Alfa Laval Kathabar liquid desiccant
Engineering reference guide
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Kathabar Dehumidification Systems

Alfa Laval Kathabar dehumidification systems are engineered solutions for temperature and humidity control for industrial, commercial, educational, institutional and green/LEED facilities. These cost-effective dehumidification and energy recovery systems are used to clean, cool and dehumidify air for a wide range of industries worldwide – including pharmaceutical, meat and poultry, healthcare, cold storage, food and beverage, and many more.

These systems help to improve the reliability, economy and efficiency of any conditioned air application that is humidity, temperature or microorganism-sensitive. We meet the ever-changing needs of our customers with quality products – providing reliable, precise and economical temperature and humidity control.

Alfa Laval Kathabar FRP series

The latest product of this design evolution, the Kathabar FRP series, is designed to provide additional values for all dehumidification applications. This completely corrosion-resistant line of dehumidification equipment utilizes an extremely efficient direct contact packing and an external heat exchanger for greater longevity and performance than previous designs. Its values and benefits include the following:

- Simple, accurate control of performance
- Large airflow capacity
- Simple integration
- Low utility consumption
- Low maintenance cost
- Improved air quality
- Insensitivity to airborne contamination
- Long equipment and desiccant life
Operating principle

- Kathabar systems operate on the principle of chemical absorption of water vapor from air. The absorbent or desiccant solution used, Kathene®, is a water solution of lithium chloride salt. Kathene solution is non-toxic, will not vaporize, and is not degraded by common airborne contaminants.
- The ability of Kathene to remove or add water vapor from the air is determined by the temperature and concentration of the solution. The concentration of Kathene can be adjusted so the conditioner delivers air at any desired relative humidity between about 18% and 80%. For a given Kathene concentration, lower solution temperatures enable the conditioner to deliver cooler, dryer air.
- Figure 1 below shows the basic elements of a Kathabar system. In operation, air to be conditioned is cooled and dehumidified by contacting the Kathene in the conditioner. By continuously circulating the desiccant through a heat exchanger, energy is extracted from the air and transferred to a coolant. The amount of heat extracted by the Kathabar dehumidifier is modulated by controlling coolant flow through the heat exchanger.
- A small portion of the desiccant diluted by the water removed from the air stream flows to the regenerator where it is heated to transfer the water to a scavenger air stream and returned to the conditioner to maintain the proper conditioner desiccant concentrator.

Alfa Laval Kathabar system schematic – Figure 1
Alfa Laval Kathabar equipment pictures

Alfa Laval Kathabar conditioners

Alfa Laval Kathabar regenerator

Alfa Laval Kathabar small packaged (SP) unit
Alfa Laval Kathabar small packaged unit
SP 240 Alfa Laval Kathabar unit – Figure 2

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>Cond. Fan HP</th>
<th>Nominal Fan CFM</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP 240</td>
<td>5</td>
<td>2,400</td>
</tr>
</tbody>
</table>

Notes
1. A clearance of two feet minimum is required for maintenance access.
2. All piping, ductwork, and conduit to run clear of all access doors.
3. Ductwork entering the inlet plenums must be designed for a maximum velocity of 15 ft./min.
4. Inlet plenums must extend a minimum of 36 inches from the unit to provide adequate room for maintenance.
Alfa Laval Kathabar small packaged unit
SP 400 & 600 Alfa Laval Kathabar units – Figure 3

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>Dimensions (Inches)</th>
<th>Cond. Fan HP</th>
<th>Nominal Fan CFM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>SP 400</td>
<td>119</td>
<td>125</td>
<td>48</td>
</tr>
<tr>
<td>SP 600</td>
<td>163</td>
<td>132</td>
<td>72</td>
</tr>
</tbody>
</table>

Notes
1. A clearance of two feet minimum is required for maintenance access.
2. All piping, ductwork, and conduit to run clear of all access doors.
3. Ductwork entering the inlet plenums must be designed for a maximum velocity of 15 ft./min.
4. Inlet plenums must extend a minimum of 36 inches from the unit to provide adequate room for maintenance.
Vertical Alfa Laval Kathabar conditioner
FV 240 Alfa Laval Kathabar conditioner – Figure 4

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>Nominal Pump HP</th>
<th>Nominal Fan HP</th>
<th>Nominal Fan CFM</th>
</tr>
</thead>
<tbody>
<tr>
<td>FV 240</td>
<td>2</td>
<td>5</td>
<td>2400</td>
</tr>
</tbody>
</table>

Notes
1. A clearance of two feet minimum is required for maintenance access.
2. All piping, ductwork, and conduit to run clear of all access doors.
3. Tower and sump are permanently bonded and shipped as one piece.
4. Ductwork leaving the discharge plenum must be designed for a maximum velocity of 1000 ft./min.
5. Discharge plenum must be one-half inch larger than the outlet opening. Discharge plenum must extend a minimum of 36 inches from the unit to provide adequate room for maintenance. Larger plenums may be required to meet the duct velocity criteria in note number 4 above.
Vertical Alfa Laval Kathabar conditioner
FV 400 & 600 Alfa Laval Kathabar conditioners – Figure 5

