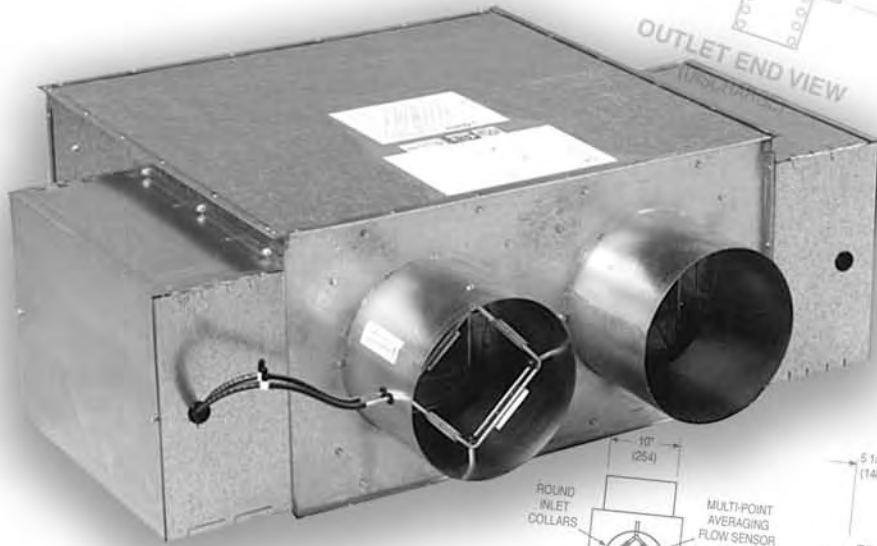


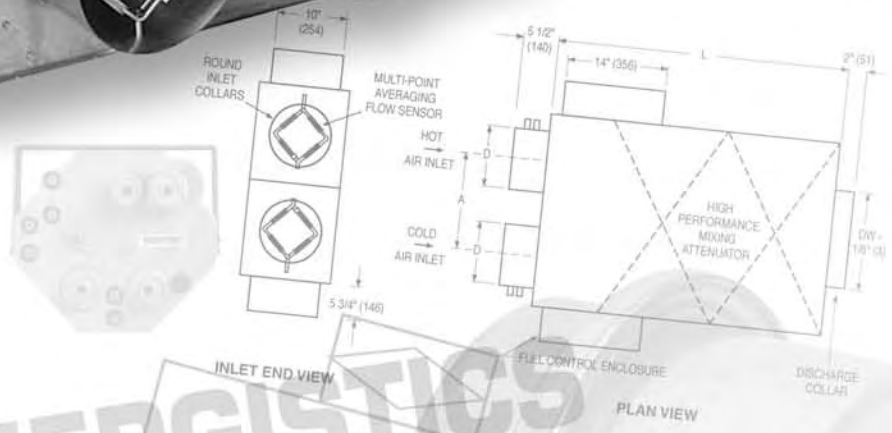
DUAL DUCT TERMINALS



PLAN VIEW

SLIP AND DRIVE CLEAT CONNECTION

OUTLET END VIEW



ENERGISTICS
LABORATORY

Nailor
Industries Inc.

Contents

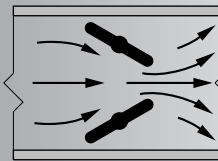
	Page No.
Models 3210 and 3230	
Description and Features	C3
3210 • Dimensional Data, Performance Data	C4
3230 • Dimensional Data	C5
• NC Level Application Guide	C6
• Performance Data Explanation	C7
• Discharge Sound Power Levels	C8
• Radiated Sound Power Levels	C9
Model 3240 "BlendMaster™"	
Description and Features	C10
• Dimensional Data	C11
• NC Level Application Guide	C12
• Discharge Sound Power Levels	C13
• Radiated Sound Power Levels	C14
Recommended Airflow Ranges	C15
Flow Sensor Locations	C16
Control Strategies	C17
Standard Control Sequences	C18
Optional Liners for 'IAQ' Sensitive Applications	C20
Suggested Specifications	C21

DUAL DUCT VARIABLE OR CONSTANT AIR VOLUME

3200 SERIES
• 1 : 12 MIXING

Models:

- 3210 Without Attenuator**
- 3230 With Compact Mixing Attenuator**



Opposed blade valve configuration minimizes noisy turbulence and provides smooth, accurate, near linear flow control.



Model 3230

**Steri-Liner
Performance
Tested**

DUAL DUCT TERMINAL UNITS

Dual Duct terminal units utilize pressure independent controls for accurate temperature and volume control. Nailor dual duct terminals are designed to precisely regulate and vary the volume of both the hot and cold deck of a dual duct system in response to thermostat demand. Many control sequences are possible with today's sophisticated controls. Each deck can be set to reset between a minimum and maximum air volume limit with numerous possibilities for hot and cold air mixing and proportioning.

Nailor has **three types** of dual duct terminal units. When no mixing is required, Model 3210 may be used. Essentially, two single duct terminal units working in tandem. When blending of hot and cold air is required, the Model 3230 comes with an integral compact mixing attenuator section which provides some attenuation of discharge noise and through the use of internal baffles, mixing of the hot and cold airstreams. The compact design of the 3230 lends itself to applications where there are tight space limitations, while still meeting or exceeding industry standard sound and mixing requirements. Minimum mixing efficiency is 1 in 12. That means there is less than a 1°F (0.55°C) temperature variation at the discharge for each 12°F (6.66°C) temperature difference between the hot and cold decks.

For the most demanding applications see model 3240 "Blendmaster™".

STANDARD 3230 FEATURES:

- 1 in 12 minimum mixing efficiency.
- 22 ga. (0.86) zinc coated steel casing, mechanically sealed, low leakage construction.
- Special extra-low leakage opposed blade damper design with blade and jamb seals. Damper leakage is less than 1% of nominal flow at 6" w.g. (1.5 kPa) per ASHRAE Standard 130. 90° rotation. 1/2" (13) dia. plated steel driveshaft. An indicator mark at the end of the driveshaft shows damper position.
- Low leakage casing. Less than 1% of rated airflow at 6" w.g. (1.5 kPa).
- Designed for pneumatic, analog electronic or digital pressure

independent control.

- Multi-point averaging 'Diamond Flow' sensors standard for all applications; ensure accurate flow control.
- Gauge taps provided for field calibration and balancing.
- Downstream total flow sensing available for maximum control accuracy.
- Available in ten unit sizes to handle from 215 – 4050 cfm (101 – 1912 l/s).
- Unequal inlet sizes are an available option.
- Independently tested and certified to ARI 880 using Steri-Liner insulation, the preferred choice

for the majority of dual duct applications.

Options:

- 3/4" (19) dual density fiberglass insulation. Exposed edges are coated to prevent erosion. Meets the requirements of NFPA 90A and UL 181.
- Model 3230 is available with a bottom access door.
- Other 'IAQ' insulations are available.



ARI Standard 880
A Participating Corporation
in the ARI 880
Certification program.



Dimensions

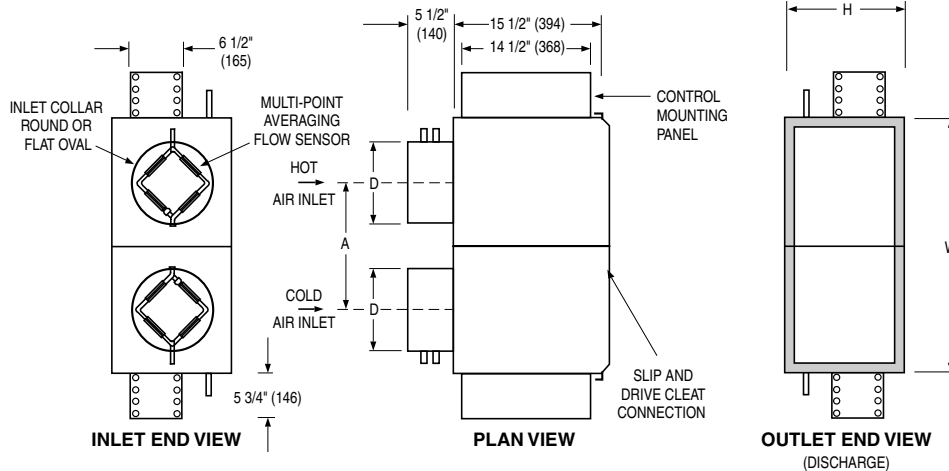
Model 3210 • Without Attenuator • Non-Mixing Applications

- Variable volume cold and variable volume hot deck control. Zero minimum. No mixing.
- Multi-point flow sensors in each inlet provide accurate flow control.
- Opposed blade dampers control each deck independently. 45° rotation. Right hand CW to close. Left hand CCW to close.

- Rectangular discharge with slip and drive connection.
- Choice of right or left hand cold deck location. Hand of unit is determined by location of cold deck looking in direction of airflow. Right hand unit illustrated.
- For performance data, use single duct Model Series 3000 data on pages B7 – B12.

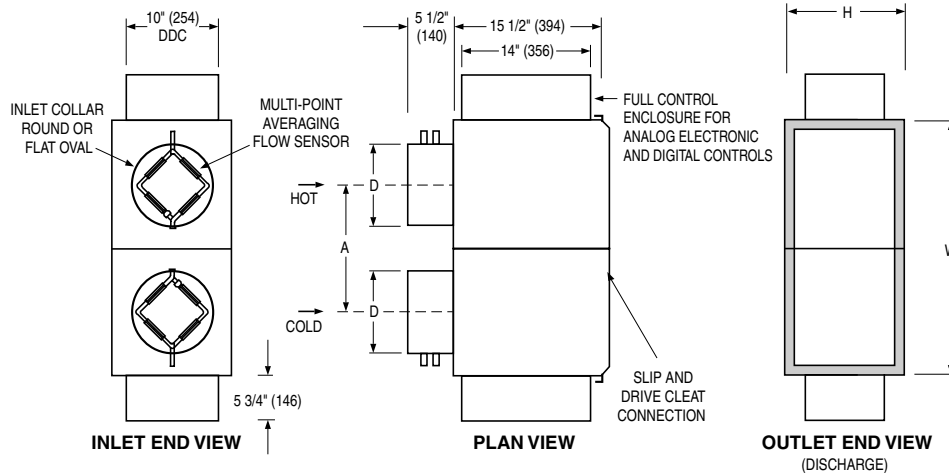
Pneumatic Controls

- Universal pneumatic control mounting panel features double wall stand-off construction for strength and rigidity. Controls mounting screws do not penetrate casing.



Analog Electronic and Digital Controls

- A full NEMA 1 controls enclosure is provided for factory mounted controls. Optional for field mounted controls.



