TIME-TEMPERATURE TABLES FOR COOKING READY-TO-EAT POULTRY PRODUCTS

The 1999 FSIS final rule, Performance Standards for the Production of Certain Meat and Poultry Products, requires a 6.5 $\log_{10}$ relative reduction (6.5 $\log_{10}$ lethality) of *Salmonella* for cooked beef, roast beef and corned beef (9 CFR318.17). Appendix A in the compliance guidelines for this 1999 final rule, included two time-temperature (TT) columns in a table for roast beef, cooked beef and corned beef products. One column was for 6.5 $\log_{10}$ and the other column was for a 7.0 $\log_{10}$ relative reduction of *Salmonella* **(Attachment 1)**. The TT column for a 7.0 $\log_{10}$ relative reduction in whole beef products was included as a guide for those establishments that wanted to process these beef products to exceed the required minimum 6.5 logs for an additional measure of safety.

The 1999 final rule also established a performance standard for poultry that requires a 7.0 $\log_{10}$ lethality of *Salmonella* in RTE poultry (9 CFR 381.150). The compliance guidelines for this rule provided one temperature each for cooking uncured poultry (160º F) and for cured poultry (155º F) to meet the performance standard. FSIS did not provide a time-temperature table for cooking poultry at temperatures lower than 160º F because there was inadequate research information at that time.

FSIS has been made aware that some users of the TT tables in Appendix A are under the impression that the TT column for a 7.0 $\log_{10}$ reduction of *Salmonella* for cooked beef can also be used for cooking poultry to achieve a 7.0 log reduction in poultry and meet the performance standard. As a result, some establishments use the 7.0 $\log_{10}$ meat TT column for cooking poultry. Establishments that have been applying the 7.0 $\log_{10}$ column in the meat tables for cooking poultry could be undercooking their products. There is relatively greater risk of undercooking if the initial level of *Salmonella* in their raw product is high. Furthermore, studies have shown that there is a difference in bacterial resistance due to the type of product species. This could result in Salmonella positive products and foodborne illness. Currently, there is no information as to how many establishments use the 7.0 log meat TT tables for cooking poultry, nor is there information on actual instances of poultry products cooked at a time and temperature combination from the these tables that were inadequately cooked, resulting in *Salmonella* positive products and foodborne illness.

The 1999 final rule provides for the use of an ‘alternative’ lethality to meet the performance standard (7.0 $\log_{10}$ required lethality) for *Salmonella* in poultry products. The alternative lethality achieves the same probability that no viable *Salmonella* organisms remain in any finished product as that achieved with 7.0-$\log_{10}$ lethality for the worst case default FSIS assumption. If an establishment is using a TT combination not included in the Compliance Guidelines for cooking poultry, then it can either: 1) validate that the TT combination it is using for its cooking process to establish that it achieves a 7.0 log lethality of *Salmonella*, or 2) demonstrate in some fashion that an equivalent probability of no remaining viable *Salmonella* organisms in the finished product is obtained. For the first case, validation can be done by conducting a challenge study or using studies or documentation showing that the establishment’s lethality process is

adequate to achieve 7.0 $\log_{10}$ lethality in its cooked poultry product. For the second case, for example, an establishment can provide documentation showing that its initial *Salmonella* levels in the raw material are low enough to assure that its lethality process eliminates the pathogen in any contiguous 100 grams of finished product, to the extent of providing the same probability that there are no viable *Salmonella* as that when a 7.0 $\log_{10}$ lethality is achieved, assuming the FSIS default worst case level. In both these cases, the validation and documentation must also demonstrate the reduction of other pathogens and their toxins or toxic metabolites necessary to prevent adulteration of the finished product. The establishment should ensure that conditions of processing such as additives (e.g., salt) used in the product, and humidity applied during the lethality treatment, are reflected in the studies that determine lethalities and subsequent values of time and temperature parameters. A detailed explanation of validation or demonstration procedures for an alternative lethality can be found in Lethality and Stabilization Performance Standards for Certain Meat and Poultry Products: Technical Paper pp. 15-17 found on the FSIS website: www.fsis.usda.gov/OPPDE/rdad/FRPubs/Docs_95-033F.htm

