SYSTEM WATER VOLUME GUIDE

FOR

AERMEC UNIT

CHAPTER-1

1.1 MINIMUM WATER CONTENT (SYSTEM VOLUME) REQUIREMENT

Like any other unit, AERMEC unit uses water or glycol water to store energy. Water is used as a thermal storage to store cooling or heating capacity which the AERMEC unit produces.

If the water content is too low the machine will show low or high pressure alarm (depending on the application) and compressor will be turned OFF prematurely. This frequent ON-OFF or cycling is not efficient and can wear out the compressor as well. Therefore, there is a minimum system volume required for proper operation of the unit.

1.2 EFFECTIVE SYSTEM VOLUME

Depending on the system configuration and operation of equipment a portion or the entire water volume of a system can be useful to the AERMEC unit which will be known as “Effective System Volume”. In all cases:

EFFECTIVE SYSTEM VOLUME MUST BE ≥ REQUIRED MINIMUM WATER CONTENT FOR AERMEC UNIT

1.3 MINIMUM WATER REQUIREMENT FOR AERMEC UNITS

Minimum water requirement for AERMEC units varies depending on models and capacity of the unit.

The values mentioned in the following Tables are minimum requirement and higher volumes are recommended. Minimum water requirement are applicable for cooling loop, heating loop and heat recovery loop and must be maintained at all load conditions.

IMPORTANT: In case of Heat Pump, when outside temperature falls and building heating load becomes larger than the AERMEC unit capacity, the backup boiler must be triggered to prevent excessive temperature drop across the AERMEC unit.

Table-1: ANK UNITS

UNIT	CAPACITY		UNIT WITH STORAGE TANK	FORMULA FOR MINIMUM WATER CONTENT REQUIREMENT (GAL/TON)	MINIMUM WATER CONTENT REQUIRED FOR UNIT WITHOUT HYDRONIC KIT (USG)		MINIMUM WATER CONTENT REQUIRED FOR UNIT WITH INTERNAL STORAGE TANK (USG)	
	Cooling Capacity (Ton)	Heating Capacity (BTU/H)	Storage Tank Capacity (USG)		Cooling Mode	Heating Mode	Cooling Mode	Heating Mode
ANK030	2.51	37670	26	9.3	23	29	0	3
ANK045	3.35	51967	26	9.3	31	40	5	14
ANK050	4.02	57598	26	9.3	37	45	11	19

Table-2: NRL UNITS

UNIT	CAPACITY			UNIT WITH STORAGE TANK AND PUMP	FORMULA FOR MINIMUM WATER CONTENT REQUIREMENT (GAL/TON)		MINIMUM WATER CONTENT REQUIRED FOR STANDARD UNIT (USG)						MINIMUM WATER CONTENT REQUIRED FOR UNIT WITH INTERNAL STORAGE TANK AND PUMP (USG)			
	Cooling Capacity (T)	Heating Capacity (BTU/H)	Total Heat Recovery Capacity (BTU/H)	Storage Tank Capacity (USG)			Cooling Mode		Heating Mode		Total Heat Recovery Side		Cooling Mode		Heating Mode	
					(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
NRL0280HE	13.05	165967	199951	79	6.5	13	80	165	85	175	107	215	5	90	10	100
NRL0300HE	15.44	196710	226225	79	6.5	13	95	196	101	208	121	244	16	116	22	128
NRL0330HE	17.54	220561	265465	79	6.5	13	108	222	114	233	143	286	29	143	34	154
NRL0350HE	22.15	267341	342579	79	6.5	13	138	282	138	283	183	369	58	202	59	204
NRL0500HA	24.85	310778	370900	132	4.7	9.3	110	224	115	234	143	285	0	92	0	102
NRL0550HA	28.95	358582	436413	132	4.7	9.3	129	262	133	270	169	336	0	129	1	138
NRL0600HA	35.15	430885	529223	132	3.7	7.5	122	256	125	261	161	329	0	121	0	126
NRL0650HA	40.78	481999	603949	132	3.7	7.5	148	303	146	299	183	375	18	173	16	169
NRL0700HA	45.13	549901	676286	132	3.7	7.5	156	328	159	333	204	418	24	195	27	201
NRL0750HA	49.56	600571	720986	185	3.7	7.5	173	361	174	365	217	446	0	176	0	180
NRL0800HA	54.3	666703	774897	185	3.7	7.5	196	402	200	411	234	480	2	209	7	218
NRL0900HA	61.91	786738	901147	185	3.7	7.5	224	459	237	486	272	558	31	266	44	293
NRL1000HA	70.91	886417	1058446	185	3.7	7.5	254	524	265	546	320	655	61	331	72	353
NRL1250HA	91.94	1119532	1352914	185	3.7	7.5	332	682	337	692	410	838	139	488	144	499
NRL1400HA	98.72	1214852	1470292	185	3.7	7.5	357	732	367	751	445	910	164	539	173	558
NRL1500HA	106.01	1311794	1583916	185	3.7	7.5	382	785	394	809	479	981	188	591	201	616
NRL1650HA	113.34	1528820	1768172	185	3.7	7.5	409	839	461	945	535	1095	216	646	268	752
NRL1800HA	123.05	1701840	1952086	185	3.7	7.5	445	912	514	1053	591	1209	251	719	321	860
NRL2000HA	141.55	1771379	2117234	370	3.7	7.5	511	1048	533	1094	640	1311	125	663	147	708
NRL2250HA	162.53	2004292	2411702	370	3.7	7.5	586	1203	602	1237	731	1495	200	818	217	851
NRL2500HA	183.52	2237205	2706170	370	3.7	7.5	661	1358	671	1380	820	1677	275	972	286	994
NRL2800HA	197.05	2427670	2940925	370	3.7	7.5	713	1462	733	1501	890	1821	325	1074	344	1113
NRL3000HA	211.16	2621412	3168174	370	3.7	7.5	763	1565	790	1620	958	1962	377	1180	404	1234
NRL3300HA	226.24	3055095	3536685	370	3.7	7.5	819	1678	924	1891	1070	2190	433	1293	538	1505
NRL3600HA	245.62	3401018	3904172	370	3.7	7.5	888	1821	1028	2105	1181	2417	502	1435	642	1719

(1) For building space heating and cooling application. (2) Process application/ cooling application at low outside temperature/low load/Regulation on LWT/AERMEC unit is acting as a source for another heat pump.

