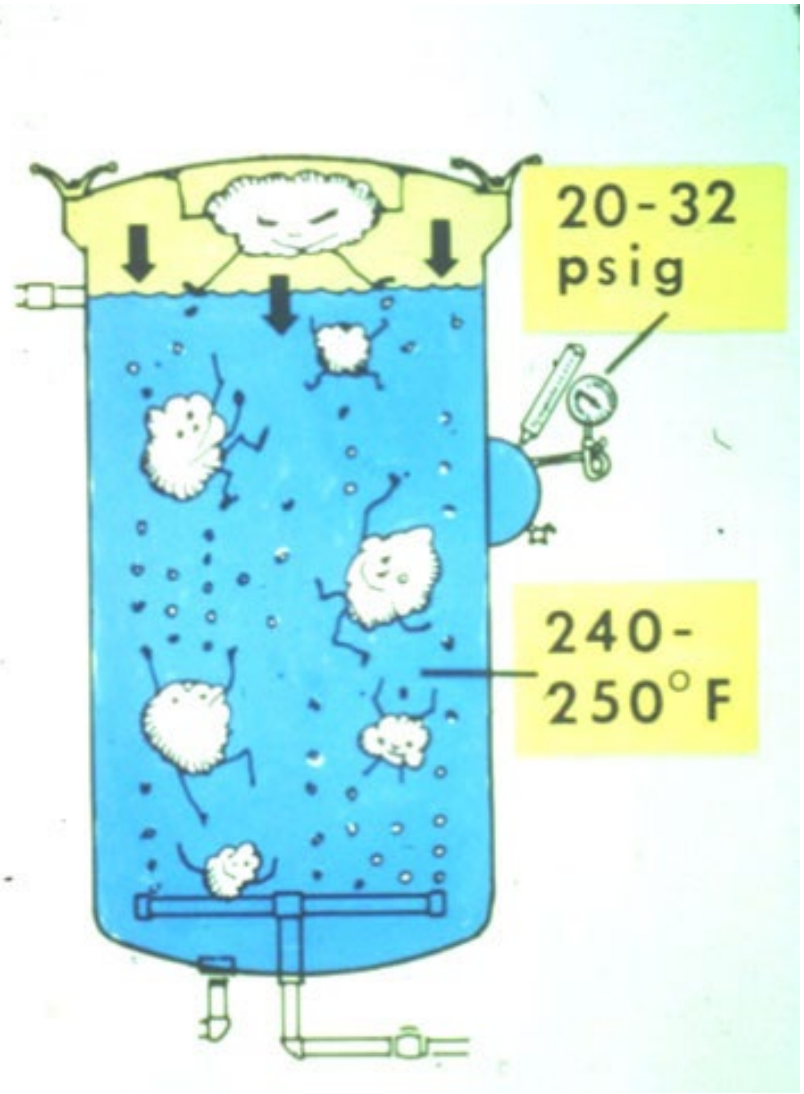
Module 11. Retorts— Processing With Overpressure

Thermal Processing for Meat and Poultry Products Training

What is Overpressure?

Overpressure:

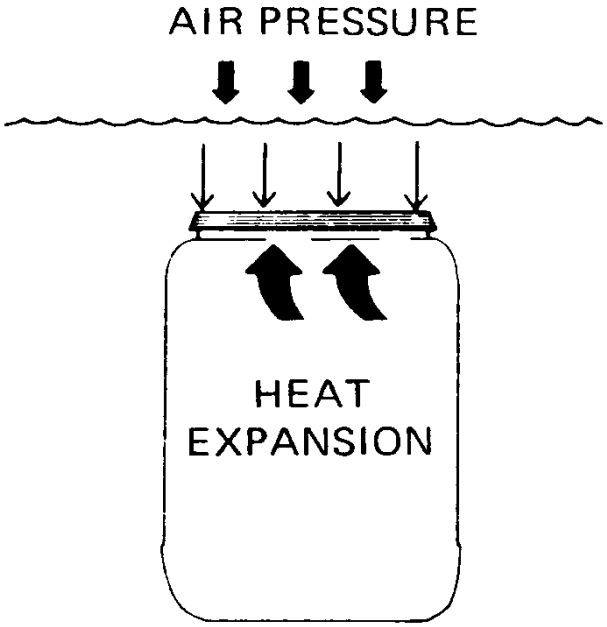
- Pressure supplied to a retort in excess of the normal pressure exerted by the heating medium at a given temperature



Purpose of Overpressure

Overpressure

- To maintain container integrity
- To permit adequate processing



Overpressure Requirements

Overpressure requirements vary:

- Too much at the start of the process could distort containers (crush containers) or damage seals
- Too little during heating could lead to container rupture or seal damage, slow heat penetration, or interfere with water circulation patterns in the retort
- Too little during cooling could lead to container rupture or seal damage

Factors Affecting Overpressure Requirements

- Product fill temperature
- Container headspace
- Container vacuum
- Entrapped air
- Processing temperature

Overpressure Applications

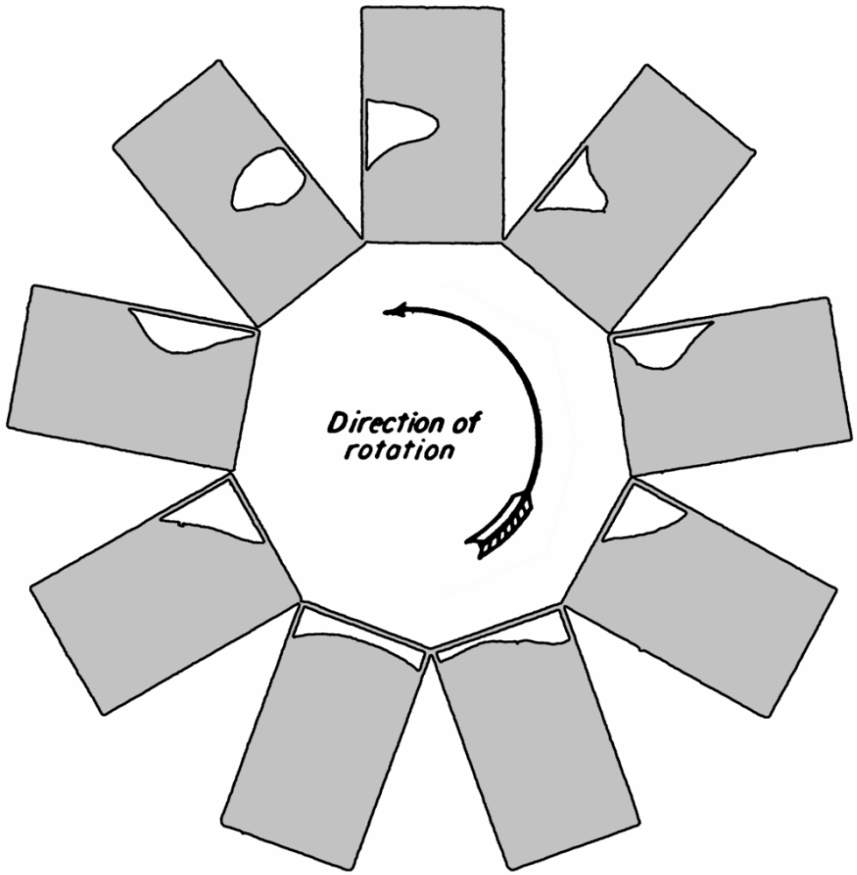
- Plastic containers
- Flexible pouches
- Metal trays
- Glass jars

General Characteristics of Retorts that Provide Overpressure

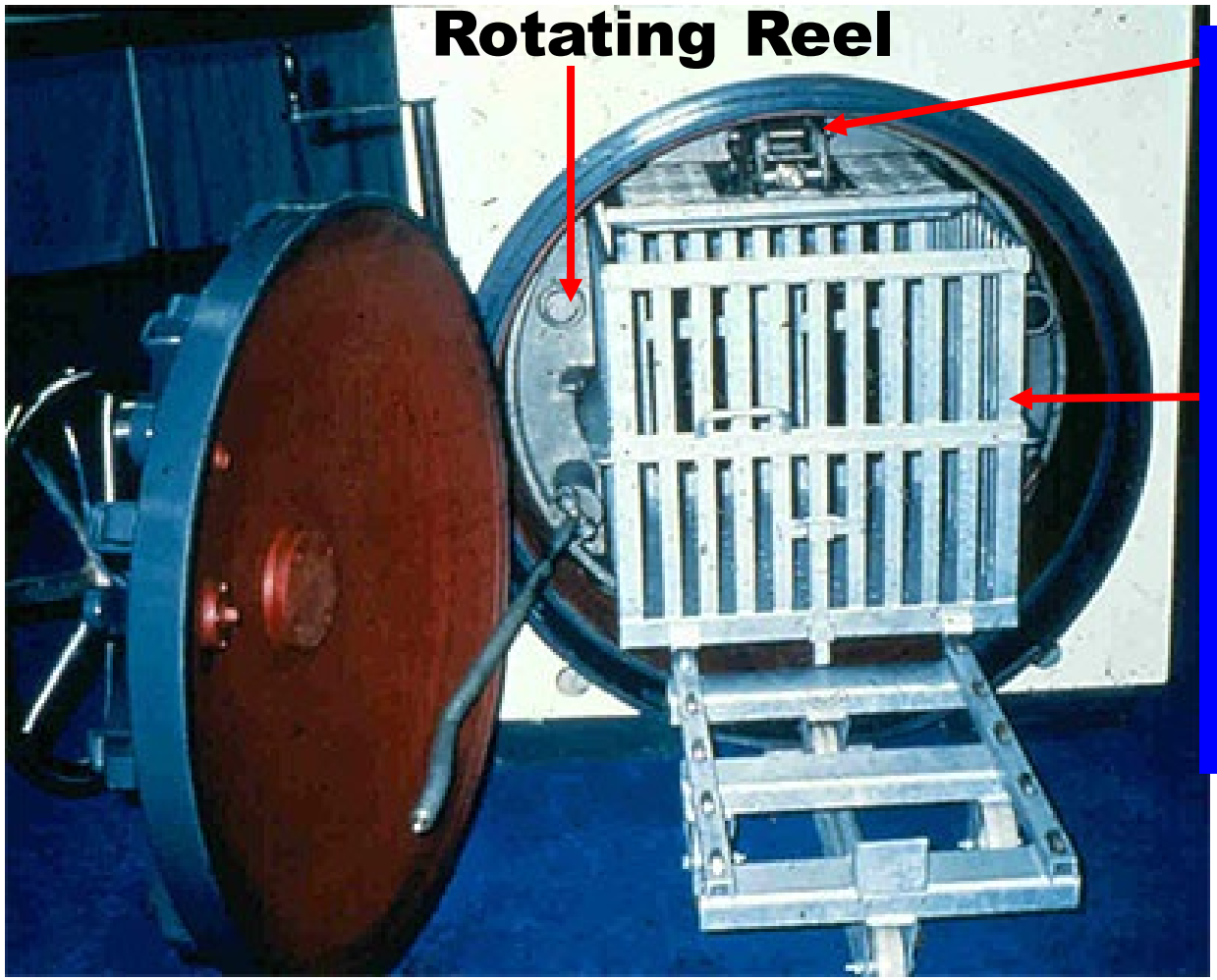
- Introduced steam or air is the source of overpressure
- Batch processing, not continuous container handling
- Static (still), rotary (end-over-end), and back and forth (Shaka®process) agitation models

End-Over-End Agitation

- Containers are held in place in the basket
- Rotating framework holds baskets
- Variable rotational speed
- Custom racking system

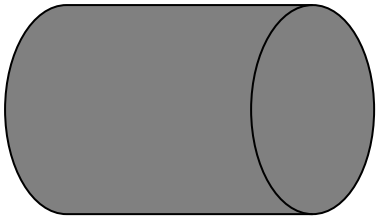


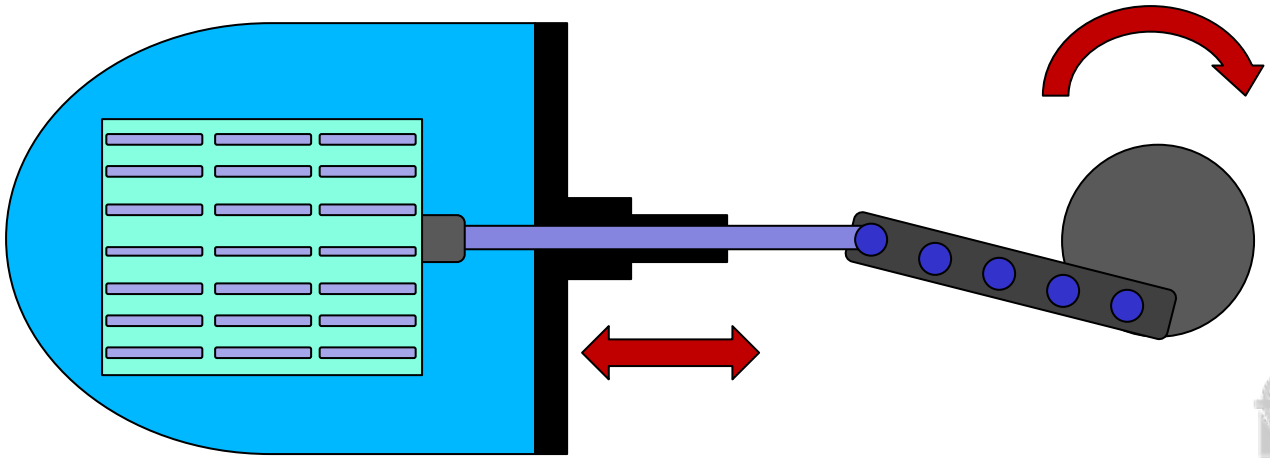
End-Over-End Agitation



Back and Forth (Shaka®process) Agitation

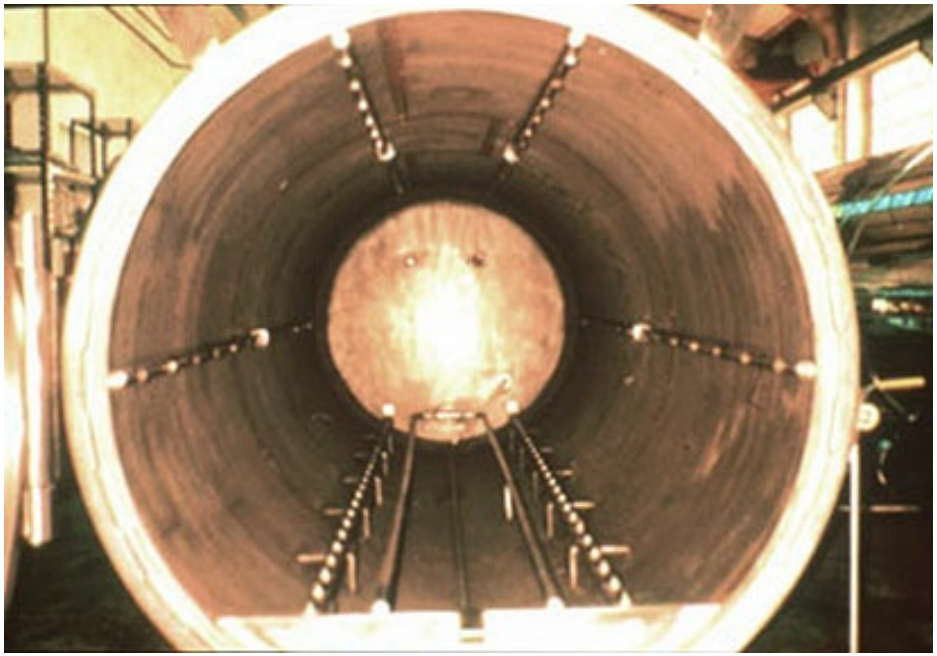
- Containers are held in place in the basket
- Variable double reciprocating strokes
- Custom racking/basket system





Retorts that Provide Overpressure

- Processing medium:
  - water immersion,
  - cascading water,
  - water spray, or
  - steam/air mixture