In order to provide guidance to establishments on the processing of poultry products, FSIS requested ARS to conduct a study to determine the times and temperatures of cooking chicken and turkey to achieve a 7.0 $\log_{10}$ relative reduction of *Salmonella*. This study provided FSIS with new time/temperature tables for cooking poultry. The proposed performance standards for processed RTE meat and poultry products (issued 2/7/2001 in FR) included these new TT tables for cooking chicken and turkey of different fat contents to achieve a 7.0 $\log_{10}$ relative reduction of *Salmonella* **(Attachment 2)**. The proposed rule with the new poultry tables is posted on the FSIS website: www.fsis.usda.gov/OPPDE/rdad/FRPubs/Docs_97-013P.htm . The published study title and authors are as follows:

TITLE: Modeling non-linear survival curves to calculate thermal inactivation of *Salmonella* in poultry of different fat levels
AUTHORS: V. K. Juneja, B. S. Eblen, H. M. Marks
JOURNAL: International Journal of Food Microbiology 70 (2001) 37-51.

The holding times for cooking poultry at specific temperatures in these new tables for a 7.0 $\log_{10}$ relative reduction of *Salmonella* in poultry are longer than those listed in the column for the 7.0 $\log_{10}$ relative reduction of *Salmonella* in roast beef, cooked beef and corned beef. The 7.0 $\log_{10}$ meat TT table achieves lower lethality compared to the new TT tables for poultry. For example, the new tables specify that for a chicken product with 7% fat, 29 minutes at 140ºF is needed to obtain a 7-$\log_{10}$ lethality, whereas for this temperature, the TT tables for cooked beef specify 12 minutes is needed. The model in the above referred paper predicts that approximate 2.7-$\log_{10}$ lethality is obtained when poultry with 7% fat is cooked for 12 minutes; thus in this case the expected obtained lethality is about 4 $\log_{10}$ less than that required. For higher fat levels the difference would be greater. For cooking of poultry products other than chicken and turkey, use of the longer time at a certain temperature from the tables is recommended. Application of humidity such as those found in Appendix A should also be considered.

Establishments have been utilizing the cooking temperatures for poultry outlined in Appendix A for a number of years. However, the guidelines reflect new data on the temperatures needed to control *Salmonella* in poultry. The Agency is not rescinding the guidance for poultry in Appendix A, but an establishment needs to take this new data regarding increased time at a specific temperature to achieve a given level of reduction of *Salmonella* into consideration. An establishment can continue to utilize Appendix A within its process and should be conducting on-going verification to confirm that the process is being effectively controlled. The Agency will continue to collect verification samples for RTE products. If an establishment is using Appendix A, and the Agency collects an RTE sample that is positive for *Salmonella*, the establishment would be required under 417.3(b) to support its decision within its hazard analysis. Consequently, it is advisable that establishments using Appendix A verify its process on an on-going basis to ensure that *Salmonella* is being controlled effectively.

To summarize, in the absence of additional scientific rationale specific to the process within an establishment, in order to meet the objective of the performance standard, i.e., achieve a 7.0 $\log_{10}$ lethality of *Salmonella* in cooked poultry products, establishments could:
1) use the TT combinations in the new chicken and turkey tables (Attachment 2), and also found in the compliance guidelines for the proposed performance standards for processed meat and poultry products, with the application of adequate humidity, if deemed appropriate by the establishment; or
2) use any TT combinations provided they are validated for a process to achieve a 7.0 $\log_{10}$ lethality of *Salmonella;* or
3) apply a different (lower) minimum lethality, provided the same probability of no viable *Salmonella* in poultry as the probability obtained when there is a 7.0 $\log_{10}$ lethality assuming FSIS's default worst-case levels, while also assuring that other pathogens and their toxins or toxic metabolites are destroyed, so as not to adulterate the finished product. This provision can be used when *Salmonella* is not uniformly distributed in the product, or can be met by a plant when that plant establishes its worst-case level of *Salmonella* to be less than the FSIS assumed worst-case level.

