

Scientific information for validation of EMO chilling and freezing requirements

August 2003

In 1997, Australian Meat Technology assembled data regarding the validation of the Export Meat Orders time/temperature requirements for the primary chilling, holding and transport of goods produced in Export Meat plants.

Food Science Australia has updated the information with recent references, taking into consideration the USDA Food Safety and Inspection Service, 1996 Pathogen Reduction/Hazard Analysis and Critical Control Point final rule, which requires establishments to develop a written HACCP plan to address and prevent identified hazards.

A copy of the Export Meat Orders can be obtained from SCALEplus website: <http://scaleplus.law.gov.au/> SCALEplus is the legal information retrieval system owned by the Australian Attorney-General's Department.

The objective of this project was to review the Export Meat Orders (EMO) and assemble references and papers, which assist in the validation of the various requirements of the EMO's that pertain to the microbiological status of meat. The review of the EMO was limited to the primary chilling, holding, loading and transport of fresh meat carcass, portion of carcasses and carcass parts.

Methods

A selected search and review of scientific and technical literature was undertaken through Food Science Australia library facilities, in order to identify and supply papers that validate the time/temperature conditions specified in the Export Meat Orders.

Sections of the EMO's were evaluated on their time/temperature requirements based on their ability to minimise or prevent the growth of food safety relevant bacteria. Papers, which

validate particular EMO's, were then referenced.

Results

The EMOs relating to the primary chilling, holding and transport of goods from an export registered works, were assessed in regard to their ability to minimise or prevent the growth of food safety bacteria.

Attached is an itemised table of the relevant EMOs, comments regarding food safety and the particular reference number, the list of references and the reference papers.

Conclusions

Much of the scientific work that has been used to support chilling requirements in the EMOs, concluded that 7°C is the minimum temperature for growth of dangerous bacteria. However, these studies were conducted under laboratory conditions that were ideal for bacterial growth. In an abattoir situation, at temperatures less than 10°C, assuming the carcass is dry and the pH is <6, the generation and lag times are so prolonged as to be of no practical significance in the normal treatment of meat. Thus, these references are relevant to support the EMO chilling requirements.

Generally speaking, the EMO were not designed to be prescriptive and many are not critical limits at genuine critical control points. The EMOs that do relate to specific critical limits are (sometimes with minor adjustments) prescriptive enough to minimise or prevent the growth of food safety relevant bacteria.

The EMOs, when used in conjunction with a HACCP based quality assurance system, will provide the desired food safety outcomes.

EMO No	Provision	Comments	References
234.1 – 234.4 236.1 – 236.2	Handling of goods, removal of carcasses etc. Refers to the handling and placing under refrigeration without delay.	Except for the maximum 2 hours for sheep, lamb and goats in 234.2, the orders are open to interpretation. However, bearing in mind the lag phase, in practise they will prevent bacteria relevant to food safety from increasing.	1, 3, 11
239	Production of green offal by cooking or scalding Refers to placing cooked or scalded offal under refrigeration within 2 hours of completion of the process; and (a) where it is to be frozen it is to be reduced to a temperature of not more than -10°C within 48h; or (b) where it is to be used for further processing, it is to be chilled to a meat temperature of not more than 7°C within 8 h	The references validate that the requirement prevents increases in numbers of surviving pathogenic and spoilage bacteria	1, 2, 3
249	Chilling practices and operations (c) refers to loading warm goods into a chiller that already contains prescribed goods from another day's operation unless the efficiency of the chiller is such that: (ii) (A) The temperature of the chiller will not rise above 10°C while the prescribed goods are present.	As validated by the references, the requirement prevents bacteria relevant to food safety from increasing.	1, 2, 3, 6
250.A1	Chilling of Carcasses etc. Refers to 250.1, 250.2, 250A.2	See EMOs 250.1, 250.2, 250A.2	
250.1	Chilling of Carcasses etc. Subject to Division VI of Part 5, prescribed goods in the form of carcasses, portions of a carcass and carcass parts, unless frozen as specified in Order 257, shall be placed in an active chiller and shall be reduced in temperature, from the time that they were first placed under refrigeration to a meat temperature of not more than – (a) 20°C within 20 hours for cattle, calves of more than 40 kg, buffalo, solipeds, pigs of more than 100kg and deer, or (b) 20°C within 8 hours for calves of not more than 40 kg, sheep lambs, goats and pigs of not more than 100 kg, and after being reduced to that temperature that goods shall be held in a chiller that is operated at a temperature that ensures that the surface temperature of the goods does not exceed a temperature of	Without a time requirement to reach a surface temperature of 7°C, this requirement will not in itself prevent the possibility of food safety, relevant bacteria from multiplying. However, bacteria causing bone taint are adequately prevented from multiplying.	3, 7, 8, 12, 16