Dimensional Data

Imperial Units (inches)					
Unit Size	cfm Range	W	H	A	Inlet Size
4	0 – 215	21	10	11	3 7/8 Round
5	0 – 310	21	10	11	4 7/8 Round
6	0 – 500	21	10	11	5 7/8 Round
7	0 – 710	25	12 1/2	13	6 7/8 Round
8	0 – 1000	25	12 1/2	13	7 7/8 Round
9	0 – 1300	29	12 1/2	15	8 7/8 Round
10	0 – 1435	29	12 1/2	15	9 7/8 Round
12	0 – 2185	37	12 1/2	19	12 1/16 x 9 1/16 Oval
14	0 – 2745	49	12 1/2	25	16 1/16 x 9 1/16 Oval
16	0 – 3730	57	12 1/2	29	19 3/16 x 9 1/16 Oval

Metric Units (mm)					
Unit Size	l/s Range	W	H	A	Inlet Size
4	0 – 101	533	254	279	98 Round
5	0 – 146	533	254	279	124 Round
6	0 – 236	533	254	279	149 Round
7	0 – 335	635	318	330	175 Round
8	0 – 472	635	318	330	200 Round
9	0 – 614	737	318	381	225 Round
10	0 – 677	737	318	381	251 Round
12	0 – 1031	940	318	483	329 x 249 Oval
14	0 – 1296	1245	318	635	408 x 249 Oval
16	0 – 1761	1448	318	737	487 x 249 Oval

Dimensions

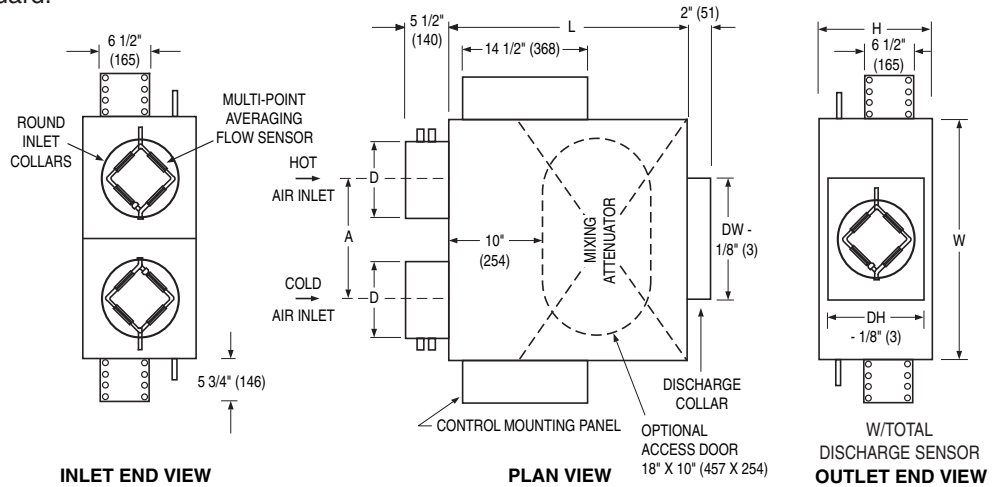
Model 3230 • Compact Mixing Attenuator • Mixing Application

- Variable volume or constant volume operation.
- Rectangular discharge collar optimally sized for duct run out.
- Integral mixing attenuator construction reduces insulation seams and reduces casing leakage.
- Multi-point 'Diamond Flow' Sensor available in three location configurations to suit exact control sequence requirement.
- Solid mixing baffles standard.

- Unique low leakage opposed blade dampers control each deck independently. 90° rotation. Right hand CW to close. Left hand CCW to close.
- When unequal sized inlets are used, the casing will be governed by the larger inlet size.
- Choice of right or left hand cold deck location. Hand of unit is determined by location of cold deck looking in direction of airflow. Right hand unit illustrated.

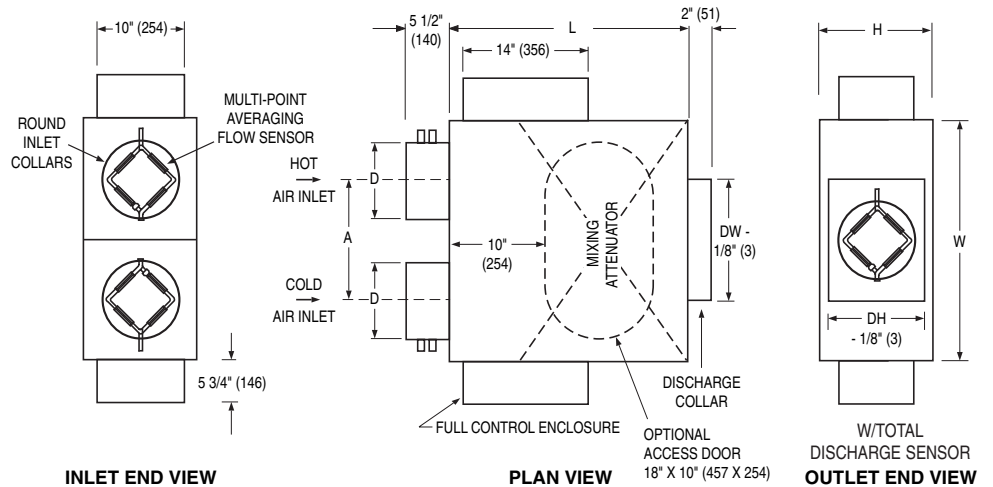
Pneumatic Controls

- Universal pneumatic control mounting panel features double wall stand-off construction for strength and rigidity. Controls mounting screws do not penetrate casing.



Analog Electronic and Digital Controls

- A full NEMA 1 controls enclosure is provided for factory mounted controls. Optional for field mounted controls.



Dimensional Data

Imperial Units (inches)							
Unit Size	Inlet Dia. D	cfm Range	W	H	L	A	Outlet DW x DH
4	3 7/8	0 - 215	24	10	24	11	8 x 8
5	4 7/8	0 - 310					
6	5 7/8	0 - 500					
7	6 7/8	0 - 710	24	12 1/2	24	11	10 x 10
8	7 7/8	0 - 1000					
9	8 7/8	0 - 1300	34	14	34	16 7/8	14 x 12
10	9 7/8	0 - 1435					
12	11 7/8	0 - 2150					
14	13 7/8	0 - 3060	42	18	38	20 7/8	22 x 16
16	15 7/8	0 - 4050					

Metric Units (mm)							
Unit Size	Inlet Dia. D	l/s Range	W	H	L	A	Outlet DW x DH
4	98	0 - 101	610	254	610	279	203 x 203
5	124	0 - 146					
6	149	0 - 236					
7	175	0 - 335	610	318	610	279	254 x 254
8	200	0 - 472					
9	225	0 - 614	864	356	864	410	356 x 305
10	251	0 - 677					
12	302	0 - 1015					
14	353	0 - 1444	1067	457	965	511	559 x 406
16	403	0 - 1912					



DUAL DUCT TERMINAL UNITS

Performance Data • NC Level Application Guide Model 3230 • With Mixing Attenuator and Steri-Liner Insulation

Inlet Size	Airflow cfm l/s		Min. inlet ΔPs " w.g. Pa	NC Levels @ Inlet pressure (ΔPs) shown												
				DISCHARGE						RADIATED						
				Min. ΔPs	0.5" w.g. (125 Pa)	1.0" w.g. (250 Pa)	1.5" w.g. (375 Pa)	2.0" w.g. (500 Pa)	3.0" w.g. (750 Pa)	Min. ΔPs	0.5" w.g. (125 Pa)	1.0" w.g. (250 Pa)	1.5" w.g. (375 Pa)	2.0" w.g. (500 Pa)	3.0" w.g. (750 Pa)	
4	200	94	0.11	28	-	-	-	-	20	22	-	-	-	-	-	22
	150	71	0.06	16	-	-	-	-	-	-	28	-	-	-	-	-
	100	47	0.03	7	-	-	-	-	-	-	-	-	-	-	-	20
	75	35	0.02	4	-	-	-	-	-	-	-	-	-	-	-	-
	50	24	0.01	2	-	-	-	-	-	-	-	-	-	-	-	-
5	300	142	0.22	54	-	-	-	24	27	27	-	-	20	25	25	29
	250	118	0.15	37	-	-	-	-	22	23	-	-	-	-	20	23
	200	94	0.10	24	-	-	-	-	-	20	-	-	-	-	-	22
	125	59	0.04	9	-	-	-	-	-	-	-	-	-	-	-	23
	75	35	0.01	3	-	-	-	-	-	-	-	-	-	-	-	-
6	500	236	0.49	122	-	-	23	28	31	35	20	23	25	30	33	35
	400	189	0.31	77	-	-	20	25	28	28	-	-	23	27	27	30
	300	142	0.17	42	-	-	-	-	22	23	-	-	-	20	23	25
	200	94	0.07	17	-	-	-	-	-	-	-	-	-	-	20	25
	100	47	0.02	5	-	-	-	-	-	-	-	-	-	-	-	-
7	650	307	0.48	119	-	20	32	38	40	44	20	23	33	39	43	49
	550	260	0.33	83	-	-	28	34	37	40	-	-	29	35	40	45
	335	158	0.11	28	-	-	23	29	29	32	-	-	32	34	38	40
	225	106	0.05	12	-	-	-	-	-	-	-	-	24	25	28	30
	110	52	0.01	2	-	-	-	-	-	-	-	-	20	22	24	27
8	850	401	0.71	177	22	*	29	37	39	45	25	*	33	38	42	50
	700	330	0.47	117	-	-	32	36	38	43	-	22	32	38	42	49
	500	236	0.23	57	-	-	25	28	29	33	-	20	30	36	40	44
	350	146	0.11	27	-	-	22	28	29	30	-	-	31	34	36	39
	200	94	0.03	8	-	-	-	-	-	-	-	-	23	25	27	30
9	1050	495	0.31	76	-	-	28	35	39	43	-	23	34	39	42	48
	900	425	0.22	54	-	-	27	34	38	42	-	22	33	38	40	47
	675	319	0.11	28	-	-	23	28	28	28	-	-	27	30	34	32
	450	212	0.04	11	-	-	-	22	20	-	-	-	20	23	28	25
	225	106	0.01	2	-	-	-	-	-	-	-	-	-	-	-	-
10	1350	637	0.48	119	-	20	29	35	38	45	24	25	34	38	43	48
	1100	519	0.31	77	-	-	28	35	37	40	-	22	33	37	40	47
	800	378	0.16	40	-	-	25	30	30	33	-	-	30	35	35	36
	550	260	0.07	17	-	-	-	25	23	20	-	-	22	25	30	26
	250	118	0.01	3	-	-	-	-	-	-	-	-	-	-	-	-
12	1950	920	0.75	187	27	*	32	36	40	46	29	*	33	36	40	47
	1600	755	0.49	122	-	21	30	36	39	44	21	22	30	36	40	45
	1200	566	0.26	65	-	-	28	34	36	40	-	-	29	35	38	42
	800	376	0.11	27	-	-	21	28	30	34	-	-	26	30	32	35
	400	189	0.03	8	-	-	-	-	20	22	-	-	-	-	22	25
14	2700	1274	0.63	157	25	*	30	34	36	40	26	*	30	34	36	40
	2100	991	0.37	92	-	-	26	32	35	37	-	20	25	31	35	38
	1600	755	0.21	52	-	-	23	28	30	35	-	-	24	30	30	35
	1050	496	0.08	20	-	-	-	20	25	30	-	-	-	24	25	30
	550	260	0.02	5	-	-	-	-	-	-	-	-	-	-	-	-
16	3425	1616	1.05	261	33	*	*	36	39	37	33	*	*	35	38	42
	2750	1298	0.66	164	20	*	28	33	35	37	25	*	27	34	35	40
	2050	967	0.37	92	-	-	21	25	27	30	-	-	25	30	32	36
	1375	649	0.16	40	-	-	-	-	22	25	-	-	20	26	28	29
	700	330	0.04	10	-	-	-	-	-	-	-	-	-	-	-	20

Performance Notes:

1. NC levels are calculated based on procedures as documented on page C7.
2. Dash (-) in space indicates NC level less than 20.
3. Asterisk (*) in space indicates that the minimum inlet static pressure requirement is greater than 0.5" w.g. (125 Pa) or 1.0" w.g. (250 Pa) at rated airflow.