Table-3: NRP UNITS

UNIT	CAPACITY	FORMULA FOR MINIMUM WATER CONTENT REQUIREMENT (GAL/TON)	MINIMUM WATER CONTENT REQUIRED FOR UNIT WITHOUT HYDRONIC KIT (USG)

	Cooling Capacity (Ton)	Heating Capacity (BTU/H)	Cooling Side		Heating Side		Cooling Side		Heating Side	
			(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
NRP0280	12.32	184010	6.5	13	9.3	13	76	156	138	195
NRP0300	14.13	213353	6.5	13	9.3	13	88	179	161	227
NRP0330	16.21	242695	6.5	13	9.3	13	101	206	184	258
NRP0350	20.29	304776	6.5	13	9.3	13	127	258	231	325
NRP0500	22.73	328258	6.5	13	9.3	13	141	289	248	349
NRP0550	26.73	381646	6.5	13	9.3	13	166	340	289	406
NRP0600	32.65	479474	6.5	13	9.3	13	205	417	364	512
NRP0650	37.03	536314	6.5	13	9.3	13	233	474	408	573
NRP0700	41.16	590505	6.5	13	9.3	13	259	526	449	631
NRP0750	44.93	660103	6.5	13	9.3	13	282	574	502	705
NRP0800	51.71	738278	6.5	13	6.5	13	333	670	397	797
NRP0900	58.45	830351	6.5	13	6.5	13	377	757	447	897
NRP1000	65.31	928369	6.5	13	6.5	13	421	845	499	1002
NRP1250	82.72	1178567	6.5	13	6.5	13	532	1070	633	1271
NRP1400	94.63	1338583	6.5	13	6.5	13	610	1225	720	1445
NRP1500	106.64	1498599	6.5	13	6.5	13	688	1381	806	1618
NRP1650	113.01	1594589	6.5	13	6.5	13	728	1463	857	1721
NRP1800	120.35	1689276	6.5	13	6.5	13	776	1558	908	1823

(1) For building space heating and cooling application.

(2) Process application/cooling application at low outside temperature/low load/Regulation on LWT/AERMEC unit is acting as a source for another heat pump.

Table-4: WRL UNITS

UNIT	CAPACITY		FORMULA FOR MINIMUM WATER CONTENT REQUIREMENT (GAL/TON)		MINIMUM WATER CONTENT REQUIRED FOR STANDARD UNIT (USG)			
	Cooling Capacity (Ton)	Heating Capacity (BTU/H)			Cooling Mode		Heating Mode	
			(1)	(2)	(1)	(2)	(1)	(2)
WRL200	12.26	198652	6.5	13	73	153	101	209
WRL400	20.64	267625	6.5	13	128	262	138	283
WRL500	26.86	344456	6.5	13	166	341	178	365

(1) For building space heating and cooling application. (2) Process application/cooling application at low outside temperature/low load/Regulation on LWT/AERMEC unit is acting as a source for another heat pump.

Table-5: NXW UNITS

UNIT	Capacity			FORMULA FOR MINIMUM WATER CONTENT REQUIREMENT (GAL/TON)		MINIMUM WATER CONTENT REQUIRED FOR STANDARD UNIT (USG)					
	Cooling Capacity (Ton)	Heating Capacity (BTU/H)	Total Heat Recovery Capacity (BTU/H)			Cooling Mode		Heating Mode		Total Heat Recovery Side	
				(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
NXW0500	31.88	388700	426900	4.7	9.3	147	293	149	298	167	331
NXW0550	34.83	422800	464500	4.7	9.3	161	321	162	324	182	360
NXW0600	37.53	453900	495200	3.7	7.5	135	278	136	280	153	310
NXW0650	42.59	517800	563500	3.7	7.5	154	316	156	320	174	352
NXW0700	48.2	584400	631800	3.7	7.5	174	357	176	361	195	395
NXW0750	53.94	656100	720600	3.7	7.5	192	397	194	402	222	450
NXW0800	62.36	773900	850400	3.7	7.5	223	460	231	476	262	532
NXW0900	73.11	888000	959700	3.7	7.5	259	536	262	543	296	600
NXW1000	82.66	995600	1079200	3.7	7.5	293	607	294	609	333	675
NXW1250	91.79	1121200	1226100	3.7	7.5	326	675	333	688	378	766
NXW1400	103.08	1254400	1376400	3.7	7.5	365	757	371	768	424	860

(1) For building space heating and cooling application. (2) Process application/cooling application at low outside temperature/low load/Regulation on LWT/AERMEC unit is acting as a source for another heat pump.

