ICT
Cooling Towers

Advanced Features In
Induced Draft, Counterflow Towers

Member MCAA
Mechanical Contractors Association of America

Member C.T.I.
Cooling Tower Institute

EVAPCO ICT Cooling Towers

It is well known in the industry that Induced Draft, Counter-Flow Cooling Towers provide the greatest operating efficiency and easiest maintenance accessibility. Its vertical air discharge and low operating weight provide more design flexibility making it the preferred choice for most cooling tower applications.

EVAPCO's ICT Cooling Tower features the advantages of the induced draft counter-flow cooling tower design and the high level of quality and service only EVAPCO provides.

The ICT is a heavy duty cooling tower well-suited for industrial as well as commercial applications utilizing its durable construction and ease of maintenance. Its design saves space, blends easily with architectural surroundings and offers low annual operating costs.

The standard ICT is constructed with EVAPCO's exclusive EVAPCOAT Corrosion Protection System. In addition, EVAPCO offers the ICT with several optional materials of construction including stainless steel and fiberglass reinforced polyester components.

The EVAPCOAT Corrosion Protection System combines heavy-gauge **G-235** hot-dip galvanized steel construction with corrosion resistant PVC wet deck fill, PVC drift eliminators, PVC water distribution system, PVC inlet louvers and stainless steel suction strainers.

For severe corrosive environments such as coastal regions and industrial plants, ICT models are available with the following optional materials: stainless steel basins, stainless steel basins with FRP casing, and complete stainless steel construction. All designs successfully incorporate the reliability and structural integrity of stainless steel with the corrosion resistance of FRP.

The thermal performance of the ICT tower, like all EVAPCO products, is backed by a full written guarantee. Through hundreds of hours of comprehensive testing, EVAPCO engineers established the performance of the ICT to ensure rated performance without variation. Performance testing is conducted in EVAPCO's new 40,000 square foot environmental test facility.

This state-of-the-art research facility located at the Evapco World Headquarters in Maryland is the largest and most advanced in the evaporative cooling industry.

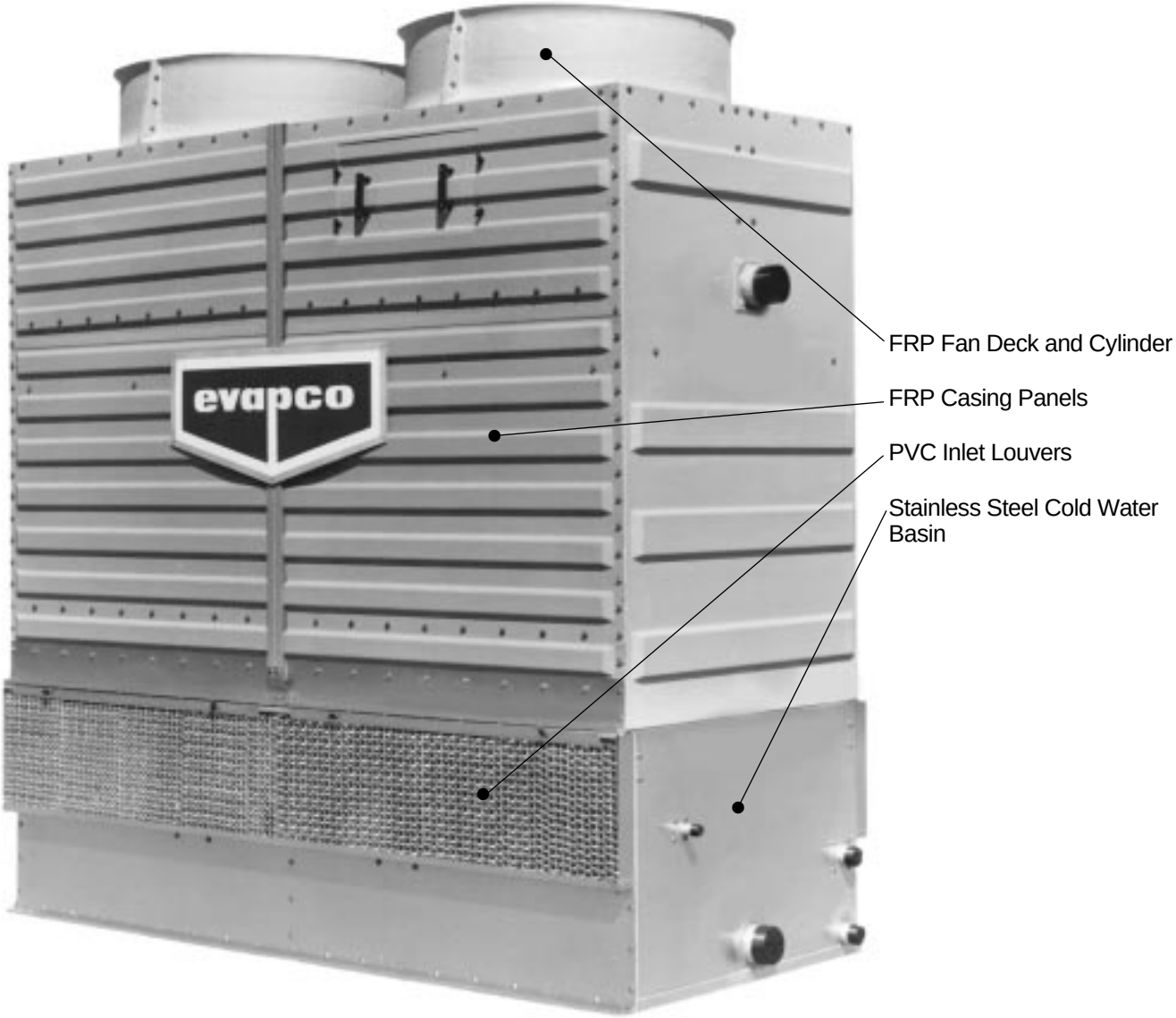
Features

- **Superior Corrosion Protection**
  G-235 Hot-Dip Galvanized Steel
  Eliminates Need for Costly, Unreliable Epoxy Paint Finishes
- **Easy Maintenance**
  Reliable, Accessible Components
- **Exclusive Three Year Warranty**
  Motor and Fan Assembly
- **Vertical Air Discharge**
  Minimizes Possibility of Recirculation
- **Efficient Drift Eliminators**
  Solve Water Carryover Problems
  Reduce Water Usage
  Lower Operating Costs
- **Superior Louver Design**
  Eliminates Splashout, Reduces Algae
- **Industrial Grade Motors**
  Totally Enclosed Motors Standard
  Inverter – Duty Motors Available for VFD Applications

Optional Stainless Steel Basin with Fiberglass Casing Construction

Available on Models ICT 4-54 to 4-912

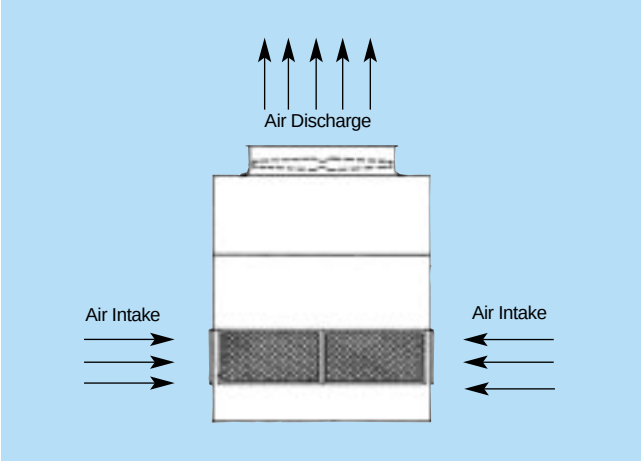
- **Stainless steel fan support and interior steel components**
  Maximum structural integrity and durability
- **FRP Casing and Fan Deck**
  Isophthalic polyester resin, gel coated, UV resistant, and specially treated to resist weathering
- **Stainless Steel Basin**
  Increased structural integrity and maximum corrosion protection



Design Features

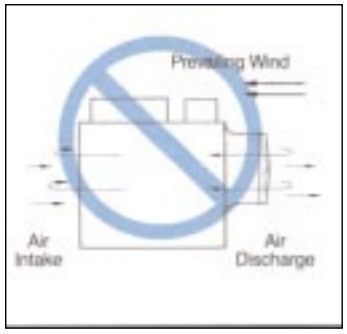
Vertical Air Discharge

The vertical air discharge of the ICT unit reduces the chance of air recirculation, since the warm humid air is directed up and away from the unit. Layout considerations and positioning are greatly simplified for all unit sizes.



VERTICAL DISCHARGE

Most larger cooling towers have vertical air discharge, similar to the ICT, but many smaller capacity crossflow designs discharge the air horizontally. This arrangement increases the chance of air recirculation since the air is not directed up and away from the tower. The results are reduced unit capacity, system operational problems and increased maintenance expense.



NO HORIZONTAL DISCHARGE

Reliable Year Round Operation

The ICT cooling tower is well suited for winter operation. With its counterflow design, the wet deck surface is encased, isolating the fill from freezing winds, and thus inhibiting ice formation on the fill.

Crossflow designs have a well known tendency to form ice along the inlet louvers and fill during cold weather operation. A buildup of ice at this point can quickly reduce the unit capacity, require extensive downtime for removal, and may require costly repairs to the fill and louvers.

The counterflow design of the ICT reduces the chances of ice formation and eliminates fill collapse.

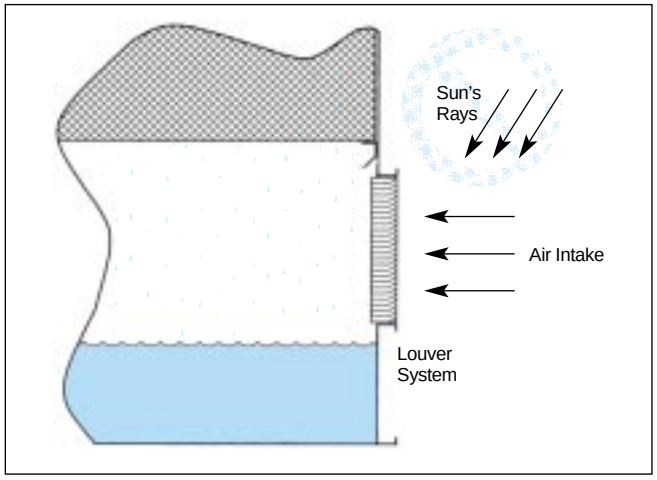
Superior Louver Design

The air inlet louvers on the ICT are constructed of corrosion-free PVC. They are a two pass design that eliminates splashout and reduces the potential for algae formation inside the tower.

