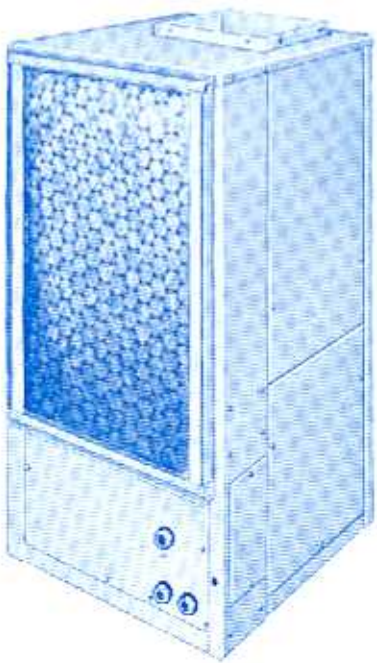
# CLIMATE CONTROL
# Water Source Heat Pumps

## APPLICATION RATINGS & DIMENSIONS

A Third Generation of Equipment, featuring

Mark III Controls



electro hydronic systems

MODEL FC
HEAT PUMP
MODEL FG
COOLING ONLY UNIT

# MODEL FEATURES

- Mark III Series Solid State Controls with:
  - Anti-Short Cycle — Random Start
  - Electronic Condensate Overflow Protection
  - Silent Reversing Valve Operation
- Descrete Voltages for Brownout Protection and long life
- Adjustable air volume blower for fast, simple air balancing
- Provisions for Easy Field Installation of WOTC, Inn Command, or Time Command
- Performance A.R.I. Certified, Safety Tested by E.T.L.

## ELECTRO-HYDRONIC SALES MODEL CODE

FAPHCS3S

Example: **FC — 330 C P R**

- **FC** — FAMILY GROUP
  - C = Ceiling Suspended, Horizontal Discharge
  - U = Ceiling Suspended, Vertical Discharge
  - F = Floor, Vertical Discharge (Bulletin ECS-601)
- **330** — NOMINAL CAPACITY (hundreds of Btuh)
- **C** — DESIGN SERIES ("C" 3rd Generation)
- **P** — VOLTAGE CODES

| | Nameplate Utilization Voltage | System Voltage |
|---|---|---|
| 2 | 115-1-60 | 120-1-60 |
| 3 | 230-1-60 | 240-1-60 |
| 5 | 208-1-60 | 208-1-60 |
| 7 | 265-1-60 | 277-1-60 |
| D | 230-3-60 | 240-3-60 |
| K | 208-3-60 | 208-3-60 |
| L | 575-3-60 | 600-3-60 |
| P | 460-3-60 | 480-3-60 |

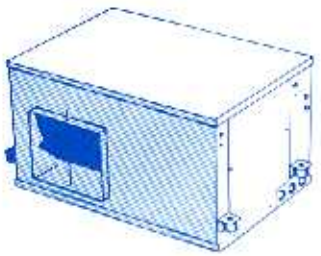
- **R** — "R" on remote Controls ONLY

CATALOG NUMBER (an eight digit Production Bill of Material No.)

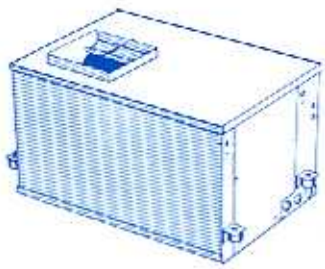
UNIT TYPE
- C = Water Source Heat Pump; A.R.I. 320-76
- G = Cooling Only Unit; A.R.I. 210-81

**AVAILABLE SALES MODELS:** CC- UC- FC
CG- UG- FG

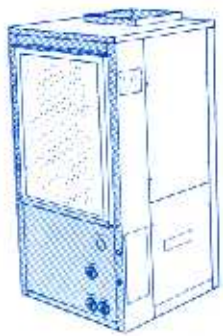
with Copper or Cupronickel Condensers.



**MODELS CC & CG**



**MODELS UC & UG**



**MODELS FC & FG**

electro hydronic systems

| MODEL SIZE | NOMINAL CFM | RATINGS AT ARI STANDARD CONDITIONS | | | | | | | APPLICATION: | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | COOLING | | | | HEATING | | | | | |
| | | Total MBH | Sensible MBH | KW Input | E.E.R. | Total MBH | KW Input | C.O.P. | Recommended Water Flow GPM | Pressure Drop (Ft.) | PAGE |
| FC-240 | 800 | 24.0 | 15.6 | 2.85 | 8.4 | 28.5 | 2.9 | 2.9 | 5.4 | 13.0 | 4 |
| FC-330 | 1000 | 33.0 | 21.5 | 3.5 | 9.4 | 35.5 | 3.55 | 2.9 | 7.4 | 13.5 | 6 |
| FC-400 | 1200 | 40.0 | 27.2 | 4.35 | 9.2 | 43.0 | 4.5 | 2.8 | 9.0 | 20.1 | 8 |
| FC-500 | 1800 | 50.0 | 32.5 | 5.3 | 9.4 | 60.0 | 5.7 | 3.1 | 11.2 | 15.6 | 10 |

# COOLING PERFORMANCE

## SALES MODEL TYPE FC-240

*Total Cooling Capacity, 24,000 Btuh / Power Input, 2650 Watts. / E.E.R. 8.4 (at A.R.I. Standard 320-81 Rating Conditions)*

## EFFECT OF VARIATION IN ENTERING AIR TEMPERATURE:

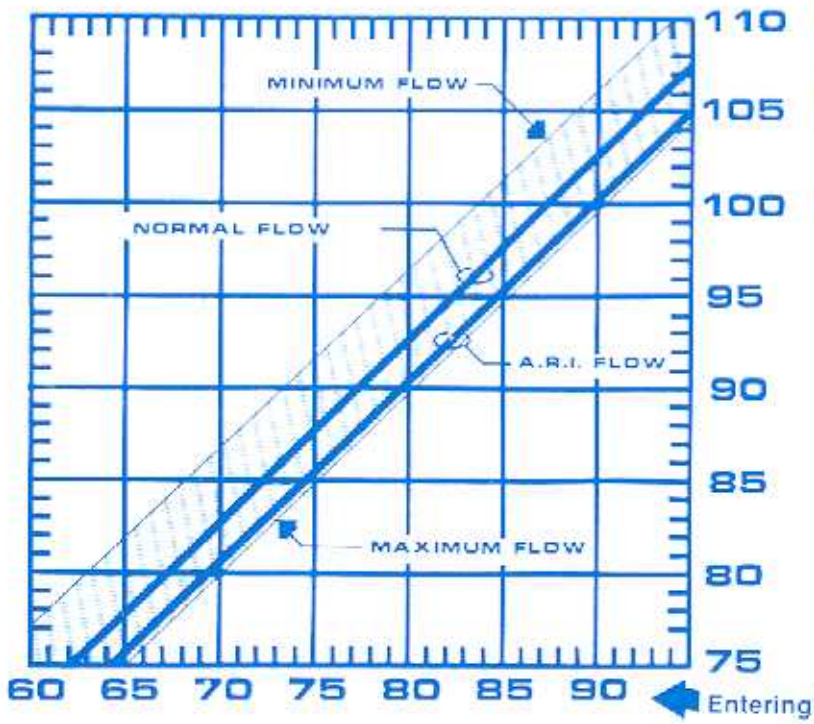
(Based upon 800 CFM & 95 Deg Leaving Water Temp)

| Entering AIR (Deg F) Wet Bulb | Total Capacity (Btuh) | Sensible Capacity (Btuh) @ Entering Air (Deg F) Dry Bulb: 75 | 80 | 85 | 90 | 95 | Heat of Rejection (Btuh) |
|---|---|---|---|---|---|---|---|
| 61 | 22,900 | 17,000 | 20,700 | — | — | — | 32,400 |
| 64 | 23,400 | 14,500 | 18,000 | 21,800 | — | — | 32,900 |
| **67** | **24,000** | 12,300 | **15,600** | 19,200 | 23,100 | — | **33,700** |
| 70 | 24,500 | 10,100 | 13,200 | 16,700 | 20,100 | 24,200 | 34,400 |
| 73 | 25,100 | — | 11,100 | 14,300 | 17,600 | 21,300 | 35,100 |

## MULTIPLIER FOR EFFECT OF VARIATION IN AIR FLOW:

| Air Flow Rate, CFM | 640 | 690 | 750 | 800 | 850 | 910 | 960 |
|---|---|---|---|---|---|---|---|
| Total Capacity | 0.94 | 0.96 | 0.98 | **1.00** | 1.02 | 1.03 | 1.04 |
| Sensible Capacity | 0.88 | 0.92 | 0.96 | **1.00** | 1.04 | 1.08 | 1.12 |
| Heat of Rejection | 0.96 | 0.98 | 0.99 | **1.00** | 1.01 | 1.02 | 1.03 |
| Power Input | 0.96 | 0.98 | 0.99 | **1.00** | 1.01 | 1.02 | 1.03 |

## COOLING CAPACITY CORRECTION for OTHER LEAVING WATER TEMPERATURES




| Leaving Water Temp. | Total & Sensible Mult. | Heat of Rejection Mult. | Power Input (Watts) |
|---|---|---|---|
| 110 | 0.92/0.96 | 0.97 | 3100 |
| 105 | 0.95/0.98 | 0.98 | 3025 |
| 100 | 0.98/0.99 | 0.99 | 2925 |
| **95** | **1.0 /1.0** | **1.0** | **2850** |
| 90 | 1.02/1.01 | 1.010 | 2775 |
| 85 | 1.04/1.02 | 1.02 | 2700 |
| 80 | 1.07/1.03 | 1.04 | 2650 |
| 75 | 1.10/1.04 | 1.06 | 2600 |

Data on this page also applies to Cooling-only units, sales model type FG, certified under A.R.I. Standard 210-81.
See page 14 for Electrical Data.

