Cooling Towers in Parallel

Whenever cooling towers are to be installed in parallel with common supply and return piping, special consideration should be given to the piping design to ensure balanced water flow through each tower. Otherwise, unequal water levels could develop in the tower basins, which, in the extreme, could cause one tower to overflow while air is being drawn through the other into the circulating pump.

Design Considerations

To avoid unequal water levels, BAC recommends the following on multiple tower installations:

1. The towers should be installed with the overflow levels at the same elevation. Set the system operating level so the minimum operating level is maintained in each unit. Refer to **Tables 1-6** on **pages J153 to J156** for the operating and overflow levels for all current BAC factory-assembled cooling towers. For previous generation cooling tower operating and overflow levels, contact your local BAC Representative. Note that the location of the overflow connection on the unit and the elevation of the actual overflow level are often different. If a situation exists where the towers cannot be adjusted so the overflow levels are at the same elevation, contact your local BAC Representative for assistance.

2. Keep the supply and return piping as symmetrical as possible to obtain balanced flows through each tower.

3. Install manual valves at the inlets and outlets of each tower for final adjustment of water flow and to serve as shut-off valves when isolating one tower for service. Whenever the inlet valves are closed, close the outlet valves. If automatic valves are used on the inlets, use automatic valves on the outlets and operate both inlet and outlet valves simultaneously. Please contact your local BAC Representative if water flow will vary through the cooling towers as a result of multiple pump operation.

4. Install equalizing lines, with shut-off valves, between tower basins to correct any differences in basin water levels that may develop during operation due to dirty strainers, valve position changes, etc.

Equalizers

The purpose of an equalizer is not to correct unbalanced flows due to piping design. This should be accomplished with balancing valves. Equalizers serve to correct any difference in water levels that may develop during operation.

While exact rules for sizing equalizer lines do not exist, BAC's experience indicates they should be selected to pass 15% of the flow rate of the largest tower when a water level differential of 1" (0.083 ft head) exists between the two cold water basins. In other words, at a flow rate equal to 15% of the design flow rate of the larger tower, the total friction loss in the equalizer lines, including entrance and exit losses should be equal to or less than 0.083 ft H2O = 0.036 psi.

Listed in **Table 7** on page **J156** are the typical equalizer sizes for two towers placed 10 to 20 ft apart. In developing this table, allowance has been made for a gate or butterfly valve in the line plus a typical number of fittings. The flow rate to be used with the table is the design flow rate of the larger tower.

Table 8 on **page J157** lists, by product, the maximum connection sizes that can be installed at the specified location. These maximums must be adhered to since they represent the largest fitting that can be physically accommodated in this unit.

Table 1. VTL Basin Water Levels and Volumes

Model Number	Operating Height			Overflow Height		
	Above Basin Bottom (in)	Above Unit Base (in)	Operating Volume (gal)	Above Basin Bottom (in)	Above Unit Base (in)	Overflow Volume (gal)
VTL-016-E to VTL-039-H	5 1/2	7 1/8	38	10	11 5/8	72
VTL-045-H to VTL-079-K	5 1/2	7 1/8	76	10	11 5/8	146
VTL-082-K to VTL-095-K	5 1/2	7 1/8	114	10	11 5/8	215
VTL-103-K to VTL-137-M	5 1/2	7 1/8	153	10	11 5/8	287
VTL-152-M to VTL-227-O	5 1/2	7 1/8	230	10	11 5/8	432
VTL-245-P to VTL-272-P	5 1/2	7 1/8	308	10	11 5/8	574