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>Dimensions (Inches)</th>
<th>Nominal Pump HP</th>
<th>Nominal Fan HP</th>
<th>Nominal Fan CFM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>FV 400</td>
<td>74</td>
<td>14 1/2</td>
<td>48</td>
<td>2</td>
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<tr>
<td>FV 600</td>
<td>98</td>
<td>16 1/2</td>
<td>72</td>
<td>3</td>
</tr>
</tbody>
</table>

Notes
1. A clearance of two feet minimum is required for maintenance access.
2. All piping, ductwork, and conduit to run clear of all access doors.
3. Fan and fan drive ship separately.
4. Tower and sump are permanently bonded and shipped as one piece.
**Vertical Alfa Laval Kathabar conditioner**

**FV 800 through 1600 & SFV 2000 Alfa Laval Kathabar conditioners** – Figure 6

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>Dimensions (Inches)</th>
<th>Nominal Pump HP</th>
<th>Nominal Fan HP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>FV 800</td>
<td>55-1/2</td>
<td>88</td>
<td>60</td>
</tr>
<tr>
<td>FV 1200</td>
<td>85-1/2</td>
<td>118</td>
<td>90</td>
</tr>
<tr>
<td>FV 1600</td>
<td>115-1/2</td>
<td>148</td>
<td>120</td>
</tr>
<tr>
<td>SFV 2000</td>
<td>147-1/2</td>
<td>180</td>
<td>150</td>
</tr>
</tbody>
</table>

**Notes**

1. A clearance of two feet minimum is required for maintenance access.
2. All piping, ductwork, and conduit to run clear of all access doors.
3. Housing and pump tank ship separately.
4. Optional fans with adapters for mounting on unit discharge.
5. Tower and sump are permanently bonded and shipped as one piece.
6. Ductwork entering the inlet plenum must be designed for a maximum velocity of 1500 ft./min. Ductwork leaving the discharge plenum must be designed for a maximum velocity of 1000 ft./min.
7. Discharge plenum must be one-half inch larger than the outlet opening. Inlet and discharge plenums must extend a minimum of 36 inches from the unit to provide adequate room for maintenance. Larger plenums may be required to meet the duct velocity criteria in note number 6 above.
Vertical Alfa Laval Kathabar conditioner
FV 2000 through 7000 Alfa Laval Kathabar conditioners—Figure 7

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>Dimensions (Inches)</th>
<th>Nominal Pump HP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>FV 2000</td>
<td>89 3/4</td>
<td>132 1/4</td>
</tr>
<tr>
<td>FV 2500</td>
<td>113 3/4</td>
<td>156 1/4</td>
</tr>
<tr>
<td>FV 3000</td>
<td>137 3/4</td>
<td>180 1/4</td>
</tr>
<tr>
<td>FV 4000</td>
<td>185 3/4</td>
<td>232 1/4</td>
</tr>
<tr>
<td>FV 5000</td>
<td>233 3/4</td>
<td>280 1/4</td>
</tr>
<tr>
<td>FV 6000</td>
<td>281 3/4</td>
<td>328 1/4</td>
</tr>
<tr>
<td>FV 7000</td>
<td>329 3/4</td>
<td>376 1/4</td>
</tr>
</tbody>
</table>

**Notes**
1. A clearance of two feet minimum is required for maintenance access.
2. All piping, ductwork, and conduit to run clear of all access doors.
3. Housing and pump tank ship separately.
4. Tower and sump are permanently bonded and shipped as one piece.
5. Ductwork entering the inlet plenum must be designed for a maximum velocity of 1500 ft./min. Ductwork leaving the discharge plenum must be designed for a maximum velocity of 1000 ft./min.
6. Discharge plenum must be one-half inch larger than the outlet opening. Inlet and discharge plenums must extend a minimum of 36 inches from the unit to provide adequate room for maintenance. Larger plenums may be required to meet the duct velocity criteria in note number 5 above.
Horizontal Alfa Laval Kathabar conditioner
FH 800 through 1600 Alfa Laval Kathabar conditioners – Figure 8

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>Dimensions (Inches)</th>
<th>Nominal Pump HP</th>
</tr>
</thead>
<tbody>
<tr>
<td>FH 800</td>
<td>A 60 3/4 B 93 1/4 C 60</td>
<td>5</td>
</tr>
<tr>
<td>FH 1200</td>
<td>A 90 3/4 B 123 1/4 C 90</td>
<td>5</td>
</tr>
<tr>
<td>FH 1600</td>
<td>A 120 3/4 B 153 1/4 C 120</td>
<td>7 1/2</td>
</tr>
</tbody>
</table>