ATTACHMENT 1

Cooked beef and roast beef, including sectioned and formed roasts, chunked and formed roasts, and cooked corned beef can be prepared using one of the following time and temperature combinations to meet either a 6.5-$\log_{10}$ or 7-$\log_{10}$ reduction of *Salmonella*. The stated temperature is the minimum that must be achieved and maintained in all parts of each piece of meat for a least the stated time:

Minimum Internal Temperature		Minimum processing time in minutes or seconds after minimum temperature is reached	
Degrees Fahrenheit	Degrees Centigrade	6.5-$\log_{10}$ Lethality	7-$\log_{10}$ Lethality
130	54.4	112 min.	121 min.
131	55.0	89 min.	97 min.
132	55.6	71 min.	77 min.
133	56.1	56 min.	62 min.
134	56.7	45 min.	47 min.
135	57.2	36 min.	37 min.
136	57.8	28 min.	32 min.
137	58.4	23 min.	24 min.
138	58.9	18 min.	19 min.
139	59.5	15 min.	15 min.
140	60.0	12 min.	12 min.
141	60.6	9 min.	10 min.
142	61.1	8 min.	8 min.
143	61.7	6 min.	6 min.
144	62.2	5 min.	5 min.
145	62.8	4 min.	4 min.
146	63.3	169 sec.	182 sec.
147	63.9	134 sec.	144 sec.
148	64.4	107 sec.	115 sec.
149	65.0	85 sec.	91 sec.
150	65.6	67 sec.	72 sec.
151	66.1	54 sec.	58 sec.
152	66.7	43 sec.	46 sec.
153	67.2	34 sec.	37 sec.
154	67.8	27 sec.	29 sec.
155	68.3	22 sec.	23 sec.
156	68.9	17 sec.	19 sec.
157	69.4	14 sec.	15 sec.
158	70.0	0 sec.**	0 sec.**
159	70.6	0 sec.**	0 sec.**
160	71.1	0 sec **	0 sec.**

** The required lethalities are achieved instantly when the internal temperature of a cooked meat product reaches 158^{o} F or above.

ATTACHMENT 2

Times for given temperature, fat level, and species needed to obtain 7-$\log_{10}$ lethality of *Salmonella**

Temperature (^{o} F)	Time for Chicken (fat%=1)	Time for Turkey (fat%=1)
136	63.3 min	64 min
137	50.1 min	51.9 min
138	39.7 min	42.2 min
139	31.6 min	34.4 min
140	25.2 min	28.1 min
141	20.1 min	23 min
142	16.1 min	18.9 min
143	13 min	15.5 min
144	10.4 min	12.8 min
145	8.4 min	10.5 min
146	6.8 min	8.7 min
147	5.5 min	7.1 min
148	4.4 min	5.8 min
149	3.5 min	4.7 min
150	2.7 min	3.8 min
151	2.1 min	3 min
152	1.5 min	2.3 min
153	1.2 min	1.8 min
154	55.9 sec	1.5 min
155	44.2 sec	1.2 min
156	35 sec	59 sec
157	27.7 sec	47.9 sec
158	21.9 sec	38.8 sec
159	17.3 sec	31.5 sec
160	13.7 sec	25.6 sec
161	10.8 sec	20.8 sec
162	<10.0 sec	16.9 sec
163	<10.0 sec	13.7 sec
164	<10.0 sec	11.1 sec
165	<10.0 sec	<10.0 sec

* The required lethalities are achieved instantly at the internal temperature in which the holding time is < 10 seconds.
Humidity is to be applied as necessary.