EMO No	Provision	Comments	References
	<p>(c) in the case of mutton carcasses in fat class 4 or 5 -- 12°C or (d) in any other case 10°C; for a period of more than 3 hours.</p>	<p>As validated by the references, the requirements are sufficiently prescriptive to minimise bacteria relevant to food safety from multiplying.</p>	<p>1, 2, 3, 5, 11, 13, 14, 17, 18</p>
250.2	<p>Following chilling in accordance with sub-order 250.1, prescribed goods that are to be held in a chilled state shall, unless intended for boning or preparation as a meat product –</p> <p>(a) be further chilled, with a minimum of delay, to a meat temperature of 4°C or lower; and (b) then subsequently be held under conditions of refrigeration that ensure the temperature of the goods is not more than 4°C and not less than minus 1.5°C at any point with the goods during storage.</p>	<p>Although open to interpretation ie. 'minimum of delay', in practice prevents bacteria relevant to food safety from multiplying.</p> <p>As validated by the references, the requirement prevents bacteria relevant to food safety from increasing.</p>	<p>11, 17 1, 2, 3, 11</p>
250A.2	<p>Where coverings that include or consist of a moisture impermeable material or a carton are to be applied to prescribed goods referred to in sub-order 250A.1, wrapping or packing of the goods shall not take place unless the goods –</p> <p>(a) are chilled to a meat temperature of 20°C or lower in accordance with sub-order 250.1 before covering is applied; (b) in the case of vacuum packing or packing in a carton, are subsequently chilled to a meat temperature of not more than 7°C within 20 hours of vacuum packing or packing in a carton and (c) are then further chilled with a minimum of delay, to a meat temperature –</p> <p>i) in the case of goods that have been vacuum packed, of 4°C or lower; or ii) in the case of vacuum packed goods of 3°C or lower.</p>	<p>Without a further time/temperature reduction requirement, this will not in itself prevent the possibility of bacteria relevant to food safety from multiplying. However, since the surface is dry, in practice prevents multiplication.</p> <p>As validated by the references, the requirement prevents bacteria relevant to food safety from increasing</p>	<p>18 3, 4, 11, 14, 18</p>
250A.3	<p>Following chilling in accordance with sub-order 250A.2, prescribed goods that are held in chilled storage shall be held under conditions of refrigeration that ensures the temperature of the goods –</p> <p>(a) in the case of goods that have not been vacuum packed, is not more than 4°C and not less than minus 1.5°C or (b) in the case of vacuum packed goods, is more than 3°C and not less than minus 2°C</p>	<p>As validated by the references, this requirement prevents bacteria relevant to food safety from increasing</p>	<p>1, 2, 3, 4, 16, 18</p>