Notes
1. A clearance of two feet minimum is required for maintenance access.
2. All piping, ductwork, and conduit to run clear of all access doors.
3. Housing and pump tank ship separately.
4. Tower and sump are permanently bonded and shipped as one piece.
5. Ductwork entering the inlet plenum must be designed for a maximum velocity of 1500 ft./min. Ductwork leaving the discharge plenum must be designed for a maximum velocity of 1000 ft./min.
6. Inlet and discharge plenums must extend a minimum of 36 inches from the unit to provide adequate room for maintenance. Larger plenums may be required to meet the duct velocity criteria in note number 5 above.
Horizontal Alfa Laval Kathabar conditioner
FH 2000 through 7000 Alfa Laval Kathabar conditioners – Figure 9

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>Dimensions (Inches)</th>
<th>Nominal Pump HP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>FH 2000</td>
<td>96 3/4</td>
<td>139 1/4</td>
</tr>
<tr>
<td>FH 2500</td>
<td>120 3/4</td>
<td>163 1/4</td>
</tr>
<tr>
<td>FH 3000</td>
<td>144 3/4</td>
<td>187 1/4</td>
</tr>
<tr>
<td>FH 4000</td>
<td>192 3/4</td>
<td>235 1/4</td>
</tr>
<tr>
<td>FH 5000</td>
<td>240 3/4</td>
<td>287 1/4</td>
</tr>
<tr>
<td>FH 6000</td>
<td>288 3/4</td>
<td>335 1/4</td>
</tr>
<tr>
<td>FH 7000</td>
<td>336 3/4</td>
<td>383 1/4</td>
</tr>
</tbody>
</table>

Notes:
1. A clearance of two feet minimum is required for maintenance access.
2. All piping, ductwork, and conduit to run clear of all access doors.
3. Housing and pump tank ship separately.
4. Tower and sump are permanently bonded and shipped as one piece.
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Alfa Laval Kathabar regenerator
FP 1.5 through 6 Alfa Laval Kathabar regenerators – Figure 10

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>Dimensions (Inches)</th>
<th>Nominal Pump HP</th>
<th>Nominal Fan HP</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP 1.5</td>
<td>A 41  B 37  C 10  D 15  E 12  F 9 3/4  G 9 1/2</td>
<td>1 1/2</td>
<td>1 1/2</td>
</tr>
<tr>
<td>FP 3</td>
<td>A 56  B 37  C 12  D 30  E 12  F 17 1/4  G 9 1/2</td>
<td>1 1/2</td>
<td>1 1/2</td>
</tr>
<tr>
<td>FP 6</td>
<td>A 62  B 50  C 16  D 36  E 16  F 20 1/4  G 14</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Notes
1. A clearance of two feet minimum is required for maintenance access.
2. All piping, ductwork, and conduit to run clear of all access doors.
3. Tower and sump are permanently bonded and shipped as one piece.
Alfa Laval Kathabar regenerator
FP 10 & 15 Alfa Laval Kathabar regenerators – Figure 11

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>Dimensions (Inches)</th>
<th>Nominal Pump HP</th>
<th>Nominal Fan HP</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP 10</td>
<td>A 46 3/4  B 79 1/4  C 26  D 22</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>FP 15</td>
<td>A 70 3/4  B 103 1/4  C 38  D 26</td>
<td>5</td>
<td>7 1/2</td>
</tr>
</tbody>
</table>

Notes:
1. A clearance of two feet minimum is required for maintenance access.
2. All piping, ductwork, and conduit to run clear of all access doors.
3. Housing and pump tank ship separately.
4. Tower and sump are permanently bonded and shipped as one piece.
Alfa Laval Kathabar regenerator
FP 20 through 40 Alfa Laval Kathabar regenerators – Figure 12

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>Dimensions (Inches)</th>
<th>Nominal Pump HP</th>
<th>Nominal Fan HP</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP 20</td>
<td>A 57 1/2 B 90 C 22 1/2 D 45 1/2 E 32 F 60 G 30 H 3 J 38 1/2 K 32 1/2</td>
<td>7 1/2</td>
<td>10</td>
</tr>
<tr>
<td>FP 30</td>
<td>A 87 1/2 B 120 C 22 1/2 D 45 1/2 E 48 F 72 G 36 H 4 J 38 1/2 K 47 1/2</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>FP 40</td>
<td>A 117 1/2 B 160 C 32 1/2 D 45 1/2 E 48 F 72 G 42 H 4 J 46 1/2 K 62 1/2</td>
<td>15</td>
<td>20</td>
</tr>
</tbody>
</table>

Notes:
1. A clearance of two feet minimum is required for maintenance access.
2. All piping, ductwork, and conduit to run clear of all access doors.
3. Housing and pump tank ship separately.
4. Tower and sump are permanently bonded and shipped as one piece.
Notes
1. Heat exchanger vent to be located at high point of Kathene supply line.
2. Use three-bond sealant on threads in Kathene piping.
3. Kathene piping and fittings are CPVC or FRP.
4. Allow at least three feet of clearance along one side of heat exchanger for maintenance access.
Kathene solution heater piping schematic