# HEATING PERFORMANCE

## SALES MODEL TYPE FC-240

*Heating Capacity, 28,500 Btuh / Power Input, 2900 Watts, / C.O.P. 2.90 (at A.R.I. Standard 320-81 Rating Conditions)*

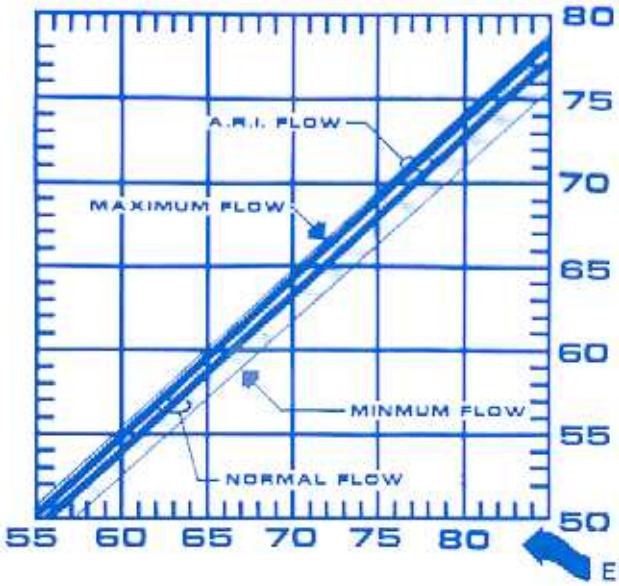
## MULTIPLIER FOR EFFECT OF VARIATION IN ENTERING AIR TEMPERATURE:

| Entering Air Temp. Deg. F. | 55 | 60 | 65 | 70 | 75 | 80 | 85 |
|---|---|---|---|---|---|---|---|
| Heating Capacity | 0.99 | 1.00 | 1.00 | **1.00** | 0.99 | 0.97 | 0.95 |
| Heat of Absorbtion | 1.02 | 1.02 | 1.01 | **1.00** | 0.97 | 0.93 | 0.90 |
| Power Input | 0.94 | 0.96 | 0.98 | **1.00** | 1.02 | 1.03 | 1.04 |

## MULTIPLIER FOR EFFECT OF VARIATION IN AIR FLOW:

| Air Flow Rate, CFM | 640 | 690 | 750 | 800 | 850 | 910 | 960 |
|---|---|---|---|---|---|---|---|
| Heating Capacity | 0.97 | 0.98 | 0.99 | **1.00** | 1.00 | 0.99 | 0.98 |
| Heat of Absorbtion | 0.94 | 0.97 | 0.99 | **1.00** | 1.01 | 1.02 | 1.03 |
| Power Input | 1.03 | 1.02 | 1.01 | **1.00** | 0.98 | 0.94 | 0.89 |

## HEATING CAPACITY CORRECTION for OTHER LEAVING WATER TEMPERATURES




| Leaving Water Temp. | Heating Capacity (Btuh) | Heat of Absorbtion (Btuh) | Power Input (Watts) |
|---|---|---|---|
| 80 | 32,500 | 21,200 | 3300 |
| 75 | 31,100 | 20,100 | 3225 |
| 70 | 29,400 | 19,000 | 3050 |
| 65 | 27,900 | 17,900 | 2925 |
| 60 | 26,200 | 16,700 | 2775 |
| 55 | 24,800 | 15,800 | 2625 |
| 50 | | | |

| WATER PRESSURE DROP: | A.R.I. | Typical Application Flow Rates: | | | |
|---|---|---|---|---|---|
| Rate, (GPM/10 MBTU) | 2.8 | 1.7 | 2.0 | 2.25 | 2.5 | 2.9 |
| Water Flow, (GPM) | 6.7 | 4.1 | 4.8 | 5.4 | 6.0 | 7.0 |
| Pressure Drop, (Ft.) | 20.0 | 7.5 | 10.3 | 13.0 | 16.0 | 21.8 |
| | | (min) | | (REC) | | (max) |

## FAN PERFORMANCE

**Maximum Air Volume External to Unit & Filter (Dry Coil)**

| C.F.M. @ E.S.P. | .05 | .10 | .15 | .20 | .25 | .30 | .35 | .40 | .45 | .50 |
|---|---|---|---|---|---|---|---|---|---|---|
| (in. W.G.) | 965 | 955 | 940 | 925 | 900 | 875 | 850 | 825 | 790 | N.R. |

(N.R. - Not Recommended)
Deduct 6% from the above values for wet coil operation.
Multiply CFM values by the air density ratio for actual CFM at higher altitudes.

# COOLING PERFORMANCE

## SALES MODEL TYPE FC-330

*Total Cooling Capacity, 33,000 Btuh / Power Input, 3500 Watts, / E.E.R. 9.4 (at A.R.I. Standard 320-81 Rating Conditions)*

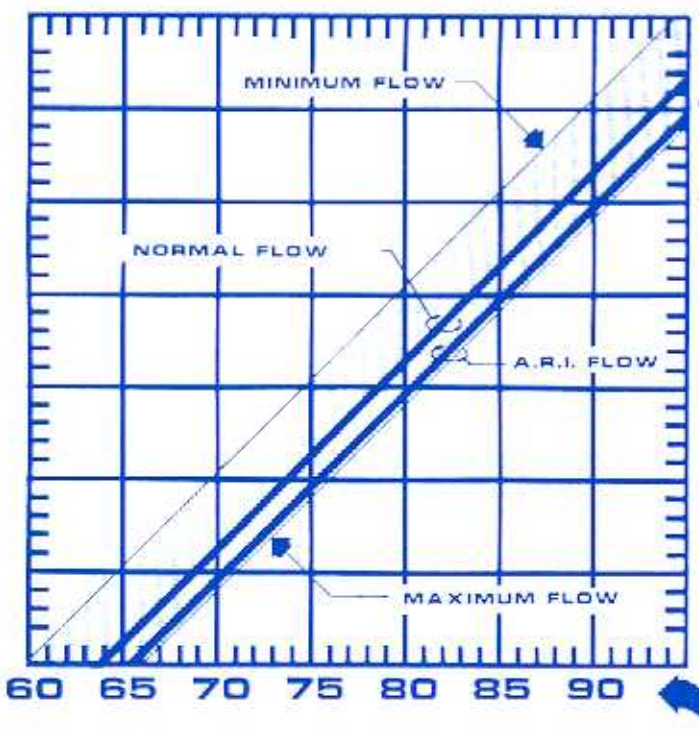
## EFFECT OF VARIATION IN ENTERING AIR TEMPERATURE:

| Entering AIR (Deg F) Wet Bulb | (Based upon 1000 CFM & 95 Deg Leaving Water Temp) Total Capacity (Btuh) | Sensible Capacity (Btuh) @ Entering Air (Deg F) Dry Bulb: 75 | 80 | 85 | 90 | 95 | Heat of Rejection (Btuh) |
|---|---|---|---|---|---|---|---|
| 61 | 31,500 | 23,300 | 25,200 | — | — | — | 43,100 |
| 64 | 32,200 | 20,000 | 24,800 | 29,900 | — | — | 43,800 |
| **67** | **33,000** | 16,800 | **21,500** | 26,400 | 31,700 | — | **44,900** |
| 70 | 33,700 | 13,800 | 18,200 | 22,900 | 27,600 | 33,300 | 45,800 |
| 73 | 34,500 | — | 15,200 | 19,700 | 24,100 | 29,300 | 46,700 |

## MULTIPLIER FOR EFFECT OF VARIATION IN AIR FLOW:

| Air Flow Rate, CFM | 800 | 860 | 940 | 1000 | 1060 | 1140 | 1200 |
|---|---|---|---|---|---|---|---|
| Total Capacity | 0.94 | 0.96 | 0.98 | **1.00** | 1.02 | 1.03 | 1.04 |
| Sensible Capacity | 0.88 | 0.92 | 0.96 | **1.00** | 1.04 | 1.08 | 1.12 |
| Heat of Rejection | 0.96 | 0.98 | 0.99 | **1.00** | 1.01 | 1.02 | 1.03 |
| Power Input | 0.96 | 0.98 | 0.99 | **1.00** | 1.01 | 1.02 | 1.03 |

## COOLING CAPACITY CORRECTION for OTHER LEAVING WATER TEMPERATURES




| Leaving Water Temp. | Total & Sensible Mult. | Heat of Rejection Mult. | Power Input (Watts) |
|---|---|---|---|
| 110 | 0.92/0.96 | 0.97 | 3825 |
| 105 | 0.95/0.98 | 0.98 | 3700 |
| 100 | 0.98/0.99 | 0.99 | 3600 |
| **95** | **1.0 /1.0** | **1.0** | **3500** |
| 90 | 1.02/1.01 | 1.010 | 3400 |
| 85 | 1.04/1.02 | 1.02 | 3325 |
| 80 | 1.07/1.03 | 1.04 | 3250 |
| 75 | 1.10/1.04 | 1.06 | 3175 |

Data on this page also applies to Cooling-only units, sales model type FG, certified under A.R.I. Standard 210-81.
See page 14 for Electrical Data.

