evapco for LIFE

EVAPORATIVE CONDENSERS

LSC-E
LRC

Evaporative Condensers

GLOBAL COLD CHAIN ALLIANCE®

IARW International Association of Refrigerated Warehouses

Member of iiar International Institute of Ammonia Refrigeration www.iiar.org

MEMBER OF AHRI Air-Conditioning, Heating, and Refrigeration Institute

LOW SOUND AND LOW PROFILE FORCED DRAFT CONDENSERS

Technology for the Future...Available Today!

EVAPCO Global Headquarters, Taneytown, Maryland USA

Get to Know EVAPCO

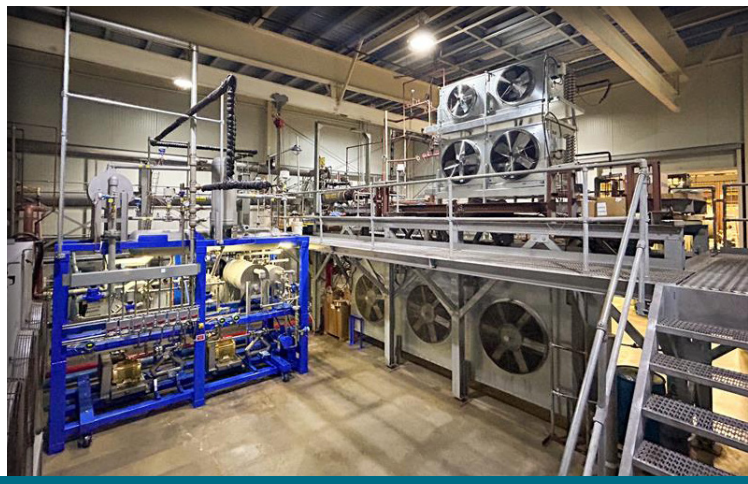
Since its founding in 1976, EVAPCO, Incorporated has become an industry leader in the engineering and manufacturing of quality heat transfer products around the world. EVAPCO's mission is to provide first class service and quality products for the following markets:

- **Industrial Refrigeration**
- Commercial HVAC
- Industrial Process
- Power

These quality products for the industrial refrigeration market include: refrigerant condensers, cooling towers, evaporative condensers, evaporators, hygienic air handlers, packaged low charge ammonia systems, packaged Transcritical CO_2 rack systems, pressure vessels and packages, waters systems and controls and automation.

The EVAPCO Wilson E. Bradley Research & Development Center

Featuring a state-of-the-art, low-temperature, insulated environmental test chamber and a fully functional ammonia refrigeration system designed to operate at suction temperatures as low as -51.1°C (-60°F), the EVAPCO Research & Development Center enables us to find groundbreaking solutions for the industry's biggest challenges. The newest addition to EVAPCO's R&D center is a CO_2 testing lab.



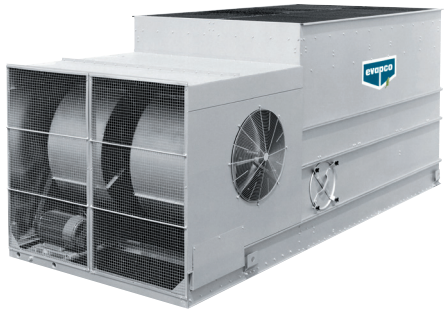
LSC-E and LRC Principle of Operation

Low Sound and Low Rise Forced Draft Evaporative Condensers

EVAPCO's LSC-E/LRC Evaporative Condensers utilize EVAPCO's Thermal-Pak® II coil design featuring the revolutionary CROSSCOOL™ Internal Tube Enhancement. The CROSSCOOL™ Internal Tube Enhancement increases the internal heat transfer coefficient of the coil and thus increases the cooling capacity of the unit. This series of condensers is the ideal solution for indoor application, confined layouts, low sound requirements and direct replacements to name a few. Both models are designed for easy maintenance and long, trouble free operation.

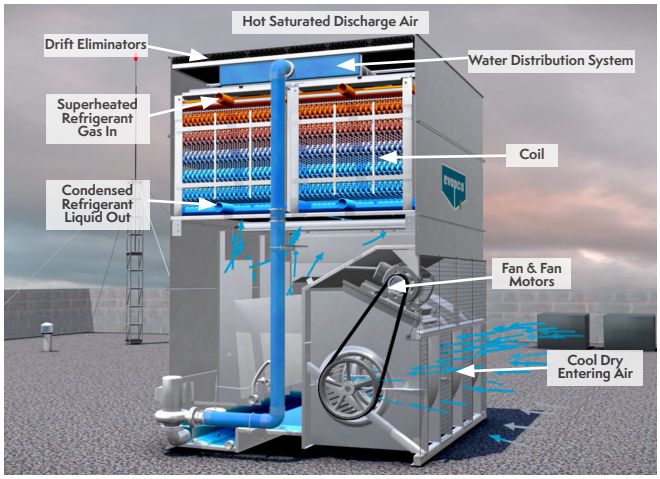
LSC-E

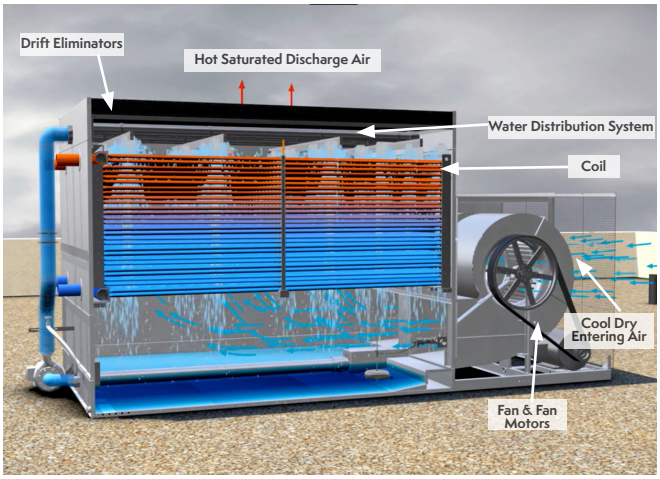
The standard for forced draft centrifugal fan designs.



LRC

With the fan section located beside the heat transfer casing, this unit satisfies even the strictest of height requirements in a unitary, compact design.



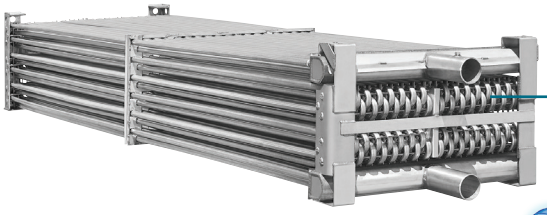


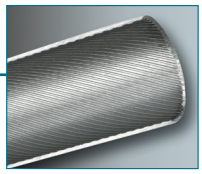
Principle of Operation

The refrigerant gas is discharged from the compressor into the inlet connection of the evaporative condenser. Water from the condenser's sump is continuously distributed over the condenser coil, while ambient air is simultaneously forced into the unit. As the ambient air moves up through the coil section, a portion of the spray water is evaporated into the air stream. The evaporative process cools the spray water, which in turn cools the tubes containing the refrigerant gas. The cool tube walls cause the refrigerant gas to give up heat and condense into a liquid. The condensed liquid flows out of the coil's sloping tubes to the high pressure liquid receiver for return to the system. The hot saturated air is driven through the drift eliminators, where any entrained water droplets are removed. The condenser's fan then discharges this air stream out of the top of the unit at a high velocity, where it can dissipate harmlessly into the atmosphere. The water which was not evaporated falls into the sump and is recirculated by the spray pump to the water distribution system above the condensing coil section.

*Dimensions, weights, and data are subject to change without notice.