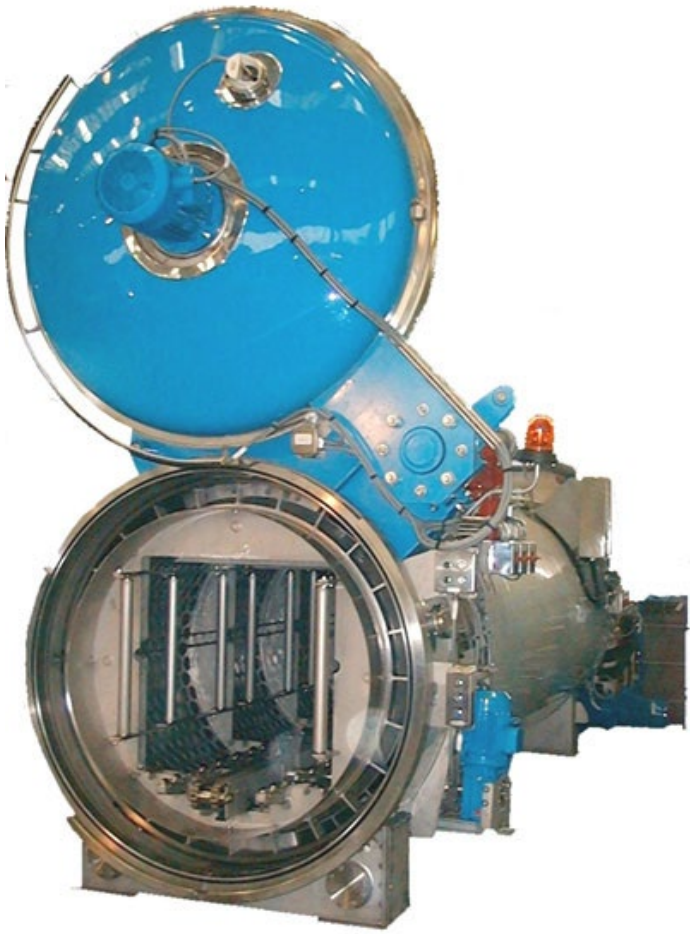


Water Spray

Installation and Operation of Overpressure Retorts

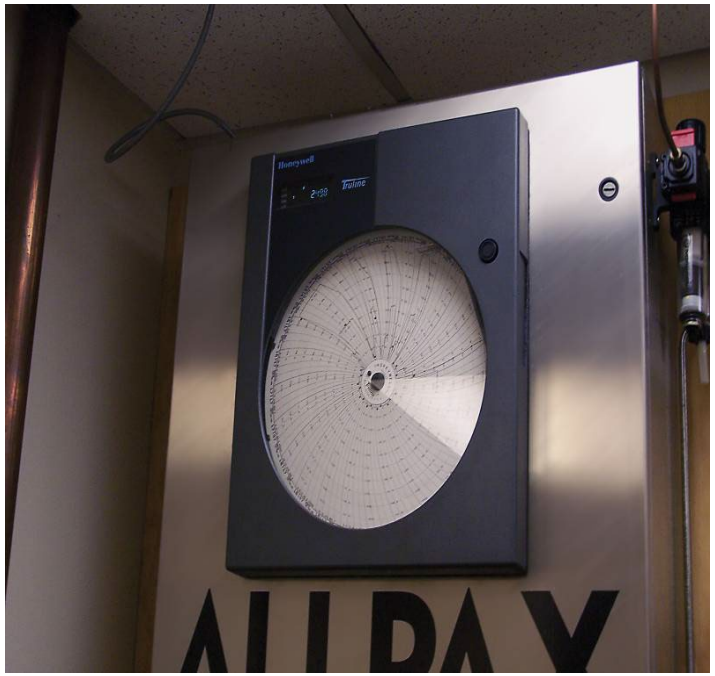
Common Considerations:

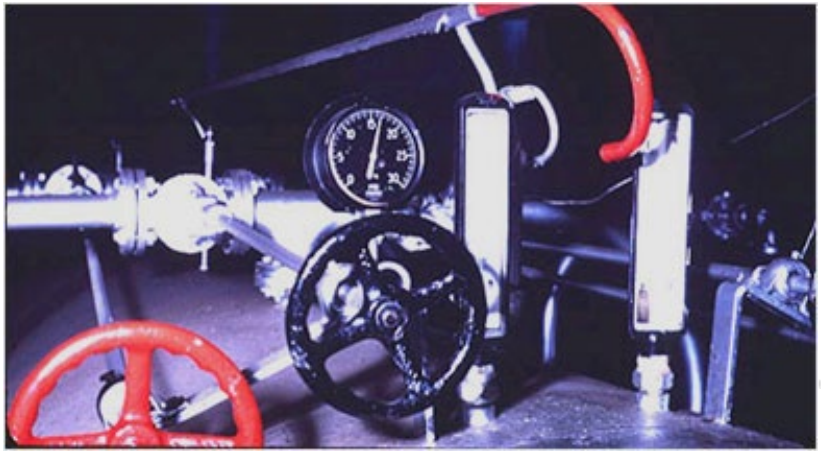
- Installation, operation, and controls vary based on the processing medium
- Usually equipped with various alarms and warning devices to monitor critical operating procedures



Instrumentation-Pressure Control

- Each retort **must** have a pressure recording device
- Each retort **should** have pressure gauge



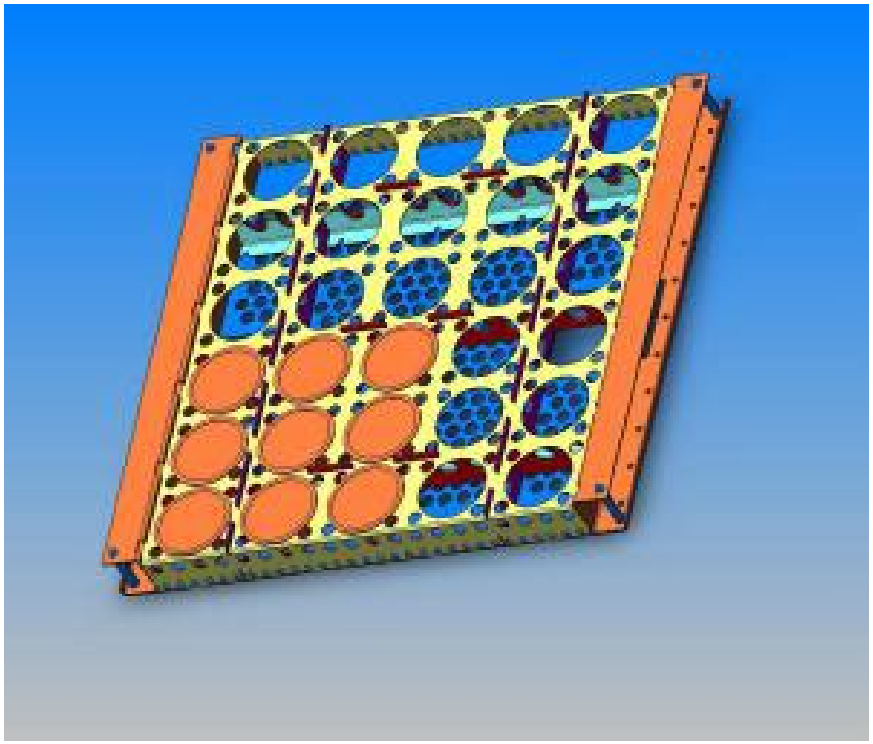


Processing Medium Circulation

- Each retort **must** have a means of providing uniform HD/TD during processing
- The efficiency of the circulation system **must** be documented in HD/TD data or other documentation from a PA
- HD/TD data **must** be on file at the establishment to support the retort operating procedures

Factors that may Affect Heat Distribution or Processing Medium Circulation

- Crate and rack design
- Loading configuration
- Container type, size, or position



Nested Pouches

Factors that may Affect Heat Distribution or Processing Medium Circulation

- Operating pressure
- Come-up procedures
- Partial loads
- Fan or pump off or not functioning properly

Full Water Immersion Retorts

Water Immersion Retort Characteristics

- Water is the heating/cooling medium which completely covers the containers
- Horizontal and vertical configurations
- Introduced air *or* steam provides overpressure
- Several manufacturers

Instrumentation - Temperature Indicating Device

- Sensor (probe) located beneath water surface
- Sensor (probe) must extend at least 2" into water
- Vertical retorts – sensor (probe) may be located in thermometer pocket

Instrumentation - Temperature Indicating Device

- Horizontal retorts – sensor (probe) **must** be directly in shell for a retort using a steam spreader
- Horizontal retorts using a heat exchanger – sensor (probe) is located on the water return pipe before the entry to the exchanger

Instrumentation - Temperature/Time Recording Device

- Recorder sensor (probe) usually adjacent to temperature indicating device sensor
- May be combined with the steam controller to be a recorder-controller
- Vertical retort – sensor (probe) **must** be below lowest crate support where steam does not strike it directly

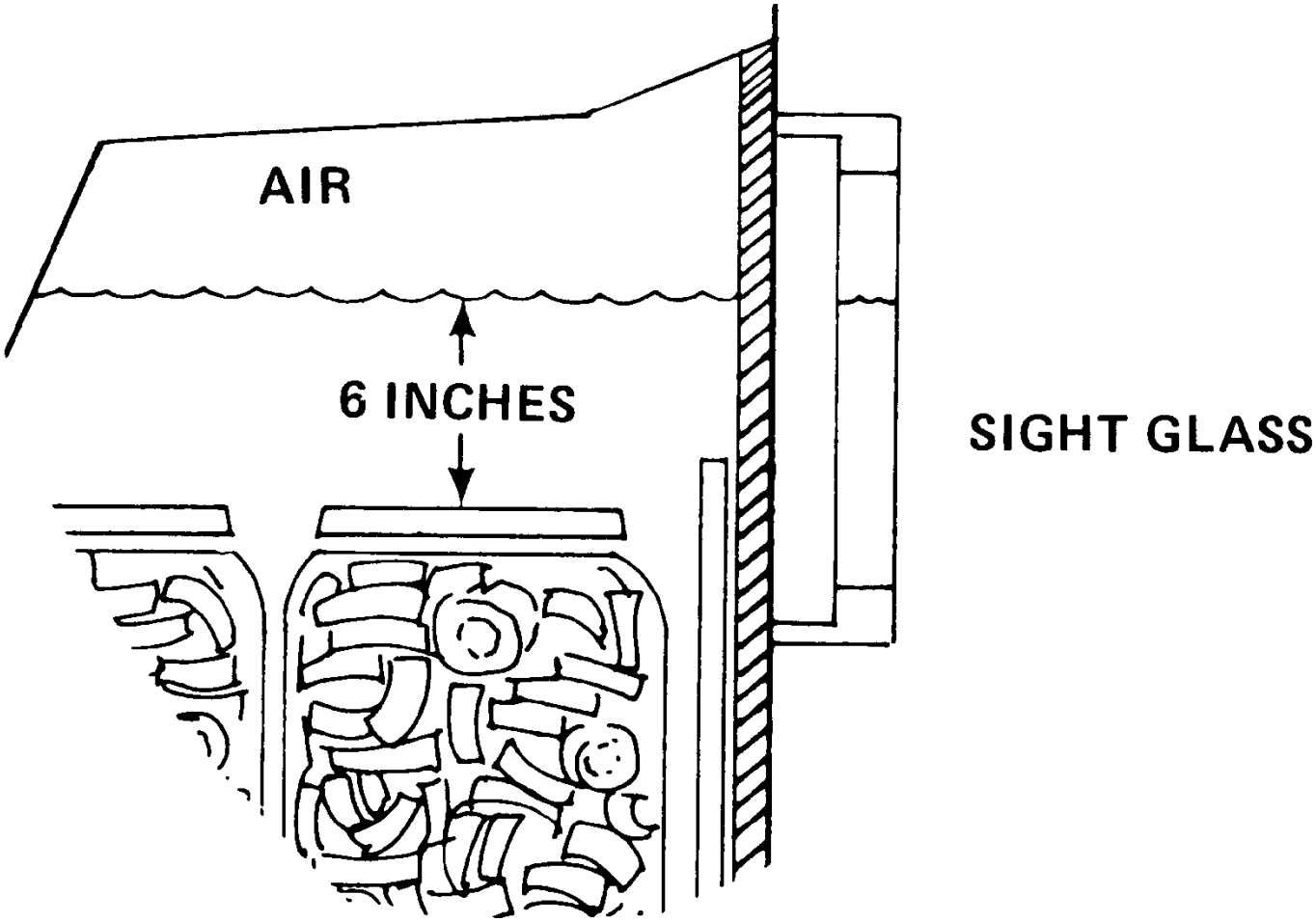
Instrumentation – Recorder/Controller Sensor Location

- Horizontal retort – sensor (probe) **must** be between water surface and center line in a retort using a steam spreader
- Horizontal retorts using a heat exchanger – sensor (probe) is located on the water return pipe before the entry to the exchanger

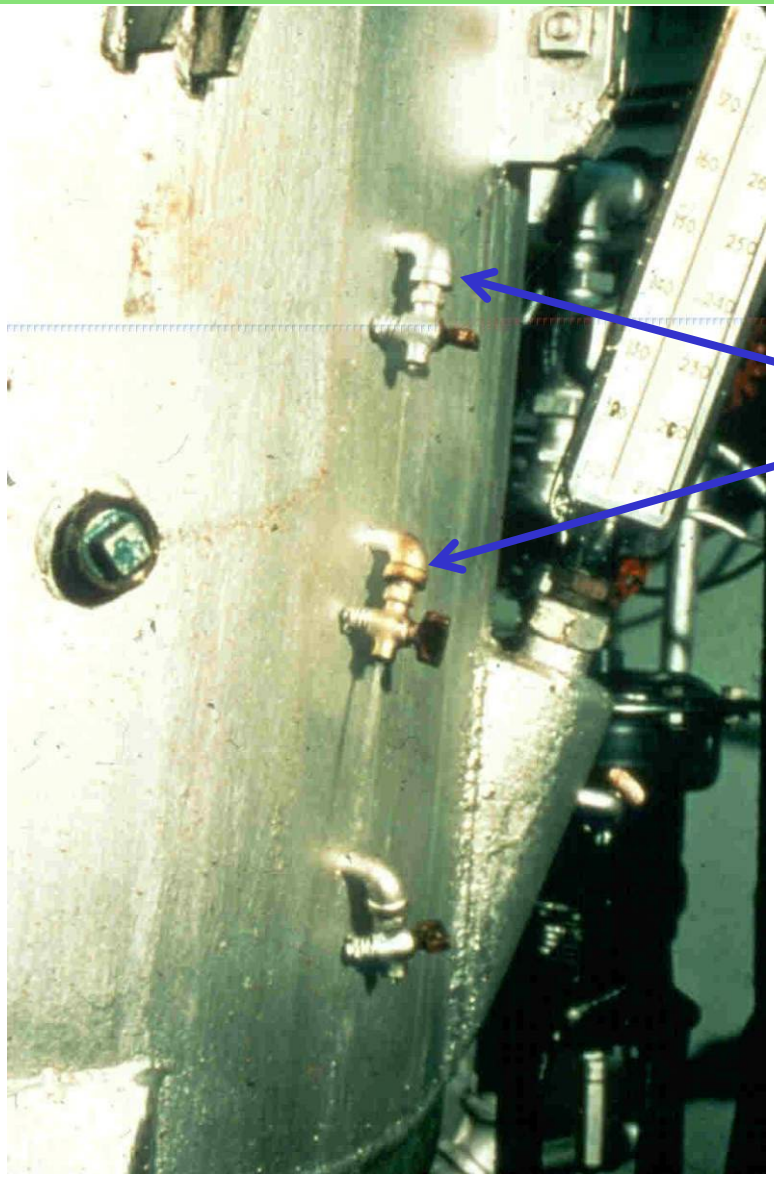
Instrumentation - Water Level Indicator

- Each retort **must** be equipped with a water level indicator, e.g.,
  - Water sight glass tube
  - Water level alarm (visual and audible)
  - Petcock valves