Table 2. VT0 and VT1 Basin Water Levels and Volumes

Model Number	Operating Height			Overflow Height		
	Above Basin Bottom (in)	Above Unit Base (in)	Operating Volume (gal)	Above Basin Bottom (in)	Above Unit Base (in)	Overflow Volume (gal)
VT0 12-E to VT0-28-H	12 7/8	20 3/8	11	19 1/8	26 1/8	26
VT0 32-H to VT0-57-K	12 7/8	20 3/8	24	19 1/8	26 1/8	55
VT0 65-J to VT0-88-L	12 7/8	20 3/8	37	19 1/8	26 1/8	85
VT0 102-L to VT0-116-M	12 7/8	20 3/8	50	19 1/8	26 1/8	114
VT0 132-L to VT0-176-O	15 1/2	30 7/8	72	22 1/2	36 3/4	153
VT1-N209-P to VT1-N255-P	17	22 5/8	212	31	36 5/8	488
VT1-N301-Q to VT1-N395-R	17	22 5/8	322	31	36 5/8	742
VT1-N418-P to VT1-N510-P	17	22 5/8	431	31	36 5/8	994
VT1-M316-O to VT1-M420-R	18	23 3/4	367	26 1/4	32	595
VT1-M431-N to VT1-M610-P	18	23 3/4	559	26 1/4	32	905
VT1-M632-O to VT1-M840-R	18	23 3/4	734	26 1/4	32	1,190
VT1-M948-O to VT1-M1260-R	18	23 3/4	1101	26 1/4	32	1,785
VT1-275-P to VT1-415-R	14	19 5/8	474	24 1/2	30 1/8	900
VT1-416-O to VT1-600-P	14	19 5/8	720	24 1/2	30 1/8	1,367
VT1-550-P to VT1-830-R	14	19 5/8	965	24 1/2	30 1/8	1,832
VT1-825-P to VT1-1335-S	14	19 5/8	1,455	24 1/2	30 1/8	2,764

Table 3. Series 3000 and Series 5000 Basin Water Levels and Volumes

Model Number	Operating Height			Overflow Height		
	Above Basin Bottom (in)	Above Unit Base (in)	Operating Volume (gal)	Above Basin Bottom (in)	Above Unit Base (in)	Overflow Volume (gal)
S3E/XES3E-8518-05x	8 3/4	10 3/4	404	14 1/8	16 1/8	857
S3E/XES3E-8518-06x	8 3/4	10 3/4	404	14 7/8	16 7/8	921
S3E/XES3E-8518-07x S5E-8518-07x	8 3/4	10 3/4	404	17 1/2	19 1/2	1,149
S3E/XES3E-1020-06x	8 3/4	10 3/4	500	14 3/4	16 3/4	1,152
S3E/XES3E-1020-07x S5E-1020-07x	8 3/4	10 3/4	500	25 1/2	17 1/2	1,236
S3E/XES3E-1222-06x	8 3/4	10 3/4	639	14 5/8	16 5/8	1,474
S3E/XES3E-1222-07x S5E-1222-07x	8 3/4	10 3/4	639	15 1/4	17 1/4	1,564
S3E/XES3E-1222-10x	9 3/4	11 3/4	745	20 1/8	22 1/8	2,182
S3E/XES3E-1222-12x	9 3/4	11 3/4	745	21 5/8	23 5/8	2,400
S3E/XES3E-1222-13x	9 3/4	11 3/4	745	22	24	2,455
S3E/XES3E-1222-14x S5E-1222-14x	9 3/4	11 3/4	745	22	24	2,455
S3E/XES3E-1424-07x S5E-1424-07x	9 3/4	11 3/4	989	16	18	2,165
S3E/XES3E-1424-12x	9 3/4	11 3/4	946	19 5/8	21 5/8	2,742
S3E/XES3E-1424-13x	9 3/4	11 3/4	946	20 1/4	22 1/4	2,860
S3E/XES3E-1424-14x S5E-1424-14x	9 3/4	11 3/4	946	21	23	3,004

Table 4. FXT Basin Water Levels and Volumes

Model Number	Operating Height			Overflow Height		
	Above Basin Bottom (in)	Above Unit Base (in)	Operating Volume (gal)	Above Basin Bottom (in)	Above Unit Base (in)	Overflow Volume (gal)
FXT-58, 68	6	9 5/8	55	14	17 5/8	197
FXT-74, 87, 95	6	9 5/8	82	14	17 5/8	273
FXT-115, 130, 136	6	9 5/8	126	14	17 5/8	420
FXT-160, 175, 192	6	9 5/8	168	14	17 5/8	558
FXT-216, 240, 257	6	9 5/8	168	16	19 5/8	666