In single pass louver systems, circulating water droplets tend to splashout, especially when the fans are shut off. With the two pass louver system, the water droplets are captured on the inward sloping pass, eliminating splashout problems.

Another benefit of this design is that the louvers completely enclose the basin area. Direct sunlight is blocked from the water inside the cooling tower, reducing the potential of algae formation. Water treatment and maintenance costs are substantially reduced.

While effectively containing the recirculating water and blocking sunlight, the louver design has a low pressure drop for efficient operation. Low fan energy consumption results with this superior louver system.



LOUVER SYSTEM

Three Year Drive Warranty

EVAPCO provides a standard 3-year fan and motor warranty on all ICT cooling towers. This unique warranty is designed to offer the end user optimum protection against fan and motor failure. It is a comprehensive plan which includes both the fan and the motor. This 3-year warranty is unsurpassed by any other cooling tower manufacturer.

Materials of Construction

EVAPCOAT System

Historically, EVAPCO has been a leader in the design and implementation of corrosion protection techniques. EVAPCO's Research and Development has produced many design and material improvements to extend the life of cooling towers. These include increased galvanizing thickness for steel, cold galvanizing for sheared edges and welds, PVC construction of fill and drift eliminators, and stainless steel strainers.

EVAPCO offers as standard the EVAPCOAT Corrosion Protection System on all cooling towers. This system combines heavy gauge **G-235** hot-dip galvanized steel with PVC and stainless steel materials in key areas to offer maximum corrosion protection at an economical price.

EVAPCOAT CONSTRUCTION WITH OPTIONAL 304 STAINLESS STEEL BASIN (SHOWN)

Optional Materials of Construction

The modular design of the ICT Cooling Tower also allows for specific areas to be enhanced for increased corrosion protection. EVAPCO offers two options for cost effective security from corrosion.

- **Type 304 Stainless Steel Basin**
  Stainless steel is supplied for the entire basin area. **The pan section of the cooling tower is a critical component since it provides the structural base for the unit and is located in a severe corrosive environment.**
- **All Type 304 Stainless Steel Construction**
  Provides the important advantages of both optimum structural integrity and maximum corrosion protection.

Stainless Steel Basin with Fiberglass Casing Option

Corrosive environments such as coastal installations or industrial plants call for aggressive construction techniques. This option for cooling towers is designed to provide further protection from corrosion and builds upon the EVAPCOAT system with Type 304 stainless steel and FRP construction. Each component has been carefully analyzed and selected specifically for performance in severe duty applications.

STAINLESS STEEL BASIN WITH FIBERGLASS CASING OPTION

Stainless Steel Basin with Fiberglass Casing

This construction feature is available for models ICT 4-54 through ICT 4-912. The major design features are:

- Type 304 stainless steel basin for structural integrity and maximum corrosion protection.
- Fan support and interior steel components are Type 304 stainless steel.
- Casing panels and fan deck are constructed of high grade isophthalic polyester resin with color pigments. All FRP components are gel coated, UV resistant and specifically treated to resist weathering.

NOTE: Stainless Steel Basin with Fiberglass Casing Option is not available on models ICT 3-63 to 3-93.

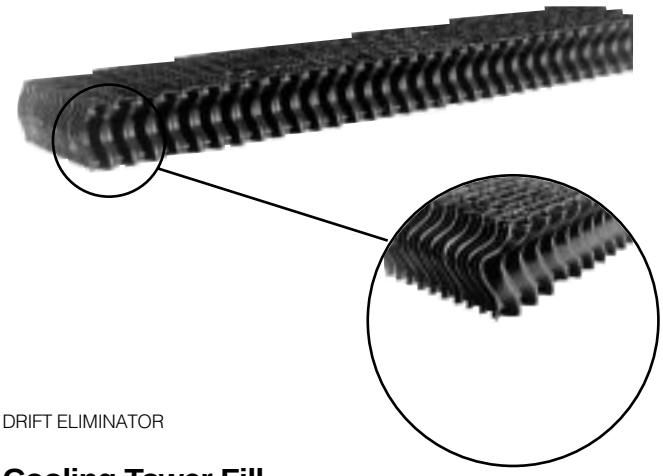
Quality Construction

Efficient Drift Eliminators

An extremely efficient drift eliminator system is standard on the ICT. The system removes entrained water droplets from the air stream to limit the drift rate to less than 0.001% of the recirculating water rate.

With a low drift rate, ICT cooling towers can be located in areas where minimum water carryover is critical, such as parking lots.

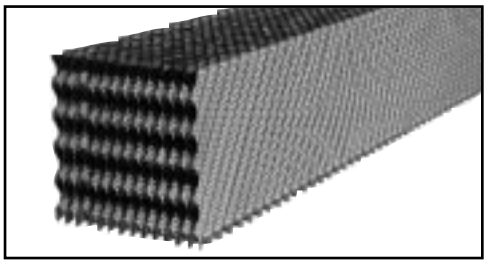
The drift eliminators are constructed of an inert polyvinyl chloride (PVC) plastic material which effectively eliminates corrosion of these vital components. They are assembled in sections to facilitate easy removal for inspection of the water distribution system.



DRIFT ELIMINATOR

Cooling Tower Fill

The patented* EVAPAK® fill design used in the ICT is specially designed to induce highly turbulent mixing of the air and water for superior heat transfer. Special drainage tips allow high water loadings without excessive pressure drop. The fill is constructed of inert polyvinyl chloride (PVC). It will not rot or decay and is formulated to withstand water temperatures of 130˚F. Because of the unique way in which the crossfluted sheets are bonded together, the structural integrity of the fill is greatly enhanced, making the fill usable as a working platform.



FILL

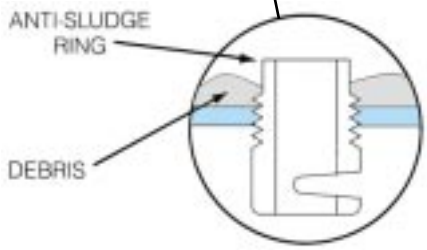
The fill selected for the ICT has excellent fire resistant qualities. In tests conducted according to ASTM-E84-81a, its flame spread rating was 5. (The flame spread rating scale ranges from 0 for noncombustible to 100 for highly combustible.)

A high temperature fill is available for water temperatures exceeding 130˚F. Consult your EVAPCO representative for further details.

Water Distribution System

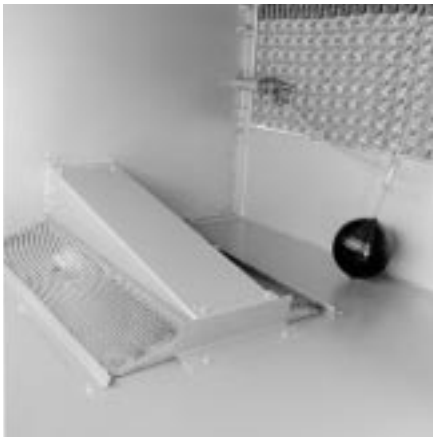
The water distribution system is made of Schedule 40 PVC pipe and ABS plastic water diffusers for corrosion protection in this key area. This system is greatly simplified with only one header which is easily removable for cleaning. The water diffusers have a minimum opening of 3/8 by 1 inch and are practically impossible to clog. They also have an anti-sludge ring extending into the headers to prevent dirt from building up in the diffuser opening.

WATER DISTRIBUTION SYSTEM



Stainless Steel Strainers

One other component of the cooling tower which is subject to excessive wear is the basin suction strainer. The EVAPCO standard for this very important part is Type 304 stainless steel.



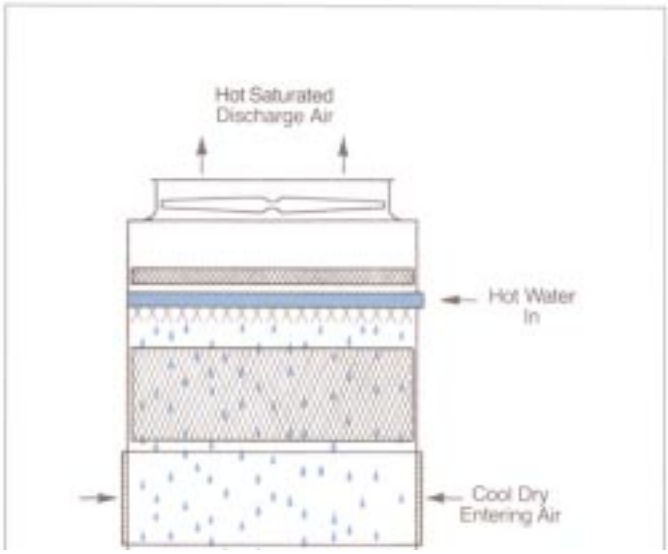
STRAINER

*U.S. Patent No. 5,124,087

Selection Procedure

Principle of Operation

Warm water from the heat source is pumped to the water distribution system at the top of the tower. The water is distributed over the wet deck fill by means of large orifice nozzles. Simultaneously, air is drawn in through the air inlet louvers at the base of the tower and travels upward through the wet deck fill opposite the water flow. A small portion of the water is evaporated which removes the heat from the remaining water. The warm moist air is drawn to the top of the cooling tower by the fan and discharged to the atmosphere. The cool water drains to the basin at the bottom of the tower and is returned to the heat source.



PRINCIPLE OF OPERATION

Selection

To size a cooling tower for any application it is necessary to know the flow rate of water to be cooled in gpm, the entering water temperature, the desired leaving water temperature, and the wet bulb temperature at the cooling tower location.

Example

Given: to cool 200 gpm of water from 97°F to 85°F at 76°F wet bulb temperature.

Selection:

1. Determine the range through which the water is to be cooled:
   Entering Water Temperature – Leaving Water Temperature = Range (97° – 85° = 12°)

2. Determine the approach of the leaving water temperature to the wet bulb temperature:
   Leaving Water Temperature – Wet Bulb Temperature = Approach (85° – 76° = 9°)

3. Calculate the nominal ton load:

$$\text{Load} = \frac{\text{flow rate (gpm) X range (°F) X 500}}{\text{15,000 btuh/ton}}$$

$$= \frac{200 \text{ X } 12 \text{ X } 500}{15{,}000} = 80 \text{ nominal tons}$$

4. Determine the application factor by turning to the 76°F wet bulb table, page 10. Enter the top of the table in the 12° range column and read down to the horizontal line which represents 9° approach. Read the application factor which lies at the intersection of the two columns.
   Application Factor = .81

5. Determine Corrected Load:
   Nominal Load X Application Factor = Corrected Load
   80 X .81 = 64.8 corrected tons

6. Select the proper cooling tower by referring to the ICT capacity curves, page 12. Enter the chart at the design flow and read up to the corrected ton line. Select a tower whose curve lies above the intersection point of the gpm and corrected ton lines. For the example shown above, select the model ICT 4-76.