EMO No	Provision	Comments	References
251.1	<p>Chilling of edible offals</p> <p>Subject to sub-order 251.2, edible offal (other than green offal), unless frozen as specified in sub-order 258.1 shall be --</p> <ul style="list-style-type: none"> (a) placed in an active chiller and reduced to a meat temperature of not more than 7 °C within 12 hours of removal from the carcass, during dressing, (b) maintained under conditions that ensure the meat temperature of the goods does not rise above 7 °C after that temperature has been reached. 	<p>As validated by the references, the requirement prevents bacteria relevant to food safety from increasing.</p>	<p>6, 9, 10, 19</p>
251.2	<p>Items of edible offal comprising –</p> <ul style="list-style-type: none"> (a) tails, tongues or portions of the diaphragm; or (b) other items as determined by the Secretary, <p>that have been vacuum packed in a gas-impervious plastic covering may be held for a period of not more than 96 hours under chilling refrigeration provided the</p> <ul style="list-style-type: none"> (c) vacuum packing is undertaken within 36 hours of removal from the carcass during dressing; (d) vacuum packaged goods are reduced to a meat temperature of not more than 0°C and not less than minus 1.5°C with a minimum delay after packaging. (e) vacuum packaged goods are maintained within the temperature range specified in paragraph (c) during storage. 	<p>The intention of this sub-order is unclear, however it was probably intended to apply to goods to be subsequently frozen. 251.2.(e) wrongly refers to 251.2.(c).It should refer to 251.2.(d).</p> <p>As validated by the references, the requirements prevent bacteria relevant to food safety from increasing.</p>	<p>6, 9, 10, 19</p>
257.1	<p>Freezing of carcasses, etc</p> <p>Prescribed goods in the form of carcasses, portions of carcasses and carcass parts other than those carcass, portions that—</p> <ul style="list-style-type: none"> (a) are permitted to be held in an unrefrigerated handling area as specified in sub-order 234.2; (b) are to be boned as specified in Division VI of Part 15; or (c) have been placed under active chiller <p>shall be placed under refrigeration for freezing without delay.</p>	<p>Although this is open to interpretation, in practice it prevents bacteria relevant to food safety from multiplying.</p>	<p>7, 8</p>

EMO No	Provision	Comments	References
257.2	<p>Freezing of carcasses, etc.</p> <p>Prescribed goods in the form of carcasses, portions of carcasses and carcase parts placed in a freezer shall be reduced in temperature, from the time that they were first placed under refrigeration for freezing, to a meat temperature of not more than minus 10°C within –</p> <ul style="list-style-type: none"> (a) 80 hours for cattle, calves of more than 40 kg, buffalo and solipeds; (b) 60 hours for pigs and deer; or (c) 48 hours calves of not more than 40 kg, sheep, lambs and goats. 	<p>Without a time requirement to reach 7°C surface, this requirement will not in itself prevent the possibility of bacteria relevant to food safety from multiplying. However, the requirement to reach a prescribed meat temperature in practice means that there will be no growth of bacteria relevant to food safety.</p>	4, 7
257A.1	<p>Freezing of wrapped carcasses, etc.</p> <p>Prescribed goods in the form of carcasses, portions or carcasses or carcasses parts, including goods chilled in accordance with order 250, maybe wrapped or packed before, or in the course of, freezing, provided –</p> <ul style="list-style-type: none"> (a) subject to paragraph 257AL(b), freezing is in accordance with sub- order 257.2 and (b) in the case of packing in a carton <ul style="list-style-type: none"> i) packing in a carton does not take place until the meat temperature has been reduced to 20°C or lower and ii) the goods are reduced in temperature to a meat: temperature of – <ul style="list-style-type: none"> (A) not more than minus 6°C within 48 hours; and (B) not more than minus 10°C within 80 hours, of packing in a carton 	<p>Without a time requirement, these requirements will not in itself prevent the possibility of bacteria relevant to food safety from multiplying. (However, in practice the requirements prevent bacteria relevant to food safety from increasing).</p>	1, 2, 3, 7, 8
257A.2	<p>Where chilled vacuum packed goods are held in chilled storage for ageing then freezing, those goods shall not be frozen unless the goods –</p> <ul style="list-style-type: none"> (a) have been held in chilled storage in accordance with paragraph 250.2(b), for a period not longer than 8 weeks; and (b) are frozen to a meat temperature of minus 10 °C within 48 hours of being placed under refrigeration for freezing. 	<p>As validated by the references, the requirement prevents bacteria relevant to food safety from increasing.</p>	4
258.1	<p>Freezing of edible offal</p> <p>Following handling and treatment in accordance with sub-order 234.3 or 234.4, edible offal, unless handled as specified in order 251 or sub-order 258.2, shall be frozen and shall be –</p> <ul style="list-style-type: none"> (a) placed under refrigeration in the chamber in which freezing is to take place within 2 hours of 	<p>Without a time requirement to reach 7°C, this requirement will not in itself prevent the possibility of bacteria relevant to food safety from multiplying</p>	10, 19