Notes
1. Use drip leg from steam main when:
   a. Steam supply to control valve exceeds 50 feet.
   b. Steam supply is branched from side or bottom of main.
   c. Steam supply is lowered and then lifted between steam main and control valve or lowered and stopped by control valve.
2. Use pressure reducing valve when steam supply pressure exceeds 30 psig.
3. When condensate return line is overhead, a condensate receiver and pump must be used.
4. Use drip leg ahead of heater when pipe run from control valve exceeds 50 feet or when steam supply is lowered and then lifted between control valve and heater.
5. Service hand valves are required in Kathene supply and discharge lines if heater is installed at an elevation lower than the regenerator pump tank.
6. See cooler piping schematic for installation details of pressure gauge and thermometer.
7. Elevate heater to provide sufficient height for 12 inches vertical condensate drop and pitch of gravity return line to condensate pump or return main.
8. Vent valve to be located at high point of Kathene supply line.
9. Heater Kathene piping and fittings are FRP.
10. Use three-bond sealant on threads in Kathene piping.
11. Allow at least three feet of clearance along one side of heat exchanger for maintenance access.
Kathene control and piping schematic
Gravity equalized system

Legend

**BT**  
**Bubbler Tube** - Used in conjunction with the **LCP/ECP** to pneumatically sense solution level.

**FM**  
**Flow Meter** - Measures and controls the transfer of concentrated solution from the regenerator to the conditioner.

**LCP/ECP**  
**Level & Electrical Control Panel (PLC)** - Provides:
- High level, low level alarms
- Water make-up **V5**
- Modulating control of **V3** based on TT leaving air set-point
- Modulating control of **V4** based on **BT** to maintain level

**TT**  
**Temperature Transmitter** - Senses leaving air temperature and transmits the signal to the PLC in **LCP/ECP** for **V3** modulation control to maintain set-point.

**V3**  
**Conditioner Solution Cooler Valve** - Receives a modulating signal from the PLC in **ECP/LCP** to maintain **BT** set-point.

**V4**  
**Regenerator Heater Valve** - Receives a modulating signal from the PLC in **ECP/LCP** to maintain **BT** set-point.

**V5**  
**Water Make-up Valve** - Receives a on/off signal from the PLC in **ECP/LCP** based on **BT** low level set-point.
Kathene control and piping schematic
Pump in, pump out system

Legend

**BT 1 & 2**  **Bubbler Tube** - Used in conjunction with the **LCP/ECP** to pneumatically sense solution level.

**FM**  **Flow Meter** - Measures and controls the transfer of concentrated solution from the regenerator to the conditioner.

**LCP/ECP 1**  **Level & Electrical Control Panel** – Provides:
- High level, low level alarms
- Modulating control of **V4** based on **BT 1** to maintain level.

**KV7**  **Conditioner Pump Out Valve** - Receives a modulating signal from the **LCP/ECP 2** to maintain **BT 2** set-point.

**TT**  **Temperature Transmitter** - Senses leaving air temperature and transmits the signal to the PLC in **LCP/ECP 2** for **V3** modulation control to maintain set-point.

**LCP/ECP 2**  **Level & Electrical Control Panel (PLC)** – Provides:
- High level, low level alarms
- Water make-up **V5**
- Modulating control of **V3** based on **TT** leaving air set-point.
- Modulating control of **KV7** based on **BT 2** to maintain level.

**V3**  **Conditioner Solution Cooler Valve** - Receives a modulating signal from the PLC in **ECP/LCP 2** based on **TT** set-point.

**V4**  **Regenerator Heater Valve** - Receives a modulating signal from the PLC in **ECP/LCP 1** to maintain **BT 1** set-point.

**V5**  **Water Make-up Valve** - Receives an on/off signal from the PLC in **ECP/LCP 2** based on **BT 2** low level set-point.
Alfa Laval Kathabar performance estimating
Sample problem design data

Outside air requirements 1,000 SCFM
Outside air summer design 95°F DB, 78°F WB
Space maintained conditions 75°F, 30% R.H. 39 Gr/Lb
Internal sensible load (including fan heat) 450,000 BTU/Hr
Internal latent load 325,000 BTU/Hr
Maximum diffusion temperature difference 20°F
Available coolant 45°F chilled water
Available heat source 200°F hot water

A. Determine conditioner leaving air temperature and airflow
Leaving temperature = 75°F maintained - 20°F diffusion = 55°F
Airflow = 450,000 BTU/Hr ISL = 20,833 SCFM
20°F diffusion x 1.08

B. Select conditioner size from Engineering data table, page 29
Unit size 2000 will accommodate 20,833 SCFM

C. Determine maximum diffusion humidity difference
Difference = 325,000 BTU/Hr ILL = 22.9 Gr/Lb
20,833 SCFM x .68

D. Determine conditioner leaving air humidity
Leaving air humidity = 39 Gr/Lb space maintained - 22.9 Gr/Lb diffusion difference = 16.1 Gr/Lb