LSC-E Design & Construction Features





INTERNAL TUBE ENHANCEMENT

Galvanized Steel Coil Elliptical Thermal-Pak® II COIL Construction Featuring CROSScool™ Internal Tube Enhancement Technology

- Internal tube enhancement improves heat transfer efficiency providing **additional evaporative capacity**
- Elliptical return bends allows for more circuits per coil bundle increasing maximum capacity per footprint
- Coil located in the airstream increasing dry bulb switchover temperature

Optional Factory Mounted Solid Chemical Water Treatment Systems (Not Shown)

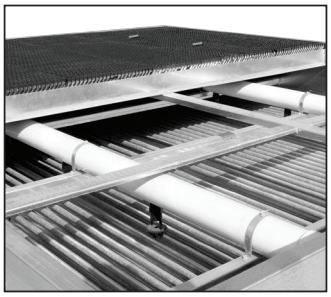
The LSC-E is available with a **Smart Shield®** (not shown) solid chemical water treatment system. **Smart Shield®** is environmentally sensitive alternatives for treating water in evaporative cooled equipment. The **Smart Shield®** system includes all components required for an effective water treatment system; factory mounted and wired.

IBC Compliant Design

- All standard models meet IBC requirements
- Upgraded designs available for high seismic and wind load areas
- Shake table verified for 1.5 Importance Factor installations

Zero Maintenance PVC Spray Distribution Header with ZM®II Nozzles

- Fixed position nozzles require zero maintenance
- Large orifice nozzles prevent clogging



Easy Field Assembly

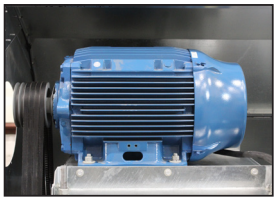
- Ensures easy assembly and fewer fasteners
- Incorporates self-guiding channels to guide the coil casing section into position improving the quality of the field seam

Clean Pan Design

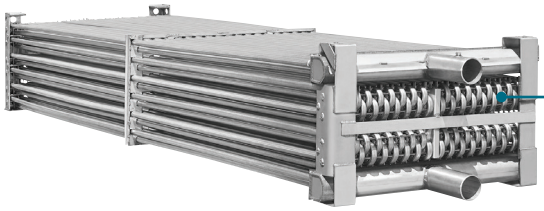
- Sloped design allows water to drain completely from cold water basin
- Easier removal of dirt and debris

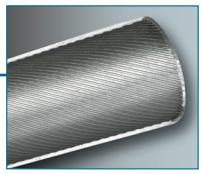
Totally Enclosed Fan Motors

- Assures long life
- All normal maintenance can be performed quickly from outside the unit
- If required, motor may be easily removed
- Motors are now located outboard on multi-motor units for even easier drive system access



LRC Design and Construction Features

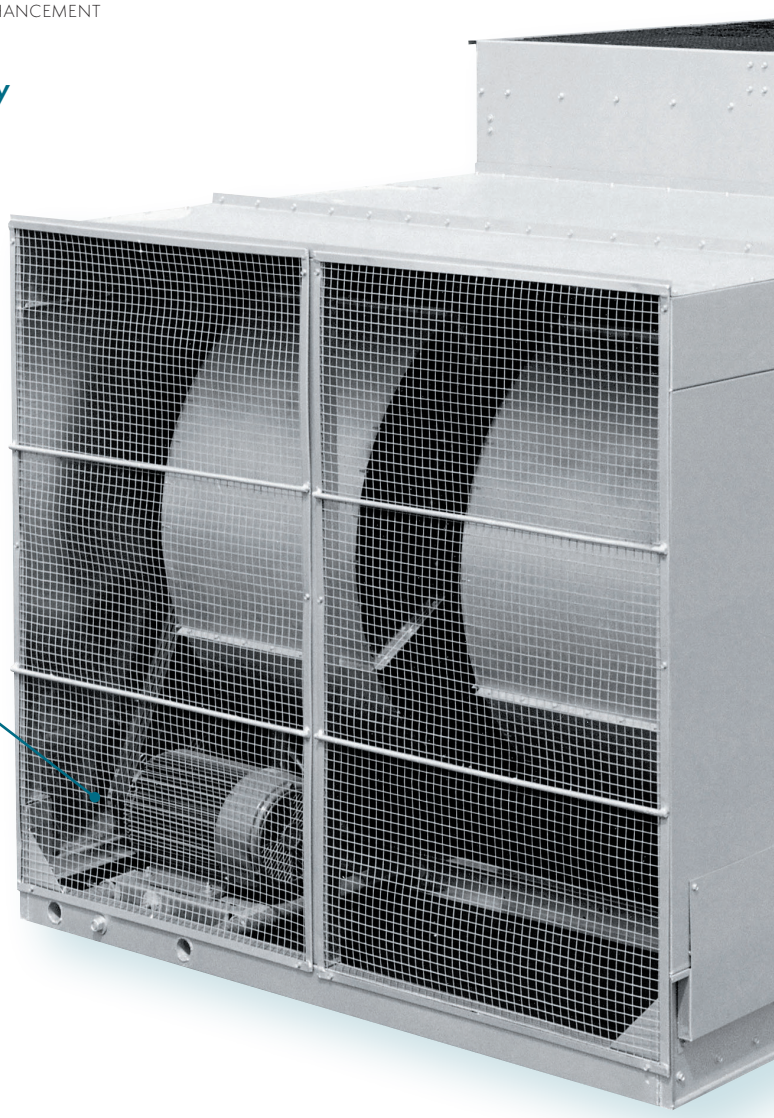


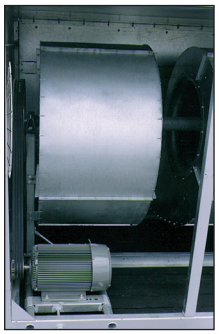


INTERNAL TUBE ENHANCEMENT

Galvanized Steel Coil Elliptical Thermal-Pak® II COIL Construction Featuring CROSSCOOL™ Internal Tube Enhancement Technology

- Internal tube enhancement improves heat transfer efficiency providing **additional evaporative capacity**
- Elliptical return bends allows for more circuits per coil bundle increasing maximum capacity per footprint
- Coil located in the airstream increasing dry bulb switchover temperature