# HEATING PERFORMANCE

## SALES MODEL TYPE FC-330

*Heating Capacity, 35,500 Btuh / Power Input, 3550 Watts, / C.O.P. 2.90 (at A.R.I. Standard 320-81 Rating Conditions)*

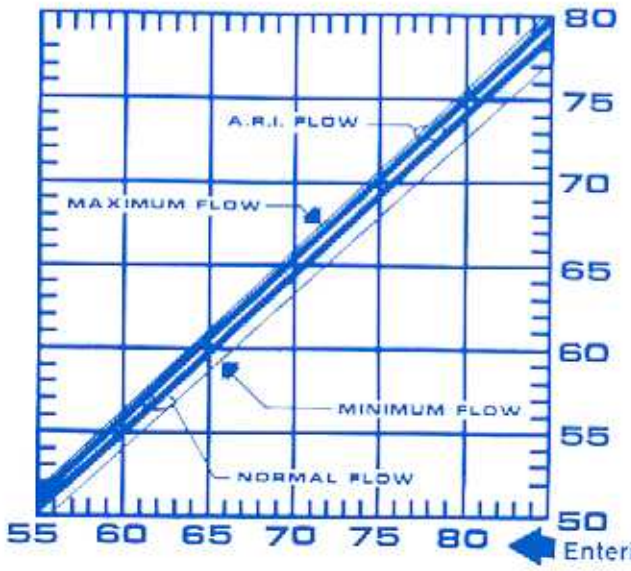
## MULTIPLIER FOR EFFECT OF VARIATION IN ENTERING AIR TEMPERATURE:

| Entering Air Temp. Deg. F. | 55 | 60 | 65 | 70 | 75 | 80 | 85 |
|---|---|---|---|---|---|---|---|
| Heating Capacity | 0.99 | 1.00 | 1.00 | **1.00** | 0.99 | 0.97 | 0.95 |
| Heat of Absorbtion | 1.02 | 1.02 | 1.01 | **1.00** | 0.97 | 0.93 | 0.90 |
| Power Input | 0.94 | 0.96 | 0.98 | **1.00** | 1.02 | 1.03 | 1.04 |

## MULTIPLIER FOR EFFECT OF VARIATION IN AIR FLOW:

| Air Flow Rate, CFM | 800 | 860 | 940 | 1000 | 1060 | 1140 | 1200 |
|---|---|---|---|---|---|---|---|
| Heating Capacity | 0.97 | 0.98 | 0.99 | **1.00** | 1.00 | 0.99 | 0.98 |
| Heat of Absorbtion | 0.94 | 0.97 | 0.99 | **1.00** | 1.01 | 1.02 | 1.03 |
| Power Input | 1.03 | 1.02 | 1.01 | **1.00** | 0.98 | 0.94 | 0.89 |

## HEATING CAPACITY CORRECTION for OTHER LEAVING WATER TEMPERATURES




| Leaving Water Temp. | Heating Capacity (Btuh) | Heat of Absorbtion (Btuh) | Power Input (Watts) |
|---|---|---|---|
| 80 | 40,500 | 26,700 | 4050 |
| 75 | 38,700 | 25,500 | 3850 |
| 70 | 36,600 | 24,100 | 3650 |
| 65 | 34,800 | 22,900 | 3475 |
| 60 | 32,700 | 21,500 | 3275 |
| 55 | 30,900 | 20,300 | 3100 |

| WATER PRESSURE DROP: | A.R.I. | Typical Application Flow Rates: | | | |
|---|---|---|---|---|---|
| Rate, (GPM/10 MBTU) | 2.7 | 1.7 | 2.0 | 2.25 | 2.5 | 2.9 |
| Water Flow, (GPM) | 9.0 | 5.6 | 6.6 | 7.4 | 8.3 | 9.6 |
| Pressure Drop, (Ft.) | 20.0 | 7.7 | 10.8 | 13.5 | 17.0 | 22.8 |
| | | (min) | | (REC) | | (max) |

## FAN PERFORMANCE

**Maximum Air Volume External to Unit & Filter (Dry Coil)**

| C.F.M. @ E.S.P. | .05 | .10 | .15 | .20 | .25 | .30 | .35 | .40 | .45 | .50 | .55 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (in. W.G.) | 1320 | 1295 | 1270 | 1240 | 1200 | 1175 | 1130 | 1090 | 1050 | 995 | 940 |

Deduct 6% from the above values for wet coil operation.
Multiply CFM values by the air density ratio for actual CFM at higher altitudes.

# COOLING PERFORMANCE

## SALES MODEL TYPE FC-400

*Total Cooling Capacity, 40,000 Btuh / Power Input, 4350 Watts, / E.E.R. 9.2 (at A.R.I. Standard Conditions)*

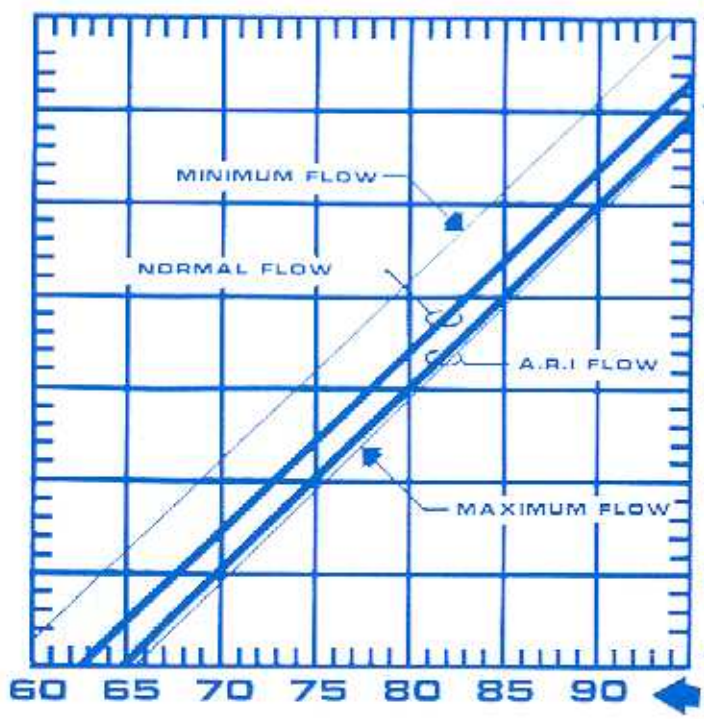
## EFFECT OF VARIATION IN ENTERING AIR TEMPERATURE:

| Entering AIR (Deg F) Wet Bulb | (Based upon 1200 CFM & 95 Deg Leaving Water Temp) Total Capacity (Btuh) | Sensible Capacity (Btuh) @ Entering Air (Deg F) Dry Bulb: 75 | 80 | 85 | 90 | 95 | Heat of Rejection (Btuh) |
|---|---|---|---|---|---|---|---|
| 61 | 38,400 | 30,000 | 36,100 | — | — | — | 52,600 |
| 64 | 39,000 | 25,400 | 31,600 | 37,900 | — | — | 53,500 |
| **67** | **40,000** | 21,600 | **27,200** | 33,600 | 39,600 | — | **54,850** |
| 70 | 40,800 | 18,000 | 23,300 | 29,400 | 35,100 | 40,800 | 55,900 |
| 73 | 41,800 | — | 19,700 | 25,100 | 31,000 | 37,200 | 57,000 |

## MULTIPLIER FOR EFFECT OF VARIATION IN AIR FLOW:

| Air Flow Rate, CFM | 960 | 1030 | 1130 | 1200 | 1270 | 1370 | 1440 |
|---|---|---|---|---|---|---|---|
| Total Capacity | 0.94 | 0.96 | 0.98 | **1.00** | 1.02 | 1.03 | 1.04 |
| Sensible Capacity | 0.88 | 0.92 | 0.96 | **1.00** | 1.04 | 1.08 | 1.12 |
| Heat of Rejection | 0.96 | 0.98 | 0.99 | **1.00** | 1.01 | 1.02 | 1.03 |
| Power Input | 0.96 | 0.98 | 0.99 | **1.00** | 1.01 | 1.02 | 1.03 |