E. Check conditioner leaving air temperature and humidity to be sure that the desired performance falls within the conditioner performance envelope
Desired performance is 55°F, 16.1 Gr/Lb per Psychrometric chart, page 25, at a leaving air temperature of 55°F the conditioner can deliver air as dry as 11 Gr/Lb
Therefore, conditioner can meet desired performance

F. Determine air temperature and humidity entering conditioner
1,000 SCFM outside air @ 95°F DB, 78°F WB, 118 Gr/Lb
20,833 SCFM - 1,000 SCFM = 19,833 SCFM return air @ 75°F, 39 Gr/Lb
Mix air temperature = 75°F + 1,000 SCFM (95°F - 75°F) = 76°F
20,833 SCFM
Mix air humidity = 39 Gr/Lb + 1,000 SCFM (118 Gr/Lb - 39 Gr/Lb) = 42.8 Gr/Lb
20,833 SCFM
Therefore, air enters at 76°F, 42.8 Gr/Lb
G. Determine maximum coolant supply temperature that will achieve the desired conditioner performance

Air enters conditioner at 76°F, 42.9 Gr/Lb
Air leaves conditioner at 55°F, 16.1 Gr/Lb
Air temperature depression = 76°F - 55°F = 21°F
Air humidity depression = 42.9 Gr/Lb - 16.1 Gr/Lb = 26.7 Gr/Lb
See Air to coolant approach curves (see Figures 15 and 16, page 26)
With Kathabar FV, approach = 7.8°F
Maximum coolant supply temp. = 55°F - 7.8°F = 47.2°F
With Kathabar FH, approach = 10.4°F
Maximum coolant supply temp. = 55°F - 10.4°F = 44.6°F
Therefore, Kathabar FV Conditioner can provide desired performance with 45°F chilled water

H. Determine the design moisture removal (MR) load on the conditioner

Air humidity depression = 26.7 Gr/Lb
Airflow = 20,833 SCFM
20,833 SCFM x .643 x 26.7 Gr/Lb = 358 Lbs/Hr (MR)

I. Determine regenerator capacity
Lbs/Hr/Ft²
Air leaves conditioner @ 55°F, 16.1 Gr/Lb (25% R.H.)
Kathabar regenerator capacity curve (see Figure 18, page 27)
Therefore, with 200°F hot water and 25% R.H. air, regenerator capacity = 40 Lbs/Hr/Ft²

J. Calculate minimum regenerator face area required to handle design moisture removal load
358 Lbs/Hr = 9.0 Ft² min. face area
40 Lbs/Hr/Ft²

K. Select regenerator having sufficient face area using Kathabar regenerator engineering data table, page 29. Per table, select a 10 FP Regenerator with 10 Ft² face area

L. Determine regenerator load using design moisture removal and face area of selected regenerator
358 Lbs/Hr = 35.8 Lbs/Hr/Ft²
10 Ft² Face

M. Determine regenerator heat requirements at design load, using Kathabar regenerator heat requirements (see Figure 20, page 28)
Regenerator load = 35.8 Lbs/Hr/Ft²
Conditioner leaving humidity = 25% R.H.
Conditioner leaving temperature = 55°F
Therefore, 2,075 BTU/Lb x 358 Lbs/Hr MR = 743,000 BTU/Hr regenerator heat input
Alfa Laval Kathabar performance estimating (continued)

N. Determine conditioner cooling load at design conditions as follows:

Calculate sensible cooling loads
20,833 SCFM x 1.08 x (76°F - 55°F) = 472,500 BTU/Hr sensible load

Calculate latent cooling load using design moisture removal and Kathabar conditioner “L” factor (see Figure 17, page 27)

Regenerator load = 35.8 Lbs/Hr/Ft²
Conditioner leaving humidity = 25% R.H.
Conditioner leaving temperature = 55°F
Therefore, “L” Factor = 1,320 BTU/Lb
358 Lbs/Hr x 1,320 BTU/Lb = 472,600 BTU/Hr latent load
Total cooling load = 472,500 BTU/Hr + 472,600 BTU/Hr = 945,100 BTU/Hr (78.8 tons)

System flow diagram – Figure 13
Advantages of liquid desiccant dehumidification

- High energy efficiency
- Can make use of low cost coolant and heat sources
- Provides anti-microbial filtration of incoming air without the need of added filtration & pressure drop
- Applicable for delivered air relative humidity between ~18-80%

Advantages of dry desiccant dehumidification

- Can be provided as a complete packaged unit on a single skid base
- Can make use of scavenger heat sources to aide in desiccant reactivation
- Can provide dew-points as low as -65°F (-54°C)
Alfa Laval Kathabar performance curves

Alfa Laval Kathabar FV air to coolant approach – Figure 15

Alfa Laval Kathabar FH air to coolant approach – Figure 16
Alfa Laval Kathabar performance curves

Alfa Laval Kathabar conditioner
“L” factor – Figure 17

Alfa Laval Kathabar regenerator capacity – Figure 18
Pressure drop through Alfa Laval Kathabar conditioners – Figure 19