EMO No	Provision	Comments	References
	<p>removal from the carcase during dressing; and</p> <p>(b) reduced to a meat temperature of not more than minus 10°C within 48 hours from the time the offal was placed under refrigeration for freezing.</p>	prevent the possibility of bacteria relevant to food safety from multiplying	
258.2	<p>Edible offal that has been chilled in accordance with Order 251 shall not be placed under refrigeration for freezing if –</p> <p>(a) in the case of items of vacuum packed offal that have been handled in accordance with sub-order 251.2, more than 14 days; or</p> <p>(b) in all other cases, more than 96 hours,</p> <p>Have elapsed from the time the edible offal was first placed under refrigeration for chilling.</p>	<p>The requirement to chill in accordance with Order 251 effectively controls growth of most food pathogens.</p> <p>As validated by the references, the additional requirement is sufficiently prescriptive to control bacteria relevant to food safety.</p>	10,11, 19
259.1 – 259.3	Restrictions on freezing of chilled carcasses etc	Refer to 250.2(b); 250 A.3 (a)	
259A	Freezing of certain vacuum packed goods	Refers to 257A.2 and 259.3(c) and 259.3 (d)	
264	<p>Thawing or tempering of frozen prescribed goods</p> <p>Operation of refrigerated chamber.</p> <p>The refrigerated chamber shall be operated –</p> <p>(a) in a manner that ensures the uniform treatment of the prescribed goods, and</p> <p>(b) in the case of thawing -- at a temperature that ensures</p> <p>(i) the meat temperature if the prescribed goods does not rise above 7°C; and</p> <p>(ii) the surface temperature of the goods does not rise above 10°C or</p> <p>(c) in the case of tempering -- at a temperature that ensures that the temperature at any point within the prescribed goods does not rise above minus 2°C.</p>	As validated by the references, the requirement minimises bacteria relevant to food safety from increasing.	1, 2, 3, 4, 5, 7
270	<p>General requirement for boning</p> <p>Area in which boning takes place</p> <p>Where prescribed goods in the form of carcasses, portions of carcasses and carcase parts are to be boned, all procedures including –</p> <p>(a) readying for boning or trimming</p> <p>(b) boning;</p> <p>(c) packing; or</p>		

