SERVICE MANUAL

FOR

USO – Lick Observatory

941-G001

(1) ASP-15A (1) Pump

MANUFACTURED BY MULTISTACK

365 South Oak Street
West Salem, WI 54669
Phone: (608) 786-3400
Fax: (608) 786-3450
www.airstack.com
the leader in modular chillers.
Multistack® and Airstack™ utilize the most innovative technologies to create modular chiller systems that meet the challenging needs of today's marketplace. Our small footprint, quiet and efficient operation, and easy to install modular design make Multistack and Airstack the equipment of choice for savvy owners, contractors, and engineers.

**Water-Cooled Chillers**

**Packaged Scroll and Reciprocating Modules**

Modules are available in 20, 30 and 50-ton packages each with dual independent scroll compressors. The 50-ton module is available in a reciprocating version as well. Modules may be mix-matched and up to 12 modules may be assembled together to form chillers from 20 to 600-tons.

**Large Packaged Screw Modules**

Modules are available in 70 and 90-ton packages each with a single twin-screw compressor. Modules may be mix-matched and up to eight modules may be assembled together to form chillers from 70 to 720-tons.

**Centrifugal Chiller Modules**

Centrifugal chiller modules are available in 80-ton packages utilizing the industry's most advanced magnetic-bearing, oil-free compressor technology. The compressor shaft levitates in a near-frictionless magnetic field eliminating metal-to-metal contact. An integral variable frequency drive controls compressor speed and capacity to precisely match the load creating the most efficient modular chiller ever devised. Modules utilize R-134A refrigerant and may be assembled to form chillers from 80 to 640 tons.

**Air-Cooled Packaged Chillers**

**Scroll Chiller Modules**

Modules are available in 10, 15 and 20-ton packages each with dual scroll tandem compressor sets. Modules may be mix-matched and up to 10 modules may be assembled together to form chillers from 10 to 200-tons. Units are available with high-static condenser fans for ducted applications.

**Airstack Accessory Modules**

A complete line of accessory modules is available for integration into the Packaged Air-Cooled Chiller. These accessory modules include packaged pumping modules, free-cooling modules and expansion-tank/glycol feeder modules.

**Water-Cooled Condensing Units**

All of Multistack's Packaged Water-Cooled Chillers are available in a Water-Cooled Condensing Unit version. Most required refrigerant specialties are factory mounted within the module. Units are designed to interconnect to a field-supplied evaporator.
Air Cooled Split-System Chillers
All of Multistack's Packaged Water-Cooled Chillers are available in an Airstack Split-System Air-Cooled version. All required refrigerant specialties (for standard ambient) are factory mounted within the indoor module. Multistack provides matching remote air-cooled condensers. Chiller systems are available from 20 to 720-tons.

Chiller-Heaters
Water-to-Water Heat Pump
Modules are available in a 30-ton scroll and 50-ton reciprocating package each with dual independent compressors. Units are suitable for use in both closed loop and ground loop water source heat pump applications. Up to 12 modules may be assembled together to form Chiller-Heaters from 30 to 600-tons.

Dedicated Heat Recovery Chillers
Dedicated heat recovery chillers are available for many hydronic heating applications. Multistack's heat recovery chillers can produce hot water in excess of 130°F while simultaneously producing chilled water for the hydronic cooling systems. Contact your local representative for specific selection information.

So, whether you need superior redundancy, peak efficiency over a wide range of conditions, or are simply stuck with an old chiller in a tight space, Multistack and Airstack can provide guaranteed expandable solutions.
# AIRSTACK

**PACKAGED CHILLER**

**JOB NAME**
USO - Lick Observatory

**ENGINEER**

**LOCATION**

**ARCHITECT**

**CUSTOMER**

**CONTRACTOR**

Kurt Wessels / S.D.

---

**Multistack Order Number**
941-G001

**Customer P.O. Number**
DH20163

**Sales Representative**
Kurt Wessels

**Submitted by**

**Approved by**

**Approval Date**

---

**Total Number of Modules:** 2.0

**Overal Height (In):** 77

**Width:** 31 1/2

**Length:** 119 3/4

(Dimensions Do Not Include J-Boxes)

### CHILLED WATER DESIGN

| Master Module ASP-15A (MF) | 1 |
| Slave Front ASP... (SF) | 0 |
| Slave Rear ASP... (SR) | 0 |

**Chilled Water:** 22% Ethylene Glycol

| Entering Temperature | 33.0 °F |
| Leaving Temperature | 24.0 °F |
| Flow Rate | 26.5 GPM |
| Evaporator ΔP | 2.9 Feet |

### AMBIENT AIR TEMPERATURE

| Design | 95.0 °F |
| Low | 0.0 °F |

### FULL LOAD CHILLER PERFORMANCE

| Cooling Capacity | 8.7 Tons |
| Power Input | 15.7 KW |
| EER | 6.6 |

### FREE COOL DESIGN

- Free Cool Front ASP-00F (FF)
- Free Cool Rear ASP-00F (FR)

| Chilled Water: |
| Entering Temp | N/A °F |
| Leaving Temp | N/A °F |
| Flow Rate (each) | N/A GPM |
| Total Flow Rate | N/A GPM |
| Operating ΔP | N/A Feet |
| Bypass ΔP | N/A Feet |

### ACCESSORY MODULES

- 180 Gallon Tank Module(s) ASP-00T
- Glycol Feeder Module(s) ASP-00G
- Pump Module(s) ASP-00P

### PUMP DESIGN

- **Pump Size:** (2) 1.5x1x8
- **Flow Rate:** 26.5 GPM
- **Pump:** 2 hp
- **Total Head:** 52.0 Feet

Assumes 49.1 ft of external head

---

### ELECTRICAL DATA

**MAIN POWER SUPPLY**

230 / 60 / 3

**FANS:** 4 FLA per fan motor

### ELECTRICAL CIRCUIT(S) CAPACITY

- **CHILLER**
  - ASP-15A: 23.2 FLA per compressor
- **CIRCUIT***
  - 67
- **ASP-00P:** 6.6 FLA per module

**Recommended Dual Element Fuse**

**Minimum Circuit Ampacity (amps)**

**Maximum Fuse Size (amps)**

**First Letter**

- M = Master Chiller Module
- S = Slave Chiller Module
- P = Pump Module
- F = Free Cool Module
- G = Glycol Feeder Module

**Second Letter**

- F = Front Module
- R = Rear Module

---

**IMPORTANT:** To assure full equipment design performance, life and reliability, the MULTISTACK chiller must be piped in accordance with Installation Manual unless specifically authorized otherwise by MULTISTACK in writing.

---

**CHILLER LAYOUT**

| PF | MF | J |
Series 4280
1.5x1x8
Centerline Disc End Suction Motor Mounted Pump

Project Number:
Name:
Reference:
Location:
Engineer:
Contractor:

Representative: Multistack
365 South Oak St, West Salem, WI
Phone: 608-786-3400, Fax: 608-786-3450
Order No: Date:
Submitted by: Scott DeGier Date: 1/20/2006
Approved by: Date:

PUMP DESIGN DATA
Tag Num:
Service:
Location:
No. of Pumps: 1
Capacity: 26.5 usgpm
Head: 52 ft
Piping: Single
Suction Pressure: 0 ft
Liquid: EthyleneGlycol:22
Op. Temperature: 24°F
Viscosity: 4.43 cp
Sp. Gravity: 1.03
Suction Size: 1.5 in
Discharge Size: 1 in

MOTOR DESIGN DATA
Motor Supplier: Factory Choice
Motor Size: 2 hp @ 1800 rpm
Frame Size: 145JH
Enclosure: ODP
Cycle/Phase/Voltage: 60/3/230
Motor Eff: Std
Insulation: Class "B" Insulation (266.0 °F)
Starter Config: DOL
Full Load/Starting (A) 6.8 / 50.0

MECHANICAL SEAL DESIGN DATA
Manufacturer: John Crane
Seal Type: Inside Unbalanced
Rotating Face: Carbon
Stationary Seat: Ceramic
Secondary Seal: EPDM
Springs: Stainless Steel
Rotating Hardware: Stainless Steel

MATERIALS OF CONSTRUCTION
Construction BF (Bronze Fitted)
ANSI Flange Rating 125 lb. (Cast Iron)
Impeller Bronze (B584-844)
Casing Cast Iron (A48-30)
Casing Gasket Confined Non-Asbestos Fiber
Adapter Cast Iron (A276-30)
Motor Shaft Carbon Steel
Shaft Sleeve Bronze (B584-844)

Operating Limits
Temperature-Pressure

DIMENSIONAL DATA (in, lbs, hp) NOT for CONSTRUCTION

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>Cmax</th>
<th>D1</th>
<th>D2</th>
<th>E</th>
<th>F</th>
<th>N</th>
<th>H</th>
<th>X</th>
<th>TotWgt</th>
<th>Wgt</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>6</td>
<td>14</td>
<td>5.25</td>
<td>3.5</td>
<td>2.75</td>
<td>5</td>
<td>6.63</td>
<td>0.34</td>
<td>6.5</td>
<td>99</td>
<td>99</td>
</tr>
</tbody>
</table>

1/20/2006, 14:24:51, Scott DeGier, Multistack, 608-786-3400, Fax: 608-786-3450
Series 4280
1.5x1x8
Centerline Disc. End Suction Motor Mounted Pump

--- Admin Data ---
Tag Num:
Service:
Location:

--- Motor Data ---
Motor Size: 2 hp
Motor Speed: 1800 rpm

--- Design Duty Point ---
Flow: 28.5 usgpm
Head: 52 ft
Impeller: 7.23 in

--- Performance Data ---
- NPSHR: 3.3 ft
- Eff. @ Design: 37.46 %
- BHP @ Design: 0.96 hp
- BEP @ Design Imp.: 54.52 % @ 61.4 usgpm
- BHP @ Runout: 2.01 hp @ 92.2 usgpm
- %max imp. range: 56.10 %

EthyleneGlycol:22, sg= 1.03 Flow (usgpm)
PACKAGED AIR COOLED
Product Data Catalog

Airstack
Chiller Module
Free Cool Module
Pump Module

MODELS
ASP-10A
ASP-15A
ASP-20A
ASP-00P
ASP-00F
ASP-00G

The Leader in Modular Chillers
AIRSTACK AIR COOLED MODULAR PACKAGED WATER CHILLER

Highly Dependable
- Multiple independent refrigeration circuits
- Comprehensive computer monitoring of operations
- Automatic diagnostic recording of fault conditions
- Automatic rotation of lead compressors

Simple To Operate
- LCD Screen displays information in plain English
- Simple keypad provides control of system operations

Easy To Install
- Compact modules fit through standard doorways and into elevators
- Modules interconnect easily and quickly to form chillers from 10 to 200-tons
- All refrigeration systems are factory charged and run tested

Computer Control System
- Operates only the capacity required by the load
- Operates at peak efficiency at any given load

Design Flexibility
- Wide array of module combinations
- Install only the capacity required at the time

Simple To Service
- Does not require proprietary training
- Service can often be performed on a convenient non-emergency basis
- Most components are standard, off the shelf design
### ASP-10A Air Cooled Modular Chiller
Single Module Performance Data

**Ambient Air Temperature °F**
(A suitable antifreeze solution is required for operation below 40°F Ambient)

<table>
<thead>
<tr>
<th></th>
<th>85.0</th>
<th></th>
<th>95.0</th>
<th></th>
<th>105.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tons</td>
<td></td>
<td></td>
<td>Tons</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>KW</td>
<td>EER</td>
<td></td>
<td>KW</td>
<td>EER</td>
</tr>
<tr>
<td>40.0</td>
<td>9.4</td>
<td>9.8</td>
<td>11.5</td>
<td>8.8</td>
<td>10.9</td>
</tr>
<tr>
<td>42.0</td>
<td>9.8</td>
<td>9.8</td>
<td>12.0</td>
<td>9.2</td>
<td>10.9</td>
</tr>
<tr>
<td>44.0</td>
<td>10.2</td>
<td>9.8</td>
<td>12.5</td>
<td>9.6</td>
<td>10.9</td>
</tr>
<tr>
<td>45.0</td>
<td>10.4</td>
<td>9.8</td>
<td>12.8</td>
<td>9.8</td>
<td>10.9</td>
</tr>
<tr>
<td>46.0</td>
<td>10.6</td>
<td>9.8</td>
<td>13.0</td>
<td>10.0</td>
<td>10.9</td>
</tr>
<tr>
<td>48.0</td>
<td>11.0</td>
<td>9.8</td>
<td>13.5</td>
<td>10.4</td>
<td>10.9</td>
</tr>
<tr>
<td>50.0</td>
<td>11.5</td>
<td>9.8</td>
<td>14.1</td>
<td>10.8</td>
<td>10.9</td>
</tr>
</tbody>
</table>

### ASP-15A Air Cooled Modular Chiller
Single Module Performance Data

**Ambient Air Temperature °F**
(A suitable antifreeze solution is required for operation below 40°F Ambient)

<table>
<thead>
<tr>
<th></th>
<th>85.0</th>
<th></th>
<th>95.0</th>
<th></th>
<th>105.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tons</td>
<td></td>
<td></td>
<td>Tons</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>KW</td>
<td>EER</td>
<td></td>
<td>KW</td>
<td>EER</td>
</tr>
<tr>
<td>40.0</td>
<td>13.9</td>
<td>14.1</td>
<td>11.8</td>
<td>13.0</td>
<td>15.8</td>
</tr>
<tr>
<td>42.0</td>
<td>14.5</td>
<td>14.1</td>
<td>12.3</td>
<td>13.6</td>
<td>15.8</td>
</tr>
<tr>
<td>44.0</td>
<td>15.0</td>
<td>14.1</td>
<td>12.8</td>
<td>14.2</td>
<td>15.8</td>
</tr>
<tr>
<td>45.0</td>
<td>15.3</td>
<td>14.1</td>
<td>13.0</td>
<td>14.4</td>
<td>15.8</td>
</tr>
<tr>
<td>46.0</td>
<td>15.6</td>
<td>14.1</td>
<td>13.3</td>
<td>14.7</td>
<td>15.8</td>
</tr>
<tr>
<td>48.0</td>
<td>16.2</td>
<td>14.2</td>
<td>13.8</td>
<td>15.3</td>
<td>15.8</td>
</tr>
<tr>
<td>50.0</td>
<td>16.9</td>
<td>14.2</td>
<td>14.3</td>
<td>15.9</td>
<td>15.8</td>
</tr>
</tbody>
</table>

### ASP-20A Air Cooled Modular Chiller
Single Module Performance Data

**Ambient Air Temperature °F**
(A suitable antifreeze solution is required for operation below 40°F Ambient)

<table>
<thead>
<tr>
<th></th>
<th>85.0</th>
<th></th>
<th>95.0</th>
<th></th>
<th>105.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tons</td>
<td></td>
<td></td>
<td>Tons</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>KW</td>
<td>EER</td>
<td></td>
<td>KW</td>
<td>EER</td>
</tr>
<tr>
<td>40.0</td>
<td>19.4</td>
<td>18.5</td>
<td>12.6</td>
<td>18.3</td>
<td>20.7</td>
</tr>
<tr>
<td>42.0</td>
<td>20.2</td>
<td>18.5</td>
<td>13.1</td>
<td>19.1</td>
<td>20.7</td>
</tr>
<tr>
<td>44.0</td>
<td>21.0</td>
<td>18.5</td>
<td>13.6</td>
<td>19.9</td>
<td>20.7</td>
</tr>
<tr>
<td>45.0</td>
<td>21.4</td>
<td>18.5</td>
<td>13.9</td>
<td>20.3</td>
<td>20.7</td>
</tr>
<tr>
<td>46.0</td>
<td>21.8</td>
<td>18.5</td>
<td>14.1</td>
<td>20.7</td>
<td>20.7</td>
</tr>
<tr>
<td>48.0</td>
<td>22.7</td>
<td>18.6</td>
<td>14.7</td>
<td>21.5</td>
<td>20.7</td>
</tr>
<tr>
<td>50.0</td>
<td>23.6</td>
<td>18.6</td>
<td>15.2</td>
<td>22.3</td>
<td>20.8</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Capacity is based on pure water. For performance using Glycol Solution, see Adjustment Factor on Page 6.
2. All performance data is based on a 10°F chilled water temperature drop through the evaporator.
3. Fan and controls KW is included in tabular KW data.
## ASP-00F Free Cooling Module
### Single Module Performance Data
*Capacity in Refrigeration Tons*

<table>
<thead>
<tr>
<th>LEAVING WATER TEMPERATURE/GPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>45°F</td>
</tr>
<tr>
<td>Ambient</td>
</tr>
<tr>
<td>40°F</td>
</tr>
<tr>
<td>35°F</td>
</tr>
<tr>
<td>30°F</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Capacity is based on pure water. For performance using Glycol Solution, see Adjustment Factor on Page 6.
2. A suitable antifreeze solution is required for operation below 40°F Ambient.