Table **5.** Series 1500 Basin Water Levels and Volumes

Model Number	Operating Height			Overflow Height		
	Above Basin Bottom (in)	Above Unit Base (in)	Operating Volume (gal)	Above Basin Bottom (in)	Above Unit Base (in)	Overflow Volume (gal)
S15E/XE15E-1285-06x	7	9	200	13 1/2	15 1/2	575
S15E/XE15E-1285-07x	7	9	200	14	16	604
S15E/XE15E-1285-09x	7	9	200	16	18	719
S15E/XE15E-1285-10x	7	9	200	17	19	777
S15E/XE15E-1212-07x	7	9	282	15	17	943
S15E/XE15E-1212-09x	7	9	282	16 1/4	18 3/4	1,046
S15E/XE15E-1212-10x	7	9	282	16 3/4	18 3/4	1,087
S15E/XE15E-1212-11x	7	9	282	17 1/2	19 1/2	1,149
S15E/XE15E-1212-12x	7	9	282	17 1/2	19 1/2	1,149
S15E/XE15E-1218-07x	9	17	685	16 3/4	24 3/4	1,655
S15E/XE15E-1218-09x	9	17	685	18	26	1,812
S15E/XE15E-1218-10x	9	17	685	18 3/4	26 3/4	1,906
S15E/XE15E-1218-11x	9	17	685	19	27	1,937
S15E/XE15E-1218-12x	9	17	685	19 1/2	27 1/2	2,000

Table 6. PT2 Basin Water Levels and Volumes

Model Number	Operating Height			Overflow Height		
	Interior Basin Bottom (in)	Exterior Unit Base (in)	Operating Volume (gal)	Interior Basin Bottom (in)	Exterior Unit Base (in)	Overflow Volume (gal)
PT2-0412A	6 5/8	8 5/8	175	10 1/2	12 1/2	275
PT2-0709A	6 5/8	8 5/8	150	10 1/2	12 1/2	295
PT2-0809A	6 5/8	8 5/8	175	10 1/2	12 1/2	342
PT2-1009A	6 5/8	8 5/8	192	10 1/2	12 1/2	390
PT2-0812A	6 5/8	8 5/8	235	10 1/2	12 1/2	460
PT2-1012A	6 5/8	8 5/8	260	10 1/2	12 1/2	525
PT2-1212A	6 5/8	8 5/8	256	10 1/2	12 1/2	578
PT2-1218A	8 1/2	15	615	11 3/4	18	1,080
PT2-0814A	6 5/8	8 5/8	267	11	13	567

Table 7. Equalizer Connection Sizes

Flow to Tower (USGPM)	Equalizer Size (IPS)[1]
Up to 120	3
121-240	4
241-630	6
631-1,170	8
1,171-1,925	10
1,936-2,820	12
2,821-3,465	14
2,336-3,850	(2) 10 or (1) 16
3,851-5,640	(2) 12 or (1) 18
5,641-6,930	(2) 14 or (1) 20
6,931-7,560	(3) 12 or (2) 16 or (1) 20

NOTE:

1. Schedule 40 for 3” - 10”, Standard Weight for 12” and above.

CAUTION:

Where bottom connections are employed, care must be taken to ensure that the supporting steel does not interfere with the proposed connection.

Table 8. Maximum Allowable Equalizer Connection Sizes and Locations

Type of Unit	End of Connection[1] (in)	Back Connection[2] (in)	Bottom Connection[3] (in)
Low Profile and Series V			
VTL-016-E to VTL-272-P	6	-	10
VT0-12-E to VT0-116-M	4	6	-
VT0-132-L to VT0-176-O	6	8	-
VT1-N209-P to VT1-N510-P	12	12	-
VT1-M316-O to VT1-M1260-R	14	14	20
VT1-275-P to VT1-1335-S	14	14	20
Series 3000 and Series 5000			
S3E/XES3E-8518 to S3E/XES3E-1424 and S5E	14	14	14
Series 1500			
S15E/XES15E-1285	10	10	10
S15E/XES15E-1212	12	12	12
S15E/XES15E-1218	14	14	14
FXT			
FXT-58 to FXT-95	6	-	6
FXT-115 to FXT-257	8	-	8
PT2			
PT2-0412	-	-	-
PT2-0709, PT2-0809, PT2-0812, PT2-0814	12	12	14
PT2-1009, PT2-1012, PT2-1212, PT2-1218	12	12	14