EMO No	Provision	Comments	References
	<p>(d) holding of goods -- (i) awaiting readying for boning; or (ii) that have been readied for boning shall be undertaken in an area that – (e) has been approved for this purpose by the Secretary; (f) is controlled at a temperature of not more than 10°C while prescribed goods are present; and (g) is fitted with a temperature measuring or recording device that shall operate effectively..... except that, where the temperature of the area has risen to not more than 12°C the authorised officer in charge at the registered establishment may permit prescribed goods to remain in that area in accordance with the Export Meat Manual.</p>	<p>As validated by the references, the requirement prevents bacteria relevant to food safety from increasing.</p> <p>As validated by the references, the requirements is sufficiently prescriptive to minimise bacteria relevant to food safety multiplying.</p>	<p>3, 5, 7</p> <p>5, 7, 15</p>
272	<p>Boning of chilled goods</p> <p>Handling of boned goods</p> <p>Prescribed goods derived from the boning of carcasses, portions of carcasses or carcase parts that have been chilled to the temperature specified in Order 250 shall be</p> <p>(a) placed under refrigeration for further chilling for freezing in accordance with order 273 within 2 hours of the time boning was completed; or</p> <p>(b) incorporated into a meat product provided processing of the product commences within 2 hours of the time boning was completed.</p>	<p>As validated by the references, the requirement prevents bacteria relevant to food safety from increasing.</p>	<p>3, 5, 7</p>
273.1	<p>Chilling or freezing of boned goods</p> <p>Prescribed goods derived from the boning of chilled carcasses, portions of carcasses or carcase parts, when placed under refrigeration without being vacuum packed, shall, if intended for export, as-</p> <p>(a) chilled goods: be at a meat temperature of not more than 7°C within 20 hours of the time boning was completed; or</p> <p>(b) frozen goods:</p> <p>i) be reduced to a meat temperature of not more than -6°C within 48 hours of the time boning was completed and further reduced to a meat temperature of not more than -10°C within 80 hours of the time boning was completed;</p> <p>ii) in the case of meat boned and packed while at a meat temperature of not more than 7°C</p>	<p>As validated by the references, the requirement is sufficiently prescriptive to minimise bacteria relevant to food safety multiplying.</p>	<p>1, 2, 3, 4, 5, 6, 7, 11, 13, 14, 15</p>

EMO No	Provision	Comments	References
	<p>and maintained at or below that temperature, be placed under refrigeration for freezing within 24 hours of the time boning was completed and reduced to a meat temperature of minus 10°C within 48 hours of be placed under refrigeration for freezing; or</p> <p>iii) in the case of a carton of meat that is not completely filled, be -</p> <p>(A) reduced to a meat temperature of not more that 7°C within 20 hours of boning being completed and maintained at or below that temperature; and</p> <p>(B) filled and placed under refrigeration for freezing within 96 hours of boning being completed and reduced to a meat temperature of not more than -10°C within 48 hours</p>		
273.2	<p>Chilling or freezing of boned goods</p> <p>Where it is intended that prescribed goods that have been chilled in accordance with paragraph 273.1 (a) are to be subsequently frozen the -</p> <p>(a) approval of the authorised officer in charge of the establishment shall be obtained to freeze the goods;</p> <p>(b) goods shall be placed under refrigeration for freezing within 96 hours of the time the goods were placed under refrigeration for chilling</p> <p>(c) goods shall be reduced to a meat temperature of not more than minus 10° C within 48 hours of being placed under refrigeration for freezing;</p> <p>(d) occupier of the establishment shall make an application to the Secretary to change the trade description applied to the goods in accordance with order 64 of the Prescribed Goods (general) Orders.</p>	<p>As validated by the references, the requirement prevents bacteria relevant to food safety from increasing.</p>	<p>As for 273.1</p>

