Developing a Hot-Fill-Hold Process for Acid or Acidified Foods

A thermal process is required for most foods after container filling to ensure safety and shelf stability. For **acidified canned foods,** thermal processing is most often either placement in boiling water/pure steam (canning) or using a hot-fill-hold process. The type of thermal process is based on the type of food, properties of the food, and the container/closure system. For many canning processes, a **Process Authority** must review and approve a thermal process.

A general guide to processing via immersion in **boiling water** can be found at the **National Center for Home Food Preservation** (https://nchfp.uga.edu) Many foods, however, lend themselves to a **hot-fill-hold process**. Sauces, salsa and other foods with a smooth consistency and a pre-cook process can often be effectively hot-filled.

1) food is heated (very hot),
2) hot food is placed into clean containers (often pre-warmed),
3) a closure or lid is applied. The sealed container is most often inverted to ensure pasteurization of the container headspace.

After inversion for a short period of time, the container is turned right side up and allowed to cool prior to labelling. **NOTE:** A 2-piece lid **may not** be used with an inverted hot hold.

Research provides **minimum** hot-fill hold conditions to ensure destruction of pathogens. Higher temperatures or longer hold times are necessary to ensure safety, shelf stability, and seal integrity.

Minimum hot-fill hold times for acidified foods with an equilibrium pH of 4.1 or below (partial table; see page 271 of the manuscript (below) for more information)

Temp(°F)	Time(min.)	Temp(°F)	Time(min.)	Temp(°F)	Time(min.)	Temp(°F)	Time (min.)
140	12.7	150	3.9	160	1.2	170	0.4
142	10.1	152	3.1	162	0.9	172	0.3
144	7.9	154	2.4	164	0.7	174	0.2
146	6.3	156	1.9	166	0.6	176	0.2
148	4.9	158	1.5	168	0.5	178	0.1

Reference: F. Breidt, K.P. Sandeep, and F.M. Arritt. 2010. Use of linear models for thermal processing of acidified foods. Food Protection Trends 30:268-272.

Using this information, the heating step in a scheduled process step for spaghetti sauce, pH 3.8, can be described as follows:

1. Fill jars with hot sauce, minimum fill temperature 180°F, target temperature is 200°F, set headspace at ½" and cover with properly prepared closure/lid.
2. Invert jar and hold, 180°F or higher for 2 minutes or longer. Turn jar ride side up, allow to air cool.

The hold time is, at a minimum 6 seconds (0.1 minutes) at 178°F. The processor chooses to hold the product longer, and at a higher temperature, to ensure safety and that a strong seal is achieved on the container. As long as temperature of the fill kettle maintains at least 180°F (recorded every 15 minutes), internal temperature does not have to be measured, only hold time.

Minimum hot-fill hold times for acidified foods with an equilibrium pH of 4.1 - 4.6 (partial table; see page 137 of the manuscript (below) for more information)

Temp(°F)	Time(min.)	Temp(°F)	Time(min.)	Temp(°F)	Time(min.)	Temp(°F)	Time (min.)
		150	22.4	160	5.6	170	1.4
142	67.7	152	17.0	162	4.3	172	1.1
144	51.4	154	12.9	164	3.2	174	0.8
146	39.0	156	9.8	166	2.5	176	0.6
148	29.6	158	7.4	168	1.9	178	0.5

Reference: F. Breidt, K. Kay, J. Osborne, B. Ingham, and F. Arritt. 2014. Thermal processing of acidified foods with pH 4.1 to 4.6. Food Protection Trends 34:132-138.