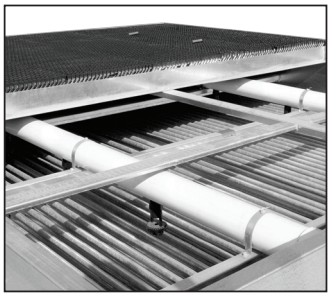


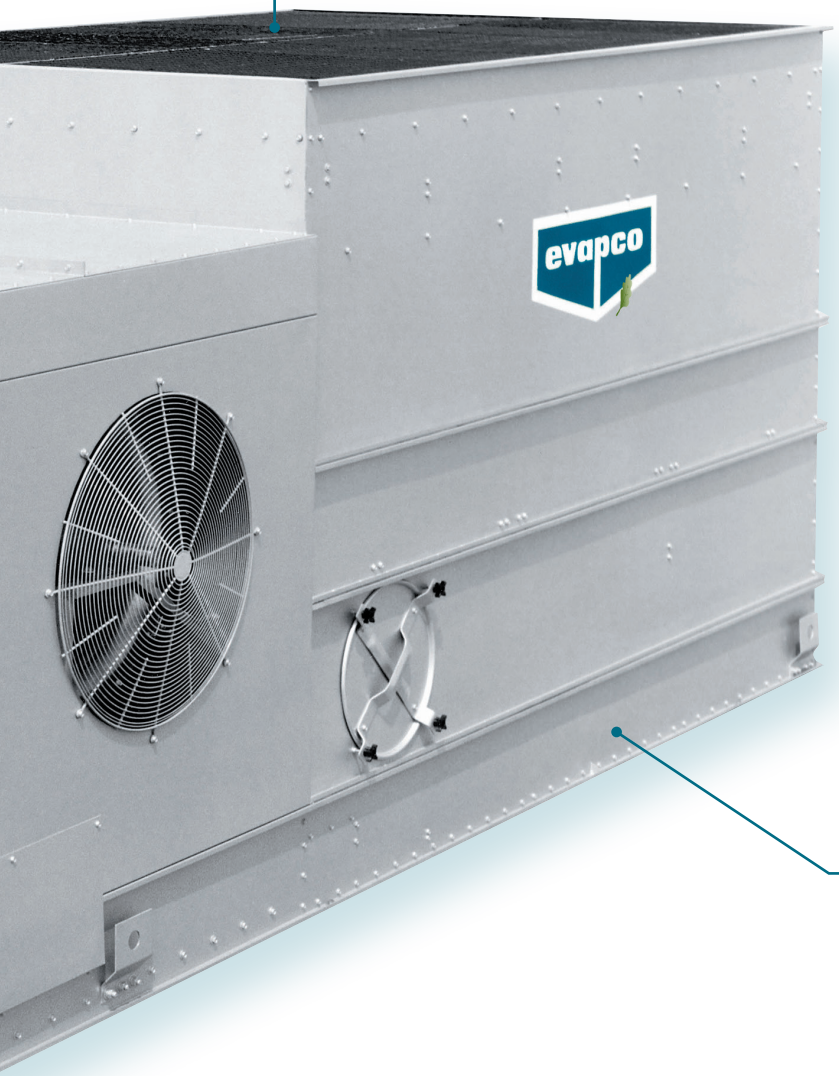
Easy to Service Motor & Drive System

- Belt tensioning and bearing lubrication can be performed from outside the unit
- Locking mechanism can also be used as a wrench to adjust the belts
- Motor is fully accessible by removing one inlet screen
- Split fan housings allow removal of all mechanical equipment through the end of the unit

Zero Maintenance PVC Spray Distribution Header with ZM®II Nozzles

- Fixed position nozzles require zero maintenance
- Large orifice nozzles prevent clogging





evapco SMARTSHIELD®

Optional Factory Mounted Solid Chemical Water Treatment Systems (Not Shown)

The LRC is available with a **Smart Shield®** (not shown) solid chemical water treatment system. **Smart Shield®** is environmentally sensitive alternatives for treating water in evaporative cooled equipment. The **Smart Shield®** system includes all components required for an effective water treatment system; factory mounted and wired.

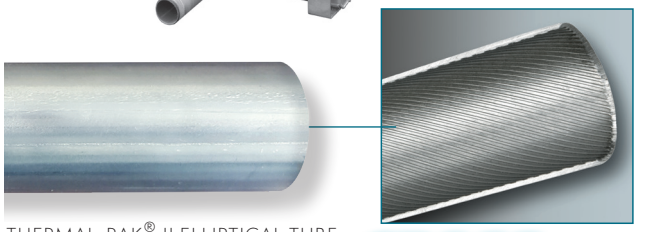
G-235 Galvanized Steel Cold Water Basin Design

(Stainless steel available as an affordable option)

Innovative Design Features

Elliptical Thermal-Pak® II Heat Transfer Coil

Featuring



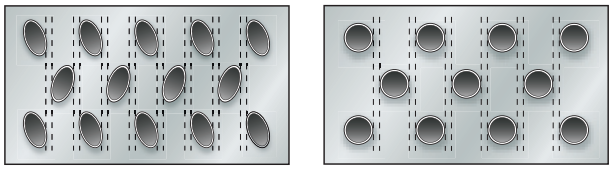
THERMAL-PAK® II ELLIPTICAL TUBE

CROSSCOOL™

INTERNAL TUBE ENHANCEMENT

Galvanized steel elliptical Thermal-Pak® II coil featuring CROSSCOOL™ Internal Tube Enhancement Technology

- Internal Tube Enhancement provides additional evaporative capacity
- Elliptical tube design allows for more circuits per coil bundle increasing maximum capacity per footprint
- Elliptical tube design results in lower airflow resistance than typical round tube designs



EVAPCO's Thermal-Pak® II Elliptical Tube ***Competitors Round Tube Coil***

The LSC-E and LRC evaporative condensers utilize EVAPCO's Thermal-Pak® II coil design. The elliptical tube design allows for closer tube spacing, resulting in greater surface area per plan area than round-tube coil designs.

In addition, the Thermal-Pak® II design has lower resistance to airflow and also permits greater water loading making the Thermal-Pak® II coil a highly efficient design available.

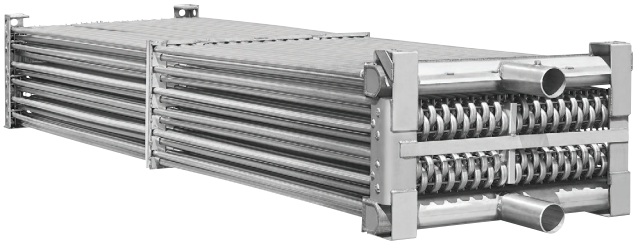
The Thermal-Pak® II coil design also features EVAPCO's Internal Tube Enhancement Technology. This increases turbulence through the coil, further increasing the evaporative capacity.

The coils are manufactured from high quality steel tubing in accordance with the most stringent quality control procedures. Each circuit is inspected to ensure the material quality and then tested before being assembled into a coil. The coil shall have design pressure of 2.07MPa (300psi) and shall be in compliance with ANSI/ASME B31.5, Refrigeration Piping and Heat Transfer Components. The coil assembly shall be strength tested in accordance with ANSI/ASME B31.5 and subsequently leak tested underwater.

To protect the coil against corrosion, it is placed in a heavy steel frame and then the entire assembly is dipped into molten zinc (hot-dipped galvanized) at a temperature of approximately 427°F (800°F).

Stainless Steel Coil Option

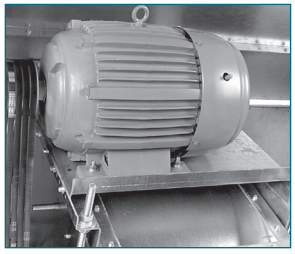
EVAPCO offers the optional TITAN COIL. Constructed with Type 304L Stainless Steel, the TITAN COIL is manufactured using EVAPCO's elliptical tube Thermal-Pak® II design upgraded to tough construction featuring: durability, corrosion resistance, and **5 Year Coil Warranty** as standard. Type 316 Stainless Steel Coil is also available upon request.



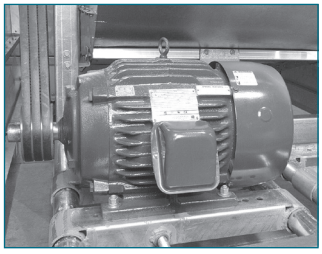
Thermal-Pak® II Coil

Fan Motor Mount

TEFC fan motors are mounted in a convenient open area for ease of belt tensioning, motor lubrication and electrical connection. The motor base is designed for easy adjustment and is locked into position to maintain proper belt tension.



Example LSC-E Fan Motor Mount



LRC Fan Motor Mount

Fan Access-Split Housing

Another unique feature of the LRC evaporative condenser is the split fan housing. The split fan housing on the LRC allows quick removal of the fans from the front end of the unit. This feature allows fan removal when units are placed side by side where space is minimal.

Mechanical Drive System Access

The LSC-E and LRC mechanical drive systems are easy to maintain. Bearing lubrication and belt adjustment can be performed from outside the unit. There is no need to remove fan screens to maintain important drive components. In addition, the locking mechanism used to maintain belt tension can also work as a wrench to adjust the belt.