## COOLING CAPACITY CORRECTION for OTHER LEAVING WATER TEMPERATURES




| Leaving Water Temp. | Total & Sensible Mult. | Heat of Rejection Mult. | Power Input (Watts) |
|---|---|---|---|
| 110 | 0.92/0.96 | 0.97 | 4750 |
| 105 | 0.95/0.98 | 0.98 | 4600 |
| 100 | 0.98/0.99 | 0.99 | 4475 |
| **95** | **1.0 /1.0** | **1.0** | **4350** |
| 90 | 1.02/1.01 | 1.010 | 4225 |
| 85 | 1.04/1.02 | 1.02 | 4125 |
| 80 | 1.07/1.03 | 1.04 | 4050 |
| 75 | 1.10/1.04 | 1.06 | 3950 |

Data on this page also applies to Cooling-only units, sales model type FG, certified under A.R.I. Standard 210-81.
See page 14 for Electrical Data

# HEATING PERFORMANCE

## SALES MODEL TYPE FC-400

*Heating Capacity, 43,000 Btuh / Power Input, 4500 Watts, / C.O.P. 2.80 (at A.R.I. Standard 320-81 Rating Conditions)*

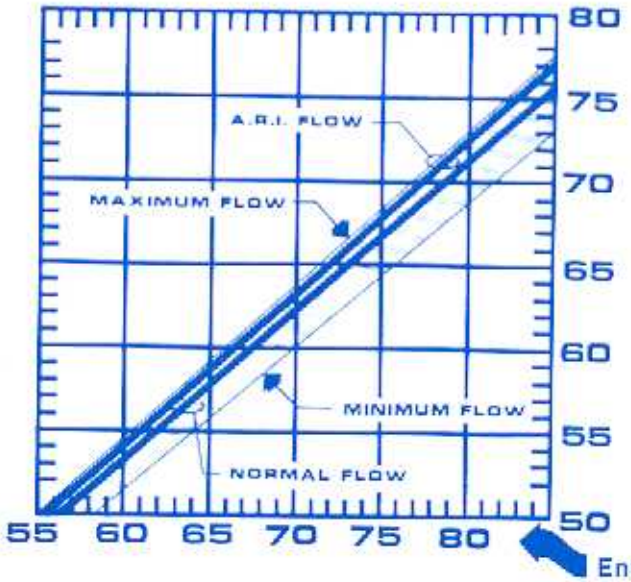
## MULTIPLIER FOR EFFECT OF VARIATION IN ENTERING AIR TEMPERATURE:

| Entering Air Temp. Deg. F. | 55 | 60 | 65 | 70 | 75 | 80 | 85 |
|---|---|---|---|---|---|---|---|
| Heating Capacity | 0.99 | 1.00 | 1.00 | **1.00** | 0.99 | 0.97 | 0.95 |
| Heat of Absorbtion | 1.02 | 1.02 | 1.01 | **1.00** | 0.97 | 0.93 | 0.90 |
| Power Input | 0.94 | 0.96 | 0.98 | **1.00** | 1.02 | 1.03 | 1.04 |

## MULTIPLIER FOR EFFECT OF VARIATION IN AIR FLOW:

| Air Flow Rate, CFM | 960 | 1030 | 1130 | 1200 | 1270 | 1370 | 1440 |
|---|---|---|---|---|---|---|---|
| Heating Capacity | 0.97 | 0.98 | 0.99 | **1.00** | 1.00 | 0.99 | 0.98 |
| Heat of Absorbtion | 0.94 | 0.97 | 0.99 | **1.00** | 1.01 | 1.02 | 1.03 |
| Power Input | 1.03 | 1.02 | 1.01 | **1.00** | 0.98 | 0.94 | 0.89 |

## HEATING CAPACITY CORRECTION for OTHER LEAVING WATER TEMPERATURES




| Leaving Water Temp. | Heating Capacity (Btuh) | Heat of Absorbtion (Btuh) | Power Input (Watts) |
|---|---|---|---|
| 80 | 49,000 | 31,500 | 5125 |
| 75 | 46,900 | 30,200 | 4900 |
| 70 | 44,300 | 28,500 | 4625 |
| 65 | 42,100 | 27,100 | 4400 |
| 60 | 39,600 | 25,400 | 4150 |
| 55 | 37,400 | 24,000 | 3925 |
| 50 | | | |

| WATER PRESSURE DROP: | A.R.I. | Typical Application Flow Rates: | | | |
|---|---|---|---|---|---|
| Rate, (GPM/10 MBTU) | 2.8 | 1.7 | 2.0 | 2.25 | 2.5 | 2.9 |
| Water Flow, (GPM) | 11.0 | 6.8 | 8.0 | 9.0 | 10.0 | 11.6 |
| Pressure Drop, (Ft.) | 30.0 | 11.5 | 15.9 | 20.1 | 24.8 | 33.4 |
| | | (min) | | (REC) | | (max) |

## FAN PERFORMANCE

**Maximum Air Volume External to Unit & Filter (Dry Coil)**

| C.F.M. @ E.S.P. (in. W.G.) | .05 | .10 | .15 | .20 | .25 | .30 | .35 | .40 | .45 | .50 | .55 | .60 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1535 | 1520 | 1510 | 1490 | 1475 | 1455 | 1430 | 1400 | 1365 | 1325 | 1275 | 1225 |

Deduct 6% from the above values for wet coil operation.
Multiply CFM values by the air density ratio for actual CFM at higher altitudes.

# COOLING PERFORMANCE

## SALES MODEL TYPE FC-500

*Total Cooling Capacity, 50,000 Btuh / Power Input, 5300 Watts. / E.E.R. 9.40 (at A.R.I. Standard 320-81 Rating Conditions)*

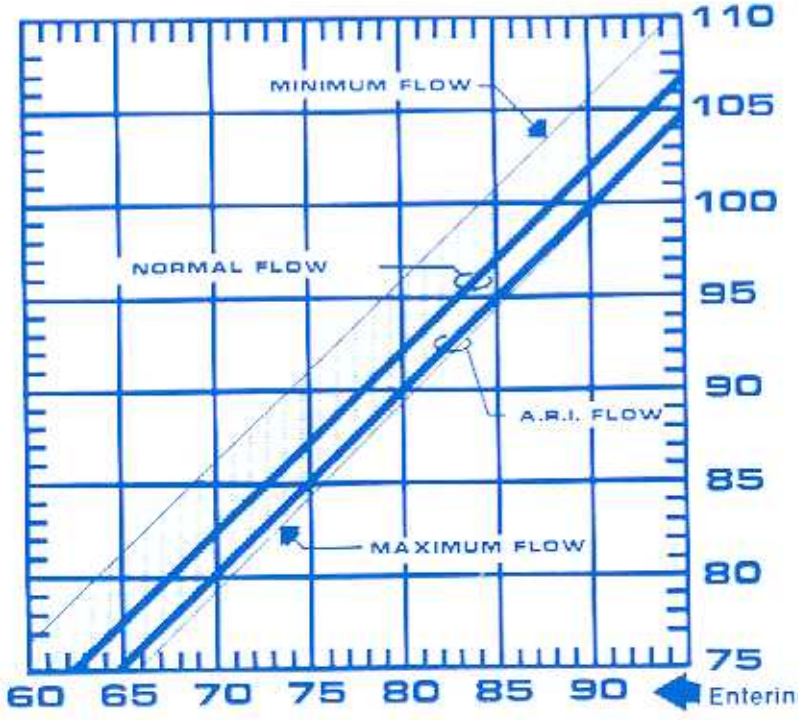
## EFFECT OF VARIATION IN ENTERING AIR TEMPERATURE:

| Entering AIR (Deg F) Wet Bulb | (Based upon 1800 CFM & 95 Deg Leaving Water Temp) Total Capacity (Btuh) | Sensible Capacity (Btuh) @ Entering Air (Deg F) Dry Bulb: 75 | 80 | 85 | 90 | 95 | Heat of Rejection (Btuh) |
|---|---|---|---|---|---|---|---|
| 61 | 48,000 | 35,500 | 43,200 | — | — | — | 67,200 |
| 64 | 48,700 | 30,200 | 37,500 | 45,300 | — | — | 68,200 |
| **67** | **50,000** | 25,500 | **32,500** | 40,000 | 48,000 | — | **70,000** |
| 70 | 50,900 | 20,900 | 27,500 | 34,600 | 41,800 | 48,500 | 71,300 |
| 73 | 52,200 | — | 22,900 | 29,800 | 36,600 | 44,500 | 72,700 |

## MULTIPLIER FOR EFFECT OF VARIATION IN AIR FLOW:

| Air Flow Rate, CFM | 1440 | 1545 | 1690 | 1800 | 1905 | 2025 |
|---|---|---|---|---|---|---|
| Total Capacity | 0.94 | 0.96 | 0.98 | **1.00** | 1.02 | 1.03 |
| Sensible Capacity | 0.88 | 0.92 | 0.96 | **1.00** | 1.04 | 1.08 |
| Heat of Rejection | 0.96 | 0.98 | 0.99 | **1.00** | 1.01 | 1.02 |
| Power Input | 0.96 | 0.98 | 0.99 | **1.00** | 1.01 | 1.02 |

## COOLING CAPACITY CORRECTION for OTHER LEAVING WATER TEMPERATURES




| Leaving Water Temp. | Total & Sensible Mult. | Heat of Rejection Mult. | Power Input (Watts) |
|---|---|---|---|
| 110 | 0.92/0.96 | 0.97 | 5780 |
| 105 | 0.95/0.98 | 0.98 | 5610 |
| 100 | 0.98/0.99 | 0.99 | 5470 |
| **95** | **1.0 /1.0** | **1.0** | **5300** |
| 90 | 1.02/1.01 | 1.010 | 5125 |
| 85 | 1.04/1.02 | 1.02 | 5025 |
| 80 | 1.07/1.03 | 1.04 | 4950 |
| 75 | 1.10/1.04 | 1.06 | 4825 |

Data on this page also applies to Cooling-only units, sales model types FG, certified under A.R.I. Standard 210-81.
See page 14 for Electrical Data.

