Sausage Operations Equations/Methods/Regulatory Limits
(Quick Reference)

Antioxidant and Added Water Regulatory Limits for Raw Sausages

Individual Antioxidant = .01%
Antioxidants in Combination = .02%
Added Water 3% in Total Ingredients

Antioxidants Added through a Compound Calculation Steps

Step 1: Determine fat content (target or through raw materials in the formula)
Step 2: Determine % of each antioxidant/synergist in the compound
Step 3: Determine the total % of antioxidants (i.e., add up %)
Step 4: Determine maximum amount of antioxidant allowed using these rules
   No antioxidant or synergist > 50%, multiply fat content by .02%
   One antioxidant or synergist > 50%, multiply fat content by .01%
   One antioxidant or synergist = 50%, multiply fat content by .01% or .02%
Step 5: Max. antioxidant allowed ÷ by major antioxidant or synergist % (when it is over
   50% of total antioxidants) = max. antioxidant compound.
   OR
   Max. antioxidant allowed, ÷ by total antioxidants % (when no
   antioxidant/synergist is over 50% of the total antioxidants) = max. antioxidant
   compound

Ingoing Curing Agent and Curing Accelerator PPM

\[ \text{ppm} = \frac{\text{lb RI} \times 1,000,000}{\text{lb meat block}} \]

RI (Restricted Ingredient) = specific curing agent or curing accelerator
Meat block = meat, meat byproducts, poultry, and/or poultry byproducts

Curing Agent Added to the Formula in a Curing Compound or Mix

\[ \text{ppm} = \frac{\text{lb of cure mix} \times \% \text{ of cure agent in mix} \times 1,000,000}{\text{lb of meat block}} \]

Maximum Curing Agent or Curing Accelerator Allowed

\[ \text{Max. cure agent or } = \left( \frac{\text{lb of meat block}}{100 \text{ lb}} \right) \times \text{Restricted agent/accelerator level per} \\
\text{(curing accelerator)} \times 100 \text{ lb of meat block} \]
Regulatory Limits

Curing Agents

(1) Nitrite - .25 oz./100 lb of chopped meat, meat byproduct, poultry, and poultry byproduct OR 156 ppm ingoing

(2) Nitrate - 2.75 oz./100 lb of chopped meat, meat byproduct, poultry, and poultry byproduct OR 1,718 ppm ingoing

Cure Accelerators

(1) Ascorbate/Erythorbate - .875 oz./100 lb of chopped meat, meat byproduct, poultry, and poultry byproduct OR 547 ppm ingoing

(2) Ascorbic acid/ erythorbic acid - .75 oz/100 lb of chopped meat, meat byproduct, poultry, and poultry byproduct OR 469 ppm ingoing

Regulatory Limits for Additives in Cooked Sausages-Based on the Projected Finished Weight (PFW)

Binders and Extenders: Cereal, NFDM, CRDSM, and many more listed is section 424.21(c) -- 3.5% maximum individually or collectively

Phosphates - 0.5% (5000 ppm)

PFW Calculation Steps/Ingredient Compliance Determination based on the PFW

Step 1: Remove the weight of water from the formula (batch) weight and the target % the water represents (10, 12, 15, etc.);

Step 2: Continue by removing the weight of any ingredients with a regulatory limit based on a PFW, (e.g., binders and phosphates) from the remaining formula (batch) weight and their % regulatory limit from the remaining formula %;

Step 3: Divide the remaining weight of the formula (batch) by the % it represents to determine the PFW; and then

Step 4. Multiply the PFW by the ingredient’s % regulatory limit to determine maximum amount of that ingredient allowed in the formula.

Potential Pitfalls: Not removing any rework from formula (batch) weight before starting the PFW calculation and not considering water in corn syrup.
PPM Equation

\[
ppm = \frac{lb \ RI \ (Restricted \ Ingredients) \times \% \ Pump \times 1,000,000}{lb \ Pickle}
\]

Note: If a curing compound is used, multiple the weight of the compound by the \% of nitrite/nitrate in the compound to determine the weight of the nitrite/nitrate (RI).

Pump, Pick-up, Added Solution or Gain Equation

\[
\% \ pump, \ pick-up, \ gain = \frac{pumped \ wt - green \ wt}{green \ wt} \times 100
\]

Percent Yield Equation

\[
\% \ yield = \frac{finished \ wt}{green \ wt} \times 100
\]

Volume of Rectangular Tank Equation

\[
cubic \ inches = (length \ in \ inches) \times (width \ in \ inches) \times (height \ in \ inches)
\]

Note: 1 gallon = 231 cubic inches
### TABLE II
**Maximum Ingoing Nitrite and Nitrate Limits (in PPM) for Meat and Poultry Products**

<table>
<thead>
<tr>
<th>Curing Agent</th>
<th>Curing Method</th>
<th>Immersion Cured</th>
<th>Massaged or Pumped</th>
<th>Comminuted</th>
<th>Dry Cured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Nitrite</td>
<td>200</td>
<td>200</td>
<td>156</td>
<td>625</td>
<td></td>
</tr>
<tr>
<td>Potassium Nitrite</td>
<td>200</td>
<td>200</td>
<td>156</td>
<td>625</td>
<td></td>
</tr>
<tr>
<td>Sodium Nitrate</td>
<td>700</td>
<td>700</td>
<td>1718</td>
<td>2187</td>
<td></td>
</tr>
<tr>
<td>Potassium Nitrate</td>
<td>700</td>
<td>700</td>
<td>1718</td>
<td>2187</td>
<td></td>
</tr>
</tbody>
</table>

*Except for bacon

### TABLE III
**Maximum Ingoing Cure Accelerators (in PPM) for Meat and Poultry Products**

<table>
<thead>
<tr>
<th>Cure Accelerator</th>
<th>Maximum Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascorbic Acid</td>
<td>469 ppm*</td>
</tr>
<tr>
<td>Erythorbic Acid</td>
<td>469 ppm*</td>
</tr>
<tr>
<td>Sodium Ascorbate</td>
<td>547 ppm*</td>
</tr>
<tr>
<td>Sodium Erythorbate (isoascorbate)</td>
<td>547 ppm*</td>
</tr>
</tbody>
</table>

*Except in bacon

**RI Regulatory Limits for Pumped or Massaged Bacon**

Establishment’s written procedure:

- Must demonstrate 120 ppm ingoing sodium nitrite or 148 ppm potassium nitrite **AND**
- Must demonstrate 550 ppm of sodium erythorbate or sodium ascorbate

**Note:** A plus or minus 20% allowance at the time of injecting or massaging.

**Meat and Poultry Products with Added Solutions**

**Calculation Equation/Quick Reference**

**Pump, Pick-up, Added Solution or Gain Equation for RAW Products**

\[
\% \text{ pump, pick-up, gain} = \frac{\text{pumped (treated) wt} - \text{green wt}}{\text{green wt}} \times 100
\]

**Pump, Pick-up, Added Solution or Gain Equation for COOKED Products**

\[
\% \text{ pump, pick-up, gain} = \frac{\text{finished wt} - \text{green wt}}{\text{finished wt}} \times 100
\]