   NOTE: Contact your local representative to receive a copy of EVAPCO's exclusive EVAPSPEC® II Computer Selection Program.

Application Factors

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Approach °F.	RANGE																		
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
4	–	2.91	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
5	–	2.47	2.13	1.90	1.70	1.53	1.40	1.29	1.20	1.10	1.01	.94	.88	.82	.78	.74	.70	.67	.64
6	2.55	2.16	1.88	1.67	1.51	1.37	1.25	1.16	1.08	1.01	.93	.86	.81	.77	.73	.69	.65	.62	.59
7	2.28	1.91	1.70	1.51	1.37	1.24	1.14	1.05	.98	.92	.86	.80	.75	.71	.67	.64	.61	.58	.55
8	2.01	1.73	1.54	1.37	1.25	1.13	1.05	.96	.90	.84	.79	.74	.70	.66	.63	.60	.57	.54	.52
9	1.82	1.59	1.41	1.26	1.15	1.06	.97	.89	.84	.79	.74	.70	.66	.62	.59	.56	.54	.51	.49
10	1.67	1.46	1.29	1.17	1.07	.98	.90	.84	.80	.74	.70	.66	.63	.60	.56	.54	.51	.49	.47
11	1.53	1.34	1.20	1.09	1.00	.92	.85	.80	.75	.70	.66	.62	.59	.56	.54	.51	.49	.47	.45
12	1.39	1.24	1.12	1.02	.94	.87	.80	.75	.71	.67	.63	.60	.57	.54	.51	.49	.47	.45	.43
13	1.27	1.15	1.04	.95	.88	.81	.76	.71	.67	.63	.59	.56	.53	.51	.49	.47	.45	.43	.41
14	1.17	1.07	.97	.89	.83	.77	.72	.67	.63	.60	.57	.54	.51	.49	.47	.45	.43	.41	.39
15	1.09	1.00	.92	.84	.79	.73	.68	.63	.60	.57	.54	.51	.49	.47	.45	.43	.41	.39	.38
16	1.02	.94	.86	.80	.74	.69	.65	.61	.58	.54	.52	.49	.47	.45	.43	.41	.39	.38	.36
17	.96	.87	.81	.75	.70	.66	.61	.58	.55	.52	.49	.47	.45	.43	.41	.39	.38	.36	.35
18	.90	.83	.77	.72	.67	.62	.58	.55	.52	.49	.47	.44	.42	.41	.39	.37	.36	.35	.33
19	.84	.78	.73	.68	.64	.59	.56	.52	.50	.47	.45	.42	.41	.39	.37	.36	.34	.33	.32
20	–	.74	.70	.65	.61	.57	.53	.50	.48	.45	.43	.41	.39	.37	.36	.34	.33	.32	.31
21	–	.71	.67	.62	.58	.55	.51	.48	.46	.43	.41	.39	.37	.36	.34	.33	.32	.31	.30
22	–	.68	.64	.60	.56	.53	.50	.46	.44	.42	.39	.37	.36	.34	.33	.32	.30	.29	.28
23	–	.66	.61	.58	.54	.51	.48	.45	.43	.40	.38	.36	.35	.33	.32	.31	.29	.28	.27
24	–	.63	.59	.56	.53	.50	.47	.44	.41	.39	.37	.35	.34	.32	.31	.30	.29	.27	.26
25	–	.61	.57	.54	.51	.48	.45	.43	.40	.38	.36	.34	.33	.31	.30	.29	.28	.27	.26

62 W.B.

Approach °F.	RANGE																		
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
4	–	2.79	2.44	2.18	1.96	1.74	1.57	1.42	–	–	–	–	–	–	–	–	–	–	–
5	–	2.35	2.03	1.81	1.62	1.46	1.33	1.24	1.14	1.05	.97	.90	.84	.79	.75	.72	.68	.65	.62
6	2.46	2.06	1.80	1.06	1.43	1.30	1.20	1.10	1.03	.95	.89	.83	.78	.73	.70	.67	.63	.60	.57
7	2.17	1.84	1.62	1.44	1.31	1.19	1.10	1.00	.94	.88	.82	.77	.73	.68	.65	.62	.59	.56	.53
8	1.93	1.66	1.47	1.31	1.20	1.09	1.00	.92	.86	.81	.76	.71	.67	.64	.61	.58	.55	.52	.50
9	1.75	1.52	1.34	1.21	1.10	1.01	.93	.86	.81	.76	.71	.67	.63	.60	.57	.54	.52	.50	.47
10	1.59	1.38	1.24	1.12	1.02	.94	.87	.81	.76	.71	.67	.63	.60	.57	.54	.52	.49	.47	.45
11	1.45	1.27	1.15	1.04	.95	.88	.82	.76	.72	.67	.63	.60	.57	.54	.51	.49	.47	.46	.44
12	1.33	1.18	1.07	.97	.89	.83	.77	.72	.67	.64	.60	.57	.54	.51	.49	.47	.45	.43	.42
13	1.21	1.10	.99	.91	.84	.78	.72	.68	.63	.60	.57	.54	.51	.49	.47	.45	.43	.41	.39
14	1.12	1.02	.93	.85	.79	.73	.68	.64	.60	.57	.54	.51	.49	.47	.45	.43	.41	.39	.38
15	1.04	.95	.87	.81	.75	.70	.65	.61	.58	.55	.52	.49	.47	.45	.43	.41	.39	.38	.36
16	.98	.89	.82	.76	.70	.66	.61	.58	.55	.52	.49	.47	.44	.43	.41	.39	.38	.36	.35
17	.92	.84	.78	.72	.67	.62	.58	.55	.52	.49	.47	.44	.42	.40	.39	.37	.36	.35	.33
18	.86	.79	.73	.68	.64	.59	.56	.52	.49	.47	.44	.42	.40	.39	.37	.36	.34	.33	.32
19	.81	.75	.70	.65	.61	.57	.53	.50	.47	.45	.42	.40	.39	.37	.35	.34	.33	.32	.31
20	–	.71	.67	.62	.58	.55	.51	.48	.45	.43	.41	.39	.37	.35	.34	.33	.31	.30	.29
21	–	.68	.63	.59	.56	.53	.49	.46	.44	.41	.39	.37	.36	.34	.33	.31	.30	.29	.28
22	–	.65	.61	.57	.54	.51	.47	.45	.42	.40	.38	.36	.34	.33	.31	.30	.29	.28	.27
23	–	.63	.59	.55	.52	.49	.46	.43	.41	.39	.36	.35	.33	.32	.30	.29	.28	.27	.26
24	–	.60	.57	.54	.51	.48	.45	.42	.40	.38	.36	.34	.32	.31	.30	.28	.27	.26	.25
25	–	.58	.55	.52	.49	.46	.43	.41	.38	.36	.35	.33	.31	.30	.29	.28	.27	.26	.25

64 W.B.

Approach °F.	RANGE																		
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
4	–	2.67	2.34	2.09	1.85	1.67	1.50.	1.36	1.26	1.15	1.06	.99	.92	.86	.81	.77	.73	.70	.66
5	2.65	2.25	1.94	1.72	1.53	1.39	1.28	1.18	1.10	1.01	.93	.88	.82	.77	.73	.69	.66	.63	.60
6	2.34	1.96	1.72	1.53	1.37	1.25	1.15	1.06	.98	.92	.86	.80	.75	.71	.67	.64	.61	.58	.55
7	2.06	1.76	1.55	1.38	1.25	1.14	1.06	.97	.90	.84	.79	.74	.70	.66	.63	.60	.57	.54	.52
8	1.85	1.60	1.41	1.26	1.15	1.05	.96	.89	.83	.78	.73	.69	.65	.62	.59	.56	.55	.51	.49
9	1.66	1.44	1.28	1.16	1.05	.96	.89	.82	.78	.72	.68	.64	.61	.58	.55	.53	.50	.48	.46
10	1.50	1.32	1.18	1.07	.97	.90	.83	.77	.73	.68	.65	.61	.58	.55	.52	.50	.48	.46	.44
11	1.37	1.21	1.09	.99	.91	.84	.78	.73	.69	.65	.61	.58	.55	.52	.50	.48	.46	.44	.42
12	1.25	1.12	1.01	.93	.86	.79	.74	.69	.65	.61	.58	.55	.52	.50	.47	.45	.44	.42	.40
13	1.15	1.04	.95	.87	.80	.75	.69	.65	.61	.58	.55	.52	.50	.47	.45	.43	.42	.40	.38
14	1.06	.97	.89	.82	.76	.71	.66	.61	.58	.55	.52	.50	.47	.45	.43	.41	.40	.38	.37
15	.99	.91	.83	.77	.71	.66	.62	.58	.55	.52	.49	.47	.45	.43	.41	.39	.38	.36	.35
16	.93	.85	.78	.73	.68	.63	.59	.55	.52	.50	.47	.45	.43	.41	.39	.37	.36	.35	.34
17	.86	.80	.74	.69	.64	.59	.56	.52	.50	.47	.45	.42	.41	.39	.37	.36	.34	.33	.32
18	.81	.75	.70	.66	.61	.57	.53	.50	.48	.45	.43	.40	.39	.37	.35	.34	.33	.32	.31
19	–	.72	.67	.63	.58	.55	.51	.48	.46	.43	.41	.39	.37	.35	.34	.33	.31	.30	.29
20	–	.68	.64	.60	.56	.52	.49	.46	.44	.41	.39	.37	.35	.34	.33	.31	.30	.29	.28
21	–	.65	.61	.57	.54	.51	.47	.44	.42	.40	.37	.36	.34	.33	.31	.30	.29	.28	.27
22	–	.62	.59	.55	.52	.49	.46	.43	.41	.38	.36	.35	.33	.32	.30	.29	.28	.27	.26
23	–	.60	.57	.53	.50	.47	.44	.42	.39	.37	.35	.34	.32	.31	.29	.28	.27	.26	.25
24	–	.58	.55	.52	.48	.46	.43	.40	.38	.36	.34	.33	.31	.30	.29	.27	.26	.25	.24
25	–	.56	.53	.50	.47	.44	.42	.39	.37	.35	.33	.32	.30	.29	.28	.27	.26	.24	.24

Shaded areas of tables indicate entering water temperature exceeding maximum 130˚F.
Consult factory for alternate high temperature fill options.