Performance Data Explanation

Sound Power Levels vs. NC Levels

The **Nailor 3200 Series** dual duct 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 130-1996 and ARI Standard 880-98. This data is "raw" with no attenuation deductions and includes ARI Certification standard rating points.

Nailor also provides an "NC Level" table as an application aid in terminal selection, which include attenuation allowances as explained below. The suggested attenuation allowances are typical and are 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 ARI 885-98 for accurate space sound levels.

Explanation of NC Levels

Tabulated NC levels are based on attenuation values as outlined in ARI Standard 885-98 "Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets." ARI Standard 885-98, Appendix E provides typical sound attenuation values for air terminal discharge sound and air terminal radiated sound.

As stated in ARI-885-98, Appendix E, "These values can be used as a quick method of estimating space sound levels when a detailed evaluation is not available. The typical attenuation values are recommended for use by manufacturers to estimate application sound levels. In product catalogs, the end use 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."

Please refer to the Performance Data Caveat on page A17 of this catalog.

Radiated Sound

Table E1 of Appendix E provides typical 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 ARI Standard 885-98.

	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 (313 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 ARI Standard 885-98.

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. (200) Flex Duct	6	10	18	20	21	12
End Reflection	9	5	2	0	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. (200) Flex Duct	6	10	18	20	21	12
End Reflection	9	5	2	0	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. (200) Flex Duct	6	10	18	20	21	12
End Reflection	9	5	2	0	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 ARI Standard 885-98.

DUAL DUCT VARIABLE OR CONSTANT AIR VOLUME

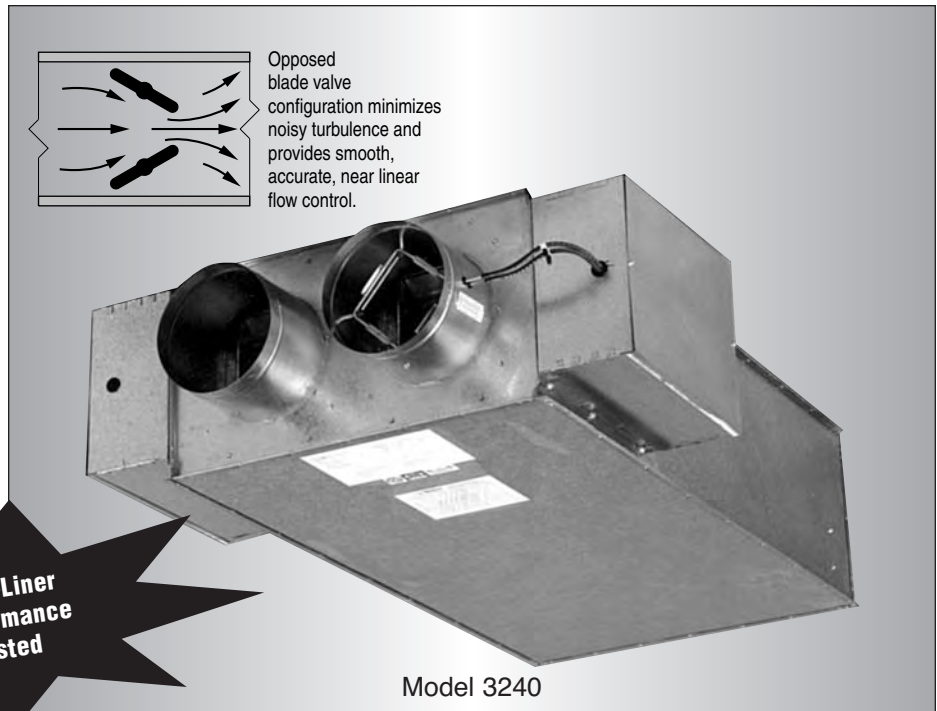
"BLENDMASTER™"

- 1 : 30 MIXING
- INDUSTRY LEADING PERFORMANCE

Model:

3240 With High Efficiency Mixing Attenuator

**Steri-Liner
Performance
Tested**



Model 3240

The model 3240 "BlendMaster™" is a newly designed dual duct terminal unit offering superior performance for the most demanding applications. Maintaining high ventilation rates, humidity control and achieving high comfort levels in the pursuit of improved indoor air quality have regenerated interest in the benefits of a dual duct system design. Applications include hospitals, research laboratories, schools and other institutional facilities where both overhead heating and cooling are required and a dual duct design has been deemed the preferred system.

Equipped with specially designed low leakage opposed blade dampers, the "BlendMaster™" provides accurate airflow control of the hot and cold decks with tight shut-off. An extended integral mixer attenuator section provides superior blending of the hot and cold airflow during mixing at reduced minimum operating pressures compared to other manufacturers designs thus ensuring uniform flow and temperature equalization downstream. Minimum mixing efficiency is an unprecedented 1:30; less than 1°F (0.55°C) temperature variation at the discharge for each 30°F (16.67°C) temperature difference between the hot and cold decks.

Dual duct terminals, being inherently suited to high indoor air quality applications, are frequently specified with an 'IAQ' insulation option. For this reason, the sound data presented for this terminal unit is the first to result from extensive independent testing with the Steri-Liner option, rather than standard fiberglass insulation, thus permitting a more accurate selection than is possible with other manufacturers equipment.

STANDARD 3240 FEATURES:

- 1 in 30 minimum mixing efficiency, from independent testing in accordance with ASHRAE Std 130.
- 22 ga. (0.86) zinc coated steel casing, mechanically sealed, low leakage construction.
- Special extra-low leakage opposed blade damper design with blade and jamb seals. Damper leakage is less than 1% of nominal flow at 6" w.g. (1.5 kPa) per ASHRAE Standard 130. 90° rotation. ½" (13) dia. plated steel driveshaft. An indicator mark at the end of the driveshaft shows damper position.
- Low leakage casing. Less than 1% of rated airflow at 6" w.g. (1.5 kPa).

- Designed for pneumatic, analog electronic or digital pressure independent control.
- Multi-point averaging 'Diamond Flow' sensors standard for all applications; ensure accurate flow control.
- Gauge taps provided for field calibration and balancing.
- Downstream total flow sensing available for maximum control accuracy.
- Available in nine unit sizes to handle from 215 – 3060 cfm (101 – 1444 l/s).
- Unequal inlet sizes are an available option.
- Independently tested and certified

to ARI 880 using Steri-Liner insulation, the preferred choice for the majority of dual duct applications.

Options:

- ¾" (19) dual density fiberglass insulation is available. Exposed edges are coated to prevent erosion. Meets the requirements of NFPA 90A and UL 181.
- Available with a bottom access door.
- Other 'IAQ' insulations are available.



ARI Standard 880

A Participating Corporation in the ARI 880 Certification program.



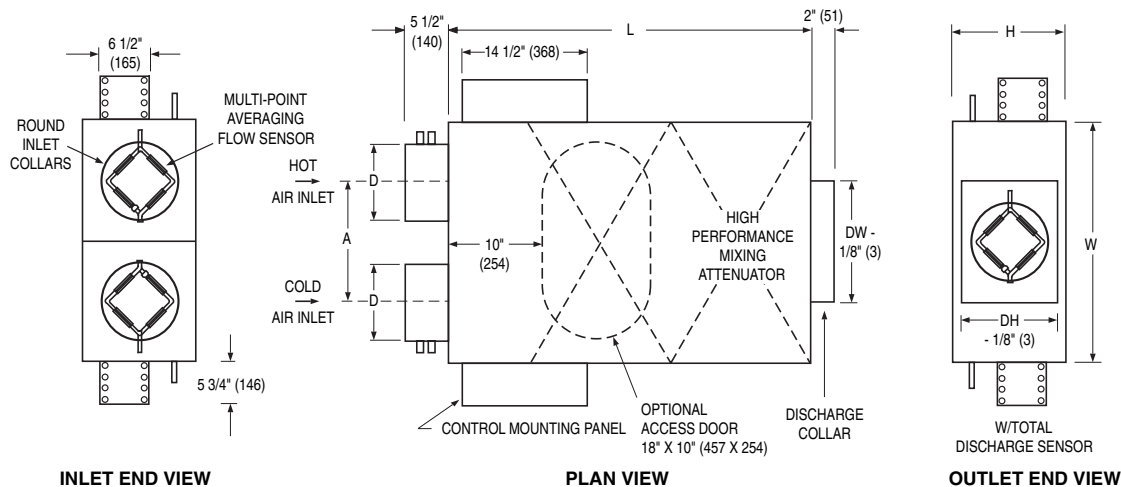
Model 3240 "BlendMaster™" • Dimensions • Mixing Applications

- Variable volume or constant volume operation.
- Rectangular discharge collar optimally sized for duct run out.
- Integral mixing attenuator construction reduces insulation seams and reduces casing leakage.
- Multi-point 'Diamond Flow' Sensor available in three location configurations to suit exact control sequence requirement.
- Double set of solid mixing baffles are standard.

- Unique low leakage opposed blade dampers control each deck independently. 90° rotation. Right hand CW to close. Left hand CCW to close.
- When unequal sized inlets are used, the casing will be governed by the larger inlet size.
- Choice of right or left hand cold deck location. Hand of unit is determined by location of cold deck looking in direction of airflow. Right hand unit illustrated.

