



Institute For Thermal Processing Specialists

TEMPERATURE DISTRIBUTION PROTOCOL FOR PROCESSING IN STEAM STILL RETORTS, EXCLUDING CRATELESS RETORTS

Various methods and equipment may be employed to achieve and verify a condition of temperature distribution in the retort that ensures all areas of the retort receive the scheduled process.

The following recommendations are to be considered voluntary guidelines. While they do not preclude the application of other methods and equipment for determining whether adequate temperature distribution is achieved in the retort - to ensure delivery of the scheduled process - these guidelines have been developed by consensus of the Institute For Thermal Processing Specialists and should be given serious consideration for adoption as methodology by individuals performing temperature distribution studies in steam still retorts, excluding crateless retorts.

1. PREPARATION; GENERAL PROCESSING EQUIPMENT SURVEY

It is important to develop or establish proper documentation during the survey of the processing equipment that will enable a proper evaluation to be made prior to the process of selecting the test retort(s). Prior to selection of the test retort(s), a survey should be made of the following:

1.1 *Steam Supply to the Retorts:*

1.1.1 Boiler(s) capacity and pressure.

1.1.2 Retort header pressure. It is important to ensure that adequate steam pressure and volume is being delivered to the test retort(s).

1.1.3 Pipe size and length, valve size and types, from the main steam line to the retort room.

1.1.4 Size of all connecting steam pipes to the main line noting equipment using steam (e.g., blanchers, exhaust boxes, etc.).

1.2 *Retort Room:*

1.2.1 Types and size of each retort.

1.2.2 Steam lines from the main line to each retort, including size of pipes, fittings and valve sizes and types.

1.2.3 Vent plumbing configurations including valve types and sizes, pipe sizes and connections.

1.3 Loading Equipment:

1.3.1 Container size, orientation and loading configuration.

1.3.2 Maximum number of containers per layer; maximum number of crates in each retort.

1.3.3 Hole size and spacing of the base plate and separator sheets used in the crates or baskets.

1.3.4 Determine the percent open area of the separator sheets, if used.

2. SELECTION OF THE TEST RETORT(S)

All piping systems, valve sizes and types, and loading equipment should be taken into consideration when selecting the test retort(s). The retort(s) selected for the test as a result of the general processing equipment survey should represent the worst possible condition that could influence the delivery of the scheduled process. Factors such as use of the retort at the end of the steam supply line; smallest container; dividers between container layers (vs. jumble pack) generally represent a worst case situation.

3. TEST RETORT(S) DOCUMENTATION

List, provide a diagram and describe the operation and condition of the following:

3.1 Retort Shell: Physical dimensions and number. Of crates used in each run. Note for vertical retorts the presence of centering guides and or baffle plates.

3.2 Steam Supply from Main Line to Retort: Pipe size, valve size and type, pressure regulators or reducers and all pipe fittings including steam by-pass pipes.

3.3 Steam Control: Temperature or pressure actuated; controlling thermal element; type and location.

3.4 Air Systems for Controls (if applicable): Size of air compressors, air dryer capacity, filter location(s) and types.

3.5 Piping:

3.5.1 Steam spreader - shape, size, location and configuration; number, size and location of holes in pipe; size of "T", or any other pipe fittings.

3.5.2 Vents - location and size of pipes, also type and size of valve(s).

3.5.3 Vent manifold or manifold headers location and size of all pipes and connecting pipes.

3.5.4 Bleeders, mufflers - location, number, size and construction.

3.5.5 Drains - location and size.

3.5.6 Water supply - location and size of pipes, valve size and type (if applicable).

3.5.7 Air supply - location and size of pipes, valve size and type (if applicable).

3.5.8 MIG thermometer - location on the retort.

3.5.9 Pressure gauge - location on the retort.

3.5.10 Additional piping or equipment such as condensate removal systems, etc.

3.6. *Recording Device:* Recorder or recorder/ controller type and description.

4. TEST EQUIPMENT

4.1 *Data Logger:* Equipped with sufficient channels to adequately monitor and record temperatures within the process delivery system.

4.2 *Thermocouples:* Or other temperature sensors of sufficient size, length, number and quality to adequately monitor the heating medium temperatures within the retort.

4.3 *Pressure Indicating Device(s):* If needed.

4.4 *Mercury-in-Glass Thermometers:* If the test retort MIG is not to be used.

4.5 *Stuffing Box (Packing Gland):* For entry of lead wires into the retort.

5. STANDARDIZATION OF TEST EQUIPMENT

5.1 *Retort Thermometer:* The retort mercury-in-glass (MIG) thermometer should conform to the applicable Federal Regulations and should have been checked for accuracy against a known accurate thermometer within the past year.

5.2 Temperature Measurement System: Including data logger, thermocouples, extension wires, or other temperature measuring devices (TMD), etc.

5.2.1 Prior to conducting the actual temperature distribution study, standardization or calibration of test equipment should be performed in the test retort (as defined in Section 2) selected at the factory, with all leads, extensions and connections assembled as they will be used under actual test conditions.

5.2.2 Bundle all TMDs and locate them in close proximity to the known accurate MIG thermometer probe, taking care not to inhibit steam flow past the MIG probe or TMDs.

5.2.3 Bring the retort up to the temperature to be used during the distribution tests and allow the entire system to equilibrate.

5.2.4 Checked the accuracy of the TMDs against the known accurate retort MIG. Any single TMD should agree within 0.5 degrees F (0.3C) of the MIG. The range for all TMDs should be not more than 1 degreeF (0.6C). Any TMD which deviates from the above criteria should not be used until corrective action is performed which results in the TMD meeting the established criteria. The TMD in closest agreement with the known accurate MIG thermometer should be attached to its probe and becomes the reference TMD for data evaluations.