Table-6: NXP UNITS

UNIT	CAPACITY		FORMULA FOR MINIMUM WATER CONTENT REQUIREMENT (GAL/TON)		MINIMUM WATER CONTENT REQUIRED FOR STANDARD UNIT (USG)			
	Cooling Capacity (Ton)	Heating Capacity (BTU/H)			Cooling Side		Heating Side	
			(1)	(2)	(1)	(2)	(1)	(2)
NXP500	31	426518	6.5	13	202	403	231	462
NXP550	33	453815	6.5	13	215	429	246	492
NXP600	40	549355	6.5	13	260	520	298	595
NXP650	45	610773	6.5	13	293	585	331	662
NXP700	55	730198	6.5	13	358	715	396	791
NXP750	62	829151	6.5	13	403	806	449	898
NXP800	72	1003170	6.5	13	468	936	543	1087
NXP900	80	1112358	6.5	13	520	1040	603	1205
NXP1000	87	1211310	6.5	13	566	1131	656	1312
NXP1250	98	1334148	6.5	13	637	1274	723	1445
NXP1400	111	1504755	6.5	13	722	1443	815	1630
NXP1500	127	1699247	6.5	13	826	1651	920	1841
NXP1650	142	1910800	6.5	13	923	1846	1035	2070

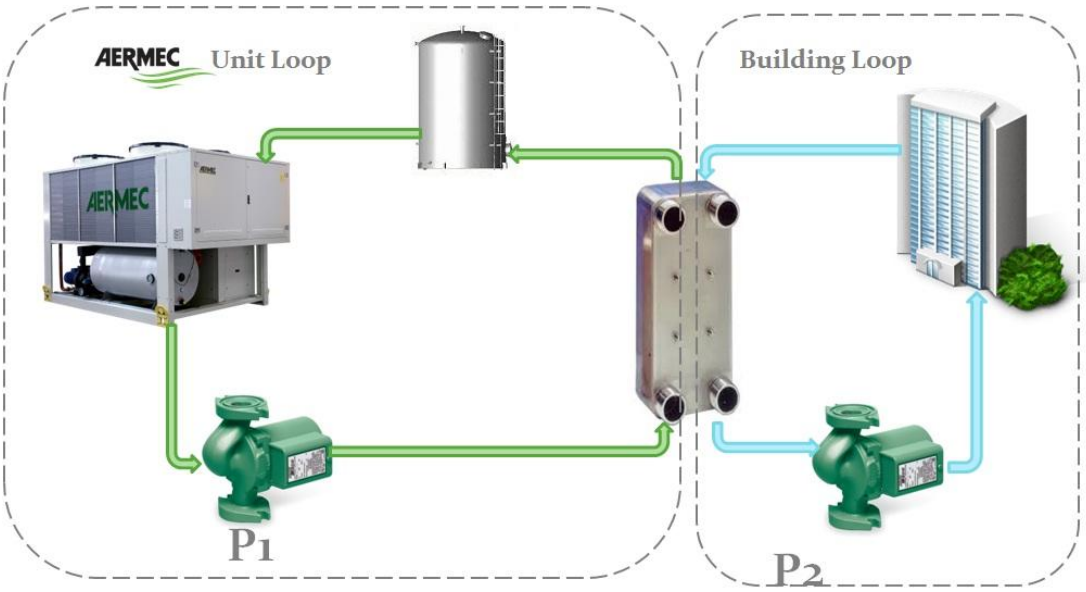
(1) For building space heating and cooling application. (2) Process application/cooling application at low outside temperature/low load/Regulation on LWT/AERMEC unit is acting as a source for another heat pump.

CHAPTER-2

In this section different system configuration and their conditions will be discussed to determine the Effective System Volume for AERMEC unit.

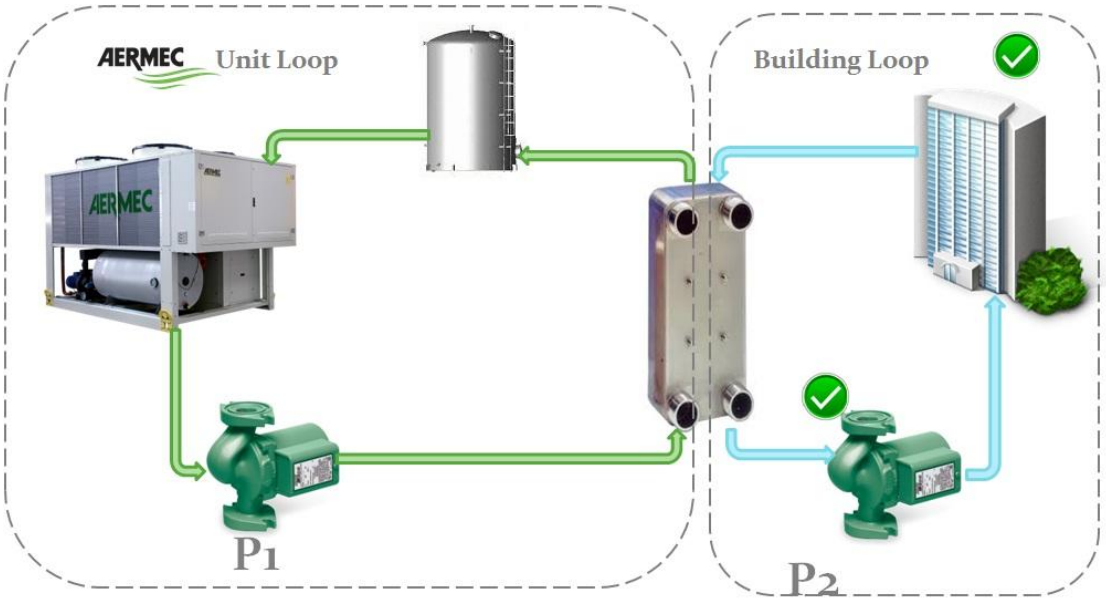
2.1 CONFIGURATION-1

AERMEC unit is connected to a heat exchanger with a buffer tank in the AERMEC unit loop. This configuration can have two scenarios depending on the operation of the building loop pump (P-2).