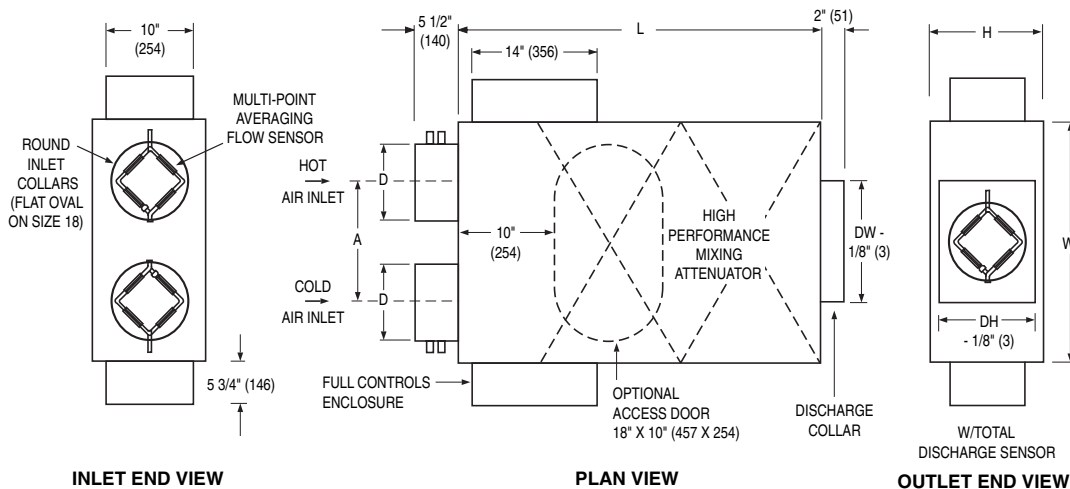
Pneumatic Controls

• Universal pneumatic control mounting panel features double wall stand-off construction for strength and rigidity. Controls mounting screws do not penetrate casing.



Analog Electronic and Digital Controls

• A full NEMA 1 controls enclosure is provided for factory mounted controls. Optional for field mounted controls.



Dimensional Data

Imperial Units (inches)							
Unit Size	Inlet Dia. D	cfm Range	W	H	L	A	Outlet DW x DH
4	3 7/8	0 - 215	24	10	47	11	8 x 8
5	4 7/8	0 - 310					
6	5 7/8	0 - 500					
7	6 7/8	0 - 710	24	12 1/2	47	11	10 x 10
8	7 7/8	0 - 1000					
9	8 7/8	0 - 1300	34	14	60	16 7/8	14 x 12
10	9 7/8	0 - 1435					
12	11 7/8	0 - 2150					
14	13 7/8	0 - 3060	42	18	72	20 7/8	22 x 16

Metric Units (mm)							
Unit Size	Inlet Dia. D	l/s Range	W	H	L	A	Outlet DW x DH
4	98	0 - 101	610	254	1194	279	203 x 203
5	124	0 - 146					
6	149	0 - 236					
7	175	0 - 335	610	318	1194	279	254 x 254
8	200	0 - 472					
9	225	0 - 614	864	356	1524	410	356 x 305
10	251	0 - 677					
12	302	0 - 1015					
14	353	0 - 1444	1067	457	1829	511	559 x 406



DUAL DUCT TERMINAL UNITS

Performance Data • NC Level Application Guide Model 3240 "BlendMaster™" • With Mixing Attenuator and Steri-Liner Insulation

DUAL DUCT TERMINAL UNITS

Inlet Size	Airflow		Min. inlet ΔPs " w.g. Pa	NC Levels @ Inlet pressure (ΔPs) shown												
				DISCHARGE						RADIATED						
				Min. ΔPs	0.5" w.g. (125 Pa)	1.0" w.g. (250 Pa)	1.5" w.g. (375 Pa)	2.0" w.g. (500 Pa)	3.0" w.g. (750 Pa)	Min. ΔPs	0.5" w.g. (125 Pa)	1.0" w.g. (250 Pa)	1.5" w.g. (375 Pa)	2.0" w.g. (500 Pa)	3.0" w.g. (750 Pa)	
4	200	94	0.08	21	-	-	-	-	-	-	-	-	-	-	-	
	150	71	0.05	13	-	-	-	-	-	-	-	-	-	-	-	
	100	47	0.03	6	-	-	-	-	-	-	-	-	-	-	-	
	75	35	0.02	4	-	-	-	-	-	-	-	-	-	-	-	
	50	24	0.01	2	-	-	-	-	-	-	-	-	-	-	-	
5	300	142	0.15	36	-	-	-	-	-	-	-	-	-	23	27	
	250	118	0.11	26	-	-	-	-	-	-	-	-	-	-	20	
	100	94	0.07	18	-	-	-	-	-	-	-	-	-	-	-	
	125	59	0.03	8	-	-	-	-	-	-	-	-	-	-	-	
	75	35	0.01	3	-	-	-	-	-	-	-	-	-	-	-	
6	500	236	0.32	80	-	-	-	-	-	23	-	-	22	25	26	30
	400	189	0.22	55	-	-	-	-	-	20	-	-	-	21	25	28
	300	142	0.13	32	-	-	-	-	-	-	-	-	-	-	20	22
	200	94	0.06	15	-	-	-	-	-	-	-	-	-	-	-	20
	100	47	0.02	5	-	-	-	-	-	-	-	-	-	-	-	-
7	650	307	0.57	141	-	-	-	27	30	35	-	-	27	33	38	42
	550	260	0.43	106	-	-	-	23	27	32	-	-	23	29	34	39
	335	158	0.18	45	-	-	-	-	-	-	-	-	24	25	20	23
	225	106	0.09	23	-	-	-	-	-	-	-	-	-	-	-	-
	110	52	0.03	7	-	-	-	-	-	-	-	-	-	-	-	-
8	850	401	0.72	179	-	*	-	24	26	35	20	-	26	33	36	41
	700	330	0.50	124	-	-	-	25	29	35	-	*	25	33	36	40
	500	236	0.29	72	-	-	-	24	25	23	-	-	25	32	35	35
	350	146	0.15	37	-	-	-	-	-	-	-	-	23	25	20	22
	200	94	0.06	15	-	-	-	-	-	-	-	-	-	-	-	-
9	1050	495	0.29	72	-	-	-	25	29	35	-	-	27	34	38	42
	900	425	0.22	55	-	-	-	24	28	34	-	-	25	33	37	40
	675	319	0.13	33	-	-	-	-	-	-	-	-	22	25	28	28
	450	212	0.06	16	-	-	-	-	-	-	-	-	-	-	22	22
	225	106	0.02	5	-	-	-	-	-	-	-	-	-	-	-	-
10	1350	637	0.40	99	-	-	-	25	29	35	22	22	27	33	38	43
	1100	519	0.28	70	-	-	-	25	29	35	-	-	25	33	36	40
	800	378	0.16	40	-	-	-	22	23	20	-	-	25	29	30	30
	550	260	0.08	20	-	-	-	-	-	-	-	-	-	21	24	25
	250	118	0.02	5	-	-	-	-	-	-	-	-	-	-	-	-
12	1950	920	0.74	184	27	*	26	32	35	42	30	*	32	36	41	48
	1600	755	0.50	124	-	-	25	31	35	40	21	21	30	37	41	46
	1200	566	0.28	70	-	-	23	30	32	34	-	-	30	35	37	37
	800	376	0.13	32	-	-	-	21	21	20	-	-	23	25	25	30
	400	189	0.03	8	-	-	-	-	-	-	-	-	-	-	-	20
14	2700	1274	0.78	194	25	*	26	29	30	35	30	*	32	37	40	48
	2100	991	0.45	112	-	-	20	24	27	31	21	21	31	37	40	46
	1600	755	0.26	65	-	20	-	20	25	30	-	-	30	35	37	37
	1050	496	0.11	27	-	-	-	-	20	23	-	-	23	25	25	31
	550	260	0.03	8	-	-	-	-	-	-	-	-	-	-	-	20

Performance Notes:

1. NC levels are calculated based on procedures as documented on page C7.
2. Dash (-) in space indicates NC level less than 20.
3. Asterisk (*) in space indicates that the minimum inlet static pressure requirement is greater than 0.5" w.g. (125 Pa) at rated airflow.

Recommended Airflow Ranges For Model 3230 and 3240. Dual Duct VAV Terminal Units (Model 3210, see page B7).

The recommended airflow ranges below are for dual duct terminal units with pressure independent controls and are based upon controller sensitivity limits as shown for each control type. For a given unit size, the minimum and the maximum flow settings for the hot and cold decks respectively must be within the range limits to ensure pressure independent operation, accuracy and repeatability. The high end of the tabulated Total Airflow Range represents the Diamond Flow Sensor's differential pressure reading at 1" w.g. (250 Pa). This is a common high limit for many VAV controllers, whether pneumatic or analog/DDC transducers. For these reasons, factory settings will not be made outside these ranges. A minimum setting of zero (shut-off) is also available.

Pneumatic control sequences utilize the 3000 Controller for its superior control characteristics. The constant reset span feature of this controller ensures that both the hot and cold decks track each other and respond over the same thermostat signal range regardless of the individual



minimum and maximum settings which may be different. Control accuracy is therefore ensured.

ARI Standard 880 "Air Terminal Units" is the method of test for the certification program. The "standard rating condition" (certification rating point) airflow volumes for each terminal unit size are tabulated below. These air volumes equate to an approximate inlet velocity of 2000 fpm (10.2 m/s).

When digital or other controls are mounted by **Nailor**, but supplied by others, these values are guidelines only, based upon experience with the majority of controls currently available. Controls supplied by others for factory mounting are configured and calibrated in the field.

Imperial Units, Cubic Feet per Minute

Unit Size	Total Airflow Range cfm	Airflow at 2000 fpm Inlet Velocity (nom.) cfm	Range of Minimum and Maximum Settings, cfm		
			Pneumatic 3000 Controller	Analog Electronic Controls	Digital Controls
			Min. – Max.	Min. – Max.	Min. – Max.
4	0 – 215	150	30 – 215	25 – 215	25 – 215
5	0 – 310	250	55 – 310	45 – 310	45 – 310
6	0 – 500	400	85 – 500	70 – 500	70 – 500
7	0 – 710	550	125 – 710	100 – 710	100 – 710
8	0 – 1000	700	180 – 1000	150 – 1000	150 – 1000
9	0 – 1300	900	210 – 1300	170 – 1300	170 – 1300
10	0 – 1435	1100	250 – 1435	205 – 1435	205 – 1435
12	0 – 2150	1600	395 – 2150	325 – 2150	325 – 2150
14	0 – 3060	2100	495 – 3060	400 – 3060	400 – 3060
16	0 – 4050	2800	760 – 4050	625 – 4050	625 – 4050

Metric Units, Liters per Second

Unit Size	Total Airflow Range l/s	Airflow at 10.2 m/s Inlet Velocity (nom.) l/s	Range of Minimum and Maximum Settings, l/s		
			Pneumatic 3000 Controller	Analog Electronic Controls	Digital Controls
			Min. – Max.	Min. – Max.	Min. – Max.
4	0 – 101	71	14 – 101	12 – 101	12 – 101
5	0 – 146	118	26 – 146	21 – 146	21 – 146
6	0 – 236	189	40 – 236	33 – 236	33 – 236
7	0 – 335	260	59 – 333	47 – 335	47 – 355
8	0 – 472	330	85 – 472	71 – 472	71 – 472
9	0 – 614	425	99 – 614	80 – 614	80 – 614
10	0 – 677	519	118 – 677	97 – 677	97 – 677
12	0 – 1015	755	186 – 1015	153 – 1015	153 – 1015
14	0 – 1444	991	234 – 1444	189 – 1444	189 – 1444
16	0 – 1912	1322	359 – 1912	295 – 1912	295 – 1912

Diamond Flow Sensor Locations

All dual duct terminal units utilize pressure independent controls which require two flow sensors. When selecting dual duct terminal units for specific application, it is necessary to specify the correct flow sensor location.