NOTES:

1. End equalizer connections on the Series V (VTL, VT0, VT1) and Series 3000 Cooling Towers must be located on end of tower opposite the suction connection. The low operating level of VTL and Series 1500 Cooling Towers may restrict the use of the end equalizer connection. Consult your local BAC Representative for applications requiring end equalizers on these products. PT2 end equalizer connections are defined as Face A/B.
2. PT2 Cooling Towers have a “side” connection which is defined as Face C.
3. Bottom connections for 8” through 20” will be a bolt circle for 150# standard flange and 6” and smaller will be MPT. On model VTL Cooling Towers, all bottom connections will be a bolt circle for 150# flanges.

Sample Problem

Given: A S3E-8518-06M tower cooling 975 USGPM from 95°F (35°C) to 85°F (29.4°C) at 78°F (25.6°C) entering wet bulb is to be installed in parallel with an existing FXT-240 tower cooling 750 USGPM from 95°F (35°C) to 85°F (29.4°C) at 78°F (25.6°C) entering wet bulb. The cooling towers will be arranged side-by-side as shown below:

Find: What size equalizer line should be used and where should it be connected to the towers? Also, what is the proper elevation for the towers?

NOTE:

Figures 1-4 are NOT to scale.

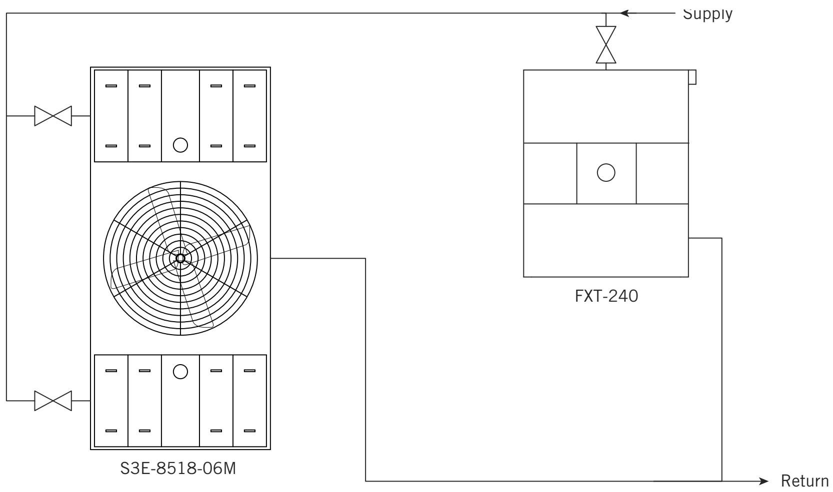

Figure 1. Sample Problem; Plan View

Solution

1. The larger flow rate is 975 USGPM. From **Table 7**, find an 8” equalizer is satisfactory for tower flow rates of 631 USGPM to 1,170 USGPM.

2. From **Table 8**, an 8” equalizer connection can be located either on the ends or on the bottom of both units. With towers situated side-by-side, it is more convenient to locate the equalizer connections on the ends of both towers, as shown in **Figure 2**.

3. From **Table 3** the overflow level for the S3E-8518-06M is 16 7/8” above the exterior base of the unit. The operating level is 10 3/4” above the exterior base of the unit. **Table 4** shows the overflow level of the FXT-240 is 19 5/8” above the exterior base of the unit. Its operating level is 9 5/8” above the exterior base of the unit. In order to have the overflow level at the same elevation, the S3E-8518-06M must be installed 2 7/8” above the base of the FXT-240.

4. To set the operating levels, raise the float ball on the make-up valve arrangement in the FXT-240 by 8” to obtain a 17 5/8” operating level. This setting will maintain the 14 3/4” minimum operating level required for the model S3E-8518-06M. This is illustrated in **Figures 3** and **4**. Adjust the float balls to ensure the make-up valves operate evenly. Note, adjusting the valves may cause one valve to operate excessively while the other remains closed.