### General Data Table of Air Cooled Standard Modules

<table>
<thead>
<tr>
<th>Compressor</th>
<th>ASP - 00F</th>
<th>ASP - 10A</th>
<th>ASP - 15A</th>
<th>ASP - 20A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>n/a</td>
<td>Scroll</td>
<td>Scroll</td>
<td>Scroll</td>
</tr>
<tr>
<td>Weight (lb. each)</td>
<td>n/a</td>
<td>104</td>
<td>119</td>
<td>141</td>
</tr>
<tr>
<td>Nominal Capacity (per compressor)</td>
<td>n/a</td>
<td>5</td>
<td>7.5</td>
<td>10</td>
</tr>
<tr>
<td>Quantity</td>
<td>n/a</td>
<td>2 (tandem pair)</td>
<td>2 (tandem pair)</td>
<td>2 (tandem pair)</td>
</tr>
<tr>
<td>Oil Charge (pints per compressor)</td>
<td>n/a</td>
<td>3.6</td>
<td>5.25</td>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evaporator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
</tr>
<tr>
<td>Weight</td>
</tr>
<tr>
<td>Evap Water Storage (gallons each)</td>
</tr>
<tr>
<td>Quantity</td>
</tr>
<tr>
<td>Header Storage (gallons per header)</td>
</tr>
<tr>
<td>Refrigerant Type</td>
</tr>
<tr>
<td>Number of Circuits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Condenser Fans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Type</td>
</tr>
<tr>
<td>HP</td>
</tr>
<tr>
<td>Quantity</td>
</tr>
<tr>
<td>Fan Type</td>
</tr>
<tr>
<td>Fan Material</td>
</tr>
<tr>
<td>Air Flow (cfm) (per module)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Condenser Coils*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fin Material</td>
</tr>
<tr>
<td>Tube Material</td>
</tr>
<tr>
<td>Tube Diameter (in.)</td>
</tr>
<tr>
<td>Number of Rows</td>
</tr>
<tr>
<td>Coil Dimensions/Quantity</td>
</tr>
<tr>
<td>Receiver Capacity (lb.)</td>
</tr>
<tr>
<td>Module Dry Weight (lb.)</td>
</tr>
</tbody>
</table>

*On Free Cool Modules, coils are utilized as water precoolers rather than for refrigerant condensing.
## ASP-00P DUAL PUMP SELECTION CHART

(ALL PUMPS IN PRIMARY/STANDBY ARRANGEMENT – DATA FOR SINGLE PUMP)

Charts Show Pump BHP Requirement at Given Condition

### ARMSTRONG SERIES 4382 – 3x3x6 Pump

<table>
<thead>
<tr>
<th>Flow (USGPM)</th>
<th>60</th>
<th>80</th>
<th>100</th>
<th>120</th>
<th>140</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>160</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>240</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### ARMSTRONG SERIES 4382 – 4x4x6 Pump

<table>
<thead>
<tr>
<th>Flow (USGPM)</th>
<th>60</th>
<th>80</th>
<th>100</th>
<th>120</th>
<th>140</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>250</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>300</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>350</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### ARMSTRONG SERIES 4382 – 6x6x6 Pump

<table>
<thead>
<tr>
<th>Flow (USGPM)</th>
<th>60</th>
<th>80</th>
<th>100</th>
<th>120</th>
<th>140</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>300</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>400</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500*</td>
<td>10.93*</td>
<td>14.14*</td>
<td>17.34*</td>
<td>20.59*</td>
<td></td>
</tr>
<tr>
<td>600*</td>
<td>13.06*</td>
<td>16.68*</td>
<td>20.26*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>700*</td>
<td>15.48*</td>
<td>19.51*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>800*</td>
<td>18.35*</td>
<td>22.76*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**

1. DO NOT SELECT IN SHADED AREA.
2. All selections based on 40% Ethylene Glycol Solution.
3. Pump speed is 3600 RPM.
4. All pump modules have automatic changeover controls in the event of loss of flow and manual lead/lag selector switch.

* For selections above 400 GPM contact factory
**Figure 1.** Performance Adjustment Factor

**Figure 3.** Ethylene Glycol Adjustment Factors

**Figure 2.** Water Pressure Drop

**Figure 4.** Propylene Glycol Adjustment Factors
SELECTION
To select an AIRSTACK Air Cooled chiller, the following information is required.
1. Load in tons of refrigeration.
2. Chilled water temperature drop.
3. Leaving chilled water temperature.
4. Design ambient air temperature.

CAPACITY TABLES
Capacity tables are based on a 10°F temperature drop through the evaporator. For other than 10°F temperature drop, apply the respective performance adjustment factors from Figure 1.

EVAPORATOR WATER FLOW RATE
Evaporator water flow is determined as follows:
GPM = (24) (tons) / temperature drop

WATERSIDE PRESSURE DROP
Evaporator waterside pressure drops are provided in Figure 2. To use Figure 2, divide the total chilled water GPM by the number of modules in the chiller.

CHILLED WATER SELECTION SAMPLE (Assumes ASP-15 Modules)
System load = 55 tons. Chilled water drop at 12°F. Leaving chilled water temperature of 45°F. Design ambient air temp of 95°F.
1. Use Figure 1 adjustment factor to convert tons at 12°F to equivalent tons at 10°F for use with capacity tables. Tons = 55/1.012 = 54.3 tons
2. Select the appropriate performance table based on module to be used. Read the capacity and KW of a single module at the water temperature specified (45°F) and design ambient air temperature (95°F) capacity = 14.4 tons, KW = 15.8
3. Divide equivalent tons required at 10°F temperature drop by single module capacity from tables. Modules required = 54.3/14.4 = 3.8 modules
Chiller capacity = 14.4 x 4 = 57.6 tons
Power input = 15.8 x 4 = 63.2 KW at 12°F temperature drop, applying Figure 1 performance adjustment factor results in:
Tons = (67.6) (1.012) = 68.3 vs. system load of 55 tons
4. To determine evaporator water flow and pressure drop, first determine GPM.
GPM = (24)(54.3)/12=108.6
GPM/module = 108.6 = 27.2
From Figure 2, read pressure drop from curve C pressure drop = 2.4 ft. of water.

LOW TEMPERATURE OPERATION WITH GLYCOL
(Assumes ASP-15 Modules)
Ethylene Glycol adjustment factors (Figure 3) should be used to adjust performance depending on the percent of glycol use in the evaporator circuit. The factors in Figure 3 are based on a 10°F change in fluid temperature through the evaporators.

Capacity and KW should be obtained by extrapolating no more than 10°F from the lowest leaving chilled water temperature shown in the capacity tables.
AIRSTACK should be contacted if leaving Glycol temperatures below 32°F are required.

Adjustment factors for Propylene Glycol are shown in Figure 4, and are used in the same way given in the following example.

ETHYLENE GLYCOL SELECTION EXAMPLE (Assumes ASP-15 Modules)
Determine capacity, GPM, pressure drop and KW for an ASP-15 module cooling 30% Ethylene Glycol from 45°F to 35°F, with design ambient air temperature of 95°F.
1. By extrapolating from the performance tables:
   capacity: 11.5 tons; 15.8 KW;
2. Evaporator water flow and pressure drop is determined for water as in the previous example.
   GPM = (24)(11.5) = 27.6 GPM
   10
   From Figure 2 read pressure drop from curve C pressure drop = 2.6 ft of water
3. To convert performance for water to performance with Ethylene Glycol read adjustment factors from Figure 3 at 30% Glycol.
   Capacity adjustment: 0.94
   KW adjustment: 0.99
   GPM adjustment: 1.10
   Pressure drop adjustment 1.22
4. Calculate performance with 30% Ethylene Glycol by multiplying performance for water by adjustment factors.
   Capacity: 11.5 x .94 = 10.8 tons
   KW: 15.8 x .99 = 15.6 KW
   GPM: 27.6 x 1.10 = 30.4 GPM
   Pressure drop: 2.6 x 1.22 = 3.2 ft. of water

If a water temperature drop greater or less than 10°F is required, begin by first multiplying the capacity using the performance adjustment factor from Figure 1.
IMPORTANT MODULE CONFIGURATION INFORMATION

ASP-00P PUMP MODULE:
1. When present, a Pump Module is only allowed in the “Front” position.
2. Incoming water to the chiller system must enter at the Pump Module.
3. Leaving water from the chiller system may be from either end of the chiller.

ASP-00F FREE COOL MODULE:
1. When present, incoming system water must enter through the Free Cool Modules prior to entering an ASP-10A, 15A, 20A Chiller Module.
2. You may not attach a Rear Free Cool Module to a Front ASP-10A, 15A, 20A Chiller Module.
4. Only a Free Cool Module may be attached to the rear of a Pump Module.

ASP-00G GLYCOL FEEDER MODULE:
1. An ASP-00G Glycol Feeder Module may be attached in any rear position.

ASP-10A, 15A, 20A CHILLER MODULE:
1. Maximum number of ASP-10A, 15A, 20A modules with a single Master Module is 10 (i.e., (1) Front-Master, (4) Front-Slaves, and (5) Rear-Slaves).
2. You may have more than one Master Module in a single Chiller Bank.
3. Piping sides of an ASP-10A, 15A, 20A, Chiller without Free Cool or Pump Modules attached are field selectable.

VALID CONFIGURATIONS

<table>
<thead>
<tr>
<th>SR</th>
<th>SR</th>
<th>SR</th>
<th>SR</th>
<th>GR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF</td>
<td>SF</td>
<td>SF</td>
<td>SF</td>
<td>SF</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SR</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF</td>
<td>MF</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FR</th>
<th>SR</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF</td>
<td>FF</td>
<td>MF</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SR</th>
<th>GR</th>
<th>SR</th>
<th>SR</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF</td>
<td>SF</td>
<td>SF</td>
<td>MF</td>
<td>SF</td>
</tr>
<tr>
<td>SF</td>
<td>SF</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

INVALID CONFIGURATIONS

<table>
<thead>
<tr>
<th>SR</th>
<th>SR</th>
<th>SR</th>
<th>SR</th>
<th>SR</th>
<th>SR</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF</td>
<td>SF</td>
<td>SF</td>
<td>SF</td>
<td>SF</td>
<td>SF</td>
<td></td>
</tr>
</tbody>
</table>

**Problem:** Too many Slaves on one Master.
**Solution:** Add an additional Master in place of one of the Slaves.

<table>
<thead>
<tr>
<th>SR</th>
<th>SR</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF</td>
<td>MF</td>
<td>SF</td>
</tr>
</tbody>
</table>

**Problem:** Slave cannot be attached to rear of Pump Module.
**Solution:** Move Slave to front position on opposite end of chiller.

<table>
<thead>
<tr>
<th>SR</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF</td>
<td>PF</td>
</tr>
</tbody>
</table>

**Problem:** Pump Module must be on entering waterside of chiller.
**Solution:** Swap position of Pump with Master Module.

<table>
<thead>
<tr>
<th>FR</th>
<th>SR</th>
<th>SR</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF</td>
<td>FF</td>
<td>MF</td>
<td>SF</td>
</tr>
</tbody>
</table>

**Problem:** Slave module is attached to the rear of a Free Cool Module.
**Solution:** Move this Slave to the right of the last Front Slave.

<table>
<thead>
<tr>
<th>SR</th>
<th>SR</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF</td>
<td>MF</td>
<td>GF</td>
</tr>
</tbody>
</table>

**Problem:** Glycol Feeder Module is attached in a front position.
**Solution:** Move Glycol Feeder Module to rear position and exchange Slave Rear Module for Slave Front Module.

*For other configurations contact your local Airstack Representative.*

**LEGEND:**

**FIRST LETTER**
- M = Master Chiller Module (ASP-10A, 15A, 20A)
- S = Slave Chiller Module (ASP-10A, 15A, 20A)
- P = Pump Module (ASP-00P)
- F = Free Cool Module (ASP-00F)
- G = Glycol Feeder Module (ASP-00G)

**SECOND LETTER**
- F = Front Module
- R = Rear Module

FRONT OF CHILLER BANK IS TOWARD THE BOTTOM OF THE PAGE
(Master Module location determines front of chiller)
MULTIPLE MODULES

NOTES

SINGLE MODULE

MODULES
AIRSTACK PACKAGED AIR COOLED
REQUIRED CHILLED WATER PIPING
SUPPLIED AND INSTALLED BY OTHERS
(* If ASP-00P Pump Module is Supplied by Airstack, eliminate external Pump shown below.)

**ELECTRICAL DATA**

<table>
<thead>
<tr>
<th>Model</th>
<th>Number of Compressors</th>
<th>RLA per Compressor</th>
<th>FLA per Fan Motor</th>
<th>Max Pump FLA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3 phase 1 phase</td>
<td>Number of Fan Motors</td>
<td>3 phase 1 phase</td>
</tr>
<tr>
<td>ASP - 10A</td>
<td>2 (tandem pair)</td>
<td>16.5/7.7/6.2 25.4</td>
<td>2</td>
<td>4.2/2.0/1.5</td>
</tr>
<tr>
<td>ASP - 15A</td>
<td>2 (tandem pair)</td>
<td>24.6/11.7/9.4 n/a</td>
<td>2</td>
<td>4.2/2.0/1.5</td>
</tr>
<tr>
<td>ASP - 20A</td>
<td>2 (tandem pair)</td>
<td>34.0/15.8/12.7 n/a</td>
<td>2</td>
<td>4.2/2.0/1.5</td>
</tr>
<tr>
<td>ASP - 00F</td>
<td>n/a</td>
<td>n/a n/a n/a</td>
<td>2</td>
<td>4.2/2.0/1.5</td>
</tr>
<tr>
<td>ASP - 00P</td>
<td></td>
<td></td>
<td>5</td>
<td>16.7/7.6/6.1</td>
</tr>
<tr>
<td>ASP - 00P</td>
<td></td>
<td></td>
<td>7.5</td>
<td>24.2/11/9</td>
</tr>
<tr>
<td>ASP - 00P</td>
<td></td>
<td></td>
<td>10</td>
<td>30.8/14/11</td>
</tr>
<tr>
<td>ASP - 00P</td>
<td></td>
<td></td>
<td>15</td>
<td>46.2/21/17</td>
</tr>
<tr>
<td>ASP - 00P</td>
<td></td>
<td></td>
<td>20</td>
<td>59.4/27/22</td>
</tr>
<tr>
<td>ASP - 00P</td>
<td></td>
<td></td>
<td>25</td>
<td>74.8/34/27</td>
</tr>
<tr>
<td>ASP - 00G</td>
<td></td>
<td></td>
<td>n/a</td>
<td>2/1/1</td>
</tr>
</tbody>
</table>

**WIRING SIZING**
(MCA = MINIMUM CIRCUIT AMPACITY)

MCA = (1.25 x RLA1*) + RLA2 + RLA3

**FUSE SIZING**
(MFS = MAXIMUM FUSE SIZE)

MFS = (2.25 x RLA1*) + RLA2 + RLA3

Where MFS does not equal a standard size fuse, the next larger fuse should be used.

**NOTES:**
1. Compressor Rated Load Amps (RLA) are based on 125°F Saturated Condensing Temperature.
2. *RLA1 = RLA of the largest motor in the system.
   RLA2 & RLA3 = RLA of other motors in the system.
3. Wire sizing is based on Nat. Electr. Code (NEC) rating for 75°C wire, with 3 wires per conduit.
4. Wiring distance from branch circuit shall not exceed 100 feet.
GENERAL
Chiller Modules shall be ETL listed in accordance with UL Standard 1995, CSA certified per Standard C22.2#236, and bear the ASME UM stamp on all water-to-refrigerant heat exchangers.

Modules shall ship wired and charged with refrigerant. All modules shall be factory run tested prior to shipment.

Compressors, heat exchangers, condenser fans, piping and controls shall be mounted on a heavy gauge steel frame. Electrical controls, contractors, and relays for each module shall be mounted within that module. Module shall be provided within a steel enclosure suitable for outdoor use. Exposed steel surfaces shall be provided with a powder coat paint finish.

CHILLED WATER MAINS
Each module shall include supply and return mains for chilled water. Grooved end connections are provided for interconnection to four inch standard (4.5" outside diameter) piping with Victaulic type couplings. Each inlet water header shall incorporate a built in 30-mesh in-line strainer system to prevent heat exchanger fouling.

EVAPORATORS
Each evaporator shall be a brazed plate heat exchanger constructed of 316 stainless steel; designed, tested, and stamped in accordance with ASME code for 360 psig water-side working pressure.

COMPRESSOR
Each module shall contain hermetic scroll compressor(s) mounted to the module with rubber-in-shear isolators. Each system shall also include high discharge pressure and low suction pressure safety cut-outs.

CONDENSER COILS
Air cooled condenser coils shall have aluminum fins mechanically bonded to copper tubing. Condensers shall have integral subcooling circuitry and be factory leak tested.

CONDENSER FANS
Each module shall contain dual condenser fans for each refrigerant circuit. These fans shall be multi-blade vane-axial type made of plastic composite material for quiet operation. Fans shall be direct driven at maximum RPM of 1150. All fan motors shall be pressure controlled and suitable for outdoor use.

CENTRAL CONTROL SYSTEM
Scheduling of the various compressors shall be performed by a microprocessor based control system

AIRSTACK PACKAGED AIR COOLED
MECHANICAL SPECIFICATIONS
(Master Controller). A new lead compressor is selected every 24 hours to assure even distribution of compressor run time.

The Master Controller shall monitor and report the following on each refrigeration system:

- Discharge Pressure Fault
  - Suction Pressure Fault
  - Compressor Winding Temperature Fault
  - Suction Temperature
  - Evaporator Leaving Chilled Water Temperature

The Master Controller shall monitor and report the following system parameters:

- Chilled Water Entering and Leaving Temperature
- Discharge Refrigerant Temperature
- Chilled Water Flow Fault

An out-of-tolerance indication from these controls or sensors shall cause a "fault" indication at the Master Controller and shutdown of that compressor with the transfer of load requirements to the next available compressor. In the case of a System Fault the entire chiller will be shut down. When a fault occurs, the Master Controller shall record conditions at the time of the fault and store the data for recall. This information shall be capable of being recalled through the keypad of the Master Controller and displayed on the Master Controller's LCD. A history of faults shall be maintained including date and time of day of each fault (up to the last 20 occurrences).

Individual monitoring of leaving chilled water temperatures from each refrigeration system shall be programmed to protect against freeze-up.

The control system shall monitor entering and leaving chilled water temperatures to determine system load and select the number of compressor circuits required to operate. Response times and set points shall be adjustable.

LOW AMBIENT OPERATION
Each refrigerant circuit shall include all refrigerant specialties to provide reliable operation down to 0°F Ambient.

OPTIONAL LOW AMBIENT TO -20°F
Chiller shall incorporate appropriate refrigerant specialties including a properly sized refrigerant receiver and flooded head pressure control valves for operation to -20°F.
OPTIONAL SINGLE POINT POWER CONNECTION

Chiller shall be provided with a single point power connection. This will include pre-engineered wiring for field installation and connection to a factory mounted chiller junction box. Junction box shall include individual fusing for each Module Set and provide a single point of connection to building power.

OPTIONAL FREE COOLING MODULE

Free Cooling Modules shall interconnect through the common chiller header system and require no additional water connections. Free Cooling Modules shall include glycol cooling coils, temperature controlled fans and an automatic 3-way bypass valve to eliminate the need for mechanical cooling under low ambient conditions. Module shall be completely factory assembled and tested before shipment.

