

## □ TABLES □



**TABLE 1**

**U.S. CUSTOMARY/SI CONVERSION FACTORS**

<b>U.S. Customary</b>	<b>SI</b>
1 gallon	3.78 liters
1 inch	2.54 centimeters
1 micromho	1 microsiemens
212 ° Fahrenheit	100 ° Celsius
1 part per million (ppm)	1 milligram per liter
1 psig	7.03 kilo pascal
1 part per billion (ppb)	1 microgram per liter

**TABLE 2**  
**CODE OF FEDERAL REGULATIONS**  
**April 1, 1993**

Subpart D — Specific Usage Additives

§ 173.310 Boiler Water Additives

Boiler water additives may be safely used in the preparation of steam that will contact food, under the following conditions:

- (a) The amount of additive is not in excess of that required for its functional purpose, and the amount of steam in contact with food does not exceed that required to produce the intended effect in or on the food.
- (b) The compounds are prepared from substances identified in paragraphs (c) and (d) of this section and are subject to the limitations, if any described.
- (c) List of substances:

<b>Substances</b>	<b>Limitations</b>
Acrylamide sodium acrylate resin	Contains not more than 0.05 percent by weight of acrylamide monomer.
Acrylic acid/2-acrylamide-2-methyl propane sulfonic acid co-polymer having a minimum weight average molecular weight of 9,000 and a minimum number average molecular weight of 5,700 as determined by a method entitled "Determination of Weight Average and Number Average Molecular Weight of 60/40 AA/AMPS" (October 23, 1987), which is incorporated by reference in accordance with 5 U.S.C. 552(a). Copies may be obtained from the Division of Food and Color Additives, Center for Food Safety and Applied Nutrition (HFF-330), Food and Drug Administration, 200 C St. SW, Washington, DC 20204, or may be examined at the Office of the Federal Register, 1100 L St. NW, Washington, DC.	Total not to exceed 20 parts per million (active) in boiler feedwater.
Ammonia alginate	
Cobalt sulfate (as catalyst)	
1-hydroxyethylidene-1, 1-diphosphonic acid (CAS Reg. No. 2809-21-4) and its sodium and potassium salts	

<b>Substances</b>	<b>Limitations</b>
Lignosulfonic acid	Total not to exceed 20 parts per million (active) in boiler feedwater.
Monobutyl ethers of polyethylene-polypropylene glycol produced by random condensation of a 1:1 mixture by weight of ethylene oxide and propylene oxide with butanol	Minimum molecular weight 1,500
Poly (acrylic acid-co-hypophosphite), sodium salt (CAS Reg. No. 71050-62-9), produced from a 4:1 to a 16:1 mixture by weight of acrylic acid and sodium hypophosphate	Total not to exceed 1.5 parts per million in boiler feedwater. Co-polymer contains not more than 0.5 percent by weight of acrylic acid monomer (dry weight basis).
Polyethylene glycol	As defined in § 172.820 of this chapter
Polymaleic acid (CAS Reg. No. 26099-09-2), and/or its sodium salt (CAS Reg. No. 30915-61-8)	Total not to exceed 1 part per million in boiler feedwater (calculated as the acid)
Polyoxypropylene glycol	Minimum molecular weight 1,000
Potassium carbonate	
Potassium triphosphate	
Sodium acetate	
Sodium alginate	
Sodium aluminate	
Sodium carbonate	
Sodium carboxy-methylcellulose	Contains not less than 95 percent sodium carboxymethylcellulose on a dry-weight basis, with maximum substitution of 0.9 carboxymethylcellulose groups per anhydroglucose unit, and with a minimum of viscosity of 15 centipoises for 2 percent by weight aqueous solution at 25 °C; by method prescribed in the "Food Chemicals Codex", 3rd Ed. (1981), pp. 280–282, which is incorporated by reference. Copies may be obtained from the National Academy Press, 2101 Constitution Avenue, NW, Washington, D C 20418, or may be examined at the Office of the Federal Register, 1100 L St. NW, Washington, DC 20408.
Sodium glucoheptonate	
Sodium hexametaphosphate	Less than 1 part per million cyanide in the sodium glucoheptonate.

Substances	Limitations
Sodium humate	Less than 1 part per million cyanide in the sodium glucoheptonate.
Sodium hydroxide	
Sodium lignosulfonate	
Sodium metabisulfite	
Sodium metasilicate	
Sodium nitrate	
Sodium phosphate (mono-, di, tri)	
Sodium polyacrylate	
Sodium polymethacrylate	
Sodium silicate	
Sodium sulfate	
Sodium sulfite (neutral or alkaline)	
Sodium tripolyphosphate	
Tannin (including quebracho extract)	
Tetrasodium EDTA	
Tetrasodium pyrophosphate	

(d) Substances used alone or in combination with substances in paragraph (c) of this section:

Substances	Limitations
Cyclohexylamine	Not to exceed 10 parts per million in steam, and excluding use of such steam in contact with milk and milk products
Diethylaminoethanol	Not to exceed 15 parts per million in steam, and excluding use of such steam in contact with milk and milk products
Hydrazine	Zero in steam
Morpholine	Not to exceed 10 parts per million in steam, and excluding use of such steam in contact with milk and milk products
Octadecylamine	Not to exceed 3 parts per million in steam, and excluding use of such steam in contact with milk and milk products
Trisodium nitrilotriacetate	Not to exceed 5 parts per million in steam, and excluding use of such steam in contact with milk and milk products

(e) To assure safe use of the additive, in addition to the other information required by the Act, the label or labeling shall bear:

1. The common or chemical name or names of the additive or additives.
2. Adequate directions for use to assure compliance with all the provisions of this section.

## □ REFERENCES □

1. "An Assessment of the Health Risks of Morpholine and Diethylaminoethanol" by the Committee on Toxicology, National Research Council, National Academy Press, Washington, D.C., August, 1983.
2. Wilkes, J. F., Commercial – Industrial Water and Steam Treatment — Effect on Humidification. ASHRAE Publication No. 72-12, pp. 16–23.
3. Edgerton, S. A., D. U. Kenny, and D. W. Joseph. "Determination of Amines in Indoor Air From Steam Humidification." *Environmental Science & Technology*, 23:4, 1989.
4. American Society of Mechanical Engineers, *Consensus on Operating Practices for the Control of Feedwater and Boiler Water Quality in Modern Industrial Boilers*, 1994.
5. American Boiler Manufacturers Association, *Boiler Water Limits and Steam Purity Recommendations for Watertube Boilers*, 3rd Edition, 1983.
6. Jonas, O., "Development of a Steam Sampling System," EPRI TR-100196 Research Project 2712-8, December, 1991.
7. Robinson, J. O., A. W. Fynsk. "A Practical Guide to Avoiding Steam Purity Problems in the Industrial Plant." International Water Conference, October 1992.