Times for given temperature, fat level, and species needed to obtain 7-$\log_{10}$ lethality of *Salmonella**

---------- fat%=2 ----------

Temperature (^{o} F)	Time for Chicken	Time for Turkey
136	64.5 min	64.3 min
137	51 min	52.2 min
138	40.5 min	42.5 min
139	32.2 min	34.6 min
140	25.7 min	28.3 min
141	20.5 min	23.2 min
142	16.4 min	19 min
143	13.2 min	15.6 min
144	10.6 min	12.8 min
145	8.6 min	10.6 min
146	6.9 min	8.7 min
147	5.5 min	7.1 min
148	4.4 min	5.8 min
149	3.5 min	4.7 min
150	2.7 min	3.7 min
151	2 min	2.9 min
152	1.5 min	2.3 min
153	1.2 min	1.8 min
154	56.9 sec	1.5 min
155	45 sec	1.2 min
156	35.6 sec	59.3 sec
157	28.2 sec	48.1 sec
158	22.3 sec	39 sec
159	17.6 sec	31.7 sec
160	14 sec	25.7 sec
161	11 sec	20.9 sec
162	<10.0 sec	16.9 sec
163	<10.0 sec	13.7 sec
164	<10.0 sec	11.2 sec
165	<10.0 sec	<10.0 sec

* The required lethalities are achieved instantly at the internal temperature in which the holding time is < 10 seconds.
Humidity is to be applied as necessary.

Times for given temperature, fat level, and species needed to obtain 7-$\log_{10}$ lethality of *Salmonella**

---------- fat%=3 ----------

Temperature (^{o} F)	Time for Chicken	Time for Turkey
136	65.7 min	64.6 min
137	52.1 min	52.4 min
138	41.3 min	42.7 min
139	32.9 min	34.9 min
140	26.2 min	28.5 min
141	21 min	23.3 min
142	16.8 min	19.1 min
143	13.5 min	15.7 min
144	10.8 min	12.9 min
145	8.7 min	10.6 min
146	7 min	8.7 min
147	5.6 min	7.1 min
148	4.5 min	5.8 min
149	3.5 min	4.7 min
150	2.7 min	3.7 min
151	2 min	2.9 min
152	1.5 min	2.3 min
153	1.2 min	1.9 min
154	58 sec	1.5 min
155	45.9 sec	1.2 min
156	36.3 sec	59.5 sec
157	28.7 sec	48.3 sec
158	22.7 sec	39.2 sec
159	18 sec	31.8 sec
160	14.2 sec	25.8 sec
161	11.2 sec	21 sec
162	<10.0 sec	17 sec
163	<10.0 sec	13.8 sec
164	<10.0 sec	11.2 sec
165	<10.0 sec	<10.0 sec

* The required lethalities are achieved instantly at the internal temperature in which the holding time is < 10 seconds.
Humidity is to be applied as necessary.

Times for given temperature, fat level, and species needed to obtain 7-$\log_{10}$ lethality of *Salmonella**

---------- fat%=4 ----------

Temperature (^{o} F)	Time for Chicken	Time for Turkey
136	67 min	64.9 min
137	53.2 min	52.8 min
138	42.2 min	43 min
139	33.6 min	35.1 min
140	26.8 min	28.7 min
141	21.5 min	23.5 min
142	17.2 min	19.3 min
143	13.8 min	15.9 min
144	11.1 min	13 min
145	8.9 min	10.7 min
146	7.2 min	8.8 min
147	5.7 min	7.2 min
148	4.5 min	5.8 min
149	3.6 min	4.7 min
150	2.7 min	3.7 min
151	2.1 min	2.9 min
152	1.6 min	2.3 min
153	1.2 min	1.9 min
154	59.1 sec	1.5 min
155	46.8 sec	1.2 min
156	37 sec	59.8 sec
157	29.3 sec	48.5 sec
158	23.2 sec	39.4 sec
159	18.3 sec	32 sec
160	14.5 sec	26 sec
161	11.5 sec	21.1 sec
162	<10.0 sec	17.1 sec
163	<10.0 sec	13.9 sec
164	<10.0 sec	11.3 sec
165	<10.0 sec	<10.0 sec

* The required lethalities are achieved instantly at the internal temperature in which the holding time is < 10 seconds.
Humidity is to be applied as necessary.