OPTIONAL PUMP MODULE

The Pump Module shall be interconnected though the common chiller header system and require no additional water connections. Pump Module will become an integral part of the chiller system. Pump Module shall incorporate dual in-line centrifugal pumps in a Primary/Standby pumping arrangement. Pump starters and controls shall be provided to enable manual selection of lead pump. In addition, in the event of a loss-of-flow failure of the chilled water system, the Pump Module controls shall disable the lead pump and automatically start the standby pump. Module shall be completely factory assembled and tested prior to shipment.

OPTIONAL GLYCOL FEEDER MODULE

Optional Glycol Feeder and Expansion Tank shall be incorporated into the chiller system through a modular arrangement and interconnect through the common chiller header system requiring no additional water connections. System shall include a 48 gallon storage/mixing tank with lid and cover; pump suction hose with inlet strainer; pressure pump with thermal cut-out, and integral pressure switch; pre-charged accumulator tank with EPDM diaphragm, manual diverter valve for purging and agitating contents of storage tank, adjustable 5-55 psi pressure regulating valve with pressure gauge, fast fill lever, integral replaceable strainer, built in check valve, and built in shut-off valve. Glycol feeder system shall be compatible with glycol solutions of up to 50% concentration. Pump shall be capable of running dry without damage.

Expansion tank shall be welded steel with butyl rubber diaphragm and capable of a maximum operating temperature of 240°F and maximum working pressure of 100 psig. Tank shall be interconnected through the common chiller header system and require no additional water connections. Module shall be completely factory assembled and tested prior to shipment.
Introduction

The AIRSTACK “ASP” is a modular air-cooled chiller system with a nominal capacity of 10, 15 and 20 tons per module. The chiller system consists of a Master module (front module with controller), front and rear modules, free cooling module and a pump module. This system utilizes a fully hermetic scroll compressor, 316 stainless steel brazed plate heat exchanger, 4 or 6 row copper tube, aluminum fin, condenser coils and a microprocessor-based control. Operating capacity is based on the entering chilled liquid temperature. Precise control and system reliability is best served in this fashion.

This manual was created for the express purpose of assisting the owner or installing contractor of the AIRSTACK Packaged Air Cooled Product “ASP”. Please review the material contained in this document carefully before installing and operating this equipment. Additional inquiries regarding installation and operation should be directed to AIRSTACK or its authorized agents. Failure to handle, install and operate this equipment in accordance with this manual may result in damage to the equipment and/or personal injury. Failure to comply may void some or all of the AIRSTACK warranty options.

Any questions regarding the content of this Installation Manual, the handling or installation of the AIRSTACK Chiller components should be directed immediately to your authorized representative or to the Service Department at (608) 786-3400 or FAX (608) 786-3450.
**Equipment Description**

**AIRSTACK “ASP”**
The chiller will consist of Modules (one master, fronts, and backs), with an optional Free Cooling Module (no compressors), and an optional Water Pump Module.

**Master Module**
The Master Module for each chiller is designated at the factory. This module includes the Microprocessor Display.

**Front Module**
Front Modules contain the 4” water header distribution pipes and has a slave control board. This module will bolt together with the Rear Module.

**Rear Module**
This module will be attached to the Front Module by vertical frame bolts and the evaporator is connected by cross over pipes to the Front Modules water header pipes. It also has its own slave board.

**Free Cooling Modules**
This module has fin and tube coils for free cooling operation and no mechanical refrigeration (no compressors). The module contains a 3-way diverting valve for either enabling free cooling or by-pass for mechanical cooling.

**Pump Package Module**
This module contains a centrifugal dual-arm pump and water distribution headers. This module is for installations where no pump is provided for the chilled water system or when additional pumping capacity is required.
## Important Module Configurations

### ASP-00P Pump Module
1. When present, a Pump Module is only allowed in the "Front" position.
2. Incoming water to the chiller system must enter at the Pump Module.
3. Leaving chilled water may be from either end of the chiller.
4. An ASP-10A, 15A, or 20A Chiller Module may not be attached in the rear module position of a Pump Module.

### ASP-00F Free Cool Module
1. When present, incoming system water must enter through the Free Cool Modules prior to entering an ASP-10A, 15A, or 20A Chiller Module.
2. You may **NOT** attach a Rear ASP-10A, 15A, or 20A Chiller Module to a Chiller Module.
3. You may **NOT** attach a Rear ASP-10A, 15A, or 20A Chiller Module to a Front Free Cool Module.
4. Only a Free Cool Module may be attached to the rear of a Pump Module.

### ASP-00G Glycol Feeder Module
1. An ASP-00G Glycol Feeder Module may be attached in any rear position.

### ASP-10A, 15A, or 20A Chiller Module
1. Maximum number of ASP-10A, 15A, or 20A modules with a single Master Module is 10 (i.e. (1) Front Master, (4) Front-Slaves, and (5) Rear-Slaves).
2. You may have more than one Master Module in a single Chiller Bank.
3. Piping sides of an ASP-10A, 15A, or 20A Chiller without Free Cool or Pump Modules attached are field selectable.
4. Master Module must be on the Front Side of the Chiller.

### Valid Configurations

<table>
<thead>
<tr>
<th>SR</th>
<th>SR</th>
<th>SR</th>
<th>SR</th>
<th>GR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF</td>
<td>SF</td>
<td>SF</td>
<td>SF</td>
<td>SF</td>
</tr>
</tbody>
</table>

### Invalid Configurations

<table>
<thead>
<tr>
<th>SR</th>
<th>SR</th>
<th>SR</th>
<th>SR</th>
<th>SR</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF</td>
<td>SF</td>
<td>SF</td>
<td>SF</td>
<td>SF</td>
<td>SF</td>
</tr>
</tbody>
</table>

**Problem:** Too many Slaves on one Master.  
**Solution:** Add an additional Master in place of one of the Slaves.

<table>
<thead>
<tr>
<th>SR</th>
<th>SR</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF</td>
<td>MF</td>
<td>SF</td>
</tr>
</tbody>
</table>

**Problem:** Slave cannot be attached to rear of Pump Module.  
**Solution:** Move Slave to front position on opposite end of chiller.

<table>
<thead>
<tr>
<th>SR</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF</td>
<td>PF</td>
</tr>
</tbody>
</table>

**Problem:** Pump Module must be on entering waterside of chiller.  
**Solution:** Swap position of Pump with Master Module.

<table>
<thead>
<tr>
<th>FR</th>
<th>SR</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF</td>
<td>FF</td>
<td>MF</td>
</tr>
</tbody>
</table>

**Problem:** Slave module is attached to the rear of a Free Cool Module.  
**Solution:** Move this Slave to the right of the last Front Slave.

<table>
<thead>
<tr>
<th>SR</th>
<th>SR</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF</td>
<td>MF</td>
<td>GF</td>
</tr>
</tbody>
</table>

**Problem:** Glycol Feeder Module is attached in a front position.  
**Solution:** Move Glycol Feeder Module to rear position & exchange Slave Rear Module for Slave Front Module.

---

**Contact your local Airstack Representative for other configurations.**

---

**LEGEND:**
- **M** = Master Chiller Module (ASP-10A, 15A 20A)
- **S** = Slave Chiller Module (ASP-10A, 15A, 20A)
- **P** = Pump Module (ASP-00P)
- **F** = Free Cool Module (ASP-00F)
- **G** = Glycol Feeder Module (ASP-00G)

**Second Letter:**
- **F** = Front Module
- **R** = Rear Module
Modules

**Single Module**

**NOTES:**
1. All Modules have same dimensions.
2. No obstructions allowed above Condenser Fans.
3. Required service clearance at Module ends: 36".
4. Required Air Intake clearance: 42".
5. Required clearance from any high voltage panel: 42".

**Multiple Modules**

**NOTES:**
1. Modules are bolted together in field.
2. Hardware quantities are specific to each Chiller (# of modules).
3. All Modules have same dimensions.
4. No Obstructions allowed above condenser fans.
5. Required service clearance at Module ends: 36".
6. Required air intake clearance: 42".
7. Required clearance from any high voltage panel: 42".
**Transportation Claims**

If the AIRSTACK product is damaged in any way during shipping and handling by the transportation company or any of its agents, the owner, or installing contractor should promptly file a claim with the transportation company and so advise AIRSTACK.

---

**Handling of Modules**

**Fork Lift or Pallet Jack**
The modules can safely be lifted and maneuvered with a forklift or pallet jack. Forks can be positioned under the evaporator and between the tandem compressors.

**Use of a Crane or other lifting devices**
If lifting modules by crane ensure the slings (do not use chains) do not damage the modules. The lift points are at the corners of the base of the chiller. The modules are shipped with the panels pre-fitted. The use of a spreader bar will prevent damage.

---

**Site Preparation**

**CHW piping recommendations (stubs, valves, etc.)**

The above components are required to ensure proper performance of the AIRSTACK “ASP” chiller. All piping must be properly supported at coupling connections and suitable intervals. It is the responsibility of the installing contractor to ensure all water connections conform to local and national codes. The drawing shows piping exiting on right end. Depending on location of master module, exit can be on either end.
Site Preparation

Pipe System Flushing Procedure

Prior to connecting the Airstack chiller to the water/glycol-piping loop, the system piping should be flushed with a detergent and hot water (110-130°F) to remove previously accumulated dirt and/or other organic residue. After removal of organic residue, flushing should continue with a diluted phosphoric, sulfamic, or citric acid mixture if inorganic scale is present in system. (Note: Cleaning chemicals such as Calgon 789™ or equivalent suitable for both organic residue and scale removal may be substituted. Any other detergents and acids shall not be combined unless approved by chemical manufacturers. Only chemicals compatible with 316 stainless steel, copper and carbon steel shall be used. (Any concentrations of hydrochloric or sulfuric acid or chloride containing chemicals shall not be allowed to come in contact with copper brazed 316 stainless steel evaporators.)

During the flushing, 30 mesh (max.) Y strainers (or acceptable equivalent) shall be in place in the system piping and examined periodically as necessary to remove collected residue. The flushing process shall take no less than 6 hours, or until the strainers when examined after each flushing are clean. Old systems with heavy encrustation shall be flushed for a minimum of 24 hours and may take as long as 48 hours before the filters run clean. Detergent and acid concentrations shall be used in strict accordance with the respective chemical manufacturers instructions. After flushing, the system loop shall be purged with clean water for at least one hour to ensure that all residual cleaning chemicals have been removed.

Prior to supplying water to the Airstack chiller, the Water Treatment Specification shall be consulted for requirements regarding the water quality during chiller operation. The Airstack service literature shall be available to the operator and/or service contractor and consulted for guidelines concerning preventative maintenance.

Airstack® is manufactured by Multistack®

Site Preparation

Clearances

Required Service Clearance At Module Ends ...... 36"
Required Air Intake Clearance ..................... 42"
Required Clearance From Any  
High Voltage Panel ............................... 42"

Site Preparation

Water Treatment / Specification

Supply water for the evaporator water circuits shall be analyzed and treated by a professional water treatment specialist who is familiar with the operating conditions and materials of construction specified for the heat exchangers, headers and associated piping. Cycles of concentration shall be controlled such that recirculated water quality for modular chillers using 316 stainless steel brazed plate heat exchangers and carbon steel headers is maintained within the following parameters:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>ph</td>
<td>&gt;7 and &lt;9</td>
</tr>
<tr>
<td>Total Dissolved Solids (TDS)</td>
<td>Less than 1000 ppm</td>
</tr>
<tr>
<td>Hardness as CaCO3</td>
<td>30 to 500 ppm</td>
</tr>
<tr>
<td>Alkalinity as CaCO</td>
<td>30 to 500 ppm</td>
</tr>
<tr>
<td>Chlorides</td>
<td>Less than 200 ppm</td>
</tr>
<tr>
<td>Sulfates</td>
<td>Less than 200 ppm</td>
</tr>
</tbody>
</table>
Installing Single & Multiple Modules

The modules should be mounted on a level surface with steel rails. This will ensure proper alignment of all fittings.

Rails should run parallel with module water flow (headers). For maximum stability 3 rails should be used, 1 rail for each outside edge and 1 rail to be shared in the center.

The outside rails should be placed flush with outside frame. Internal rail shares half the distance (2") with Rear and Front modules.

1. Starting with the master front modules, position on rails (27" center to center).

2. Lubricate rails with solid vegetable shortening (Crisco™) or other non-petroleum lubricant.

3. Install the 18-inch long evaporator heat exchanger connecting pipes.

Note: Seismic restraint information available from AIRSTACK Headquarters.
4. Lubricate gaskets with a vegetable based lubricant and hand tighten only. Make sure the bottom connector pipe and the sensor pocket is positioned to accept the sensor for the rear module.

5. Position the rear module on the rails. Align the rear module with the front module.

Continue to the next page for step 6 of Airstack module installation.
Installing Single and Multiple Modules Continued

6. Fit the connector pipes from the front module to the rear module, lubricate the gasket and tighten both front and rear couplings at this time. You may need to slide the evaporator mounting plate forward or backward to accomplish this.

7. By loosening the 4 bolts on the plate you can slide the evaporator to the correct distance. If further adjustments are needed, you can loosen the header pipes and front evaporator plate as well.

8. To secure the front and rear modules, align the 3 holes on both ends and install the (6) 3/8" bolts provided.

The Next Step

For installation of subsequent modules follow the same procedure as discussed previously, always begin with the front module. Before installing further rear modules align the 4" water header pipes, lubricate and install the gaskets and couplings connecting to the previous modules header pipe. When bolting the second full module to the first full module align the 3 outer holes on each end and install the 3/8" bolts provided.
**Important Module Configurations**

**ASP-00P Pump Module**
1. When present, a Pump Module is only allowed in the “Front” position.
2. Incoming water to the chiller system must enter at the Pump Module.
3. Leaving chilled water may be from either end of the chiller.
4. An ASP-10A, 15A, or 20A Chiller Module may not be attached in the rear module position of a Pump Module.

**ASP-00F Free Cool Module**
1. When present, incoming system water must enter through the Free Cool Modules prior to entering an ASP-10A, 15A, or 20A Chiller Module.
2. You may **NOT** attach a Rear ASP-10A, 15A, or 20A Chiller Module to a Chiller Module.
3. You may **NOT** attach a Rear ASP-10A, 15A, or 20A Chiller Module to a Front Free Cool Module.
4. Only a Free Cool Module may be attached to the rear of a Pump Module.

**ASP-00G Glycol Feeder Module**
1. An ASP-00G Glycol Feeder Module may be attached in any rear position.

**ASP-10A, 15A, or 20A Chiller Module**
1. Maximum number of ASP-10A, 15A, or 20A modules with a single Master Module is 10 (i.e. (1) Front master, (4) Front-Slaves, and (5) Rear-Slaves).
2. You may have more than one Master Module in a single Chiller Bank.
3. Piping sides of an ASP-10A, 15A, or 20A Chiller without Free Cool or Pump Modules attached are field selectable.
4. Master Module must be on Front Side of the Chiller.

---

**Valid Configurations**

![Valid Configurations Diagram]
Invalid Configurations

Problem: Too many Slaves on one Master.
Solution: Add an additional Master in place of one of the Slaves.

Problem: Slave cannot be attached to rear of Pump Module.
Solution: Move Slave to front position on opposite end of chiller.

Problem: Pump Module must be on entering waterside of chiller.
Solution: Swap position of Pump with Master Module.

Problem: Slave module is attached to the rear of a Free Cool Module.
Solution: Move this Slave to the right of the last Front Slave.

Problem: Glycol Feeder Module is attached in a front position.
Solution: Move Glycol Feeder Module to rear position & exchange Slave Rear Module for Slave Front Module.

Contact your local Airstack Representative for other configurations.

LEGEND

First Letter    Second Letter

M = Master Chiller Module (ASP-10A, 15A, 20A)     F = Front Module
S = Slave Chiller Module (ASP-10A, 15A, 20A)     R = Rear Module
P = Pump Module (ASP-00P)     G = Glycol Feeder Module (ASP-00G)
Installation of Free Cool and Pump Module

Free cooling and pump modules must be installed at either end of the chiller bank. These modules are not to go in-between or to separate mechanical modules. These modules are to be installed in the same manner as the standard mechanical modules.

Main Power

Locate the power distribution box on the specified end of the chiller. Wire and conduit will need to be run from the distribution box to the front module of each chiller. The wire and conduit may be pre-sized and fabricated at the factory.

Field Wiring

It is the responsibility of the contractor to supply and install a flow switch in the LCHW piping.

The master module of the ASP chiller has inputs for the following options: remote start/stop, run status, system alarm, 4-20ma input, and remote communication. Supply and return CHW sensors, module communication plugs, and communication interface cables are all provided with the chiller.

The sensors and cables will be installed and tested by the Factory Authorized Start-Up Technician. (See electrical diagrams for locations of all inputs/outputs.)
Electronic Components

**Microprocessor Display**
This is the computer controller that is installed on the master module and controls all connected modules.

**Module Slave Board**
Each front and rear module have one of these. This board transfers communication from one module to the next.

**Communication**
All modules are linked together through a communication cable. The communication port is J11 on the module slave board.

**Chilled Water Temperature Sensors**
These sensors are factory supplied and field installed on the supply and return chilled water header stubs.

**Sensor Well**
The factory supplied LCHW system sensor well should be installed near the master module. Sensor well is 1/2" pipe thread.

**Compressor Pressure Transducers**
These are factory installed on the suction and discharge lines of each refrigeration circuit to monitor the suction and discharge pressures.
ASP INSTALLATION CHECKLIST AND REQUEST FOR AUTHORIZED START-UP ENGINEER

CUSTOMER: ____________________________  
JOB NAME: ____________________________  
JOB LOCATION: ____________________________  
CUSTOMER ORDER NO.: ____________________________

The work as checked below is in process and will be completed by: Date ____________________________. The service of a Airstack Authorized Start-up Engineer is requested on this date and it is understood that if the work checked below is not completed, the engineer’s time and expenses will be billed to us by Airstack. Terms Net 30 days. Airstack to be notified at least ten (10) working days in advance of the start-up date.

CHILLED WATER
- Piping complete and connected to Airstack Units.  
- Water system filled and vented.  
- Pumps installed (Rotation checked).  
- Recommended strainers installed.  
- Controls (3-way valves & by-pass valves, etc.) operable.  
- Water system operated and flow balanced to meet unit design requirements.  
- Strainers checked for unusual debris.  
- Flow or differential pressure switch installed.