Centrifugal Fan Assembly

Fans on LSC-E and LRC evaporative condensers are of the forward curved centrifugal design with hot-dip galvanized steel construction. All fans are statically and dynamically balanced and are mounted in a hot-dip galvanized steel housing.

Maintenance Free ZM®II Spray Nozzle Water Distribution System

ZM®II Nozzle

EVAPCO's Zero Maintenance ZM®II spray nozzle remains clog-free while providing even and constant water distribution for reliable evaporative cooling under all operating conditions.

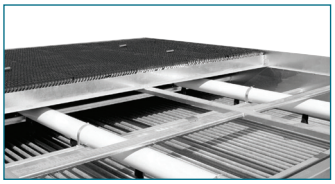
The heavy duty nylon ZM®II spray nozzles have a 1-5/16" (33.3mm) diameter opening and a 1-1/2" (38mm) splash plate clearance. Furthermore, the fixed position ZM®II nozzles are mounted in corrosion-free PVC water distribution pipes that have threaded end caps. Together, these elements combine to provide unequaled coil coverage and scale prevention, and make it an industry-leading performing non-corrosive, maintenance-free water distribution system.

Efficient Drift Eliminators

The LSC-E and LRC are provided with an efficient drift eliminator system that effectively reduces entrained water droplets from the air discharge to less than 0.001% of the spray water flow rate.

The eliminators are constructed of non-corrosive PVC with a multi-pass design for maximum drift reduction. They are assembled in modular sections for easy removal and access to the water distribution system.

In addition to reducing drift, the eliminators also function as effective debris screens which protect the spray system from sunlight and debris.



LSC-E and LRC Drift Eliminator

Drift Eliminators Removed for Coil Inspection

Two methods of selection are presented, the first is based on the total heat of rejection as described immediately below. The second and more simple method is based on evaporator tons. The evaporator ton method is only applicable to systems with open type reciprocating compressors.

The heat of rejection method is applicable to all but centrifugal compressor applications and is normally used for selecting evaporative condensers for use with hermetic compressors and screw compressors. It can also be used for standard open type reciprocating compressors as an alternate to the evaporator ton method.

The evaporator ton method is based on the estimated heat of compression. **The heat of rejection method of selection is more accurate and should be used whenever possible.**

Refer to the factory for selections on systems with centrifugal compressors.

Heat of Rejection Method

In the heat of rejection method, a factor for the specified operating conditions (condensing temperature and wet bulb) is obtained from **Table 1** or **2** and multiplied times the heat of rejection.

The resultant figure is used to select a unit from **Table 3**. Unit capacities are given in Table 3 in kW.

If the heat of rejection is not known, it can be determined by one of the following formulas:

Open Compressors:

Heat of Rejection (kW) = Evaporator Load (kW)
+ Compressor BHP (kW)

Hermetic Compressors:

Heat of Rejection (kW) = Evaporator Load (kW)
+ Compressor Input (kW)

EXAMPLE

Given: 880kW load, ammonia refrigerant 36°C condensing temperature, 26°C wet bulb temperature and 220kW compressor.

Selection: Heat of Rejection

Evaporator Load = 880kW
Compressor Load = 220kW
Total = 1100kW

From **Table 2** the capacity factor for 36°C condensing and 26°C wet bulb = 1.39 1100 x 1.39 = 1529kW. Therefore, select model LSC-355E or LRC-361.

Note: *For screw compressor selections employing water cooled oil cooling, select a condenser for the total kW as in the example. The condenser can then function in one of two ways:*

(1) Recirculating water from the water sump can be used directly in the oil cooler. A separate pump should be employed and the return water should be directed into the water sump at the opposite end from the pump suction.

(2) The condenser coil can be circuited so that water or a glycol-water mixture for the oil cooler can be cooled in a separate section of the coil. Specify load and water flow required.

For refrigerant injection cooled screw compressors, select the condenser in the same manner as shown in the example.

If the oil cooler is supplied by water from a separate source, then the oil cooling load should be deducted from the heat of rejection before making the selection.

Table 1 - HCFC-22 and HFC-134a Heat Rejection Factors

Condensing Pres (kPa)		Cond. Temp. (°C)	Wet Bulb Temperature (°C)																	
HCFC-22	HFC-134a		10	12	14	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1090	669	30	1.07	1.15	1.25	1.38	1.47	1.57	1.69	1.83	2.00	2.23	2.50	2.86	3.36	-	-	-	-	-
1154	718	32	0.94	1.01	1.09	1.19	1.26	1.32	1.40	1.49	1.60	1.74	1.90	2.11	2.36	-	-	-	-	-
1220	759	34	0.85	0.90	0.97	1.04	1.09	1.14	1.20	1.26	1.34	1.43	1.54	1.66	1.81	2.02	2.31	-	-	-
1253	785	35	0.80	0.85	0.91	0.97	1.02	1.06	1.11	1.15	1.21	1.29	1.37	1.46	1.56	1.71	1.89	2.13	2.41	2.77
1287	814	36	0.77	0.81	0.86	0.92	0.96	1.00	1.04	1.07	1.13	1.19	1.26	1.34	1.43	1.56	1.71	1.90	2.14	2.43
1359	856	38	0.70	0.74	0.78	0.82	0.85	0.86	0.90	0.93	0.96	1.01	1.06	1.11	1.18	1.26	1.35	1.47	1.62	1.78
1431	915	40	0.65	0.67	0.70	0.73	0.76	0.78	0.80	0.83	0.86	0.89	0.93	0.97	1.02	1.08	1.14	1.22	1.32	1.44
1508	978	42	0.59	0.62	0.64	0.67	0.68	0.70	0.72	0.74	0.77	0.80	0.83	0.86	0.89	0.94	0.98	1.04	1.11	1.19
1587	1026	44	0.54	0.56	0.59	0.61	0.62	0.63	0.65	0.66	0.68	0.70	0.73	0.75	0.78	0.82	0.82	0.89	0.92	0.97

Table 2 - Ammonia (R-717) Heat Rejection Factors

Condensing Pres. (kPa)	Cond. Temp. (°C)	Wet Bulb Temperature (°C)																	
		10	12	14	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1063	30	0.95	1.03	1.12	1.23	1.31	1.40	1.51	1.63	1.79	1.99	2.24	2.56	3.00	-	-	-	-	-
1133	32	0.84	0.90	0.97	1.06	1.12	1.18	1.25	1.32	1.43	1.55	1.70	1.88	2.11	-	-	-	-	-
1206	34	0.76	0.81	0.86	0.93	0.98	1.02	1.07	1.12	1.19	1.28	1.36	1.48	1.61	1.80	2.06	-	-	-
1245	35	0.71	0.76	0.81	0.87	0.91	0.95	0.99	1.03	1.08	1.15	1.23	1.30	1.39	1.53	1.69	1.90	2.15	2.47
1284	36	0.69	0.73	0.77	0.82	0.86	0.89	0.92	0.96	1.01	1.07	1.13	1.20	1.28	1.39	1.53	1.70	1.91	2.17
1365	38	0.63	0.66	0.69	0.73	0.76	0.78	0.81	0.83	0.86	0.90	0.94	0.99	1.05	1.12	1.21	1.31	1.44	1.59
1451	40	0.58	0.60	0.62	0.65	0.67	0.70	0.72	0.74	0.76	0.80	0.83	0.87	0.91	0.96	1.02	1.09	1.18	1.29
1539	42	0.53	0.55	0.57	0.60	0.61	0.63	0.64	0.66	0.68	0.71	0.74	0.76	0.80	0.84	0.88	0.93	0.99	1.06
1630	44	0.49	0.50	0.52	0.54	0.56	0.56	0.58	0.59	0.61	0.63	0.65	0.67	0.70	0.73	0.76	0.79	0.83	0.86