# HEATING PERFORMANCE

## SALES MODEL TYPE FC-500

*Heating Capacity, 60,000 Btuh / Power Input, 5700 Watts, / C.O.P. 3.10 (at A.R.I. Standard 320-81 Rating Conditions)*

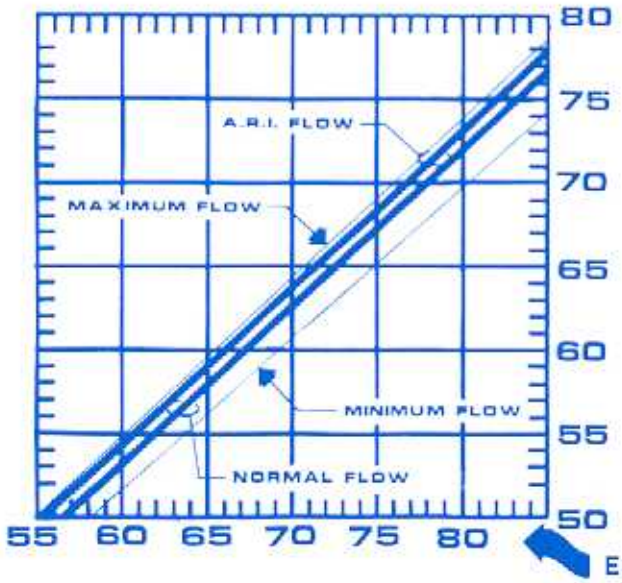
## MULTIPLIER FOR EFFECT OF VARIATION IN ENTERING AIR TEMPERATURE:

| Entering Air Temp. Deg. F. | 55 | 60 | 65 | 70 | 75 | 80 | 85 |
|---|---|---|---|---|---|---|---|
| Heating Capacity | 0.99 | 1.00 | 1.00 | **1.00** | 0.99 | 0.97 | 0.95 |
| Heat of Absorbtion | 1.02 | 1.02 | 1.01 | **1.00** | 0.97 | 0.93 | 0.90 |
| Power Input | 0.94 | 0.96 | 0.98 | **1.00** | 1.02 | 1.03 | 1.04 |

## MULTIPLIER FOR EFFECT OF VARIATION IN AIR FLOW:

| Air Flow Rate, CFM | 1440 | 1545 | 1690 | 1800 | 1905 | 2025 |
|---|---|---|---|---|---|---|
| Heating Capacity | 0.97 | 0.98 | 0.99 | **1.00** | 1.00 | 0.99 |
| Heat of Absorbtion | 0.94 | 0.97 | 0.99 | **1.00** | 1.01 | 1.02 |
| Power Input | 1.03 | 1.02 | 1.01 | **1.00** | 0.98 | 0.94 |

## HEATING CAPACITY CORRECTION for OTHER LEAVING WATER TEMPERATURES




| Leaving Water Temp. | Heating Capacity (Btuh) | Heat of Absorbtion (Btuh) | Power Input (Watts) |
|---|---|---|---|
| 80 | 68,400 | 47,800 | 6320 |
| 75 | 65,400 | 45,300 | 6040 |
| 70 | 61,800 | 42,800 | 5760 |
| 65 | 58,800 | 40,200 | 5480 |
| 60 | 55,200 | 37,700 | 5190 |
| 55 | 52,200 | 35,600 | 4890 |
| 50 | | | |

| WATER PRESSURE DROP: | A.R.I. | Typical Application Flow Rates: | | | |
|---|---|---|---|---|---|
| Rate, (GPM/10 MBTU) | 2.7 | 1.7 | 2.0 | 2.25 | 2.5 | 2.9 |
| Water Flow, (GPM) | 13.6 | 8.5 | 10.0 | 11.2 | 12.5 | 14.5 |
| Pressure Drop, (Ft.) | 23.0 | 9.0 | 12.4 | 15.6 | 19.4 | 26.1 |
| | | (min) | | (REC) | | (max) |

## FAN PERFORMANCE

**Maximum Air Volume External to Unit & Filter (Dry Coil)**

| C.F.M. @ E.S.P. | .10 | .15 | .20 | .25 | .30 | .35 | .40 | .45 | .50 | .55 | .60 | .65 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (in. W.G.) | N.R. | 1855 | 1840 | 1825 | 1800 | 1780 | 1760 | 1735 | 1710 | 1675 | 1630 | 1575 |

Deduct 6% from the above values for wet coil operation.
Multiply CFM values by the air density ratio for actual CFM at higher altitudes.

# Suggested Procedure for Determining Noise Criteria (NC)

## APPROACH

For duct connected equipment such as Models CC, UC, & FC Heat Pumps, it is generally accepted that octave band sound power rating is the only practical way to express acoustic performance. We have tested this equipment in our laboratory for total maximum sound power level over the octave band center frequencies Hz. These data are compatible with the suggested method of calculation of permissible sound power level in ASHRAE Guide, Systems, 1980, Chapter 35.

## METHOD OF TESTING

A number of mechanical designers have expressed the need for sound power data under two conditions:

Condition 1.

One series of data read within the space occupied by the machine, which is similar to a concealed mounting above a hung ceiling or a closet plenum. See sketch of Position A and data tabulation.

Condition 2.

A second series read as the sound power generated at the discharge of a normally recommended duct discharging air into the sound room with the conditioner completely out of the sound room.

a. Sound Power is shown with the square elbow duct work arrangement and a single register discharge normally used on our smaller sizes of conditioners with an air volume range of 250 to 700 CFM. See sketch of Position B and data tabulation.
b. Sound Power is also shown for one register of a multi-register duct system used on the larger sizes of conditioners. The air volume at the discharge opening has been held constant at 500 CFM with adjustment made in the trunk duct air volume. See sketch of Position C and data tabulation.

## PROCEDURE

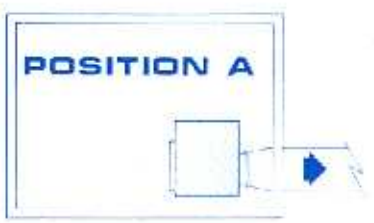
Condition 1, Conditioner in Space.

The sound power data for a conditioner mounted within a space may be used, with the necessary physical composition and attenuation factors for a hung ceiling or partition, to attain a satisfactory noise background from the conditioner in a specific room.

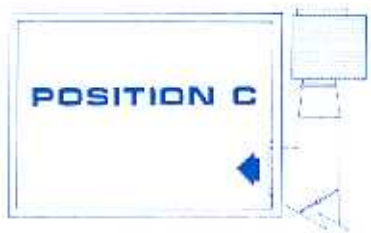
Condition 2, Ductwork Terminal Grille.

Design specifications are normally directed toward attaining a desired sound pressure level (NC). The room absorbtion effect must be determined as well as the number of duct terminals in order to arrive at the permissible sound level per terminal.

Procedures covering Conditions 1 & 2 are shown in ASHRAE Guide, Systems, 1970, Chapter 33.







# SOUND RATING

## SALES MODELS TYPES CC, UC, & FC

DATA:

Maximum Sound Power* at Machine, Position A

| Model Size | Octave Band Center Frequency (HZ) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
| 240 | 62 | 59 | 57 | 53 | 51 | 48 | 45 | 39 |
| 330 | 63 | 60 | 58 | 54 | 52 | 50 | 46 | 42 |
| 400 | 64 | 61 | 59 | 55 | 53 | 52 | 48 | 44 |
| 500 | 65 | 62 | 60 | 56 | 54 | 53 | 49 | 55 |

Maximum Sound Power* per terminal, Positions B & C

| Model Size | Octave Band Center Frequency (Hz) | | | | | | | | Test Duct Size |
|---|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | |
| 240 | 56 | 54 | 52 | 49 | 47 | 43 | 38 | 27 | 10 x 20 |
| 330 | 58 | 55 | 53 | 50 | 48 | 44 | 39 | 29 | 10 x 20 |
| 400 | 59 | 56 | 54 | 52 | 51 | 45 | 40 | 32 | 10 x 20 |
| 500 | 61 | 58 | 55 | 53 | 52 | 46 | 41 | 35 | 10 x 20 |

Test Duct outside dimensions with 1/2" fibrous glass lining on four sides and with transition per ASHRAE recommendations of "Good Practice".

