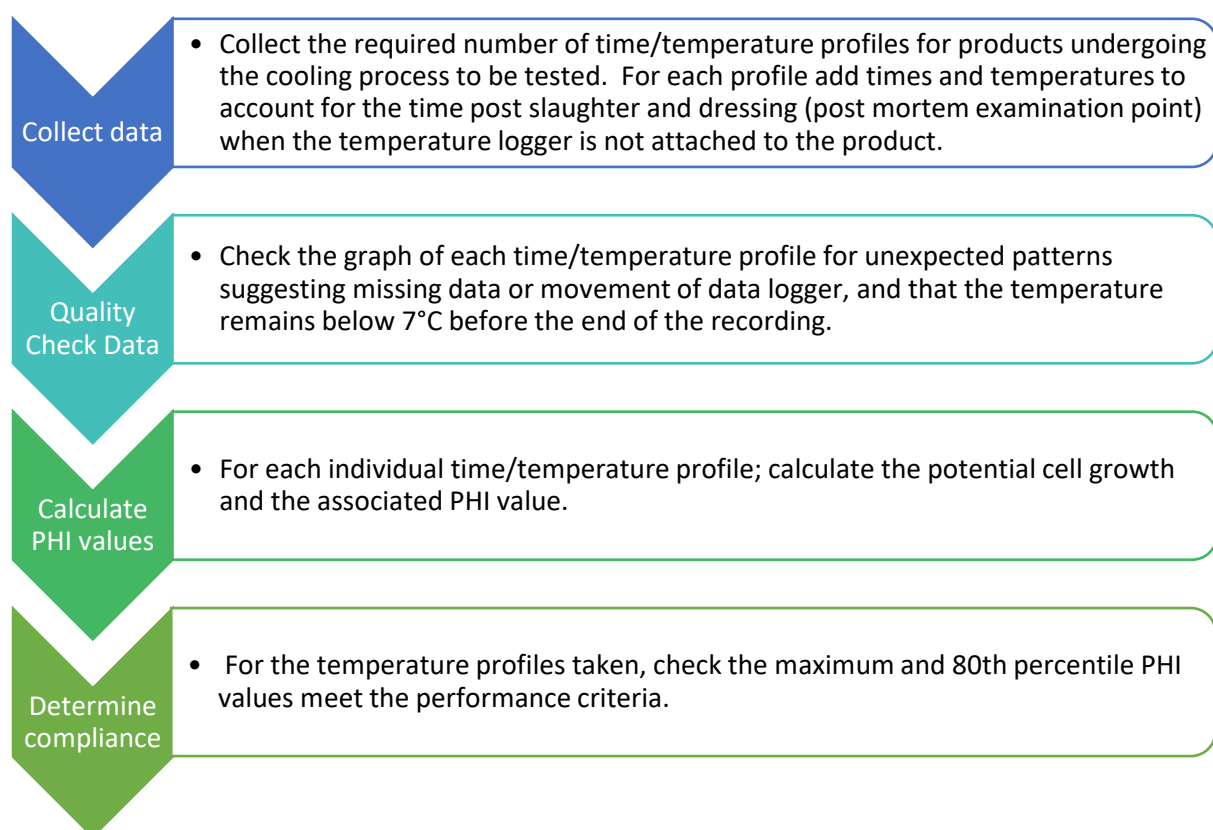# Introduction to the Process Hygiene Index (V2.0)

What is the Process Hygiene Index?

The Process Hygiene Index (PHI) is currently used by the New Zealand Meat Industry as a food safety tool to validate post slaughter cooling processes. The index is an indicator of the potential growth of mesophilic (cold intolerant) bacteria on the product surface following slaughter and dressing of a carcass until the product reaches and remains below 7°C.

The growth model[1] underpinning the PHI value is based on experiments conducted using meat processing related *Escherichia coli* (E. coli) strains. *E. coli* was chosen as it was considered to have similar growth characteristics as other mesophilic bacteria relevant to the meat industry.