Case-1: P-2 IS RUNNING AS LONG AS AERMEC UNIT IS RUNNING

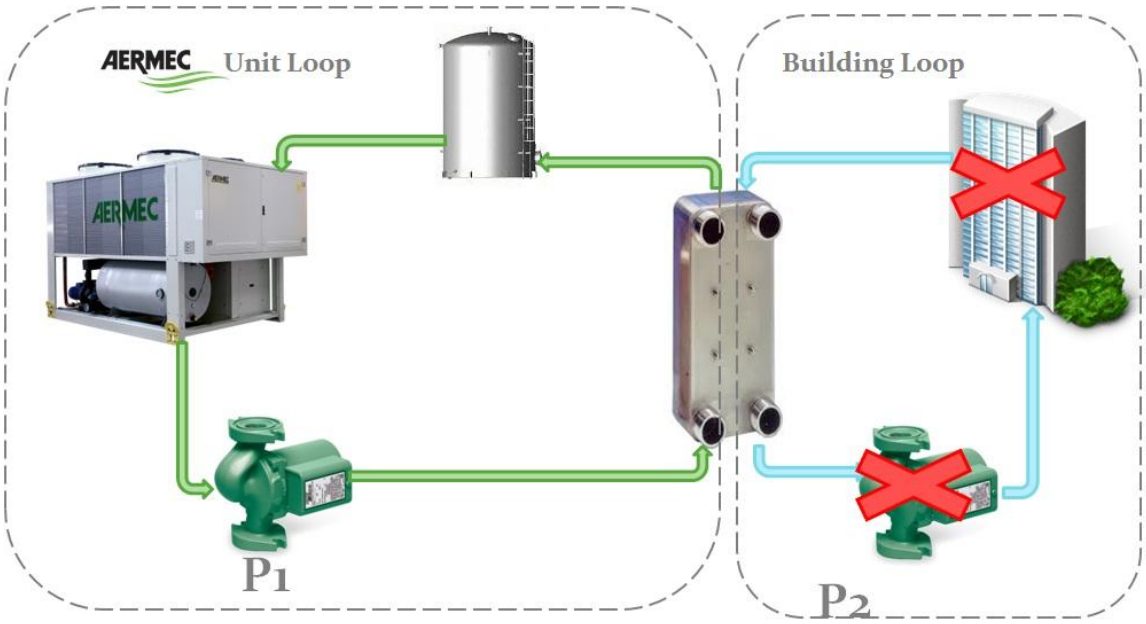
Effective System Volume	Conditions
Combined Water Volume in AERMEC Unit Loop and Building Loop	Building loop pump (P-2) must run whenever AERMEC unit loop pump (P-1) is running.



EFFECTIVE SYSTEM VOLUME = WATER VOLUME IN AERMEC UNIT LOOP + WATER VOLUME IN BUILDING LOOP

Case-2: P-2 IS ON/OFF BASED ON BUILDING LOAD

Effective System Volume	Conditions
Water Volume in AERMEC Unit Loop Only	• AERMEC unit loop pump (P-1) is running as long as AERMEC unit is running. • Building loop pump (P-2) is running based on building demand.

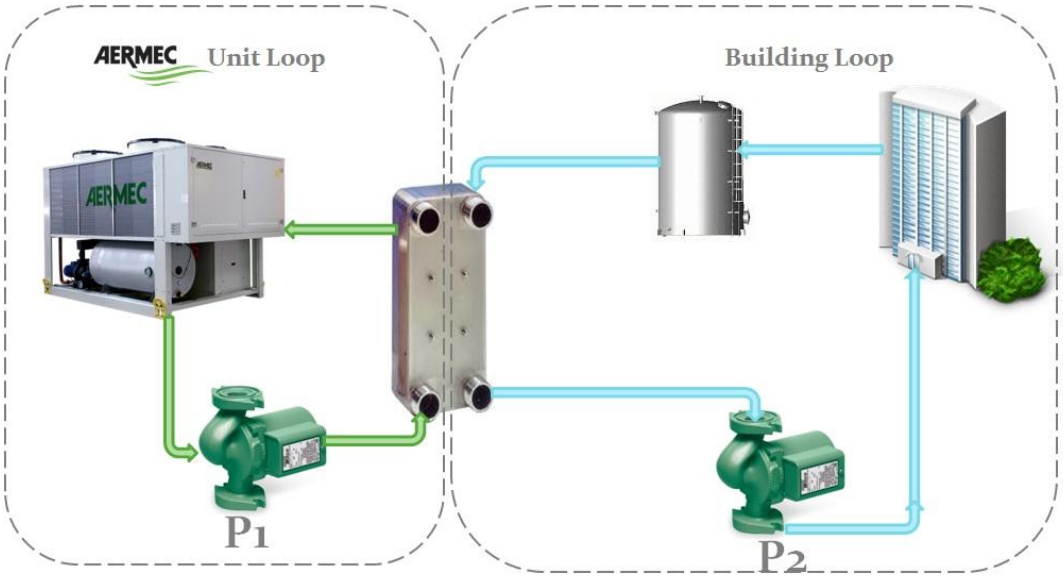


EFFECTIVE SYSTEM VOLUME = WATER VOLUME IN AERMEC UNIT LOOP

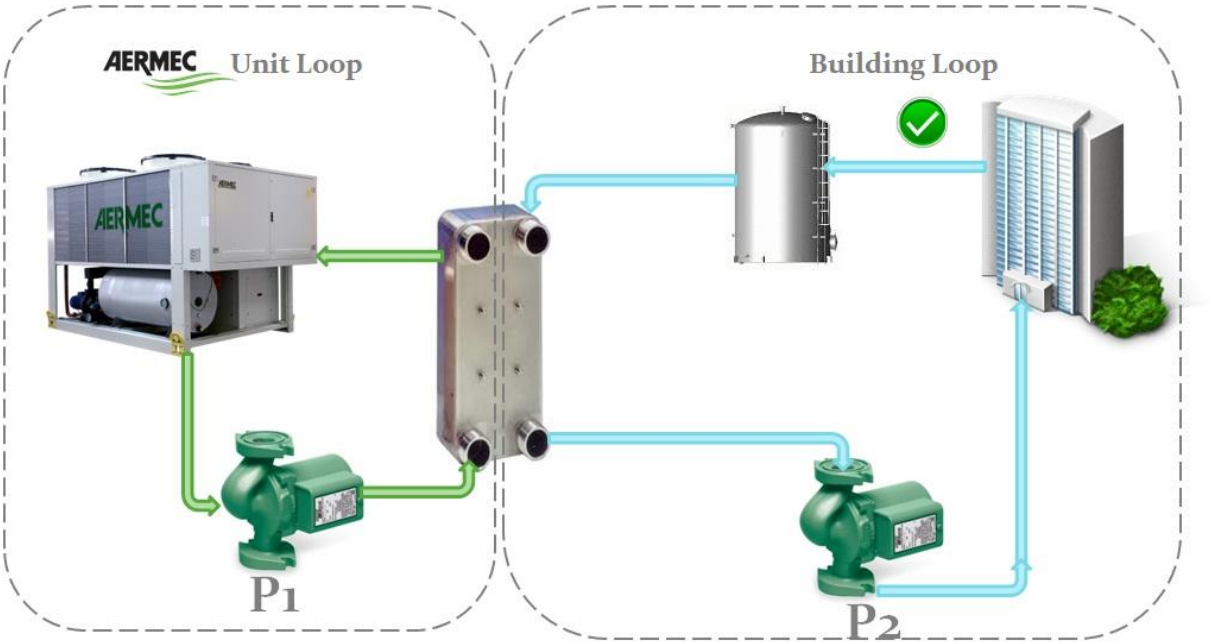
IMPORTANT: Heat Exchanger needs to be sized properly so that energy transferred to the water by AERMEC unit in the unit loop is transferred to the water on the building loop effectively.