Table 3 - Unit Heat Rejection

LSC-E Models									
Model	kW Base	Model	kW Base	Model	kW Base	Model	kW Base	Model	kW Base
LSC-36E	155	LSC-210E	905	LSC-400E	1,723	LSC-620E	2,671	LSC-960E	4,136
LSC-41E	177	LSC-225E	969	LSC-410E	1,766	LSC-625E	2,693	LSC-980E	9,188
LSC-48E	207	LSC-240E	1,034	LSC-430E	1,853	LSC-650E	2,800	LSC-1000E	9,555
LSC-54E	233	LSC-250E	1,077	LSC-431E	1,857	LSC-660E	2,843	LSC-1020E	9,702
LSC-65E	280	LSC-280E	1,206	LSC-450E	1,939	LSC-690E	2,973	LSC-1030E	10,143
LSC-70E	302	LSC-281E	1,211	LSC-460E	1,982	LSC-691E	2,977	LSC-1060E	10,158
LSC-75E	323	LSC-295E	1,271	LSC-475E	2,046	LSC-720E	3,102	LSC-1080E	10,584
LSC-80E	345	LSC-300E	1,292	LSC-480E	2,068	LSC-721E	3,106	LSC-1100E	10,599
LSC-90E	388	LSC-310E	1,335	LSC-490E	2,111	LSC-755E	3,253	LSC-1120E	11,099
LSC-100E	431	LSC-315E	1,357	LSC-500E	2,154	LSC-770E	3,317	LSC-1180E	11,319
LSC-110E	474	LSC-330E	1,422	LSC-510E	2,197	LSC-800E	3,447	LSC-1250E	11,760
LSC-120E	517	LSC-335E	1,443	LSC-515E	2,219	LSC-805E	3,468	LSC-1310E	11,834
LSC-135E	582	LSC-345E	1,486	LSC-530E	2,283	LSC-820E	2,533	LSC-1380E	12,054
LSC-150E	646	LSC-355E	1,530	LSC-540E	2,326	LSC-860E	3,705	LSC-1440E	12,642
LSC-155E	668	LSC-360E	1,551	LSC-550E	2,369	LSC-861E	3,709	LSC-1510E	12,657
LSC-170E	732	LSC-370E	1,594	LSC-560E	2,413	LSC-900E	3,877	LSC-1610E	13,230
LSC-185E	797	LSC-385E	1,659	LSC-590E	2,542	LSC-920E	3,964		
LSC-200E	862	LSC-386E	1,663	LSC-591E	2,546	LSC-950E	4,093		

LRC Models									
Model	kW Base	Model	kW Base	Model	kW Base	Model	kW Base	Model	kW Base
LRC-25	108	LRC-65	280	LRC-128	552	LRC-211	909	LRC-269	1,159
LRC-27	116	LRC-72	310	LRC-131	564	LRC-213	918	LRC-287	1,236
LRC-29	125	LRC-76	327	LRC-140	603	LRC-225	969	LRC-300	1,292
LRC-35	151	LRC-84	362	LRC-155	668	LRC-227	978	LRC-321	1,383
LRC-38	164	LRC-91	392	LRC-174	750	LRC-233	1,004	LRC-336	1,447
LRC-42	181	LRC-101	435	LRC-183	788	LRC-240	1,034	LRC-361	1,555
LRC-48	207	LRC-108	465	LRC-188	810	LRC-246	1,060	LRC-379	1,633
LRC-51	220	LRC-114	491	LRC-190	819	LRC-249	1,073		
LRC-58	250	LRC-116	500	LRC-201	866	LRC-255	1,099		

Note:
1) Table 3 presents only the standard model selections. Other models exist for special fan power or layout applications. Please consult the factory or EVAPCO Representative for the special situations.
2) The heat of rejection in Table 3 is based on HCFC-22 or HCFC-134a standard conditions of 40.6°C (105°F) condensing and 25.6°C (78°F) wet bulb.

LSC-E/LRC Selection Procedure

Evaporator Ton Method

In the evaporator ton method, factors for the specified operating conditions (suction temperature, condensing temperature and wet bulb) are obtained from either Table 5 or 6 and multiplied times the heat load in tons. The resultant figure is used to select a unit from Table 4. The condenser model in Table 4 is equal to the unit capacity in evaporator tons for HCFC-22 or HFC-134a conditions of 40.6°C (105°F) condensing, 4.4°C (40°F) suction and 25.6°C (78°F) wet bulb.

EXAMPLE

Given: 200 ton evaporator load, R-717, condensing at 35°C (95°F), with -12.2°C (+10°F) suction and 24.4°C (76°F) wet bulb temperatures.

Selection: The capacity factor from Table 6 for the given condensing and wet bulb conditions is 1.38, and the capacity factor for the suction temperature of -12.2°C (+10°F) is 1.03, so the corrected capacity required may be determined as:

200 X 1.38 X 1.03 = 284 corrected tons. Therefore, select a model LSC-295E or LRC-287 depending on unit type desired, and any layout or horsepower considerations.

Table 4 - Unit Sizes

LSC-E Models			
LSC-36E	LSC-281E	LSC-510E	LSC-900E
LSC-41E	LSC-295E	LSC-515E	LSC-920E
LSC-48E	LSC-300E	LSC-530E	LSC-950E
LSC-54E	LSC-310E	LSC-540E	LSC-960E
LSC-65E	LSC-315E	LSC-550E	LSC-980E
LSC-70E	LSC-330E	LSC-560E	LSC-1000E
LSC-75E	LSC-335E	LSC-590E	LSC-1020E
LSC-80E	LSC-345E	LSC-591E	LSC-1030E
LSC-90E	LSC-355E	LSC-620E	LSC-1060E
LSC-100E	LSC-360E	LSC-625E	LSC-1080E
LSC-110E	LSC-370E	LSC-650E	LSC-1100E
LSC-120E	LSC-385E	LSC-660E	LSC-1120E
LSC-135E	LSC-386E	LSC-690E	LSC-1180E
LSC-150E	LSC-400E	LSC-691E	LSC-1250E
LSC-155E	LSC-410E	LSC-720E	LSC-1310E
LSC-170E	LSC-430E	LSC-721E	LSC-1380E
LSC-185E	LSC-431E	LSC-755E	LSC-1440E
LSC-200E	LSC-450E	LSC-770E	LSC-1510E
LSC-210E	LSC-460E	LSC-800E	LSC-1610E
LSC-225E	LSC-475E	LSC-805E	
LSC-240E	LSC-480E	LSC-820E	
LSC-250E	LSC-490E	LSC-860E	
LSC-280E	LSC-500E	LSC-861E	

LRC Models			
LRC-25	LRC-76	LRC-174	LRC-246
LRC-27	LRC-84	LRC-183	LRC-249
LRC-29	LRC-91	LRC-188	LRC-255
LRC-35	LRC-101	LRC-190	LRC-269
LRC-38	LRC-108	LRC-201	LRC-287
LRC-42	LRC-114	LRC-211	LRC-300
LRC-48	LRC-116	LRC-213	LRC-321
LRC-51	LRC-128	LRC-225	LRC-336
LRC-58	LRC-131	LRC-227	LRC-361
LRC-65	LRC-140	LRC-233	LRC-379
LRC-72	LRC-155	LRC-240	

Note:

1) Table 4 presents only the standard model selections. Other models exist for special horsepower or layout applications. Please consult the factory or EVAPCO Representative for the special situations.

2)The condenser model in Table 4 is equal to the capacity in evaporator tons for HCFC-22 or HCFC-134a conditions of 40.6°C (105°F) condensing, 4.4°C (40°F) suction and 25.6°C (78°F) wet bulb.