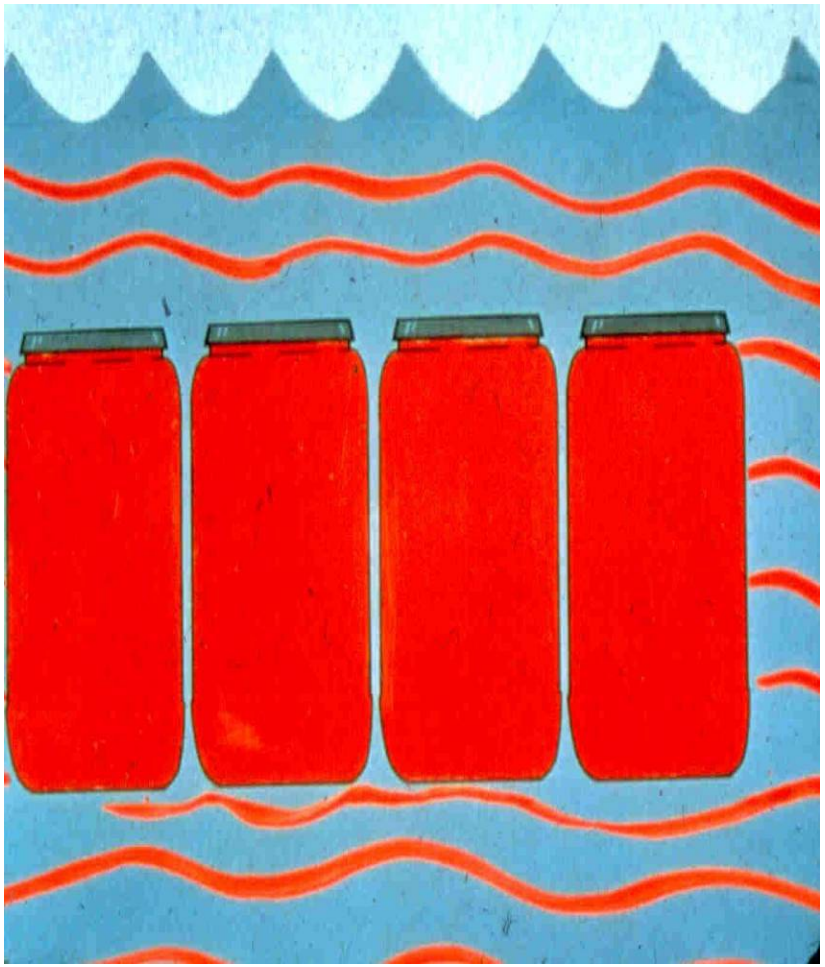
Instrumentation - Water Level Indicator



Instrumentation - Water Level Indicator



Instrumentation - Water Level Indicator



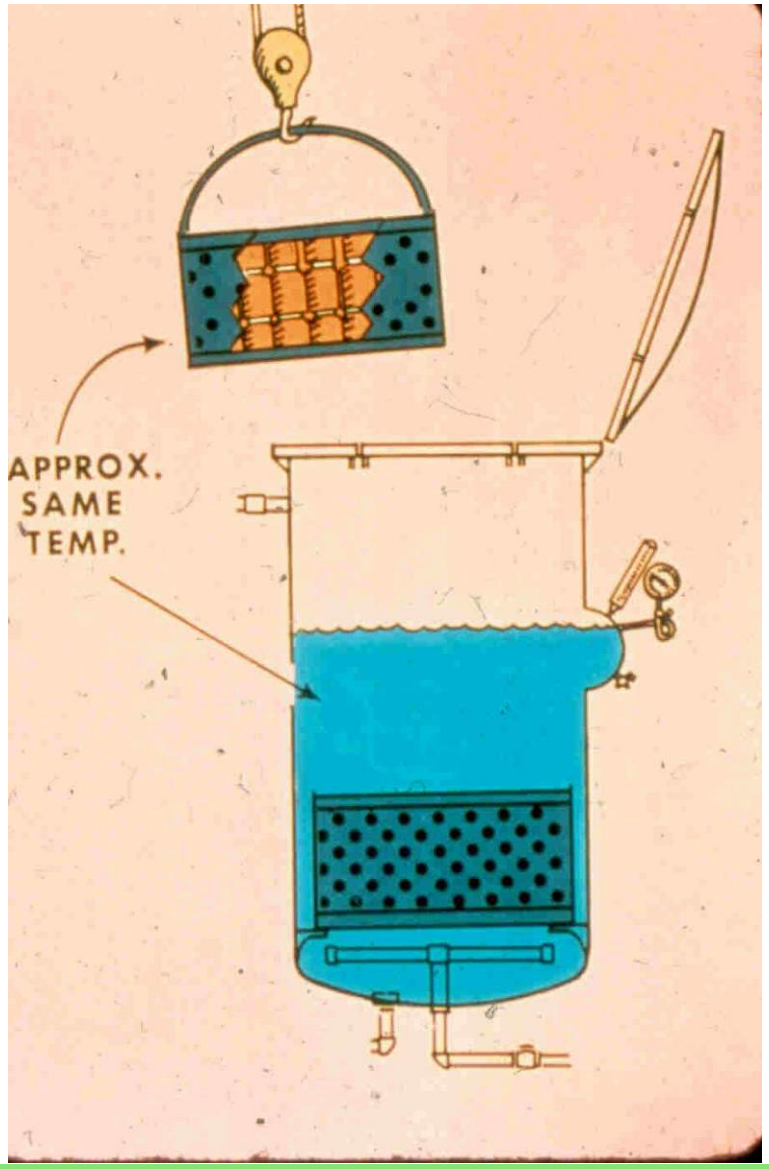
Instrumentation - Drain Valves

- Water immersion retorts **must** be equipped with non-clogging, watertight drain valve to ensure minimum water level
- **Must** have screens over drain openings to prevent loose containers and debris from entering circulation system

Instrumentation - Crate Supports

- For vertical water immersion retorts:
  - Bottom crate supports are **required**
  - Crate centering guides are recommended
  - Bottom baffle plates prohibited

Vertical Retorts



Vertical Retorts - Water Circulation

- By compressed air or
- By mechanical means such as a pump

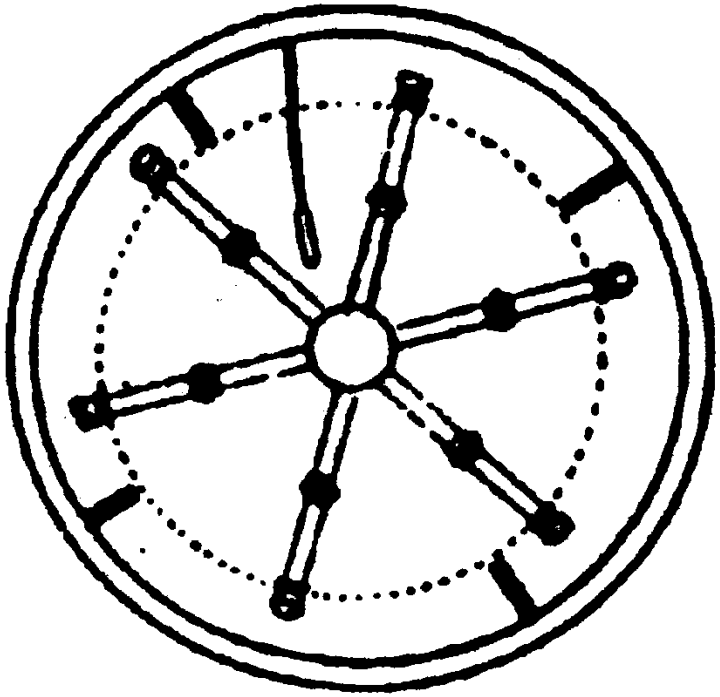
Vertical Retorts - Compressed Air Water Circulation

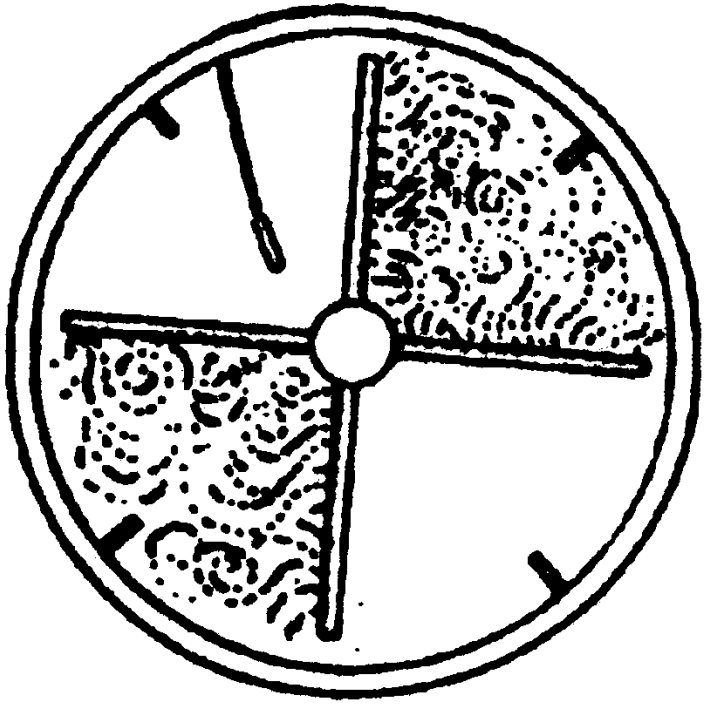
- Air is introduced with steam through bottom spreader
- Air bubbles agitate water as they rise upward
- During CUT, a greater volume of air is needed to prevent steam hammer (noise)

Vertical Retorts - Compressed Air Water Circulation

- During processing, the air volume is reduced to recommended level
- The air in the retort headspace maintains the overpressure
- Two steam spreader designs

Vertical Retorts - Spreader Configurations

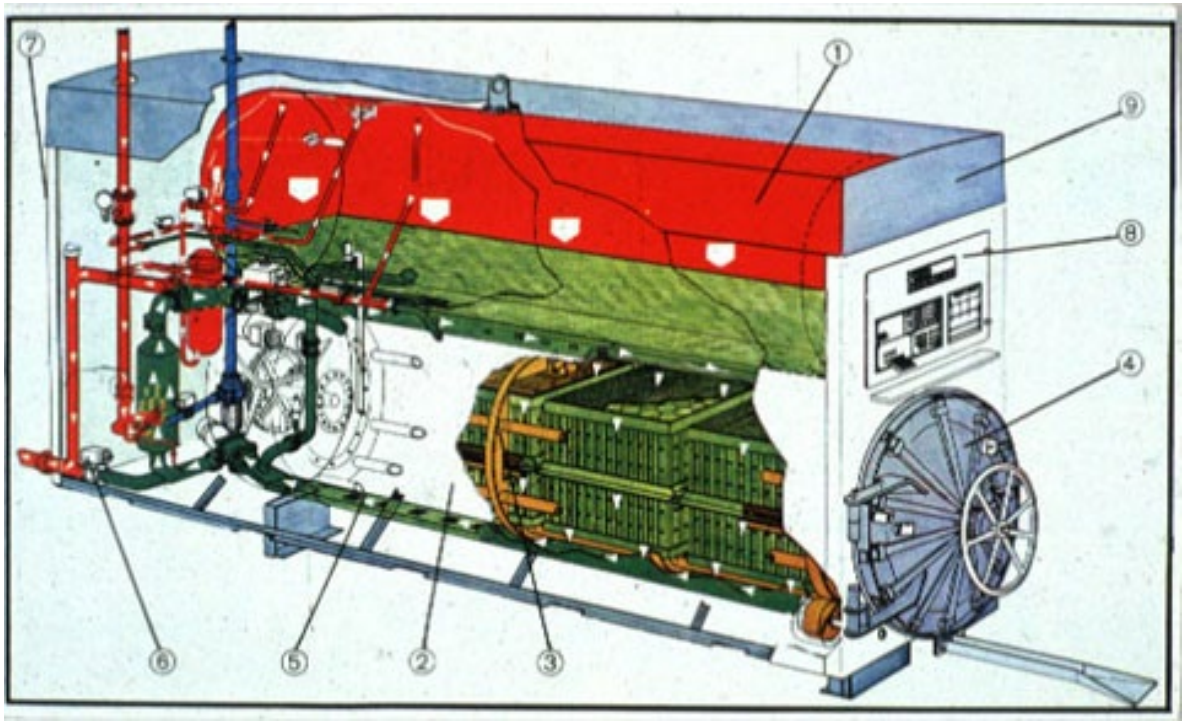




Horizontal Retorts - Design

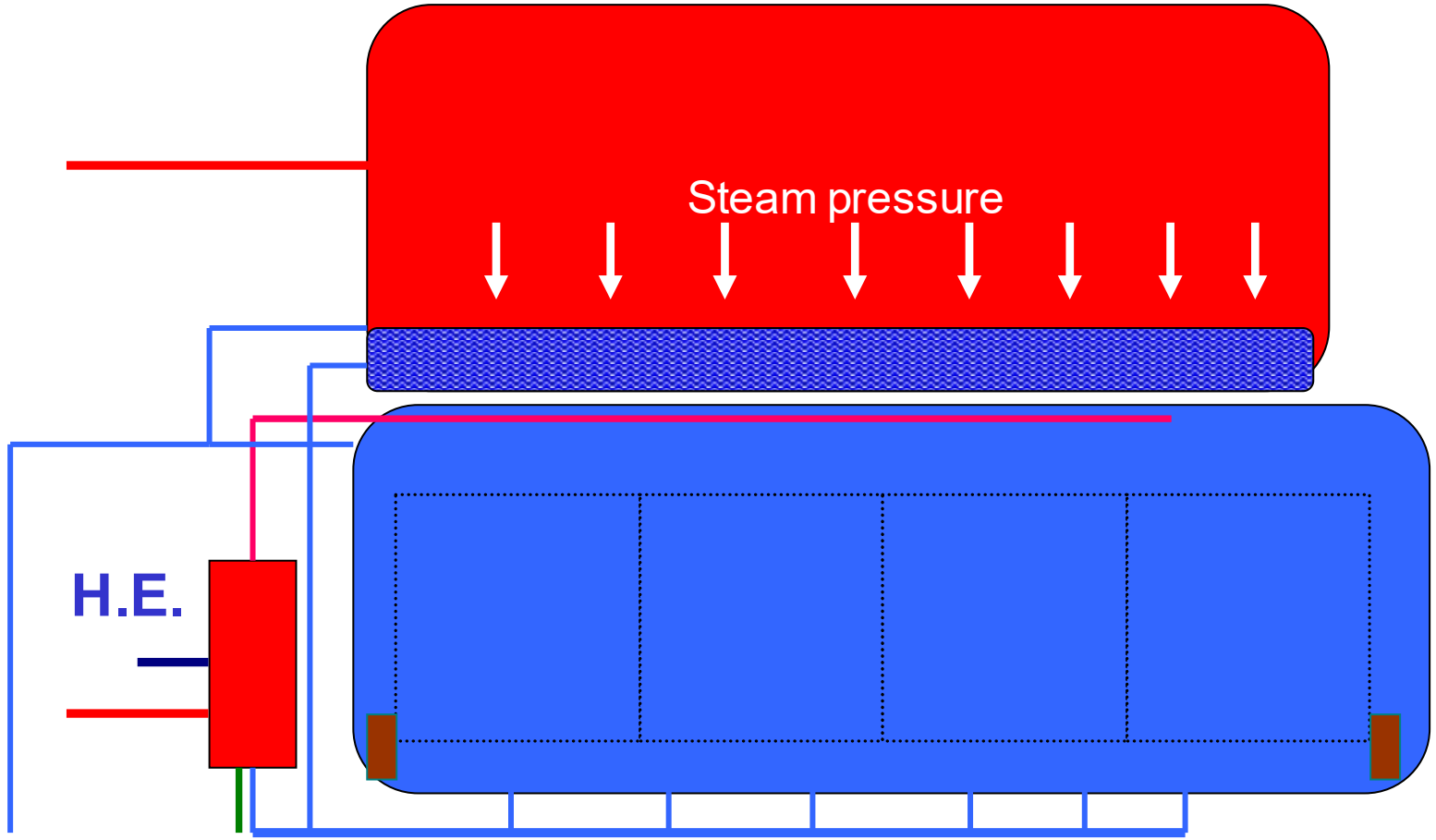
AllPax

Stock Rotomat



Horizontal Retorts - Design

AllPax or Stock Rotomat

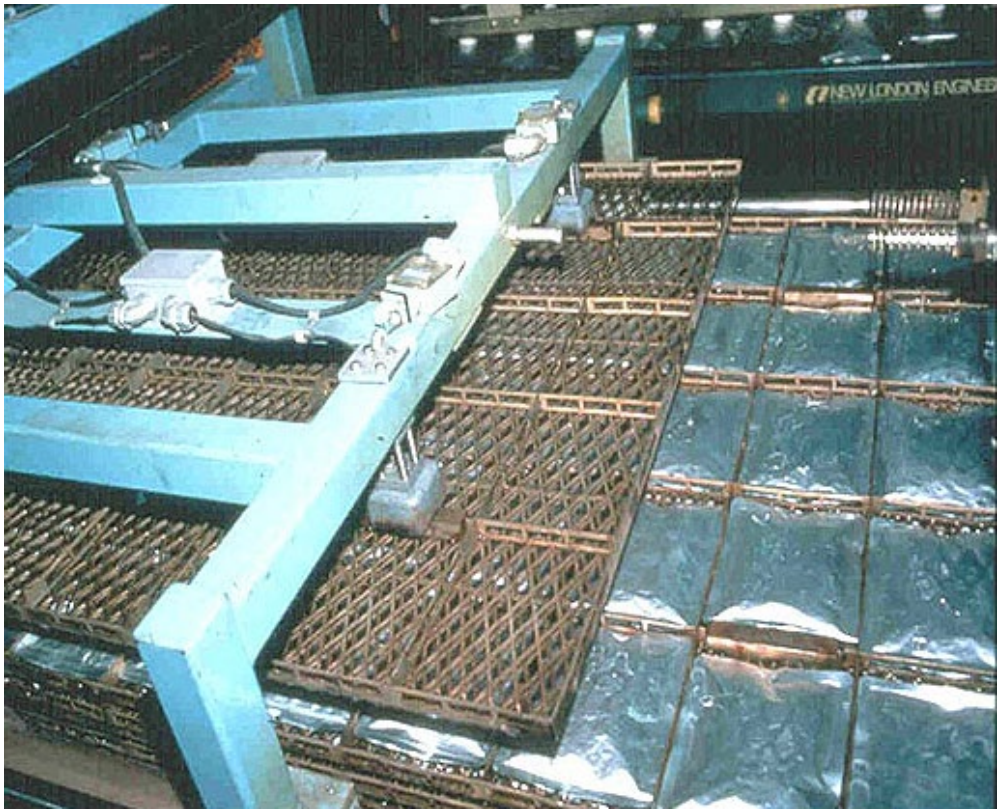


Horizontal Retorts - Mechanical Water Circulation

- Horizontal retorts need a water recirculation system which is usually a pump
- Suction manifold in the bottom of the retort
- Distribution system (spreader) along the top of the retort
- Suction outlets **must** be protected with screens
- Pump **must** be equipped with warning device to indicate when it is not functioning

Water Immersion Retort - Crates/Container Orientation/Loading Configuration

- Racks designed to positively hold containers
- **Must** provide free movement of the water
- Adequacy **must** be documented in HD/TD data