*Sound Power (db re $10^{-12}$ Watt).

# ELECTRICAL CHARACTERISTICS:

## SALES MODELS TYPES CC, CG, UC, UG, FC, & FG, HEAT PUMPS OR COOLING-ONLY UNITS.

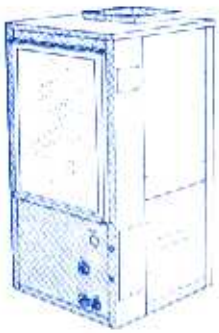
UNIT NAMEPLATE UTILIZATION VOLTAGE:

| Model Size | | 115-1 60 HZ. | 208-1 60 HZ. | 230-1 60 HZ. | 265-1 60 HZ. | 208-3 60 HZ. | 230-3 60 HZ. | 460-3 60 HZ. | 575-3 60 HZ. |
|---|---|---|---|---|---|---|---|---|---|
| 240 | COMP. R.L.A. | — | 15.1 | 12.9 | 11.0 | 8.5 | 7.7 | 3.7 | — |
| | COMP. L.R.A. | — | 68.0 | 64.0 | 61.0 | 49.0 | 49.0 | 24.0 | — |
| | FAN F.L.A. | — | 2.3 | 1.5 | 1.1 | (2.3) | (1.5) | (.9) | — |
| | MIN. CKT. AMPS | — | 21.2 | 17.7 | 14.9 | 13.0 | 11.2 | 5.6 | — |
| | MAX FUSE | — | 35 | 30 | 25 | 20 | 15 | 15 | — |
| 330 | COMP. R.L.A. | — | 19.1 | 16.8 | 14.6 | 14.7 | 14.0 | 4.7 | — |
| | COMP. L.R.A. | — | 75.0 | 76.0 | 69.0 | 65.0 | 65.0 | 27.0 | |
| | FAN F.L.A. | — | 2.3 | 2.1 | 1.7 | (2.3) | (2.1) | (.9) | |
| | MIN. CKT. AMPS | — | 26.2 | 23.1 | 20.0 | 20.7 | 19.7 | 6.8 | — |
| | MAX FUSE | — | 45 | 35 | 30 | 35 | 30 | 15 | — |
| 400 | COMP. R.L.A. | — | 24.2 | 20.6 | — | 13.8 | 12.9 | 6.2 | — |
| | COMP. L.R.A. | — | 113.0 | 103.0 | — | 72.0 | 72.0 | 35.0 | — |
| | FAN F.L.A. | — | 2.3 | 2.1 | — | (2.3) | (2.1) | (1.2) | — |
| | MIN. CKT. AMPS | — | 32.6 | 27.9 | — | 19.6 | 18.3 | 9.0 | — |
| | MAX FUSE | — | 50 | 45 | — | 30 | 30 | 15 | — |
| 500 | COMP. R.L.A. | — | 31.0 | 29.0 | — | 16.8 | 15.1 | 7.2 | 6.0 |
| | COMP. L.R.A. | — | 132.0 | 132.0 | — | 103.0 | 103.0 | 54.0 | 35.0 |
| | FAN F.L.A. | — | 3.8 | 3.8 | — | (3.8) | (3.8) | (1.6) | (1.3) |
| | MIN. CKT. AMPS | — | 42.6 | 40.1 | — | 24.8 | 22.7 | 10.6 | 8.8 |
| | MAX FUSE | — | 70 | 60 | — | 40 | 35 | 15 | 15 |

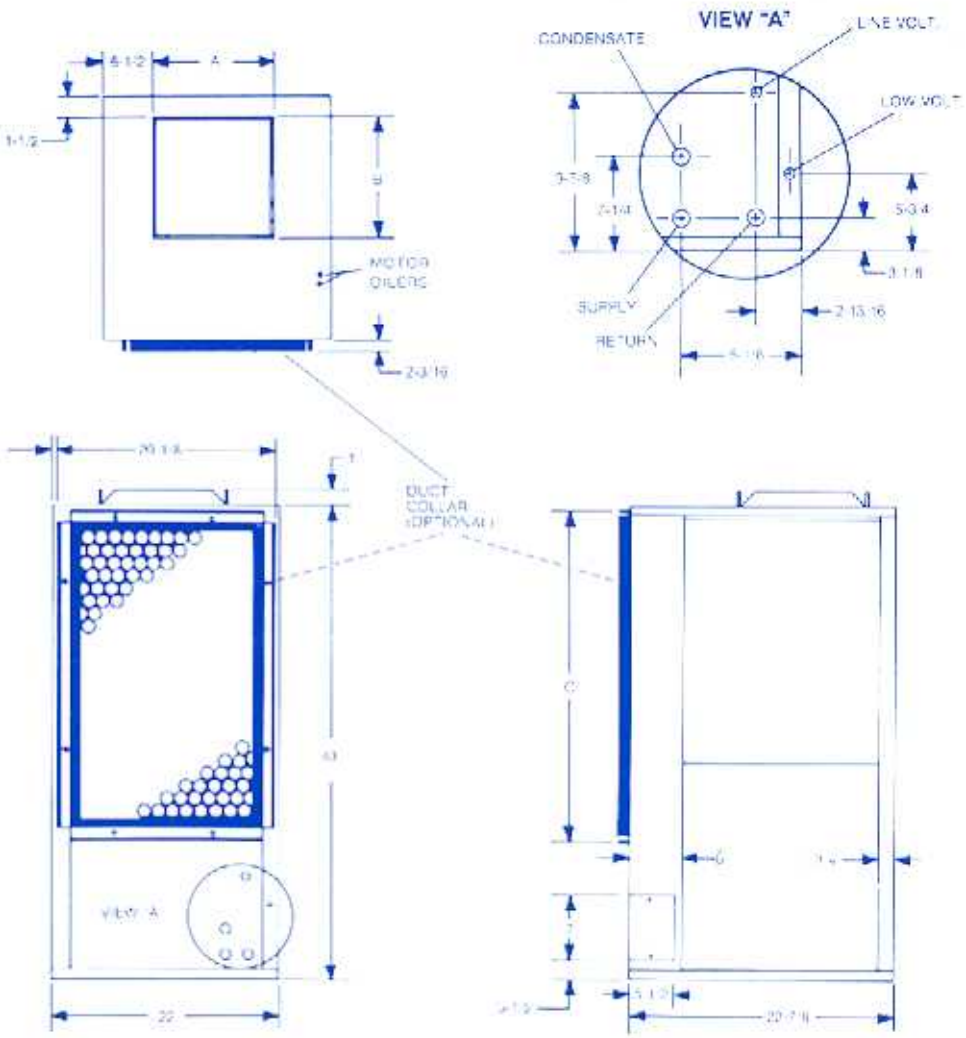
NOTES:

1. Where the Fan F.L.A. is enclosed within parenthesis, it indicates a single phase blower motor in a unit designed for operation from a three phase power supply. It may be necessary for the installer to connect multiple units in progressive sequence in order to ensure System Phase Balance (e.g. the first unit is connected Phases A, B, C; the second unit, Phases B, C, A, the third unit Phases C, A, B, etc.) It may be additionally necessary to reconnect certain units to achieve Phase Balance by controlled "Zone" when certain control schemes are implemented, such as night setback systems.

# — FC & FG — 240, 330 400 & 500 —



Model FC or FG




| Δ p Across Coil and Filter @ Various Air Flow Rates | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Size 240 | CFM | 1000 | 950 | 900 | 850 | 800 | 750 | 700 | |
| | Δ p | 47 | 43 | 39 | 36 | 32 | 29 | 26 | |
| Size 330 | CFM | 1550 | 1500 | 1250 | 1200 | *1150 | *1100 | *1050 | 1000 |
| | Δ p | 48 | 45 | 41 | 38 | 35 | 33 | 31 | 28 |
| Size 400 | CFM | 1650 | 1600 | 1450 | 1400 | 350 | 1300 | *1250 | 1200 |
| | Δ p | 57 | 54 | 52 | 48 | 46 | 43 | 41 | 38 |
| Size 500 | CFM | 1850 | 1750 | 1650 | *1550 | 1450 | *1350 | 1250 | 1250 |
| | Δ p | 47 | 43 | 39 | 35 | 32 | 28 | 25 | 25 |

Utilize this information to adjust for capacity to specified CFM.

| MAXIMUM AIR VOLUME, External to Unit & Filter (Dry Coil) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFM @ Ext. S.P. in. W.G. | .05 | .10 | .15 | .20 | .25 | .30 | .35 | .40 | .45 | .50 | .55 | .60 | .65 |
| 240 | 965 | 955 | 940 | 925 | 900 | 875 | 850 | 825 | 790 | — | — | — | — |
| 330 | 1300 | 1295 | *1270 | 1240 | 1200 | *1175 | 1130 | 1090 | 1050 | 985 | | | |
| 400 | 1535 | 1520 | 1510 | 1490 | 1475 | *1455 | 1430 | 1400 | 1365 | *1325 | *1275 | 1220 | — |
| 500 | — | — | *1855 | *1840 | 1825 | *1800 | 1780 | 1760 | 1735 | 1710 | 1675 | 1630 | 1575 |

The AAV adjustable air volume feature permits adjustment to a preset air quantity at any external static pressure, providing that the minimum air flow limits are observed.