2.2 CONFIGURATION-2

AERMEC unit is directly connected to a heat exchanger. The Buffer tank is located in between heat exchanger and building load of the system.



Effective System Volume	Conditions
Combined Water Volume in AERMEC Unit Loop and Building Loop	• AERMEC unit loop pump (P-1) and building loop pump (P-2) are running whenever the AERMEC unit is running. • If VFD pump is used for P-2, a minimum GPM must be circulated throughout the building loop when the P-1 is ON, which can be calculated from formula (A).



EFFECTIVE SYSTEM VOLUME = WATER VOLUME IN AERMEC UNIT LOOP + WATER VOLUME IN BUILDING LOOP

$$Minimum\ \ GPM\ Required\ in\ Building\ Loop = \frac{Heating\ \ or\ Cooling\ \ Capacity\ \ of\ the\ heat\ exchanger\ \ (\frac{BTU}{H})}{500 * Heat\ \ Exchanger\ \ \Delta T_{Building\ \ \ Loop}} \quad (A)$$

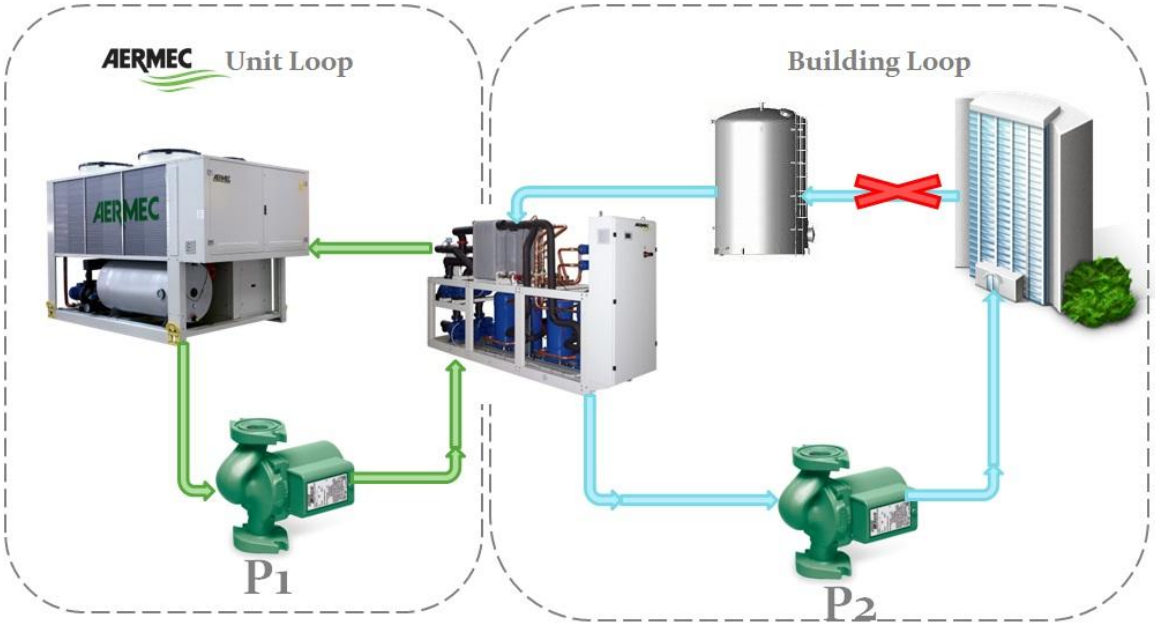
Table-2

ΔT Building loop(F)	Minimum GPM Required				
	Capacity of the Heat Exchanger (BTU/H)*				
	48000	120000	600000	1440000	1800000
9	10.7	26.7	133.3	320.0	400.0
10	9.6	24.0	120.0	288.0	360.0
15	6.4	16.0	80.0	192.0	240.0
20	4.8	12.0	60.0	144.0	180.0
* Amount of heat transferred to the building loop side of the heat exchanger.					

