livestock must test for Escherichia coli Biotype 1 (*E. coli*). Establishments that slaughter more than one type of livestock or both livestock and poultry, shall test the type of livestock or poultry slaughtered in the greatest number."<sup>4</sup> (9 CFR Section 310.25)

#### **Critical Control Point**

Once the testing has taken place, the results are categorized into three categories; acceptable, marginal, and unacceptable.

**Beef** - In order to comply by these laws, establishments slaughtering more than 6,000 head of cattle each year are required to test one cattle per 300 carcasses, or at least one test per week.

**Swine** - To meet the regulations set by the FSIS, swine establishments that slaughter over 20,000 head of swine in a year must test one per 1,000 carcasses, or at least one per week.

Regardless of the animal, the sample must be selected at random after the slaughter process has completed and the carcass has been chilled for at least 12 hours.

#### Data Logging Solution

When a sample is being tested for E. coli, it is required to be between 32 °F and 41 °F. As these stipulations do not leave much room for error, monitoring temperature to assure that the sample meets the criteria is important. Thermocouple based data loggers may be used to measure and record the temperature of the sample to validate that it never went outside of the permitted zone.





In June 1999, the FSIS issued an updated Compliance Guidelines for Cooling Heat Treated Meat. These regulations state that chilling should begin within 90 minutes after the cooking cycle is completed. All product should be chilled from 120°F (48°C) to 55°F (12.7°C) in no more than 6 hours. Chilling should then continue until the product reaches 40°F (4.4°C); the product should not be shipped until it reaches 40°F (4.4°C). (USDA Appendix B) Cooling should be rapidly executed as meat within these temperature zones provide the most rapid growth for contaminants such as clostridia.



#### Critical Control Point

Cooling temperatures should be closely monitored to prevent deviation and validate compliance with performance standards.

#### Data Logging Solution

Data Loggers can be used to measure the internal temperature of product throughout the cooling cycle. For small freezers/refrigerators, a simple solution is to use a thermocouple based data logger. The data logger itself is kept outside of the cooler, while the wired thermocouple probe is run inside the cooler and can be inserted into the product. Some thermocouple data loggers provide an LCD with the current reading as well as minimum, maximum and average statistics.

Certain data loggers feature stainless steel housings and are completely waterproof. Typically these models can be placed directly into the product and into the oven or smokehouse. They can also be taken directly into coolers to address USDA Appendix B Compliance Guidelines.

Emerging Cloud technology allows data loggers to not only monitor and record, but also transmit data wirelessly in real time to a host PC that users can view. Wireless data loggers give users the power to confirm the product is being cooked and cooled to proper temperatures within certain required regulatory time frames. The constant contact provided through wireless data loggers also gives users the chance to take action if deviation occurs to ensure compliance.



# Cooking

#### Regulation

According to USDA Appendix A, "Cooked beef, including sectioned and formed roasts and chunked and formed roasts, and cooked corned beef should be moist cooked throughout the process. The moist cooking may be accomplished by placing the meat in a sealed, moisture impermeable bag, removing the excess air, and cooking; by completely immersing the meat, unbagged in water throughout the entire cooking process; or by using a sealed oven or steam injection to raise the relative humidity above 90 percent throughout the cooking process."<sup>6</sup> (USDA Appendix A, Section 1, #2)

#### **Critical Control Point**

Cooling temperature and humidity must be closely monitored throughout the entire process.

#### Data Logging Solution

Because meat must be moist cooked, monitoring humidity levels as well as temperature takes precedence over other enviornmental factors.. Luckily, some data loggers have more than one channel, meaning they have the capability of recording both temperature and humidity throughout the entire process.



To help comply with HACCP Principal 🏻 👍



**RFOT** Wireless Temperature Data Logger



The FSIS supplies strict chilling requirements with which meat processors must comply. According to FSIS, once livestock has been slaughtered, it is "required to chill carcass surfaces and hot-boned meat to 50 °F (*10* °C) within 5 hours and then to 40 °F (*4.4* °C) within 24 hours of slaughter or meat and bone separation."<sup>7</sup> (*FSIS*) Unless the meat is going directly from slaughtering to processing, chilling is required.



## Critical Control Point

To help comply with HACCP Principal 4

Maintaining the temperatures during storage also factors in to the assurance against contaminants. Meat must maintain an internal temperature of 40 °F or below while being stored or transported.

#### Data Logging Solution

Data loggers with internal sensors can be kept inside the coolers for proper verification of cooler and freezer temperatures. Data loggers with external sensors such as an RTD probe or a thermocouple probe can be inserted directly into the meat so that the device can keep an accurate record of the internal temperature of the product. The only way to monitor internal temperature is by using a probe.





