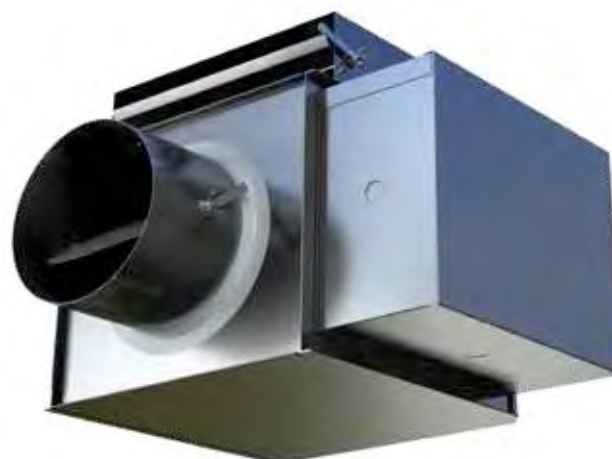


BYPASS TERMINAL UNITS 3400 SERIES

- "DUMP BOX"
- UNIQUE "FLOW DIVERTER" VALVE

Models:

3400	Cooling
34RW	Cooling with Hot Water Reheat
34RE	Cooling with Electric Reheat



Model 3400

The **3400 Series – Bypass Terminal Unit** is a single duct pressure dependent air terminal unit, designed for use with popular constant volume low and medium pressure packaged air handling systems or roof top air conditioning units at low prime cost. Units may be used with cooling and heating/cooling systems. Temperature control is achieved by supplying only enough conditioned air to the space to satisfy room thermostat demand. Excess air is diverted (bypassed) directly to the return air ceiling plenum for free or ducted return. Airflow to each occupied zone will vary on thermostat demand, from full flow to shut-off or to a mechanically set minimum air volume.

A bypass box, commonly referred to also as a "dump box" handles a constant supply of primary air through its inlet and uses a diverting damper to bypass part of the supply air into the plenum return. The damper is directly controlled by the room thermostat in the occupied space to provide the volume of air required to meet the thermal demand. The pressure requirement through the supply air path to the conditioned space is set with an inlet balancing damper. A second manual balancing damper in the bypass is field adjusted to match the resistance in the discharge duct in order to maintain minimum airflow to the space, maintain supply air from the primary system at a constant volume and ensure smooth modulation of the supply airflow volume.

Bypass terminals can be added to a single-zone constant volume system to provide zoning without the energy penalty of a conventional reheat system, providing low first cost with minimum fan controls. Although variable volume to the space in operation, total airflow of the fan remains constant, so the fan power and associated energy cost are not reduced. This method is therefore energy inefficient as compared to a VAV fan system. Its most frequent application is on small systems.

FEATURES:

- Casing – 22 ga. galvanized steel with round or flat oval inlets. Outlets are rectangular with slip and drive connections.
- Damper – Heavy gauge steel cylindrical Flow Diverter valve design for reliable long term operation. Eliminates any internal damper linkage. 90° rotation. CW to close.
- 1/2" (13) dia. plated steel drive shaft. An indicator mark on the end of the shaft shows damper position.
- 3/4" (19) dual density insulation. Exposed edges are coated to prevent airflow erosion. Material meets requirement of NFPA 90A and UL 181 standards.
- Inlet balancing damper.
- Easily adjustable bypass port balancing dampers.

- Sizes range from 6" (152) to 16" (406) with capacities from 100 to 2750 cfm. Tested in accordance with ANSI / ASHRAE Standard 130 and AHRI Standard 880, in an independent test laboratory.

- Compact low profile design is ideally suited for installation in tight spaces.

- Minimum air volume stop on electric actuator. It cannot be factory set and must be field adjusted as required for the application.

Controls:

- Pressure dependent pneumatic or analog electronic control. Factory supplied and mounted.
- Variety of control options available, based on applications.
- Electronic thermostat and actuator provide accurate modulating control.

Options:

- Hot water and electric reheat coil sections.
- Multi-outlet plenum.
- Round/Oval discharge collar.



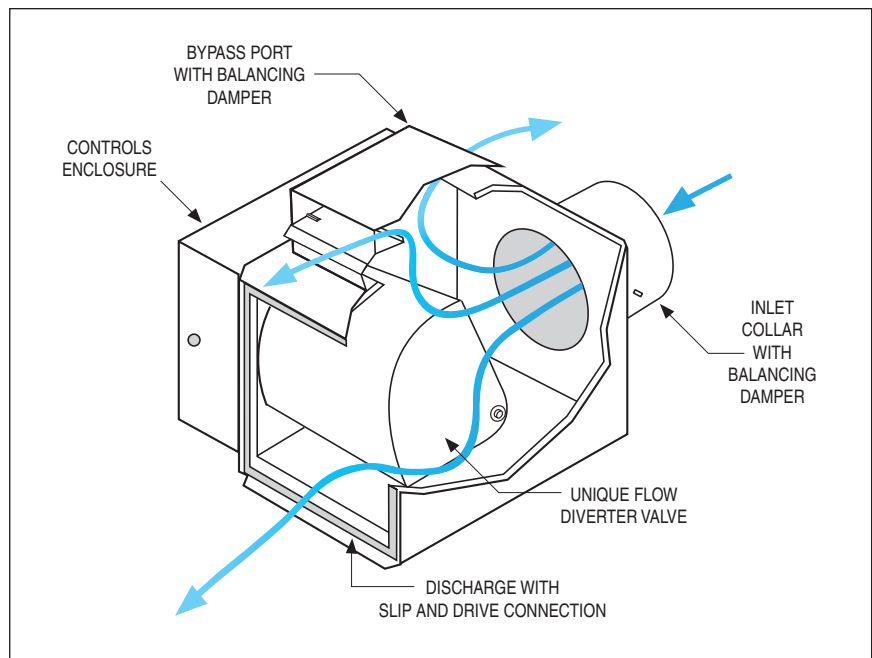
Intertek



Unique "Flow Diverter" Valve

Nailor's 3400 Series Mark II bypass terminal units utilize a unique cylindrical flow diverter valve for superior control and performance. A common problem with standard pivoted single blade damper designs is objectionable noise and loss of modulation due to pulsating and/or a snap-closing action of the valve. This is caused by a poor valve design, which struggles to modulate turbulent airflow and requires excessive torque.

The Nailor flow diverter valve eliminates these problems. The rugged cylindrical damper design smoothly modulates between supply and bypass conditions and when installed under airflow is essentially self-balancing, requiring only a negligible torque requirement. The result is superior reliable long-term performance and quiet operation.



Analog Electronic Modulating Controls

Nailor offers a series of analog electronic control packages which provide true modulating control and superior performance over conventional electric controls. These older packages essentially provide on/off control of the bypass terminal. Commonly, the damper is driven to the full supply or full bypass position before a change in space temperature is sensed by the room thermostat. Low speed actuators are often used to slow the damper response, but result in sluggish control and large swings in occupied space temperature which waste energy and provide poor comfort.



Digital display room thermostat (VT7200C5000), Floating actuator (MEP-4003) and Auto changeover duct temperature sensor.

Nailor's analog electronic packages feature advanced microcomputer electronics and proportional plus integral (P + I) control algorithms to provide precise temperature control. The digital display thermostat provides a true multi-position modulating output to a conventional 24 VAC tri-state floating actuator. The thermostat output cycles the actuator with shorter or longer "on times" proportional to the temperature offset, preventing temperature overshoot. The thermostat also tracks how long the room temperature has varied from set point and adjusts the output accordingly. This eliminates wasted energy caused by typical on/off cycling with conventional SPDT thermostats, resulting in significant energy savings and superior comfort. Control deadband accuracy is $\pm 0.4^{\circ}\text{F}$ ($\pm 0.2^{\circ}\text{C}$) around set point. When an electric reheat stage is required, depending on the control sequence selected, the electronic thermostat can provide a time proportional output signal (10 second time base) to a SSR/SCR that proportionately modulates the reheat coil, adjusting the amount of "on time" in accordance with room temperature offset.

Options:

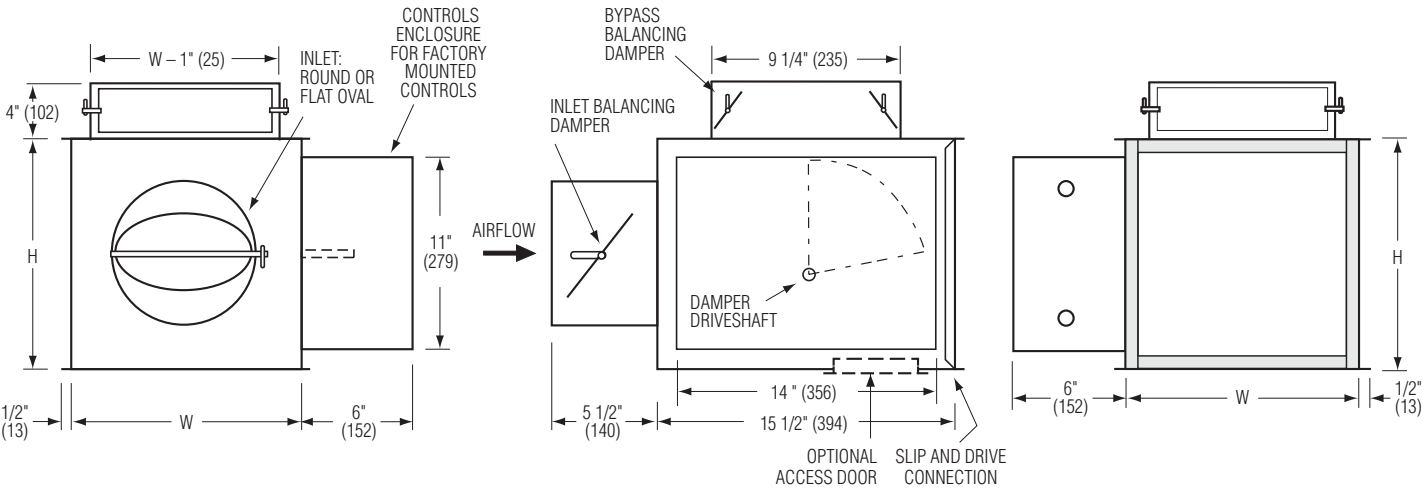
- 24 VAC Control transformer.
- Toggle disconnect switch.