ELECTRICAL
- Power wiring complete and in accordance with nameplate rating on unit and prepared for connection in accordance with installation manual.  

NOTE: No power is to be applied to unit prior to inspection by authorized engineer.  
All interlock wiring complete between control panel and complies with Airstack specifications and with applicable codes.

MISCELLANEOUS
- Chiller sensor wells, gauges, controls installed  
- A minimum system load of 50% of total building load is available for testing and adjusting controls.

We understood that authorized representatives of the installing electrical and piping contractor must be available during the start-up period and that coordination is our responsibility.

We further understand that the services of an Authorized Start-up Engineer will be furnished for a period of not more than sixteen (16) consecutive normal working hours and we agree that a charge for time and expenses will be made by Airstack if services are required for longer than sixteen (16) consecutive normal working hours or if repeat calls are required through no fault of Airstack.

Signed ____________________________  
Title ____________________________  
Company Name ____________________________  
Company Location ____________________________  
Company Telephone ____________________________  
Job Location Telephone ____________________________
Airstack Packaged "ASP"
Pump Module

Drawing #’s
2000-0199
2000-0077
2000-0198

AIRSTACK®
Manufactured By MULTISTACK®
1065 Maple Ave..
Sparta, WI 54656
Phone #: (608) 366-2400  Fax #: (608) 366-2450
Web Site: www.airstack.com
Airstack Packaged “ASP”
Dual Circuit Mechanical Cooling Modules

Drawing #’s
631-C005-01
631-C005-02
631-C005-03
2000-0341
2000-0342

AIRSTACK®
Manufactured By MULTISTACK®
365 South Oak Street
West Salem, WI 54669
Phone #: (608) 786-3400  Fax #: (608) 786-3450
Web Site: www.airstack.com
Airstack Package 15-

Wind Information

Airstack, LLC

Dundee, IL 61316
630-200-2000
630-200-2005
630-200-2007
630-200-2009
630-200-2011
630-200-2013
630-200-2015
630-200-2017

www.airstack.com
NOTES

1. ----- COMPONENTS & WIRING BY OTHERS. (#16 MIN. WIRE)

2. INPUTS TO TERMINALS 1 THRU 6 OF TS2 MUST BE WIRING CLOSED IF NOT USED.

3. EXTERNAL INPUTS: (CLOSED TO OPERATE)
   EX1 = REQUIRES MANUAL RESET
   EX2 = AUTO RESET: REMOTE START/STOP
   EX4 = AUTO Reset: POWER/PHASE MONITOR
   FS = FLOW SWITCH (CHILLED WATER)
   MS = AUX. INTERLOCK (CHILLED WATER PUMP STARTER)
   CHILLED WATER RESET = SELECTABLE 0-10V OR 0-20 MA
   LOAD LIMIT RESET = SELECTABLE 0-10V OR 4-20 mA

4. EXTERNAL OUTPUTS:
   FLR = FULL LOAD RELAY (24 VAC, 5 VA MAX.)
   CAR = COOLING ALARM RELAY (24 VAC, 5 VA MAX.)
ARMSTRONG
Series 4280
1.5x1x8
Centerline Disc, End Suction Motor Mounted Pump

--- Admin Data ---
Tag Num:
Service:
Location:

--- Motor Data ---
Motor Size: 2 hp
Motor Speed: 1800 rpm

--- Design Duty Point ---
Flow: 26.5 usgpm
Head: 52 ft
Impeller: 7.23 in

--- Performance Data ---
- NPSHR: 5.3 ft
- Eff. @ Design: 97.46 %
- BHP @ Design: 0.99 hp
- BEP @ Design Imp.: 54.52 % @ 61.4 usgpm
- BHP @ Runout: 2.01 hp @ 92.2 usgpm
- % max imp. range: 55.10 %

--- EARTH TECH, INC. ---
[Approval status]
[Signature and Date: January 22, 2006]
Centerline Disc. End Suction Motor Mounted Pump

Tag Num: 1
Service: 26.5 gpm
Location: 52 ft.
Capacity: Single
Heads: 0 ft.
Suction Pressure: 24°F
Viscosity: 4.43 cp.
Sp. Gravity: 1.03
Suction Size: 1.5 in.
Discharge Size: 1 in.

MATERIALS OF CONSTRUCTION
Construction: BF (Bronze Fitted)
ANSI Flange Rating: 150 (Cast Iron)
Impeller: Bronze (BS84-444)
Casing: Cast Iron (A48-30)
Casing Gasket: Confined Non-Asbestos Fiber
Adapter: Cast Iron (A278-30)
Motor Shaft: Carbon Steel
Shaft Sleeve: Bronze (BS84-444)

MOTOR DESIGN DATA
Motor Supplier: Factory Choice
Motor Size: 2 hp @ 1800 rpm
Frame Size: 145M
Enclosure: ODP
Cycle/Phase/Voltage: 60/3/230
Motor Eff.: Std
Insulation: Class "B" Insulation (269°F)
Starter Config.: DOL
Full Load/Starting (A): 4.9/50.0

MECHANICAL SEAL DESIGN DATA
Manufacturer: John Crane
Manu. Code: [JC 21]
Seal Type: Inside Unbalanced
Relating Face: Carbon
Stationary Seat: Ceramic
Secondary Seal: EPDM
Springs: Stainless Steel
Rotating Hardware: Stainless Steel

Dimensions for Construction

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>5.25</td>
</tr>
<tr>
<td>G</td>
<td>3.5</td>
</tr>
<tr>
<td>H</td>
<td>2.75</td>
</tr>
<tr>
<td>W</td>
<td>6</td>
</tr>
<tr>
<td>Y</td>
<td>6.63</td>
</tr>
<tr>
<td>X</td>
<td>0.34</td>
</tr>
<tr>
<td>N</td>
<td>6.5</td>
</tr>
<tr>
<td>M</td>
<td>99</td>
</tr>
<tr>
<td>L</td>
<td>99</td>
</tr>
</tbody>
</table>

Simplified Operating Limit

APPROVED AS SHOWN
1/20/2006, 14:24:51, Scott DeGler, Multistack, 608-788-3400, Fax: 608-788-3450
## CHILLED WATER DESIGN

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master Module ASP-15A (MF)</td>
<td>1</td>
</tr>
<tr>
<td>Slave Front ASP___A (SF)</td>
<td>0</td>
</tr>
<tr>
<td>Slave Front ASP___A (SF)</td>
<td>0</td>
</tr>
<tr>
<td>Slave Rear ASP___A (SR)</td>
<td>0</td>
</tr>
<tr>
<td>Slave Rear ASP___A (SR)</td>
<td>0</td>
</tr>
</tbody>
</table>

### Chilled Water: 22% Ethylene Glycol
- **Entering Temperature**: 33.0 °F
- **Leaving Temperature**: 24.0 °F
- **Flow Rate**: 26.5 GPM
- **Evaporator ΔP**: 2.9 Feet

## FREE COOL DESIGN

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free Cool Front ASP-00F (FF)</td>
<td>N/A</td>
</tr>
<tr>
<td>Free Cool Rear ASP-00F (FR)</td>
<td>N/A</td>
</tr>
<tr>
<td>Chilled Water: Entering Temp</td>
<td>N/A   °F</td>
</tr>
<tr>
<td>Chilled Water: Leaving Temp</td>
<td>N/A   °F</td>
</tr>
<tr>
<td>Flow Rate (each)</td>
<td>N/A   GPM</td>
</tr>
<tr>
<td>Total Flow Rate</td>
<td>N/A   GPM</td>
</tr>
<tr>
<td>Operating ΔP</td>
<td>N/A   Feet</td>
</tr>
<tr>
<td>Bypass ΔP</td>
<td>N/A   Feet</td>
</tr>
</tbody>
</table>

## ACCESSORY MODULES

<table>
<thead>
<tr>
<th>Module</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>180 Gallon Tank Module(s) ASP-00T</td>
<td>0</td>
</tr>
<tr>
<td>Glycol Feeder Module(s) ASP-00G</td>
<td>0</td>
</tr>
<tr>
<td>Pump Module(s) ASP-00P</td>
<td>1</td>
</tr>
</tbody>
</table>

## PUMP DESIGN

- **Pump Size**: (2) 1.5x1x8
- **Flow Rate**: 26.5 GPM
- **Pump**: 3 hp
- **Total Head**: 52.0 Feet

Assumes 49.1 ft of external head

---

## AMBIENT AIR TEMPERATURE

<table>
<thead>
<tr>
<th>Design</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>95.0   °F</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0.0         °F</td>
</tr>
</tbody>
</table>

## FULL LOAD CHILLER PERFORMANCE

- **Cooling Capacity**: 8.7 Tons
- **Power Input**: 15.7 KW
- **EER**: 6.6

---

## ELECTRICAL DATA

### MAIN POWER SUPPLY

- **Voltage**: 230 / 60 / 3
- **FANS**: 4 FLA per fan motor
- **CHILLER CIRCUIT**
  - ASP-15A: 23.2 FLA per pump
  - ASP-00P: 9.6 FLA per module

### ELECTRICAL CIRCUIT(S) CAPACITY

- **Minimum Circuit Ampacity (amps)**: 70
- **Maximum Fuse Size (amps)**: 93
- **Recommended Dual Element Fuse**: 100

---

**First Letter**
- M = Master Chiller Module
- S = Slave Chiller Module
- P = Pump Module
- F = Free Cool Module
- G = Glycol Feeder Module

**Second Letter**
- F = Front Module
- R = Rear Module

---

**CHILLER LAYOUT**

1. **PF**
2. **MF**
3. **J**

---

**IMPORTANT:** To assure full equipment design performance, life and reliability, the MULTISTACK chiller must be piped in accordance with installation manual unless specifically authorized otherwise by MULTISTACK in writing.
AIR COOLED PACKAGED CHILLER

MASTER CONTROLLER

PCO² CONTROLLER USER MANUAL

CONTROLLER FOR “ASP-2C” AIR-COOLED PACKAGED CHILLER
for Version – MCAS G07, MCAL G07, MCAB G07
2 Refrigerant Circuits in 1 Module - Networked

Airstack

MFG BY AIRSTACK, A DIVISION OF MULTISTACK®
Introduction

An Airstack Air-cooled Packaged Chiller-2 Circuit (ASP-2C) is a modular air-cooled chiller, composed of one or more modules, to provide chilled liquid to an external circuit. These mechanical cooling modules interconnect through a common chilled water header system. Each module contains 2 scroll compressors, a stainless steel, dual circuit, brazed plate heat exchanger, copper tube with copper condenser coils, two fans, and other related control components. There are two independent refrigerant circuits in each ASP-2C module. The chiller is operated by a microprocessor based controller that monitors the status of each refrigerant circuit and provides a signal to operate compressors and fans as required. The chiller uses the entering chilled water temperature (ECHWT) and system setpoints to determine the need for cooling to the external circuit.

![Figure 1 - pCO2 Master Controller](image)

Master Controller

The *master controller* is equipped with a 4x20 character LCD with backlight and a six button keypad. These aid the operator in setting *SYSTEM VARIABLES*, checking faults, monitoring the status of the chiller. The *master controller* is also the interface to field supplied remote connections such as Remote Start/Stop, Flow Switch inputs, Customer Alarm outputs, and CHILLED WATER or LOAD LIMIT RESET signals. There is also an optional communication link for remote monitoring and control of the chiller system. Each *master controller* can control up to 8 modules.

![Figure 2 - pCO2 Module Board](image)

Module Board

Each module has a *module board*, which sends information to the *master controller* regarding the temperatures, pressures, and activity of the module. The feedback from the *module board* determines the status of its circuits. The *module board* performs safety checks and alerts the *master controller* when something is wrong. Loss of communication with the *master controller* results in the shutting down of the module, unless the module is running in *manual mode*. The inputs and outputs for the first module in the chiller are integrated into the *master controller* board.
Controller Keys
On the master controller, there are six buttons to assist the user in navigating the screens of the controller. The following information describes the use of each button.

↑ The UP arrow button is used to go back to the previous category on the screen or to increase the value of a digit in a numeric variable field.

↓ The DOWN arrow button is used to advance to the next category on the screen or to decrease the value of a digit in a numeric variable field.

← The ENTER button is used to make a selection from any of the menu screens in the program. It is also used to enter and exit edit mode while in the SYSTEM VARIABLES screens.

ALAR The ALARM button is the menu for current system or module faults. When the backlight is red, it indicates that a fault has occurred.

Prg The PROGRAM button goes to the MAIN MENU from any screen in the program.

Esc The ESCAPE button goes to the previous screen or the main status screen, if you are at the top of the MAIN MENU.

Controller Setup
On each controller, master or module board, there is a set of six DIP switches. These switches define the network of the chiller system and identify each module in the system. The DIP switches are set in binary code addressing, where the first switch is a value of 1, the second is a value of 2, the third is a value of 4, the forth is a value of 8, the fifth is a value of 16, and the sixth is a value of 32. The following DIP switch would give an address of 30 to its controller. (The black square is the switch position.)

<table>
<thead>
<tr>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 3 4 5 6</td>
</tr>
</tbody>
</table>

\[
\begin{array}{c|c}
\text{Switches} & \text{Value} \\
\hline
\text{ON} & \text{Value} \\
2 & 2 \\
3 & 4 \\
4 & 8 \\
5 & 16 \\
6 & 30 \\
\end{array}
\]

The following are the addressing parameters for setting up an ASP chiller network:

- Mechanical Cooling Addresses – 2 thru 8
- Master Controller Address – 30
- Remote LCD Display – 32

In setting up the network, the master controller must have an address of 30. The first mechanical cooling module is integrated into the master controller board. The second mechanical cooling module would be 2, the next 3 and so on. For more help in DIP switch settings, see Appendix A on page 18.
Each mechanical cooling module has a Manual/Off/Auto switch. In manual mode, the staging of the compressors is done by its module board. The control is independent of the other modules and is based on the LCHW of that module. When auto mode is selected, the staging of the compressors is handled by the master controller. The master controller will determine how many compressors need to be on to satisfy the load requirements. Control of the compressors is based on the system ECHW when in auto mode. Disabled mode (off) selection disables the module and the compressors are not allowed to run. However, the fans will still cycle on and off based on the high pressure in that module.

Main Menu

The MAIN MENU displays the options the user can access in the program. Press the Prg button to get to the MAIN MENU and then use the UP and DOWN arrow buttons to scroll through the menu. The ENTER button allows displaying of the sub-menu that the greater than sign (>) is located beside. The MAIN MENU contains ON/OFF CONTROL, STATUS, SYSTEM VARIABLES, FAULT REVIEW, LOAD PROFILE, and SECURITY.

On/Off Control Screen

Upon power up, the initial screen will go through a 12 second delay before giving control to the user. The ON/OFF CONTROL screen will be the next screen. It allows the user to command the chiller on or off. The display will read ‘CHILLER OFF, PUSH ENTER TO START’. Pushing the ENTER button, will display a message of ‘30 SECONDS TO START!’ and will change to ‘CHILLER ON, PUSH ENTER TO STOP’. After the 30 second delay, the display will change to the main status screen and the lead compressor will turn on, if needed. The last line of the screen shows any critical system faults such as WAITING FOR CHW FLOW and REMOTE START/STOP.

System Variables

Once power is connected to the master controller, the SYSTEM VARIABLES can be accessed. These variables determine how the chiller system will run and are assigned default values. For most installations, these values will provide optimum performance. However, special operating conditions may require different settings.

Use the UP or DOWN arrow buttons to locate the SYSTEM VARIABLES in the MAIN MENU. The greater than sign (>) is the cursor indicator. Press the ENTER button to enter the SYSTEM VARIABLES’ MENU. Press the ENTER button again to enter one of the sub-menus. The SYSTEM VARIABLES’ MENU includes MECHANICAL COOLING, CUSTOMER RESETS, TEMPERATURE READINGS, and TIME AND DATE.

To change the value of a variable, press the ENTER button. A blinking block cursor will appear in that system variables’ value field indicating that the program is in edit mode. Use the UP or DOWN arrow buttons to change the value of the variable. To save the new setting, press the ENTER button or press the Esc button to cancel the change. The cursor will move back to the upper left corner of the screen indicating that the program is no longer in edit mode. An asterisk (*) next to the variable indicates that the SYSTEM VARIABLES are locked and cannot be adjusted. For assistance on unlocking the SYSTEM VARIABLES, see SECURITY on page 14.

Mechanical Cooling System Variables

The following is a list of SYSTEM VARIABLES for the mechanical cooling modules:

1. **UPPER SETPOINT:** The entering chilled water temperature (ECHW) at full load. When the water entering the chiller is at or above this setpoint, all available compressors should be running.
2. **LOWER SETPOINT**: The leaving chilled water temperature (LCHW – System sensor) at full load. The temperature drop across this chiller is based on flow rate. If the design temperature drop (ΔT) is 10°F across the chiller, then the LOWER SETPOINT should be 10°F below the UPPER SETPOINT.

3. **VSP SETPOINT**: A percentage used to determine the no load chilled water temperature. If the UPPER SETPOINT is at 55°F, the LOWER SETPOINT is at 45°F, and the VSP is at 50%, then the no load point would be 50% of the difference between the UPPER SETPOINT and the LOWER SETPOINT settings, which is 5°F. Therefore, all compressors would be on at 55°F and all compressors would be off at 50°F by the temperature of the ECHW Sensor.

4. **LOAD LIMIT**: A percentage used to limit the maximum system load.

5. **T-DIFF** (Time Difference): The minimum time in seconds between starts and stops of compressors. This time should be set to the loop time. The loop time is the time it takes for the water to make one pass through the entire CHW loop of the building.

6. **FAIL INDIC** (Failure Indicator): A percentage value which provides for an output signal whenever compressors of the indicated value have failed. A 0% setting will give an output signal after any failure within the system.

7. **LEAD COMP**: Determines which compressor is the first on and the last off. The compressors will appear in a format of M1-1, M1-2, M2-1, etc. This format stands for Module #1–Compressor #1 and so on.

8. **MAN. SETPOINT**: Please see page 8 on manual mode operation for further details.

9. **MAN. RANGE**: Please see page 8 on manual mode operation for further details.

10. **MAN. OFFSET**: Please see page 8 on manual mode operation for further details.