MADGETE

Wireless Temperature Data Logger



To help comply with HACCP Principal 6

"For safety, it is important to verify the temperature of the refrigerator. Refrigerators should be set to maintain a temperature of 40 °F or below. Foods held at temperatures above 40 °F for more than 2 hours should not be consumed." *(FSIS)* 

#### **Critical Control Point**

To address the holding temperature requiremants, it is important to monitor the enviornmental parameters of any area that product is stored, which can include coolers, refrigerators and freezers. Thermometers can be used, but require an employee to manually check the temperatures. A data logger can replace a thermometer and save company time, while still providing the same information.

#### Data Logging Solution

Certain data logging systems are available with wireless capabilities with the benefit of having all of the data transmitted back to a central PC for viewing; there is no need to retrieve data loggers to download the record. Many systems have various features which can include an access portal, in which multiple employees can view the data, as well as alarming capabilities via email and text, In case any of the storage areas exceed a set temperature range.



RFTCTemp2000A Wireless RTD Temperature Data Logger with LCD Display





To help comply with HACCP Principal 6

The FSIS encourages the development of controls for ensuring the condition of the products through all phases of distribution to protect from contamination. Transportation vehicles, accessories and equipment should be kept clean and examined before loading with procedures specified in writing. Vehicles should be pre-cooled for at least one hour before loading to remove residual heat and doors should be closed at all times. The temperature setting of the unit should be no higher than 26 °F. Temperature of the product must be 40 °F or lower before loading, and should not remain on the loading dock in warm weather in order to prevent the product temperature from rising above 40 °F.

#### **Critical Control Point**

The temperature and function of the refrigeration unit should be checked amd recorded every 4 hours.

#### Data Logging Solution

There are data loggers designed specifically for shipping and transportation to monitor the integrity of the product while in transit. Cold chain data loggers are essential for verifying products were not exposed to temperature/humidity fluctuations and maintained within regulation.



#### **TransTempll** Shipping Temperature Data Logger





The United States FDA publishes and updates the Food Code. The Food Code provides guidance for various levels of government to create their own food safety rules to be consistent with federal regulations<sup>9</sup>. Section 3-403.11 of the Food Code provides guidance for specific temperatures and time to which 'potentially hazardous food' and 'ready-to-eat' food should be reheated.



## Data Logging Solution

The Food Code also outlines that the reheated food must never be between 41 °F and 135 °F for more than two hours. To ensure time durations have been met, using a data logger with LCD read out provides users with the same comfort of an instant read thermometer. Data loggers with LCD displays are also available with RTD connections so an external probe can still be utilized, but also a record that can be printed and saved.

To help comply with HACCP Principal 4 6

Wireless RTD Temperature Data Logger with LCD Display

RFTCTemp2000A

![](_page_14_Picture_7.jpeg)

http://www.fda.gov/Food/GuidanceRegulation/ RetailFoodProtection/FoodCode/ucm374275.htm

## Summary

Hazard Analysis and Critical Control Points (HACCP) helps meat processors identify, control and prevent hazards in the food supply through a systematic approach. Because of the success in the food and meat industries, HACCP plans are being increasingly applied to industries other than food.

HACCP is currently mandatory for meat, poultry, seafood, dairy and juice processors in the United States, as well as retail food services.

The creation of customized HACCP plans requires strong knowledge of the seven principles as applied throughout the production process, designed to prevent problem before the occur and to correct deviations as soon as they are detected.

Data loggers naturally lend themselves as an optimal way for monitoring many of the various measurable data points, as well as alerting the user in a timely manner that a deviation has occurred in the process so that corrective action may be taken.

The computerized automation that data loggers provide simplify the necessary record keeping tasks for a HACCP. Tasks are made less labor intensive and diminish the possibility of human error, since both measurement and report generation are automated."

It is critical to stay up-to-date with the requirements and regulations, both at the federal and state level. Such regulations and requirements are always subject to change. In addition, individual states may have their own regulations that impose additional requirements to producers in those states.

The published material on the FDA website represents the most up-to-date possible guidance and should be checked regularly to ensure compliance is maintained.

![](_page_15_Picture_9.jpeg)

![](_page_16_Picture_0.jpeg)

# MadgeTech 4 Data Logger Software

When using data loggers, in most cases there will be software required. Depending on the model of the data logger, the software may be needed to download data and communicate with the device. Certain software programs include features that can help for further analysis of data.

## Simple, Easy-to-use Software

A traditional data logging system consists of a data logger, communication cable and software. The software is installed on the PC, and the communication cable is connected to the PC and data logger. The data logger is started through the PC prior to being deployed. Configurations can include setting the required high and low alarm, reading rate (frequency the device will take a reading; for example, 1 second, 1 minute or 1 hour) and more. The device is then placed in the process and after completion, the data logger is reconnected to the cable, and the data is downloaded.

Wireless data loggers are becoming more prevalent, designed to be placed remotely in locations such as coolers, freezers, warehouses, etc. To retrieve data, wireless receivers are strategically placed throughout the building to transmit the data back to the central location where it can be viewed through a PC from one or multiple locations. Alarms are common with wireless systems, which provide a great benefit to processors, as plant employees can be immediately notified of deviations.