Times for given temperature, fat level, and species needed to obtain 7-$\log_{10}$ lethality of *Salmonella**

---------- fat%=5 ----------

Temperature (^{o} F)	Time for Chicken	Time for Turkey
136	68.4 min	65.3 min
137	54.3 min	53.2 min
138	43.2 min	43.4 min
139	34.4 min	35.4 min
140	27.5 min	29 min
141	22 min	23.8 min
142	17.6 min	19.5 min
143	14.2 min	16.1 min
144	11.4 min	13.2 min
145	9.2 min	10.8 min
146	7.4 min	8.9 min
147	5.9 min	7.3 min
148	4.7 min	5.9 min
149	3.6 min	4.7 min
150	2.8 min	3.7 min
151	2.1 min	2.9 min
152	1.6 min	2.3 min
153	1.3 min	1.9 min
154	1 min	1.5 min
155	47.7 sec	1.2 min
156	37.7 sec	1 min
157	29.8 sec	48.8 sec
158	23.6 sec	39.6 sec
159	18.7 sec	32.1 sec
160	14.8 sec	26.1 sec
161	11.7 sec	21.2 sec
162	<10.0 sec	17.2 sec
163	<10.0 sec	13.9 sec
164	<10.0 sec	11.3 sec
165	<10.0 sec	<10.0 sec

* The required lethalities are achieved instantly at the internal temperature in which the holding time is < 10 seconds.
Humidity is to be applied as necessary.

Times for given temperature, fat level, and species needed to obtain 7-$\log_{10}$ lethality of *Salmonella**

---------- fat%=6 ----------

Temperature (^{o} F)	Time for Chicken	Time for Turkey
136	69.9 min	65.8 min
137	55.5 min	53.6 min
138	44.2 min	43.8 min
139	35.2 min	35.8 min
140	28.2 min	29.3 min
141	22.6 min	24.1 min
142	18.1 min	19.8 min
143	14.6 min	16.3 min
144	11.8 min	13.4 min
145	9.5 min	11 min
146	7.6 min	9 min
147	6.1 min	7.4 min
148	4.8 min	6 min
149	3.8 min	4.8 min
150	2.9 min	3.8 min
151	2.1 min	2.9 min
152	1.6 min	2.3 min
153	1.3 min	1.9 min
154	1 min	1.5 min
155	48.6 sec	1.2 min
156	38.4 sec	1 min
157	30.4 sec	49 sec
158	24 sec	39.8 sec
159	19 sec	32.3 sec
160	15 sec	26.2 sec
161	11.9 sec	21.3 sec
162	<10.0 sec	17.3 sec
163	<10.0 sec	14 sec
164	<10.0 sec	11.4 sec
165	<10.0 sec	<10.0 sec

* The required lethalities are achieved instantly at the internal temperature in which the holding time is < 10 seconds.
Humidity is to be applied as necessary.

Times for given temperature, fat level, and species needed to obtain 7-$\log_{10}$ lethality of *Salmonella**

---------- fat%=7 ----------

Temperature (^{o} F)	Time for Chicken	Time for Turkey
136	71.4 min	66.3 min
137	56.8 min	54.1 min
138	45.3 min	44.2 min
139	36.2 min	36.2 min
140	29 min	29.7 min
141	23.2 min	24.4 min
142	18.7 min	20.1 min
143	15.1 min	16.6 min
144	12.2 min	13.7 min
145	9.8 min	11.3 min
146	7.9 min	9.2 min
147	6.3 min	7.5 min
148	5 min	6.1 min
149	3.9 min	4.9 min
150	3 min	3.9 min
151	2.2 min	3 min
152	1.7 min	2.3 min
153	1.3 min	1.9 min
154	1 min	1.5 min
155	49.5 sec	1.2 min
156	39.2 sec	1 min
157	31 sec	49.2 sec
158	24.5 sec	40 sec
159	19.4 sec	32.4 sec
160	15.3 sec	26.3 sec
161	12.1 sec	21.4 sec
162	9.6 sec	17.3 sec
163	<10.0 sec	14.1 sec
164	<10.0 sec	11.4 sec
165	<10.0 sec	<10.0 sec

