HYDROSTATIC RETORTS

Equipment and procedures for pressure processing in steam in hydrostatic retorts are covered by 9 CFR 431.6(b)(4).

Generally, the hydrostatic retort is usually very large and many stories high. It can be thought of as a still steam retort operated at a constant process temperature through which containers are conveyed by a continuous carrier chain at a constant rate designed to provide the correct process time.

Hydrostatic retorts are manufactured by the FMC Corporation in the U.S. and by Stork and others in Europe. Newer designs now offer end over end or axial agitation of the product; the use of overpressure for the maintenance of container integrity; the ability to process glass and flexible pouches; and water as a heating medium in addition to steam. The systems are often used for high volume products which need long cook times such as condensed soups and pet foods.

Hydrostatic pressure is pressure from a body of water at rest. The weight of the water causes the pressure. The higher the water is in a vertical column, the greater the pressure. The name hydrostatic is derived from the fact that the pressure in the steam dome is counter balanced by water in the entry and exit legs of the retort. The containers are conveyed through this steam dome. The higher the water level, the higher the pressure and temperature obtained in the steam dome. They are pre-heated in a feed leg (hot water leg) prior to entering the steam dome and cooled in an exit or discharge (cooling) leg after the steam dome. Containers are carried by chain conveyors. The water is under “hydrostatic pressure” created by pressure in the water legs which seals the steam in the steam chamber.
Startup procedures for a hydrostatic retort requires venting of the retort and bringing the water in the feed legs up to temperature. This procedure takes a longer period than the venting of still steam retorts. The hydrostatic retort is normally operated for periods of up to several weeks and may be shut down and cooled only when required for maintenance or repairs.

Containers are loaded into a horizontal carrier on the continuous chain and conveyed up to the inlet leg of the sterilizer. The inlet leg is filled with water which counterbalances the pressure in the steam dome. The temperature of the water increases as the container moves from the top of the inlet leg down toward the steam-water interface at the bottom of the leg. Water temperature in the inlet leg may range from ambient to boiling. The feed leg may contribute to the process lethality by increasing the initial temperature of the product. If process lethality is claimed for the inlet leg of the retort, the water temperature in the inlet leg must be carefully controlled.

There is minimal product agitation unless specifically designed into the system. Steam is generally used as the heating medium. There are no doors and transfer valves between the processing chamber (steam dome) and the atmosphere. Process times are basically the same as a still retort. The conveyor system is being used to increase the number of containers processed. Steam may enter at the top or middle of the dome.

For example, the water height in the water legs must be 37 feet high at sea level to counterbalance a processing temperature of 250° F (121° C). Operating at temperatures above 250° F will require a higher water level. The retorts can be operated below the maximum temperature if the pressure remains high enough to prevent water contact with the containers in the steam dome.

The container is conveyed through the steam water interface into the steam dome. The number of times that the carrier passes through the steam dome as well as the speed of the carrier determines the process time. Traveling from the top of the steam dome to the bottom, and vice-versa, is referred to as one pass. Hydrostatic retorts with 2, 4, 6, and 8 passes are common. After traveling through the steam dome, the containers are conveyed into the exit water leg where the temperature decreases as the container passes up the leg. The cans leaving the steam dome are heated to a high level and give up their heat to the water in the discharge leg. This results in several situations depending upon the design of the retort.

As the container exits the leg it is exposed to atmospheric pressure, and it may pass through a series of water spray coolers to further cool the product. The conveyor chain carries the containers back to near the loading station where the processed product is unloaded from the continuous carrier. Because the container inlet and exit are close together, care must be taken to ensure that unprocessed containers do not become mixed with processed containers. Containers found on the floor or elsewhere whose status is questionable should be destroyed.

9 CFR 431.6(b)(4)(i) requires that the MIG thermometer be installed in the retort steam dome near the steam-water interface. This should be the coldest spot in the retort dome. There must be a steam controller.

9 CFR 431.6(b)(4)(i) requires the installation of additional temperature recorders near the top and bottom of each hydrostatic water leg if the process schedule specifies maintenance of particular temperatures in the water legs.

An automatic steam controller must be utilized for all retorts to maintain the retort temperature (9 CFR 431.6(a)(3)).

Before the start of operations, the steam dome must be vented just like a regular steam, batch, still, retort. The venting time and temperature must be recommended by the equipment manufacturer or the plant's process authority.

9 CFR 431.6(b)(4)(iv) requires the hydrostatic retort to be equipped with at least one bleeder 1/4 inch or larger at the top of the steam chamber or chambers at the opposite end of steam entry. In addition, all bleeders must be arranged in such a way that the operator can observe that they are functioning properly.

Control of the water levels in the feed and exit legs are important to maintain the hydrostatic pressure in the retort. The water level is normally controlled through a differential pressure controller which adds water when it is needed and dumps excess water from the legs. Water level fluctuation in the feed and exit legs may be caused by fluctuations in the feeding and discharge of containers. As more containers are fed into the container conveyor more water is displaced from the legs, a lack of production results in a lack of containers in the legs and the water level falls.

The container-conveyor is driven by a variable speed motor and must be checked and recorded at the beginning of processing and recorded at least every 4 hours. Changing container-conveyor speed changes the process time. Operating at a slower speed than in the process schedule will result in longer cook times which effect product quality. Operating at a faster speed than outlined in the process schedule will result in shorter cook times and potentially

underprocessed product, which could indicate a food safety issue.

Water contacting containers in the bottom loops is a serious concern. It may result in underprocessing. If containers contact the water, the containers **must** be segregated and evaluated by the processing authority.

The feed leg cannot be lower than the minimum product initial temperature (IT) or the leg temperature becomes the IT. Critical factors must be measured and recorded in accordance with the method and frequency in the written procedure, as is true for all retorts (9 CFR 431.4). Records must include conveyor (chain) speed and be checked at least every 4 hours (9 CFR 431.6(b)(v)).