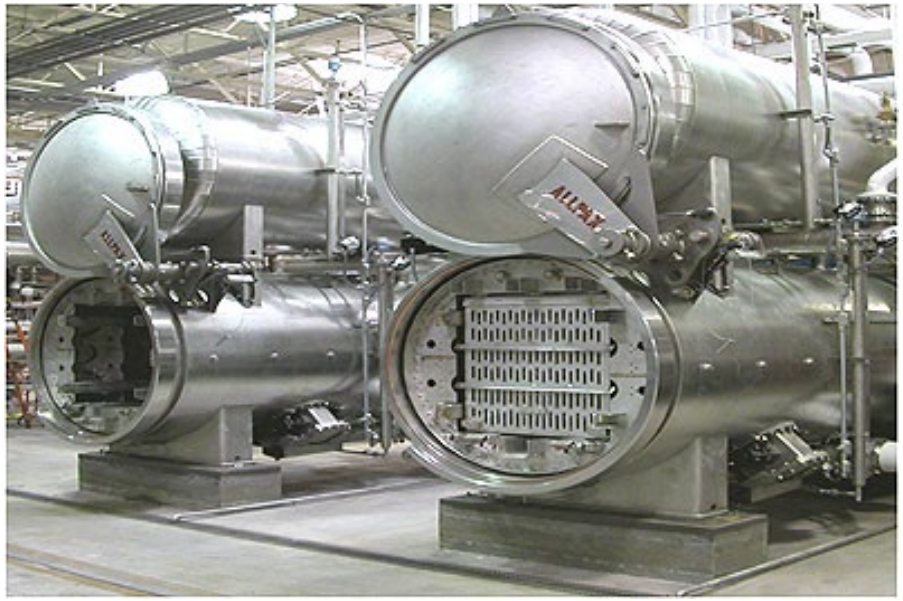


Water Immersion Retort - Cooling Water Supply

- Should not strike jars directly
- Vertical retorts - introduced into process water about 4 inches above top layer of jars
- Horizontal retorts - introduced into suction side of water circulation system

Water Immersion Retort – Critical Operating Parameters

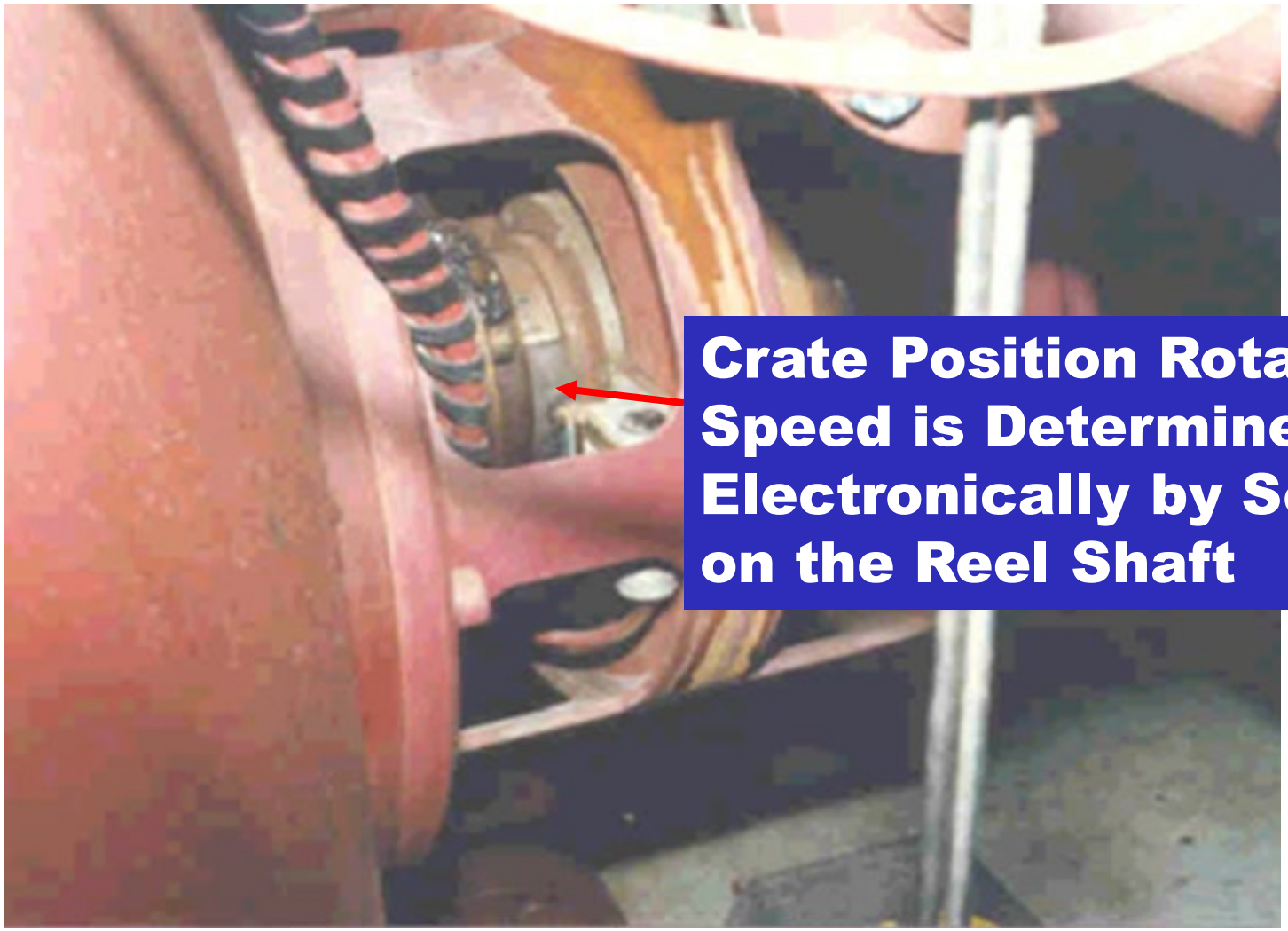
- Water level
- Air circulation rate for vertical retorts
- Water recirculation rate for retorts using pumps
- Overpressure
- Reel speed timing for agitating processes



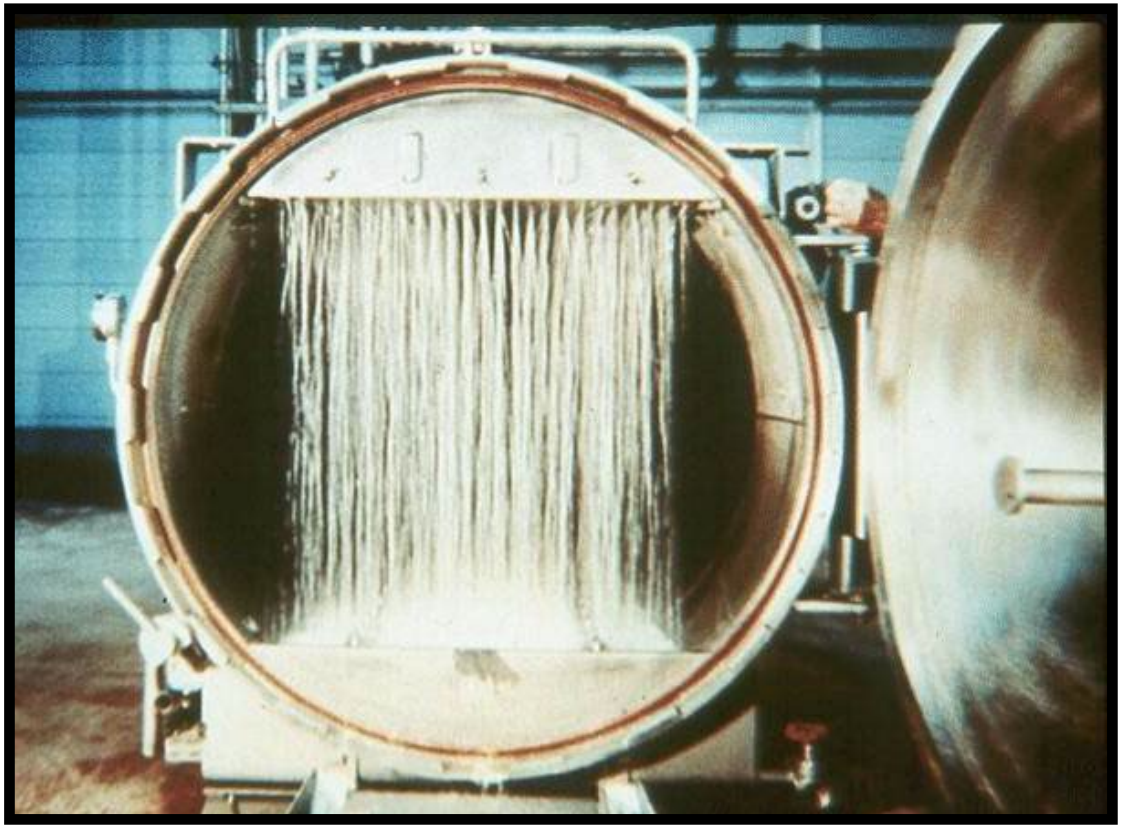
Agitating Water Immersion Retorts - Rotational Speed

- **Must** be checked before process timing starts and, if needed, adjusted as specified in the process schedule
- **Must** be determined and recorded for each retort load
- Prevent unauthorized changes
  - Lock or Posted Sign

Agitating Water Immersion Retorts - Rotational Speed



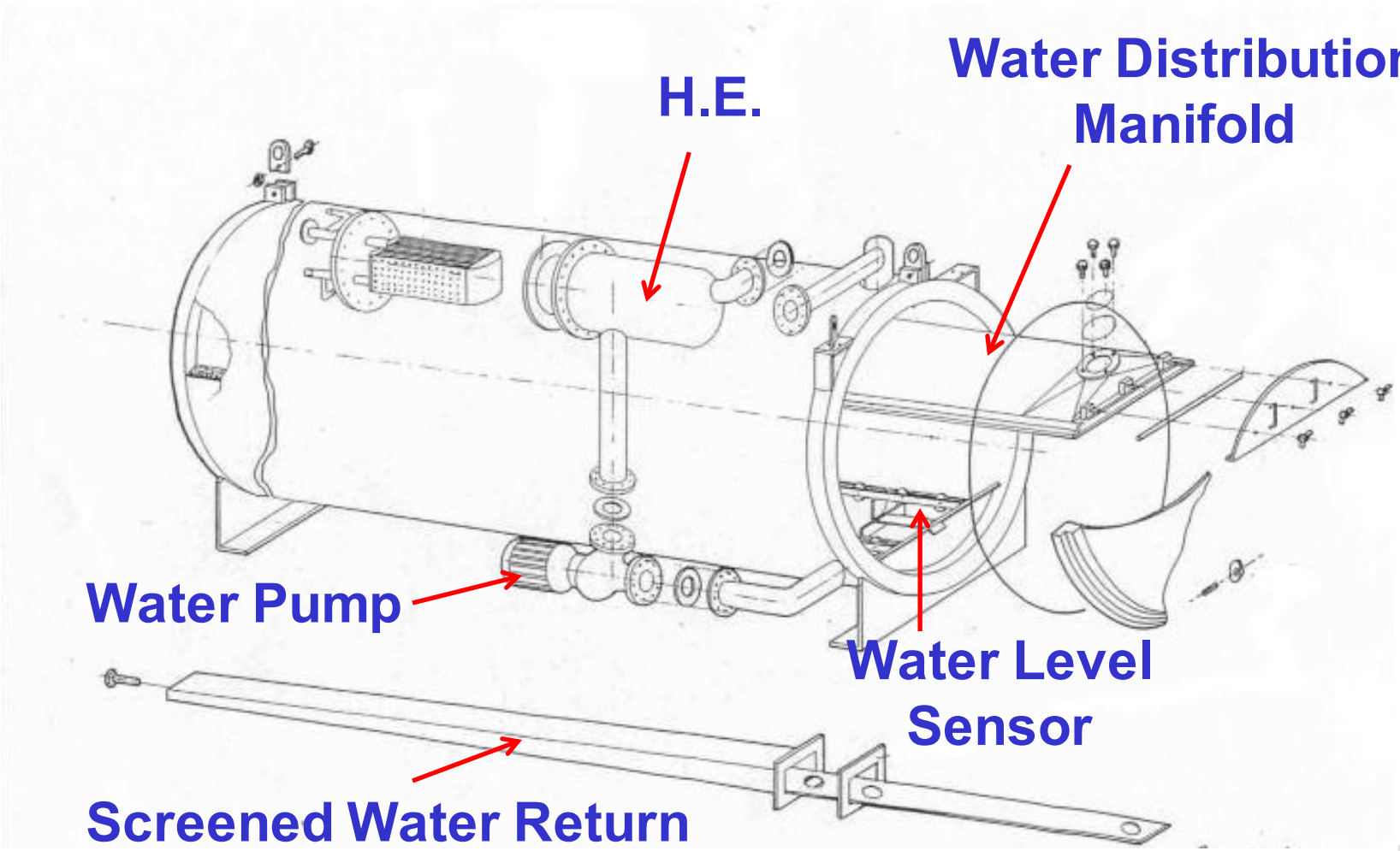
Cascading Water Retorts



Cascading Water Retort Characteristics

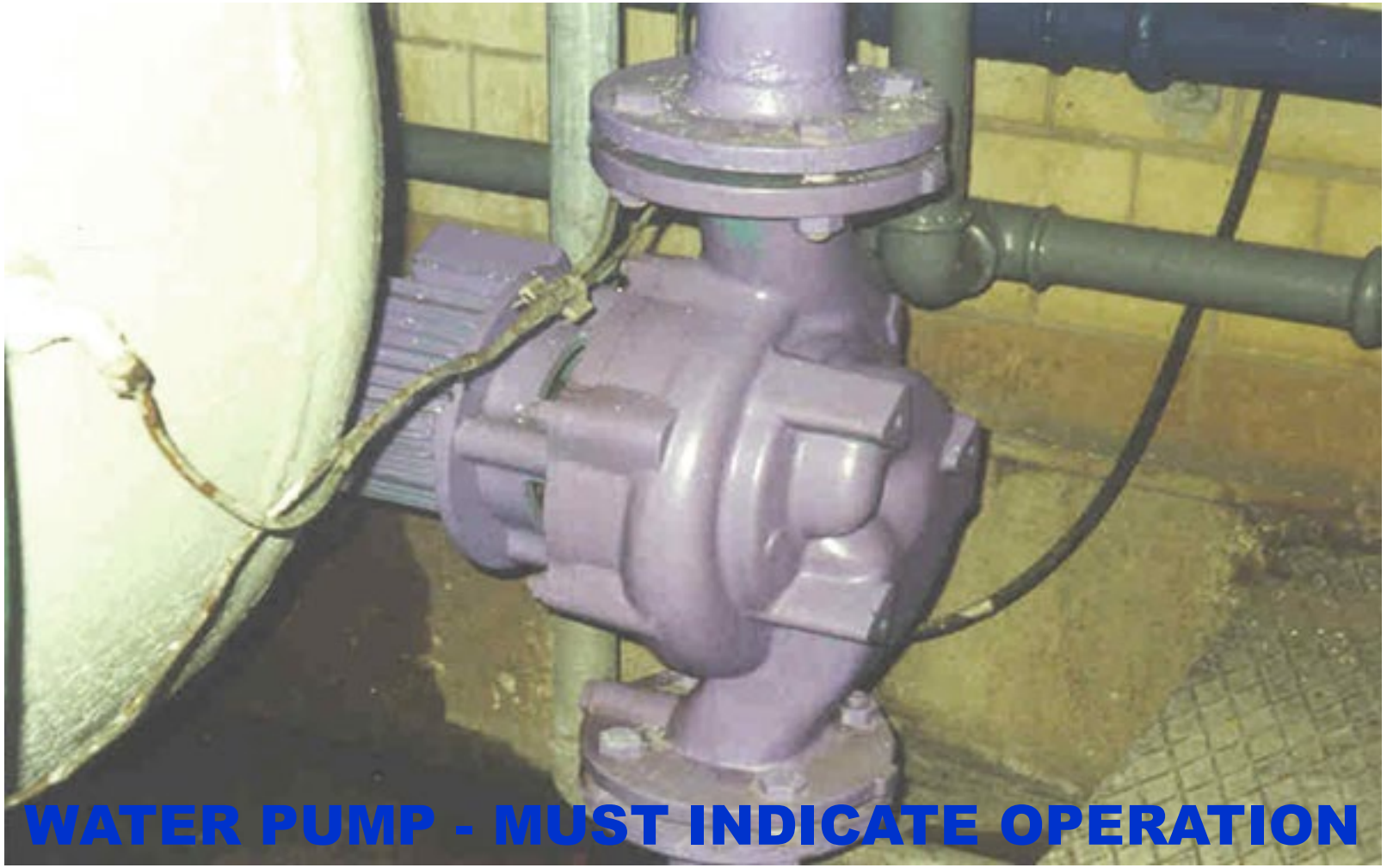
- Water is the heating/cooling medium that rains (cascade) down over and through the containers
- Horizontal configuration
- Introduced air provides overpressure
- Several manufacturers