11. **NUM OF MODULES**: This is the number of mechanical cooling modules that are in the chiller system.

12. **FAN SETPOINT**: The point, measured in psig, where the last fan turns off.

13. **FAN OFFSET**: The value, measured in psig, when added to the FAN SETPOINT where the first fan turns on. When psig reaches 2 times the FAN OFFSET, the second fan will turn on. Ex. If the FAN SETPOINT is at 235 psig and the FAN OFFSET is at 30 psig, the first fan will come on at 265 psig and the second at 295 psig. They will then turn off at 265 psig and 235 psig.

14. **HP CUTOUT**: The point where a high pressure fault occurs based on the high pressure transducer. Note: Each refrigerant circuit also has a mechanical high pressure switch with a manual reset. If this setting is set higher than the switch setting, the mechanical switch will take the compressor offline with a high pressure fault.

15. **SEQUENCE**: Determines the order for loading and unloading the compressors.
   - **STANDARD** – The compressors turn on in numerical order starting with the lead compressor.
   - **ODD/EVEN** – A scheme developed to bring one compressor in each module on before the second compressor in any module is allowed to run. If the LEAD COMPRESSOR ends in -2 (M1-2, M2-2, etc), then all even compressors would start before the odd compressors. If the LEAD COMPRESSOR ends in -1 (M1-1, M2-1, etc), then all add compressors would start before the even compressors. See Appendix D on page 23 for more information on compressor rotations.

16. **INDEXING**: The indexing can either be ON or OFF. If ON, the lead compressor changes every 24 hours at midnight. If OFF, the LEAD COMPRESSOR stays the same and will have the most runtime. See Appendix D on page 23 for more information on compressor rotations.
Standard Application

System Variable Ranges & Default Settings

Mechanical Cooling
The following table defines all of the SYSTEM VARIABLE ranges and default values for mechanical cooling modules.

<table>
<thead>
<tr>
<th>System Variable</th>
<th>Range</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPPER SETPOINT</td>
<td>45°F to 80°F</td>
<td>55°F</td>
</tr>
<tr>
<td>LOWER SETPOINT</td>
<td>40°F to 70°F</td>
<td>45°F</td>
</tr>
<tr>
<td>VSP VALUE</td>
<td>0% to 80%</td>
<td>50%</td>
</tr>
<tr>
<td>LOAD LIMIT</td>
<td>0% to 100%</td>
<td>100%</td>
</tr>
<tr>
<td>T-DIFF</td>
<td>15 to 200 sec</td>
<td>90 sec</td>
</tr>
<tr>
<td>FAIL INDIC</td>
<td>0% to 90%</td>
<td>0%</td>
</tr>
<tr>
<td>LEAD COMP.</td>
<td>M1-1 to M14-2</td>
<td>M1-1</td>
</tr>
<tr>
<td>NUM OF MODULES</td>
<td>1 to 14</td>
<td>1</td>
</tr>
<tr>
<td>FAN SETPT.</td>
<td>170 to 350 psig</td>
<td>200 psig</td>
</tr>
<tr>
<td>FAN OFFSET</td>
<td>20 to 60 psig</td>
<td>30 psig</td>
</tr>
<tr>
<td>HP CUTOUT</td>
<td>300 to 425 psig</td>
<td>365 psig</td>
</tr>
<tr>
<td>SEQUENCE</td>
<td>STANDARD or ODD/EVEN</td>
<td>STANDARD</td>
</tr>
<tr>
<td>INDEXING</td>
<td>OFF or ON</td>
<td>ON</td>
</tr>
</tbody>
</table>

Standard Module Cutouts and Reset Points

- Low Suction Temp: Cutout → 25°F Reset @ 30°F
- Low Leaving CHW: Cutout → 36°F Reset @ 40°F
- Low Pressure: Cutout → 15 psig Reset @ 30 psig
Mechanical Cooling (Auto Mode)

The following chart defines how the chiller works in auto mode. It is based on a 10 compressor system (5 modules) with a 10°F ΔT, and operation between 55°F and 45°F. It shows the system relationship between ECHWT, LCHWT, and VSP at various load conditions.

![Diagram of Mechanical Cooling (Auto Mode)]

**System Conditions:**
- Full Load ΔT = 10 °F
- 10 Compressors
- UPPER SETPOINT - 55 °F
- LOWER SETPOINT - 45 °F

The data below shows same operating conditions that could occur based on the information from the chart.

<table>
<thead>
<tr>
<th>VSP = 20%</th>
<th>VSP = 50%</th>
<th>VSP = 80%</th>
</tr>
</thead>
<tbody>
<tr>
<td>% LOAD</td>
<td>ECHWT</td>
<td>LCHWT</td>
</tr>
<tr>
<td>0</td>
<td>47</td>
<td>47</td>
</tr>
<tr>
<td>50</td>
<td>51</td>
<td>46</td>
</tr>
<tr>
<td>100</td>
<td>55</td>
<td>45</td>
</tr>
</tbody>
</table>
Mechanical Cooling – Manual Mode

In manual mode operation, each module acts independently, depending on the sensor inputs to that module. The staging of the compressors is done by its module board. The control is based on the LCHW temperature of that module. The following are SYSTEM VARIABLES that are used in manual mode operation:

1. MAN. SETPOINT: The LCHW temperature where the last compressor will turn off.

2. MAN. RANGE: A value, when added to the MAN. SETPOINT where the first compressor will turn on.

3. MAN. OFFSET: A value, when added to the MAN. RANGE point where the second compressor will turn on.

Caution: Operation of chiller in manual mode bypasses the flow protection and power phase monitor safeties. Operation of the chiller in this mode is not recommended for extended periods. Proper precautions must be made to prevent freezing of the heat exchangers.

Manual Mode Ranges and Default Settings

<table>
<thead>
<tr>
<th>System Variable</th>
<th>Range</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAN. SETPOINT</td>
<td>40°F to 70°F</td>
<td>45°F</td>
</tr>
<tr>
<td>MAN. RANGE</td>
<td>2°F to 20°F</td>
<td>10°F</td>
</tr>
<tr>
<td>MAN. OFFSET</td>
<td>0°F to 5°F</td>
<td>2°F</td>
</tr>
</tbody>
</table>

---

57.0°F
OFFSET = 2.0°F
55.0°F
TURN COMPR. 1 ON

55.0°F
57.0°F
RANGE = 10.0°F
47.0°F
TURN COMPR. 2 OFF

45.0°F
TURN COMPR. 1 OFF

SETPOINT = 45.0°F
Master Controller Status Screens

System Screens

The main status screen displays information about the chiller.

1. **CAPACITY**: A percentage of how many compressors are turned on, compared to the total installed. An asterisk (*) displayed next to capacity indicates that it is being controlled by an external source, either LOAD LIMIT or CHILLED WATER RESET.

2. **DEMAND**: A percentage of current load needed compared to the maximum design load. This value is determined by the system ECHW temperature and the settings of the SYSTEM VARIABLES.

3. **DELAY**: A time in seconds between starts or stops up of compressors. A compressor should only turn on or off if the delay time counter is at zero. This is determined by the mechanical cooling module’s system variable T-DIFF.

4. **FAULTS**: A value showing the number of current or resettable faults that are in the chiller.

5. **ECHW**: The Entering Chilled Water temperature of the chiller. (Return Water from the building.)

6. **LCHW**: The Leaving Chilled Water temperature of the chiller. (Supply Water to the building.)

Press the DOWN arrow button once to display the next status screen with system information.

1. **LEAD COMP**: The compressor shown is the first on and the last off.

2. **LOAD LIMIT**: A percentage value to limit the max number of compressors available at any given time. An asterisk (*) indicates that an external LOAD LIMIT RESET signal is enabled.

3. **CHW OFFSET**: Shows value of customer CHW RESET signal. Range 0 to 10°F. An asterisk (*) indicates the external CHW RESET signal is enabled.

**Mechanical Cooling Screens**

Press the DOWN arrow button again to display information for the first module. The following information is available:

1. **LCHW**: The leaving chilled water temperature in the module.

2. **COMP1 and COMP2**: This displays the status of the compressors, ON or OFF in that module.

3. **FAN1 and FAN2**: Displays the status of the fans, ON or OFF. FAN 2 always turns on first.

4. **Status Line**: The status line of the module can be the mode in which the module is in or it can be what the current fault is on that module. If nothing appears in the status portion of the screen, then the module is in auto mode and there are no faults. If MANUAL MODE or DISABLED appears on the status line, then the module is in manual mode or disabled. The faults that occur on the modular level will also be displayed on the status line when the fault is current.

Press the ENTER button to display information for compressor circuit #1 of module 1.

1. **COMP1**: This displays the status of the compressors, ON or OFF in that module.

2. **SUCT**: The suction temperature in the refrigerant circuit measured on the compressor suction line.

3. **HP**: The high side pressure of the refrigerant circuit measured in psig.

4. **LP**: The low side pressure of the refrigerant circuit measured in psig.
5. **HOURS**: The total number of hours the compressor has run. To reset the run hours of a compressor, press and hold the **ALARM** and **DOWN** arrow buttons simultaneously on the screen of the compressor whose hours need to be reset.

6. **Status Line**: The status line of the module can be the mode in which the module is in or it can be what the current fault is on that module. If nothing appears in the status portion of the screen, then the module is in **auto mode** and there are no faults. If **MANUAL MODE** or **DISABLED** appears on the status line, then the module is in **manual mode** or **disabled mode**. The faults that occur on the modular level will also be displayed on the status line when the fault is current.

Press the **ENTER** button to display information for compressor circuit #2 of module 1. Press the **ESC** button to go back to the Module 1 Status Screen. Press the **DOWN** arrow button to go to the Module 2 Status Screen. Repeat the above steps to view the detailed information for module 2 and further modules.

**Inputs and Outputs**

**Inputs - Analog**

1. **High Pressure Transducers**: A 4-20 mA input sensor that measures the high side pressure of the refrigerant in a refrigerant circuit. There is one HP transducer for each refrigerant circuit.

2. **Low Pressure Transducers**: A 4-20 mA input sensor that measures the low side pressure of the refrigerant in a refrigerant circuit. There is one LP transducer for each refrigerant circuit.

3. **Leaving Chilled Water Sensor**: NTC type sensors that measure the temperature of each module’s LCHW coming from the each **mechanical cooling** module.

4. **System Entering Chilled Water Sensor**: A NTC type sensor that measures the temperature of the ECHW going to the **mechanical cooling** modules from the building.

5. **System Leaving Chilled Water Sensor**: NTC type sensors that measure the temperature of the chiller’s LCHW coming from the **mechanical cooling** modules to the building.

6. **Suction Sensors**: NTC type sensors that measure the temperature of the suction line in each refrigerant circuit. There is one suction sensor for each refrigerant circuit.

7. **Customer Reset Signal**: A 0-10 Volt, 0-20 mA, or 4-20 mA, customer supplied, **external** signal that shifts the **UPPER** and **LOWER SETPOINTS** from 0 to 10°F or changes the **LOAD LIMIT** from 0 to 100%.

**Inputs – Digital**

1. **EX1**: A customer supplied input that is a closed circuit to operate; open to stop operation. Requires manual reset to resume operation. This input will create a fault.

2. **Remote Start/Stop**: An input that is a closed circuit to operate; open to stop operation. Automatic restart of the chiller. This input does **NOT** create a fault.

3. **Power Phase Monitor**: An input that is a closed circuit to operate; open to stop operation. Automatic restart returns the chiller to the previous on/off state of the chiller.

4. **CHW Flow Switch**: An input that is a closed circuit to operate; open to stop operation. Circuit opens when there is **NO FLOW**. After 4 seconds, the chiller shuts down. When the flow switch closes, the chiller will automatically restart.

5. **High Pressure Switch**: An input that indicates when the switch for the high side pressure of a refrigerant circuit has tripped. There is one HP switch for each refrigerant circuit.
6. **Circuit Faults**: An input that monitors the control circuit of each compressor for abnormal operating conditions. A 1 or 2 would be displayed to show which compressor circuit has a fault.

7. **Manual Mode/Auto Mode**: Inputs from the Manual/OFF/Auto Switch that tell the module board which mode of operation to run that module in.

**Outputs – Digital**

1. **Compressor Start Signal**: A 24V output to start the compressors.

2. **Fan Start Signal**: A 24V output to start the fans.

3. **Liquid Line Solenoid Valve**: A 24V output to energize the liquid line solenoid valves.

4. **Alarm Light**: A 24V output which indicates that there is an alarm on the module.

5. **Remote Pump Enable**: This is a 24V AC, 5VA max signal that can be used to remotely enable the pump. The signal will be high anytime the chiller is on. When the chiller is turned off, the pump will continue to run for two times the amount of time of TDIFF. The exception is when the Power Phase Monitor is tripped; the pump signal goes to low with no time delay.

6. **Run Status Relay**: A 24V output which indicates that at least one compressor is running.

7. **Customer Alarm Relay**: This is a 24V AC, 5VA max signal that can power a relay to trigger an alarm.

8. **Full Load Indicator Relay**: This is a 24V AC, 5VA max signal that can power a relay to show that the chiller system is at full load (all compressors on).
Faults

If a fault has occurred, the ALARM button will illuminate. To view the current fault(s), press the ALARM button. Use the UP and DOWN arrow and ENTER buttons to view and clear the fault(s). If the fault returns, then it will need to be reset elsewhere first.

Chiller Faults

If any of the following faults occur, all modules in the chiller will be disabled.

1. **EX1**: Customer Input – EX1 requires a reset and restart command at the master controller.

2. **REMOTE START/STOP**: Customer Input – This is NOT a true fault. This circuit operates like an on/off switch. If closed, the chiller is on, as long as the chiller has been commanded on. If open, the chiller is disabled and the compressors will not run. When this input is closed then opened and then closed again, the chiller will start.

3. **POWER PHASE**: This fault alerts the customer of a disruption in power. There is no reset required at the master controller. If the chiller is on when fault occurs, it will default back to on after the fault clears.

4. **CHW Flow**: This alerts the master controller of NO FLOW in the chiller and disables all modules. There is an automatic restart after the flow switch closes.

5. **ECHW Sensor Failure**: The sensor for the system ECHW has either opened or shorted to the master controller. This fault requires resetting at the master controller.

6. **LCHW Sensor Failure**: The sensor for the system LCHW has either opened or shorted to the master controller. This fault requires resetting at the master controller.

7. **System LOCHW Temp**: Low Leaving Chilled Water temperature. If the LCHW of the system falls below 36°F, the compressor will turn off. The water temperature must rise to 40°F before the fault can change from current to reset. This requires resetting the fault at the master controller and restarting the chiller.

Individual Compressor Faults

1. **High Pressure**: High Pressure Cutout. This high pressure fault can come from either the transducer reading or the HP switch being tripped. If the HP transducer reaches the pressure of the HP Cutout variable the alarm goes off, shutting down that module. In this case, the fault only needs to be reset at the master controller after the high side pressure drops below 300 psig. If the HP switch trips then, it requires resetting at the module HP switch and the master controller to resume operation. The fault will remain current until the HP switch is manually reset.

2. **HP Sensor Failure**: The High Pressure Transducer has either opened or shorted to the master controller. This fault requires resetting at the master controller.

3. **Low Pressure**: Low Pressure Cutout. If the reading from the LP transducer falls below 15 psig, then that module will be shut down and in an alarm state. This fault will remain current until the low side pressure rises above 25 psig. The fault can then be reset at the master controller. (Typically indicates loss of refrigerant charge.)

4. **LP Sensor Failure**: The Low Pressure Transducer has either opened or shorted to the master controller. This fault requires resetting at the master controller.
5. **Low Pressure Delay**: Occurs when the low side pressure drops below 25 psig disabling the compressor in that circuit for 5 minutes. It automatically resets after the 5 minutes, as long as the low side pressure reading is above 30 psig. The compressor will be allowed to run for 1 minute between 15 and 25 psig, before being shut down, upon start of the compressor.

6. **LOCHW Temp**: Low Leaving Chilled Water temperature. If the LCHW of the circuit falls below 36°F, the compressor will turn off. The water temperature must rise to 40°F before the fault can change from current to reset. This requires resetting the fault at the master controller.

7. **LCHW Sensor Failure**: The sensor for each circuit’s LCHW has either opened or shorted to the master controller. This fault requires resetting at the master controller.

8. **Circuit Fault**: A CIRCUIT FAULT will occur if the compressor contactor is not operating normally. Three conditions could potentially create a CIRCUIT FAULT. One would be, if the program signals for a contactor to be closed and it does not close within 5 seconds. Once the contactor has been closed for 5 seconds, if the contactor ever opens for 1 second while under normal operating conditions (indicating a chattering contactor), a fault will occur. The third condition would be if the program turns a contactor off and the contactor remains closed for an additional 10 seconds, this fault would occur (indicating a welded contactor). The fourth way to get a circuit fault would be if the difference between the high pressure and the low pressure in the circuit is not at least 50 psi with in 60 seconds. This fault requires resetting at the master controller to resume normal operation.

9. **LOSUCT**: Low Suction Temperature: This is measured by the circuit suction sensor and would affect that circuit only. If during operation this temperature should drop below 25°F, that circuit’s compressor will shut down. This requires resetting at the master controller, but only after the temperature has risen above 30°F.

10. **SUCT SENSOR FAILURE**: Suction Sensor Failure. This would occur if the suction line sensor opened or shorted to the master controller. This fault requires resetting at the master controller.

11. **COMMUNICATION ERROR**: This would occur if more than one module is addressed the same, or if there is a problem with communications of that individual module to the master controller. This fault only occurs in auto mode.
Fault Review

The FAULT REVIEW is a history of the faults that have occurred in the chiller system. The review holds up to 25 faults. The review can be found in the MAIN MENU. The faults are in order by the most recent to the oldest. Pushing the UP and DOWN arrow buttons allows scrolling through the faults. Pushing the ENTER button on a particular fault allows for viewing of a second screen of information. Pushing ENTER again returns to the first screen of the fault. The following is a sample of what the two screens contain.