* The required lethalities are achieved instantly at the internal temperature in which the holding time is < 10 seconds.
Humidity is to be applied as necessary.

Times for given temperature, fat level, and species needed to obtain 7-$\log_{10}$ lethality of *Salmonella**

---------- fat%=8 ----------

Temperature (^{o} F)	Time for Chicken	Time for Turkey
136	73 min	66.9 min
137	58.2 min	54.7 min
138	46.4 min	44.8 min
139	37.2 min	36.7 min
140	29.8 min	30.2 min
141	24 min	24.9 min
142	19.4 min	20.5 min
143	15.6 min	17 min
144	12.6 min	14 min
145	10.2 min	11.5 min
146	8.2 min	9.5 min
147	6.6 min	7.7 min
148	5.2 min	6.3 min
149	4.1 min	5 min
150	3.1 min	4 min
151	2.3 min	3.1 min
152	1.7 min	2.3 min
153	1.3 min	1.9 min
154	1.1 min	1.5 min
155	50.4 sec	1.3 min
156	39.9 sec	1 min
157	31.6 sec	49.5 sec
158	25 sec	40.1 sec
159	19.8 sec	32.6 sec
160	15.6 sec	26.4 sec
161	12.4 sec	21.5 sec
162	9.8 sec	17.4 sec
163	<10.0 sec	14.1 sec
164	<10.0 sec	11.5 sec
165	<10.0 sec	<10.0 sec

* The required lethalities are achieved instantly at the internal temperature in which the holding time is < 10 seconds.
Humidity is to be applied as necessary.

Times for given temperature, fat level, and species needed to obtain 7-$\log_{10}$ lethality of *Salmonella**

---------- fat%=9 ----------

Temperature (^{o} F)	Time for Chicken	Time for Turkey
136	74.8 min	67.6 min
137	59.7 min	55.3 min
138	47.7 min	45.4 min
139	38.3 min	37.3 min
140	30.8 min	30.8 min
141	24.9 min	25.5 min
142	20.1 min	21.1 min
143	16.3 min	17.4 min
144	13.2 min	14.4 min
145	10.7 min	11.9 min
146	8.6 min	9.8 min
147	6.9 min	8 min
148	5.5 min	6.5 min
149	4.3 min	5.2 min
150	3.3 min	4.1 min
151	2.5 min	3.2 min
152	1.8 min	2.4 min
153	1.4 min	1.9 min
154	1.1 min	1.5 min
155	51.4 sec	1.3 min
156	40.7 sec	1 min
157	32.2 sec	49.7 sec
158	25.4 sec	40.3 sec
159	20.1 sec	32.7 sec
160	15.9 sec	26.6 sec
161	12.6 sec	21.6 sec
162	10 sec	17.5 sec
163	<10.0 sec	14.2 sec
164	<10.0 sec	11.5 sec
165	<10.0 sec	<10.0 sec

* The required lethalities are achieved instantly at the internal temperature in which the holding time is < 10 seconds.
Humidity is to be applied as necessary.