Dimensions

Model 3400 • Basic Unit with Controls

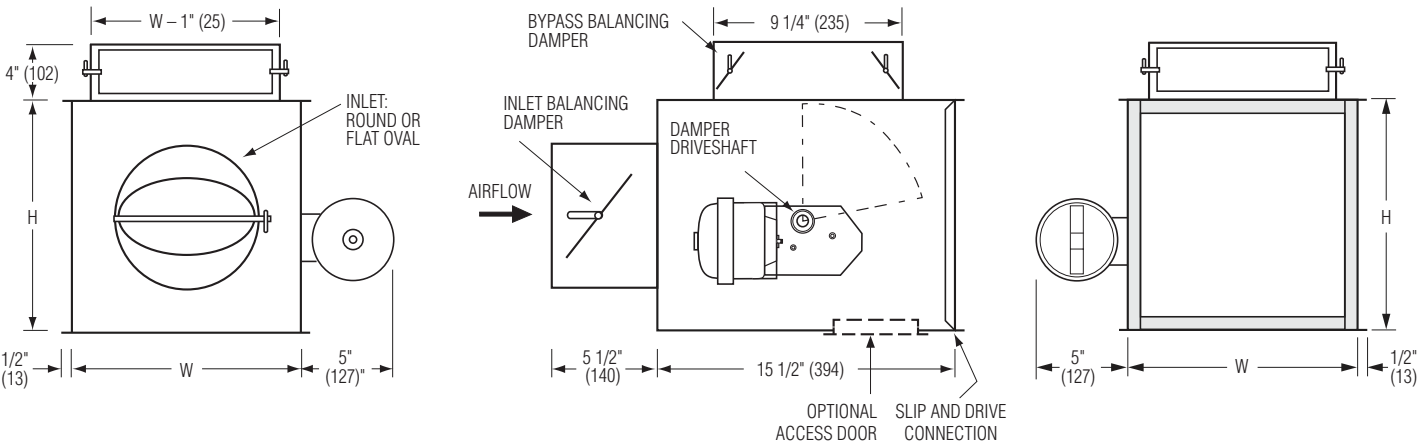
Digital and Analog Electronic Controls

- A full NEMA1 controls enclosure is provided for factory mounted controls. Optional for field mounted controls.



Pneumatic Controls

- Direct drive rotary pneumatic actuator. MCP-3631 Series. Minimum damper position must be field set.



Dimensional Data

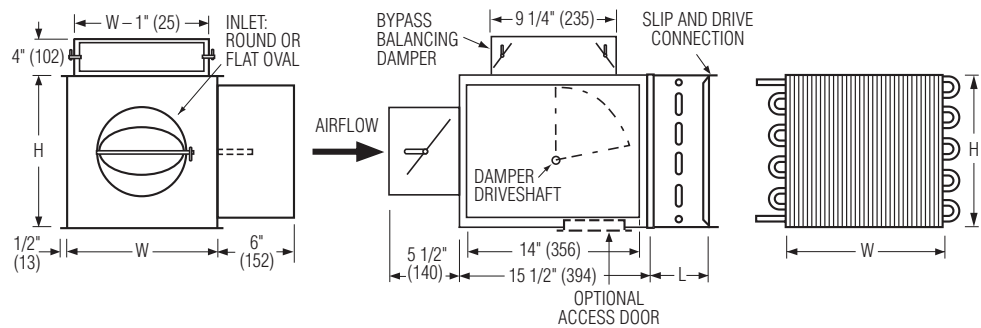
Unit Size	W	H	Inlet Size
6	10 (254)	12 1/2 (318)	5 7/8 (149) Round
8	12 (305)	12 1/2 (318)	7 7/8 (200) Round
10	14 (356)	12 1/2 (318)	9 7/8 (251) Round
12	18 (457)	12 1/2 (318)	12 15/16 x 9 13/16 (329 x 249) Oval
14	24 (610)	12 1/2 (318)	16 1/16 x 9 13/16 (408 x 249) Oval
16	28 (711)	12 1/2 (318)	19 3/16 x 9 13/16 (487 x 249) Oval

Dimensions

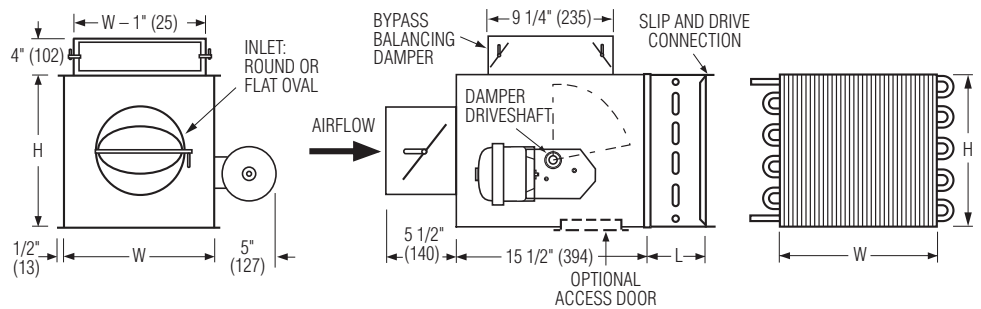
Model 34RW • Hot Water Reheat Coils

- One, two, three and four row available.
- Hot water coils have copper tubes and aluminum ripple fins. Coils have 1/2" (13) or 7/8" (22) O.D. sweat connections. Right or left hand coil connection is determined by looking through the terminal inlet in the direction of airflow.
- Galvanized steel casing with slip and drive discharge duct connection.
- AHRI Certified.
- Optional low leakage gasketed access door is recommended for coil access and cleaning.
- Performance data on page E15.

Analog Electronic and Digital Controls



Pneumatic Controls



Dimensional Data

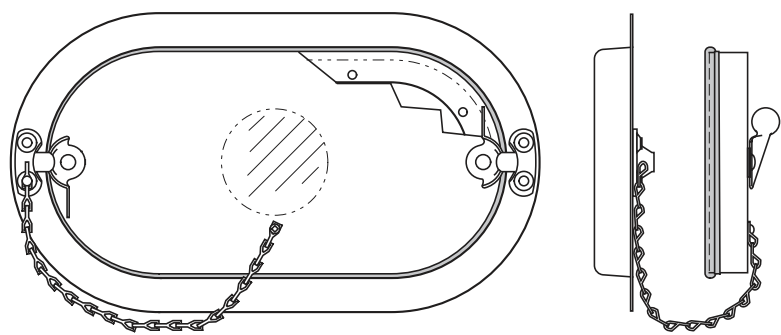
Unit Size	W	H	Hot Water Coil	
			L (1 & 2 row)	L (3 & 4 row)
6	10 (254)	12 1/2 (318)	5 (127)	7 1/2 (191)
8	12 (305)	12 1/2 (318)	5 (127)	7 1/2 (191)
10	14 (356)	12 1/2 (318)	5 (127)	7 1/2 (191)
12	18 (457)	12 1/2 (318)	5 (127)	7 1/2 (191)
14	24 (610)	12 1/2 (318)	5 (127)	7 1/2 (191)
16	28 (711)	12 1/2 (318)	5 (127)	7 1/2 (191)

Options:

Access Door

Ultra-low leakage, premium quality and performance. Flat oval design.

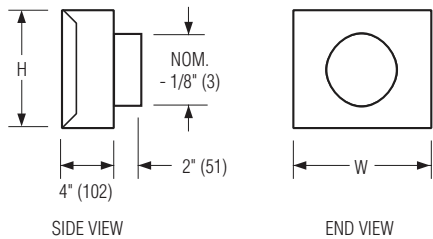
- Die formed 22 ga. (0.85) galvanized steel flanged frame and door panel.
 - Positive bulb door seal.
 - Plated steel camlock fasteners.
 - 1" (25) insulation with 22 ga. (0.85) galvanized backing plate.
- Leakage tested in conformance with British Standard DW/142 Class C.
 - See 0800-1 submittal for more detailed information.



Terminal Unit Size	Nominal Door Size	Max. Leakage 8" w.g. (2 kPa) cfm
6, 8, 10, 12	8" x 5" (203 x 127)	0.036 cfm (1.02 l/min.)
14, 16	12" x 6" (305 x 152)	0.064 cfm (1.8 l/min.)

FF Round/Flat Oval Discharge Collar

- Same size as unit inlet.



Unit Size	FF Nomonal Outlet Size	W	H
6	6" (152) Round	10" (254)	12 1/2" (318)
8	8" (203) Round	12" (305)	12 1/2" (318)
10	10" (254) Round	14" (356)	12 1/2" (318)
12	12" (305) Flat Oval	16" (406)	12 1/2" (318)
14	14" (356) Flat Oval	18" (457)	12 1/2" (318)
16	16" (406) Flat Oval	24" (610)	12 1/2" (318)

Performance Data • NC Level Application Guide

3400 Series

Inlet Size	Airflow		Min. Discharge Δ Ps		Min. Bypass Δ Ps		NC Levels		
							DISCHARGE	RADIATED	
	cfm	l/s	"w.g.	Pa	"w.g.	Pa		Bypass Closed	Bypass Open
6	400	189	0.01	2	0.14	35	-	-	26
	300	142	0.01	2	0.08	20	-	-	-
	200	94	0.01	2	0.04	10	-	-	-
	100	47	0.01	2	0.01	2	-	-	-
8	700	330	0.01	2	0.21	52	-	-	30
	500	236	0.01	2	0.11	27	-	-	20
	350	165	0.01	2	0.05	12	-	-	-
	200	94	0.01	2	0.02	5	-	-	-
10	1100	519	0.01	2	0.43	107	-	20	37
	800	378	0.01	2	0.23	57	-	-	26
	500	236	0.01	2	0.09	22	-	-	-
	200	94	0.01	2	0.01	3	-	-	-
12	1600	755	0.01	2	0.50	124	-	21	41
	1200	566	0.01	2	0.28	70	-	-	33
	800	378	0.01	2	0.13	32	-	-	23
	400	189	0.01	2	0.03	7	-	-	-
14	2100	991	0.20	50	0.50	124	21	31	43
	1550	731	0.10	25	0.27	68	-	23	35
	1000	472	0.04	10	0.11	28	-	-	24
	450	212	0.01	2	0.02	5	-	-	-
16	2750	1298	0.12	29	0.50	124	21	34	47
	2050	967	0.06	16	0.28	70	-	24	38
	1350	637	0.03	8	0.12	30	-	-	28
	650	307	0.01	2	0.03	7	-	-	-

Performance Notes:

1. NC levels are calculated from the published raw data and based on procedures outlined in Appendix E, AHRI Standard 885.
2. Discharge sound attenuation deductions are based on environmental effect, duct lining, branch power division, insulated flex duct, end reflection and space effect and are as follows:
3. Radiated sound attenuation deductions are based on a mineral tile ceiling and environmental effect and are as follows:
4. Minimum discharge Δ Ps is the static pressure loss through the unit with 100% airflow through discharge outlet.

Radiated attenuation	Octave Band						
	2	3	4	5	6	7	
Total dB reduction	18	19	20	26	31	36	

5. Minimum bypass Δ Ps is the static pressure loss through the unit with 100% airflow through the bypass outlet.
6. Dash (–) in space denotes an NC level of less than 20.
7. For a complete explanation and details on NC calculations, refer to page E14 and the engineering section of this catalog.