Exploded View of Cascading Water Retort

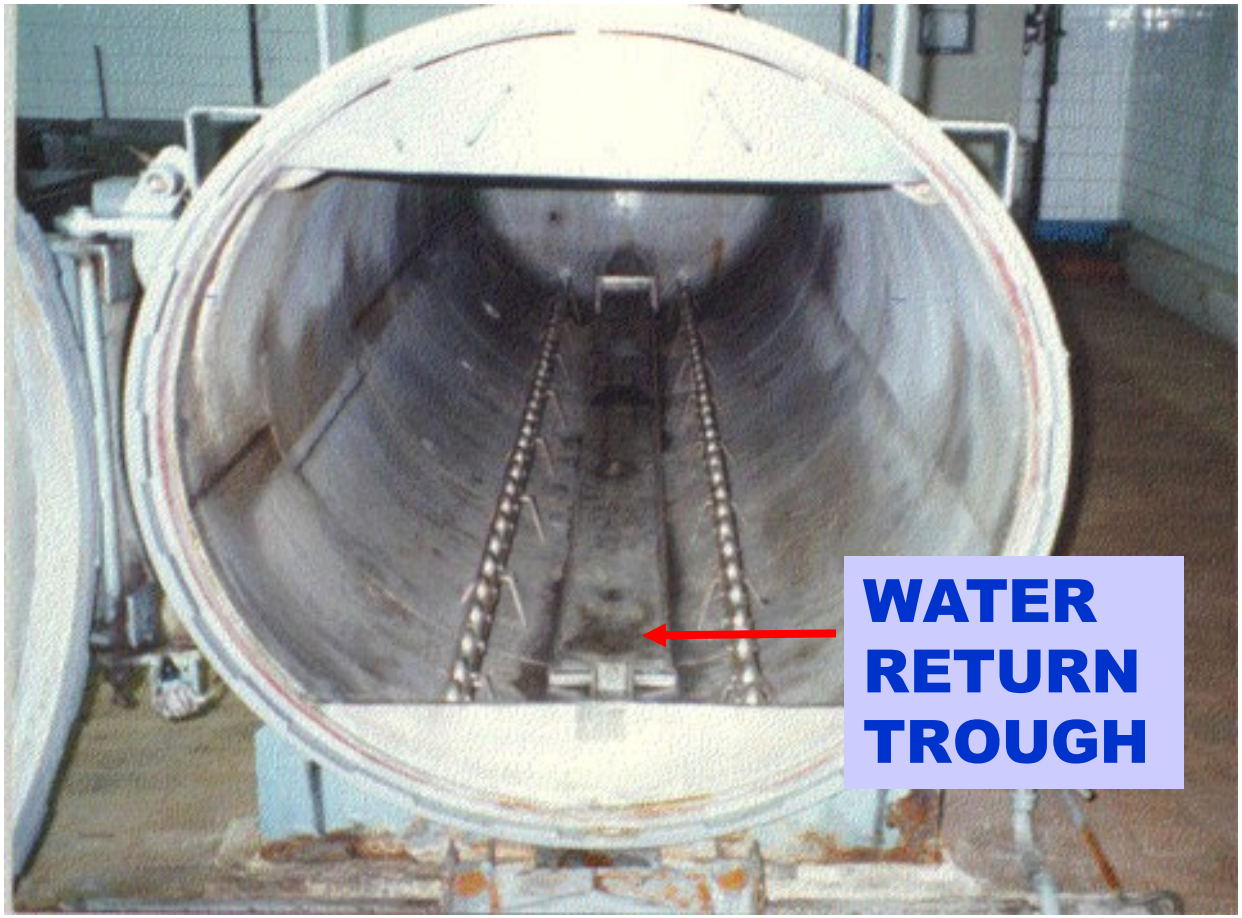


Cascading Water Retort Design

Water is Recirculated with a Pump

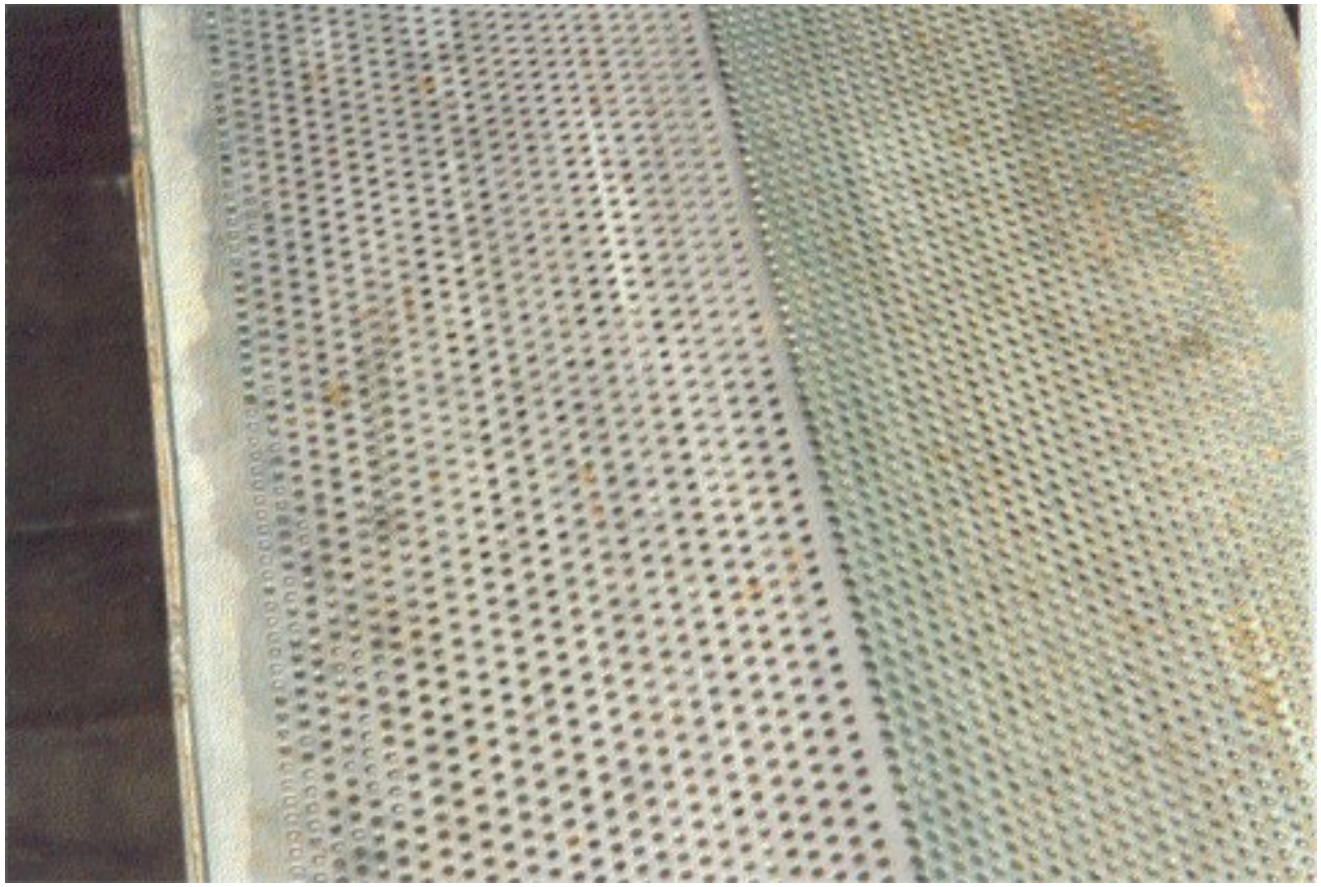


Cascading Water Retort Design

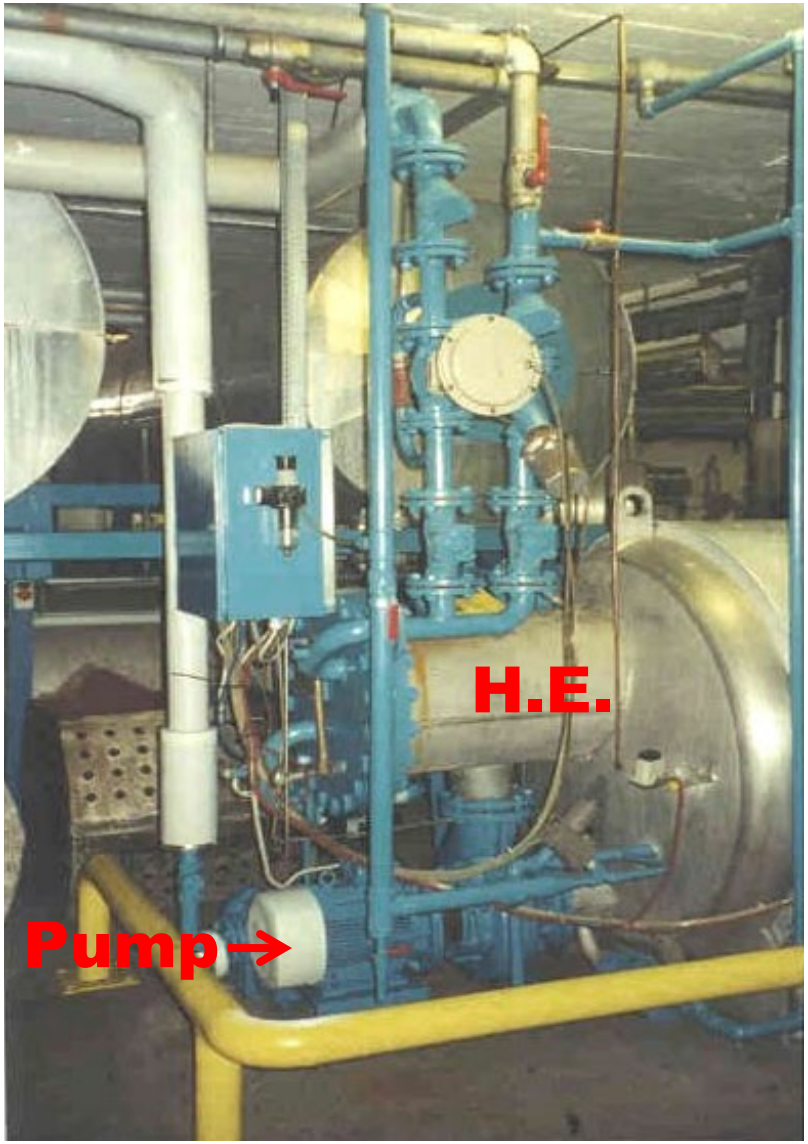


Cascading Water Retort Design

Screen in Water Return Trough on Retort- 1.5 mm Holes



Cascading Water Retort Design



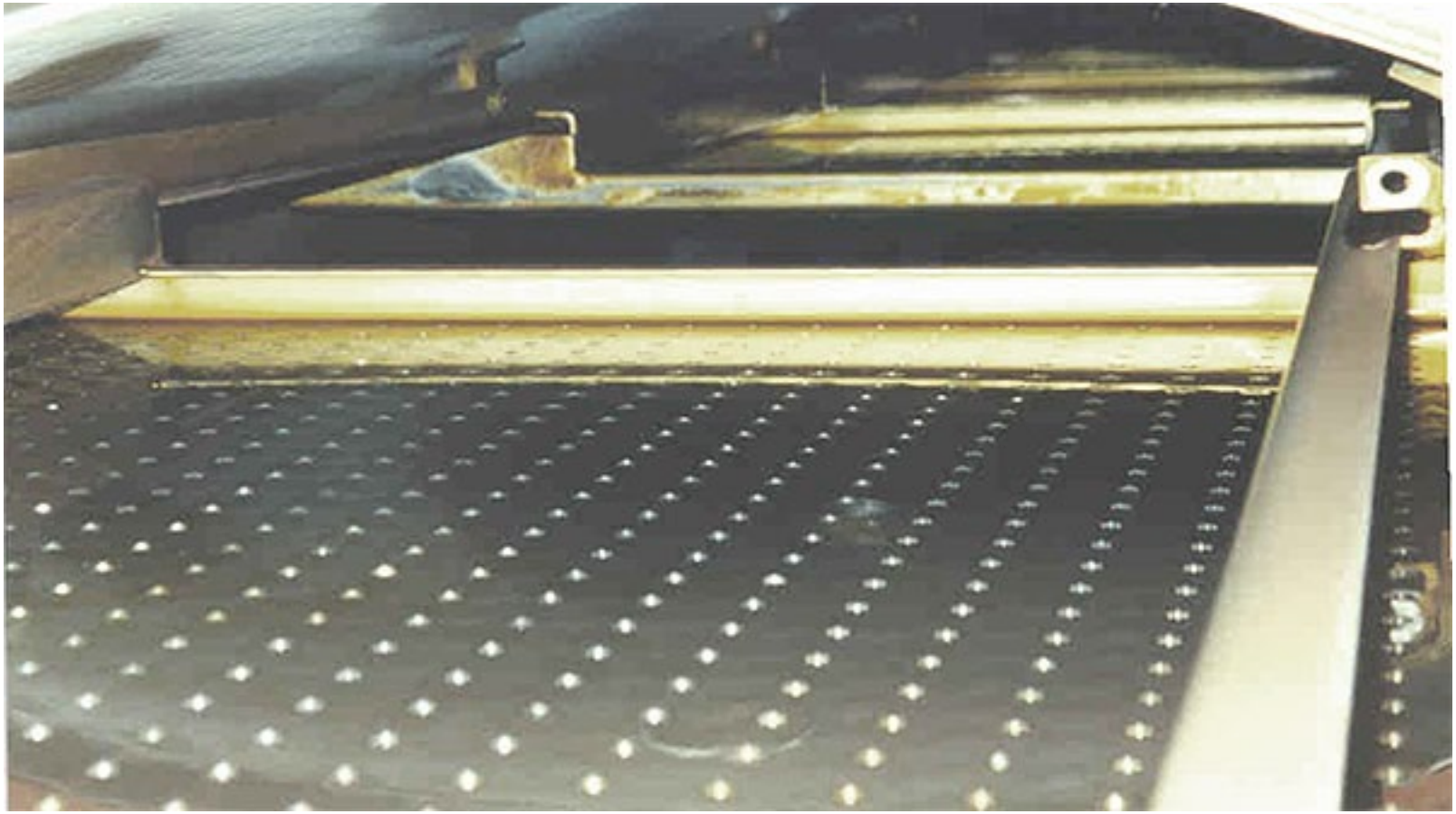
Rear View with Heat Exchanger and Water Return at Rear of Retort