Alfa Laval Kathabar regenerator heat requirements – Figure 20
Alfa Laval Kathabar small packaged unit, conditioner and regenerator engineering data

Small packaged units (SP series)

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>Conditioner</th>
<th>Regenerator</th>
<th>Unit Weight, Lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Airflow</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP 240</td>
<td>1,500</td>
<td>3,000</td>
<td>6</td>
</tr>
<tr>
<td>SP 400</td>
<td>2,500</td>
<td>5,000</td>
<td>10</td>
</tr>
<tr>
<td>SP 600</td>
<td>3,750</td>
<td>7,500</td>
<td>15</td>
</tr>
</tbody>
</table>

Conditioner units (FV, FH series)

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>Kathabar FV (Vertical)</th>
<th>Kathabar FH (Horizontal)</th>
<th>Unit Weight, Lbs</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Airflow</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Min. CFM</td>
<td>Max. CFM</td>
<td>Air Face Sq. Ft.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>240</td>
<td>1,500</td>
<td>3,000</td>
<td>6</td>
</tr>
<tr>
<td>400</td>
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<td>5,000</td>
<td>10</td>
</tr>
<tr>
<td>600</td>
<td>3,750</td>
<td>7,500</td>
<td>15</td>
</tr>
</tbody>
</table>

Regenerator units (FP series)

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>Airflow</th>
<th>Unit Weight, Lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inlet SCFM</td>
<td>Outlet ACFM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FP 1.5</td>
<td>475</td>
<td>630</td>
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<tr>
<td>FP 3</td>
<td>950</td>
<td>1,200</td>
</tr>
<tr>
<td>FP 6</td>
<td>1,900</td>
<td>2,500</td>
</tr>
</tbody>
</table>

Engineering data notes
1. Nominal horsepower listed are for typical installations. Actual horsepower may be higher or lower depending on performance requirements.
2. Normal operating weight should be used for sizing vibration isolators, if required.
3. Maximum operating weight should be used for structural calculations.
4. All weights are approximate.
5. All regenerators are furnished with FRP exhaust plenums.
Alfa Laval Kathabar installation notes

The following equipment is normally supplied by Alfa Laval Kathabar:

- Kathabar conditioner
- Conditioner fan (3000 and smaller units)
- Kathene solution cooler and control valve
- Kathabar regenerator with fan
- Regenerator exhaust plenum
- Kathene solution heater and control valve
- All hand valves in Kathene solution piping
- Kathene solution transfer meter
- Electric control panel
- Level control panel

The following items are required for a complete system installation but are not normally supplied by Alfa Laval Kathabar:

- Conditioner fan (4000 and larger units)
- Interconnecting ductwork with access doors for servicing eliminators and diffusers
- Interconnecting Kathene solution piping (except SP units factory piped)
- Conditioner coolant piping
- Regenerator steam or hot water piping
- Makeup water piping
- Interconnecting electrical wiring (except SP units factory wired)
- Insulation
- Sound attenuator and vibration isolation, if required

The following optional equipment can be supplied by Alfa Laval Kathabar:

- Transfer interchanger
- Preconditioning module, which may contain inlet air louver, air filters, winter preheat coil, summer precool coil and controls, complete with appropriate access doors and access plenums

- Post-conditioning module, which may contain afterheat coil, aftercool coil, final filters and controls, complete with appropriate access doors and access plenums
- Factory packaging of Kathabar conditioner and regenerator, which may include mounting of all components on a curbed FRP platform, factory installation of Kathene piping, power wiring and controls, and single-point connections for utilities

Pre-installation storage

Equipment should be protected from the weather prior to installation. Indoor storage is preferred. If indoor storage cannot be arranged, the equipment should be set on blocking and securely covered with tarpaulins. Kathene solution must be stored in an area having a minimum temperature above freezing.

Rigging and handling

Kathabar equipment should be lifted only from the bottom of the unit. When lifting lugs or eyes are provided, they should be used for lifting by crane. If lifting lugs are not provided, slings should be used. Spreader bars must be used to prevent equipment damage. If the equipment must be laid on its back or side during movement, Kathabar Engineering should be consulted for advice to prevent equipment damage.

Equipment location

Conditioner and regenerator units need not be installed in the same location, and may be located wherever convenient. Units may be installed outside if adequate freeze protection is provided for water, steam and condensate piping and weatherproof insulation is provided as needed.
The Engineering Data Tables should be used to obtain the operating weights of the conditioner and regenerator units for structural design. Conditioner and regenerator units should be set on a level concrete floor, housekeeping pad, or piers. If piers are to be used, contact Alfa Laval Kathabar for recommendations on pier size and location. Before the equipment is set in place, the floor should be sealed with an epoxy sealant. To facilitate startup and normal maintenance procedures, the equipment should be surrounded by curbing. A floor drain should be located inside the curbing and near the conditioner pump tank. If the equipment cannot be surrounded by curbing, piping should be run from the safety drain connection to a floor drain or a suitable container. Adequate area should be provided around the conditioner, regenerator, and heat exchangers for maintenance. Recommended maintenance access areas are shown on the equipment drawings.