Screen #1

FAULT 01  CURRENT
COMMUNICATION ERROR
MOD1  9/17  12:35
PRESS ENTER FOR MORE

Screen #2

FAULT 01  SUCT  00.0
'SYSTEM  LCHW  00.0
'ECHW  00.0  HP = 000
'LCHW  00.0  LP = 000

Screen one displays information about the fault. The status of the fault will be displayed as CURRENT, RESET, or RECORD. CURRENT means that the fault is still present, RESET means that the fault can be reset at the master controller, and RECORD means that the fault is part of the history for future reference. The date and time of the fault, the fault that occurred and where the fault occurred are also displayed on the first screen. On screen two, the system temperatures at the time the fault occurred will be displayed on the left side of the screen and are starred with an asterisk (*). On the right side of the screen is module information that was current at the time of the fault. If the fault is a system fault the module information will display all zeros.

Clearing the faults from the FAULT REVIEW removes all the faults at once. Hold down the PRG and UP arrow buttons simultaneously for all faults to be removed from the FAULT REVIEW. When a message of NO MORE ALARMS appears on the screen, release the buttons.

Load Profile

The LOAD PROFILE displays the operating history of the mechanical cooling modules. It relates the total operating hours to the load percent and is subdivided into 10% segments. This screen is located in the MAIN MENU of the master controller. There are three screens used to display the information. Pressing the DOWN arrow button will allow all screens to be viewed. To reset the hours in the LOAD PROFILE, hold down the DOWN arrow and the ALARM buttons simultaneously while viewing the LOAD PROFILE. The SYSTEM VARIABLES must be unlocked to clear the LOAD PROFILE.

Time and Date

The TIME AND DATE option is located in the SYSTEM VARIABLES’ MENU. Press ENTER on the TIME AND DATE option. The time appears first and is displayed in military time. To change the time, press the ENTER button, putting the program into edit mode. The cursor is now in the hour field, use the UP and DOWN arrow buttons to change the hour to the correct time. Press the ENTER button again to move the cursor to the minute field to change it. Press the ENTER button one more time to set the TIME. Press the Esc button, anytime, to abort the time change.

After setting the TIME, use the DOWN arrow button to move to the DATE screen. Press ENTER to move the cursor into the month field. Using the UP and DOWN arrow buttons, change the value to the current month. Press ENTER again to move the cursor to the day field, adjust the day accordingly. Press ENTER again to move to the year field, adjust the year accordingly. Press ENTER one more time to accept the DATE. Press the Esc button, anytime, to abort the date change.
Temperature Readings

The temperature readings default to Fahrenheit (°F). The readings may be set to display in Celsius (°C), by going to the `SYSTEM VARIABLES' MENU`. Press ENTER on TEMP. READINGS option. Press ENTER again to move the cursor into the field. Use the UP or DOWN arrow button to change the field from Fahrenheit to Celsius. Press ENTER again to accept the change.

Customer Resets

CHILLED WATER RESET (CHW) and LOAD LIMIT RESET are external inputs that are program selectable as 0-10 Volt, 0-20 mA, or 4-20 mA. The `CUSTOMER RESET` option is located in the `SYSTEM VARIABLES' MENU`. The customer can send a signal to change these values remotely. The CHW RESET will increase the SETPOINT in the `mechanical cooling` modules anywhere from 0 to 10 °F. The LOAD LIMIT RESET will allow the LOAD LIMIT of the `mechanical cooling` modules to be changed. There will be an asterisk (*) by the SETPOINT and the LOAD LIMIT values on the second `status screen`, if they are enabled. An asterisk (*) also appears next to CAPACITY on the `main status screen` when either reset is enabled. Press ENTER and use the UP and DOWN arrow buttons to choose which reset will be used. Press ENTER again to select the type of input provided. (0-10 Volt, 0-20 mA, or 4-20 mA) Both default to DISABLED, but when enabling the user must select the type of input being used. Press ENTER to accept the reset value.

Security

The security option in the `MAIN MENU` is used to lock the `SYSTEM VARIABLES`. The first screen tells whether the variables are locked or unlocked. Initially the screen will say 'SYSTEM VARIABLES UNLOCKED'. Press ENTER to change the status of the security. The cursor will be on the first letter of the password code. Enter a five letter password, using the UP and DOWN arrow buttons to change the letter and press ENTER to move to the next letter. After entering the last letter, the next screen is to accept the password or clear the password. Press ENTER again to set the password or Esc to clear the password. The screen will then display the status of the `SYSTEM VARIABLES` as LOCKED.

If the password is forgotten, please call your Multistack Service Representative at 608-786-3400.

Board LED’s

Five LED’s are present on each board, master and module. Two LED’s are located at the bottom of the board, one yellow and one red. The yellow one indicates that the board is receiving power. The red one is an alarm LED that would indicate that something maybe wrong with the board internally. Three more LED’s are located at the top of the board next to the DIP switches. These LED’s indicate that the connection, address definition and pLan (network of the modules) are working correctly. The green and yellow LED’s should be lit for the network to be working properly.

Program Version

The program version is found by going to the `MAIN MENU` and pressing the UP arrow and PRG buttons simultaneously. A screen will appear that displays the version of the program in the controllers and the month and year the program was developed. The version will appear in a format similar to MCAS_A01. When looking at the version, the forth position could vary between S, L, and B. The S stands for a Standard application, the L for a Low Ambient application, and the B for a Brine or Low Temperature application. This each of these programs may have different cutouts or temperature ranges available to the customer. The `SYSTEM VARIABLES` and cutouts are located on page 4. The cutouts for the Low Ambient and Low Temperature applications are found in Appendix B on page 18.
BAS Interface

The master controller is capable of tying into a building automation system. Modbus and BACnet are the two protocols that are currently available. First the BAS INTERFACE needs to be enabled. This is accomplished by going to the SYSTEM VARIABLES Menu and changing the enable point, under BAS INTERFACE, to yes. The enable defaults to no. This menu also has a variable to select which Protocol will be used. Select the appropriate Protocol for the job. BACnet is the default for this variable.

Modbus

Modbus requires that a RS485 card is installed into the pCO2 Master Controller. This card plugs into the serial port and communicates Modicon Modbus Protocol Rev. D. The Modbus protocol used is RTU type. The configuration is multipoint for RS-485. The data communication is asynchronous serial, 8 data bits, 2 stop bits, and no parity across an EIA-485 two-wire half-duplex connection. The cable size recommended is an AWG20/22 two-wire twisted shielded cable. The pin wiring is GND, RX+/TX+, RX-/TX- and is stamped on the terminal connector. The customer can adjust the Baud Rate and the Network Number. These settings are found in the SYSTEM VARIABLES Menu under BAS INTERFACE. The Baud Rate defaults to 9600 bps and can be adjusted to 1200, 2400, 4800, 9600, or 19200 bps. The Network Number is the same as a slave address and defaults to 1. This number must be unique to the Modbus network. The range for the Network Number is from 1-200. See the ASP Modbus Technical Manual for a table of Modbus register points.

![Figure 3 - RS485 Card](image1)
![Figure 4 - pCO2 with RS485 Card](image2)

BACnet

BACnet requires that a pCO Web card is installed in to the pCO2 Master Controller. This card plugs into the serial port and communicates BACnet over Ethernet (ISO8802-2 or 8802-3) or BACnet over TCP/IP (Addenda A/Annex J). The recommended cable is shielded class 5, max 100mt. The Baud Rate is selectable and defaults to 19200. See the ASP BACnet Technical Manual for a table of points and instructions on changing the IP Addressing scheme.

![Figure 3 – pCO Web Card](image3)
![Figure 4 - pCO2 with pCO Web Card](image4)
APPENDIX A

DIPSWITCH SETUP
The following are the positions of the DIP switches to setup the network of ASP's. The black square represents the location of the switch.

**Mechanical Cooling Modules**

**Module 2**

**Module 3**

**Module 4**

**Module 5**

**Module 6**

**Module 7**

**Module 8**

**Master Controller W/ Module 1**

**Remote Display**
APPENDIX B

DEFINITION OF
INPUTS AND OUTPUTS
DEFINITION OF INPUTS
MODULE w/ TWO REFRIGERANT CIRCUITS
10, 15, 20 TON MODULES
USES pCO2 LARGE BOARD

ANALOG INPUTS

B1 HP TRANSUDER CIRCUIT 1
B2 LP TRANSUDER CIRCUIT 1
B3 MODULE LCHW SENSOR
B4 SYSTEM ECHW SENSOR*
B5 SYSTEM LCHW SENSOR*
B6 HP TRANSUDER CIRCUIT 2
B7 LP TRANSUDER CIRCUIT 2
B8 CUSTOMER RESET SIGNAL*
B9 SUCTION TEMPERATURE SENSOR CIRCUIT 1
B10 SUCTION TEMPERATURE SENSOR CIRCUIT 2

DIGITAL INPUTS

ID1 MANUAL MODE
ID2 AUTO MODE
ID3
ID4 HP SWITCH CIRCUIT 1
ID5 HP SWITCH CIRCUIT 2
ID6 CIRCUIT FAULT COMPRESSOR 1
ID7 CIRCUIT FAULT COMPRESSOR 2
ID8
ID9 EXI INPUT*
ID10 REMOTE START/STOP*
ID11 POWER PHASE MONITOR*
ID12 CHILLED WATER FLOW SWITCH INPUT*
ID13 PUMP #1 STATUS**
ID14 PUMP #2 STATUS**
ID15 LOW GLYCOL TANK LEVEL**
ID16
ID17
ID18

* Entries that are bold and italic are only on a master controller board and deal with inputs for the chiller as a whole.
** Inputs that may not be used depending on the application of the chiller.
DEFINITION OF OUTPUTS
MODULE w/ TWO REFRIGERANT CIRCUITS
10, 15, 20 TON MODULES
USES pCO2 LARGE BOARD

ANALOG OUTPUTS
Y1
Y2
Y3
Y4
Y5
Y6

DIGITAL OUTPUTS (RELAY TYPE)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J12 NO1</td>
<td>COMPRESSOR #1 START SIGNAL</td>
</tr>
<tr>
<td>NO2</td>
<td>LIQUID LINE SOLENOID VALVE CIRCUIT #1</td>
</tr>
<tr>
<td>NO3</td>
<td>ALARM LIGHT</td>
</tr>
<tr>
<td>NO4</td>
<td>FAN #1 START SIGNAL</td>
</tr>
<tr>
<td>NO5</td>
<td>FAN #2 START SIGNAL</td>
</tr>
<tr>
<td>NO6</td>
<td>REMOTE PUMP ENABLE *</td>
</tr>
<tr>
<td>NO7</td>
<td>RUN STATUS *</td>
</tr>
<tr>
<td>NO8</td>
<td>COMPRESSOR #2 START SIGNAL</td>
</tr>
<tr>
<td>NC8</td>
<td>LIQUID LINE SOLENOID VALVE CIRCUIT #2</td>
</tr>
<tr>
<td>NO9</td>
<td>CUSTOMER ALARM RELAY *</td>
</tr>
<tr>
<td>J16 NO10</td>
<td>FULL LOAD INDICATOR RELAY *</td>
</tr>
<tr>
<td>NO11</td>
<td></td>
</tr>
<tr>
<td>J17 NC12</td>
<td></td>
</tr>
<tr>
<td>NO12</td>
<td></td>
</tr>
<tr>
<td>J18 NC13</td>
<td></td>
</tr>
<tr>
<td>NO13</td>
<td></td>
</tr>
<tr>
<td>NO14</td>
<td></td>
</tr>
<tr>
<td>NC14</td>
<td></td>
</tr>
<tr>
<td>NO15</td>
<td></td>
</tr>
<tr>
<td>NC15</td>
<td></td>
</tr>
<tr>
<td>NO16</td>
<td></td>
</tr>
<tr>
<td>NO17</td>
<td></td>
</tr>
<tr>
<td>NO18</td>
<td></td>
</tr>
</tbody>
</table>

* Entries that are bold and italic are only on a master controller board and deal with outputs for the chiller as a whole.
APPENDIX C

SYSTEM VARIABLE RANGES & DEFAULTS
FOR LOW AMBIENT APPLICATIONS
& LOW TEMPERATURE APPLICATIONS
System Variable Ranges & Default Settings

Mechanical Cooling Modules
The following table defines all of the SYSTEM VARIABLE ranges and default values for mechanical cooling modules with a low temperature program.

<table>
<thead>
<tr>
<th>System Variable</th>
<th>Range</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPPER SETPOINT</td>
<td>45°F to 80°F</td>
<td>55°F</td>
</tr>
<tr>
<td>LOWER SETPOINT</td>
<td>40°F to 70°F</td>
<td>45°F</td>
</tr>
<tr>
<td>VSP VALUE</td>
<td>0% to 80%</td>
<td>50%</td>
</tr>
<tr>
<td>LOAD LIMIT</td>
<td>0% to 100%</td>
<td>100%</td>
</tr>
<tr>
<td>T-DIFF</td>
<td>15 to 200 sec</td>
<td>90 sec</td>
</tr>
<tr>
<td>FAIL INDIC</td>
<td>0% to 90%</td>
<td>0%</td>
</tr>
<tr>
<td>LEAD COMP</td>
<td>M1-1 to M14-2</td>
<td>M1-1</td>
</tr>
<tr>
<td>NUM OF MODULES</td>
<td>1 to 14</td>
<td>1</td>
</tr>
<tr>
<td>MAN. SETPOINT</td>
<td>40°F to 70°F</td>
<td>45°F</td>
</tr>
<tr>
<td>MAN. RANGE</td>
<td>2°F to 20°F</td>
<td>10°F</td>
</tr>
<tr>
<td>MAN. OFFSET</td>
<td>0°F to 5°F</td>
<td>2°F</td>
</tr>
<tr>
<td>FAN SETPT</td>
<td>170 to 350 psig</td>
<td>235 psig</td>
</tr>
<tr>
<td>FAN OFFSET</td>
<td>20 to 60 psig</td>
<td>30 psig</td>
</tr>
<tr>
<td>HP CUTOUT</td>
<td>300 to 425 psig</td>
<td>365 psig</td>
</tr>
<tr>
<td>SEQUENCE</td>
<td>STANDARD or ODD/EVEN</td>
<td>STANDARD</td>
</tr>
<tr>
<td>INDEXING</td>
<td>OFF or ON</td>
<td>ON</td>
</tr>
</tbody>
</table>

Module Cutouts and Reset Points

- Low Suction Temp: Cutout → 20°F, Reset @ 25°F
- Low Leaving CHW: Cutout → 36°F, Reset @ 40°F
- Low Pressure: Cutout → 15 psig, Reset @ 30 psig

LOW SUCTION FAULT

The low suction fault in the low temperature and low ambient application works differently than in the standard program. One compressor in the module must be on for 30 seconds before a low suction fault can occur. This allows the suction line to increase its temperature on a cold start before receiving a fault. The chiller system must have Glycol in place in order to have the low temperature or low ambient program options available. This is measured by the module suction sensor and would affect the entire module. If during operation this temperature should drop below 20°F, the module’s compressors will shut down. This requires resetting at the master controller, but only after the temperature has risen above 25°F.
LOW TEMPERATURE APPLICATION (Special Program Required)
Program Version Format MCAB_A01

System Variable Ranges & Default Settings

Mechanical Cooling Modules
The following table defines all of the SYSTEM VARIABLE ranges and default values for mechanical cooling modules with a low temperature program.

<table>
<thead>
<tr>
<th>System Variable</th>
<th>Range</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPPER SETPOINT</td>
<td>25°F to 80°F</td>
<td>40°F</td>
</tr>
<tr>
<td>LOWER SETPOINT</td>
<td>20°F to 70°F</td>
<td>30°F</td>
</tr>
<tr>
<td>VSP VALUE</td>
<td>0% to 80%</td>
<td>50%</td>
</tr>
<tr>
<td>LOAD LIMIT</td>
<td>0% to 100%</td>
<td>100%</td>
</tr>
<tr>
<td>T-DIFF</td>
<td>15 to 200 sec</td>
<td>90 sec</td>
</tr>
<tr>
<td>FAIL INDIC</td>
<td>0% to 90%</td>
<td>0%</td>
</tr>
<tr>
<td>LEAD COMP</td>
<td>M1-1 to M14-2</td>
<td>M1-1</td>
</tr>
<tr>
<td>NUM OF MODULES</td>
<td>1 to 14</td>
<td>1</td>
</tr>
<tr>
<td>MAN. SETPOINT</td>
<td>25°F to 70°F</td>
<td>45°F</td>
</tr>
<tr>
<td>MAN. RANGE</td>
<td>2°F to 20°F</td>
<td>10°F</td>
</tr>
<tr>
<td>MAN. OFFSET</td>
<td>0°F to 5°F</td>
<td>2°F</td>
</tr>
<tr>
<td>FAN SETPT</td>
<td>170 to 350 psig</td>
<td>235 psig</td>
</tr>
<tr>
<td>FAN OFFSET</td>
<td>20 to 60 psig</td>
<td>30 psig</td>
</tr>
<tr>
<td>HP CUTOUT</td>
<td>300 to 425 psig</td>
<td>365 psig</td>
</tr>
<tr>
<td>SEQUENCE</td>
<td>STANDARD or ODD/EVEN</td>
<td>STANDARD</td>
</tr>
<tr>
<td>INDEXING</td>
<td>OFF or ON</td>
<td>ON</td>
</tr>
</tbody>
</table>

Module Cutouts and Reset Points

- Low Suction Temp: Cutout → 15°F, Reset @ 20°F
- Low Leaving CHW: Cutout → 20°F, Reset @ 25°F
- Low Pressure: Cutout → 15 psig, Reset @ 30 psig

LOW SUCTION FAULT
The low suction fault in the low temperature and low ambient application works differently than in the standard program. One compressor in the module must be on for 30 seconds before a low suction fault can occur. This allows the suction line to increase its temperature on a cold start before receiving a fault. The chiller system must have Glycol in place in order to have the low temperature or low ambient program options available. This is measured by the module suction sensor and would affect the entire module. If during operation this temperature should drop below 15°F, the module's compressors will shut down. This requires resetting at the master controller, but only after the temperature has risen above 20°F.
APPENDIX D

DEFINITION OF
COMPRESSOR ROTATIONS
Compressor Rotations

Based on the settings in the `SYSTEM VARIABLES` of SEQUENCE and INDEXING, the LEAD COMPRESSOR can change from day to day. This would also change the order that the compressors would turn on or off. The following are some common configurations and how the compressors would stage in that particular configuration.