Cascading Water Retort Design

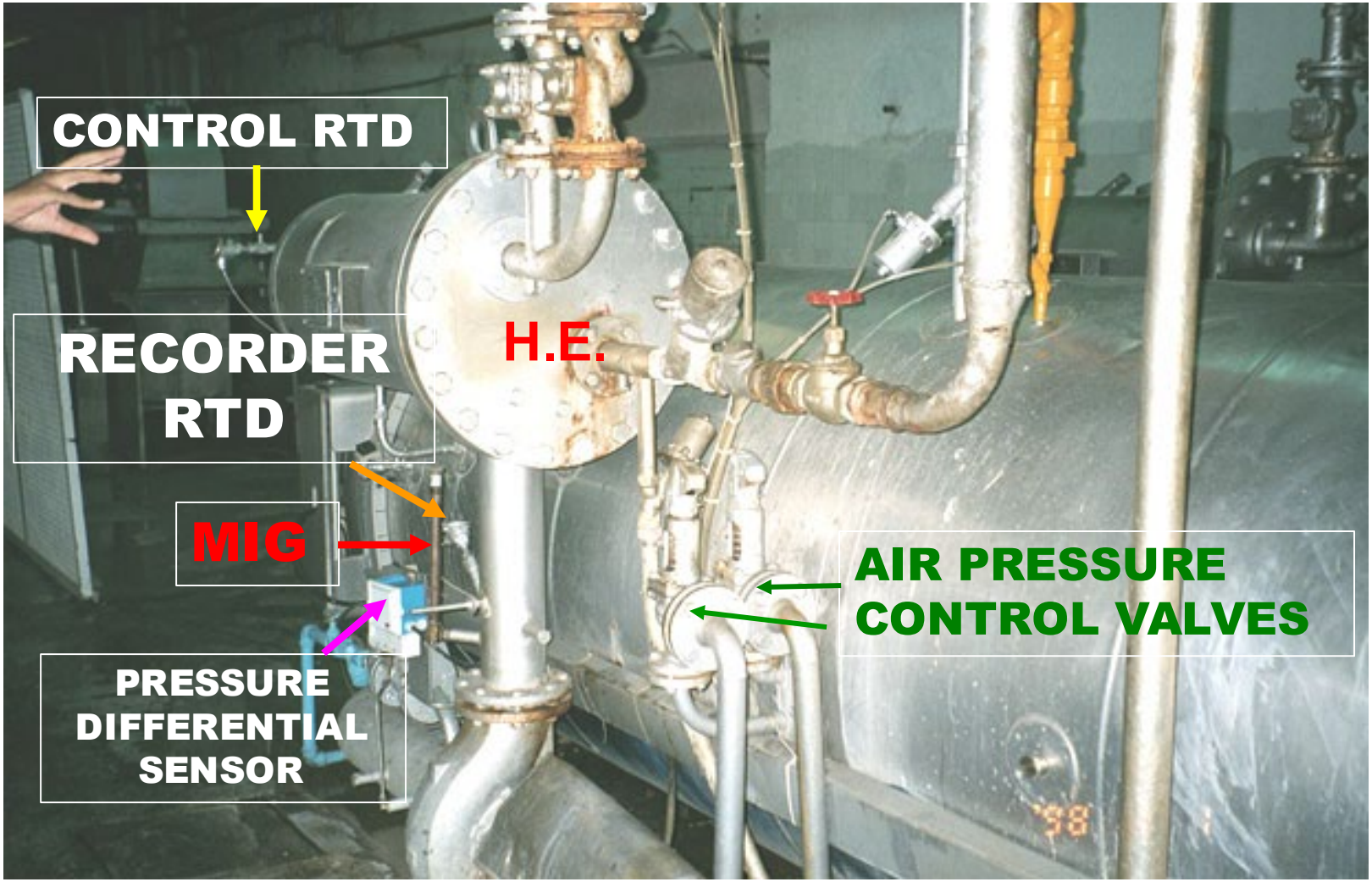
Water Shower

Cascading Water Retort Design

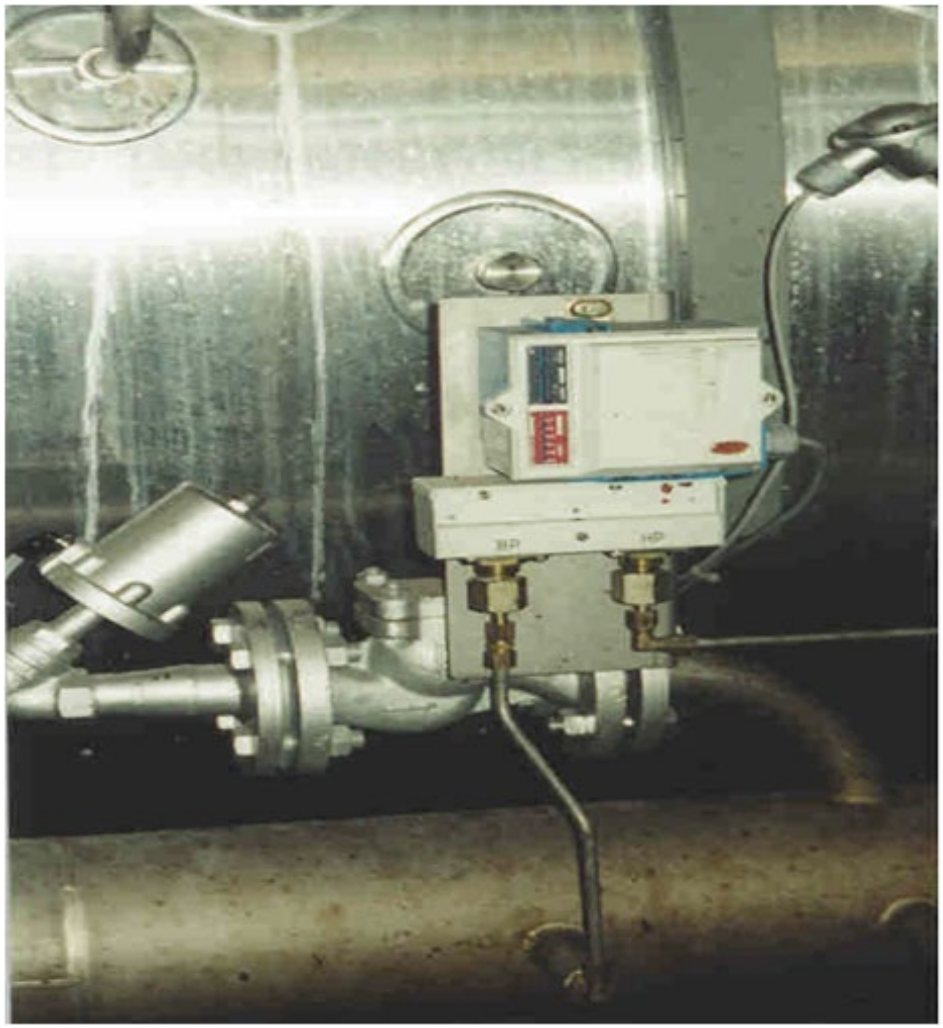
Separate Water Distribution Manifolds



Cascading Water Retort - Instrumentation



Cascading Water Retort – Water Pressure Monitoring

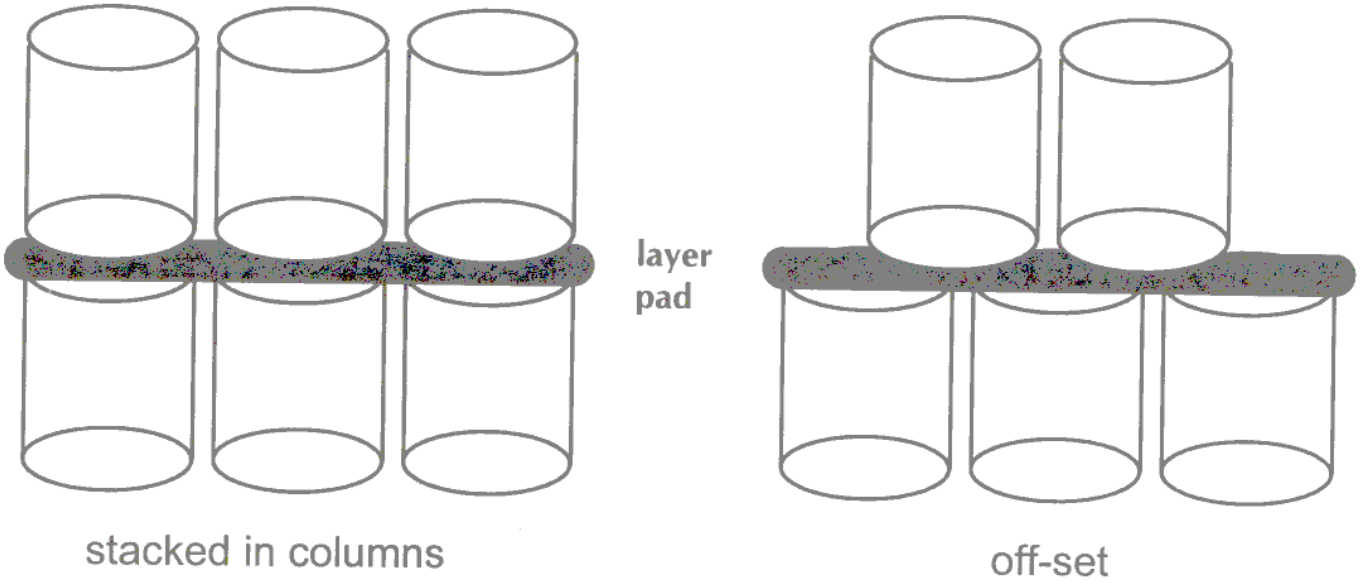


Pressure Differential Sensor is used to Alert Operator to Changes in Pressure from One Side of Pump to the Other Side

Cascading Water Retort – Compressed Air Entry

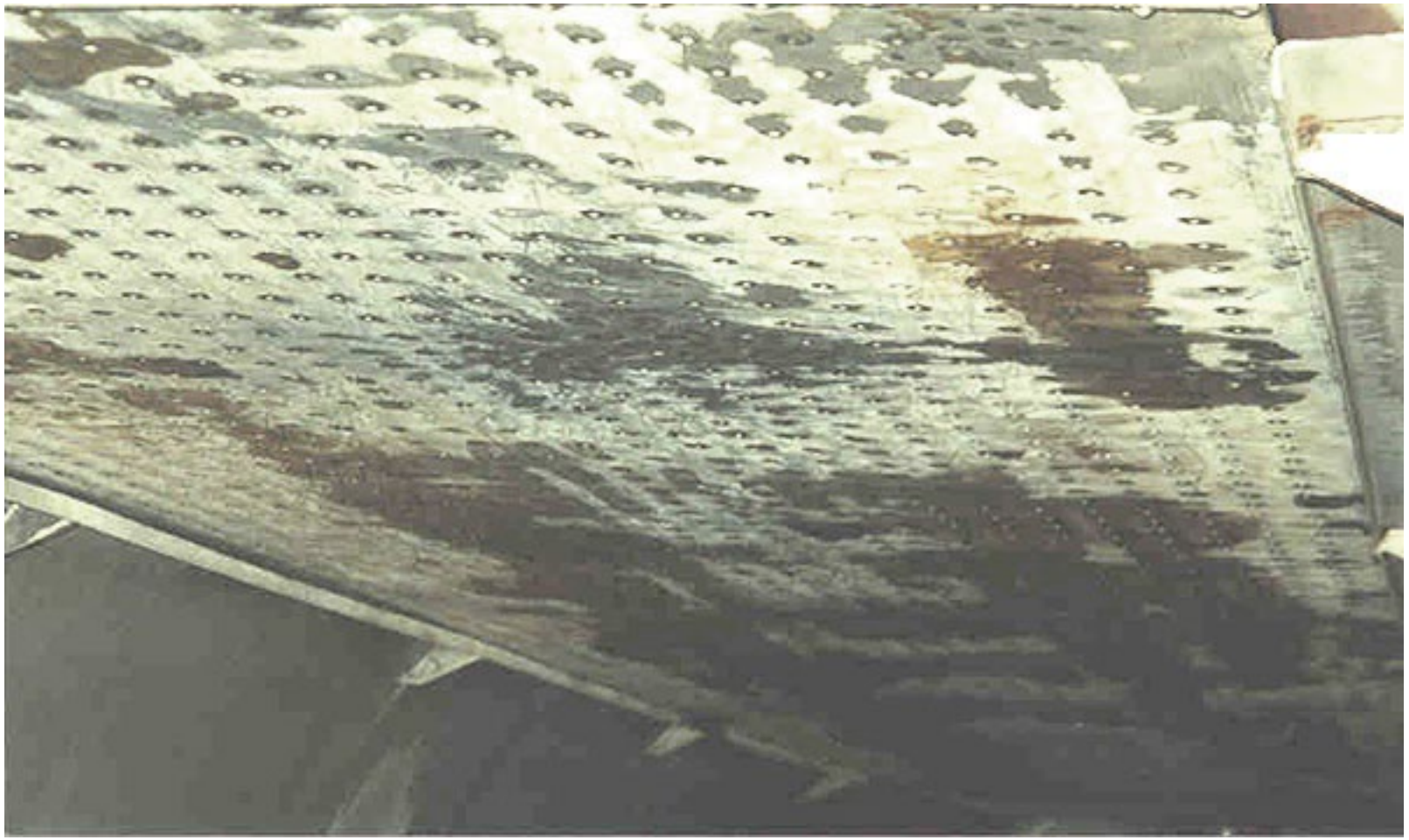
Cascading Water Retort - Crates/Container Orientation/Loading Configuration

- **Must** provide free movement of the water and allow water to contact the containers
- Adequacy **must** be documented in HD/TD data



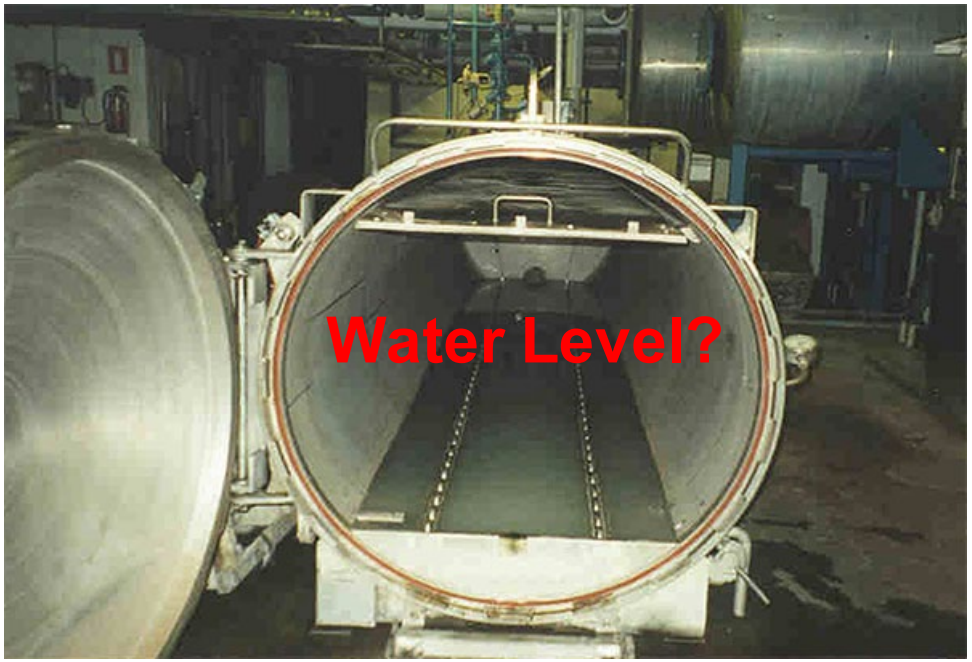
Cascading Water Retort - Water Distribution Manifold Maintenance

Mineral Scale Buildup



Cascading Water Retort – Water Level

- Water level must be maintained within the range specified by retort manufacturer or PA during come-up, thermal processing, and cooling periods

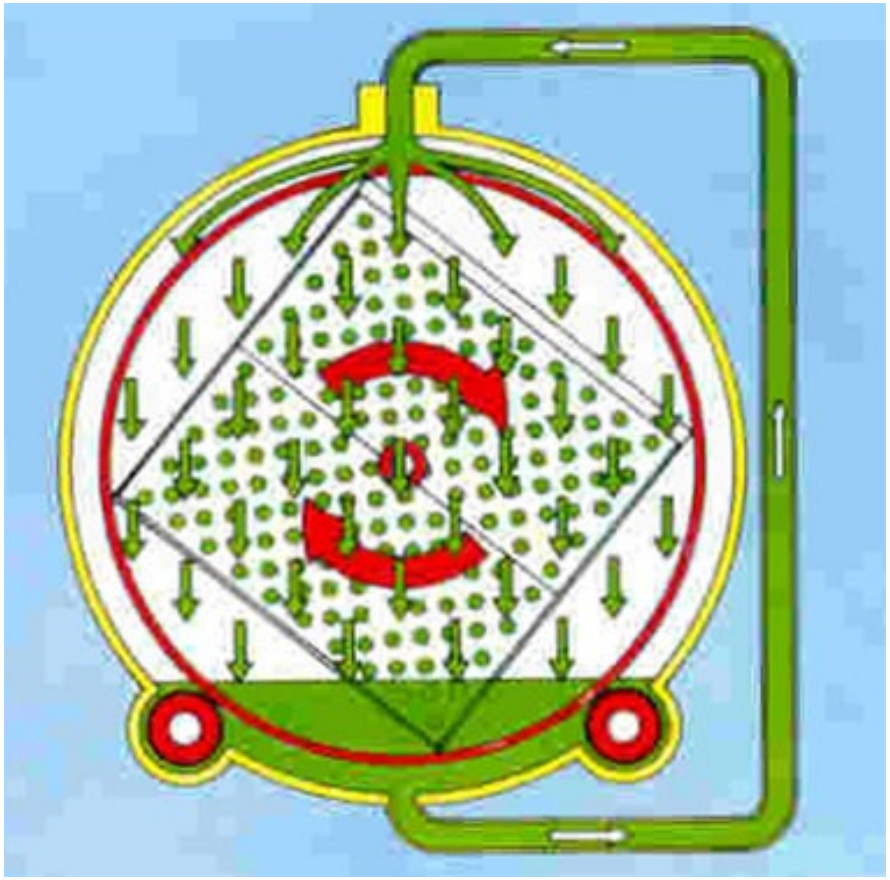


Cascading Water Retort – Water Recirculation

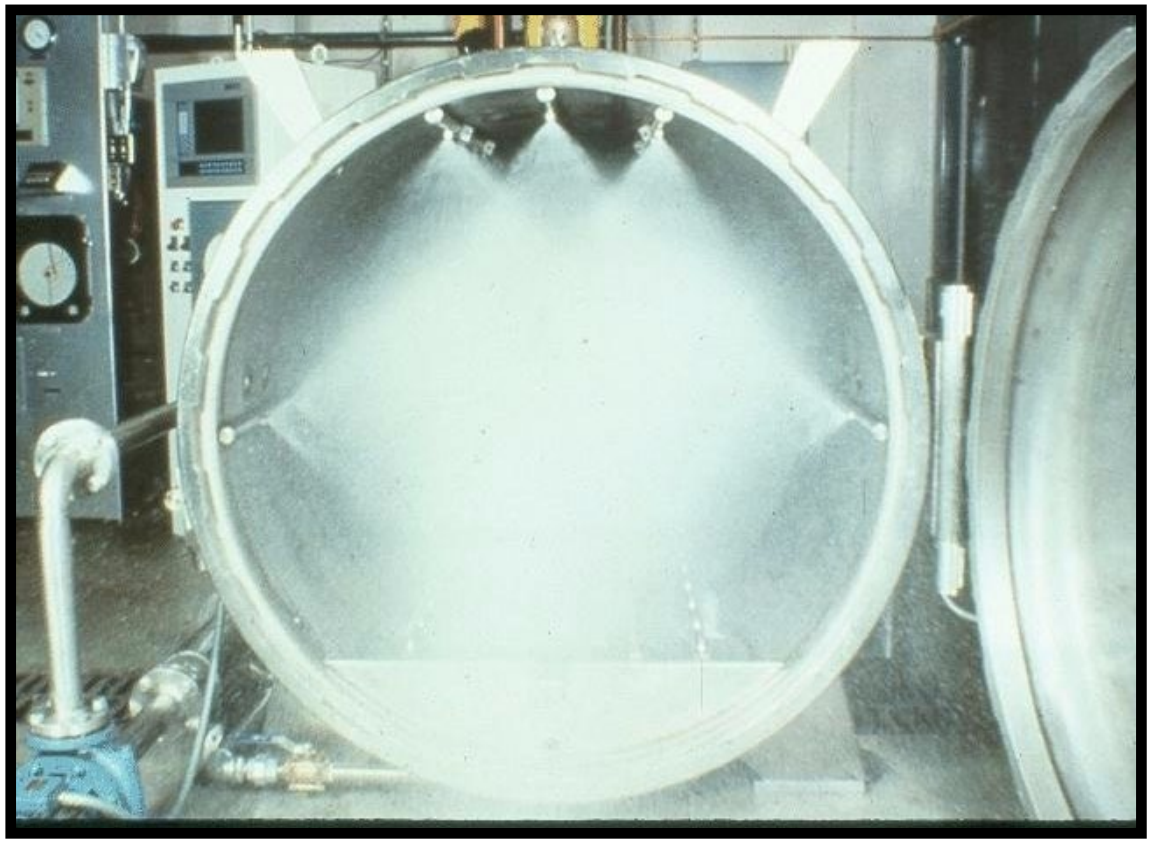
- Water recirculation (flow rate, e.g., gallons per minute) for maintaining uniform heat distribution in the retort must be documented by HD/TD data or other documentation from the PA