Plenums and ductwork
Kathabar units are provided with flanges on the air openings for duct connection. Inlet and outlet plenums should be bolted to the flange with a gasket between the connection. Closed-cell foam gasketing at least one-fourth inch thick is recommended.

Access doors, for servicing diffusers and eliminators, must be provided in the inlet and outlet plenums. See the equipment drawings for recommended access door size and location. Inlet ductwork must be designed to allow uniform distribution of the air across the entire opening.

Outlet plenums and ductwork must be designed to allow adequate room for servicing the eliminators and to provide proper airflow through the equipment.

See the equipment drawings for recommended plenum and ductwork sizes.

Regenerator exhaust ductwork
Because the regenerator exhaust air is hot and humid, the regenerator exhaust ductwork should be made of fiber-reinforced polyester (FRP). The material should be rated for continuous duty at 180°F. Duct joints should be of watertight construction. Long horizontal duct runs should be pitched slightly in the direction of airflow, and should incorporate low-point condensate drains.

Kathene solution piping
The conditioner piping should be CPVC or FRP. If the design Kathene temperature in the conditioner is below freezing, FRP pipe should be used because CPVC pipe becomes brittle at low temperatures. Only FRP piping is recommended for the regenerator.

Black iron, galvanized and stainless steel pipe must not be used for Kathene piping. CPVC piping should be Schedule 80, Type IV, Grade 1, 412, in accordance with ASTM Standard 1784. FRP piping should be Fibercast Centricast III EP, Smith Green Thread, or other equivalent epoxy resin pipe and fittings with an interior corrosion barrier and rated for continuous service at 225°F with chloride brines. Valves in the conditioner Kathene piping should be made of CPVC or thermoplastic-lined cast iron with non-metallic disc. Consult Kathabar Engineering for more detailed materials and construction information.

Thermowells in the Kathene piping should be titanium (available from Kathabar). Stainless steel thermowells must not be used.

All pipe fittings should be socket fittings, and all connections with valves and other components must be flanged. Threaded fittings and connections should be avoided because the pipe is significantly weakened, and threaded joints in non-metallic pipe are difficult to make leak-tight. Red rubber or neoprene full-face gaskets are recommended in flanged connections. The piping must be supported so that no stress is placed on connections to the Kathabar equipment. Pipe supports and anchors may require closer spacing than with metal pipe.
Alfa Laval Kathabar installation notes (continued)

Piping should be installed at least two feet away from all maintenance access openings and belt guards.

If the Kathene piping cannot drain completely by gravity, low-point drains with lined metal or non-metallic hand valves must be provided.

Kathene pump discharge piping must be arranged to allow removal of the pump from the pump tank. The pump discharge piping should incorporate a 90° elbow or a vertical spool piece at least four feet long so the pump can be lifted vertically from the tank.

**Insulation**
To prevent surface condensation (sweating) and minimize coolant use, conditioners should be insulated whenever a coolant other than cooling tower water is used. The entire unit including Kathene and coolant piping should be insulated. Flexible rubber, rigid foam plastic, or other non-permeable, vapor-tight insulation material is recommended for conditioners. When the equipment is installed outside, an ultraviolet and weather protective coating should be applied to the insulation.

Regenerators need not be insulated unless heat gain in the equipment location is a concern. Steam or hot water piping should be insulated with at least two-inch-thick rigid plastic faced fiberglass or equal. Kathene solution piping should also be insulated if required for personnel protection. If the equipment is installed outside, weather protective covering should be applied.

The outer casing of the conditioner and regenerator must not be penetrated with insulation fasteners. The use of contact cement or other adhesive is recommended for insulation fastening. Contact the insulation manufacturer for adhesive recommendations for an FRP substrate. All piping should be pressure tested for leaks before insulating.
Alfa Laval Kathabar sample specifications

General
The humidity conditioning system shall be of the liquid desiccant type, as manufactured by Alfa Laval Kathabar.

The system shall be capable of simultaneous air cooling and dehumidification, as described in the Performance section of this specification. The system shall automatically, fully modulate the usage of conditioner coolant and regenerator heat to match the system cooling and dehumidification loads.

The desiccant solution, Kathene, shall consist of a water solution of lithium chloride salt. The solution shall be stable and non-toxic and shall not exist in the vapor phase in the conditioned airstream. The manufacturer shall provide the end user with analysis and recommendations for maintenance of the desiccant solution six times yearly free of charge, for the life of the equipment.

The humidity conditioning system shall consist of separate conditioning and regeneration units, providing complete separation of conditioned and regeneration airstreams. The manufacturer shall guarantee that there will be no cross leakage of conditioner and regenerator airstreams under any circumstances.

Equipment

SP units
The equipment supplied shall consist of a conditioner, conditioner fan, conditioner Kathene cooler, regenerator, regenerator fan, regenerator Kathene heater, control panel and base platform.