S.I. Units

Condensing Pres (kPa)		Cond. Temp. (°C)	Wet Bulb Temperature (°C)																	
HCFC-22	HFC-134a		10	12	14	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1090	669	30	1.02	1.10	1.19	1.32	1.41	1.50	1.61	1.74	1.90	2.12	2.38	2.73	3.20	-	-	-	-	-
1154	718	32	0.91	0.97	1.05	1.15	1.21	1.28	1.35	1.43	1.55	1.67	1.83	2.03	2.27	-	-	-	-	-
1220	759	34	0.82	0.88	0.94	1.01	1.06	1.11	1.16	1.22	1.30	1.39	1.50	1.62	1.75	1.96	2.24	-	-	-
1253	785	35	0.78	0.83	0.89	0.95	0.99	1.03	1.08	1.12	1.18	1.26	1.34	1.43	1.52	1.67	1.85	2.08	2.35	2.70
1287	814	36	0.75	0.80	0.85	0.90	0.94	0.98	1.01	1.05	1.11	1.17	1.24	1.32	1.40	1.53	1.68	1.86	2.09	2.38
1359	856	38	0.69	0.73	0.77	0.81	0.84	0.87	0.89	0.92	0.96	1.00	1.05	1.10	1.17	1.25	1.34	1.45	1.60	1.76
1431	915	40	0.64	0.67	0.70	0.73	0.75	0.78	0.80	0.83	0.86	0.89	0.93	0.97	1.01	1.07	1.14	1.22	1.32	1.44
1508	978	42	0.60	0.62	0.64	0.67	0.69	0.71	0.73	0.75	0.77	0.80	0.83	0.86	0.90	0.94	0.99	1.05	1.11	1.19

Suction Temp. (°F)		-28.9°	-23.3°	-17.8°	-12.2°	-6.7°	-1.1°	4.4°	10.0°
Suction Press. (kPa)	HCFC-22	69.6	113.8	165.5	226.1	296.5	378.5	472.3	579.2
	HFC-134a	-12.4	13.1	44.8	82.0	126.9	180.0	241.3	313.0
Capacity Factor		1.22	1.17	1.13	1.09	1.06	1.03	1.00	0.97

Table 5a - HCFC-22 and HFC-134a Capacity Factors

Condensing Pres. (kPa)	Cond. Temp. (°C)	Wet Bulb Temperature (°C)																	
		10	12	14	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1063	30	0.96	1.03	1.12	1.24	1.32	1.41	1.52	1.65	1.80	2.00	2.25	2.57	3.02	-	-	-	-	-
1133	32	0.85	0.92	0.99	1.08	1.14	1.20	1.27	1.35	1.45	1.57	1.72	1.91	2.14	-	-	-	-	-
1206	34	0.78	0.83	0.88	0.95	1.00	1.05	1.10	1.15	1.22	1.31	1.41	1.52	1.66	1.85	1.85	-	-	-
1245	35	0.74	0.78	0.83	0.89	0.94	0.98	1.02	1.06	1.11	1.19	1.27	1.34	1.44	1.58	1.58	1.96	2.22	2.56
1284	36	0.71	0.75	0.80	0.85	0.89	0.92	0.96	0.99	1.04	1.10	1.17	1.24	1.32	1.43	1.43	1.75	1.97	2.24
1365	38	0.65	0.69	0.72	0.76	0.79	0.82	0.84	0.86	0.90	0.94	0.98	1.03	1.10	1.17	1.17	1.37	1.51	1.66
1451	40	0.60	0.63	0.66	0.69	0.71	0.74	0.76	0.77	0.80	0.84	0.88	0.92	0.95	1.01	1.01	1.15	1.24	1.35
1539	42	0.56	0.58	0.60	0.63	0.65	0.67	0.69	0.70	0.73	0.76	0.78	0.81	0.84	0.89	0.89	0.99	1.05	1.12

Suction Temp. (°C)	-34.4°	-28.9°	-23.3°	-17.8°	-12.2°	-6.7°	-1.1°	4.4°
Suction Press. (kPa)	-11.0	24.8	62.1	108.2	164.1	231.0	310.3	404.0
Capacity Factor	1.18	1.14	1.10	1.07	1.03	1.00	0.97	0.95

Table 6a - Ammonia (R-717) Capacity Factors

English Units

Condensing Pres. (psig)		Cond. Temp. (°F)	Wet Bulb Temperature (°F)																	
HCFC-22	HFC 134a		50	55	60	62	64	66	68	70	72	74	75	76	77	78	80	82	84	86
156	95	85	1.05	1.16	1.32	1.43	1.53	1.66	1.83	2.02	2.30	2.64	2.87	3.13	3.46	3.80	-	-	-	-
168	104	90	0.90	0.98	1.10	1.17	1.24	1.31	1.40	1.52	1.65	1.82	1.93	2.05	2.17	2.30	2.75	3.38	-	-
182	114	95	0.78	0.85	0.93	0.98	1.02	1.07	1.12	1.19	1.28	1.37	1.42	1.46	1.52	1.60	1.78	2.02	2.31	2.70
196	124	100	0.70	0.75	0.81	0.84	0.87	0.90	0.93	0.97	1.02	1.08	1.11	1.14	1.19	1.23	1.33	1.44	1.61	1.80
211	135	105	0.63	0.66	0.70	0.72	0.75	0.77	0.80	0.83	0.87	0.91	0.93	0.95	0.97	1.00	1.06	1.13	1.23	1.35
226	146	110	0.57	0.60	0.63	0.65	0.66	0.68	0.70	0.72	0.75	0.78	0.79	0.81	0.83	0.85	0.89	0.94	0.99	1.05

Suction Temp. (°F)		-20°	-10°	-0°	+10°	+20°	+30°	+40°	+50°
Suction Press. (psig)	HCFC-22	10.1	16.5	24.0	32.8	43.0	54.9	68.5	84.0
	HFC-134a	-1.8	1.9	6.5	11.9	18.4	26.1	35.0	45.4
Capacity Factor		1.22	1.17	1.13	1.09	1.06	1.03	1.00	0.97

Table 5b - HCFC-22 and HFC-134a Capacity Factors

Condensing Pres. (psig)	Cond. Temp. (°F)	Wet Bulb Temperature (°F)																	
		50	55	60	62	64	66	68	70	72	74	75	76	77	78	80	82	84	86
152	85	0.99	1.09	1.25	1.34	1.44	1.57	1.73	1.91	2.17	2.49	2.71	2.95	3.26	3.59	-	-	-	-
166	90	0.84	0.93	1.03	1.10	1.16	1.23	1.32	1.42	1.55	1.71	1.81	1.92	2.04	2.16	2.59	3.17	-	-
181	95	0.74	0.80	0.87	0.92	0.97	1.01	1.06	1.12	1.21	1.29	1.33	1.38	1.44	1.51	1.68	1.91	2.18	2.55
185	96.3	0.72	0.78	0.85	0.89	0.93	0.97	1.01	1.07	1.14	1.22	1.26	1.30	1.35	1.41	1.56	1.76	2.01	2.33
197	100	0.66	0.71	0.76	0.79	0.82	0.85	0.87	0.91	0.96	1.01	1.04	1.07	1.12	1.15	1.25	1.36	1.52	1.69
214	105	0.59	0.62	0.66	0.68	0.71	0.73	0.75	0.78	0.82	0.86	0.88	0.90	0.91	0.94	1.00	1.07	1.16	1.27
232	110	0.53	0.56	0.59	0.61	0.62	0.64	0.66	0.68	0.71	0.73	0.74	0.76	0.78	0.80	0.84	0.89	0.93	0.99

Suction Temp. (°F)	-30°	-20°	-10°	0°	+10°	+20°	+30°	+40°
Suction Press. (psig)	-1.6	3.6	9.0	15.7	23.8	33.5	45.0	58.6
Capacity Factor	1.18	1.14	1.10	1.07	1.03	1.00	0.97	0.95

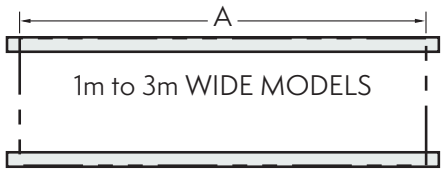
Table 6b - Ammonia (R-717) Capacity Factors

LSC-E / LRC Steel Support

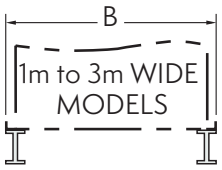
The recommended support for EVAPCO condensers is structural "I" beams located under the outer flanges and running the entire length of the unit. Mounting holes, 3/4" (19mm) in diameter are located in the bottom channels of the pan section to provide for bolting to the structural steel. (Refer to certified drawings from the factory for bolt hole locations.)