Cascading Water Retort – Critical Operating Parameters

- Stepped come-up procedures
- Water recirculation (flow) rate
- Overpressure
- Reel speed timing for agitating processes

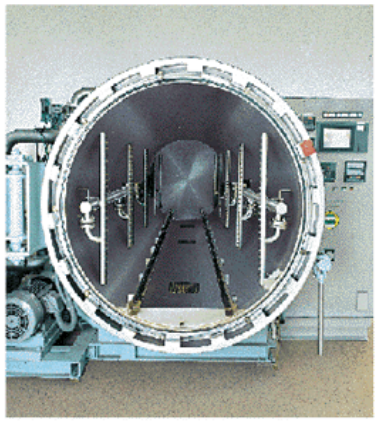


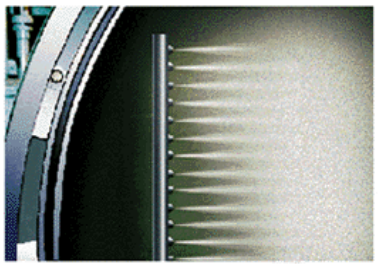
Water Spray Retorts

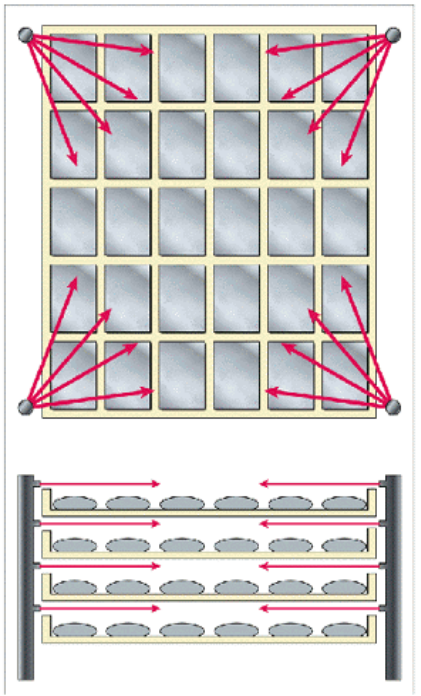


Water Spray Retort Characteristics

- Water is sprayed over the containers from several angles
- Direct and indirect steam heating of the process water
- Some inject steam into the retort
- When steam is injected, a steam/water mixture heats the containers



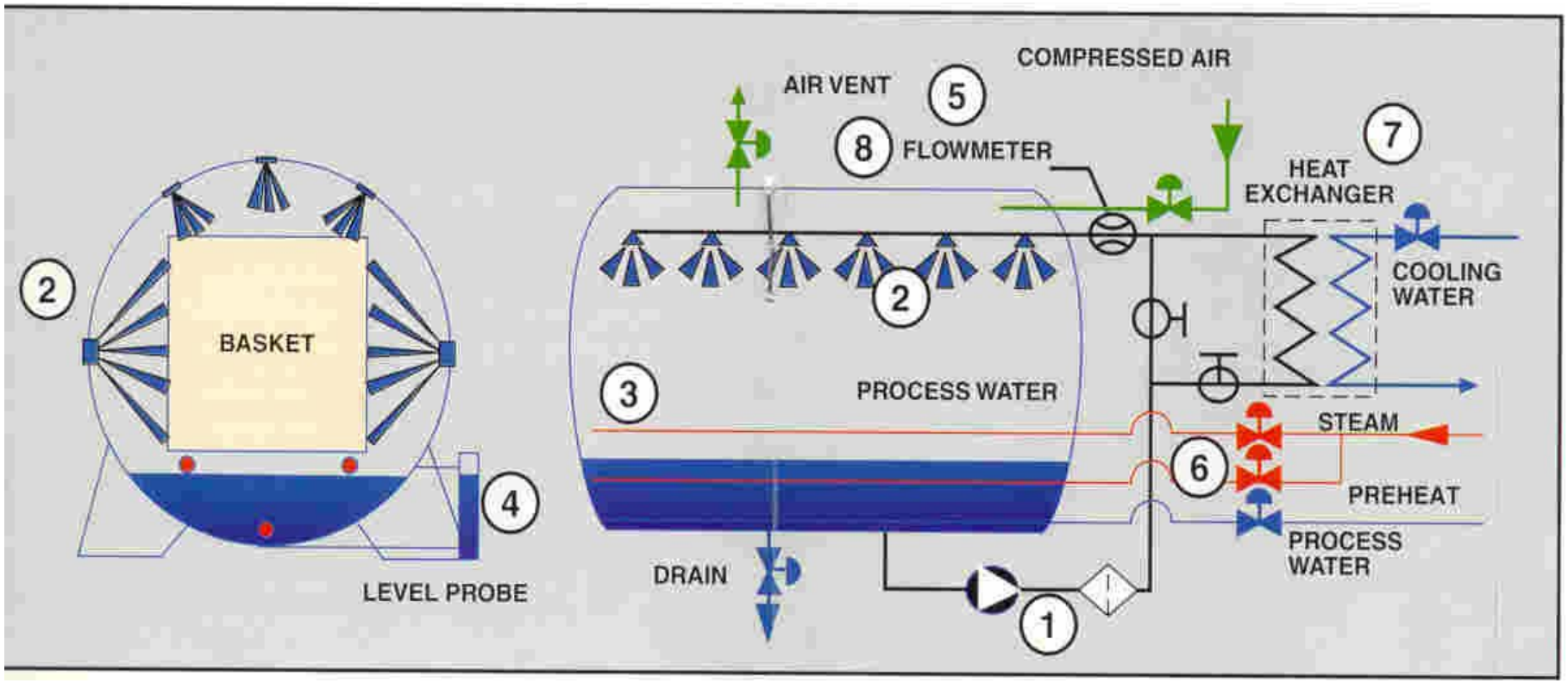




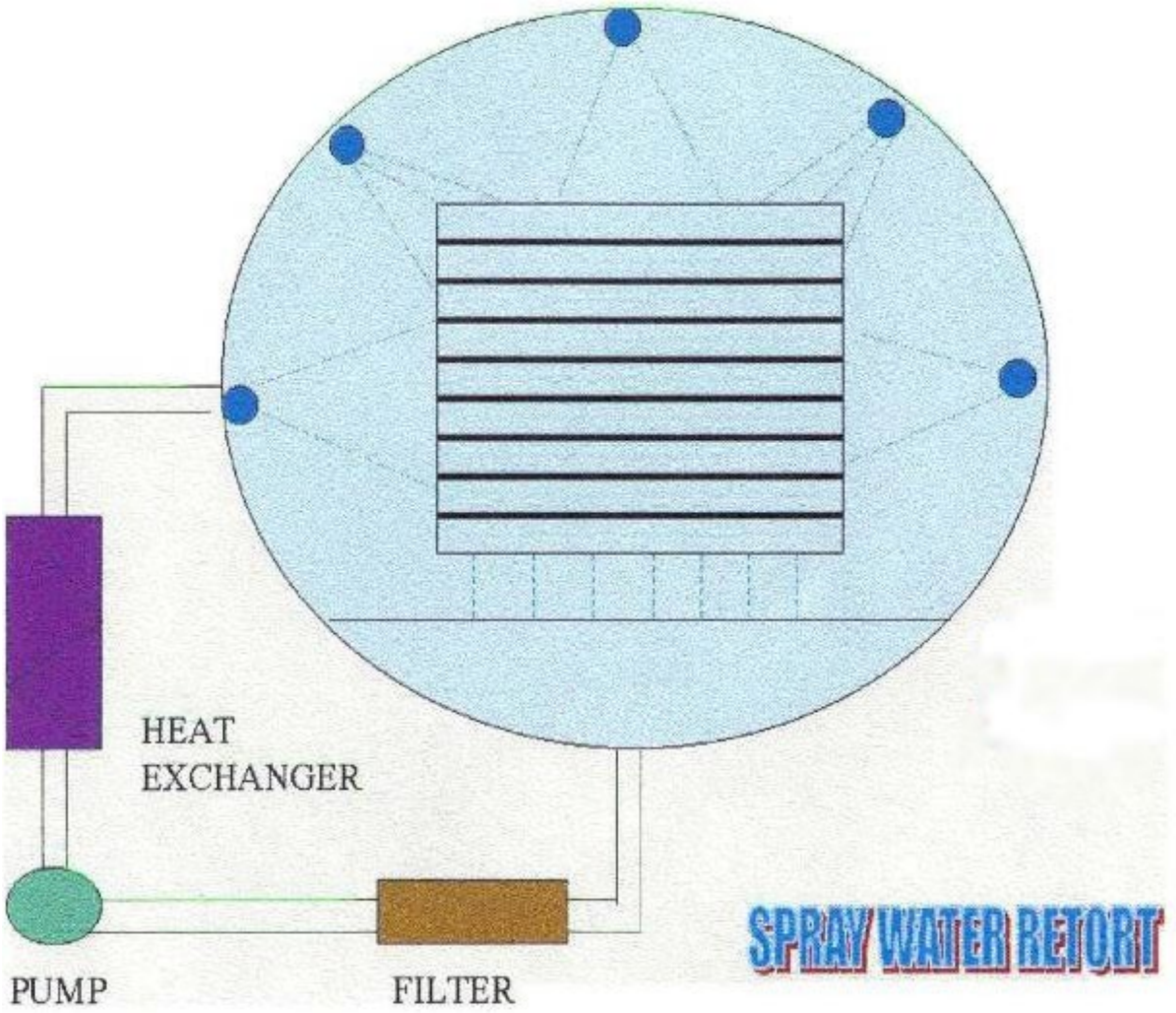
Water Spray Retort Characteristics

- Horizontal configuration
- Introduced air provides overpressure
- Several manufacturers