Data loggers can assist processors in complying with regulations in a simple, cost-effective manner. From cooking to cooling and shipping to storage, data loggers can be used throughout the entire production process.

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140-	6/26/2012	2:17:37 PM	-04:00	+00:04:00
	6/26/2012	2:18:37 PM	-04:00	+00:05:00
136	6/26/2012	2:19:37 PM	-04:00	+00:06:00
	6/26/2012	2:20:37 PM	-04:00	+00:07:00
132-	6/26/2012	2:21:37 PM	-04:00	+00:08:00
	6/26/2012	2:22:37 PM	-04:00	+00:09:00
128	6/26/2012	2:23:37 PM	-04:00	+00:10:00
	6/26/2012	2:24:37 PM	-04:00	+00:11:00
	6/26/2012	2:25:37 PM	-04:00	+00:12:00
	6/26/2012	2:26:37 PM	-04:00	+00:13:00
	6/26/2012	2:27:37 PM	-04:00	+00:14:00
	6/26/2012	2:28:37 PM	-04:00	+00:15:00
Hagi (L2L/52-F)	6/26/2012	2:29:37 PM	-04:00	+00:16:00
116-	6/26/2012	2:30:37 PM	-04:00	+00:17:00
	6/26/2012	2:31:37 PM	-04:00	+00:18:00
	6/26/2012	2:32:37 PM	-04:00	+00:19:00
	6/26/2012	2:33:37 PM	-04:00	+00:20:00
108-	6/26/2012	2:34:37 PM	-04:00	+00:21:00
	6/26/2012	2:35:37 PM	-04:00	+00:22:00
	6/26/2012	2:36:37 PM	-04:00	+00:23:00
Flag2 (103.68 °F) 00:43:00	6/26/2012	2:37:37 PM	-04:00	+00:24:00
	6/26/2012	2:38:37 PM	-04:00	+00:25:00
	6/26/2012	2:39:37 PM	-04:00	+00:26:00
	6/26/2012	2:40:37 PM	-04:00	+00:27:00
96-	6/26/2012	2:41:37 PM	-04:00	+00:28:00
	6/26/2012	2:42:37 PM	-04:00	+00:29:00
92	6/26/2012	2:43:37 PM	-04:00	+00:30:00
	C (0C (001 0	2.44.27.014	04.00	00.21.00

## Software Features

![](_page_16_Figure_9.jpeg)

Cooling Flags to address USDA Appendix B

![](_page_16_Picture_11.jpeg)

Lethality Equations

![](_page_16_Picture_13.jpeg)

Minimum, Maximum, Average Statistics

# Suggested References

## Relating to Meat Regulations

http://www.fsis.usda.gov/wps/portal/fsis/topics/regulatory-compliance/haccp/small-and-very-small-plant-outreach/guidebook-for-the-preparation-of-haccp-plans-and-generic-haccp-models

http://www.fsis.usda.gov/Oa/fr/95033f-a.htm?redirecthttp=true

http://www.fsis.usda.gov/Oa/background/keyhaccp.htm?redirecthttp=true

http://www.fsis.usda.gov/wps/portal/fsis/topics/regulatory-compliance/haccp

http://www.aamp.com/news/documents/HeatTreated-ShelfStableGenericHACCPModel.pdf

## Endnotes

1 http://www.fsis.usda.gov/oa/background/keyhaccp.htm

- 2 http://www.fsis.usda.gov/oa/background/keyhaccp.htm
- 3 http://www.fsis.usda.gov/oa/background/keyhaccp.htm
- 4 http://www.versuslaw.com/cfr/09cfr/09cfr=00310@228859.asp
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- 6 http://www.fsis.usda.gov/OPPDE/rdad/FRPubs/95-033F/95-033F\_Appendix%20A.htm
- 7 http://www.fsis.usda.gov/OPPDE/rdad/FRPubs/93-016F\_Part\_2.htm
- 8 http://www.fsis.usda.gov/wps/portal/fsis/topics/food-safety-education/get-answers/food-safety-fact-sheets/safe-food-handling/refrigeration-and-food-safety/ct\_index
- 9 http://www.fda.gov/Food/GuidanceRegulation/RetailFoodProtection/FoodCode/ucm374275.htm

## Notes

#### Disclaimer

This publication is meant to provide meat industry producers with the basics of HACCP. It is not intended as an in-depth guide to HACCP or regulatory requirements. We hope we have pointed readers of this publication in the right directions to find further information needed to take their knowledge to the next level. Nothing in the publication is intended as or may be taken as legal advice. For all such matters the appropriate regulatory authorities are the final word on the topics discussed herein, and provide the appropriate source for the ultimate understanding on any questions regarding these topics.

![](_page_19_Picture_0.jpeg)

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