66 W.B.

Approach °F.	RANGE																		
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
4	–	2.54	2.20	1.97	1.74	1.57	1.42	1.31	1.21	1.11	1.03	.95	.89	.83	.78	.74	.71	.68	.65
5	2.58	2.14	1.86	1.65	1.48	1.34	1.22	1.14	1.06	.98	.91	.84	.80	.75	.71	.68	.64	.61	.58
6	2.22	1.87	1.65	1.47	1.32	1.21	1.11	1.02	.95	.89	.83	.78	.73	.69	.66	.62	.59	.56	.54
7	1.94	1.68	1.49	1.32	1.20	1.09	1.01	.93	.87	.81	.76	.71	.68	.64	.61	.58	.55	.53	.50
8	1.74	1.53	1.35	1.21	1.10	1.01	.92	.86	.81	.75	.71	.67	.63	.60	.57	.54	.52	.49	.47
9	1.58	1.37	1.22	1.11	1.01	.93	.86	.80	.75	.70	.66	.62	.59	.56	.53	.51	.49	.47	.45
10	1.43	1.26	1.13	1.03	.94	.87	.80	.75	.70	.66	.62	.59	.56	.53	.50	.48	.46	.45	.43
11	1.29	1.16	1.04	.95	.88	.82	.76	.70	.66	.62	.59	.56	.53	.51	.48	.46	.44	.42	.41
12	1.17	1.06	.97	.88	.82	.76	.71	.66	.62	.59	.56	.53	.50	.48	.46	.44	.42	.40	.39
13	1.08	.99	.91	.83	.77	.72	.67	.62	.59	.56	.53	.50	.48	.46	.44	.42	.40	.38	.37
14	1.01	.93	.85	.79	.73	.68	.63	.59	.56	.53	.50	.48	.45	.43	.42	.40	.38	.37	.35
15	.94	.86	.79	.74	.68	.64	.59	.56	.53	.50	.47	.45	.43	.41	.39	.38	.36	.35	.34
16	.88	.81	.75	.69	.65	.60	.56	.53	.50	.48	.45	.43	.41	.39	.37	.36	.34	.33	.32
17	.82	.76	.71	.66	.61	.57	.54	.50	.48	.45	.43	.41	.39	.37	.36	.34	.33	.32	.31
18	–	.72	.68	.63	.58	.55	.51	.48	.46	.43	.41	.39	.37	.35	.34	.33	.31	.30	.29
19	–	.69	.64	.60	.56	.53	.49	.46	.44	.41	.39	.37	.36	.34	.33	.31	.30	.29	.28
20	–	.66	.61	.57	.54	.51	.47	.44	.42	.40	.37	.36	.34	.33	.31	.30	.29	.28	.27
21	–	.62	.59	.55	.52	.49	.46	.43	.41	.38	.36	.34	.33	.31	.30	.29	.28	.27	.26
22	–	.60	.57	.53	.50	.47	.44	.41	.39	.37	.35	.33	.32	.30	.29	.28	.27	.26	.25
23	–	.58	.55	.51	.48	.46	.43	.40	.38	.36	.34	.32	.31	.30	.28	.27	.26	.25	.24
24	–	.56	.52	.49	.46	.44	.41	.39	.37	.35	.33	.31	.30	.29	.27	.26	.25	.24	.23
25	–	.54	.51	.48	.45	.42	.40	.37	.36	.34	.32	.31	.29	.28	.27	.26	.25	.24	.23

68 W.B.

Approach °F.	RANGE																		
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
4	–	2.42	2.10	1.87	1.68	1.49	1.35	1.25	1.16	1.06	.98	.91	.85	.80	.76	.72	.69	.66	.62
5	2.43	2.03	1.78	1.59	1.42	1.29	1.18	1.08	1.01	.94	.87	.82	.77	.72	.69	.65	.62	.59	.56
6	2.10	1.78	1.59	1.41	1.28	1.15	1.07	.98	.91	.85	.80	.75	.71	.67	.63	.60	.57	.55	.52
7	1.85	1.61	1.42	1.27	1.16	1.05	.96	.89	.83	.78	.73	.69	.65	.62	.59	.56	.53	.51	.49
8	1.68	1.46	1.29	1.16	1.05	.96	.89	.82	.77	.73	.68	.64	.61	.58	.55	.52	.50	.48	.46
9	1.49	1.31	1.17	1.06	.97	.89	.82	.76	.72	.68	.64	.60	.57	.54	.52	.49	.47	.46	.44
10	1.34	1.20	1.08	.98	.90	.83	.77	.72	.68	.64	.60	.57	.54	.51	.49	.47	.45	.43	.41
11	1.22	1.10	.99	.91	.84	.78	.72	.67	.63	.60	.56	.54	.51	.49	.46	.44	.43	.41	.39
12	1.11	1.01	.92	.84	.78	.73	.67	.63	.60	.56	.53	.51	.48	.46	.44	.42	.40	.39	.37
13	1.03	.94	.86	.80	.74	.68	.64	.60	.57	.53	.50	.48	.46	.44	.42	.40	.38	.37	.36
14	.96	.88	.81	.75	.69	.65	.60	.57	.54	.51	.48	.45	.43	.41	.40	.38	.36	.35	.34
15	.89	.82	.75	.70	.65	.61	.57	.53	.50	.48	.45	.43	.41	.39	.37	.36	.35	.33	.32
16	.83	.77	.71	.67	.62	.58	.54	.50	.48	.45	.43	.41	.39	.37	.36	.34	.33	.32	.31
17	–	.73	.68	.64	.59	.55	.52	.48	.46	.43	.41	.39	.37	.35	.34	.33	.31	.30	.29
18	–	.69	.65	.60	.56	.53	.49	.46	.44	.41	.39	.37	.35	.34	.32	.31	.30	.29	.28
19	–	.66	.61	.58	.54	.51	.48	.44	.42	.40	.37	.36	.34	.32	.31	.30	.29	.28	.27
20	–	.63	.59	.55	.52	.49	.46	.43	.40	.38	.36	.34	.33	.31	.30	.29	.28	.27	.26
21	–	.60	.56	.53	.50	.47	.44	.41	.39	.37	.35	.33	.32	.30	.29	.28	.27	.26	.25
22	–	.58	.54	.51	.48	.45	.42	.40	.38	.36	.34	.32	.31	.29	.28	.27	.26	.25	.24
23	–	.56	.52	.49	.46	.43	.41	.38	.37	.35	.33	.31	.30	.28	.27	.26	.25	.24	.23
24	–	.53	.50	.47	.45	.42	.40	.37	.35	.34	.32	.30	.29	.28	.27	.25	.25	.23	.22
25	–	.51	.48	.46	.43	.41	.38	.36	.34	.33	031	.29	.28	.27	.26	.25	.24	.23	.22

70 W.B.

Approach °F.	RANGE																		
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
4	2.72	2.31	1.98	1.76	1.58	1.42	1.30	1.20	1.11	1.02	.94	.87	.83	.77	.73	.70	.66	.63	.60
5	2.35	1.93	1.70	1.52	1.36	1.23	1.13	1.04	.96	.90	.84	.79	.74	.69	.66	.63	.60	.57	.54
6	2.02	1.71	1.51	1.34	1.22	1.11	1.03	.93	.87	.81	.76	.71	.67	.64	.61	.58	.55	.52	.50
7	1.78	1.55	1.36	1.22	1.11	1.01	.92	.86	.80	.75	.70	.66	.63	.60	.57	.54	.51	.49	.47
8	1.59	1.39	1.23	1.11	1.01	.92	.85	.79	.75	.70	.65	.62	.59	.56	.53	.51	.48	.46	.45
9	1.44	1.26	1.13	1.02	.93	.86	.80	.74	.69	.65	.62	.58	.55	.52	.50	.48	.46	.44	.42
10	1.28	1.15	1.03	.94	.87	.80	.74	.69	.65	.61	.58	.54	.52	.49	.47	.45	.43	.41	.40
11	1.17	1.05	.95	.87	.80	.74	.69	.64	.61	.57	.54	.51	.49	.47	.45	.43	.41	.39	.38
12	1.06	.97	.88	.81	.75	.69	.65	.60	.57	.54	.51	.48	.46	.44	.42	.40	.39	.37	.36
13	.99	.90	.82	.76	.70	.65	.61	.57	.54	.51	.48	.46	.44	.42	.40	.38	.37	.35	.34
14	.92	.84	.77	.72	.66	.62	.58	.54	.51	.48	.46	.43	.41	.39	.38	.36	.35	.34	.33
15	.85	.78	.73	.67	.62	.58	.54	.51	.48	.45	.43	.41	.39	.37	.36	.34	.33	.32	.31
16	–	.74	.69	.64	.59	.55	.52	.49	.46	.43	.41	.39	.37	.35	.34	.33	.31	.30	.29
17	–	.70	.65	.61	.57	.53	.50	.46	.44	.41	.39	.37	.35	.34	.32	.31	.30	.29	.28
18	–	.67	.62	.58	.54	.51	.48	.45	.42	.40	.37	.36	.34	.32	.31	.30	.29	.28	.27
19	–	.63	.59	.55	.52	.49	.46	.43	.40	.38	.36	.34	.33	.31	.30	.29	.28	.27	.26
20	–	.60	.57	.53	.50	.47	.44	.41	.39	.37	.35	.33	.32	.30	.29	.28	.26	.26	.25
21	–	.58	.54	.51	.48	.45	.42	.40	.37	.35	.34	.32	.30	.29	.28	.27	.26	.25	.24
22	–	.56	.52	.49	.46	.43	.41	.38	.36	.34	.33	.31	.30	.28	.27	.26	.25	.24	.23
23	–	.53	.50	.47	.44	.42	.39	.37	.35	.33	.32	.30	.29	.27	.26	.25	.24	.23	.22
24	–	.51	.48	.45	.43	.40	.38	.36	.34	.32	.31	.29	.28	.27	.26	.25	.24	.23	.22
25	–	–	.46	.44	.41	.39	.37	.34	.33	.31	.30	.28	.27	.26	.25	.24	.23	.22	.21

Shaded areas of tables indicate entering water temperature exceeding maximum 130˚F.
Consult factory for alternate high temperature fill options.

