

NOTE: Biological treatment and control of Legionella and other potentially health-threatening bacteria is essential. Consult a competent water treatment expert or service company.

pH	6.5 to 9.0 (special materials may be required beyond these limits)
Temperature	125° F (51.7° C) maximum, or up to 180° F (82.2° C) with special materials
Langelier Saturation Index	0.0 to 1.0 recommended; higher allowed if scale is controllable.
M-Alkalinity	100 to 500 ppm as CaCO ₃
Silica	150 ppm as SiO ₂ maximum (scale formation)
Iron	3 ppm maximum (staining and scale contributor)
Manganese	0.1 ppm maximum (staining and scale contributor)
Sulfides	Greater than 1 ppm can be corrosive to copper alloys, iron, steel, and galvanized steel. See table below for limits with film fill.
Ammonia	50 ppm maximum if copper alloys present; lower limits apply for film fill - see table.
Chlorine / bromine	2 ppm free residual intermittently (shock), or 1 ppm continuously maximum. Excess can attack sealants, accelerate corrosion, increase drift, and embrittle PVC.
Organic solvents	These can attack plastics and promote bio-growth. Trace amounts may be acceptable, depending on the solvent.
TDS	Over 5000 ppm can affect thermal performance and be detrimental to wood in alternately wet/dry zones such as fan deck and louver face.
<u>Individual Ions:</u>	<u>MAXIMUM:</u>
Cations:	
Calcium	800 ppm as CaCO ₃ , (300 ppm with MX75 fill in arid climate)
Magnesium	Depends on pH and Silica level
Sodium	No limit
Anions:	
Chlorides	450 ppm as Cl ⁻ (300 for galvanized towers) upgrades are required for higher chloride levels.
Sulfates	800 ppm as CaCO ₃
Nitrates	300 ppm as NO ₃ (bacteria nutrient)
Carbonates/Bicarbonates	300 ppm as CaCO ₃ maximum preferred for wood

Fouling Contaminant Limits

Bacteria counts listed below relate to maintaining fill thermal efficiency only. Biocidal treatment is required for all cooling tower installations. (see NOTE above).

<u>Fill Type</u>	<u>Aerobic Bacteria Heterotrophic Plate Count</u>	<u>Total Suspended Solids (TSS)</u>	<u>Oil and Grease</u>	<u>Sulfides</u>	<u>Ammonia</u>
DF121	1,000 CFU/ml	10 ppm	0.2 ppm	0.1 ppm	2 ppm
MC75	10,000 CFU/ml	50 ppm	1 ppm	0.5 ppm	10 ppm
FB20, SNCS ('Coolfilm'), MX75 (crossflow), ClearFlow Modules	100,000 CFU/ml	50 ppm	1 ppm	1.0 ppm	15 ppm
	10,000 CFU/ml	150 ppm			
DF254, MCR16, MCR12	100,000 CFU/ml	150 ppm	5 ppm	1.5 ppm	25 ppm
FC18, DF381 with 1' MC75 overlay	1,000,000 CFU/ml	50 ppm	5 ppm	1.5 ppm	25 ppm
	100,000 CFU/ml	150 ppm			
DF381, Tricklebloc, AAFNCS ('Cleanflow')	1,000,000 CFU/ml	250 ppm	10 ppm	2.0 ppm	25 ppm
Splash bar or grid fill	1,000,000 CFU/ml target	No specific limit	10 ppm	N/A	N/A

Note: Any amount of oil or grease is likely to adversely affect thermal performance. Sulfides and ammonia promote bacterial growth which can cause fill fouling; conformance to the limits above will assist in controlling bacteria to the recommended levels.

Drift Effects:

Certain contaminants or treatment chemicals such as surfactants, glycols, biodispersants and antifoams may increase drift rate. When minimizing drift is vital, the circulating water shall have a surface tension of at least 65 dynes/cm and a total organic carbon (TOC) level below 50 ppm. Reclaim or re-use waters in particular may contain contaminants which increase drift rate either directly or by necessitating the use of treatment chemicals which increase drift rate.

Miscellaneous Solids and Nutrients

Avoid high efficiency fill (MC75) with water containing bacteria nutrients such as alcohols, nitrates, ammonia, fats, glycols, phosphates, black liquor, or TOC greater than 50 ppm. Clog-resistant fills may be considered for contaminated water, case by case. For all film fills, avoid fibrous, oily, greasy, fatty, or tarry contaminants, which can plug fill. In general, do not use film fill in Steel Plants, Pulp & Paper Mills, Food Processing Operations, or similar applications unless leaks and contamination by airborne or waterborne particulates, oil, or fibers are extremely unlikely. If film fill is used, biological-growth control must be stringent and diligent.