Discharge attenuation	Octave Band						
	2	3	4	5	6	7	
< 300 cfm	24	28	39	53	59	40	
300 – 700 cfm	27	29	40	51	53	39	
> 700 cfm	29	30	40	51	52	39	

Performance Data • AHRI Certification and Performance Notes

3400 Series • Bypass • AHRI Certification Rating Points

Fiberglass Liner

Inlet Size	Airflow		Min. Inlet ΔPs		Discharge Sound Power Levels @ 1.5" w.g. (375 Pa) ΔPs							Radiated Sound Power Levels @ 1.5" w.g. (375 Pa) ΔPs						
					Octave Band							Octave Band						
	cfm	l/s	"w.g.	Pa	2	3	4	5	6	7	2	3	4	5	6	7		
6	400	189	0.01	2	63	59	55	50	42	40	42	37	33	24	20	20		
8	700	330	0.01	2	61	58	52	48	38	32	47	41	34	28	26	20		
10	1100	519	0.01	2	63	57	50	48	43	42	52	49	46	37	32	23		
12	1600	755	0.01	2	64	58	53	49	44	36	48	51	47	37	35	29		
14	2100	991	0.20	50	70	64	58	53	50	45	54	58	56	49	49	41		
16	2750	1298	0.12	29	69	64	60	56	52	45	64	63	59	49	46	37		



Ratings are certified in accordance with AHRI Standards.

Performance Notes for Sound Power Levels:

1. Discharge sound power is the noise emitted from the unit discharge into the downstream duct. Discharge Sound Power Levels (SWL) now include duct end reflection energy as part of the standard rating. Including the duct end correction provides sound power levels that would normally be transmitted into an acoustically, non-reflective duct. The effect of including the energy correction to the discharge SWL, is higher sound power levels when compared to previous AHRI certified data. For more information on duct end reflection calculations see AHRI Standard 880.
2. Radiated sound power is the breakout noise transmitted through the unit casing walls.
3. Sound power levels are in decibels, dB re 10⁻¹² watts.
4. All sound data listed by octave bands is raw data without any corrections for room absorption or duct attenuation. Dash (-) in space indicates sound power level is less than 20 dB or equal to background.
5. Data derived from independent tests conducted in accordance with ANSI/ASHRAE Standard 130 and AHRI Standard 880.
6. Minimum discharge ΔPs is the static pressure loss through the unit with 100% airflow through discharge outlet.
7. Minimum bypass ΔPs is the static pressure loss through the unit with 100% airflow through the bypass outlet.

Performance Data Explanation

Sound Power Levels vs. NC Levels

The **Nailor Models: 3400, 34RW and 34RE** bypass terminal unit performance data is presented in two forms.

The laboratory obtained discharge and radiated sound power levels in octave bands 2 through 7 (125 through 4000 Hz) center frequency for each unit size at various flow rates and inlet static pressures is presented. This data is derived in accordance with ANSI/ASHRAE Standard 130 and AHRI Standard 880. This data is raw with no attenuation deductions and includes AHRI Certification standard rating points.

Nailor also provides an NC Level table as an application aid in terminal selection, which includes attenuation allowances as explained below. The suggested attenuation allowances are typical not representative of specific job site conditions. It is recommended that the sound power level data be used and a detailed NC calculation be performed using the procedures outlined in AHRI Standard 885, Appendix E for accurate space sound levels.

Explanation of NC Levels

Tabulated NC levels are based on attenuation values as outlined in AHRI Standard 885 "Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets". AHRI Standard 885, Appendix E provides typical sound attenuation values for air terminal discharge sound and air terminal radiated sound.

As stated in AHRI Standard 885, Appendix E, "These values can be used as a quick method of estimating space sound levels when a detailed evaluation is not available. The attenuation values are required for use by manufacturers to catalog application sound levels. In product catalogs, the end user environments are not known and the following factors are provided as typical attenuation values. Use of these values will allow better comparison between manufacturers and give the end user a value which will be expected to be applicable for many types of space."

Radiated Sound

Table E1 of Appendix E provides radiated sound attenuation values for three types of ceiling: Type 1 – Glass Fiber; Type 2 – Mineral Fiber; Type 3 – Solid Gypsum Board.

Since Mineral Fiber tile ceilings are the most common construction used in commercial buildings, these values have been used to tabulate Radiated NC levels.

The following table provides the calculation method for the radiated sound total attenuation values based on AHRI Standard 885.

	Octave Band					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0
Ceiling/Space Effect	16	18	20	26	31	36
Total Attenuation Deduction	18	19	20	26	31	36

The ceiling/space effect assumes the following conditions:

1. 5/8" (16) tile, 20 lb/ft³ (320 kg/m³) density.
2. The plenum is at least 3 feet (914) deep.
3. The plenum space is either wide (over 30 feet [9 m]) or lined with insulation.
4. The ceiling has no significant penetration directly under the unit.

Discharge Sound

Table E1 of Appendix E provides typical discharge sound attenuation values for three sizes of terminal unit.

1. Small box; Less than 300 cfm (142 l/s)
(Discharge Duct 8" x 8" [203 x 203]).
2. Medium box; 300 – 700 cfm (142 - 330 l/s)
(Discharge Duct 12" x 12" [305 x 305]).
3. Large box; Greater than 700 cfm (330 l/s)
(Discharge Duct 15" x 15" [381 x 381]).

These attenuation values have been used to tabulate Discharge NC levels applied against the terminal airflow volume and not terminal unit size.

The following tables provide the calculation method for the discharge sound total attenuation values based on AHRI Standard 885.

Small Box <300 cfm	Octave Band					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0
5 ft. (1.5 m) 1" (25) Duct Lining	2	6	12	25	29	18
Branch Power Division (1 outlet)	0	0	0	0	0	0
5 ft. (1.5 m), 8 in. dia. (203) Flex Duct	5	10	18	19	21	12
End Reflection	10	5	2	1	0	0
Space Effect	5	6	7	8	9	10
Total Attenuation Deduction	24	28	39	53	59	40

Medium Box 300 – 700 cfm	Octave Band					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0
5 ft. (1.5 m) 1" (25) Duct Lining	2	4	10	20	20	14
Branch Power Division (2 outlets)	3	3	3	3	3	3
5 ft. (1.5 m), 8 in. dia. (203) Flex Duct	5	10	18	19	21	12
End Reflection	10	5	2	1	0	0
Space Effect	5	6	7	8	9	10
Total Attenuation Deduction	27	29	40	51	53	39

Large Box >700 cfm	Octave Band					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0
5 ft. (1.5 m) 1" (25) Duct Lining	2	3	9	18	17	12
Branch Power Division (3 outlets)	5	5	5	5	5	5
5 ft. (1.5 m), 8 in. dia. (203) Flex Duct	5	10	18	19	21	12
End Reflection	10	5	2	1	0	0
Space Effect	5	6	7	8	9	10
Total Attenuation Deduction	29	30	41	51	52	39

1. Flexible duct is non-metallic with 1" (25) insulation.
2. Space effect (room size and receiver location) 2500 ft.³ (69 m³) and 5 ft. (1.5 m) distance from source.

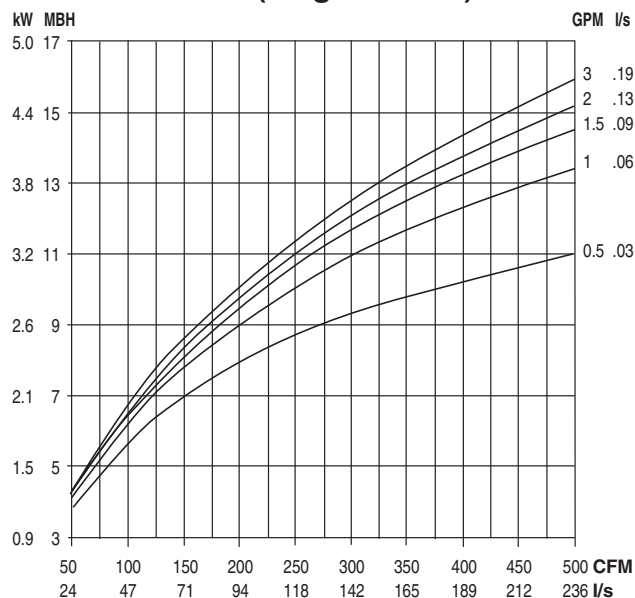
For a complete explanation of the attenuation factors and the procedures for calculating room NC levels, please refer to the acoustical engineering guidelines at the back of this catalog and AHRI Standard 885.

Performance Data • Hot Water Coil

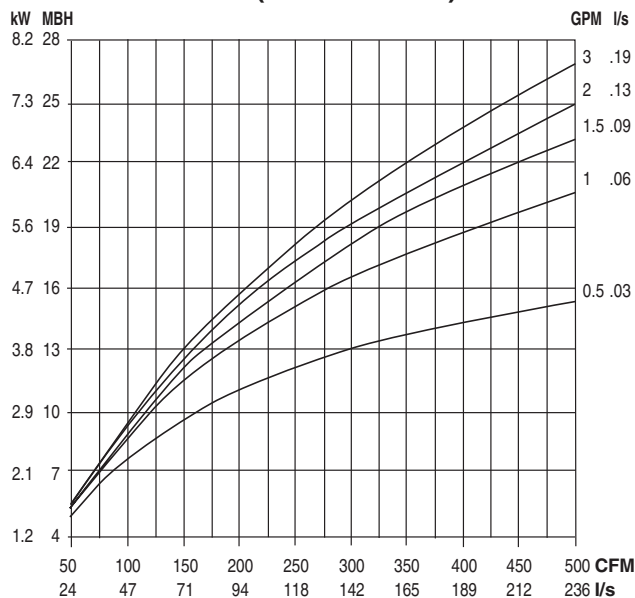
Model: 34RW

Unit Size 6

1 Row (single circuit)

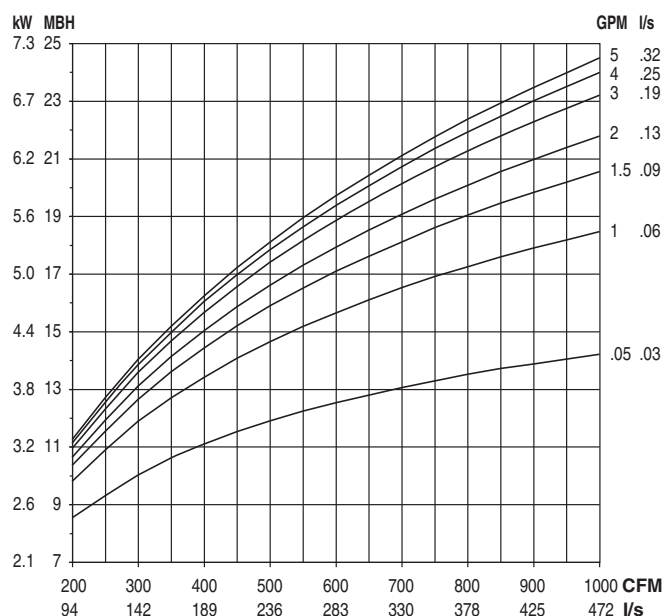


2 Row (multi-circuit)

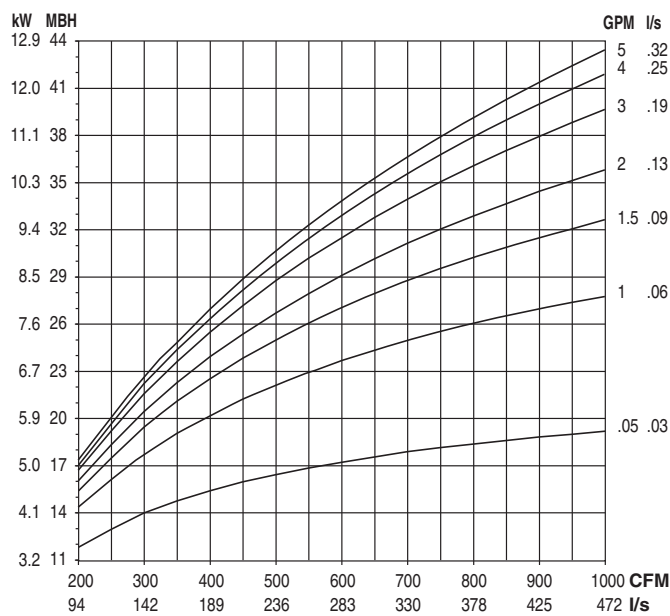


Unit Size 8

1 Row (single circuit)



2 Row (multi-circuit)



NOTES:

- Capacities are in MBH (kW), **thousands of Btu per hour (kiloWatts)**.
- MBH (kW) values are based on a Δt (temperature difference) of 125°F (69°C) between entering air and entering water. For other Δt 's; multiply the MBH (kW) values by the factors below.

- Air Temperature Rise.

$$\text{ATR (°F)} = 927 \times \frac{\text{MBH}}{\text{cfm}}, \text{ATR (°C)} = 829 \times \frac{\text{kW}}{\text{l/s}}$$

- Water Temp. Drop.

$$\text{WTD (°F)} = 2.04 \times \frac{\text{MBH}}{\text{GPM}}, \text{WTD (°C)} = .224 \times \frac{\text{kW}}{\text{l/s}}$$

- Connections: 1 Row 1/2" (13), 2, 3 and 4 Row 7/8" (22); O.D. male solder.

Altitude Correction Factors:

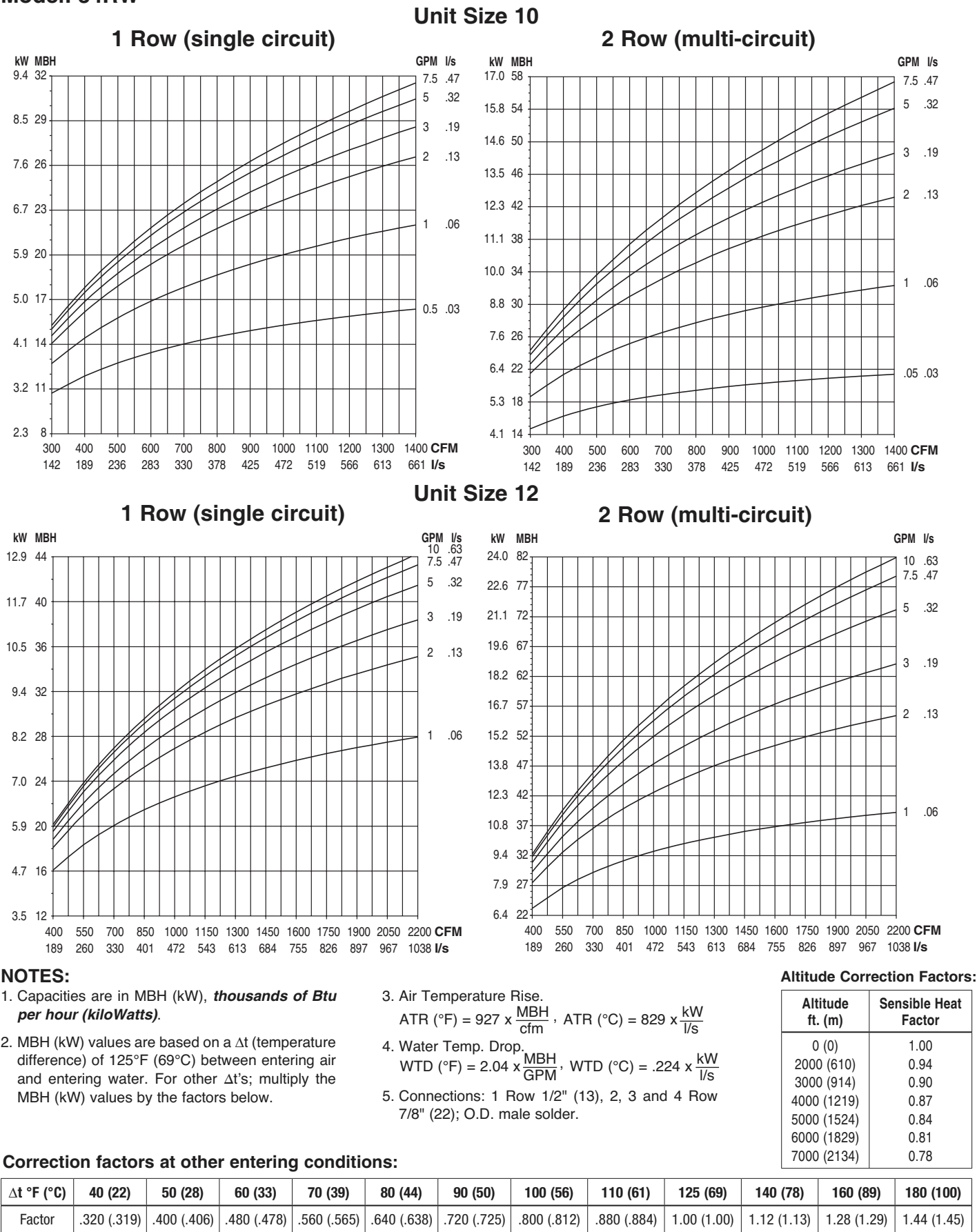
Altitude ft. (m)	Sensible Heat Factor
0 (0)	1.00
2000 (610)	0.94
3000 (914)	0.90
4000 (1219)	0.87
5000 (1524)	0.84
6000 (1829)	0.81
7000 (2134)	0.78

Correction factors at other entering conditions:

Δt °F (°C)	40 (22)	50 (28)	60 (33)	70 (39)	80 (44)	90 (50)	100 (56)	110 (61)	125 (69)	140 (78)	160 (89)	180 (100)
Factor	.320 (.319)	.400 (.406)	.480 (.478)	.560 (.565)	.640 (.638)	.720 (.725)	.800 (.812)	.880 (.884)	1.00 (1.00)	1.12 (1.13)	1.28 (1.29)	1.44 (1.45)

Performance Data • Hot Water Coil

Model: 34RW

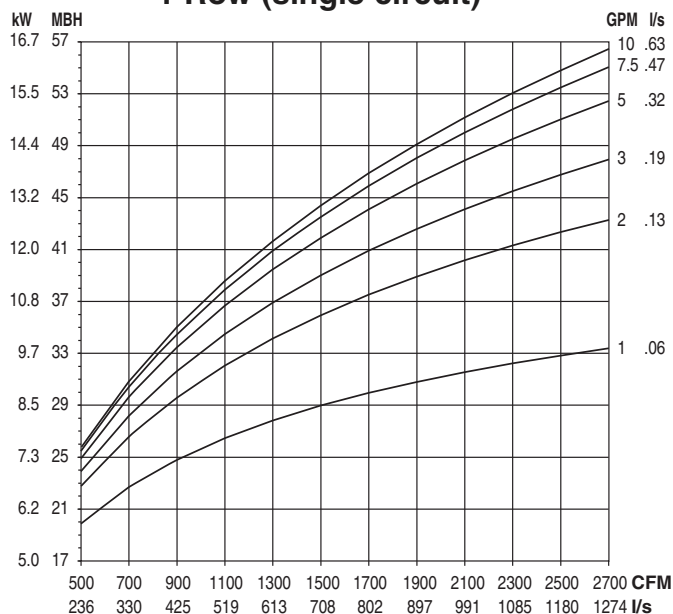


Performance Data • Hot Water Coil

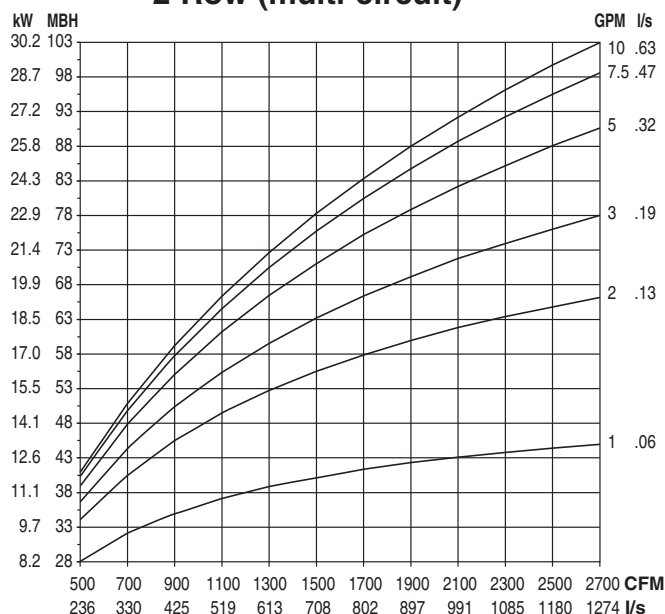
Model: 34RW

Unit Size 14

1 Row (single circuit)

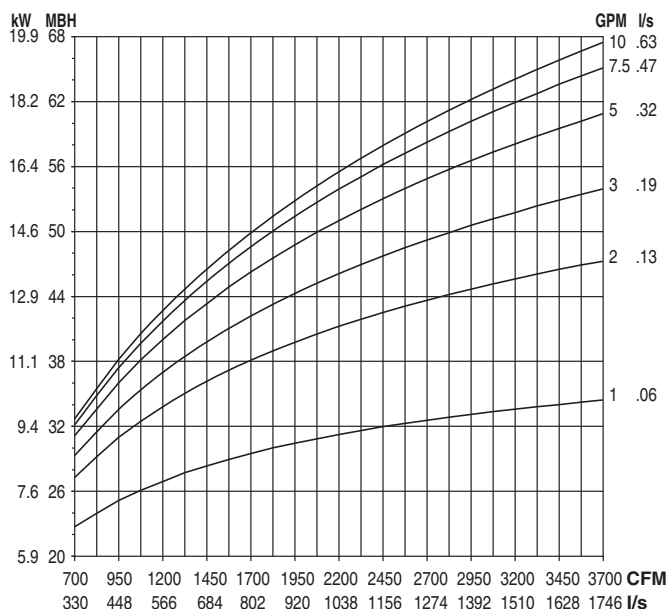


2 Row (multi-circuit)

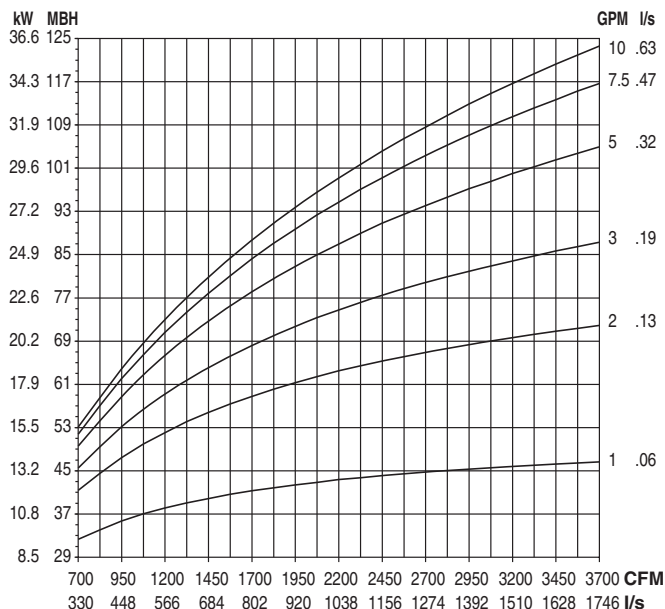


Unit Size 16

1 Row (single circuit)



2 Row (multi-circuit)



NOTES:

- Capacities are in MBH (kW), **thousands of Btu per hour (kiloWatts)**.
- MBH (kW) values are based on a Δt (temperature difference) of 125°F (69°C) between entering air and entering water. For other Δt 's; multiply the MBH (kW) values by the factors below.

- Air Temperature Rise.

$$\text{ATR (}^{\circ}\text{F)} = 927 \times \frac{\text{MBH}}{\text{cfm}}, \text{ ATR (}^{\circ}\text{C)} = 829 \times \frac{\text{kW}}{\text{l/s}}$$

- Water Temp. Drop.

$$\text{WTD (}^{\circ}\text{F)} = 2.04 \times \frac{\text{MBH}}{\text{GPM}}, \text{ WTD (}^{\circ}\text{C)} = .224 \times \frac{\text{kW}}{\text{l/s}}$$

- Connections: 1 Row 1/2" (13), 2, 3 and 4 Row 7/8" (22); O.D. male solder (Unit Size 14). 1, 2, 3 and 4 Row 7/8" (22); O.D. male solder (Unit Size 16)

Altitude Correction Factors:

Altitude ft. (m)	Sensible Heat Factor
0 (0)	1.00
2000 (610)	0.94
3000 (914)	0.90
4000 (1219)	0.87
5000 (1524)	0.84
6000 (1829)	0.81
7000 (2134)	0.78

Correction factors at other entering conditions:

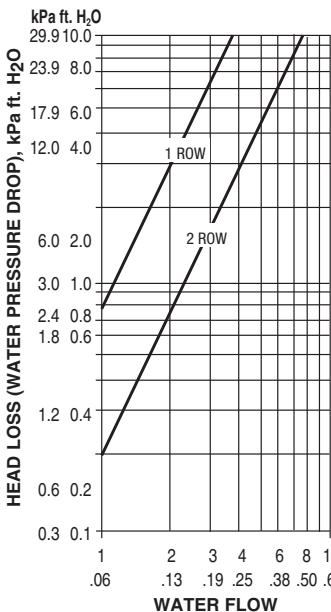
Δt °F (°C)	40 (22)	50 (28)	60 (33)	70 (39)	80 (44)	90 (50)	100 (56)	110 (61)	125 (69)	140 (78)	160 (89)	180 (100)
Factor	.320 (.319)	.400 (.406)	.480 (.478)	.560 (.565)	.640 (.638)	.720 (.725)	.800 (.812)	.880 (.884)	1.00 (1.00)	1.12 (1.13)	1.28 (1.29)	1.44 (1.45)