Times for given temperature, fat level, and species needed to obtain 7-$\log_{10}$ lethality of *Salmonella**

---------- fat%=10 ----------

Temperature (^{o} F)	Time for Chicken	Time for Turkey
136	76.7 min	68.4 min
137	61.4 min	56.2 min
138	49.2 min	46.2 min
139	39.6 min	38.1 min
140	32 min	31.5 min
141	25.9 min	26.2 min
142	21 min	21.7 min
143	17.1 min	18 min
144	13.9 min	15 min
145	11.3 min	12.4 min
146	9.1 min	10.2 min
147	7.4 min	8.4 min
148	5.8 min	6.8 min
149	4.6 min	5.4 min
150	3.5 min	4.3 min
151	2.6 min	3.3 min
152	1.9 min	2.5 min
153	1.4 min	1.9 min
154	1.1 min	1.6 min
155	52.4 sec	1.3 min
156	41.4 sec	1 min
157	32.8 sec	49.9 sec
158	25.9 sec	40.5 sec
159	20.5 sec	32.9 sec
160	16.2 sec	26.7 sec
161	12.8 sec	21.7 sec
162	10.2 sec	17.6 sec
163	<10.0 sec	14.3 sec
164	<10.0 sec	11.6 sec
165	<10.0 sec	<10.0 sec

* The required lethalities are achieved instantly at the internal temperature in which the holding time is < 10 seconds.
Humidity is to be applied as necessary.

Times for given temperature, fat level, and species needed to obtain 7-$\log_{10}$ lethality of *Salmonella**

---------- fat%=11 ----------

Temperature (^{o} F)	Time for Chicken	Time for Turkey
136	78.9 min	69.5 min
137	63.3 min	57.2 min
138	50.9 min	47.2 min
139	41.1 min	39.1 min
140	33.4 min	32.5 min
141	27.1 min	27.1 min
142	22.1 min	22.6 min
143	18.1 min	18.8 min
144	14.8 min	15.7 min
145	12.1 min	13 min
146	9.8 min	10.8 min
147	7.9 min	8.8 min
148	6.3 min	7.2 min
149	4.9 min	5.8 min
150	3.8 min	4.5 min
151	2.9 min	3.5 min
152	2.1 min	2.7 min
153	1.4 min	1.9 min
154	1.1 min	1.6 min
155	53.4 sec	1.3 min
156	42.2 sec	1 min
157	33.4 sec	50.2 sec
158	26.4 sec	40.7 sec
159	20.9 sec	33 sec
160	16.5 sec	26.8 sec
161	13.1 sec	21.8 sec
162	10.3 sec	17.7 sec
163	<10.0 sec	14.3 sec
164	<10.0 sec	11.6 sec
165	<10.0 sec	<10.0 sec

* The required lethalities are achieved instantly at the internal temperature in which the holding time is < 10 seconds.
Humidity is to be applied as necessary.

Times for given temperature, fat level, and species needed to obtain 7-$\log_{10}$ lethality of *Salmonella**

---------- fat%=12 ----------

Temperature (^{o} F)	Time for Chicken	Time for Turkey
136	81.4 min	70.8 min
137	65.5 min	58.5 min
138	52.9 min	48.5 min
139	43 min	40.4 min
140	35 min	33.7 min
141	28.7 min	28.2 min
142	23.5 min	23.7 min
143	19.3 min	19.8 min
144	15.9 min	16.6 min
145	13 min	13.8 min
146	10.6 min	11.5 min
147	8.6 min	9.4 min
148	6.8 min	7.7 min
149	5.4 min	6.2 min
150	4.2 min	4.9 min
151	3.1 min	3.8 min
152	2.3 min	2.8 min
153	1.6 min	2.1 min
154	1.1 min	1.6 min
155	54.4 sec	1.3 min
156	43 sec	1 min
157	34 sec	50.4 sec
158	26.9 sec	40.9 sec
159	21.3 sec	33.2 sec
160	16.9 sec	26.9 sec
161	13.3 sec	21.9 sec
162	10.5 sec	17.7 sec
163	<10.0 sec	14.4 sec
164	<10.0 sec	11.7 sec
165	<10.0 sec	<10.0 sec

* The required lethalities are achieved instantly at the internal temperature in which the holding time is < 10 seconds.
Humidity is to be applied as necessary.