Non-indexing and Standard Sequencing

The LEAD COMPRESSOR would be the first on and the last off. The LEAD COMPRESSOR would always be M1-1, unless changed in the `SYSTEM VARIABLES`. The compressors would then come on in numerical order.

M1-1, M1-2, M2-1, M2-2, M3-1, M3-2, M4-1, M4-2

Non-indexing and Odd/Even Sequencing

The LEAD COMPRESSOR would always be M1-1, unless changed in the `SYSTEM VARIABLES`. The compressors would come on all odd first and then all even or all even first, if the LEAD COMPRESSOR was even, and then all odd.

Odd lead compressor → M1-1, M2-1, M3-1, M4-1, M1-2, M2-2, M3-2, M4-2
Even lead compressor → M1-2, M2-2, M3-2, M4-2, M1-1, M2-1, M3-1, M4-1

Indexing and Standard Sequencing

The LEAD COMPRESSOR would rotate by one at midnight each night. There would be an eight day rotation schedule for a four module chiller.

Day 1  M1-1, M1-2, M2-1, M2-2, M3-1, M3-2, M4-1, M4-2
Day 2  M1-2, M2-1, M2-2, M3-1, M3-2, M4-1, M4-2, M1-1
Day 3  M2-1, M2-2, M3-1, M3-2, M4-1, M4-2, M1-1, M1-2
Day 4  M2-2, M3-1, M3-2, M4-1, M4-2, M1-1, M1-2, M2-1
Day 5  M3-1, M3-2, M4-1, M4-2, M1-1, M1-2, M2-1, M2-2
Day 6  M3-2, M4-1, M4-2, M1-1, M1-2, M2-1, M2-2, M3-1
Day 7  M4-1, M4-2, M1-1, M1-2, M2-1, M2-2, M3-1, M3-2
Day 8  M4-2, M1-1, M1-2, M2-1, M2-2, M3-1, M3-2, M4-1

Indexing and Odd/Even Sequencing

The LEAD COMPRESSOR would rotate at midnight following the odd/even pattern. There would be an eight day schedule for a four module chiller.

Day 1  M1-1, M2-1, M3-1, M4-1, M1-2, M2-2, M3-2, M4-2
Day 2  M2-1, M3-1, M4-1, M1-1, M2-2, M3-2, M4-2, M1-2
Day 3  M3-1, M4-1, M1-1, M2-1, M3-2, M4-2, M1-2, M2-2
Day 4  M4-1, M1-1, M2-1, M3-1, M4-2, M1-2, M2-2, M3-2
Day 5  M1-2, M2-2, M3-2, M4-2, M1-1, M2-1, M3-1, M4-1
Day 6  M2-2, M3-2, M4-2, M1-2, M2-1, M3-1, M4-1, M1-1
Day 7  M3-2, M4-2, M1-2, M2-2, M3-1, M4-1, M1-1, M2-1
Day 8  M4-2, M1-2, M2-2, M3-2, M4-1, M1-1, M2-1, M3-1
APPENDIX E

REMOTE DISPLAY
APPENDIX E

REMOTE DISPLAY
Remote Display Setup

If the remote display is not displaying the same information the master is, follow these steps to correct it. First look on the back of the remote display, the DIP switches should be addressed to 32, which should be all switches off except for switch number 6, which should be on. Hold down the 3 buttons in the lower right corner of the remote display, UP and DOWN arrow buttons and the ENTER button. A screen will come up with Terminal Adr: 32 and I/O Adr: 30. The I/O Adr: should be a value of 30, to point the remote display at the master controller. Press ENTER, the next screen says Terminal config press ENTER to continue. Press ENTER to go to the remote setup screen. This screen looks like the following illustration.

<table>
<thead>
<tr>
<th>P: 30 Adr. Priv/Shared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trm1: 32 Pr</td>
</tr>
<tr>
<td>Trm2: None --</td>
</tr>
<tr>
<td>Trm3: None -- OK? NO</td>
</tr>
</tbody>
</table>

Figure 1

<table>
<thead>
<tr>
<th>P: 1 Adr. Priv/Shared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trm1: None --</td>
</tr>
<tr>
<td>Trm2: None --</td>
</tr>
<tr>
<td>Trm3: None -- OK? NO</td>
</tr>
</tbody>
</table>

Figure 2

The number after the P would be the address of the DIP switch on the board. For the remote display to work properly, this screen should look exactly like Figure 1 for the master controller (30) only. Press the ENTER button until NO is reached and change to YES. Every module, 1 – 14 should look like Figure 2. Every module number in the network needs to be setup to look like Figure2. For each new module, this requires starting from the beginning. To change the number of the I/O Adr, use the UP and DOWN arrow buttons.
APPENDIX F

PROGRAMMING KEY
PROGRAM KEY

The Program Key is an electronic card which allows transfer of the program from the key to the pCO² controller and vice-versa. The Key contains a two position switch, a LED on the top of the key, and a connector to place the key on the memory card to transfer the program. The following step by step directions are for downloading a program.

DOWNLOADING A PROGRAM

Downloading a program is taking a program from the key and putting it on the pCO² controller. Each controller must have the new program installed for the chiller to perform properly. To download the program to the controllers, the remote display will be needed.

1. Record all SYSTEM VARIABLES from the current program.
2. Command the chiller off.
3. Unplug the pLan connections from all controllers at the J11 port.
4. Set the Manual/Off/Auto switch in all modules to off.
5. In the module to be programmed, turn off the power to the controller at CB5, the single pole circuit breaker (see wiring diagram for further identification).
6. Set the dipswitches to off on the controller being programmed.
7. Remove the “Expansion Memory” cover with a small screwdriver.
8. Set the switch on the Program Key to the “key to pCO” position.
9. Insert the key connector onto the memory card inside the “Expansion Memory” port.
10. Connect the remote display to the J10 port. Prior to connecting the display, make sure the dipswitches are in their off position on the remote display.
11. Press simultaneously the UP and DOWN arrow buttons at the remote display, while cycling the power on to the controller at CB5.
12. Check the color of the LED on the Program Key; it should be red at this time. If the LED is green, cycle power off; carefully remove the Program Key and position the switch to the “key to pCO” position. Then repeat steps 9 through 12.
13. Continue holding the buttons until confirmation of copying the program appears on the display.
14. Release the buttons and confirm to copy the program by pressing the ENTER button.
15. The display will run through a series of numbers and letters and then return to a self test screen.
16. When the self test screen is reached, cycle the power off at CB5.
17. Remove the remote display from the J10 port.
18. Carefully remove the Program Key.
19. Replace the “Expansion Memory” port cover.
20. Return the dipswitches for that controller to their original positions.
21. Cycle the power on at CB5.
22. Repeat steps 5 through 21 for all remaining controllers.
23. After all controllers have been programmed, plug in the pLan connections of all controllers at the J11 port.
24. Cycle the power off at CB5, of the master controller module only, for 5 seconds.
25. Cycle the power on at CB5.
26. While on the 12 second delay screen of the program, simultaneously press the PRG and UP arrow buttons, and hold until the backlight dims, then release. Then simultaneously press the DOWN arrow and ALARM buttons. This resets the program to all default values.
27. Reset the SYSTEM VARIABLES to the values recorded before downloading the new program.
28. Set the Manual/Off/Auto switch in all modules to on.
29. Chiller is now ready to be commanded on again.

NOTE: If absolutely necessary, the modules not being programmed can be run in Manual Mode, by switching the Manual/Off/Auto switch into Manual instead of off. Please keep in mind that there is NO FLOW PROTECTION or POWER PHASE PROTECTION in Manual Mode. The Manual/Off/Auto switch should be switched to off, when programming that module.
APPENDIX G

MANUAL FOR
FREE COOL MODULES
Free Cool Modules

A Free Cool Module is designed to take advantage of the outdoor ambient temperature to pre-cool the chilled water before it enters the mechanical cooling modules. This process will reduce the number of mechanical cooling modules operating based on outdoor ambient temperature. The cooler the ambient temperature, the fewer requirements there will be for mechanical cooling modules. Therefore saving the customer money, since the power requirements to operate a fan motor are far less than the requirements to operate a compressor.

There are three main controls in a free cool module (See Fig. 3 below): Change Over Control(1), Low Temp. Lockout(2), and Fan Cycling Control(3). By manipulating these three mechanical thermostats, the module will cycle the fans on or off, as well as control a diverting valve to either force the fluid through the coils or bypass around the coils.

![Figure 5 - Free Cool Thermostats](image)

Variables Set by Thermostats

1. CHANGE OVER CONTROL: This thermostat controls the point where the free cool module is enabled or disabled, and is based on the outdoor ambient temperature. If the ambient temperature is below the thermostat setting, the free cool module is enabled. The fluid diverting valve will move to the right, and force the fluid to flow through the coils above.

2. LOW TEMP LOCKOUT: The minimum desired fluid temperature leaving the free cool modules and entering the mechanical cooling modules. If the fluid temperature gets this low, then the free cool modules will be disabled and the fluid diverting valve will move to the left and force the fluid to bypass the coils above.

3. FAN CYCLING CONTROL: This thermostat monitors the fluid temperature leaving the diverting valve. If the temperature of the fluid is above the setting on the thermostat, the fans will cycle on, as long as the module is enabled from 1 and 2 above. This thermostat is a two stage thermostat and has a built in 2°F differential between stages. This is a non-adjustable differential.

Remote Start/Stop

The user can control the free cool module from a remote location by providing a dry contact closure between terminals 1 and 4 of TS2. If the contact is open, the free cool module would be disabled. If the contact is closed, then the control of the module would be based on the setting of the three thermostats. There should be a jumper between terminals 1 and 4 of TS2 when received from the factory. This jumper needs to be removed in order to utilize the Remote Start/Stop.
A Chiller Enhancement From...

MULTISTACK
THE MODULAR WATER CHILLER

How do you INCREASE your ENERGY EFFICIENCY while REDUCING your MAINTENANCE COSTS?

MULTISTACK has the solution:
Chiller Supply Header Filter Strainers*

The 316 Stainless Steel Strainer with a Teflon coated 30 mesh screen is designed to provide protection to the brazed plate heat exchanger. This lining prevents harmful debris contamination that leads to higher energy costs.

*U.S. Patent #5,395,524

- MULTISTACK chillers with filter strainers provide 7-13 times more surface area than the alternative "Y Basket" strainers.
- Teflon coated filter strainers are now standard equipment in all MULTISTACK modules.
- The pressure drop increases by only 7% on a five module chiller.

Possible debris contaminates that drive up your energy costs include:
- Metal Chips
- Slag
- Dirt
- Insects
- Plastic Particles
- Rust
- Plant Seeds
Cleaning Procedure

- Remove the filter strainers from the header and spray it with a water hose. With a mild household detergent simply wash the mesh screen until the debris is removed.

- MULTISTACK recommends cleaning at the end of each cooling season or whenever the refrigerant discharge pressure gauge exceeds 40 - 50lbs above normal operating conditions. We also recommend cleaning the chilled water filter strainers when the evaporator is operating at 52 psig or 10-12 psig below normal.

Note: Refer to the MULTISTACK Installation Manual for instructions on cleaning the system prior to installing the Multistack Chiller.

- For normal air conditioning application 55 - 45°F entering and 105°F condensing, the optimal operating conditions are: 60 - 62 psig suction, and 200 - 212 discharge pressure.

Note: Operating conditions vary depending on the application, temperatures and flow rates.
Now Available From MULTISTACK...
151A Cleaning Kit™

Note: Illustrated instructions for cleaning MULTISTACK heat exchangers are available through the factory, document #091594 Heat Exchanger Cleaning Procedures

Problem:
Brazed plate heat exchanger fouling, due to foreign debris contamination of the condenser and evaporator, reduces the heat transfer area and chiller performance.

Solution:
MULTISTACK, Inc. has designed the 151A Heat Exchanger Cleaning Kit. This cleaning kit allows the customer to quickly and efficiently clean both the condenser and the evaporator (approximately 50 minutes per heat exchanger).

The MULTISTACK 151A Cleaning Kit Includes:
- (2) FlushGuns™ with grooved Victaulic connectors to clean the individual passages of the heat exchangers
- (1) 1-hp 120 volt 60 psig pump
- (1) 15 gallon holding tank suitable for use with mild acids or detergents (see reverse side)
- All necessary hoses and connectors
- All components of the kit are mounted on a heavy duty, easy to maneuver cart
Recommended Cleaning Solutions:

The MULTISTACK Chiller's heat exchangers can be cleaned using the 151A Cleaning Kit with a Detergent Soak or Acid Flush. Each solvent offers an advantage for removing specific types of debris.

**Detergent Soak**
Liquid Dish Soap or Sodium Hydroxide and hot water (140° F)
- Dirt and Sand Particles
- Cottonwood Seeds
- Leaves
- Oil or Grease

**Acid Flush**
Phosphoric or Sulfamic Acid*
(Contact MULTISTACK for availability)
- Carbonates
- Sludge
- Rust

*Warning: Do not use hydrochloric or sulfuric acid for cleaning any MULTISTACK Heat Exchanger. Any chemical used must be compatible with copper and stainless steel.

Note: Cleaning is complete when debris is no longer being discharged from the heat exchanger, or when acid solution is no longer being depleted.

Order your 151A MULTISTACK Cleaning Kit today!
It is available for immediate delivery. Get your cooling season off to a clean start.

MULTISTACK, Inc.
1065 Maple Avenue
PO Box 510
Sparta, WI 54656
Phone: (608) 366-2400
Fax: (608) 366-2450
www.airstack.com
Annual Cleaning Procedure for Shut-down of MULTISTACK Chillers

MULTISTACK Chillers utilize Heat Exchangers that differ greatly in design, construction and performance from other types of heat exchangers (e.g., shell and tube design), and have completely different fouling characteristics. For best performance, MULTISTACK recommends taking the first step in fighting fouling: PREVENTION.

Brazed plate heat exchangers make each MULTISTACK module highly efficient. This side view of a module, without cabinetry, shows the location of the heat exchangers.

The evaporator system is shown in this illustration. A complex series of channels within each heat exchanger gives rise to vigorous turbulence, ensuring maximum heat transfer.
FACTORS AFFECTING FOULING

- Temperature
- Velocity
- Surface Finish
- Turbulence
- Flow Distribution
- Water Quality

TYPES OF FOULING: Scaling and Particulate

Scaling
Scaling is caused by substances dissolved in the heat transfer medium which deposit on the heat transfer surface. To prevent or minimize scaling, a proper water treatment program designed by a competent water treatment professional is recommended.

Particulate
Particulate fouling is caused by solids in the heat transfer medium such as mud, silt, sand or other particles. Particulate fouling is affected by velocity, distribution of the medium, roughness of the heat transfer surface and the size of the particles. Particles can enter the heat exchanger through old rusty pipes or through the cooling tower.

To reduce particulate fouling, MULTISTACK recommends a good filtration system (i.e., strainers, sand filters, mechanical/centrifugal separators).

Note: A Teflon Coated Stainless Steel cartridge filter for the evaporator and condenser header is supplied with all MULTISTACK modules to remove particles. If required, other types of filtration systems can be added to meet specific filtration parameters.

Laminar vs. Turbulent Flow

Laminar
When a fluid passes through a tube the greatest velocity is at the center of the tube. The tube wall has no turbulence to keep particles in the fluid in suspension. These particles are allowed to precipitate out and collect on the tube wall which causes fouling of the heat transfer surface. Conventional types of heat exchangers are very sensitive to low velocities and easily get into the laminar region.

Turbulent Flow
The opposite of laminar is turbulent flow. Operating with turbulent flow is the best way to avoid fouling in the heat exchangers.

MULTISTACK Chillers dispense a high degree of turbulence to the fluid which keeps particles in the fluid in suspension, and actually performs a scouring action to help keep the heat transfer surface clean. This is accomplished by the unique design of the MULTISTACK Heat Exchanger. As the water passes through the channels it is constantly changing direction and velocity, disturbing the boundary layer and creating turbulent flow even at low velocities. Therefore, the MULTISTACK Modular Water Chiller will always operate with fully developed turbulence.
**PREVENTIVE MAINTENANCE**

Annual cleaning of the heat exchangers is recommended. If the chiller is shut down for a non-cooling season, the following cleaning procedure should be performed at time of shut down:

1. Isolate chiller (both condenser and chilled water circuits).
2. Drain chiller.
3. Backflush chiller with water to remove foreign materials.
4. Fill chiller with clean water.

**WARNING:** Do not use hydrochloric or sulfuric acid for cleaning any MULTISTACK Heat Exchangers. Make sure any chemicals used are compatible with copper and stainless steel.

**NOTE:** Operating conditions may indicate more frequent cleaning is required. A rise in discharge pressure to above 260 psi (at normal condenser water temperature) or a reduction in evaporator heat transfer, low suction pressure, and low chilled water temperatures are examples of such indicators.

If the above procedure does not restore normal operating conditions, consult the MULTISTACK Heat Exchanger Cleaning Procedures.

**CORROSION RESISTANCE**

Corrosion is a complex process influenced by many different factors. Although stainless steels are considered corrosive resistance. AISI 316 and 316L stainless steel are not resistant to chloride concentrations above 300 parts per million (ppm). MULTISTACK Heat Exchangers are made of stainless steel plates brazed together with copper (99.9%).

**CAUTION:** Knowing the chloride content of your supply water is essential. A qualified water treatment professional should test your water for chloride levels and treat the water accordingly.