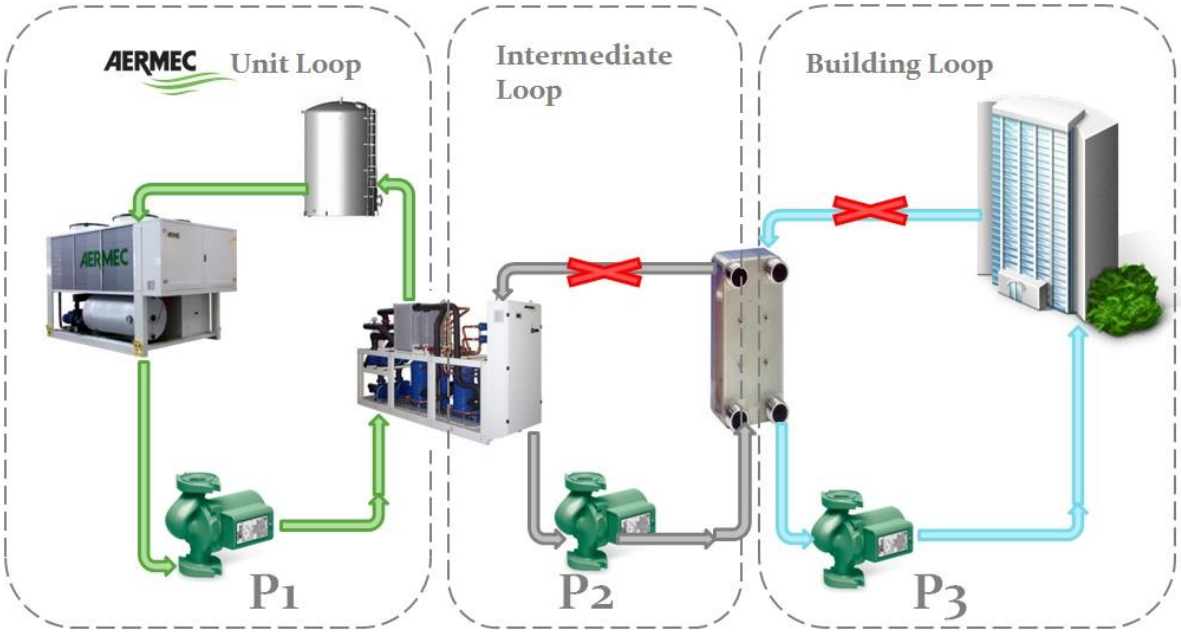
IMPORTANT: Heat Exchanger needs to be sized properly so that energy transferred to the water by AERMEC unit in the unit loop is transferred to the water on the building loop effectively.

2.3 CONFIGURATION-3

In this configuration Air Cooled AERMEC unit is connected to the source side of another Water to Water heat pump. A buffer tank is located in between Air Cooled AERMEC unit and Water to Water heat pump. This configuration can have heat exchanger or backup boiler depending on the application.



OR



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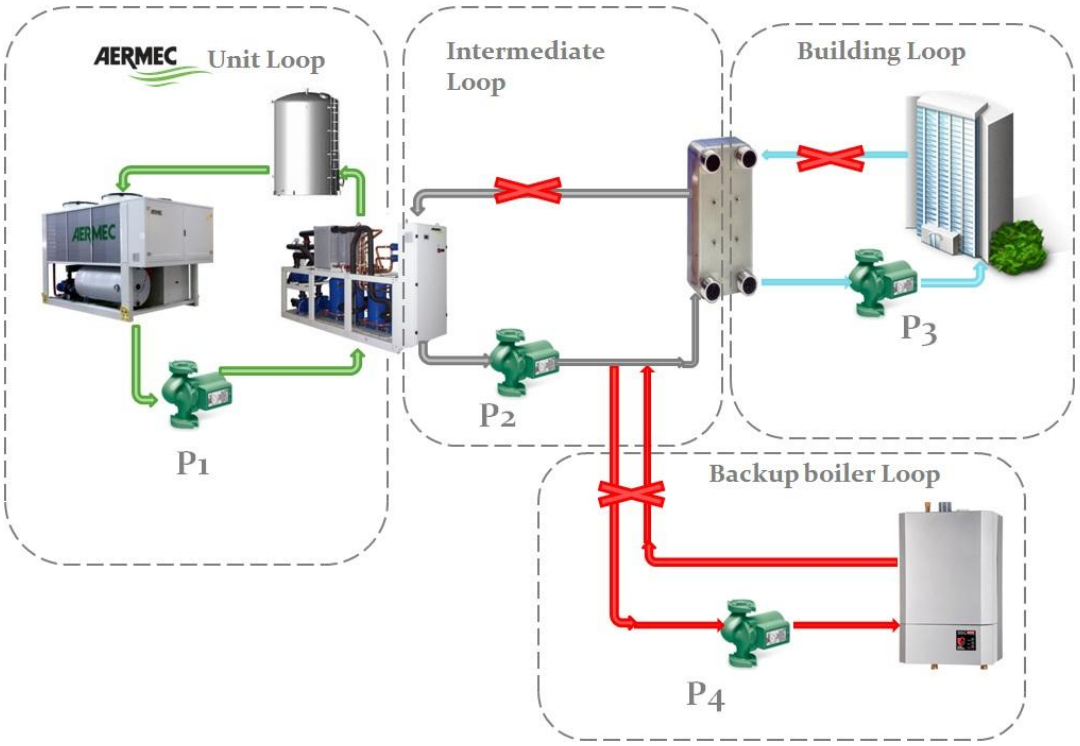
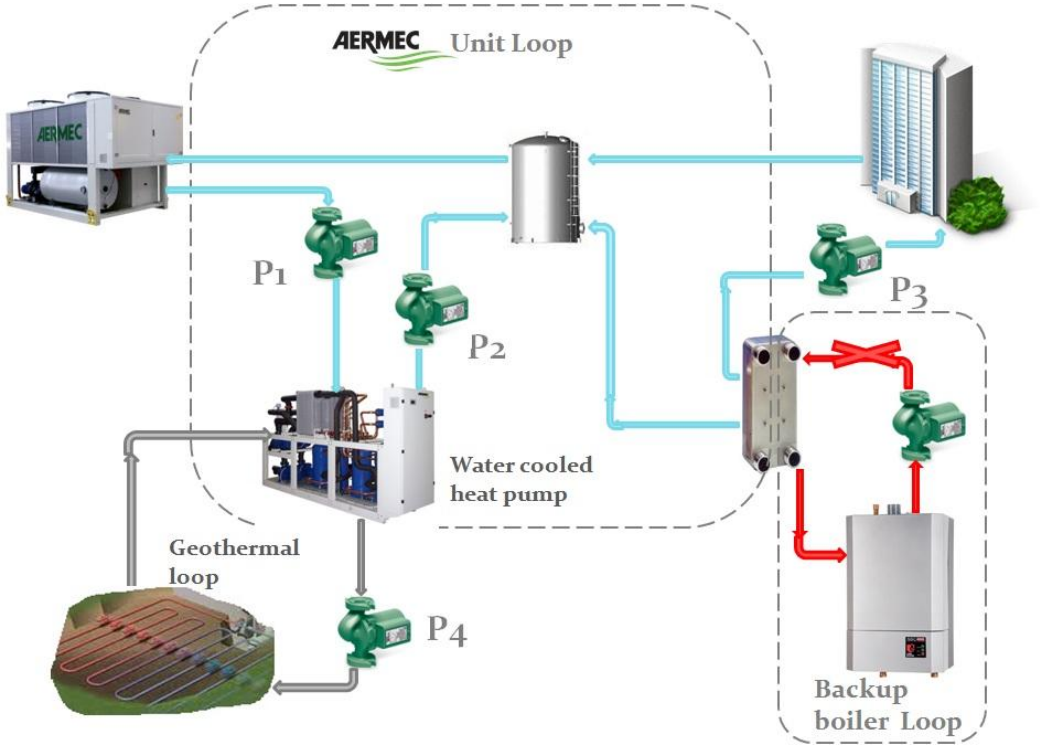