Deduct 8% from the above values for wet coil operation.

Multiply CFM values shown by the air density ratio for actual CFM at higher altitudes.

| ADDITIONAL PHYSICAL INFORMATION | | | | |
|---|---|---|---|---|
| | 240 | 330 | 400 | 500 |
| Filter Size | 26-1/2 x 19 | | | 30 x 19 |
| Supply & Return Conn. | 3-4" F.P.T. | | | |
| Condensate Conn. | 3-4" F.P.T. | | | |
| Weight Operating/Shipping (lbs.) | 265/260 | 277/270 | 308/302 | 344/338 |
| Blower Motor HP | 1/6 | 1/3 | | 1/2 |
| Blower Wheel Size (D x W) | 10 x 7-1/8 | 10 x 8-1/2 | 11-1/8 x 8-1/2 | 11-1/8 x 10-6/8 |
| Coil Face Area (Sq. Ft.) | 2.0 | 2.75 | | 3.75 |
| Coil Face Dimensions (A x B) | 18 x 16 | 18 x 22 | | 18 x 30 |
| No. of Rows | 4 | 4 | 4 | 4 |
| Refrigerant Charge (R-22 oz.) | 48 | 67 | 48 | 80 |
| Blower Disc. Width "A" | 7-1/4 | 11-5/16 | 11-7/8 | 15-3/16 |
| Blower Disc. Depth "B" | 11-5/16 | 12-3/16 | 11-7/16 | 11-7/16 |
| Optional Duct Collar Dim. C | 21-5/8 | | | 21-1/8 |

# GUIDE SPECIFICATIONS FOR CEILING-CONCEALED OR FLOOR VERTICAL CONDITIONERS:

## (E.G. SINGER Type CC, UC, or FC Water Source Heat Pumps, or Type CG, UG, or FG Interior Zone Cooling-Only Units)

1. Contractor shall furnish and install water source heat pump or cooling only conditioners where shown on plans, with capacities and characteristics as listed in the schedule.
2. Conditioner performance shall be A.R.I. certified, and listed by a nationally recognized safety testing laboratory, or agency, such as Underwriter's Laboratories (U.L.), or Electrical Testing Laboratory (E.T.L.), or Canadian Standards Association (C.S.A.).
3. Casings shall be corner post and panel construction with a 14 gauge galvanized steel base pan. Access panels shall be lined internally with acoustic type fibrous glass insulation, overcoated, and with edges sealed or tucked under flanges, to prevent the introduction of glass fibers into the discharge air. All construction shall meet the National Fire Protection Association Standard 90-A.
4. All internal sheet metal parts subject to water exposure shall be coated with a baked on, thermo-setting plastic coating.
5. Conditioner shall contain a sealed refrigerant circuit, consisting of a hermetic motor-compressor, air-to-air refrigerant finned tube coil, refrigerant flow metering device, water-to-refrigerant coaxial tube type heat exchanger, high pressure and low pressure safety cutouts, fusible pressure relief plug factory installed on the refrigerant circuit, heat pump conditioners shall additionally contain a pilot operated refrigerant reversing valve. Cooling only units shall provide a Schraeder type access valve to permit the field installation of a pressure operated water flow regulating valve, in the leaving water line.
6. The refrigerant flow metering device shall be a capillary tube on conditioners up to nominal capacity of 52,000 BTUH (ARI cooling rated). An electric expansion valve with control to provide for essentially zero degrees superheat, at all operating points within the normal application range, shall be used on all larger conditioners. Thermal expansion valves shall not be permitted.
7. High and low pressure safety switches, and pilot duty compressor thermal or current switches (when provided by the compressor manufacturer), shall be wired through a latching lockout circuit to hold the conditioner off until it is reset electrically by interrupting the power supply to the conditioner. Manual reset at the unit or by any means of thermostat cycling or switching will not be allowed.
8. Manufacturer shall guarantee heat pump conditioners to start and operate in an ambient of 40 degrees F, with entering air at 40 degrees F, with entering water at 70 degrees F, with both air and water at the flow rates used in the ARI standard rating test, for initial stystem start-up in winter (this is not a normal or continuing operating condition, and it is assumed that such a start-up is only for the purpose of bringing the building or space up to occupancy temperature).
9. A control panel shall be factory mounted within the conditioner enclosure, containing control logic for blower, compressor, and reversing valve, and a low voltage control circuit transformer, completely factory wired. (Alternate) All models shall have a separate control panel for mounting near the conditioner, at the location shown on the plans.
10. Conditioner control logic shall provide for heating or cooling as required by the set points and switch positions of the remote, field installed, low voltage wall thermostat. Internally, the conditioner control logic shall provide for cycled fan operation simultaneous with compressor operation, to prevent compressor damage. Conditioner control logic shall permit user selection of continuous fan operation, where the specified thermostat switching provides this feature. Compressor control logic shall provide anti-short-cycle and random start, and shall suspend compressor operation in the event of excess condensate accumulation in the drain pan, to prevent overflow from a plugged or slow draining condensate line.

    Alternately, in lieu of electronic sensing of condensate overflow condition, conditioner may be:

    A) Supplied with two condensate drain connections at opposite ends of the drain pan, each to be independently connected to the condensate drain pipe system by installer.

    — OR —

    B) Installed over a secondary drip pan not less than two inches wider and longer than the conditioner and not less than two inches deep, also connected to the condensate drain pipe system by the installer. Float switches, pressure switches, or other techniques (sensitive to failure from dirt accumulation or air velocity impingement) for sensing an impending condensate overflow condition shall not be allowed.

## GUIDE SPECIFICATIONS (Continued)

11. Heat pump conditioner control logic shall provide for delayed de-energization of reversing valve solenoid to permit some high to low side pressure equalization, at the completion of each heating cycle, to A) reduce pressure shock waves which may damage the compressor, B) ensure that each heating re-start is with equalized pressure, and C) virtually eliminate any reversing valve cycling noise.
12. Conditioner control logic shall contain logic circuit to provide equipment status signal to either a central monitoring panel, or an indicator light integral to the thermostat sub-base. Low voltage signal output shall be interrupted in the event of conditioner "fault" including high or low pressure safety cutout, or condensate overflow, or loss of power to the unit. (T'stat light will only indicate safety cutout or condensate overflow).
13. Capacitors used in conjunction with single phase motors shall utilize a non-PCB dielectric.
14. Conditioner blower shall be direct drive on all models up to 60,000 BTUH (ARI cooling rated), except model size "620" may be specified either direct or belt drive, and all larger units shall be belt drive, as shown on the plans. Blower wheels shall be forward curved centrifugal type, designed to produce specified air volume (CFM) at specified external static pressure at the input voltage specified.
15. A two speed blower motor shall be provided on 10,000 BTUH (ARI cooling rated) or smaller models. Factory wiring shall be for high speed, with means provided for fast, easy, terminal block field re-connection to low speed, where shown on the plans. Field wire cutting, stripping, or terminal application shall not be allowed for motor speed change.
16. All larger direct drive blowers shall provide mechanical means, external to the cabinet, of adjusting air volume to a value less than maximum at the specified external static pressure, for easy field air balancing.
17. Conditioner shall separate the air handling section from the compressor and control section with an insulated divider panel, to minimize the transmission of compressor noise, and to permit operational service testing without having air by-pass the air-to-refrigerant coil.
18. All blower motors shall have a normal two year lubrication capacity and shall be initially lubricated at the factory. External, factory installed, oiler tubes shall be provided to permit maintenance lubrication without removal of any panels, at one year intervals, as a part of normal equipment maintenance, in accordance with the conditioner manufacturer's instructions.
19. All conditioners shall be provided with a one inch thick, throw-away type fiberglass filter, installed in a two sided filter frame, arranged for "side-pull". Contractor may remount the frame to accommodate up or down pull, as required, to ensure that the completed installation is serviceable. Piping and electrical connections shall be located to eliminate any interference with removal and replacement of the filter.
20. Supply and return connections shall be IPT copper fittings, brazed to copper water tubes. Connection sub-assembly shall be mechanically fastened to the conditioner base pan. Condensate drain connection shall not be less than 3/4". Supply, return, and condensate shall be connected to loop and drain piping as detailed on plans.
21. Conditioners shall be furnished for the specific voltage and phase shown on the schedule, and the conditioner shall be guaranteed for operation at plus or minus 10% of the data plate voltage.
22. A one year warranty shall be provided by contractor for furnishing parts and labor for replacing any part of the conditioner which becomes defective in normal operation from the date of original installation.

    (Option) The hermetically sealed motor compressor assembly and all components of the refrigerating circuit not readily separable therefrom shall be warranted to the original owner for use for an additional four years.