For pneumatic control sequences with mixing, our standard construction is one sensor located in the cold duct inlet and one downstream total flow sensor (hot duct control). This configuration accommodates all standard constant and variable volume sequences. Optional hot inlet and cold total flow sensor configurations are available. Non-mixing pneumatic control sequences (Model 3210) are supplied with a cold and hot inlet sensor.

For analog electronic control sequences, sensor location is dependent on the sequence selected and the controller/actuator/thermostat combination desired. Contact your Nailor Representative for further assistance.

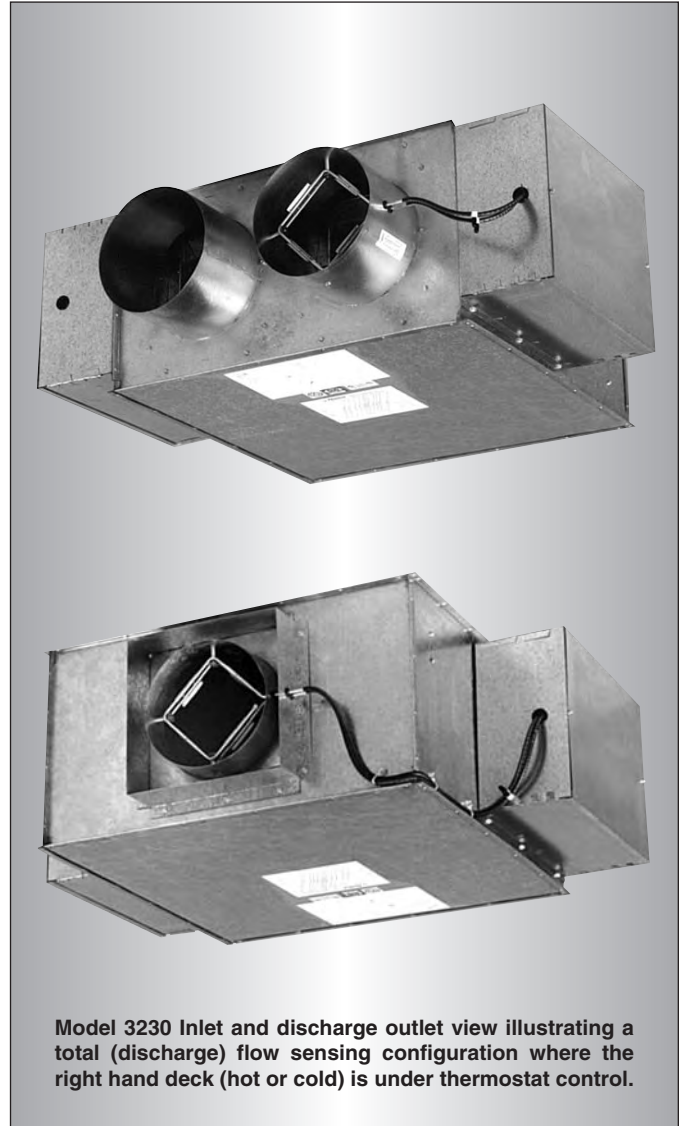
When DDC controls are being supplied by the controls contractor for factory or field mounting, the sensor location will depend on the model of controls, application and the "hand" of the terminal unit. Coordination with the controls contractor is required to determine the appropriate sensor locations.

Multi-point flow sensors are available in three different configurations to suit any application control requirement. These are:

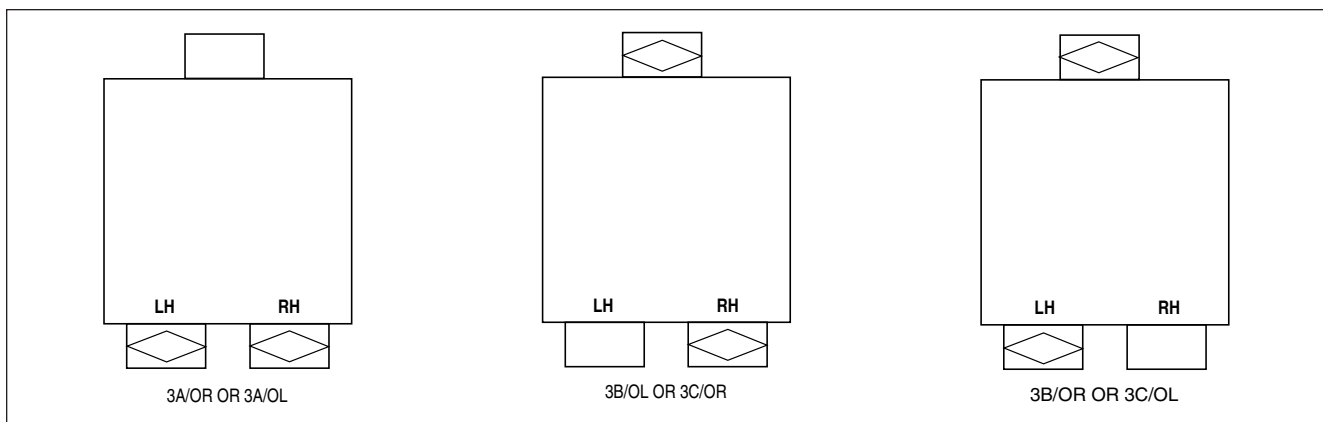
- Cold and hot duct inlet sensors (3A)
- Hot duct inlet sensor and downstream total sensor (3B)
- Cold duct inlet sensor and downstream total sensor (3C)

For all sensor location configurations, the "hand" inlet of the terminal unit (cold duct right hand or cold duct left hand) is required. Coordinate with your Nailor representative.

- Cold duct right hand (OR)
- Cold duct left hand (OL)



Sensor Location/Cold Duct "Hand" Options (plan view).



Control Strategies

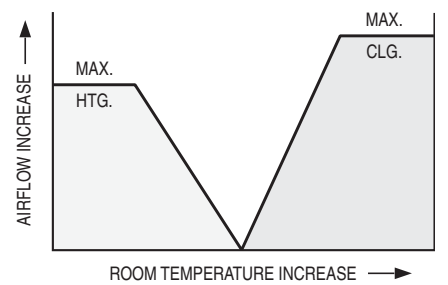
Variable Volume Hot and Cold Airflow without Mixing (Zero Minimum)

In the cooling mode, as room temperature approaches set point, cold airflow modulates from maximum to zero flow. As room temperature drops below set point, hot airflow modulates from zero to maximum. Heating and cooling maximum flow rates can be different. A deadband may be utilized.

As this is a non-blending application, a mixer/attenuator section is not required.

Models: 3210

Applicable Controls: Digital (by others)
Pneumatic or analog electronic (by Nailor)

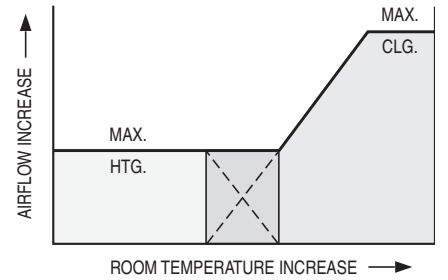


Variable Volume Cold Airflow with Minimum Mixing Equal to Maximum Heating

In the cooling mode, as room temperature approaches set point, cold air modulates from maximum to a minimum mix flow rate. As temperature continues to drop, hot airflow modulates open as cold airflow continues to close, maintaining a minimum total flow rate. Lower heating airflow rates may require smaller hot deck sizes than cold deck to optimize control. A mixer/attenuator section is required.

Models: 3230 or 3240

Applicable Controls: Digital (by others)
Pneumatic or analog electronic (by Nailor)

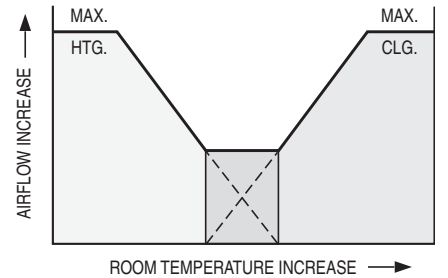


Variable Volume Hot and Cold Airflow with Mixing at Minimum Flow

The hot and cold decks may be set for equal or unequal maximum air volumes. In the cooling mode, as room temperature approaches set point, cold airflow modulates from maximum to a minimum mix flow rate. As temperature continues to drop, hot airflow begins to modulate open as cold airflow continues to close. As the hot deck continues to open, as it passes the minimum cooling setting, the cold duct damper is closed. A mixer/attenuator section is required.

Models: 3230 or 3240

Applicable Controls: Digital (by others)
Pneumatic or analog electronic (by Nailor)

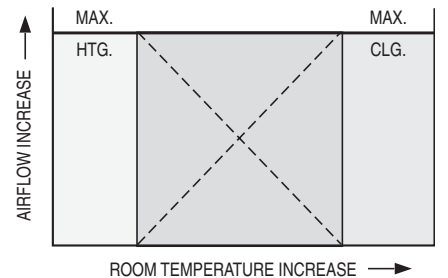


Constant Volume with Hot and Cold Airflow Mixing Hot and Cold Deck Minimums are Zero

The most commonly used sequence for high 'IAQ' applications. Cooling and heating maximum airflow rates are the same. Constant volume airflow delivery is maintained over the entire cooling and heating range. A mixer/attenuator section is required.

Models: 3230 or 3240

Applicable Controls: Digital (by others)
Pneumatic or analog electronic (by Nailor)

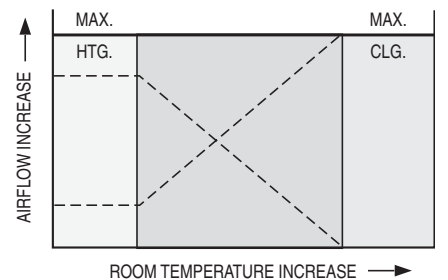


Constant Volume with Hot and Cold Airflow Mixing Minimum Air from Cold Deck

This sequence is similar to the one above, but the cold deck is calibrated with a minimum setting (rather than zero), providing a minimum outside air ventilation capability. The hot deck minimum setting is still zero. The proportions of hot and cold air are indicated by the broken lines. A mixer/attenuator section is required.

Models: 3230 or 3240

Applicable Controls: Digital (by others)
Pneumatic or analog electronic (by Nailor)



Standard Control Sequences

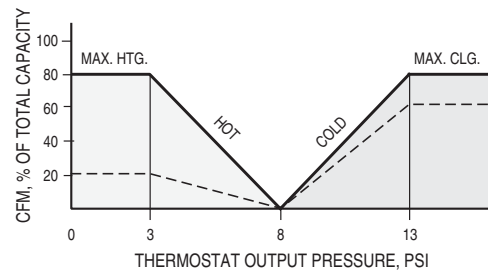
Pneumatic • Pressure Independent • 3000 Controller

The typical control diagrams shown on this page represent the most commonly used dual duct control strategies. The schematics illustrate operation with a direct acting thermostat. Similar control sequences are available for use with reverse acting thermostats. Further variations for each sequence include right or left hand cold deck and damper failure state, normally open or normally closed upon loss of main air. Application specific control strategies are available from your **Nailor** representative.