EFFECTIVE SYSTEM VOLUME = WATER VOLUME IN AERMEC UNIT LOOP

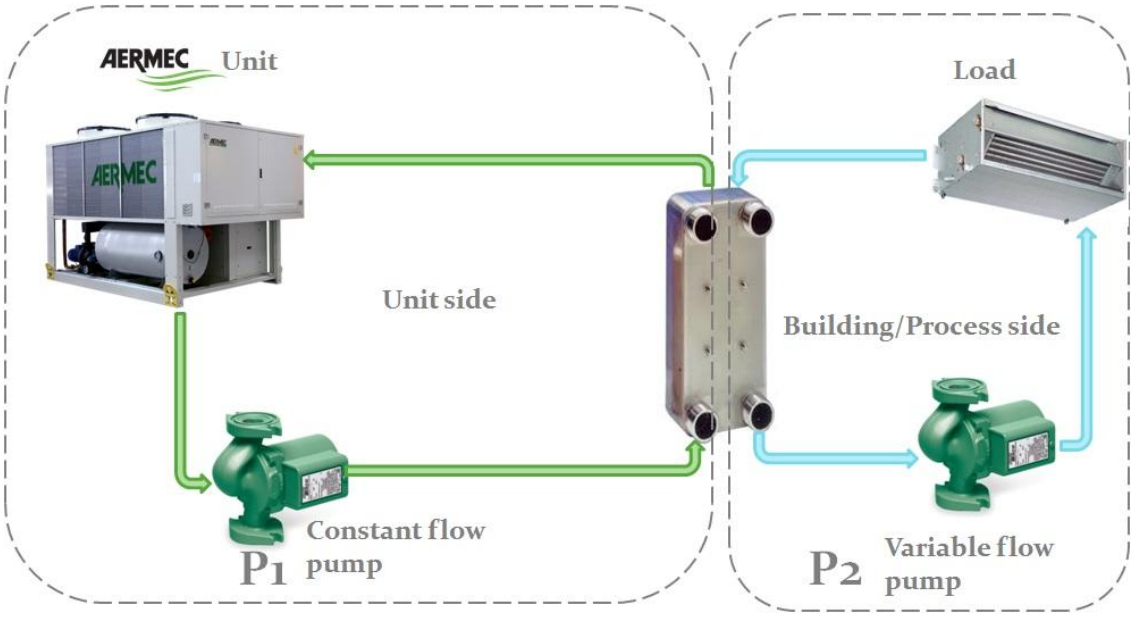
2.3 CONFIGURATION-4

In this configuration Air Cooled AERMEC unit works in series with another Water to Water heat pump. This configuration can have heat exchanger or backup boiler depending on the application.