Water Spray Retort Design

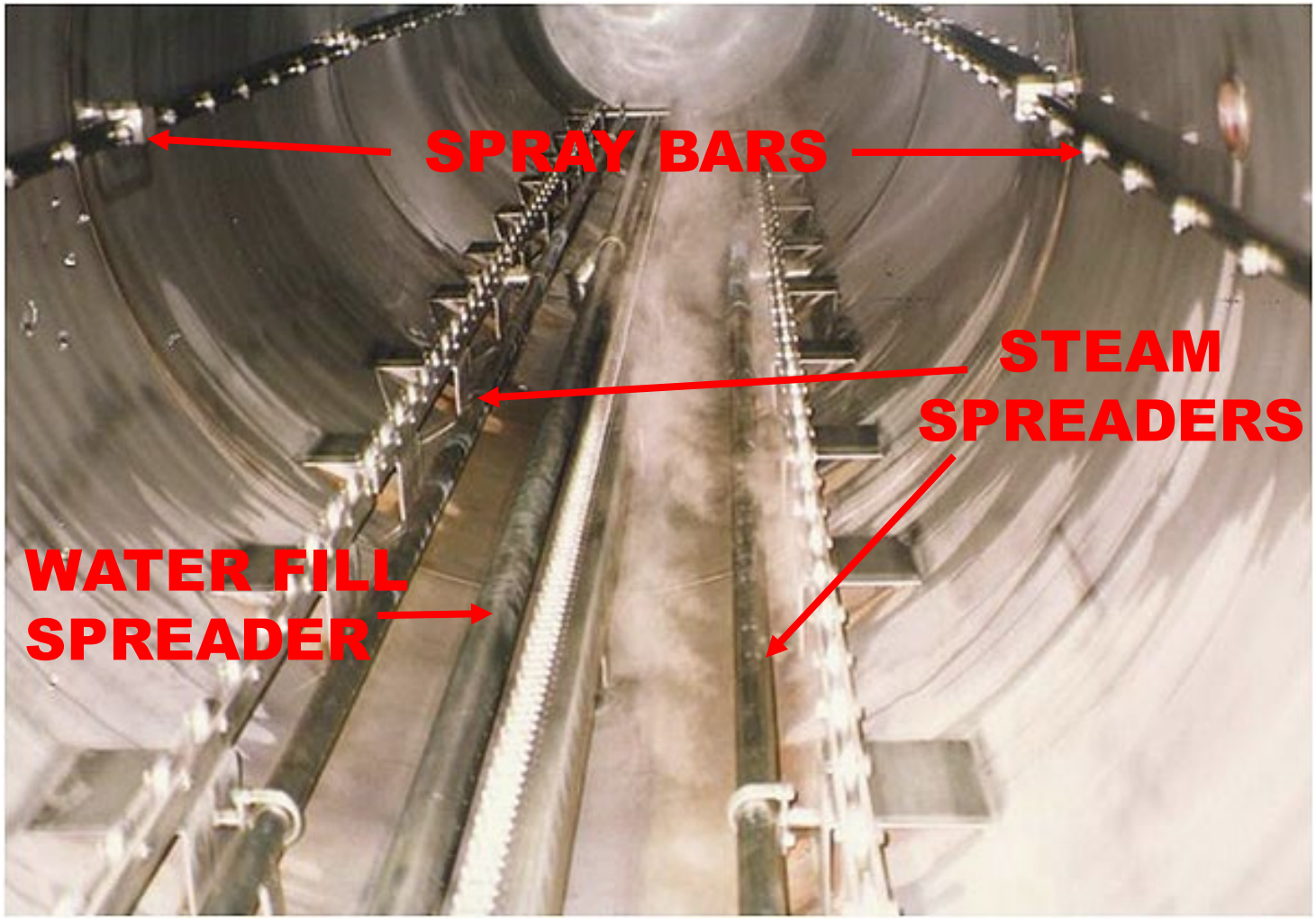


Water Spray Retort Design



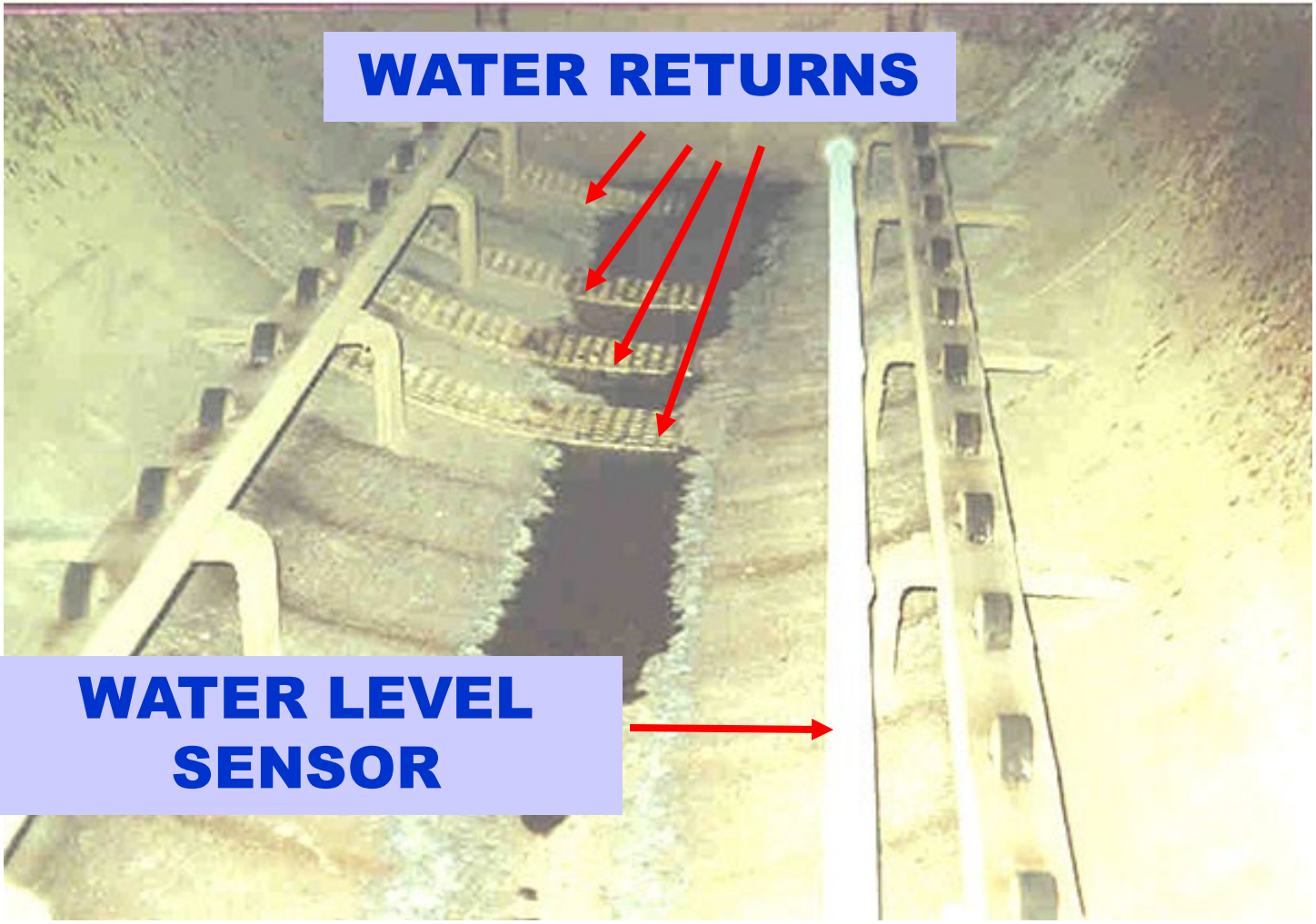
Water Spray Retort Design

Steam Spreaders and Spray Bars



Water Spray Retort Design

Water Return Through Screened Exit Ports

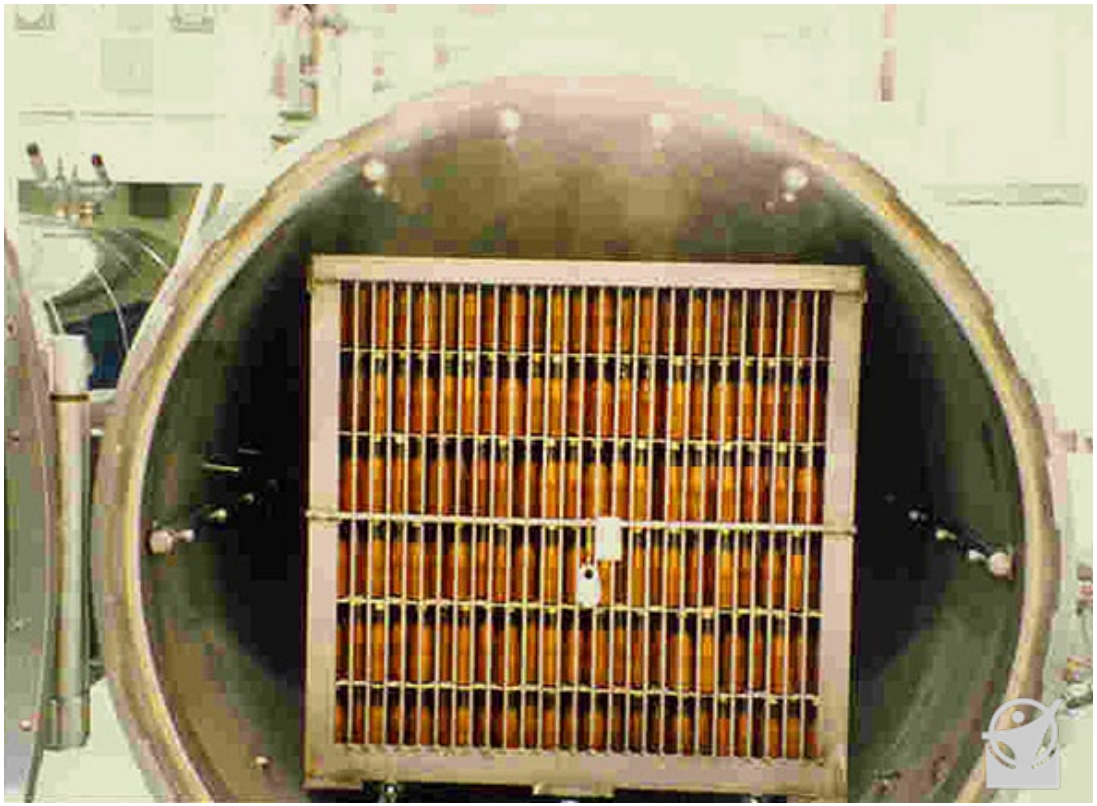


Water Spray Retort – Come-Up Procedures

- Like cascading water retorts, a stepped program with a temperature overshoot is used to bring the retort's cold spot up to process temperature

Water Spray Retort – Crates/Container Orientation/Loading Configuration

- **Must** provide free movement of the water and allow water to contact containers
- Adequacy **must** be documented in HD/TD data



Water Spray Retort – Water Level

- Water level must be maintained within the range specified by retort manufacturer or PA during come-up, thermal processing, and cooling periods

Water in Bottom? →

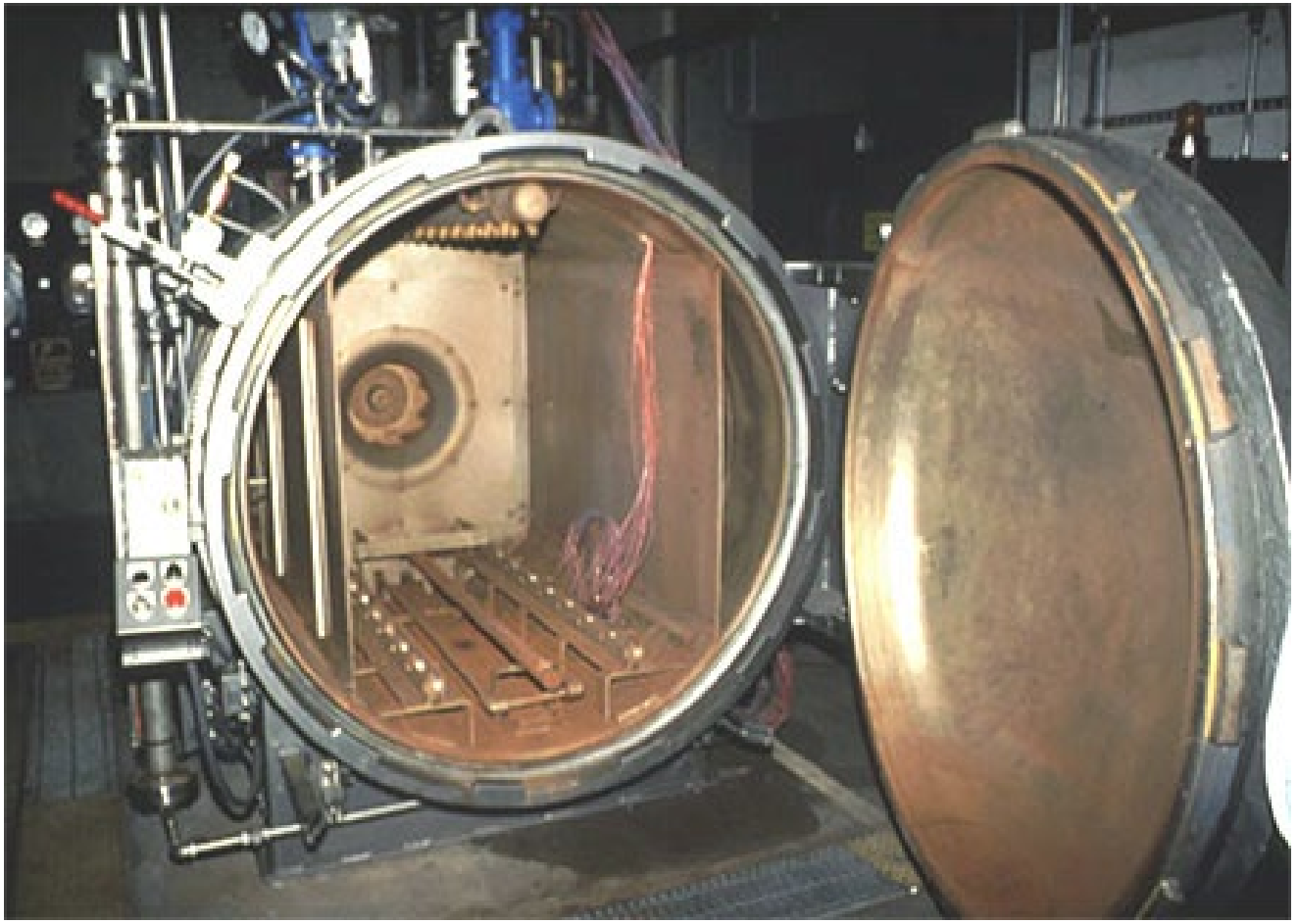
Water Spray Retort – Water Recirculation

- Water recirculation (flow rate, e.g., gallons per minute) for maintaining uniform heat distribution in the retort must be documented by HD/TD data or other documentation from the PA

Water Spray Retort – Critical Operating Parameters

- Stepped come-up procedures
- Water recirculation (flow) rate
- Overpressure to maintain container integrity
- Reel speed timing for agitating processes

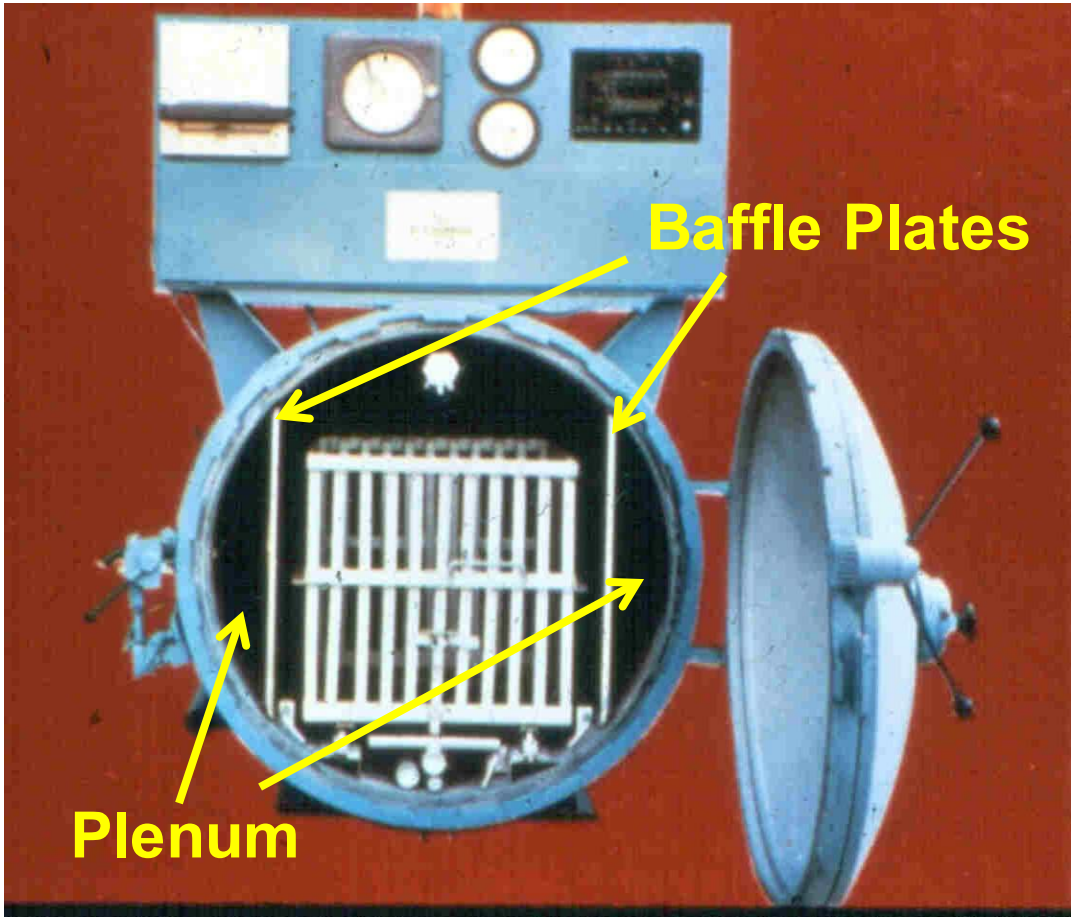
Steam/Air Retorts



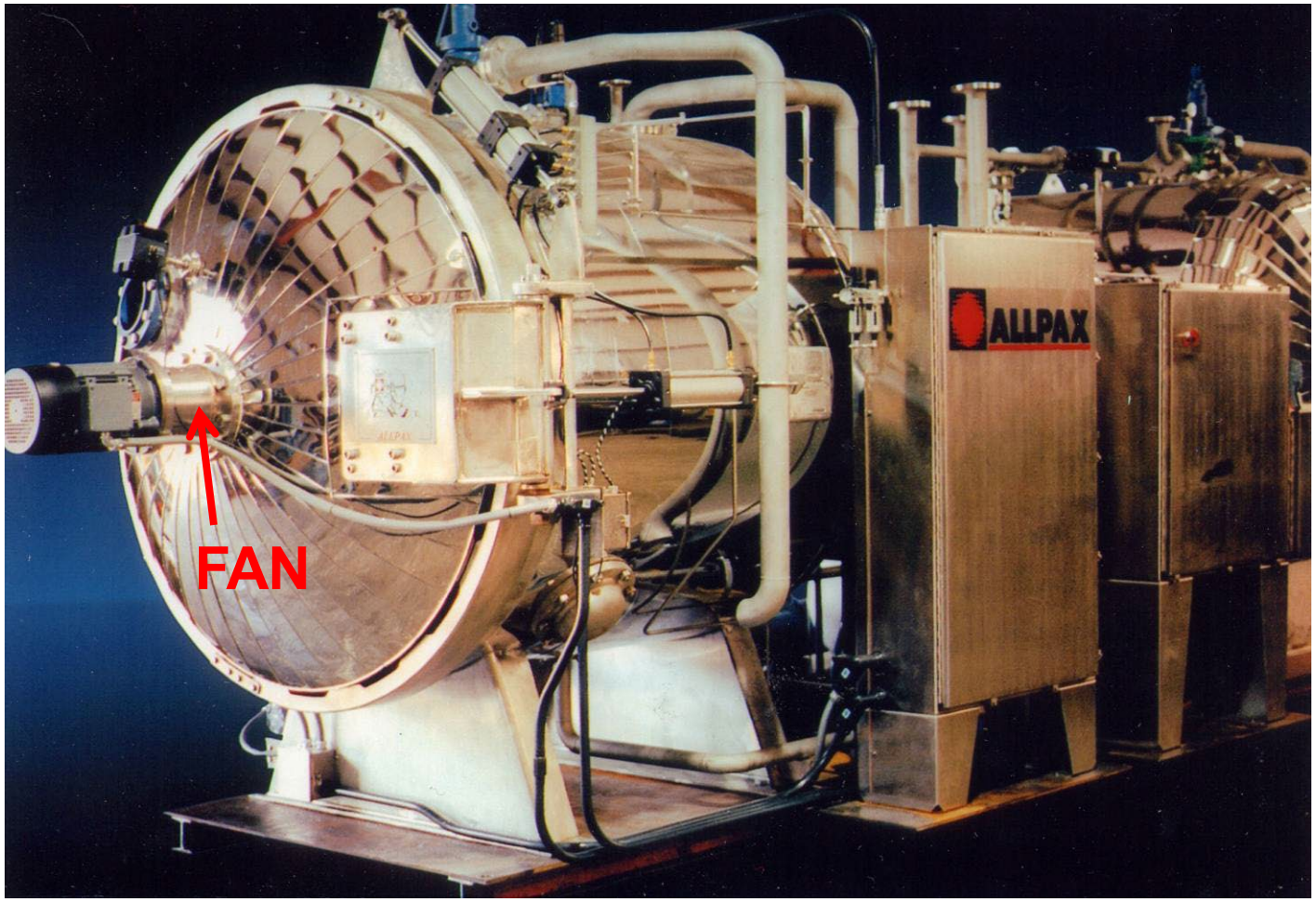
Steam/Air Retort Characteristics

- A mixture of steam and air is the heating medium
- Steam/air ratios range from 75% steam/25% air to 95% steam/5% air
- A fan is used to maintain uniform steam/air circulation
- Introduced air provides overpressure
- Several manufacturers

Steam/Air Retorts



Steam/Air Retorts



Instrumentation-Temperature Device/Recorder

- Temperature indicating device and recorder-controller probes are usually inserted directly into retort shell in such a position that steam does not strike them directly
- The location of the probes on the retort may depend on the type of steam/air retort.

Steam/Air Retort – Come-Up Procedures

- Like cascading water/water spray retorts, a stepped program with a temperature overshoot is used to bring the retort's cold spot up to process temperature

Steam/Air Circulation

- A method of circulating the steam/air mixture **must** be provided
- The circulation system, *usually a fan*, **must** be checked for proper functioning and **must** be equipped with device to warn the operator when it is not functioning

Steam/Air Retort - Critical Operating Parameters

- Stepped come-up procedures
- Percent steam/air mixture (e.g., 90%/10%), or maximum pressure (e.g., 25 PSIG)
- Steam/air mixture circulation and flow rate (e.g., 30 cubic feet/second)
- Reel speed timing for agitating processes

Steam/Air Mixture

- The steam/air mixture *or* the **temperature and pressure** (that represents a specific steam/air ratio) used to thermal process a product **must** be the same mixture *or* temperature and pressure documented in the heat penetration tests used to establish the product's process schedule

Questions

Questions?