Performance Data • Hot Water Coil • Pressure Drops

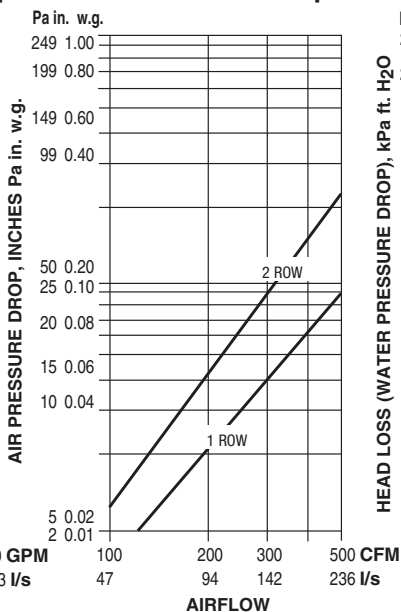
Model: 34RW

Unit Size 6

Water Pressure Drop

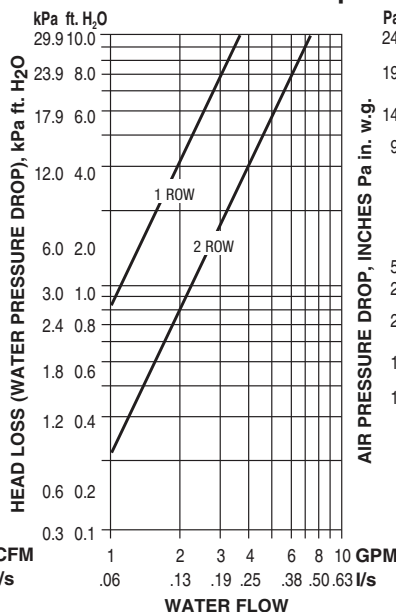


Air Pressure Drop

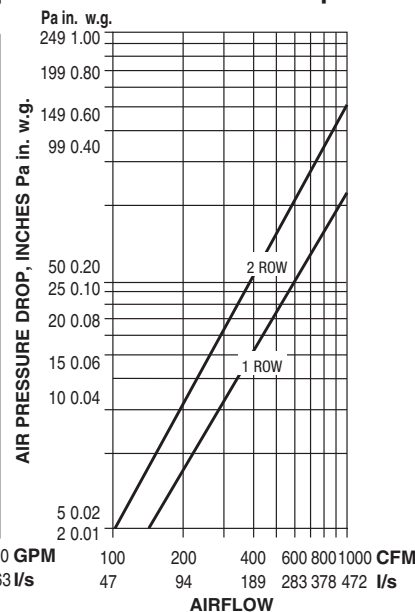


Unit Size 8

Water Pressure Drop

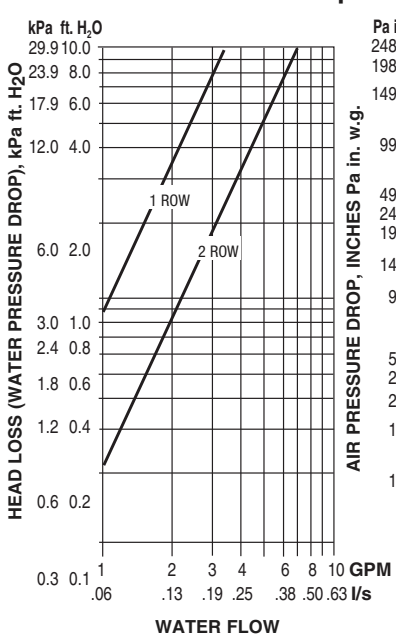


Air Pressure Drop

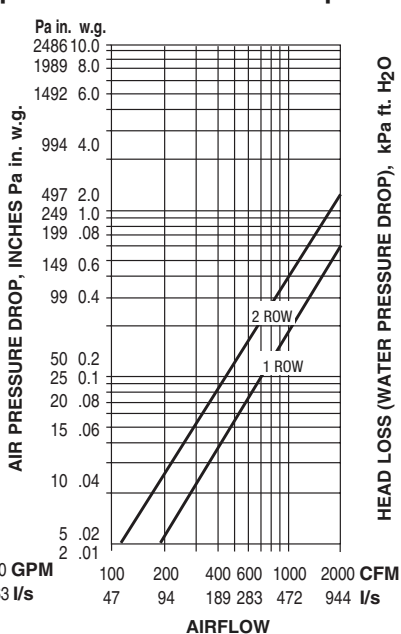


Unit Size 10

Water Pressure Drop

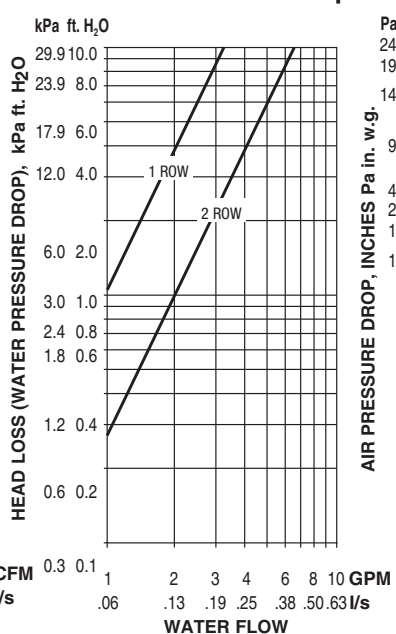


Air Pressure Drop

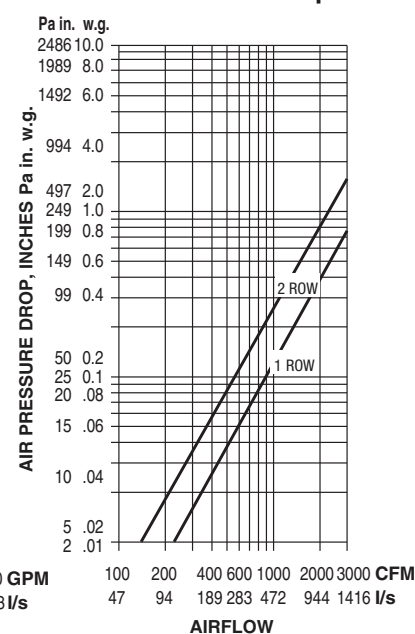


Unit Size 12

Water Pressure Drop



Air Pressure Drop

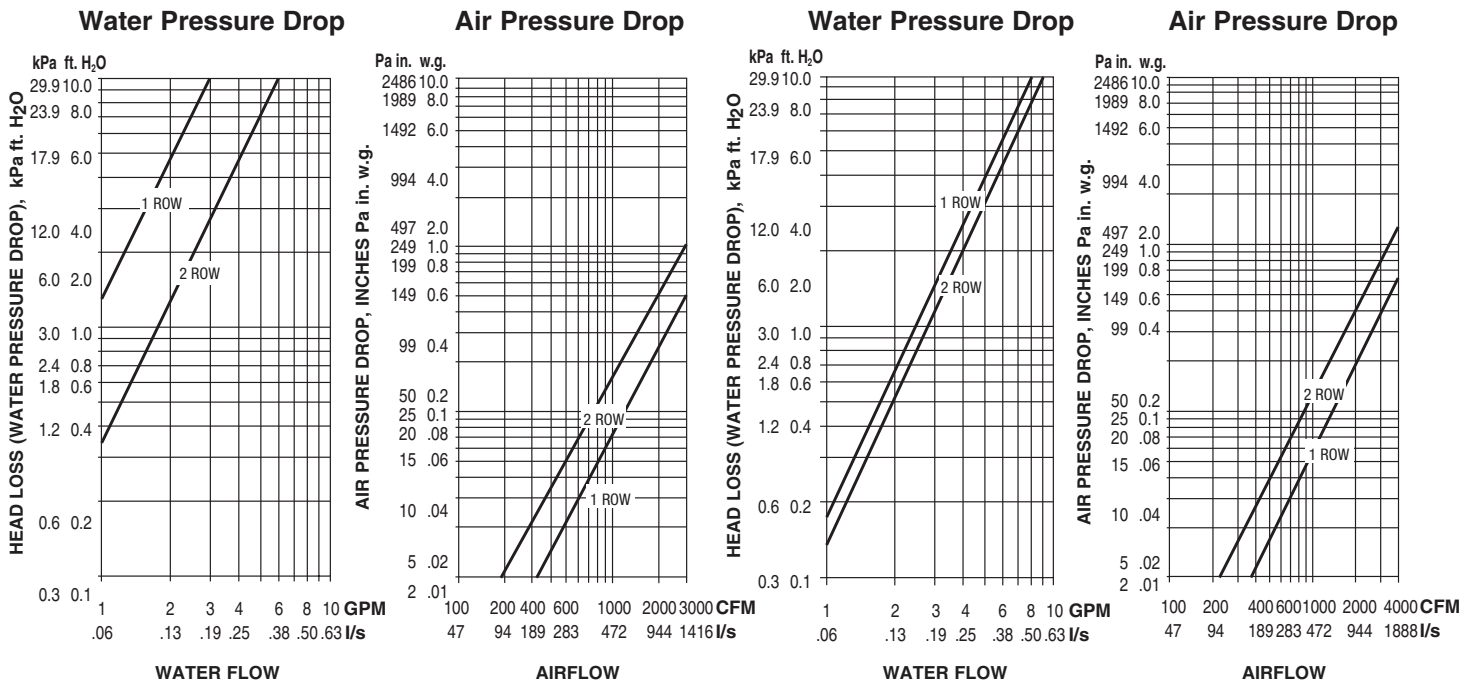


Performance Data • Hot Water Coil • Pressure Drops

Models: 34RW

Unit Size 14

Unit Size 16



Metric Conversion Factors:

- Water Flow (liters per second)
 $\text{L/s} = \text{gpm} \times 0.6309$
- Water Head Loss (kilopascals):
 $\text{kPa} = \text{ft. w.g.} \times 2.9837$
- Airflow Volume (liters per second)
 $\text{L/s} = \text{cfm} \times 0.472$
- Air Pressure Drop (Pascals):
 $\text{Pa} = \text{in. w.g.} \times 248.6$
- Heat (kiloWatts):
 $\text{kW} = \text{MBH} \times 0.293$

Electric Heating Coils Selection, Capacities and Features

Model: 34RE

Nailor manufactures its own electric heating coils. They have been specifically designed and tested for use with pressure dependent, single duct bypass units.

Nailor electric coils are factory mounted as an integral part of the terminal unit in an insulated extended plenum section, located sufficiently downstream to ensure even airflow over the coil elements. Total length of the casing including heater terminal is only 31" (787), providing a compact, easy to handle unit. Freight costs are therefore also reduced. The unique inclined opposed blade damper design provides improved and more even airflow over the coil elements compared with round butterfly damper designs, which helps to minimize air stratification, avoid nuisance tripping of the thermal cut-outs and maximize heat pick-up.

For dimensional data, see page E8.

Selection Guidelines:

The table below provides a general guideline as to the voltages and maximum kiloWatts available for each terminal unit size. Up to three stages of heat are available. A minimum of 0.5 kW/ stage is required.

For optimum diffuser performance and maximum thermal comfort, ASHRAE recommends that discharge temperatures do not exceed 15°F (8°C) above room set point, as stratification and short circuiting may occur. ASHRAE Standard 62.1 limits discharge temperatures to 90°F (32°C) or increasing the ventilation rate when heating from the ceiling. Never select kW to exceed a discharge temperatures of 115°F (46°C).

$$\Delta T \text{ (Air Temp. Rise, } ^\circ\text{F)} = \frac{\text{kW} \times 3160}{\text{cfm}}$$

The coil ranges listed are restricted to a maximum of 48 amps and do not require circuit fusing to meet NEC code requirements. Total pressure at the airflow switch should be at least 0.07" w.g. (17 Pa) to ensure correct coil operation and avoid possible nuisance tripping of the thermal cutouts due to insufficient airflow over the coil elements. Check that desired minimum airflow is within recommended operating range.

Standard Features:

- Primary auto-reset high limit thermal cut-out (one per coil in control circuit).
- Secondary manual reset high limit thermal cut-outs (one per element).
- Positive pressure airflow switch.
- Class A 80/20 nickel-chrome alloy heating elements.
- Magnetic or safety contactors and/or PE switches as required.
- Control transformer. Class II, 24 Vac for digital and analog controls.
- Line terminal block.
- Hinged door control enclosure.
- High grade rib type ceramic insulator.
- Slip and drive discharge connection.
- Class A 80/20 wire.



Electric Heater

Options:

- Quiet contactors.
- Mercury contactors.
- Toggle type disconnect switch.
- Door interlock disconnect switch.
- Power circuit fusing.
- Dust tight construction.
- SCR control.

Electric Coil Limitations

Unit Size	Heating Range* cfm	Maximum kW						
		Single Phase				Three phase		
		120V	208V	277V	377V	208V	480V	600V
6	Min - 400	5.5	7.5	7.5	7.5	7.5	7.5	7.5
8	Min - 700	5.5	9.5	13.0	13.0	13.0	13.0	13.0
10	Min - 1100	5.5	9.5	13.0	16.5	17.0	21.0	21.0
12	Min - 1600	5.5	9.5	13.0	16.5	17.0	30.0	30.0
14	Min - 2100	5.5	9.5	13.0	16.5	17.0	31.0	38.5
16	Min - 2750	5.5	9.5	13.0	16.5	17.0	31.0	38.5

* Minimum required airflow is 70 cfm per kilowatt (33 l/s/kW)
The minimum airflow requires field setting using the mechanical minimum stop on the damper actuator.



Intertek

Tested and approved
to the following
standards:

ANSI/UL
1996, 4th ed.

CSA C22.2
No. 155-M1986.

NOTES:



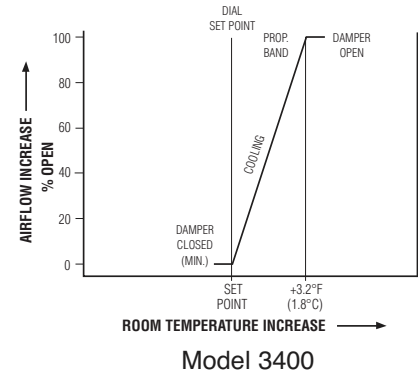
Standard Control Sequences • Bypass Terminal Units

Analog Electronic • Pressure Dependent

Control Sequence E2

Cooling Only

Central system supplies cool air. On a rise in room temperature above set point, the bypass damper will slowly modulate open, increasing the flow of air to the room, closing the bypass at the same time. On a fall in room temperature below set point, the bypass damper will modulate closed, reducing the flow of cool air into the room and opening the bypass at the same time. A mechanical air volume minimum stop is provided (field set).



Control Sequence E3

Automatic Heating/Cooling Changeover

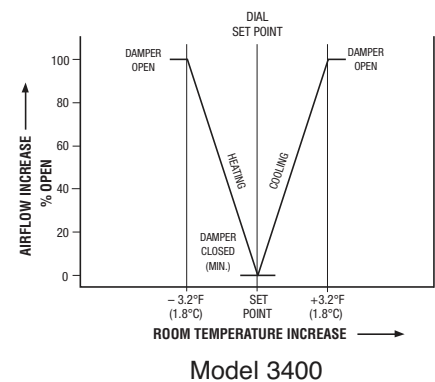
This arrangement is for systems supplying cool air in summer and hot air in winter. A duct temperature sensor senses inlet temperature and automatically reverses control action when supply air is above 78°F (26°C). A mechanical air volume minimum stop is provided (field set).

Cooling Mode:

Supply air system in cooling mode (below 75°F (24°C)). On a rise in room temperature above set point, the bypass damper will modulate open, increasing the flow of cool air to the room, closing the bypass at the same time. On a fall in room temperature below set point, the bypass damper will modulate closed, reducing the flow of cool air into the room and opening the bypass at the same time.

Heating Mode:

Supply air system in heating mode (above 78°F (26°C)). On a rise in room temperature above set point, the bypass damper will modulate closed, reducing the flow of warm air into the room to maintain set point and opening the bypass. On a fall in room temperature below set point, the bypass damper will modulate open, increasing the flow of warm air into the room to maintain the set point and closing the bypass at the same time.

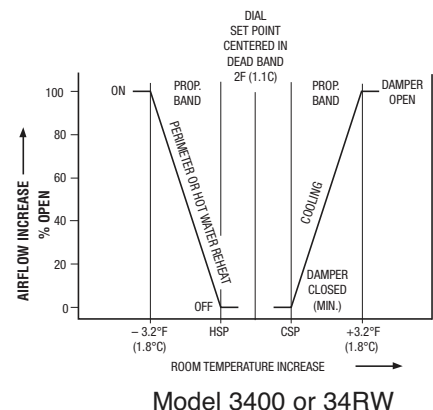


Control Sequence E4

Cooling with On/Off Auxiliary Heat (Perimeter) or Hot Water Reheat

Central system supplies cool air. On a rise in room temperature above set point, the bypass damper will slowly modulate open, increasing the flow of air to the room, closing the bypass at the same time. On a fall in room temperature below set point, the bypass damper will modulate closed, reducing the flow of cool air into the room and opening the bypass at the same time.

If room temperature continues to fall, the thermostat will energize the control relay/valve of the perimeter heating or hot water valve for reheat. A mechanical air volume minimum stop is provided (field set).



Standard Control Sequences • Bypass Terminal Units

Analog Electronic • Pressure Dependent

Control Sequence E5

Automatic Heating/Cooling Changeover with On/Off Auxiliary Heat (Perimeter) or Hot Water Reheat

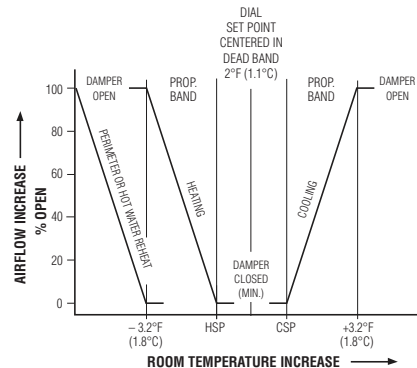
This arrangement is for systems supplying cool air in summer and hot air in winter. A duct temperature sensor senses inlet temperature and automatically reverses control action when supply air is above 78°F (26°C). A mechanical air volume minimum stop is provided (field set).