Control Sequence DP1 • Model 3210

- Variable Volume – Hot and Cold Airflow without Mixing and Zero Minimum
- Hot and Cold Deck Inlet Sensing.

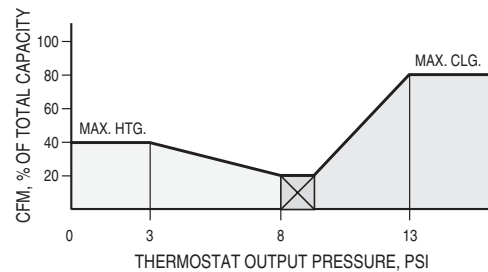
The hot and cold decks are set for equal or unequal maximum air volumes, with minimum setting of zero flow at 8 psi. With rise in room temperature the cold air damper will open to the preset maximum airflow in response to signals from room stat. The hot air damper will be closed. As the space temperature drops the cold air damper modulates to shut off at 8 psi and then the hot air damper begins to open. If the space temperature continues to drop, the hot air damper opens to the maximum setting. No mixing of hot or cold airflow occurs.



Control Sequence DP2 • Model 3230 and 3240

- Variable Volume – Hot and Cold Airflow with Mixing at Minimum Flow
- Total Air Sensing – In Common Discharge • (Hot Deck Make-up Illustrated)

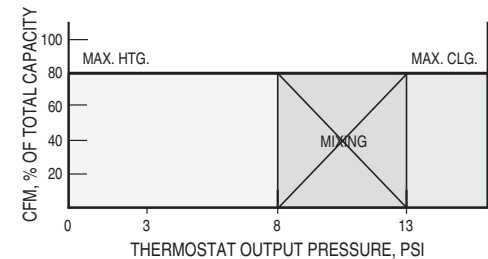
The hot and cold decks may be for equal or unequal maximum air volumes. The cold duct minimum flow rate is set for zero at 8 psi, while the hot duct minimum setting at 8 psi may be set at any desired volume up to but not exceeding its maximum setting. As the hot duct sensor located downstream is measuring total airflow, when thermostat output pressure begins to exceed 8 psi and the cold deck begins to open, the hot duct damper starts closing again and holds total airflow at the hot duct minimum setting. As the cooling load increases and the cold deck continues to open, the cold airflow, which is not controlled by the downstream sensor, exceeds the hot duct minimum setting at which point the hot duct damper is fully closed.



Control Sequence DP3 • Model 3230 and 3240

- Constant Volume – Mixing Hot and Cold Airflow
- Total Air Sensing – In Common Discharge • (Hot Deck Make-up Illustrated)

A downstream velocity sensor controls the hot deck and also holds total airflow of any hot-cold air mixture to a constant volume. Because the hot air velocity sensor is downstream of the unit, it directly measures the condition that is being controlled, i.e., total flow. The cold duct controls operate independently in response to signals from a room stat. The hot and cold deck maximum airflows are set for the same maximum flow rate. The hot deck minimum is set for zero flow at 13 psi. The cold deck minimum is set for zero flow at 8 psi. This arrangement will provide an extremely accurate constant volume flow cooling range over the entire heating and cooling range.



Standard Control Sequences

Analog Electronic • Pressure Independent

The typical control diagrams shown on this page are based on our standard **CSP 5000 Series** or **CSP 4000 Series** electronic controller/actuator. They feature the adjustment of minimum and maximum flow set points at the room thermostat, rather than at the box controller. The electronic room thermostat has a dual set point for heating and cooling.

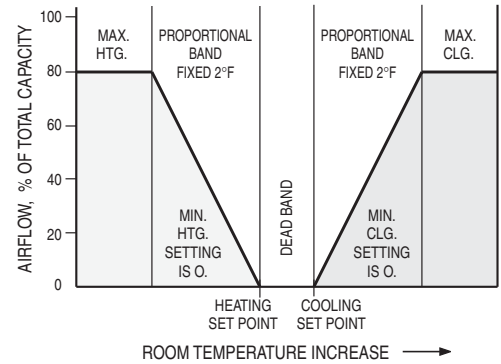
Control Sequence DE1 (CSP 5000) • Model 3210

- Variable Volume – Hot and Cold Airflow without Mixing and Zero Minimum

- Hot and Cold Deck Inlet Sensing

The hot and cold decks are set for equal or unequal maximum air volumes each with a minimum setting of zero.

At full cooling demand, the hot deck valve is closed, and the cold deck valve is at maximum cooling. On a drop in room temperature, the cold deck modulates down to zero in response to thermostat demand. On a further drop in room temperature, the hot deck begins to open and airflow increases from zero to its maximum setting.

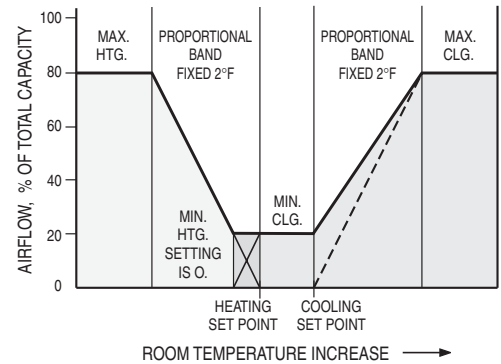


Control Sequence DE2 (CSP 5000) • Model 3230 or 3240

- Variable Volume – Hot and Cold Airflow with Limited Mixing
- Hot and Cold Deck Inlet Sensing
- Minimum Air From Cold Deck

The hot and cold decks are set for equal or unequal maximum air volumes. The hot deck has a minimum setting of zero. The minimum air is from the cold deck.

At full cooling demand, the hot deck valve is closed, and the cold deck valve is at maximum cooling. On a drop in room temperature, the cold deck modulates down to the minimum setting (or zero) in response to thermostat demand. On a further drop in room temperature, the hot deck volume increases from zero to its maximum setting and the cold deck goes to zero.



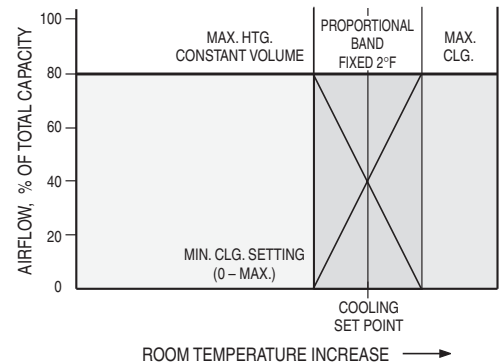
Control Sequence DE3 (CSP 4000) • Model 3230 or 3240

- Constant Volume – Hot Deck Make-Up
- Total Air Sensing In Common Discharge (Hot Deck Make-up)

The cold deck is set for calibrated minimum and maximum airflows required from the cold deck. The hot deck controller, with its sensor located in the common discharge, is set for the required constant volume, which must be equal to, or greater than the cold deck maximum flow.

At full cooling demand, the cold deck valve is at maximum cooling, and the hot deck valve is closed. On a drop in room temperature, the cold deck volume reduces to its minimum setting. As the cold deck volume reduces, the hot deck valve adds the additional air required to maintain the constant volume setting.

(This sequence is also available using the **CSP 5000 Series** controller actuator, except that hot and cold deck inlet sensing is utilized. Control Sequence DE4).

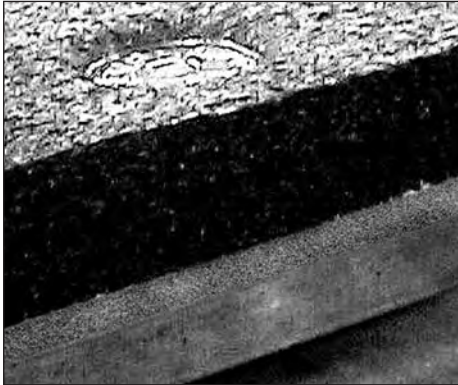


Optional Terminal Unit Liners For 'IAQ' Sensitive Applications

Nailor offers several options for terminal unit applications where the maintenance of an extremely high Indoor Air Quality is critical or a primary concern. Specific 'IAQ' liners are designed to address applications where the issue of fiberglass insulation eroding and entering the airstream is a concern and/or to reduce the risk of microbial growth.

These options are ideally suited to medical facilities including hospital operating and recovery rooms and clean room applications such as pharmaceutical and research laboratories, animal labs and food processing plants. When 'IAQ' is a major concern, Nailor 'IAQ' options can be successfully applied to regular commercial construction projects, such as schools.

Fiber-Free Liner



Fiber-Free liner

A new offering that totally eliminates fiberglass, Nailor's Fiber-Free liner is a 3/4" (19) thick, closed cell elastomeric foam. The liner has excellent insulating characteristics and provides acoustical attenuation equivalent to Steri-Liner.

The foam does not absorb water, reducing the likelihood of mold or bacterial growth.

The Fiber-Free liner surface is smooth, so that dirt and debris won't accumulate, durable, erosion resistant and washable.

Complies with the following standards and tests:

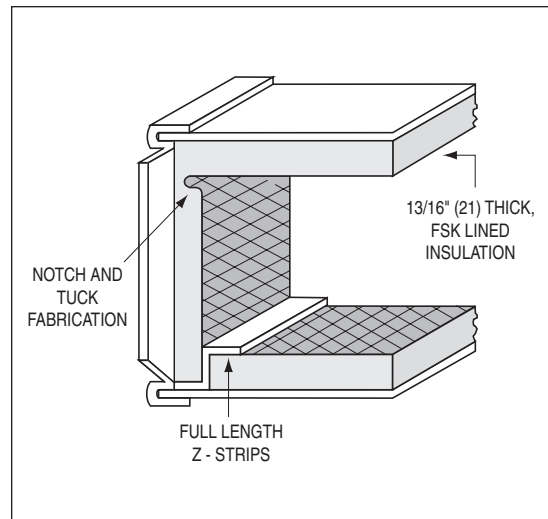
- NFPA 90A Supplementary materials for air distribution systems.
- ASTM E84 and UL 181(25/50) Smoke and Flame spread.
- ASTM C1071, G21, G22. No bacterial or fungal growth.

Steri-Liner

Steri-Liner is an internal insulation designed to reduce the risk of microbial growth within the terminal. A smooth non-porous facing provides a vapor barrier to moisture and reduces the risk of micro-organisms becoming trapped. It also facilitates cleaning and prevents insulating material erosion. Damage to the liner though, will expose fiberglass particles to the airstream.

Acoustic absorption of aluminum foil lined insulation is reduced for discharge sound levels and essentially unchanged for radiated sound levels when compared to standard fiberglass insulation.