**CAUTION:** Chloride concentrations above 300 ppm will damage stainless steel heat exchangers.

**CAUTION:** Do not add any chemicals to the water without consulting with a water treatment professional to make sure that treatment is compatible with all materials in the system including copper and stainless steel. Do not use sulfuric or hydrochloric acid.
## MULTISTACK TROUBLESHOOTING GUIDE

<table>
<thead>
<tr>
<th>SOURCE OF CONTAMINANTS</th>
<th>POSSIBLE SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water Impurities</strong></td>
<td></td>
</tr>
<tr>
<td>Oil</td>
<td>1. Organic materials can be removed with detergent cleaning.</td>
</tr>
<tr>
<td>Oil film build-up in the condenser or evaporator will reduce the transfer.</td>
<td>2. Maintain chloride levels below 300 ppm.</td>
</tr>
<tr>
<td>Chlorides</td>
<td>3. pH levels should be maintained between 7 and 9.</td>
</tr>
<tr>
<td>Chlorides entering the condenser or evaporator will corrode the brazed plate heat exchangers.</td>
<td>4. Inorganic contaminants can be removed by mild cleaning with phosphoric or sulfamic acid (e.g., NACLEAN 2568™ Scale Remover, NALCO Chemical Co.; or DrewClean-20™, Drew Industries - A Division of Ashland Chemical Co.). <strong>DO NOT USE HYDROCHLORIC OR SULFURIC ACID</strong></td>
</tr>
<tr>
<td>pH-Level</td>
<td>5. Have a water treatment contractor test your water and recommend a proper treatment plan.</td>
</tr>
<tr>
<td>High acid levels entering the condenser or evaporator will cause corrosion.</td>
<td>6. Make sure the contractor is familiar with the components of the system (e.g., 316 stainless steel heat exchanger, and copper brazing material).</td>
</tr>
<tr>
<td>Calcium</td>
<td></td>
</tr>
<tr>
<td>Calcium build-up in the condenser will reduce the heat transfer, as well as water flow through the system.</td>
<td></td>
</tr>
<tr>
<td><strong>System Impurities</strong></td>
<td></td>
</tr>
<tr>
<td>Rust</td>
<td>1. When installing a new chiller, acid wash the condenser and evaporator water loop systems before connecting the water pipes to the MULTISTACK unit.</td>
</tr>
<tr>
<td>Pipe Scale</td>
<td>2. During normal system operation, observe the discharge pressure and clean filters if head pressures approach 280 psi (high pressure cut out trips at 290 psi).</td>
</tr>
<tr>
<td>Welding Slag and Other Debris</td>
<td></td>
</tr>
<tr>
<td>Internal contaminants present in the water pipes can enter the MULTISTACK condenser or evaporator, plugging up the filters and ultimately the heat exchangers.</td>
<td></td>
</tr>
<tr>
<td><strong>Cooling Tower Impurities</strong></td>
<td></td>
</tr>
<tr>
<td>Grass</td>
<td>1. A filter (polyester or wire mesh) over the air inlet to the cooling tower will help prevent external contaminants from entering the cooling tower.</td>
</tr>
<tr>
<td>Algae</td>
<td>2. Drain and clean cooling towers as required.</td>
</tr>
<tr>
<td>Tower Fill</td>
<td>3. Whenever possible, avoid placing cooling towers in close proximity to trees, smoke stacks or outside lights.</td>
</tr>
<tr>
<td>Air-born Soot and Dirt</td>
<td></td>
</tr>
<tr>
<td>Insects</td>
<td></td>
</tr>
<tr>
<td>Cottonwood Seeds</td>
<td></td>
</tr>
<tr>
<td>Construction Debris</td>
<td></td>
</tr>
<tr>
<td>External contaminants enter the condenser of the MULTISTACK module through the cooling tower.</td>
<td></td>
</tr>
</tbody>
</table>
Cleaning the MULTISTACK stainless steel brazed plate heat exchanger can be done using FlushGun™ with an Acid Flush or Detergent Soak. Each solvent offers an advantage for removing specific types of debris.

**Acid Flush**
- Carbonates
- Sludge
- Rust

**Detergent Soak**
- Dirt and Sand Particles
- Fibrous Materials
- Grease
- Plastics

**WARNING:** Do not use hydrochloric or sulfuric acid for cleaning any MULTISTACK Heat Exchangers. Make sure any chemicals used are compatible with copper and stainless steel.

The MULTISTACK Heat Exchangers should always be cleaned from the outlet to inlet, by backflushing the particles from the corrugated passages.

1. Victaulic Coupling
2. Remove Condenser Headers
3. Remove Evaporator Headers

MULTISTACK has designed the 151A Heat Exchanger Cleaning Kit. This cleaning kit allows the customer to quickly and efficiently clean both the condenser and evaporator (approximately 50 minutes per heat exchanger).
PREPARING CHILLER FOR CLEANING

- Disconnect power to chiller.
- Isolate Chilled Water Loop by closing the condenser and evaporator isolation valves.
- Remove end caps and drain the water from the condenser or evaporator (Figure 1).

CAUTION: Be careful not to let the electrical connections get wet.

- Remove the VICTAULIC COUPLINGS and HEADERS (Figure 1).

Note: Install 6" long pipe to condenser or evaporator inlet, using one Victaulic coupling and gasket that you removed from unit (Figure 2).

Figure 1: Removing header from heat exchanger.

Figure 2: 6" Pipe connection.

PREPARE SOLVENT

Detergent

Dish soap and hot water (140°F)

CAUTION: When cleaning difficult types of debris (i.e., grease), allow heat exchanger to soak in detergent 1½ hours.

Acid

Phosphoric or sulfamic acid such as Nu-Calgon Imperial Grade Scale Remover part number 4360-84. Prepare acid solvent according to the chemical manufacturers’ directions. If further assistance is required, call Multistack, Inc.

CAUTION: When circulating solutions heated to temperatures above 128°F, the module high pressure switches will open. They will need to reset before starting.

WARNING: Do not use hydrochloric or sulfuric acid for cleaning any MULTISTACK Heat Exchangers. Make sure any chemicals used are compatible with copper and stainless steel.
USING FLUSHGUN TO CLEAN INDIVIDUAL HEAT EXCHANGERS

FlushGun kits are available in different styles, depending on the heat exchanger model. To obtain the correct FlushGun kit, simply provide MULTISTACK with the initial purchase order for your modular chiller. The correct kit will be sent to you.

FlushGun A

- Connect hose to **FlushGun A**.
- Insert **FlushGun A** into the top outlet side opening of the condenser (bottom outlet of the evaporator) until it is against the back plate.

**Step A:** Tightening the compression nut clockwise until the tool cannot be removed. Open the hand valve slowly.

![Figure 3: Inserting FlushGun into heat exchanger.](image)

**Step B:** Apply a minimum of 60 psig water pressure for ten full minutes or until all foreign particles have been flushed.

**Note:** If 60 psig is not available, connect a separate pump to compensate.

FlushGun B

- Loosen the compression nut and remove **FlushGun A**. Change hose connection to **FlushGun B**. Insert **FlushGun B** until it is at the back of the heat exchanger (Figure 3). **Repeat Steps A & B.**

![FlushGun B position mock-up.](image)
Flush Gun B
- Loosen the compression nut and pull the tool out 1 1/4", measured at the back of the compression nut. Repeat 1 1/4" increments until the entire heat exchanger has been cleaned. The 1 1/4" increments are marked on the FlushGun as 1, 2, 3, and 4.

Repeat Steps A & B.

FlushGun B position mock-up.

III FINAL CLEANING

- Repeat each of the steps for every heat exchanger until the entire chiller has been flushed.
- Once the chiller heat exchangers have been cleaned, take a standard garden hose sprayer and insert it into the inlet (condenser bottom/evaporator top) of the heat exchangers and apply full water pressure until all the debris has been dispersed from the plates.
  - Remove CARTRIDGE FILTERS from headers and clean with soap and wire brush.
  - Rinse CARTRIDGE FILTERS thoroughly with clean water.
- Remove scale from the headers with a wire brush and replace them. Attach VICTAULICS and reinstall CARTRIDGE FILTER.
- Backflush the entire chiller with clean water to ensure particles do not break free and enter the heat exchangers.

Note: See MULTISTACK Maintenance Instructions for information on fouling characteristics.
AIRSTACK
“ASP”
Air-Cooled Packaged Chiller

Parts Book

AIRSTACK (Division of MULTISTACK)
1065 Maple Avenue
Box 510
Sparta, WI 54656
Phone 608-366-2400
Fax 608-366-2450
www.airstack.com
Job Name: ________________________________
Job Number: ______________________________
Model No.: ________________________________
Serial No.: ________________________________

Note: Please reference the Airstack model number when ordering replacement parts from your local Multistack/Airstack Representative.

Representative: ________________________________
Phone: ________________________________

If you require further service information please contact Multistack/Airstack Headquarters at 608-366-2400.
ASP Parts
Mechanical Cool Parts

PART
1. Heatex 104
   Heatex 52
   Heatex 56
2. Compress 107 / 108
   Compress 104 / 106
   Compress 103 / 105
3. Drier 100
4. Valve 44 (not pictured)
   Valve 45 (not pictured)
   Valve 46 (not pictured)
5. Header 100
6. Header 101
7. Receiver 101
8. Valve 41(not pictured)
9. Valve 103

Description
ASP-10 Evaporator
ASP-15 Evaporator
ASP-20 Evaporator
5 ton 208V / 5 ton 460V (ASP-10)
7.5 ton 208V / 7.5 ton 460V (ASP-15)
10 ton 208V / 10 ton 460V (ASP-20)
liquid line drier
expansion Valve (ASP20)
expansion Valve (ASP15)
expansion Valve (ASP10)
upper ECHW header
lower LCHW header
liquid receiver tank 40 lbs.
liquid line solenoid valve
pressure relief valve
# ASP Parts

## Mechanical Cool Components

<table>
<thead>
<tr>
<th>Part#</th>
<th>Description</th>
<th>Desc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Sensor 101</td>
<td>Low Pressure transducer</td>
<td></td>
</tr>
<tr>
<td>B. Sensor 100</td>
<td>High Pressure transducer</td>
<td></td>
</tr>
<tr>
<td>C. Switch 100</td>
<td>High Pressure switch</td>
<td></td>
</tr>
<tr>
<td>D. Filter 100</td>
<td>Evaporator filter</td>
<td></td>
</tr>
</tbody>
</table>

## Part Description

<table>
<thead>
<tr>
<th>Part#</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Coil 101</td>
<td>Front condenser coil</td>
</tr>
<tr>
<td>2. Coil 100</td>
<td>Rear angled condenser</td>
</tr>
<tr>
<td>3. Motor 102</td>
<td>1 HP fan motor</td>
</tr>
<tr>
<td></td>
<td>1.5 HP fan motor</td>
</tr>
<tr>
<td>Motor 101 (option)</td>
<td></td>
</tr>
</tbody>
</table>

## Not Pictured Parts:

<table>
<thead>
<tr>
<th>Part#</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guard 100</td>
<td>Front steel grill</td>
</tr>
<tr>
<td>Shroud 100</td>
<td>Plastic fan shroud</td>
</tr>
<tr>
<td>Sensor 102</td>
<td>6' module CHW sensor</td>
</tr>
<tr>
<td>Sensor 105</td>
<td>12’ system CHW sensor</td>
</tr>
<tr>
<td>Sensor 106</td>
<td>24’ system CHW sensor (option)</td>
</tr>
<tr>
<td>Blank 100</td>
<td>4” Victaulic end cap</td>
</tr>
<tr>
<td>Blank 101</td>
<td>3” Victaulic end cap</td>
</tr>
<tr>
<td>Connect 104</td>
<td>2” braided hose for Free Cool</td>
</tr>
<tr>
<td>Couplin 101</td>
<td>4” Victaulic coupling</td>
</tr>
<tr>
<td>Couplin 102</td>
<td>3” Victaulic coupling</td>
</tr>
<tr>
<td>Gaugepanel 100</td>
<td>HP &amp; LP gauge panel (option)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part#</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasket 100</td>
<td>4” Victaulic gasket</td>
</tr>
<tr>
<td>Gasket 101</td>
<td>3” Victaulic gasket</td>
</tr>
<tr>
<td>Guard 101</td>
<td>Fan motor steel guard</td>
</tr>
<tr>
<td>Guard 102</td>
<td>Front coil guard</td>
</tr>
<tr>
<td>Valve 101</td>
<td>Free Cool control valve</td>
</tr>
<tr>
<td>Fan 102</td>
<td>4 Blade 35p ASP 2</td>
</tr>
<tr>
<td>Fan 103</td>
<td>4 Blade 25p ASP 10, 15, FC</td>
</tr>
<tr>
<td>Fan 104</td>
<td>4 Blade 30p 7/8 Hub State</td>
</tr>
<tr>
<td></td>
<td>Dept.</td>
</tr>
</tbody>
</table>
### ASP Parts

#### Mechanical Cool Components

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part</th>
<th>Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Board 104</td>
<td>Master Control Board</td>
<td>9. Transfo 100</td>
<td>208 or 460/24V</td>
<td></td>
</tr>
<tr>
<td>2. Block 100</td>
<td>12 pole terminal block</td>
<td>10. Contact 101</td>
<td>comp cont 32 amp 208V</td>
<td></td>
</tr>
<tr>
<td>3. Board 103</td>
<td>Slave Control Board</td>
<td>Contact 102</td>
<td>comp cont 25 amp 460V</td>
<td></td>
</tr>
<tr>
<td>4. Block 33</td>
<td>4 pole terminal block</td>
<td>11. CircB 100/105</td>
<td>2 pole 4 amp / 3 aamp</td>
<td></td>
</tr>
<tr>
<td>5. Switch 101</td>
<td>On/ Off/ Auto</td>
<td>12. CircB 103</td>
<td>3 pole 10 amp</td>
<td></td>
</tr>
<tr>
<td>6. CircBrk 101</td>
<td>1 pole 10 amp</td>
<td>13. CircB 102</td>
<td>3 pole 40 amp</td>
<td></td>
</tr>
<tr>
<td>7. Contact 100</td>
<td>fan contact 10 amp</td>
<td>14. CircBrk 102</td>
<td>3 pole 40 amp</td>
<td></td>
</tr>
<tr>
<td>8. Relay 100</td>
<td>fan o/l (208V)</td>
<td>15. Block 104</td>
<td>load wiring input block</td>
<td></td>
</tr>
<tr>
<td>Relay 102</td>
<td>fan o/l (460V)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Free Cool

Electrical Components

Free Cool

Parts

<table>
<thead>
<tr>
<th>Part#</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Coil 102</td>
<td>front water coil</td>
</tr>
<tr>
<td>2. Coil 103</td>
<td>rear angled water coil</td>
</tr>
<tr>
<td>3. Header 103</td>
<td>4 upper header pipe</td>
</tr>
<tr>
<td>4. Header 104</td>
<td>4 middle header pipe</td>
</tr>
<tr>
<td>5. Header 105</td>
<td>4 lower header pipe</td>
</tr>
<tr>
<td>6. Motor 102</td>
<td>1 HP motor</td>
</tr>
<tr>
<td>Motor 101</td>
<td>1.5 HP motor (option)</td>
</tr>
</tbody>
</table>
### Pump Module

#### Electrical Components

```
<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sensor 103</td>
<td>1 pole temp control</td>
</tr>
<tr>
<td>2. Sensor 103</td>
<td>1 pole temp control</td>
</tr>
<tr>
<td>3. Sensor 104</td>
<td>2 pole fan cycle</td>
</tr>
<tr>
<td>4. Relay 23</td>
<td>24V coil 250V</td>
</tr>
<tr>
<td>5. Fuse 32</td>
<td>5 amp fuse</td>
</tr>
<tr>
<td>6. Block</td>
<td>8 pin</td>
</tr>
<tr>
<td>7. Transfo 100</td>
<td>208 or 460V / 24V</td>
</tr>
<tr>
<td>8. Contact 100</td>
<td>10 amp 4 pole 208V</td>
</tr>
<tr>
<td>9. Relay 100</td>
<td>contactor relay 2.4-4 amp</td>
</tr>
<tr>
<td>Relay 101</td>
<td>contactor relay 24-32 amp</td>
</tr>
<tr>
<td>Relay 102</td>
<td>contactor relay 1.6-2.4 amp</td>
</tr>
<tr>
<td>Relay 103</td>
<td>contactor relay 4-6 amp</td>
</tr>
<tr>
<td>10. CircuitBrk 119</td>
<td>3 pole 3 amp</td>
</tr>
<tr>
<td>11. CircuitBrk 119</td>
<td>3 pole 3 amp</td>
</tr>
<tr>
<td>12. CircuitBrk 113</td>
<td>2 pole 1 amp</td>
</tr>
<tr>
<td>13. Block 104</td>
<td>line voltage block</td>
</tr>
<tr>
<td>14. Relay 23</td>
<td>24V coil 250V</td>
</tr>
<tr>
<td>15. Timer 100</td>
<td>5-10 sec delay timer</td>
</tr>
<tr>
<td>16. NS Part</td>
<td>On / Off switch</td>
</tr>
<tr>
<td>17. Fuse 32</td>
<td>5 amp fuse</td>
</tr>
<tr>
<td>18. Block</td>
<td>8 pole block</td>
</tr>
<tr>
<td>19. Transfo 100</td>
<td>208 or 460V / 24V</td>
</tr>
<tr>
<td>20. Contact 100</td>
<td>10 amp 4 pole 208V</td>
</tr>
<tr>
<td>21. Relay 100</td>
<td>relay 2.4-4 amp</td>
</tr>
<tr>
<td>Relay 101</td>
<td>relay 24-32 amp</td>
</tr>
<tr>
<td>Relay 102</td>
<td>relay 1.6-2.4 amp</td>
</tr>
<tr>
<td>Relay 103</td>
<td>relay 4-6 amp</td>
</tr>
<tr>
<td>22. CircuitBrk 113</td>
<td>2 pole 1 amp</td>
</tr>
<tr>
<td>23. CircuitBrk 119</td>
<td>3 pole 3 amp</td>
</tr>
<tr>
<td>24. CircuitBrk 119</td>
<td>3 pole 3 amp</td>
</tr>
<tr>
<td>25. Block 104</td>
<td>line voltage block</td>
</tr>
</tbody>
</table>
```

### Pump Module Parts

<table>
<thead>
<tr>
<th>Part#</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NS Part</td>
<td>5 HP chilled water pump</td>
</tr>
<tr>
<td>NS Part</td>
<td>7.5 HP chilled water pump</td>
</tr>
<tr>
<td>Pump 100</td>
<td>10 HP chilled water pump</td>
</tr>
<tr>
<td>Pump 101</td>
<td>15 HP chilled water pump</td>
</tr>
<tr>
<td>NS Part</td>
<td>20 HP chilled water pump</td>
</tr>
<tr>
<td>NS Part</td>
<td>25 HP chilled water pump</td>
</tr>
</tbody>
</table>

**NOTE:** This Parts Book contains our standard module information. Some modules may vary from the information shown here. Please call Airstack Service Department at 608-786-3400 for questions and availability.