    (Alternate option) The hermetically sealed motor compressor assembly only shall be warranted to the original owner for use for an additional four years.
23. Spare units. Provide to the owner one spare machine of each model on this project.
24. Ceiling suspended conditioners: each corner shall be provided with threaded nut and pin locator hole to accommodate hanger bracket assembly either near the top of the conditioner, or near the bottom. Where the conditioner is indicated to be ceiling hung, the conditioner manufacturer shall provide a kit of four hanger bracket assemblies, each comprised of a heavy steel hanger bracket, integral vibration isolator, cap screw, and plated isolator washer. Hanger bracket assembly shall accomodate a 3/8" maximum diameter hanger rod. No external channel or angle trapeze assemblies, nor hangers not mechanically secured to the conditioner shall be allowed.

# OPTIONS/ACCESSORIES

(1) CUPRONICKEL CONDENSERS

For applications with brackish water.

(2) HOSE ASSEMBLIES

Chamberlin Rubber Co. 300 Psig working pressure. Supply & Return hose assemblies. Clear vinyl condensate hoses w/nylon fittings.

(3) SHUTOFF/BALANCING VALVES

Ball Valves with adjustable locking stop. (Bulletin ECS-259)

(4) SPECIAL HEAT PUMP CONTROLS

WOTC — Wireless night-set-back; up to sixteen schedules, with automatic suspension of heat pump operation in event of water pump failure, and outdoor reset of morning start-up. (See Bulletin ECS-8-4).

BOILERLESS SYSTEM CONTROL — of duct heater (by others) to virtually eliminate central boiler. (See Bulletin ECS-1D)

INN COMMAND — A wireless control system for Hotel or Motel installations, with front desk console providing for two way control communication with each unit. (See Bulletin PTAC b 54).

NSB/DEMAND — Hard wired system for interface with computer control systems by others. (See Bulletin ECS-509).

TIME COMMAND — A wireless control system for commercial applications providing up to 4000 schedules, with demand control. (Available October 1982).

(5) HEAT PUMP THERMOSTATS

Standard grade Automatic or Manual changeover types.

— or —

Deluxe Types with service and clogged filter indication, adjustable "dead-band", and locking covers.

Multiple Unit Control Panel (not shown) for simultaneous operation of several units from one thermostat.

(6) FILTER OPTIONS

1" or 2" Permanent type filters.

Duct Collar & Filter Frame Kit, with 2" filter (also accepts 1" filter).

(7) SUB-ZONE COILS & CONTROL

Re-heat/Re-cool coil permits independent temperature control in the sub-zone, with no energy useage penalty, with only one unit. (See Bulletin ECS-1D).

(8) MARK III CONTROLS TESTER

Microprocessor based "go/no-go" tester permits service diagnosis by ordinary air conditioning service personnel, without electronic training. (See Bulletin ECS-000).

(9) SYSTEM CONTROL & ALARM PANEL

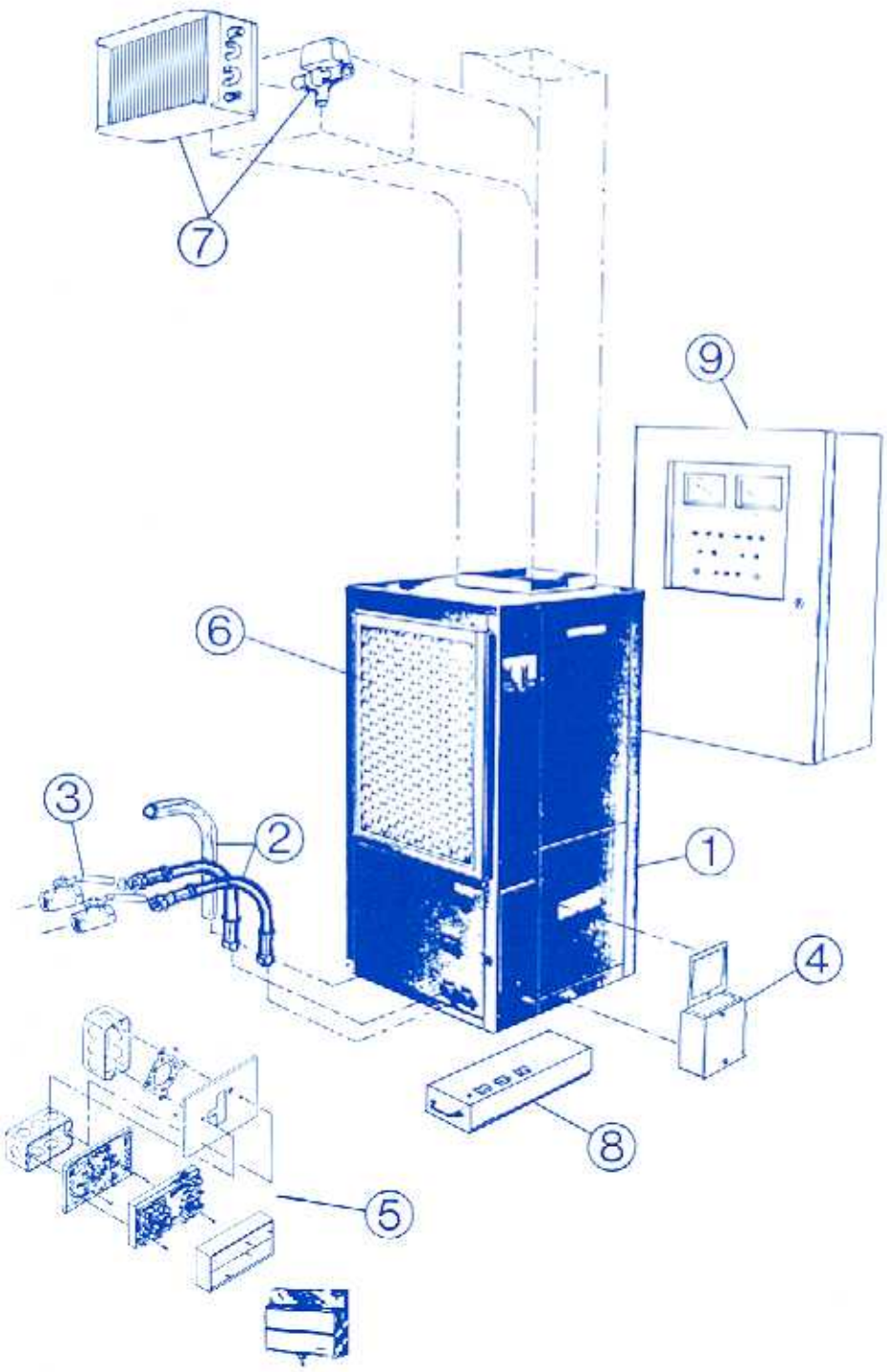
Up to six stages of heat rejection and sixteen stages of heat addition, with automatic outdoor reset of heating control point, automatic pump sequencing, and alarm functions for flow, and high or low water temperature. (See Bulletin ECS-8-3).

(10) ATTITUDE SIGNAL DISPLAY PANEL

A single Class II conductor to the "A" terminal of a Mark III Heat Pump will provide for a constant green light to indicate operable units, or a flashing red light with audible alarm if heat pump has a fault condition. Up to 36 stations per Panel. (NOT SHOWN — See Bulletin ECS-8-6).

(11) THREE PUMP CONTROLLER

For large projects which require three pumps, two operating, with the third as stand-by for either of the operating pumps; with manual lead/lag selection of any combination of pumps. (NOT SHOWN — See Bulletin ECS-451).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# APPLICATION LIMITS

## 1. Environment:

This equipment is designed for indoor installation ONLY. Sheltered locations, such as attics, garages, etc. generally will not provide sufficient protection against extremes in temperature and/or humidity, and equipment performance, reliability, and service life may be adversely affected.

Singer guarantees heat pump conditioners to start and operate in an ambient of 40 degrees F. with entering air at 40 degrees F. with entering water at 70 degrees F. with both air and water at the flow rates used in the A.R.I. Standard 320-81 rating test, for initial system start-up in winter (this is not a normal or continuing operating condition, and it is assumed that such a startup is for the purpose of bringing the building or space up to occupancy temperature).

## 2. Air Enthalpy:

| | COOLING | HEATING |
|---|---|---|
| Minimum ambient air | 52 F | 50 F |
| Normal ambient air | 80 | 70 |
| Maximum ambient air | 100 | 85 |
| Minimum entering air (1) (3) | 52 F | 60 F |
| Normal entering air | 80/67 | 70 |
| Maximum entering air (1) (3) | 95/78 | 85 |

## 3. Water Enthalpy:

| | | |
|---|---|---|
| Minimum entering water (2) (3) | 60 | 60 |
| Normal entering water | 85 | 70 |
| Maximum entering water (2) (3) | 105 | 85 |

(1) At A.R.I. flow rate, or equivalent enthalpy.
(2) At A.R.I. flow rate, or equivalent enthalpy, not exceeding a velocity of 12 Ft. per second in the heat exchanger.
(3) Maximum and Minimum values may not be combined; if one value is at maximum or minimum, the other two conditions may not exceed the Normal condition.

## 4. Power Supply:

1. A voltage variation of plus or minus 10% of nameplate utilization voltage is acceptable.
2. Three phase system unbalance shall not exceed 4%.

**CLIMATE CONTROL**
A UNIT OF SNYDER GENERAL CORPORATION


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