- 13/16" (21) thick, 4 lb./sq. ft. (64 kg/m³) density rigid fiberglass with a fire resistant reinforced aluminum foil-scrim-kraft (FSK) facing.
- Meets the requirements of NFPA 90A and UL 181 for smoke and flame spread and the bacteriological requirements of ASTM C665. Will not support the growth of fungi or bacteria.
- No exposed edges. Steri-Liner features 'notch and tuck' fabrication and full seam length steel Z-strip construction providing both superior edge protection and an extremely rigid terminal.



Steri-Liner detail on dual duct terminal unit.

Solid Metal Liner

Nailor also offers a solid inner metal liner that completely isolates the standard insulation from the airstream. Solid metal liners offer the ultimate protection against exposure of fiberglass particles to the airstream, all but eliminating the possibility of punctures exposing fiberglass. This option is also resistant to moisture. The encased insulation still provides thermal resistance and radiated sound attenuation, but acoustic absorption of discharge sound is eliminated. Fabricated as a box within a box to separate all surfaces and exposed edges of the insulation.

Perforated Metal Liner

Provides additional security and retains standard dual density fiberglass insulation or optional Steri-Liner insulation reducing possibility of long term erosion or breakdown.



Suggested Specifications

Model 3210 Dual Duct Terminal Unit Section 15840

1.01 Furnish and install **Nailor Model 3210 Dual Duct Variable Volume Terminal Units** of the sizes and capabilities as indicated on the drawings. Units shall be pressure independent with (pneumatic, analog electronic, DDC) controls. Units shall reset to any flow between 0 and the maximum cataloged airflow as allowed by the specific controller.

1.02 The terminal units shall be provided with two primary variable air volume dampers that control the air quantity in response to a (pneumatic, electric, analog electronic, or DDC) thermostat. The space limitations shall be reviewed carefully to insure that all units will fit into the space allowed.

1.03 Unit casing shall be 22 gauge galvanized steel with round or flat oval inlets with 5 1/2" (140 mm) deep inlet duct collar for field connection. Outlets shall be rectangular and configured for slip and drive connections. Casing leakage downstream of the damper shall not exceed 1% @ 1" w.g. (250 Pa). High side casing leakage shall not exceed 2% @ 3" w.g. (750 Pa).

1.04 Damper assemblies of 16 gauge galvanized steel shall be multiple opposed blade construction 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 the shaft 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. (750 Pa) inlet static pressure as rated by ASHRAE Standard 130.

1.05 The terminal units shall be capable of operation as described herein with an inlet static pressure of 0.10" w.g. (24 Pa) from 0 to 2000 fpm. (The sequence of operations should be described here, if not part of the temperature controls specifications.) Each unit shall be complete with factory mounted (pneumatic, analog electronic, or DDC) controls. Gauge tap ports shall be supplied in the piping between the flow pick up and the controller.

1.06 Each unit shall be constructed with single point electrical (or pneumatic) connections. 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 box. The entire assembly shall be ETL listed and so labeled.

1.07 Each unit shall be internally lined with 3/4" (19) dual density fiberglass insulation. Edges shall be sealed against airflow erosion. Units shall meet NFPA 90A and UL 181 standards.

1.08 All sound data shall be compiled in an independent laboratory and in accordance with the latest version of ARI Standard 880 and ANSI/ASHRAE Standard 130. All units shall be ARI certified and bear the ARI certification label.

Dual Duct VAV Terminal Units – MODEL 3230 AND 3240 "BLENDMASTER™" Section 15840

The following specification is recommended where an independent laboratory test and performance verification is required.:

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. The requirements of the General Conditions, Supplementary Conditions, and the following specification sections apply to all Work herein:

1. Section 15 - - - General.
2. Section 15 - - - Scope of Work.
3. Section 15 - - - Design Conditions.
4. Section 15 - - - Electric Motors and Controllers.
5. Section 15 - - - Access Doors and Color Coded Identification in General Construction.
6. Section 15 - - - Ductwork and Sheet Metal.
7. Section 15 - - - Testing, Balancing, and Adjusting.

1.02 SUMMARY

A. Furnish and install all air terminal units herein specified and as indicated on the Drawings.

1.03 REFERENCE STANDARDS

A. All air terminal units shall be designed, manufactured, and tested in accordance with the latest applicable industry standards including the following:

1. ANSI/ASHRAE Standard 130-96.
2. ARI Standard 880-98.
3. Underwriters Laboratories UL Standard 1995.
4. Underwriters Laboratories UL Standard 1996.

1.04 QUALITY ASSURANCE

A. All equipment and material to be furnished and installed on this Project shall be UL or ETL listed, in accordance with the requirements of the Authority having jurisdiction, and suitable for its intended use on this Project. Space limitations shall be reviewed to ensure that the equipment will fit into the space allowed.

B. All equipment and material to be furnished and installed on this Project shall be run tested at the factory and results of that testing shall be tabulated and provided to the engineer when the equipment ships to the job site. See paragraph 2.03 G for specific requirements.

1.05 SUBMITTALS

A. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 1 Specifications, and Section 15 - - - General and shall include but not be limited to:

1. Dual Duct Variable Air Volume Terminal Units, complete with capacity data, test data, construction details, physical dimensions, electrical characteristics, etc.

1.06 ACOUSTICS

This acoustical specification describes sound power levels as tested to ARI 880 and ASHRAE 130.

A. Sound Power Acoustical Performance:

1. Discharge Noise: Maximum permissible sound power levels in octave bands of discharge sound through discharge ducts from terminal units operated at an inlet pressure of 1.0" w.g. and the maximum amount of air volume shown on the Project Mechanical Drawings leaving the terminal unit and entering the reverberant chamber shall be as follows:

Octave Band	NC-35	NC-40
2	67	71
3	64	69
4	67	72
5	66	71
6	67	72
7	67	72

Table 1. Maximum Discharge Sound Power Levels (dB re 10⁻¹² Watts).

DUAL DUCT TERMINAL UNITS

Suggested Specifications

Dual Duct VAV Terminal Units

MODEL 3230 AND 3240 "BLENDMASTER™" Section 15840 (continued)

2. Radiated Noise: Maximum permissible radiated sound power levels in octave bands of radiated transmission from terminal units operated at an inlet pressure of 1.0" w.g. and the maximum scheduled air quantity in an installed condition over occupied spaces shall be as follows:

Octave Band	NC-35	NC-40
2	64	68
3	57	62
4	53	58
5	50	55
6	50	55
7	53	58

Table 2. Maximum Radiated Sound Power Levels (dB re 10⁻¹² Watts).

1.07 WARRANTY

A. Manufacturer shall warrant equipment for one year from start up or 18 months from shipment.

PART 2 - PRODUCTS

2.01 UNAUTHORIZED MATERIALS

A. Materials and products required for the work of this section shall not contain asbestos, polychlorinated biphenyl's (PCB) or other hazardous materials identified by the Engineer or Owner.

2.02 ACCEPTABLE MANUFACTURERS

A. These Specifications set forth the minimum requirements for dual duct VAV terminal units. If they comply with these Specifications, dual duct VAV terminal units manufactured by one of the following manufacturers will be acceptable:

1. Nailor Industries.

2.03 DUAL DUCT VARIABLE AIR VOLUME TERMINAL UNITS

A. Furnish and install dual duct VAV terminal units as indicated on the Drawings. The units shall be designed and built as a single unit and provided with two primary variable air volume dampers that control the primary cold and warm air quantity in response to a temperature control signal. The damper construction shall be rectangular with multiple opposed blades designed to operate on a 90° arc. Blades shall be extruded aluminum, single thickness construction with heavy-duty gasket for tight shut-off. Units shall be suitable for pressure independent control with [pneumatic, analog electronic or electronic DDC] controls. The space limitations shall be reviewed carefully to ensure all terminal units will fit into the space provided including National Electric Code clearances required in front of all panels containing electrical devices. Unit casings shall be of minimum 20 gauge galvanized steel. Removable access doors rated for high pressure and low leakage shall be factory installed in the mixing section of the unit and shall provide access to service all internal components. Unit shall be fully lined with at least ¾" thick, fiberglass board type insulation completely encapsulated between solid outer and foil inner liners, which comply with NFPA 90 for fire and smoke resistivity and UL 181 for erosion. Casing leakage shall not exceed 1% of terminal rated airflow at 6" w.g. interior casing pressure. All high side casing joints shall be sealed with approved sealant and high side casing and damper leakage shall not exceed 1% of terminal rated airflow at 6" w.g..

Terminal unit manufacturer shall provide flow curves for the air sensors at both inlets and/or at the outlet, as required, clearly labeled and permanently attached on the bottom or side of each terminal unit.

The unit shall include all equipment and controls as required to provide a complete and operating system with at least the following:

1. Single point electrical connection for the voltage/phase as scheduled in the Contract Documents. See Electrical Drawings for power feeder arrangements. Units with transformers shall be rated at [24, 120 or 277] single phase as scheduled in the contract documents.

2. A door interlocking disconnect switch for terminal units with electric heating coils. All disconnecting devices shall be sized and located as required to disconnect all ungrounded power conductors to all internal electrical components.

3. Individual overcurrent protection devices as required to protect individual units and transformers.

4. The primary inlets shall be equipped with an inlet collar sized to fit the primary duct sizes shown on the Drawings. The inlet collar shall provide at least a 5½" length with a ⅛" high raised single or double bead located approximately 1½" from the inlet connection. The primary cooling and heating design airflow settings shall be clearly and permanently marked on the bottom or side of the unit along with the terminal unit identification numbers. Each terminal unit shall incorporate Nailor Diamond Flow sensors with four pick up points on each side to insure that with typical duct turbulence, the controller fidelity shall be +/- 5% of set volume even with a hard 90° elbow at the inlet. Static variation of 0.5" w.g. to 6.0" w.g. shall not affect the flow reading. Each flow sensor, whether mounted in the inlet or outlet of the unit, shall be equipped with gauge taps for field balancing and adjustment of the controls. Provide a transformer with 24 volt AC secondary to provide power for the unit's controls (Division 17 controls). The VAV terminal unit manufacturer and the Division 17 Building Controls Subcontractor shall verify compatibility of the multi-point flow sensors with transducer and DDC microprocessor furnished under Division 17 prior to bidding this Project.

5. The outlets shall have rectangular discharge collars sized for nominal duct connections. Casing shall have mounting area for hanging by sheet metal straps from a concrete slab or shall be supplied with angle brackets for mounting on all thread rods.

6. The terminal unit shall be listed in accordance with UL 1995 as a composite assembly.

7. Heating Options: **ELECTRIC OR HOT WATER HEATING COIL** [Contact Nailor Representative for assistance.]

8. The terminal unit shall be capable of operation as described herein with a maximum inlet static pressure of 0.5" w.g. at 2000 fpm inlet velocity, at full cooling or heating with no mixing of primary air streams. [The sequence of operation should be described here if not part of the temperature controls specifications. Units with mixing attenuators shall be capable of operation in variable or constant airflow modes.] The primary air dampers shall be of a design that shall vary the cold and warm air supplies in response to [a pneumatic or an electronic] signal. Primary air damper close-off leakage shall not exceed 1% of the maximum ARI rated primary air cfm as shown in the manufacturer's catalog for each size terminal unit at 6" w.g. inlet static pressure. Submit damper leakage test data to the Engineer for review. Damper connection to the operating shaft shall be a positive mechanical through bolt connection to prevent any slippage. Provide non-lubricated Celcon® or bronze oilite bearings for the damper shaft. The primary air damper in conjunction with the [pneumatic or analog electronic controller or DDC microprocessor furnished under Division 17] shall be selected to provide accurate control at low primary air velocities.