Application Factors

72 W.B.

Approach °F.	RANGE																		
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
4	2.64	2.20	1.91	1.69	1.50	1.36	1.24	1.15	1.07	.99	.91	.85	.80	.75	.71	.68	.64	.61	.58
5	2.24	1.86	1.64	1.46	1.31	1.19	1.09	1.00	.93	.87	.81	.76	.72	.68	.64	.61	.58	.55	.53
6	1.93	1.65	1.45	1.29	1.17	1.07	.97	.90	.84	.78	.73	.69	.66	.62	.59	.56	.54	.51	.49
7	1.70	1.47	1.29	1.16	1.06	.96	.88	.82	.77	.72	.67	.63	.60	.58	.55	.52	.50	.48	.46
8	1.52	1.32	1.17	1.06	.96	.89	.82	.76	.71	.67	.63	.60	.56	.54	.51	.49	.47	.45	.44
9	1.35	1.19	1.07	.98	.89	.82	.76	.71	.66	.62	.59	.56	.53	.50	.48	.46	.44	.42	.41
10	1.22	1.09	.98	.90	.83	.76	.71	.66	.62	.58	.55	.52	.50	.47	.45	.43	.42	.40	.38
11	1.11	1.00	.91	.83	.77	.71	.66	.61	.58	.55	.52	.49	.47	.45	043	.41	.39	.38	.36
12	1.02	.92	.84	.78	.71	.66	.62	.58	.55	.51	.49	.46	.44	.42	.40	.39	.37	.36	.35
13	.94	.85	.78	.72	.67	.62	.58	.54	.51	.48	.46	.44	.42	.40	.38	.37	.35	.34	.33
14	.88	.80	.74	.68	.63	.59	.55	.51	.49	.46	.43	.41	.39	.38	.36	.35	.33	.32	.31
15	.81	.75	.69	.65	.60	.56	.52	.49	.46	.43	.41	.39	.37	.36	.34	.33	.32	.31	.30
16	–	.71	.66	.61	.57	.53	.50	.47	.44	.41	.39	.37	.36	.34	.33	.31	.30	.29	.28
17	–	.67	.62	.58	.54	.51	.48	.45	.42	.40	.37	.36	.34	.32	.31	.30	.29	.28	.27
18	–	.64	.59	.56	.52	.49	.46	.43	.40	.38	.36	.34	.33	.31	.30	.29	.28	.27	.26
19	–	.61	.57	.53	.50	.47	.44	.41	.39	.37	.35	.33	.32	.30	.29	.28	.26	.26	.25
20	–	.58	.55	.51	.48	.45	.42	.39	.37	.35	.33	.32	.30	.29	.28	.27	.25	.25	.24
21	–	.56	.52	.49	.46	.43	.41	.38	.36	.34	.32	.31	.29	.28	.27	.26	.25	.24	.23
22	–	.53	.50	.47	.44	.42	.39	.37	.35	.33	.31	.30	.29	.27	.26	.25	.24	.23	.22
23	–	.51	.48	.45	.42	.40	.38	.35	.34	.32	.31	.29	.28	.26	.25	.24	.23	.22	.22
24	–	–	.46	.43	.41	.38	.36	.34	.33	.31	.29	.28	.27	.26	.25	.24	.23	.22	.21
25	–	–	.44	.42	.39	.37	.35	.33	.31	.30	.29	.27	.26	.25	.24	.23	.22	.21	.21

74 W.B.

Approach °F.	RANGE																		
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
4	2.48	2.05	1.79	1.59	1.41	1.28	1.17	1.08	1.00	.93	.87	.81	.76	.72	.68	.65	.61	.59	.56
5	2.09	1.77	1.56	1.38	1.24	1.13	1.05	.95	.88	.83	.77	.73	.68	.65	.62	.59	.56	.53	.51
6	1.81	1.57	1.38	1.23	1.11	1.02	.93	.86	.81	.75	.71	.67	.63	.60	.57	.54	.52	.49	.47
7	1.62	1.40	1.23	1.11	1.01	.92	.85	.79	.74	.69	.65	.61	.58	.55	.53	.50	.48	.46	.44
8	1.42	1.25	1.11	1.01	.92	.85	.78	.73	.69	.64	.61	.57	.54	.52	.49	.47	.45	.43	.42
9	1.27	1.13	1.02	.93	.85	.79	.73	.68	.64	.60	.57	.54	.51	.49	.46	.44	.43	.41	.39
10	1.15	1.03	.94	.85	.79	.73	.68	.63	.59	.56	.53	.50	.48	.46	.44	.42	.40	.39	.37
11	1.05	.95	.87	.80	.73	.68	.63	.59	.56	.53	.50	.47	.45	.43	.41	.39	.38	.36	.35
12	.97	.88	.80	.74	.68	.63	.59	.55	.52	.49	.47	.44	.42	.40	.39	.37	.36	.34	.33
13	.90	.81	.75	.69	.64	.59	.55	.52	.49	.46	.44	.42	.40	.38	.36	.35	.34	.32	.31
14	.83	.76	.71	.66	.60	.56	.53	.49	.47	.44	.41	.39	.38	.36	.34	.33	.32	.31	.30
15	–	.71	.67	.62	.57	.54	.50	.47	.44	.42	.39	.37	.36	.34	.33	.31	.30	.29	.28
16	–	.68	.63	.59	.55	.51	.48	.45	.42	.40	.38	.36	.34	.33	.31	.30	.29	.28	.27
17	–	.64	.60	.56	.52	.49	.46	.43	.41	.38	.36	.34	.33	.31	.30	.29	.28	.27	.26
18	–	.61	.57	.54	.50	.47	.44	.41	.39	.37	.35	.33	.32	.30	.29	.28	.26	.26	.25
19	–	.58	.55	.51	.48	.45	.42	.39	.37	.35	.34	.32	.30	.29	.28	.27	.25	.25	.24
20	–	.56	.52	.49	.46	.43	.41	.38	.36	.34	.32	.31	.29	.28	.27	.26	.25	.24	.23
21	–	.53	.50	.47	.44	.42	.39	.37	.35	.33	.31	.30	.28	.27	.26	.25	.24	.23	.22
22	–	.51	.48	.45	.42	.40	.38	.35	.34	.32	.30	.29	.28	.26	.25	.24	.23	.22	.22
23	–	–	.46	.43	.41	.38	.36	.34	.32	.31	.29	.28	.27	.25	.24	.23	.23	.22	.21
24	–	–	.44	.41	.39	.37	.35	.33	.31	.30	.28	.27	.26	.25	.24	.23	.22	.21	.20
25	–	–	.42	.40	.37	.36	.34	.32	.30	.29	.27	.26	.25	.24	.23	.22	.21	.21	.20

76 W.B.

Approach °F.	RANGE																		
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
4	2.35	1.94	1.70	1.50	1.34	1.22	1.12	1.02	.95	.88	.82	.77	.73	.68	.65	.62	.59	.56	.53
5	1.97	1.68	1.48	1.31	1.18	1.08	.98	.90	.84	.79	.74	.69	.66	.62	.59	.56	.53	.51	.49
6	1.72	1.48	1.30	1.17	1.06	.96	.88	.82	.77	.72	.67	.63	.60	.57	.54	.52	.49	.47	.45
7	1.52	1.32	1.17	1.06	.96	.88	.81	.75	.71	.66	.62	.59	.56	.53	.51	.48	.46	.45	.43
8	1.34	1.18	1.06	.96	.88	.81	.75	.70	.65	.61	.58	.55	.52	.49	.47	.45	.43	.42	.40
9	1.20	1.07	.97	.88	.81	.75	.69	.64	.61	.57	.54	.51	.49	.46	.44	.42	.41	.39	.38
10	1.09	.98	.89	.82	.75	.70	.64	.60	.57	.54	.51	.48	.46	.44	.42	.40	.38	.37	.36
11	1.00	.91	.82	.76	.70	.65	.60	.56	.53	.50	.47	.45	.43	.41	.39	.38	.36	.35	.34
12	.92	.83	.77	.71	.65	.61	.56	.53	.50	.47	.44	.42	.40	.38	.37	.35	.34	.33	.32
13	.85	.77	.72	.66	.61	.57	.53	.50	.47	.44	.42	.40	.38	.36	.35	.33	.32	.31	.30
14	–	.73	.68	.63	.58	.54	.51	.47	.45	.42	.40	.38	.36	.34	.33	.32	.30	.29	.28
15	–	.69	.64	.59	.55	.52	.48	.45	.42	.40	.38	.36	.34	.33	.31	.30	.29	.28	.27
16	–	.65	.60	.56	.52	.49	.46	.43	.41	.38	.36	.34	.33	.31	.30	.29	.27	.27	.26
17	–	.62	.58	.54	.50	.47	.44	.41	.39	.37	.35	.33	.31	.30	.29	.28	.26	.25	.25
18	–	.59	.55	.52	.48	.45	.42	.39	.37	.35	.33	.32	.30	.29	.28	.26	.25	.24	.23
19	–	.56	.53	.49	.46	.43	.41	.38	.36	.34	.32	.31	.29	.28	.27	.26	.25	.24	.23
20	–	.54	.50	.47	.44	.41	.39	.36	.35	.33	.31	.30	.28	.27	.26	.25	.24	.23	.22
21	–	.51	.48	.45	.42	.40	.37	.35	.33	.32	.30	.29	.27	.26	.25	.24	.23	.22	.21
22	–	–	.46	.43	.41	.38	.36	.34	.32	.31	.29	.28	.26	.25	.24	.23	.22	.22	.21
23	–	–	.44	.41	.39	.36	.35	.32	.31	.29	.28	.27	.26	.24	.24	.23	.22	.21	.20
24	–	–	.42	.40	.37	.35	.33	.31	.30	.28	.27	.26	.25	.24	.23	.22	.21	.20	.20
25	–	–	.40	.38	.36	.34	.32	.30	.29	.27	.26	.25	.24	.23	.22	.21	.20	.20	.19

Shaded areas of tables indicate entering water temperature exceeding maximum 130˚F.
Consult factory for alternate high temperature fill options.