The conditioner and regenerator shall each consist of a water-tight housing containing the sump, inlet air diffuser, Kathene-to-air contact surface, Kathene distribution system and mist eliminator system. The housing shall be constructed of vinylester FRP. Internal parts shall be made of non-metallic corrosion proof materials. The conditioner and regenerator Kathene circulating pumps shall be of the sealless magnetic-drive type, with wetted parts made of glass-filled PVDF or glass-filled polypropylene.

The conditioner fan shall consist of a galvanized steel housing containing a steel, forward-curved fan, and motor and drive. The fan housing shall be Heresite coated on the inside and painted with a prime and finish coat of industrial enamel on the outside. The conditioner fan shall be shipped loose for field mounting.

The regenerator fan shall consist of a vinylester FRP housing, glass-filled polyamid backward-inclined wheel and inlet cone, and direct-drive motor. The fan shall be factory-mounted on the regenerator.

The conditioner Kathene cooler and regenerator Kathene heater shall be of the plate-and-frame type, with steel frame, carrier bars and tie bolts, titanium plates and nitrile or EPDM gaskets. The solution heater shall be supplied with the heating fluid control valve. The control panel shall consist of a NEMA 3R FRP enclosure containing fused disconnect, motor starters for all motors supplied with the equipment, start/stop buttons, system status indicator lamps and PLC controller with alphanumeric display and keypad user interface. The panel shall be factory mounted on the conditioner unit.

All the above equipment shall be mounted on a FRP-clad structural steel base. All Kathene piping shall be factory-installed using FRP and CPVC pipe and fittings. All wiring between the control panel, motors and controls shall be factory-installed using PVC conduit. All FRP components shall contain additives to achieve a U.L. class 1 flame spread rating. The exterior surfaces of all FRP components shall be pigmented and UV stabilized for exposure to direct sunlight.
Alfa Laval Kathabar sample specifications (continued)

All other equipment

The major items of equipment shall consist of a condition unit, a conditioner Kathene cooler, a regenerator unit, a regenerator Kathene heater, an electrical control panel and a level control panel.

The conditioner and regenerator units shall each consist of a watertight housing containing the sump, Kathene-to-air contact surface, Kathene distribution system and mist eliminator system. FV 240 through 600 conditioners and FP 1.5 through 6 regenerators shall be mounted on a FRP-clad platform along with sealless magnetic-drive Kathene pump having all wetted parts made of glass-filled PVDF or polypropylene. All other units shall be supplied with a freestanding pump assembly with tank, vertical sealless Kathene pump and motor, full-flow filter screen and bypass polishing filter. The pump shall be made with a titanium shaft and hardware and all other wetted parts of vinylester FRP. Unit housings and pump tanks shall be made of vinylester FRP, with additives to achieve a U.L. class 1 flame spread rating. All internal parts shall be made of nonmetallic corrosion-proof materials. All external FRP surfaces shall be pigmented and UV stabilized for exposure to direct sunlight. The conditioner shall be supplied with a discharge air plenum with mist eliminator access door, and a fan box assembly consisting of housing, forward-curved fan, and motor and drive. The fan shall be made of steel. The discharge air plenum and fan box shall be made of galvanized steel, with interior surfaces Heresite coated and exterior surfaces painted with a prime and finish coat of industrial-grade acrylic machine enamel. The discharge air plenum and fan shall be shipped loose for field mounting.

The regenerator shall be supplied with a fan and fan box assembly consisting of housing, forward-curved fan, motor and drive. The fan shall be made of steel. The fan box shall be made of galvanized steel, with interior surfaces Heresite coated and exterior surfaces painted with a prime and finish coat of industrial-grade acrylic machine enamel. The fan and fan box assembly shall be shipped mounted on FP 6 and smaller regenerators. The fan and fan box assembly shall be shipped loose for field mounting on FP 10 and larger regenerators.

The regenerator shall be supplied with a vinylester FRP discharge plenum with eliminator access door, duct attachment collar and condensate collection ring. The plenum shall be shipped loose for field mounting.

The conditioner Kathene cooler and regenerator Kathene heater shall be of the plate-and-frame type, with steel frame, carrier bars and tie bolts, titanium plates and nitrile or EPDM gaskets. The Kathene heater shall be supplied complete with heating fluid control valve. The heat exchangers shall be shipped loose for field installation.

The electrical control panel shall consist of safety interlock relays and circuitry, motor starters for all motors supplied with the equipment, hand-off-auto switch, start-stop buttons, and system status indicator lamps, all contained in a NEMA 3R enclosure with lockable, fixed disconnect. The panel shall be shipped loose for field installation.

The level control panel shall consist of safety interlock pressure switch, unit pressure drop indicator, bubbler tube supply pneumatics, P/I transducer, I/P transducer, and PID single-loop microprocessor-based controller, all contained in a NEMA 3R fiberglass enclosure. The level control panel shall be shipped mounted.