Cooling Mode:

Supply air system in cooling mode (below 75°F (24°C)). On a rise in room temperature above set point, the bypass damper will modulate open, increasing the flow of cool air to the room, closing the bypass at the same time. On a fall in room temperature below set point, the bypass damper will modulate closed, reducing the flow of cool air into the room and opening the bypass at the same time. If room temperature continues to fall, the thermostat will energize the control relay/valve of the perimeter heating or hot water reheat valve for reheat.

Heating Mode:

Supply air system in heating mode (above 78°F (26°C)). On a rise in room temperature above set point, the bypass damper will modulate closed, reducing the flow of warm air into the room to maintain set point and opening the bypass. On a fall in room temperature below set point, the bypass damper will modulate open, increasing the flow of warm air into the room to maintain the set point and closing the bypass at the same time. If room temperature continues to fall, the thermostat will energize control relay/valve of the perimeter heating or the hot water valve for supplementary heat.



Model 3400 or 34RW

Control Sequence E6

Automatic Heating/Cooling Changeover with Time Proportional Electric Auxiliary Heat (Perimeter)

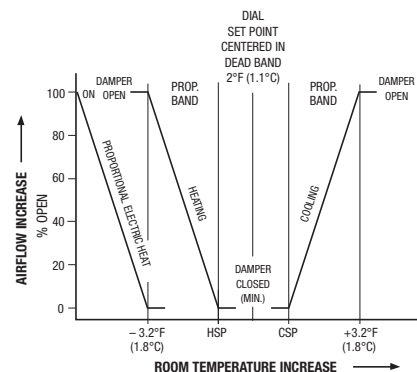
This arrangement is for systems supplying cool air in summer and hot air in winter. A duct temperature sensor senses inlet temperature and automatically reverses control action when supply air is above 78°F (26°C).

Cooling Mode:

Supply air system in cooling mode (below 75°F (24°C)). On a rise in room temperature above set point, the bypass damper will modulate open, increasing the flow of cool air to the room, closing the bypass at the same time. On a fall in room temperature below set point, the bypass damper will modulate closed, reducing the flow of cool air into the room and opening the bypass at the same time. If room temperature continues to fall, a SCR/SSR controlled electric heat coil is energized.

Heating Mode:

Supply air system in heating mode (above 78°F (26°C)). On a rise in room temperature above set point, the bypass damper will modulate closed, reducing the flow of warm air into the room to maintain set point and opening the bypass. On a fall in room temperature below set point, the bypass damper will modulate open, increasing the flow of warm air into the room to maintain the set point and closing the bypass at the same time. If room temperature continues to fall, a SCR/SSR controlled electric heating coil is energized.



Model 3400

Standard Control Sequences • Bypass Terminal Units

Analog Electronic • Pressure Dependent

Control Sequence E6

Automatic Heating/Cooling Changeover with Time Proportional Electric Reheat

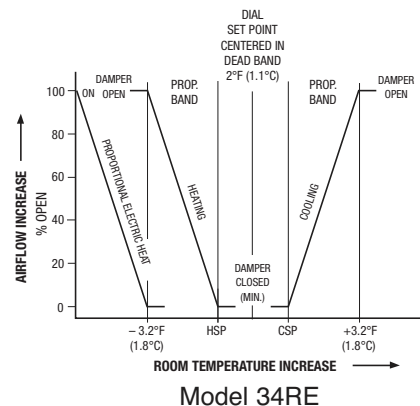
This arrangement is for systems supplying cool air in summer and hot air in winter. A duct temperature sensor senses inlet temperature and automatically reverses control action when supply air is above 78°F (26°C).

Cooling Mode:

Supply air system in cooling mode (below 75°F (24°C)). On a rise in room temperature above set point, the bypass damper will modulate open, increasing the flow of cool air to the room, closing the bypass at the same time. On a fall in room temperature below set point, the bypass damper will modulate closed, reducing the flow of cool air into the room and opening the bypass at the same time. If room temperature continues to fall, a SCR/SSR controlled electric heat coil is energized.

Heating Mode:

Supply air system in heating mode (above 78°F (26°C)). On a rise in room temperature above set point, the bypass damper will modulate closed, reducing the flow of warm air into the room to maintain set point and opening the bypass. On a fall in room temperature below set point, the bypass damper will modulate open, increasing the flow of warm air into the room to maintain the set point and closing the bypass at the same time. If room temperature continues to fall, a SCR/SSR controlled electric heating coil is energized.

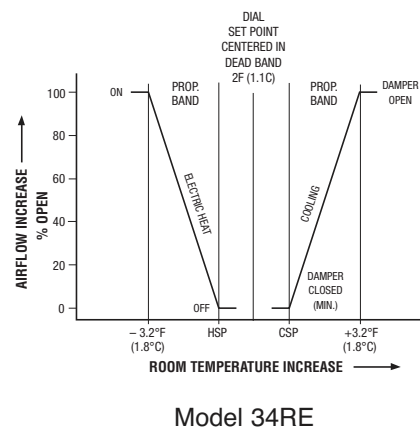


Control Sequence E7

Cooling with One Stage Electric Reheat

Central system supplies cool air. On a rise in room temperature above set point, the bypass damper will slowly modulate open, increasing the flow of air to the room, closing the bypass at the same time. On a fall in room temperature below set point, the bypass damper will modulate closed, reducing the flow of cool air into the room and opening the bypass at the same time.

If room temperature continues to fall, the thermostat will energize the control relay of the electric reheat coil.



Control Sequence E8

Automatic Heating/Cooling Changeover with One Stage Electric Reheat

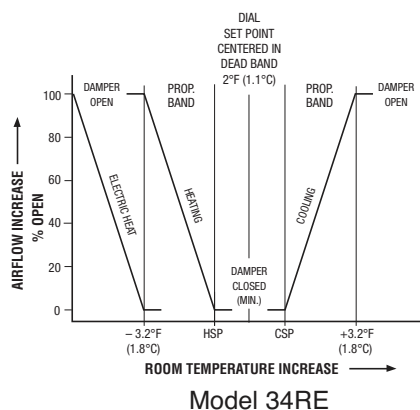
This arrangement is for systems supplying cool air in summer and hot air in winter. A duct temperature sensor senses inlet temperature and automatically reverses control action when supply air is above 78°F (26°C).

Cooling Mode:

Supply air system in cooling mode (below 75°F (24°C)). On a rise in room temperature above set point, the bypass damper will modulate open, increasing the flow of cool air to the room, closing the bypass at the same time. On a fall in room temperature below set point, the bypass damper will modulate closed, reducing the flow of cool air into the room and opening the bypass at the same time. If room temperature continues to fall, the electric heat is energized.

Heating Mode:

Supply air system in heating mode (above 78°F (26°C)). On a rise in room temperature above set point, the bypass damper will modulate closed, decreasing the flow of cool air to the room and opening the bypass at the same time. On a fall in room temperature below set point, the bypass damper will modulate open, increasing the flow of warm air into the room and closing the bypass at the same time. If room temperature continues to fall, the electric heat is energized.



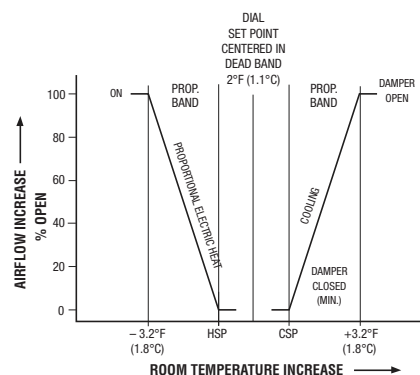
Standard Control Sequences • Bypass Terminal Units

Analog Electronic • Pressure Dependent

Control Sequence E10

Cooling with Time Proportional Electric Auxiliary Heat (Perimeter)

This arrangement is for systems supplying cool air in summer and in winter. On a rise in room temperature above set point, the bypass damper will modulate open, increasing the flow of cool air to the room, closing the bypass at the same time. On a fall in room temperature below set point, the bypass damper will modulate closed, reducing the flow of cool air into the room and opening the bypass at the same time. If room temperature continues to fall, a SCR/SSR controlled electric heat coil is energized.

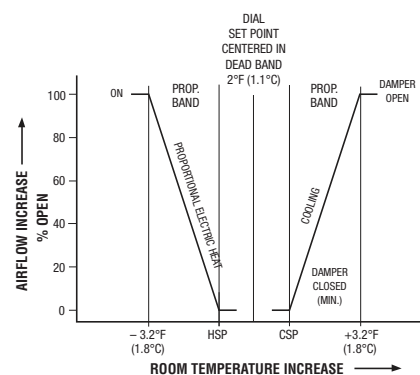


Model 3400

Control Sequence E10

Cooling with Time Proportional Electric Reheat

This arrangement is for systems supplying cool air in summer and in winter. On a rise in room temperature above set point, the bypass damper will modulate open, increasing the flow of cool air to the room, closing the bypass at the same time. On a fall in room temperature below set point, the bypass damper will modulate closed, reducing the flow of cool air into the room and opening the bypass at the same time. If room temperature continues to fall, a SCR/SSR controlled electric heat coil is energized.



Model 34RE

Pneumatic Controls (by Nailor)

A comprehensive range of factory supplied, installed and calibrated controls are available for pressure independent control applications with all terminal types. Pressure dependent controls are also available for certain terminals and applications.

Pressure Dependent pneumatic air terminal actuators are controlled directly by branch line pressure signals from the room thermostat. They do not compensate for static pressure changes immediately upstream of the terminal. Consequently, the thermostat is a damper blade positioner rather than a flow regulator.

Pressure Independent pneumatic air terminal actuators are controlled directly by a flow control device which balances velocity pressure readings from a flow sensor located at the inlet and branch air pressure from the thermostat. The controller operates within adjustable minimum and maximum flow rates.

The most commonly used thermostat is a **Direct Acting Thermostat** which causes an increase in output pressure as room temperature rises. A Reverse Acting Thermostat causes a decrease in output pressure as room temperature rises. Since the pneumatic actuator is a spring return device, the damper may be connected so that it returns either to a normally closed position (shutting off primary air) upon loss of main air, or to a normally open position upon loss of main air (allowing a central system morning warm up sequence).

The standard and recommended **Nailor 3000 Universal Controller** is a multi-function device and has a constant reset span (factory set at 5 psi) regardless of maximum and minimum flow setting for superior temperature control. The controller is suitable and may be field modified for use with either a direct or reverse acting thermostat and with either a normally open or normally closed primary air damper.