EMO No	Provision	Comments	References
273.3	<p>Chilling or freezing of boned goods</p> <p>Prescribed goods derived from the boning of chilled carcasses, portions of carcasses or carcasses parts shall, when placed under refrigeration after being vacuum packed for :</p> <p>(i) chilling, be chilled in accordance with paragraph 273.1 (a) and held for a period no longer than that specified in order 380, at a temperature of not more than 3°C and not less than minus 1.5°C</p> <p>(ii) freezing, be frozen in accordance with paragraph 273.1(b)(i); or</p> <p>(iii) ageing and then freezing, be chilled in accordance with paragraph 273.1 (a) and then reduced to and held at temperature of not more than 3°C and not less than minus 1.5°C for a period no longer than 8 weeks and then frozen to a meat temperature of not more than minus 10 °C within 48 hours of being placed under refrigeration for freezing.</p>	<p>As validated by the references, the requirement prevents bacteria relevant to food safety from increasing.</p>	<p>1, 2, 3, 4, 11, 13, 14, 16, 18</p>
282	<p>Hot boning</p> <p>Programme to be submitted for approval before commencement</p> <p>Where carcasses, portions of carcasses or carcase parts are to be boned without having first been reduced to a meat temperature specified in Order 250, the operation shall not commence until a programme has been submitted to, and approved by, the Secretary in accordance with Part 17</p>	<p>Refer to AQIS Notice 2001/21 which is sufficiently prescriptive to minimise bacteria relevant to food safety multiplying.</p>	<p>1, 2, 3</p>
283	<p>Contents of Programme</p> <p>The programme submitted under Order 282 shall ensure that --</p> <p>(a) carcasses, portions of carcase, or parts of carcasses that: are to be hot boned; and</p> <p>(b) prescribed goods derived from hot boning,</p> <p>are handled in accordance with any conditions or restrictions in the Export Meat Manual.</p>	<p>Refer to Comments in 282.</p>	<p>3, 8</p>
284	<p>Room in which hot boning takes place</p>	<p>Will prevent bacteria relevant to food safety from growing.</p>	<p>3, 8</p>
288.1	<p>Temperature during Transport</p> <p>Prescribed goods that have been reduced in temperature shall be transferred between registered establishments only under the following conditions:</p> <p>(a) in the case of goods reduced in temperature in accordance with order 250 - under refrigeration that ensures that the goods are held at an air temperature of not more than</p>	<p>Load out temperatures and temperatures during transport between registered establishments are not prescriptive. They permit loadout at a deep butt temperature of 20°C (except for Korean beef, 16°C) without any requirements</p>	<p>1, 2, 3, 4, 5, 6, 9, 11</p>

EMO No	Provision	Comments	References
	<p>10°C during transport.</p> <p>(b) in the case of goods reduced in temperature in accordance with order 251 --- under refrigeration that ensures that the goods are held at an air temperature of not more than –</p> <p>(i) 1°C during transport for vacuum packaged goods; or</p> <p>(ii) 7°C during transport for other goods;</p> <p>(c) in the case of goods reduced in temperature in accordance with sub- order 257.2 paragraph 258.1 (b) or order 411 -- under conditions that ensure that the meat temperature of the goods does not rise above minus 10°C during transport;</p> <p>(d) in the case of goods that are derived from boning and packing into a carton -- under conditions that --</p> <p>(i) ensure that the temperature and times specified in orders 273, 275, 277, 278, 280 or 281 are complied with; and</p> <p>(ii) an authorised officer has reasonable grounds to believe will not affect the goods in any way.</p> <p>(e) in the case of chilled vacuum packaged goods reduced in temperature in accordance with paragraph 250A.3(b) -- under refrigeration that ensures that the goods are held at an air temperature of not more than 3°C</p> <p>(f) in the case of chilled goods referred to in sub-order 250.2 or paragraph 250A.2 (c) -- under conditions that –</p> <p>(i) ensure that the temperature and times specified in sub-order 250.2 or paragraph 250A.2(c) are complied with; and</p> <p>(ii) an authorised officer has reasonable grounds to believe will not affect the goods in any way.</p>	<p>for surface temperature - providing the transportation refrigeration ensures the goods are held at an air temperature of not more than 10°C. Under conditions permitted, equilibration during lengthy transport could lead to the surface temperature being above 7°C for significant periods of time. There is a conflict here with the requirements of Australian Standard AS 4696: 2002 even when transport times are relatively short.</p> <p>Goods can be loaded out and transported between establishments in a manner which could lead to risk, particularly carton meat which is to be frozen, since the order does not specify a maximum meat temperature. Rather, for product to be frozen, the air temperature during transport must be not greater than the minus 10°C and the meat temperature must be reduced to minus 6°C or below within 48 hours of boning, subject to the meat temperature at boning being in accordance with EMO250.</p> <p>However in practice due to short transport times and sufficiently low meat temperatures, it is unlikely that the growth of E. coli or other pathogens will be measurably increased.</p>	<p>1, 2, 3, 4, 9, 11</p>
288.2	Refers to other provisions in the orders	Refer to 288.1	