Beams should be level to within 1.5mm in 1m before setting the unit in place. Do not level the unit by shimming between it and the "I" beams as this will not provide proper longitudinal support.

Plan View



End Elevation

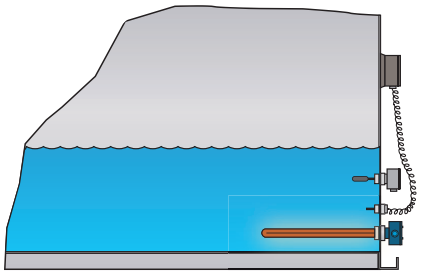


LSC-E DIMENSIONS		
1.2m Wide Models	**A (mm)**	**B (mm)**
LSC-36E to 80E	1826	1238
LSC-90E to 120E	2724	1238
LSC-135E to 170E	3651	1238
1.6m Wide Models	**A (mm)**	**B (mm)**
LSC-185E to 250E	3645	1652
LSC-280E to 385E	5483	1652
2.4m Wide Models	**A (mm)**	**B (mm)**
LSC-281E to 386E	3651	2388
LSC-410E to 560E	5486	2388
LSC-591E to 770E	7341	2388
LSC-820E to 1120E	11024	2388
3m Wide Models	**A (mm)**	**B (mm)**
LSC-400E to 515E	3651	2991
LSC-550E to 805E	5493	2991
LSC-800E to 1030E	7347	2991
LSC-1100E to 1610E	11036	2991

LRC DIMENSIONS		
1m Wide Models	**A (mm)**	**B (mm)**
LRC-25 to 72	3096	1029
1.5m Wide Models	**A (mm)**	**B (mm)**
LRC-76 to 114	3731	1540
LRC-108 to 183	4629	1540
LRC-190 to 246	5553	1540
2.4m Wide Models	**A (mm)**	**B (mm)**
LRC-188 to 269	4629	2388
LRC-249 to 379	5553	2388

Electric Heaters

Electric immersion heaters are available factory installed in the basin of the condenser. They are sized to maintain a +4.5°C (+40°F) pan water temperature with the fans off and an ambient air temperature of -18°C (0°F), -29°C (-20°F) or -40°C (-40°F). They are furnished with a thermostat and 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.



LSC-E Basin Heater Sizing			
Unit	**kW (-18°C)**	**kW (-29°C)**	**kW (-40°C)**
LSC-36E to 80E	(1) 2	(1) 3	(1) 4
LSC-90E to 120E	(1) 3	(1) 4	(1) 5
LSC-135E to 170E	(1) 3	(1) 5	(1) 7
LSC-185E to 250E	(1) 4	(1) 6	(1) 8
LSC-280E to 385E	(2) 3	(2) 4	(1) 12
LSC-281E to 386E	(1) 5	(1) 8	(1) 10
LSC-410E to 560E	(2) 4	(2) 6	(2) 7
LSC-591E to 770E	(2) 5	(2) 7	(2) 10
LSC-820E to 1120E	(2) 7	(2) 12	(2) 15
LSC-400E to 515E	(1) 7	(1) 10	(1) 15
LSC-550E to 805E	(2) 5	(2) 7	(2) 10
LSC-800E to 1030E	(2) 7	(2) 10	(2) 15
LSC-1100E to 1610E	(2) 10	(4) 7	(4) 9

LRC Basin Heater Sizing			
Unit	**kW (-18°C)**	**kW (-29°C)**	**kW (-40°C)**
LRC-25 to 72	(1) 2	(1) 3	(1) 4
LRC-76 to 114	(1) 3	(1) 5	(1) 6
LRC-108 to 183	(1) 4	(1) 6	(1) 8
LRC-190 to 246	(1) 6	(1) 8	(1) 12
LRC-188 to 269	(1) 7	(1) 9	(1) 12
LRC-249 to 379	(1) 9	(1) 12	(1) 16

LSC-E / LRC Optional Equipment

Smart Shield® Solid Chemistry Water Treatment System

EVAPCO's Smart Shield® solid chemistry water treatment system is an innovative solution to conventional liquid chemical programs. Smart Shield® was developed specifically for evaporative condensers and closed circuit coolers. The system comes factory mounted and includes all the components required for an effective water treatment system. Solid products eliminate the potential for liquid spills making it easier and safer to use. Controlled release chemistry provides uniform treatment over a 30-day period.

Self Supporting Service Platforms

Some LSC-E condensers are available with self-supporting service platforms that include access ladders which are designed for easy field installation. This option offers significant savings in comparison to field constructed, externally supported catwalks. The EVAPCO service platform option may be installed on either side or the end opposite the connections.

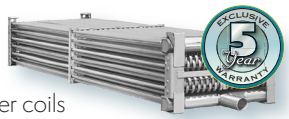
Multiple Circuit Coils

Condensers may be supplied with multiple circuit coils to match various system requirements such as split systems, or if a glycol or water circuit is desired for compressor head cooling.

ASME Coils

Evaporative condensers can be furnished with condensing coils manufactured in accordance with the ASME Pressure Vessel Code Section VIII, Division I. Coils built with this option will bear a ASME stamp U designator indicating their compliance with the ASME code.

TITAN Coils – Stainless Steel Construction



EVAPCO offers the option of Type 304L or Type 316L stainless steel construction using the Thermal Pak® II coil design. Highly efficient heat transfer coils with the ultimate corrosion protection.

Electric Water Level Control

Evaporative condensers may be ordered with an electric water level control in lieu of the standard mechanical float and make-up assembly. This package provides accurate control of water levels and does not require field adjustment.

Two Speed Motors

Two speed fan motors can provide an excellent means of capacity control. In periods of lightened loads or reduced wet bulb temperatures, the fans can operate at low speed, which will provide about 60% of full speed capacity, yet consume only about 15% of the power compared with high speed. In addition to the energy savings, the sound levels of the units will be greatly reduced at low speed.

Pony Motors

In addition to two speed fan motors, variable frequency drives (VFD's) and fan cycling on multiple motor units, pony motors are available as another capacity control method. Pony motors are smaller fan motors for use in times of reduced loading. The pony motor is typically 1/4 the kW of the primary motor and can significantly reduce energy requirements.

Remote Sump Configuration

For units operating in areas where temperatures may be very low, or where low temperatures may occur during periods when the unit is not operating, a sump located inside the building is the preferred means of ensuring that the basin water will not freeze. For these applications, the condenser will be supplied without the spray pump, suction strainers and all associated piping, but with an oversize bottom outlet.