78 W.B.

Approach °F.	RANGE																		
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
4	2.18	1.82	1.60	1.41	1.27	1.15	1.06	.96	.89	.83	.78	.73	.69	.65	.62	.59	.56	.53	.51
5	1.87	1.60	1.40	1.24	1.12	1.02	.93	.86	.81	.75	.70	.66	.63	.60	.57	.54	.51	.49	.47
6	1.63	1.41	1.24	1.11	1.00	.92	.84	.78	.73	.69	.64	.61	.58	.55	.52	.50	.48	.46	.44
7	1.43	1.25	1.11	1.00	.91	.84	.77	.72	.67	.63	.59	.56	.53	.51	.48	.46	.44	.43	.41
8	1.26	1.12	1.00	.91	.83	.77	.71	.66	.62	.58	.55	.52	.50	.47	.45	.43	.42	.40	.38
9	1.13	1.02	.92	.84	.77	.71	.66	.61	.58	.54	.51	.49	.46	.44	.42	.41	.39	.38	.36
10	1.03	.93	.85	.78	.71	.66	.61	.57	.54	.51	.48	.46	.43	.41	.40	.38	.37	.35	.34
11	.95	.85	.78	.72	.67	.62	.57	.54	.50	.48	.45	.43	.41	.39	.37	.36	.34	.33	.32
12	.88	.80	.73	.68	.62	.58	.54	.50	.48	.45	.42	.40	.38	.37	.35	.34	.32	.31	.30
13	.81	.74	.69	.64	.59	.55	.51	.48	.45	.42	.40	.38	.36	.35	.33	.32	.31	.30	.29
14	–	.70	.65	.60	.56	.52	.49	.45	.43	.40	.38	.36	.34	.33	.31	.30	.29	.28	.27
15	–	.66	.61	.57	.53	.50	.46	.43	.41	.38	.36	.34	.33	.31	.30	.29	.28	.27	.26
16	–	.62	.58	.54	.51	.47	.44	.41	.39	.37	.35	.33	.31	.30	.29	.28	.26	.26	.25
17	–	.59	.55	.52	.48	.45	.42	.40	.37	.35	.33	.32	.30	.29	.28	.27	.25	.25	.24
18	–	.56	.53	.50	.46	.43	.41	.38	.36	.34	.32	.31	.29	.28	.27	.26	.25	.24	.23
19	–	.54	.50	.47	.44	.41	.39	.36	.35	.33	.31	.30	.28	.27	.26	.25	.24	.23	.22
20	–	.51	.48	.45	.42	.40	.37	.35	.33	.31	.30	.29	.27	.26	.25	.24	.23	.22	.21
21	–	–	.46	.43	.41	.38	.36	.34	.32	.30	.29	.28	.26	.25	.24	.23	.22	.22	.21
22	–	–	.44	.41	.39	.36	.35	.32	.31	.29	.28	.27	.25	.24	.23	.22	.22	.21	.20
23	–	–	.42	.39	.37	.35	.33	.31	.30	.28	.27	.26	.25	.24	.23	.22	.21	.20	.20
24	–	–	.40	.38	.36	.34	.32	.30	.29	.27	.26	.25	.24	.23	.22	.21	.20	.20	.19
25	–	–	.38	.36	.34	.32	.30	.29	.28	.26	.25	.24	.23	.22	.21	.20	.20	.19	.18

80 W.B.

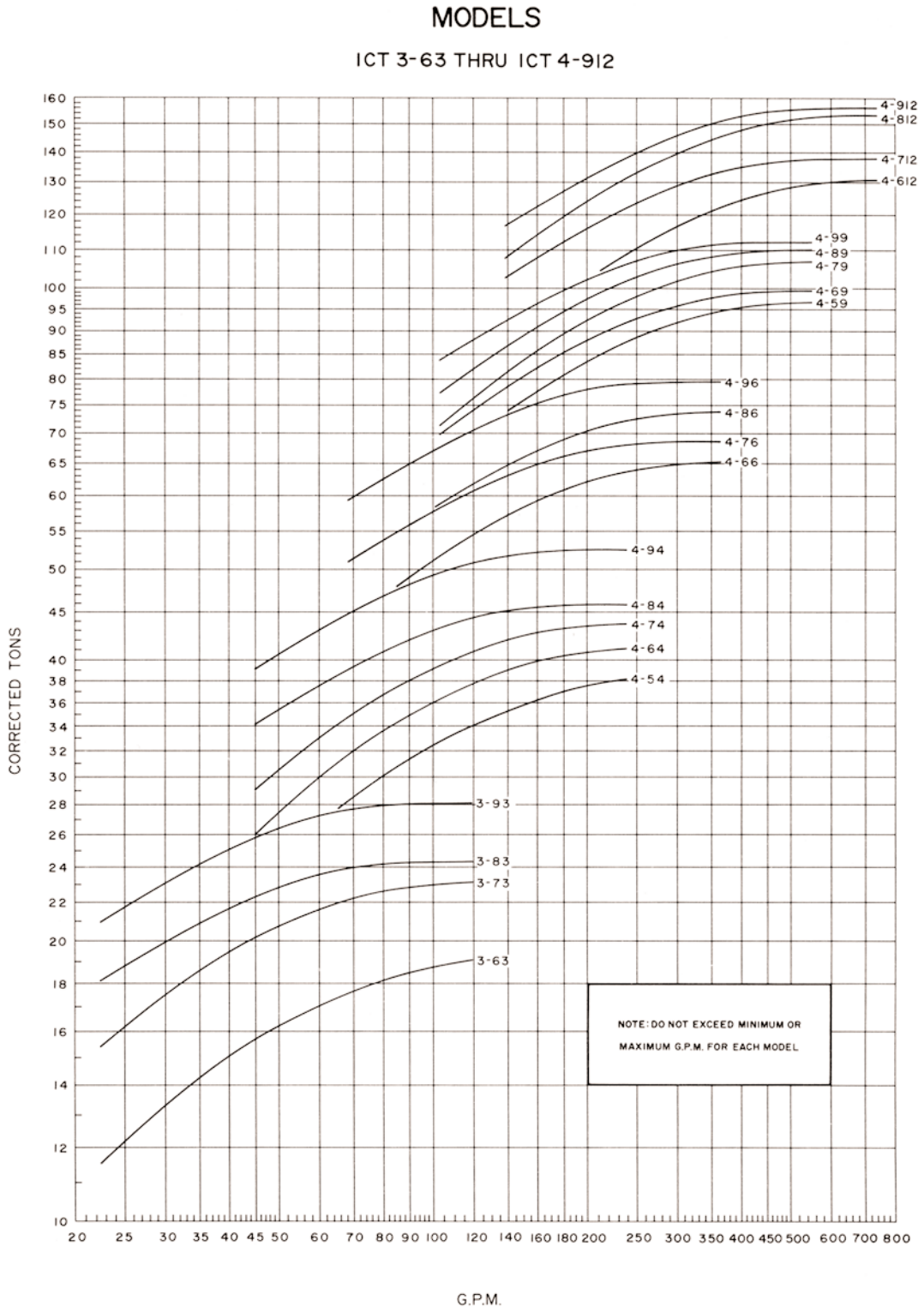
Approach °F.	RANGE																		
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
4	2.08	1.75	1.54	1.35	1.22	1.10	1.01	.92	.85	.80	.75	.70	.66	.63	.60	.57	.54	.51	.49
5	1.79	1.54	1.33	1.19	1.07	.97	.89	.82	.77	.72	.67	.63	.60	.57	.54	.52	.49	.47	.45
6	1.57	1.34	1.18	1.07	.96	.88	.81	.75	.70	.66	.62	.58	.55	.53	.50	.48	.46	.44	.43
7	1.37	1.19	1.06	.96	.87	.80	.74	.68	.64	.60	.57	.54	.51	.49	.47	.44	.43	.41	.39
8	1.20	1.06	.96	.87	.80	.73	.68	.63	.59	.56	.53	.50	.47	.45	.43	.41	.40	.38	.37
9	1.08	.97	.87	.80	.73	.68	.63	.58	.55	.52	.49	.46	.44	.42	.40	.39	.37	.36	.35
10	1.00	.90	.81	.75	.68	.63	.59	.55	.52	.48	.46	.43	.41	.39	.38	.36	.35	.34	.33
11	.91	.82	.75	.69	.64	.59	.54	.51	.48	.45	.42	.40	.39	.37	.35	.34	.33	.32	.31
12	.83	.76	.70	.65	.59	.55	.52	.48	.45	.43	.40	.38	.36	.35	.33	.32	.31	.30	.29
13	–	.71	.66	.61	.56	.52	.49	.45	.43	.40	.38	.36	.34	.33	.31	.30	.29	.28	.27
14	–	.67	.62	.57	.53	.50	.47	.43	.41	.38	.36	.34	.33	.31	.30	.29	.28	.27	.26
15	–	.63	.59	.54	.51	.48	.44	.41	.39	.37	.35	.33	.31	.30	.29	.27	.26	.25	.25
16	–	.60	.56	.52	.49	.45	.42	.39	.37	.35	.33	.32	.30	.29	.28	.26	.25	.24	.24
17	–	.57	.53	.50	.46	.43	.41	.38	.36	.34	.32	.30	.29	.28	.27	.26	.25	.24	.23
18	–	.55	.51	.48	.44	.41	.39	.36	.34	.33	.31	.29	.28	.27	.26	.25	.24	.23	.22
19	–	.52	.48	.45	.42	.40	.37	.35	.33	.31	.30	.28	.27	.26	.25	.24	.23	.22	.21
20	–	–	.46	.43	.41	.38	.36	.34	.32	.30	.29	.27	.26	.25	.24	.23	.22	.22	.21
21	–	–	.44	.41	.39	.36	.34	.32	.31	.29	.28	.26	.25	.24	.23	.22	.21	.21	.20
22	–	–	.42	.40	.37	.35	.33	.31	.30	.28	.27	.25	.24	.23	.22	.22	.21	.20	.19
23	–	–	.40	.38	.36	.34	.32	.30	.30	.27	.26	.25	.24	.23	.22	.21	.20	.19	.19
24	–	–	.38	.36	.34	.32	.30	.29	.27	.26	.25	.24	.23	.22	.21	.20	.19	.19	.18
25	–	–	.36	.35	.33	.31	.29	.28	.26	.25	.24	.23	.22	.21	.20	.19	.19	.18	.18