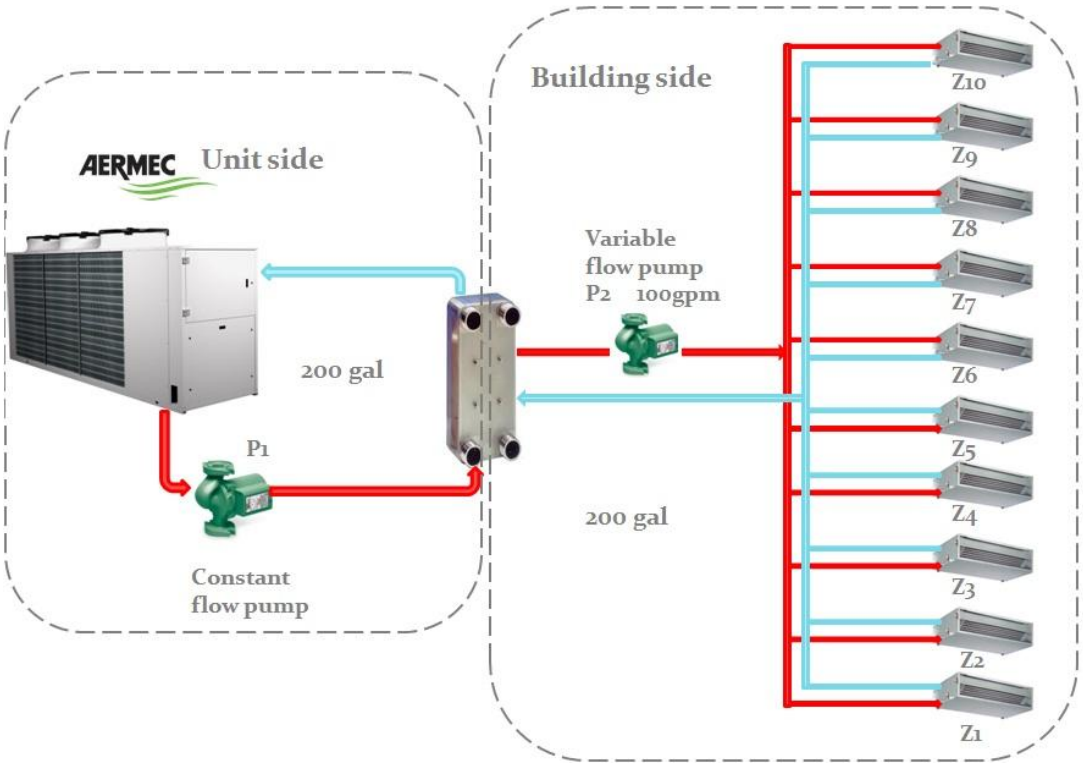


EFFECTIVE SYSTEM VOLUME = WATER VOLUME IN AERMEC UNIT LOOP

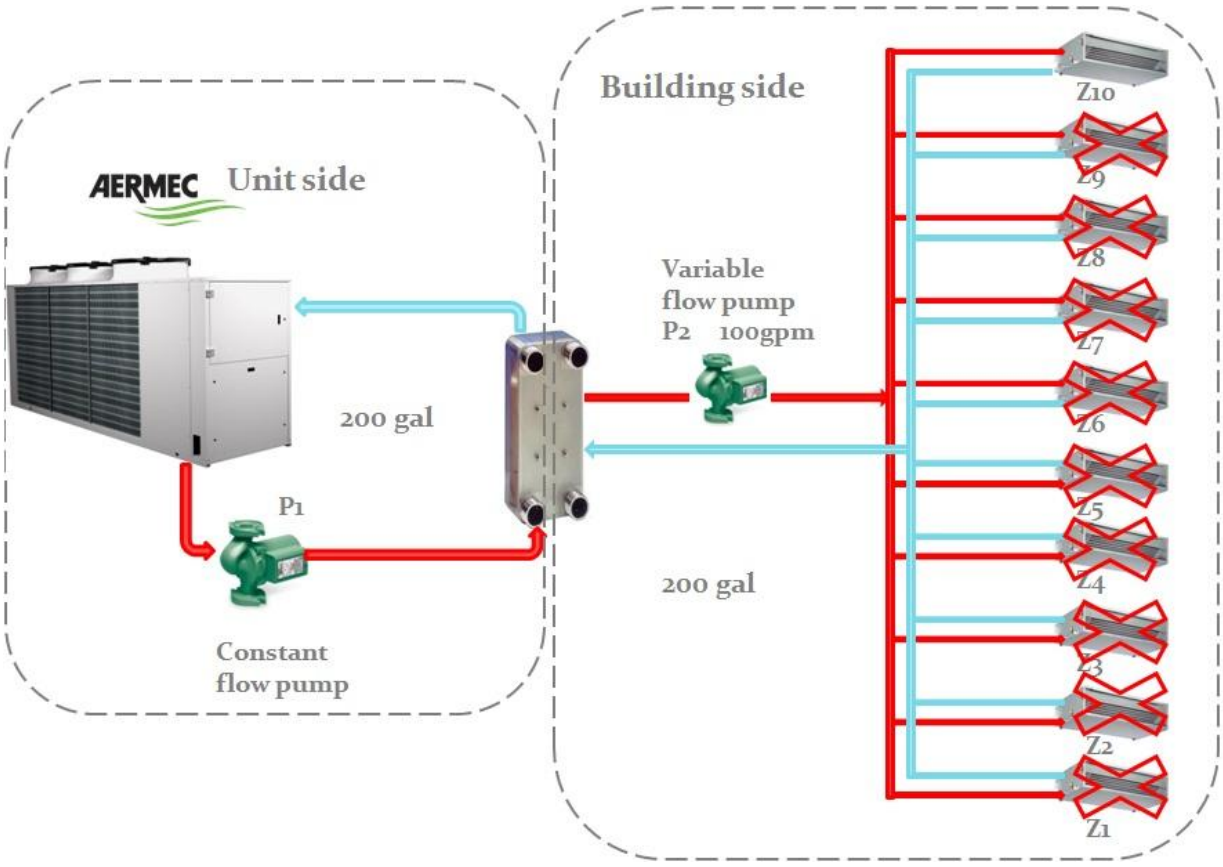
CHAPTER 2
MINIMUM WATER CONTENT ZONING



In order to guarantee proper operation of Aermec units, the minimum water content must be respected. As an example, we have drawn a system that requires 400 gallons of water volume. The system pictured has 200 gallons on the building/process side and 200 gallons on the unit side. So the volume is correct and changing flow on the building/process side will not affect the unit as the total volume is always at least 400 gallons



Here we show a second example with 10 zones on the building/process side. The system requires a total 400 gallons of water volume between the unit side and the building/process side. Each zone contains 20 gallons of water making total 200 gallons on the building/process side. Aermec unit side contains rest of the 200 gallons. Now if the zones start to close, the amount of water on the building/process side will be reduced and total water content will be less than 400 gallons. The water content will be lowest when just a single zone is open



The total volume of water shown in the picture (only single zone is open) is the lowest possible in this example
Total water volume = Amount of water in the unit side + Amount of water in the building/process side at lowest load
= 200 + 20 = 220 gallons, which is less than the minimum required water volume. This situation is not acceptable

To avoid this situation we have to follow,

REQUIRED WATER CONTENT OF THE SYSTEM =

WATER CONTENT ON THE UNIT SIDE + AMOUNT OF WATER ON THE BUILDING/PROCESS SIDE AT LOWEST LOAD (ONLY SINGLE ZONE IS OPEN)