With pressure independent controls (unlike pressure dependent), the damper normal position is not related to the thermostat action.

The selection of direct or reverse acting thermostats are most commonly dictated by the desire for supplementary heat to fail "open" or "off" (using a reverse acting thermostat) or to fail "closed" or "on" (using a direct acting thermostat). A pneumatic-electric (P.E.) switch is an integral part of the 35NE control sequence. When the primary air damper approaches its minimum flow position, the P.E. switch is activated to energize the fan.

If supplementary heat is present on 35NE (or 35SE models), additional P.E. switches are sequenced to activate the stages of electric heat. For hot water heat a pneumatic hot water valve (by others) is required.

P.E. switches are wired normally closed with a direct acting thermostat, so that the fan and optional heat fail in an "on" position. With a reverse acting thermostat, the P.E. switches are wired normally open to fail in an "off" position.

Pressure Independent Operation

The heart or 'brain' of the control package is the reset controller, which processes signals from the room thermostat (temperature) and 'Diamond Flow' sensor and resets the primary air damper accordingly.

Airflow is controlled in response to the thermostat demand for heating and cooling to accurately meet the load conditions. At the same time, it holds the airflow rate dictated by the thermostat, regardless of fluctuations in upstream duct pressure. In other words, it is pressure independent. The flow control or reset function is between the minimum and maximum air volume limits. These limits are factory set to the job specification, but can be easily readjusted in the field as required.

In operation, the amplifying sensor located in the terminal inlet signals to the pneumatic reset controller which in turn energizes the pneumatic damper actuator to obtain the required airflow. There is actually a pressure signal feedback to the controller as a result of the damper movement which will correct itself for any velocity pressure fluctuations. Hunting and over controlling are minimized, resulting in stable operating conditions.

Nailor 3000 Controller

Traditionally, the industry's most popular model. Universal pneumatic reset controller (**Model CSC-3011**) compensates for changes in duct pressure-flow. Control is pressure independent with adjustable minimum and maximum air volume settings. Can be used for any combination of direct or reverse acting thermostat action with a normally open or normally closed damper fail position.



Nailor 3000 Controller

Features:

- The controller is factory calibrated to the specified airflow, and is field adjusted easily. Field adjustment is needed only when operating conditions change.
- Pressure independent.
- Reset span remains constant with both maximum and minimum cfm adjustments.
- Reset span is adjustable from 0 to 10 psi (69 kPa) to match any thermostat. Standard setting is 5 psi (35 kPa).
- Reset start point is adjustable from 0 to 10 psi (69 kPa) to work with auxiliaries such as reheat coils. Standard setting is 8 psi (55 kPa).
- Settings for either direct acting or reverse acting thermostat action. Settings for either normally-open or normally-closed damper position, without further controls.
- Accurate control over a duct velocity range of 0–3000 fpm (15 m/s).

Standard Control Sequences • Bypass Terminal Units

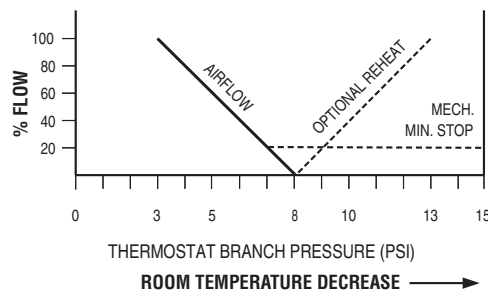
Pneumatic • Pressure Dependent

A variety of popular sequences are illustrated to suit most applications. For non-standard or other specific applications, contact your Nailor representative.

Control Sequence P1

Cooling (with Optional Reheat) • Reverse Acting/Normally Open

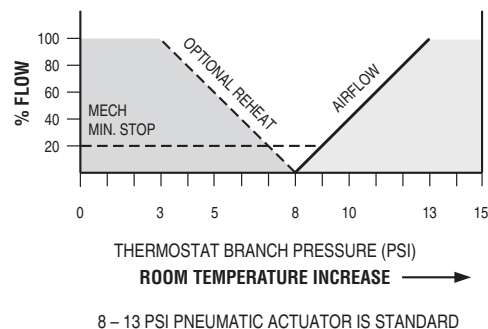
- When main control air is off, damper is fully open and the bypass is closed.
- When main control air is on, cooling airflow modulates according to thermostat output.
- On a rise in room temperature, the thermostat line pressure to the actuator decreases. The actuator moves the damper to the open position, increasing the cooling airflow to the room, closing the bypass air at the same time.
- If the room thermostat is satisfied before the damper is fully open, the damper remains in a modulated position until further demand.
- On a fall in room temperature, the thermostat line pressure increases, moving the actuator to close the damper and decreases the cooling airflow to the room. At the same time, supply air is diverted through the bypass port into the plenum.
- A mechanical minimum stop requires field setting.
- An optional hot water coil valve or electric heater may be sequenced for reheat applications (8 – 13 psi). Hot water valve is supplied by others. P.E. switch is included in electric heater.



Control Sequence Package P1A

Cooling (with Optional Reheat) • Direct Acting/Normally Closed

- When main control air is off, damper is fully closed and the bypass is open.
- When main control air is on, cooling airflow modulates according to thermostat output.
- On a rise in room temperature, the thermostat line pressure to the actuator increases. The actuator moves the damper to the open position, increasing the cooling airflow to the room, closing the bypass air at the same time.
- If the room thermostat is satisfied before the damper is fully open, the damper remains in a modulated position until further demand.
- On a fall in room temperature, the thermostat line pressure decreases, moving the actuator to close the damper and decreases the cooling airflow to the room. At the same time, supply air is diverted through the bypass port into the plenum.
- A mechanical minimum stop requires field setting.
- An optional hot water coil valve or electric heater may be sequenced for reheat applications (3 – 8 psi). Hot water valve is supplied by others. P.E. switch is included in electric heater.



Suggested Specifications

36VR Series

Model 36VRS • Basic Unit

1. Furnish and install **Nailor 36VRS Series Slide-In Retrofit Terminal Unit** of the sizes and capabilities as indicated on the drawings. Units shall be pressure independent with (DDC, analog electronic, pneumatic) controls. Units shall reset to any flow between minimum and the maximum cataloged airflow as allowed by the specific controller.

2. The entire terminal unit shall be designed and built as a single unit. The unit shall be provided with a variable air volume damper that controls the air quantity in response to a (DDC, analog electronic or pneumatic) control signal. The unit shall also include all options such as control enclosure, transformer and toggle disconnect. The space limitations shall be reviewed carefully to insure that all units will fit into the space allowed.

3. Damper assemblies of 16 ga. (1.6) galvanized steel shall be multiple opposed blade construction and arranged to close at 45 degrees from full open to minimize air turbulence and provide near linear operation. Damper blades shall be fitted with flexible seals for tight closure and minimized sound generation. Damper blades shall be screwed through ½" (13) plated solid steel shaft(s) to insure that no slippage occurs. Blade shafts shall pivot on corrosion free Celcon® bearings. In the fully closed position, air leakage past the closed damper shall not exceed 2% of the nominal catalog rating at 3" w.g. (746 Pa) inlet static pressure as rated by ASHRAE Standard 130.

4. Unit side mounting plate shall be constructed of 22 ga. (.86) galvanized steel and contain overlap flanges, top and bottom, to interface with ductwork. Control enclosures, provided standard with Nailor mounted controls, shall meet the requirements of NEMA 1 classification and be fabricated of 22 ga. (.86) galvanized steel.

5. The terminal units shall be capable of operation as described herein with a minimum inlet static pressure that shall not exceed .43" w.g. (107 Pa). (The sequence of operations should be described here, if not part of the controls specifications.) Each unit shall be complete with factory mounted (DDC, analog electronic or pneumatic) controls. Gauge tap ports shall be supplied in the piping between the flow pick up and the controller.

6. Each unit shall be constructed with single point electrical or pneumatic connection. All electrical components shall be ETL or UL listed or recognized and installed in accordance with the National Electrical Code. All electrical components shall be installed in a control enclosure. The entire assembly shall be ETL listed and so labeled.

7. All sound data shall be compiled in an independent laboratory and in accordance with the latest version of AHRI Standard 880 and ANSI/ASHRAE Standard 130. Tabulated NC levels shall be calculated and presented in accordance with latest edition of AHRI Standard 885.

8. The Slide-In Retrofit terminal unit shall be fully gasketed to provide a seal between terminal unit and ductwork.

OPTIONS

[Add the following paragraph(s):]

Control Transformer:

- Provide a 120 VAC or 208 VAC or 240 VAC or 277 VAC or 480 VAC or 600 VAC or 24/24 Isolation VAC control power transformer with an integral or separately mounted primary and/or secondary overcurrent protection device in accordance with NEC requirements.

Disconnect Switch:

- A 2-position, toggle type, disconnect switch shall be installed, labeled and rated to disconnect line voltage from the terminal unit.

3400 Series

Model 3400 • Basic Unit

General Information

Provide 3400 Series variable air volume bypass terminal units as manufactured by Nailor Industries. Performance and capacities shall be as scheduled on the drawings.

Construction

Unit casing shall be constructed of 22 ga. (0.86) zinc coated steel, acoustically and thermally lined with 3/4" (19) dual density insulation which meets the requirements of Standard NFPA 90A and UL 181. Units shall incorporate a heavy duty steel cylindrical flow diverter valve. Single blade pivoting dampers are not acceptable.

Units shall include integral inlet and bypass balancing dampers for field adjustment as standard components. Static pressure taps shall be provided to facilitate balancing.

Analog Electronic Controls

Units shall be provided with a modulating electronic control package. The 24 volt reversible actuator shall be factory mounted direct to the damper shaft and shall include an adjustable minimum air volume end stop as a standard feature.

The 24 volt modulating electronic thermostat for field mounting shall be supplied with a (°C) (°F) temperature scale. The thermostat shall be suitable for vertical wall mounting.

The thermostat shall be microprocessor based and provide proportional plus integral control of airflow and reheat when specified.

A 115 to 24 volt 20 VA transformer shall be provided, complete with all necessary hardware for field mounting.

A changeover thermistor shall be provided with control packages designed to control both heating and cooling supply air.

Pneumatic Controls

The control sequence shall be Direct acting (normally closed damper) or Reverse acting (normally open damper). All pneumatic actuators shall be furnished and factory installed by Nailor.

Water Reheat Coils

Hot water reheat units as scheduled shall include 1-row and/or 2-row coils. Coil capacities shall be as scheduled. A low-leakage access door shall be provided to allow cleaning and inspection of the coil. Coils shall be factory mounted on the discharge of the unit with slip and drive connections.

The coils shall be aluminum plate fin with copper tubes and sweat connections. Coil connections shall be right hand or left hand as detailed on drawings. Control valves, automatic air vents and drain vents, if required, shall be supplied and field installed by others.

Electric Reheat Coils

Electric reheat coils shall be ETL listed. They shall be factory mounted on the unit discharge in an extended attenuation section. Heating capacities and control components shall be as scheduled on the drawings.