82 W.B.

Approach °F.	RANGE																		
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
4	1.98	1.67	1.46	1.29	1.16	1.06	.95	.88	.82	.77	.72	.67	.64	.60	.57	.55	.52	.50	.48
5	1.71	1.46	1.27	1.14	1.03	.93	.86	.79	.74	.69	.65	.61	.58	.55	.52	.50	.48	.46	.44
6	1.49	1.28	1.13	1.02	.92	.84	.78	.72	.68	.63	.59	.56	.53	.50	.48	.46	.44	.43	.41
7	1.30	1.13	1.01	.91	.83	.77	.71	.66	.61	.58	.55	.52	.49	.47	.45	.43	.41	.39	.38
8	1.14	1.01	.91	.83	.76	.70	.65	.60	.57	.53	.50	.48	.45	.43	.41	.40	.38	.37	.36
9	1.03	.92	.83	.76	.70	.64	.60	.56	.52	.49	.47	.44	.42	.40	.38	.37	.35	.34	.33
10	.94	.85	.77	.71	.65	.60	.56	.52	.49	.46	.43	.41	.39	.37	.36	.35	.33	.32	.31
11	.86	.78	.71	.66	.60	.56	.52	.49	.46	.43	.41	.38	.37	.35	.34	.32	.31	.30	.29
12	–	.73	.67	.62	.57	.53	.49	.46	.43	.41	.38	.36	.35	.33	.32	.30	.29	.28	.27
13	–	.68	.62	.58	.54	.50	.47	.44	.41	.39	.36	.34	.33	.31	.30	.29	.28	.27	.26
14	–	.64	.59	.55	.51	.48	.45	.42	.39	.37	.35	.33	.32	.30	.29	.28	.26	.26	.25
15	–	.60	.56	.53	.49	.46	.43	.40	.37	.35	.33	.32	.30	.29	.28	.26	.25	.24	.24
16	–	.58	.54	.50	.47	.44	.41	.38	.37	.34	.32	.31	.29	.28	.27	.26	.25	.23	.23
17	–	.55	.51	.48	.45	.42	.39	.36	.35	.33	.31	.29	.28	.27	.26	.25	.24	.23	.22
18	–	.52	.49	.46	.43	.40	.37	.35	.33	.31	.30	.28	.27	.26	.25	.24	.23	.22	.21
19	–	–	.46	.43	.41	.38	.36	.34	.32	.30	.29	.27	.26	.25	.24	.23	.22	.21	.21
20	–	–	.44	.42	.39	.36	.34	.32	.31	.29	.28	.26	.25	.24	.23	.22	.21	.21	.20
21	–	–	.42	.40	.37	.35	.33	.31	.29	.28	.27	.25	.24	.23	.22	.21	.21	.20	.19
22	–	–	.40	.38	.36	.34	.32	.30	.28	.27	.26	.24	.23	.22	.22	.21	.20	.19	.19
23	–	–	.38	.36	.34	.32	.30	.29	.27	.26	.25	.24	.22	.22	.21	.20	.19	.19	.18
24	–	–	.37	.35	.33	.31	.29	.27	.26	.25	.24	.22	.22	.21	.20	.19	.19	.18	.18
25	–	–	–	.33	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

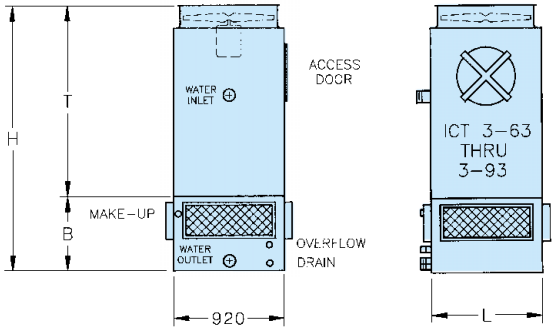
Shaded areas of tables indicate entering water temperature exceeding maximum 130˚F.
Consult factory for alternate high temperature fill options.

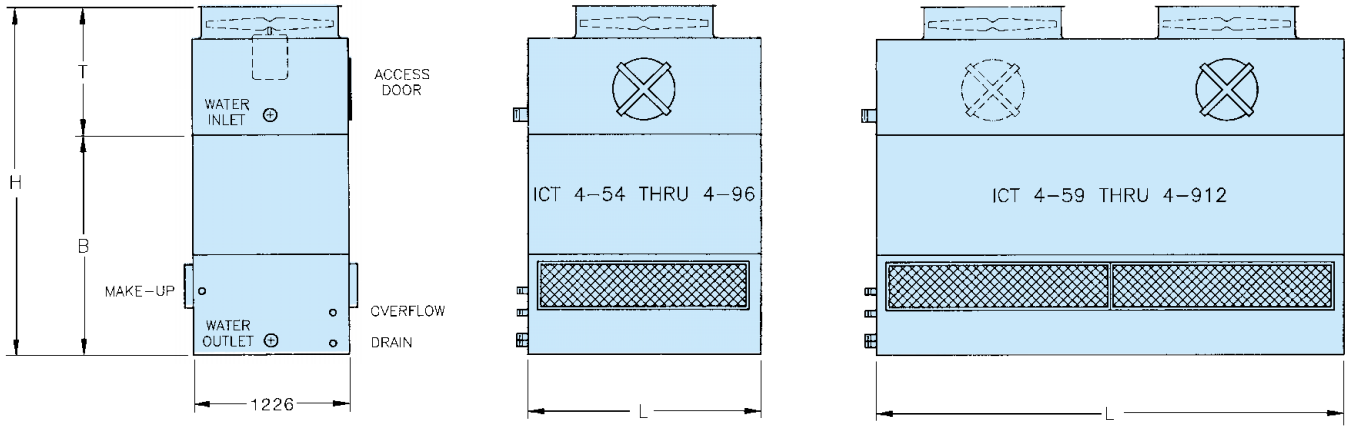
Capacity Curve



Engineering Dimensions & Data

Models
ICT 3-63 to 4-912





MODEL NO.	WEIGHTS (LBS)			Fan Motor (HP)	Air Flow (CFM)	DIMENSIONS				CONNECTIONS				
	Shipping	Operating	Heaviest Section			H	B	T	L	Water In	Water Out	Make Up	Drain	Over-Flow
ICT 3-63	520	880	520*	1	4,900	6' 2"	2' 1/2"	4' 1 1/2"	3'	3"	3"	1"	2"	2"
3-73	560	920	560*	1	4,800	7' 2"	2' 1/2"	5' 1 1/2"	3'	3"	3"	1"	2"	2"
3-83	650	970	390	1	4,700	8' 2"	2' 1/2"	6' 1 1/2"	3'	3"	3"	1"	2"	2"
3-93	670	990	410	1 1/2	5,400	8' 2"	2' 1/2"	6' 1 1/2"	3'	3"	3"	1"	2"	2"
ICT 4-54	710	1,510	710*	2	9,200	7' 7"	4' 3 1/4"	3' 3 3/4"	3' 11 7/8"	4"	4"	1"	2"	2"
4-64	820	1,570	500	2	9,100	8' 7"	5' 3 1/4"	3' 3 3/4"	3' 11 7/8"	4"	4"	1"	2"	2"
4-74	840	1,590	530	2	9,000	8' 7"	5' 3 1/4"	3' 3 3/4"	3' 11 7/8"	4"	4"	1"	2"	2"
4-84	920	1,670	600	2	8,900	9' 7"	6' 3 1/4"	3' 3 3/4"	3' 11 7/8"	4"	4"	1"	2"	2"
4-94	970	1,720	600	3	10,100	9' 7"	6' 3 1/4"	3' 3 3/4"	3' 11 7/8"	4"	4"	1"	2"	2"
ICT 4-66	1,270	2,390	770	3	13,400	8' 7"	5' 3 1/4"	3' 3 3/4"	5' 11 7/8"	4"	4"	1"	2"	2"
4-76	1,380	2,500	880	3	13,200	9' 7"	6' 3 1/4"	3' 3 3/4"	5' 11 7/8"	4"	4"	1"	2"	2"
4-86	1,310	2,430	770	5	15,800	8' 7"	5' 3 1/4"	3' 3 3/4"	5' 11 7/8"	4"	4"	1"	2"	2"
4-96	1,420	2,550	880	5	15,500	9' 7"	6' 3 1/4"	3' 3 3/4"	5' 11 7/8"	4"	4"	1"	2"	2"
ICT 4-59	1,880	3,510	1,090	(2)2	19,700	8' 7"	5' 3 1/4"	3' 3 3/4"	8' 11 1/2"	4"	4"	1"	2"	2"
4-69	1,990	3,620	1,200	(2)2	19,600	9' 7"	6' 3 1/4"	3' 3 3/4"	8' 11 1/2"	4"	4"	1"	2"	2"
4-79	1,930	3,560	1,090	(2)3	22,300	8' 7"	5' 3 1/4"	3' 3 3/4"	8' 11 1/2"	4"	4"	1"	2"	2"
4-89	2,040	3,670	1,200	(2)3	22,100	9' 7"	6' 3 1/4"	3' 3 3/4"	8' 11 1/2"	4"	4"	1"	2"	2"
4-99	2,090	3,720	1,250	(2)3	21,900	9' 7"	6' 3 1/4"	3' 3 3/4"	8' 11 1/2"	4"	4"	1"	2"	2"
ICT4-612	2,490	4,630	1,470	(2)3	27,000	8' 7"	5' 3 1/4"	3' 3 3/4"	11' 11 3/4"	6"	6"	1"	2"	2"
4-712	2,590	4,730	1,570	(2)3	26,600	9' 7"	6' 3 1/4"	3' 3 3/4"	11' 11 3/4"	6"	6"	1"	2"	2"
4-812	2,640	4,780	1,550	(2)5	31,600	9' 7"	6' 3 1/4"	3' 3 3/4"	11' 11 3/4"	6"	6"	1"	2"	2"
4-912	2,770	4,910	1,670	(2)5	31,300	9' 7"	6' 3 1/4"	3' 3 3/4"	11' 11 3/4"	6"	6"	1"	2"	2"

NOTE: (1) An adequately sized bleed line must be installed in the cooling tower system to prevent build-up of impurities in the recirculated water.
(2) Overall unit height and connection locations may change slightly on units with FRP construction – See EVAPCO certified prints for exact dimensions.
(3) Do not use catalog drawings for certified prints, dimensions subject to change.
* Units ship in one piece.

Optional Equipment

Vibration Isolators

The fans on EVAPCO cooling towers are balanced and run virtually vibration free. Therefore, vibration isolation is generally not required; however, in those cases where it is determined that vibration isolation is necessary, spring type vibration isolator rails can be furnished. The rails are constructed of heavy gauge **G-235** hot dip galvanized steel for superior corrosion resistance.

Rails are designed to be mounted between the cooling tower and the supporting framework. They are 90% efficient and have approximately 1" static deflection. Rails are designed for wind loading up to 50 mph.

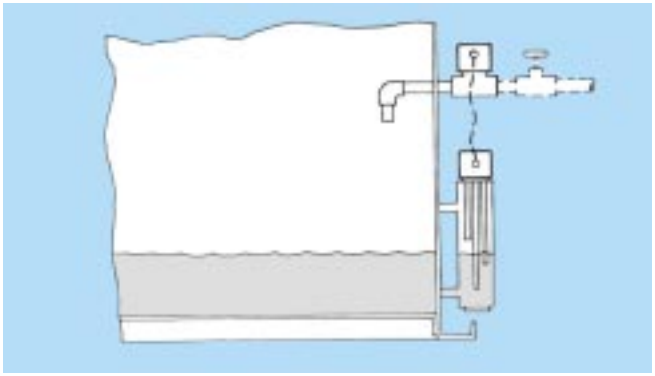
It is important to note that vibration isolation must be installed continuously along the full length of the tower on both sides of the unit. Point isolators may be used between the supporting steel and the building framework, but not between the unit and the supporting steel.