Suggested Specifications

Dual Duct VAV Terminal Units

MODEL 3230 AND 3240 "BLENDMASTER™" Section 15840 (continued)

The total deviation in primary airflow shall not exceed $\pm 5\%$ of the primary air cfm corresponding to a 300 fpm air velocity through the primary air damper.

9. Provide a mixing chamber to provide mixing of the cold and warm air streams from maximum cooling/minimum heating to maximum heating/minimum cooling. Each terminal unit shall be supplied with an integral mixer-attenuator as an essential element of the terminal unit to minimize or eliminate downstream stratification. Mixing of the cold and hot air streams shall be as described in paragraph 2.03 D.

10. Provide duct inlet and outlet connections as indicated on the Drawings.

11. The casing construction shall be a minimum 20 gauge galvanized sheet metal lined with a minimum $\frac{3}{4}$ " thick, 4 lb. density fiberglass board insulation with a foil inner liner. The terminal units shall not exceed the depth indicated on the Drawings. Mounting connections for hanging the unit by sheet metal straps shall be clearly identified on the housing. All components, including all controls and wiring, shall be factory installed, except the room sensor or thermostat. No field assembly will be allowed. The unit shall be complete and suitable to accept the following field connections:

- a. Primary cold duct.
- b. Primary hot duct.
- c. Single point electrical connection. See Drawings for control box locations required for each terminal unit.
- d. DDC controller control signals and wiring.
- e. Room sensor connection.

B. The terminal unit shall be capable of operating at an airflow of 2000 fpm inlet velocity with an inlet static pressure of 0.50" w.g. or less. See the schedules on the Contract Documents for static pressure requirements.

C. The control sequence shall be as specified in Division 17 (for DDC by others).

D. Each size of each terminal unit to be used on this Project shall be completely laboratory tested for air performance and acoustics. The acceptability of the independent testing laboratory is subject to review by the Owner, Project Acoustical Consultant, and the Engineer. The terminal unit manufacturer shall submit complete details, brochures, instrumentation information, etc., for review. The laboratory shall be capable of properly testing the largest terminal unit on this Project. See paragraph 1.06 B for acoustic guidelines. The air volume listed on the Drawings for the terminal units shall be supplied for the test with the primary cold duct supplying 55°F air and the primary hot duct supplying at 85°F. At primary air damper or valve positions as indicated hereinafter and with an inlet static pressure of 0.50" w.g., 1.0" w.g., and 1.5" w.g. the unit shall be capable of producing a mixed air stream of which the temperature shall not vary more than 1°F [2.5°F for the Model 3230] over the duct 48" downstream of terminal unit for each 30°F temperature difference between the temperatures of the entering warm and cold air. The variation of temperature shall be proportionally less at smaller temperature differences. There shall be at least fifteen temperature readings made at the discharge outlet duct over the entire discharge area as described in ARI 880 with the air entering the unit in each of the following proportions:

1. 25% cold air and 75% warm air.
2. 50% cold air and 50% warm air.
3. 75% cold air and 25% warm air.

Operation of the flow control device shall be demonstrated to repeat

under all conditions of operation of the primary air dampers or valves and duct pressures as specified hereinbefore. If the VAV terminal unit manufacturer has conducted the hereinbefore specified air performance and air mixing tests and has demonstrated to the Engineer and Owner compliance with the specified criteria the previous testing will be accepted and will not need to be repeated. Test results shall clearly state unit performance at test altitude and at Project altitude. See Section 15 - - - titled "Design Conditions".

E. After the manufacturer has submitted certified copies of the laboratory air performance and acoustical performance test results to the Engineer, the Engineer may witness the laboratory tests to verify compliance with the Specifications. See Section 15 - - - General for additional submittal and certification requirements.

F. All dual duct VAV terminal units shall be identified on the bottom of the unit (minimum $\frac{1}{2}$ " high letters) and on the shipping carton, with the floor and box number that identifies it along with the CFM settings. Every unit shall have a unique number combination that matches numbers on the contractor's coordination drawings as to its location and capacity and is coordinated with the DDC controller and the Division 17 Building Control System submittal drawings.

G. The VAV terminal unit manufacturer will verify the operation of each terminal unit before shipment. Testing shall include at least the following:

1. Apply electric power to the unit.
2. If DDC controls are mounted, disconnect the primary air damper actuator from the DDC terminal unit controller. Provide separate power source to the actuators to verify operation and rotation of dampers. Drive the dampers closed and verify by feel or observation that dampers are driven fully closed. Return dampers to the fully open position prior to shipment.
3. Provide a written inspection report for each terminal unit signed and dated by the factory test technician verifying all terminal unit wiring and testing has been performed per the manufacturer's testing and quality assurance requirements.

Control Specifications (select one)

Pneumatic Controls (Pressure Independent)

1. The terminal unit manufacturer shall provide factory mounted pressure independent controls which can be reset to modulate airflow between zero and the maximum cataloged capacity. Maximum airflow limits or mechanical volume regulators are not acceptable.
2. Each unit shall be supplied with two **Nailor** Diamond flow sensors with four pick-up points on each side to ensure that controller fidelity shall be within $\pm 5\%$ of set volume under various same size duct inlet conditions and inlet static variation of 0.05" – 6.0" w.g. (12 – 1500 Pa). The sensor shall amplify the sensed velocity pressure and provide a minimum differential pressure of 0.03" w.g. (7.46 Pa) at 500 fpm (2.54 m/s) inlet velocity. Flow measuring taps shall be furnished with each terminal.
3. Reset volume flow controllers shall have a constant reset span regardless of the minimum and maximum airflow settings selected. Reset span shall be adjustable from a minimum of 5 psi up to a maximum of 10 psi. Reset start point shall be adjustable from 3 – 10 psi. Controller air bleed off through the flow sensor is not acceptable. Controller shall be field convertible for direct or reverse acting. The compressed air consumption of each controller shall

Suggested Specifications

Dual Duct VAV Terminal Units

MODEL 3230 AND 3240 "BLENDMASTER™"
Section 15840 (continued)

not exceed 1.0 SCFH at 20 psi. Acceptable controller is Kreuter CSC-3011 or equal.

4. Reset volume controllers shall be factory calibrated and set for the scheduled maximum and minimum airflow settings. Flow measuring taps and flow charts shall be supplied with each terminal unit for field balancing and adjustment of airflow. All pneumatic tubing shall be UL listed fire retardant (FR) type. Each terminal shall be supplied with a label showing unit type, size, tag location, minimum and maximum airflow settings and control sequence number. Pneumatic spring return actuators shall be provided and factory mounted by the terminal unit manufacturer.

5. Reset volume controllers shall be factory set and calibrated for operation with a direct/reverse (select one) acting room thermostat. The cold duct actuator/damper connection shall be factory mounted to fail to a normally open/closed (select one) position upon loss of control main air pressure. The hot duct actuator/damper connection shall be factory mounted to fail to an open/closed (select one) position.

Analog Electronic Controls (Pressure Independent)

1. The terminal unit manufacturer shall provide factory mounted pressure independent analog electronic controls which can be reset to modulate airflow between zero and the maximum cataloged capacity. Each terminal shall be equipped with labels showing unit size, location and minimum and maximum airflow settings. Controls shall be factory calibrated and set for the scheduled minimum and maximum flow rates.

2. Units shall be supplied with two **Nailor** Diamond flow sensors with four pick-up points on each side to ensure that controller fidelity shall be within $\pm 5\%$ of set volume under various same size duct inlet conditions and inlet static variation of 0.05" – 6.0" w.g. (12 – 1500 Pa). The sensor shall amplify the sensed velocity pressure and provide a minimum differential pressure of 0.03" w.g. (7.46 Pa) at 500 fpm (2.54 m/s) inlet velocity. Flow measuring taps shall be furnished with each terminal. All pneumatic tubing shall be UL listed for fire retardant (FR) type.

3. Velocity controllers shall have a constant 2°F (1.11°C) reset span regardless of minimum and maximum airflow limits. They shall include an onboard flow-through transducer utilizing twin platinum resistance temperature detectors and shall be capable of controlling a velocity set point from 0 – 3300 fpm with an accuracy of 3%. The controller shall allow all airflow adjustments to be made from the matching room thermostat. The thermostat shall be furnished by the terminal unit manufacturer and provide a live velocity readout and feature semi-concealed set point slider(s) and set point indicator(s) and thermometer with a fahrenheit (centigrade optional) scale plate.

4. The terminal shall have two 24 VAC combination controller/actuator single assemblies. The actuator shall be of a direct drive design and provide a minimum torque of 50 in. lbs. (5.6 Nm). Actuators shall be of the floating reversible type and include a magnetic clutch, adjustable stops and a gear disengagement button. A tri-color LED shall indicate green for opening, red for closing and white for satisfied damper positions. Power consumption of the controller/actuator shall not exceed 4 VA.

5. The terminal manufacturer shall provide a Class 2, 24 VAC control transformer with internal current limiting protection. All controls shall be installed in an approved NEMA 1 enclosure.

Digital (DDC) Controls (Pressure Independent) Factory Mounting Procedure

1. The terminals shall be equipped with pressure independent direct digital controls supplied by the control contractor under the automatic temperature controls Division 17 and mounted by the terminal unit manufacturer. The control contractor shall, in addition to sending the controls to the terminal unit manufacturer, provide technical data sheets for all components to be mounted, including dimensional data, mounting hardware and method, as well as application specific wiring and piping diagrams for each terminal type as depicted on the schedules and mechanical drawings.

2. Controls shall be compatible with the pneumatic 'Diamond Flow' multi-point averaging flow sensor supplied by the terminal manufacturer. Sensors shall have four pick-up points on each side to ensure that controller fidelity shall be $\pm 5\%$ of set volume with any typical air turbulence in the duct and any typical flex inlet condition and with an inlet static variation of 0.05" w.g. to 6.0" w.g. (12 – 1500 Pa). The sensor shall amplify the sensed velocity pressure and provide a minimum differential pressure of 0.03" w.g. (7.46 Pa) at 500 fpm (2.54 m/s) inlet velocity. Flow measuring taps and flow curves shall be furnished with each terminal.

3. Controls shall be configured and field calibrated in the field by the control contractor after terminal installation has been completed. Pneumatic tubing shall be UL Listed fire retardant (FR) type. Each terminal shall be supplied with a label showing unit type, model number, size and tag location.

4. The terminal manufacturer shall provide a Class 2, 24 VAC control transformer with internal current limiting protection and disconnect switch. All controls shall be installed in an approved NEMA 1 enclosure supplied and installed by the terminal manufacturer.