EMO No	Provision	Comments	References
372.2	<p>Where a statement indicating the temperature at which the goods are to be stored is included in the trade description the statement shall –</p> <ul style="list-style-type: none"> (a) in the case of chilled goods - indicate the temperature at which the goods should be stored and the temperature stated shall be within the range of minus 1.5 °C to 3°C. (b) in the case of frozen goods - indicate the maximum temperature at which the goods should be stored and the temperature stated shall be not more than minus 12°C. (c) in the case of refrigerated meat product --indicate the maximum temperature at which the goods should be stored and the temperature stated shall be not more than 4°C. 	<p>As validated by the references, the requirement prevents bacteria relevant to food safety from increasing.</p> <p>As validated by the references, the requirement prevents bacteria relevant to food safety from increasing.</p>	<p>1, 2, 3, 11, 17, 18</p> <p>1, 2, 3, 4, 7</p>
384.1	<p>Temperature of prescribed goods at time of removal from refrigeration chamber</p> <p>Subject to sub-order 384.2, where prescribed goods are to be loaded into a ship, aircraft or container system unit for export, the goods shall have been reduced in temperature in accordance with the requirements of these Orders before loading</p>	<p>Refer to order 384.2</p>	
384.2	<p>The prescribed goods referred to in suborder 384.1 shall not be removed from a refrigeration chamber for loading unless the meat temperature of the goods is:</p> <ul style="list-style-type: none"> (a) in the case of frozen goods— not more than -10°C; (b) in the case of chilled edible offal: <ul style="list-style-type: none"> (i) where exported by ship, not less than -1.5°C and not more than 0°C; or (ii) where exported by aircraft, not less than -1.5°C and not more than 3°C; (c) in the case of other chilled goods: <ul style="list-style-type: none"> (i) where exported by ship, not less than -1.5°C and not more than 3°C; or (ii) where exported by aircraft, not less than -1.5°C and not more than 4°C; or (d) in the case of a more restrictive temperature required by a foreign country— at or below that temperature. 	<p>As validated by the references, the requirement prevents bacteria relevant to food safety from increasing.</p>	<p>1, 2, 3, 4, 11, 13, 14, 16</p>

EMO No	Provision	Comments	References
385	<p>Temperature of prescribed goods at time of loading</p> <p>Where prescribed goods have been removed from a refrigeration chamber in accordance with sub-order 384.2, and those goods are not loaded immediately into a ship, aircraft or container system unit, the goods shall not be loaded if the temperature if the goods is –</p> <p>(a) in the case of frozen foods other than frozen cooked meat –</p> <p>(i) more than minus 10 °C when measured as a meat temperature and</p> <p>(ii) more than minus 6°C when measured at any other point within the goods except that, where flaps or flanks are present on a carcass or portion of a carcass, the temperature of these flanks may rise above minus 6°C.</p> <p>(b) in the case of frozen cooked meat — more than -10°C at any point within the goods:</p> <p>(c) in the case of chilled edible offal –</p> <p>(i) where exported by ship, more than 1 °C; or</p> <p>(ii) where exported by aircraft, more than 4°C.</p> <p>at any point within the goods</p> <p>(d) in the case of other chilled goods --</p> <p>(i) where exported by ship, more than 3°C; or</p> <p>(ii) where exported by aircraft, more than 4°C; at any point within the goods.</p> <p>(e) in the case of a more restrictive temperature required by a foreign country authority -at or below that required temperature.</p>	<p>As validated by the references, the requirement prevents bacteria relevant to food safety from increasing.</p>	<p>1, 2, 3, 4, 9, 11, 14, 16</p>