Electric Water Level Control

EVAPCO cooling towers are available with an optional electric water level control system in place of the standard mechanical makeup valve and float assembly. This package provides very accurate control for the basin water level and does not require field adjustment, even under widely variable operating conditions.

The control was designed by EVAPCO and is manufactured exclusively for EVAPCO. It consists of multiple heavy duty stainless steel electrodes. These electrodes are mounted external to the unit in a vertical stand pipe. For winter operation, the stand pipe must be wrapped with electric heating cable and insulated to protect it from freeze up.

The weather protected slow closing solenoid valve(s) for the makeup water connection is factory supplied and is ready for piping to a water supply with a pressure between 25 and 50 psig.



ELECTRIC WATER LEVEL CONTROL

Pan Freeze Protection

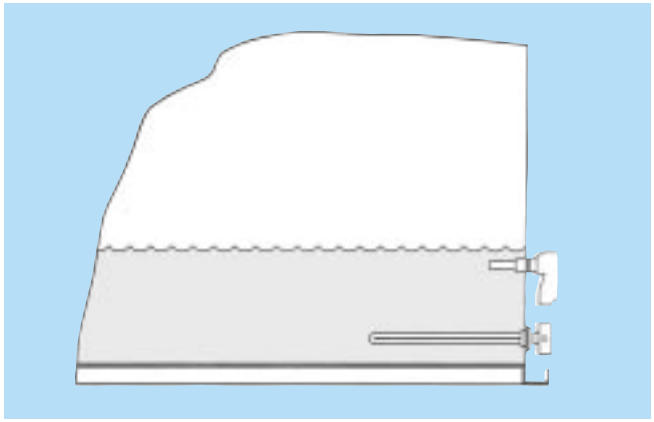
REMOTE SUMP

Whenever a cooling tower is idle during sub-freezing weather, the water in the basin must be protected from freezing and damaging the pan. The simplest and most reliable method of accomplishing this is with a remote sump tank located in a heated space in the building under the tower. With this system, the water in the tower drains to the indoor tank whenever the pump is shut off. When a tower is ordered for remote sump operation, the standard float valve and strainer are eliminated, and the unit is provided with an oversized water out connection.

If a remote sump cannot be used, pan heaters are available, either steam, hot water or electric type to keep the pan water from freezing when the unit is shut down. Water lines to and from the unit must also be wrapped with electric heating cable and insulated to protect them from freeze-up.

ELECTRIC HEATERS

Electric immersion heaters are available factory installed in the basin of the tower. They are sized to maintain a +40°F pan water temperature with the fans off. They are furnished with a combination thermostat / low water protection device to cycle the heater on when required and to prevent the heater elements from energizing unless they are completely submerged. All components are in weather proof enclosures for outdoor use. The heater power contactors and electric wiring are not included as standard.



BASIN HEATER

Electric Basin Heater Sizes

Model No.	KW*	Model No.	KW*
ICT 3-63 to 3-93	1	ICT 4-59 to 4-99	4
4-54 to 4-94	2	4-612 to 4-912	5
4-66 to 4-96	3		

* Electric heater selection based on 0°F ambient temperature.
For alternate low ambient heater selections, consult factory.

Application

System Design

EVAPCO units are of heavy-duty construction, designed for long life and trouble-free operation. However, proper equipment selection, installation and maintenance is necessary to ensure good unit performance. Some of the major considerations in the application of a cooling tower are presented as follows. For additional information, contact your local EVAPCO representative.

Air Circulation

It is important that a means for proper air circulation be provided. The best location is on an unobstructed roof top or on ground level away from walls and other barriers. Those cooling towers located in wells, enclosures or adjacent to high walls must be properly located to avoid the problems associated with recirculation. Recirculation raises the wet bulb temperature of the entering air causing the water temperatures to rise above design. For these cases, the discharge of the fan should be located at a height even with the adjacent wall, thereby reducing the chance of recirculation. **For additional information, see the EVAPCO Equipment Layout Manual, Bulletin 311.**

Maintaining the Recirculated Water System

Heat removal in a cooling tower is accomplished by the evaporation of a portion of the recirculated spray water. As a general rule, a cooling tower evaporates 3 US GPM per 100 tons of cooling capacity. As this water evaporates, it leaves behind all of its mineral content and impurities. Therefore, it is important to bleed-off an amount of water equal to that which is evaporated to prevent the buildup of impurities. If this is not done, the mineral content in the water will continue to increase until it starts to deposit out in the unit, causing heavy scaling. A bleed line should be installed in the piping, external to the unit. The bleed line must be properly sized for the application and provided with a metering connection and globe valve.

Water Treatment

In some cases the make-up water will be so high in mineral content that a normal bleed-off will not prevent scaling. In this case water treatment will be required and a reputable water treatment company familiar with the local water conditions should be consulted.

Any chemical water treatment used must be compatible with the galvanized construction of the unit. If acid is used for treatment, it should be accurately metered and the concentration properly controlled. The pH of the water should be maintained between 6.5 and 8.3. Batch chemical feeding is not recommended because it does not afford the proper degree of control. If acid cleaning is required extreme caution must be exercised and only inhibited acids recommended for use with galvanized construction should be used. **Refer to Maintenance Instructions Bulletin 112 for more information.**

Capacity Control

The design wet bulb for which the cooling tower is sized occurs only a small percentage of the time. Unless colder water temperatures are beneficial to the process being cooled, some form of capacity control will be needed. A common control practice is to cycle the fans off when the leaving water is below the minimum allowable temperature. However this does not provide close control of the leaving water temperature.

Another method is to use two-speed fan motors which add a second step of control. Two-speed motors are an excellent method of capacity control for the ICT as well as for any cooling tower. This arrangement gives capacity steps of 10% (fans off), 60% (fans half-speed) and 100%. A temperature controller can be supplied to set control at 5˚ increments, so fairly close temperature control can be maintained without excessive cycling of the fan motor.

Two-speed motors also save operating costs. At half-speed the motor draws approximately 15% of full load power. Since maximum wet bulb and maximum load very seldom coincide on air conditioning systems, the cooling tower will actually operate at half speed about 80% of the time. Thus, power costs will be reduced approximately 85% during the major portion of the operating season.

A third advantage of two-speed motors is that noise levels are reduced approximately 6dB when operating at half speed. Since both the load and wet bulb are normally lower at night, the tower will operate at low speed and the noise level will be substantially reduced during this noise sensitive period.

On units with more than one fan motor, each individual fan motor can be cycled on and off at different temperatures for capacity control. Or, fan cycling combined with two-speed motors can be used for more steps of control and greater power savings. This arrangement is simple, trouble-free and an inexpensive method of capacity control.

Piping

Cooling tower piping should be designed and installed in accordance with generally accepted engineering practice. All piping should be anchored by properly designed hangers and supports with allowance made for possible expansion and contraction. No external loads should be placed upon cooling tower connections, nor should any of the pipe supports be anchored to the unit framework.

Control of Biological Contamination

Water quality should be checked regularly for biological contamination. If biological contamination is detected, a more aggressive water treatment and mechanical cleaning program should be undertaken. The water treatment program should be performed in conjunction with a qualified water treatment company. It is important that all internal surfaces be kept clean of accumulated dirt and sludge.

Cooling Tower Specifications

Furnish and install as shown on the plans an EVAPCO Model _____ induced draft counterflow cooling tower. Each unit shall have the capacity to cool _____ GPM of water from _____ ˚F to _____ ˚F with a _____ ˚F entering wet bulb temperature.

Pan and Casing

The pan and casing shall be constructed of heavy gauge **G-235** hot-dip galvanized steel for long life and durability. Standard pan accessories shall include overflow, drain, anti-vortexing hood, Type 304 stainless steel strainers, and brass make-up valve with plastic float.

Fan Motor(s)

_____ HP totally enclosed motors with 1.15 service factor shall be furnished suitable for service on _____ volts, _____ hertz, and _____ phase.

Drive

The fan drive shall be mounted on the motor in a direct drive configuration.

Axial Propeller Fans

Fans shall be heavy duty axial propeller type statically balanced. The fans shall be constructed of aluminum alloy blades installed in a closely fitted cowl with venturi air inlet. Fan cowl shall be covered with a galvanized steel fan guard.

Fan Drive Warranty

Cooling tower fan drive components shall be covered by a three year manufacturer's warranty plan. Drive components protected by this warranty shall include the fan and fan motors.

Fill

The cooling tower fill shall be PVC of cross-fluted design for optimum heat transfer efficiency. The cross-fluted sheets shall be bonded together for strength and durability. The PVC fill shall be self-extinguishing for fire resistance with a flame spread rating of 5 per ASTM E84-81a. It shall also be resistant to rot, decay and biological attack.

Louvers

The louvers shall be constructed of PVC and shall be easily removable for access to the basin for maintenance. The louvers shall have a minimum of two changes in air direction to prevent splashout and block direct sunlight.

Water Distribution System

The spray header shall be constructed of Schedule 40 PVC pipe for corrosion resistance and shall have a threaded connection to attach the external piping. The spray header shall be removable for cleaning purposes. The water shall be distributed over the fill by precision molded ABS spray nozzles with large 3/8 by 1 inch orifice openings to eliminate clogging. The nozzles shall be threaded into the distribution piping to assure positive positioning.

Eliminators

The eliminators shall be constructed entirely of inert PVC in easily handled sections. The eliminator design shall incorporate three changes in air direction to assure complete removal of all entrained moisture from the discharge air stream. Maximum drift rate shall be .001% or less of the circulating water rate.

Finish

All pan and casing materials shall be constructed of **G-235** heavy gauge mill hot-dip galvanized steel. During fabrication, all panel edges shall be coated with a 95% pure zinc-rich compound.

Optional Materials of Construction –

- **Type 304 Stainless Steel Cold Water Basin Available on Models ICT 3-63 to 4-912**
  The entire cold water basin area shall be constructed of Type 304 stainless steel. Pan accessories shall include overflow, drain, Type 304 stainless steel anti-vortexing hood and strainer assembly, and brass make-up valve with plastic float.
- **Stainless Steel Basin with Fiberglass Casing Available on Models ICT 4-54 to 4-912**
  Fan support, interior steel components, and pan shall be Type 304 stainless steel. The casing shall be constructed of UV resistant non-corrosive Fiberglass-Reinforced Polyester (FRP). The fan cowl shall also be constructed of FRP. All FRP components shall be of high grade isophthalic polyester resin and gel coated. FRP shall also be UV resistant and color impregnated.

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