5.2.5 In order to meet the above calibration criteria, and to ensure delivery of the scheduled process, consideration should be given to minimizing errors inherent in any component of the temperature measuring system. For example, the use of premium grade thermocouple wire, from the same spool, to make all thermocouple leads and extensions.

6. PLACEMENT OF THE TEMPERATURE MEASURING DEVICES IN THE RETORT

6.1 Location of TMDs in Retort: TMDs should be placed in the following locations in the retort vessel:

6.1.1 Attached or in close proximity to the MIG thermometer probe.

6.1.2 Attached or in close proximity to the temperature controller probe, unless the MIG and temperature controller probes are located together.

6.1.3 Located in at least two containers filled with the testing medium for the purpose of obtaining initial temperatures. If there are data on hand to correlate temperatures measured by external TMDs (attached to the container) to a specific initial temperature - prior to making a run - such a procedure may be used in lieu of measuring actual initial temperature.

6.1.4 A minimum of three, each located in separate areas of each basket or crate.

6.1.5 Depending on the processing system, it may be necessary to place additional thermocouples at other locations in the vessel to adequately monitor the coldspot in the retort or initial temperature of the testing medium.

6.2 Record of TMD Locations: A schematic drawing to show the placement of all TMDs within the retort should become part of the critical records for the temperature distribution tests.

7. PREPARING THE TEST CRATES OR BASKETS WITH CONTAINERS

7.1 Container Size: Select the container size processed in the retorts, usually the smallest, that will yield the worst case situation for the operation.

7.2 Container Contents: Containers are usually filled with water; however, the fastest heating product processed in the retorts may be used.

7.3 Container Placement: Containers are placed in the crates or baskets in a manner that is equivalent to the worst case situation under the commercial operation. If separator or divider sheets are used between the layers of containers, then the sheets having the smallest percent total open area should be used for testing.

8. THE TEMPERATURE DISTRIBUTION TEST

8.1 Set Up:

8.1.1 Verify the retort survey.

8.1.2 Initial temperature - the initial temperature for a test run is the warmest of the temperatures measured by an instrumented container. The range of initial temperatures to be encountered during normal commercial operation should be taken into account in establishing the vent schedule. If instrumented containers are not used, there must be some other means of accurately determining the temperature of the container contents. The initial temperature(s) measured should be considered in the context of retort shell and crate temperatures, which may be lower or higher than the product temperature, and could have an effect on the total heat load

8.2 Data Collection Points:

8.2.1 The following are critical and should be monitored and recorded during the test:

8.2.1.1 Controller temperature set point.

8.2.1.2 Initial temperature.

8.2.1.3 Steam on or "0" time.

8.2.1.4 Time and temperature when the drain is closed, if it is open during a portion of the vent.

8.2.1.5 Time and temperature of the retort when the vent closes, taken from the MIG thermometer and reference TMD.

8.2.1.6 Time when the reference TMD (attached to or in close proximity to the MIG thermometer) reaches the processing temperature set point.

8.2.1.7 Time when the controller (if applicable) advances to the "cook" cycle in the program.

8.2.1.8 MIG thermometer readings - at sufficient intervals, including the time it reaches the processing temperature set point.

8.2.2 In addition, the following points are important and are highly recommended to be monitored and recorded during the test:

8.2.2.1 Retort steam header pressure and temperature, if superheated steam is a concern, and/or steam pressure at the end of the spreader.

8.2.2.2 Time when the temperature recording device reaches the processing temperature set point. **8.2.2.3** Retort pressure gauge (optional) readings at sufficient intervals including the time it reaches processing temperatures.

8.3 *Conducting the Test:*

8.3.1 The data logger should record the temperature of each TMD just prior to "steam on" and at sufficient intervals, not to exceed one minute, throughout the test. The data logger record should become part of the critical records for the test.

8.3.2 Critical points should be recorded at intervals of sufficient frequency to describe and verify retort operating parameters during the test. These records become part of the test records and should include the temperature recording chart(s).

8.3.3 The test should extend for at least ten minutes after the retort control system has stabilized and a definite temperature profile has been established or all temperature monitoring devices have reached a steady state condition.

8.3.4 Ideally, no TMD should read more than plus or minus 1.0 degree Fahrenheit (0.6C) from the reference TMD at the time it first indicates the processing temperature set point has

been reached. Situations or conditions that do not meet these criteria should be evaluated by a thermal processing specialist.

- **Prepared by The Committee on Temperature Distribution Institute For Thermal Processing Specialists Approved for Publication Nov. 30, 1992**

- The Institute for Thermal Processing Specialists is a non-profit organization established exclusively for the purpose of fostering education and training for those persons interested in procedures, techniques and regulatory requirements for thermal processing of all types of food or other materials, and for the communication of information among its members and other organizations.

- Part of the mandate of the IFTPS Committees is to develop protocols to be used as guides for carrying out the work of thermal processing specialists. This is the first such protocol prepared by the Committee on Temperature Distribution and reviewed extensively by members of the Institute. The protocol has been approved by the Board of Directors. **This document may be photocopied in its entirety for use.**

- Single copies of the protocol, as well as information on membership in IFTPS may be obtained from: Institute for Thermal Processing Specialists, 304 Stone Rd. W. Ste. 301, Guelph, ON N1G 4W4 Phone: (519) 824 6774 Fax: (519) 824 6642, E-Mail: info@iftps.org