The growth model provides a measure of the potential growth of bacteria during the cooling process. The model only considers time, temperature and if the cells are in an aerobic or anaerobic environment to predict growth rates. Other factors, such as decreasing pH, water activity and drying of meat surfaces are likely to reduce growth rates of bacteria on product below those predicted by the model, providing a potential safety margin.

An overview of the PHI process is given below. Refer to MPI Red Meat Code of Practice Chapter 9[2] for detailed guidance on the process.

Collect data
- Collect the required number of time/temperature profiles for products undergoing the cooling process to be tested. For each profile add times and temperatures to account for the time post slaughter and dressing (post mortem examination point) when the temperature logger is not attached to the product.

Quality Check Data
- Check the graph of each time/temperature profile for unexpected patterns suggesting missing data or movement of data logger, and that the temperature remains below 7°C before the end of the recording.

Calculate PHI values
- For each individual time/temperature profile; calculate the potential cell growth and the associated PHI value.

Determine compliance
- For the temperature profiles taken, check the maximum and 80th percentile PHI values meet the performance criteria.

---

[1] See Growth Model Factsheet in the PHI Toolbox
[2] https://www.mpi.govt.nz/processing/meat-and-game/meat-and-game-processing/codes-of-practice-rmp-templates-and-plans/

The Performance Criteria

The PHI value for a number of products subjected to the cooling process are calculated. The distribution of these PHI values is compared against the following Performance Criteria;

When post slaughter cooling processes are validated they should meet the following PHI (V2) criteria:

- *80% of PHI values   ≤ 0.72*
- *maximum PHI value   ≤ 1.0*

The number of PHI values required to test against the performance criteria is dependent on; (i) the size and number of the refrigerated rooms and, (ii) if the chilling process is being initially validated or is being verified to check the performance criteria continues to be met.

Guidance on the methodology for collecting time-temperature data for a chilling process is given in MPI Red Meat Code of Practice, Chapter 9: Post Slaughter Activity[3] and the AgResearch publication PHI User Manual (November 2009).

Updates in PHI (V2.0)

A change in PHI units

The original PHI values were based on the potential growth of bacterial cells expressed as generations of cell growth. In version 2.0 the previously calculated PHI values have been normalized such that the performance criteria maximum value (14) is equal to 1.   This reinforces the idea of the index as a tool for validating a cooling process in respect to potential growth of mesophilic bacteria, rather than predicting specific growth of bacteria on individual carcasses.

How did the change in units effect the PHI performance criteria values?

	PHI (V2.0)	PHI (original)
80% of PHI values	≤ 0.72	≤ 10
Maximum PHI value	≤ 1.0	≤ 14

---

[3] https://www.mpi.govt.nz/processing/meat-and-game/meat-and-game-processing/codes-of-practice-rmp-templates-and-plans/ (Accessed 3rd October 2019)

Introduction of initial inhibition of cell growth following transfer of cells to carcass surfaces.

During the review of international approaches to ensuring the safe cooling of meat, it was noted the Australian Refrigeration Index allows for a period of no cell growth (lag) for meat that starts the chilling process as either 'hot' or 'warm'[4].

To investigate the initial cell growth following transfer of cells onto carcass surfaces in the New Zealand context, a series of experiments were conducted by AgResearch in 2019 using freshly slaughtered beef meat[5].   The information gained from these experiments and a literature review conducted in 2017; resulted in a period of 30 minutes of no cell growth following dressing of the carcass being included in the growth model which underpins PHI.

---

[4] https://www.mla.com.au/extension-training-and-tools/tools-calculators/refrigeration-index-calculator/ (Accessed 3rd October 2019)

[5] Mills J, Ross C, Gardner A and Prakash S (2019) Determination of microbial lag phase as applied to the Process Hygiene Index. AgResearch Client Report: FBP90181 for Meat Industry Association (NZFSSRC Project). Palmerston North.