References

1. Shaw, M. K., Marr, A. G., Ingraham, J.L. (1971) Determination of the Minimal Temperature for Growth of *Escherichia coli*. *Journal of Bacteriology*, 105: 683-684.
2. Mackey, B. M., Roberts, T. A. (1980) Growth of *Salmonella* on chilled meat. *Journal of Hygiene*, 85: 115-124.
3. Smith, M.G. (1985) The generation time, lag time, and minimum temperature of growth of coliform organisms on meat, and the implications for codes of practice in abattoirs. *Journal of Hygiene*, 94: 289-300.
4. Grau, F. (1979) Fresh meats: Bacterial association. *Archiv fur lebensmittelhygiene*, 30: 87-92.
5. Smith, M.G. (1987) Calculation of the expected increase of coliform organisms, *Escherichia coli* and *Salmonella typhimurium*, in raw blended mutton tissue. *Epidemiology and Infection* 99: 323-331.
6. Gill, C.O., Phillips, D.M. (1990), Hygienically appropriate time/temperature parameters for raw meat processing. *In: Proceedings 36th International Congress Meat Science and Technology*. Havana, pp. 458-470.
7. Grau, F. (1987) Prevention of microbial contamination in the export meat abattoir, *In: Elimination of Pathogenic Organisms from Meat and Poultry*, Smulders, F.J.M. (ed), Elsevier Science Publishers B.V., Amsterdam.
8. Reichel, M.P., Phillips, D.M., Jones, R., Gill, C.O. (1991) Assessment of the hygienic adequacy of a commercial hot boning process for beef by a temperature function integration technique. *International Journal of Food Microbiology*, 14: 27-42.
9. Hanna, M. O., Smith, G. C., McKeith, F. K., Vanderzant, C. (1982) Microbial flora of livers, kidneys and hearts from beef, pork and lamb: Effects of refrigeration, freezing and thawing. *Journal of Food Protection*, 45: 63-73.
10. Gill, C.O. (1986) Temperature function integration for hygiene evaluation of food processing procedures. *Food Technology Australia*, 35: 203-204.
11. Gill, C. O., Newton, K. G. (1978) The ecology of bacterial spoilage of fresh meat at chill temperatures. *Meat Science*, 2:207-217.
12. Anonymous (1973) Bone - taint: Causes and Prevention, MIRINZ Bulletin, No. 3
13. Egan, A. F., Eustace, I. J., Shay, B. J. (1988) Meat packaging – Maintaining the quality and prolonging the storage life of chilled beef, pork and lamb. *Conference Proceedings: Meat 88*, Brisbane.
14. Grau, F.H. (1981) Microbial ecology and interactions in chilled meats, *CSIRO Food Research Quarterly*, 41:12-18.
15. Herbert, L.S., Smith, M.G. (1980) Hot boning of meat: refrigeration requirements to meet microbiological demands, *CSIRO Food Research Quarterly*, 40: 65-70.
16. McNeil, I., McPhail, N. G., Macfarlane, D. (1991) Carcass chilling. *In: Production of chilled meat for export – workshop proceedings*, B. McDonald (ed.) CSIRO, Brisbane, pp 39-52.
17. Smith, M.G. (1995) Survival of *E. coli* and *Salmonella* after chilling and freezing in liquid media. *Journal of Food Science*, 60: 509-512.
18. Grau, F.H. (1983) Growth of *E. coli* and *Salmonella typhimurium* on beef tissue at 25°C, *Journal of Food Science*, 48: 1700-1704.
19. Gill, C.O. (1988), Microbiology of edible meat by-products. *In: Edible meat by-products, Advances in Meat Research Vol 5*, Pearson, A.M. (ed), Elsevier Applied Science Publishers B.V., England.