Screened Bottom Panels

Protective inlet screens are provided on the sides and/or end of the unit's air intake. Screens are not provided below the fan section since most units are mounted on the roof or at ground level. It is recommended that bottom screens be added to the unit when it will be elevated. These screens can be provided by the factory at an additional cost or added by the installing contractor.

Solid Bottom Panels for Ducted Installations

When centrifugal fan units are installed indoors and intake air is ducted to the unit, a solid bottom panel is required to completely enclose the fan section and prevent the unit from drawing air from the room into the fan intakes. When this option is ordered, air inlet screens are omitted.

Sound Attenuation Package

For extremely noise-sensitive applications, centrifugal fan models may be supplied with intake and/or discharge attenuation packages which greatly reduce sound levels. Oversize fan motors are required for this option in order to overcome the additional static pressure.

Oversized Access Door

For enhanced basin access, the Oversized Access Door option is available on LSC-E 3 meters wide models LSC-400E through LSC-1610E. This option enables maintenance personnel to easily enter the basin for routine maintenance or for float valve adjustment.

Design

EVAPCO Evaporative Condensers are of heavy-duty construction and designed for long trouble-free operation. Proper equipment selection, installation and maintenance is, however, necessary to ensure full unit performance. Some of the major considerations in the application of a cooler are presented below. For additional information, contact the factory.

Air Circulation

In reviewing the system design and unit location, it is important that proper air circulation be provided. The best location is on an unobstructed roof top or on ground level away from walls and other barriers. Care must be taken when locating condensers in wells or enclosures or next to high walls. The potential for recirculation of hot, moist discharge air back into the fan intake exists. Recirculation raises the wet bulb temperature of the entering air causing the tower pressure to rise above the design. For these cases, a discharge hood or ductwork should be provided to raise the overall unit height even with the adjacent wall, thereby reducing the chance of recirculation. Good engineering practice dictates that the cooling tower's discharge air not be directed or located close to or in the vicinity of building air intakes. Engineering assistance is available from the factory to identify potential recirculation problems and recommend solutions.

For additional information regarding layout of cooling towers, see EVAPCO Bulletin entitled "Equipment Layout".

Piping

Condenser 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 condenser connections, nor should any of the pipe supports be anchored to the unit framework. For additional information concerning refrigerant pipe sizing and layout, see EVAPCO Bulletin entitled "Piping Evaporative Condensers".

Recirculating Water Quality

Proper water treatment is an essential part of the maintenance required for evaporative cooling equipment. A well designed and consistently implemented water treatment program will help to ensure efficient system operation while maximizing the equipment's service life. A qualified water treatment company should design a site specific water treatment protocol based on equipment (including all metallurgies in the cooling system), location, makeup water quality, and usage.

Bleed off

Evaporative cooling equipment requires a bleed or blowdown line, located on the discharge side of the recirculating pump, to remove concentrated (cycled up) water from the system. EVAPCO recommends an automated conductivity controller to maximize the water efficiency of your system. Based on recommendations from your water treatment company, the conductivity controller should open and close a motorized ball or solenoid valve to maintain the conductivity of the recirculating water. If a manual valve is used to control the rate of bleed it should be set to maintain the conductivity of the recirculating water during periods of peak load at the maximum level recommended by your water treatment company.

Water Treatment

In some cases the make-up 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 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 8.0. **Units constructed of galvanized steel operating with circulating water having a pH of 8.3 or higher will require periodic passivation of the galvanized steel to prevent the formation of "white rust".** 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. For more information see EVAPCO Bulletin entitled "Maintenance Instructions".

Control of Biological Contaminants

Evaporative cooling equipment should be inspected regularly to ensure good microbiological control. Inspections should include both monitoring of microbial populations via culturing techniques and visual inspections for evidence of biofouling.

Poor microbiological control can result in loss of heat transfer efficiency, increase corrosion potential, and increase the risk of pathogens such as those that cause Legionnaires' disease. Your site specific water treatment protocol should include procedures for routine operation, startup after a shut-down period, and system lay-up, if applicable. If excessive microbiological contamination is detected, a more aggressive mechanical cleaning and/or water treatment program should be undertaken.

LSC-E/LRC Specifications

Furnish and install, as shown on the plans, an EVAPCO model _____ evaporative condenser. Each unit shall have condensing capacity of _____ kW heat rejection, operating with _____ refrigerant at _____ °C condensing temperature and _____ °C design wet bulb temperature.

Cold Water Basin – LRC

The complete cold water basin shall be constructed of G-235 hot-dip galvanized steel for long life and durability.*

Standard cold water basin accessories shall include G-235 hot-dip galvanized steel overflow, drain, anti-vortexing hood, strainers, brass make-up valve with unsinkable, foam filled plastic float and wastewater bleed line with adjustable valve.

Casing and Fan Section – LRC

The casing and fan section shall be constructed of G-235 galvanized steel for long life and durability. Fan section shall include fans, motors and drives. The entire drive system (including fans, motors, sheaves and belts) shall be located in the dry entering airstream.

Pan and Casing – LSC-E

The pan and casing shall be constructed of G-235 hot-dip galvanized steel for long life and durability. The heat transfer section shall be removable from the pan to provide easy handling and rigging.

The pan/fan section shall include fans, motors and drives mounted and aligned at the factory. These items shall be located in the dry entering air stream to provide maximum service life and easy maintenance. Standard pan accessories shall include circular access doors, stainless steel strainers, wastewater bleed line with adjustable valve and brass makeup valve, with an unsinkable foam filled plastic float.

Centrifugal Fan Drives

Fans shall be forwardly curved centrifugal type of hot-dip galvanized construction. The fans shall be factory installed into the pan-fan section, and statically and dynamically balanced for vibration free operation. Fans shall be mounted on a hollow steel shaft with forged bearing journals. The fan shaft shall be supported by heavy-duty, self aligning bearings with cast-iron housings and lubrication fittings for maintenance.

The fan drive shall be V-belt type with taper lock bushings designed for 150% of motor nameplate horsepower. Drives are to be mounted and aligned at the factory.

Fan Motor

_____ kW totally enclosed fan cooled motor(s) shall be furnished suitable for outdoor service on _____ volts, _____ hertz, and _____ phase. Motor(s) shall be mounted on an adjustable base.

Heat Transfer Coil

The coil(s) shall be all prime surface steel, encased in steel framework with the entire assembly hot-dip galvanized after fabrication. Coil(s) shall be designed for free drainage of liquid refrigerant and tested to 390psig/2.69MPa air pressure under water.

Water Distribution System

The system shall provide a water flow rate of 4 LPS over each square meter of the unit face area to ensure proper flooding of the coil. The spray header shall be constructed of Schedule-40, PVC pipe for corrosion resistance. All spray branches shall be removable and include a threaded end plug for cleaning. The water shall be distributed over the entire coil surface by heavy-duty ABS spray nozzles with large 1-1/4" (32mm) diameter opening and internal sludge ring to eliminate clogging. ZM nozzles are threaded into Schedule-40 Polyvinyl Chloride headers equipped with removable end plugs for ease of cleaning. Nozzles shall be threaded into a spray header to provide easy removal for maintenance.

Water Recirculation Pump

The pump(s) shall be a close-coupled, centrifugal type with mechanical seal. _____ kW totally enclosed, motor shall be furnished suitable for outdoor service on _____ volts, _____ hertz, and _____ phase.

Eliminators

The eliminators shall be constructed entirely of PVC that has been specially treated to resist ultra-violet light. Assembled in easily handled sections, the eliminator blades shall incorporate three changes in air direction to assure removal of entrained moisture from the discharge air stream The maximum drift rate shall not exceed 0.001% of the recirculated water rate.

Finish-LSC-E

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

Finish-LRC

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

* Available in Type 304 and Type 316 stainless steel construction as an option.

Notes

Notes

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