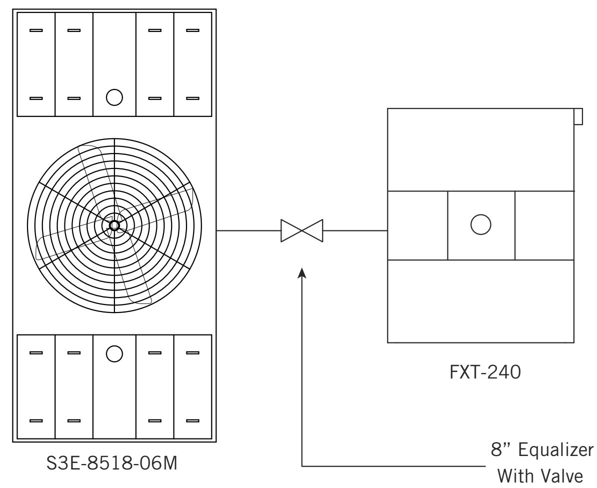

Figure 2. Sample Problem; Equalizer Connection Plan View

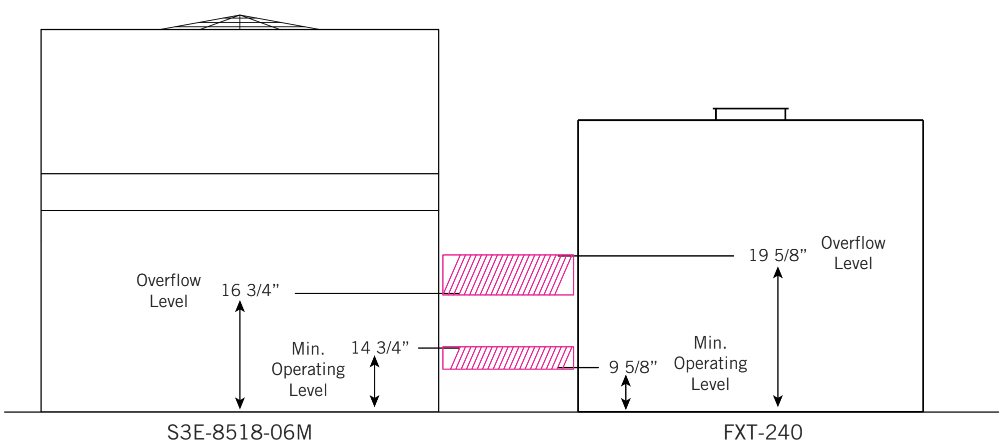

Figure 3. Sample Problem; Side View

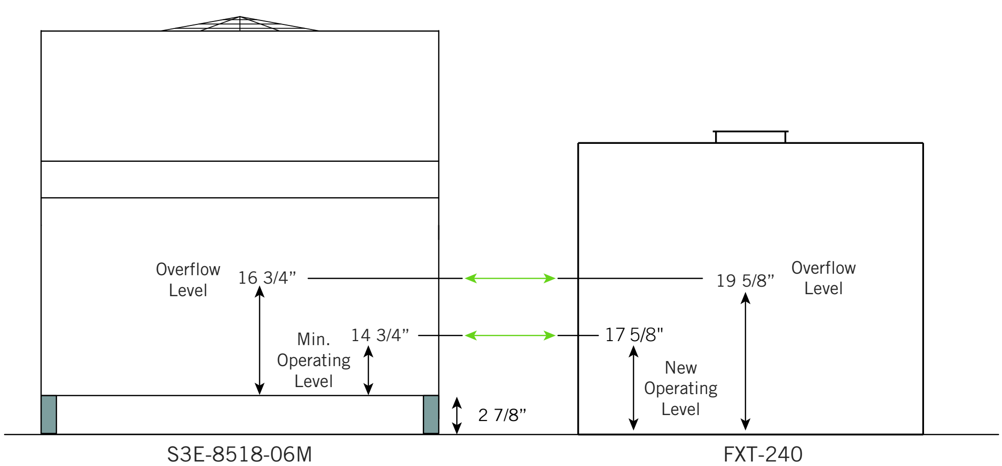

Figure 4. Sample Problem; Side View (Elevated)