

General Information

Controls

For a description of individual control components; see the controls overview section of this catalog.

Pneumatic

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.

Analog Electronic

The analog electronic controls provide pressure independent control. The components are matched and calibrated and provide regulated airflow in response to the electronic room thermostat, which is furnished as a part of the control package. Minimum and maximum airflow settings are adjusted at the thermostat, using a digital voltmeter. It is not necessary to adjust flow setting at the terminal in the ceiling space.

The new range of Nailor analog electronic controls utilize the 'Diamond Flow' multi-point averaging sensor as standard for accurate flow measurement.

The electronic thermostat has a fixed 2°F proportional band regardless of minimum or maximum velocity set points and provides a linear reset function. Thermostat has a built-in thermometer and set point indicator. The electronic controller/actuator features an on-board flow transducer.

Electric actuators are not spring return devices (there is no normally open or normally closed action). If there is a loss of power to the terminal, the damper will remain in the position it was in at the time of power failure. All electric components use low voltage (24 volt) controls. A step down transformer is provided as standard.

Direct Digital Controls

Nailor Industries Fan Powered Terminals are generic in nature and compatible with all DDC controls currently available.

Nailor can supply and mount its own 'Diamond Flow' multi-point averaging flow sensor.

Controls may be factory mounted and wired by **Nailor** or field installed by the controls contractor.

A 24 volt Class 2 control transformer and fan relay are provided by Nailor as standard on all fan powered terminals intended for use with digital controls.

Control Operation

35S, 35SST, 37S and 37SST Series • Series Flow

Pressure Independent Pneumatic and Analog Electronic

Occupied Cycle

1. The series terminal fan is directly or indirectly interlocked and energized before or when the central system starts up.

Nailor recommends that the terminal fan is indirectly interlocked by means of an airflow switch (optional) which senses primary air pressure at the inlet. Upon central system start up, the fan in the terminal is automatically energized.

2. On a rise in room temperature, the thermostat sends a signal to increase the flow of cold primary air.

3. As more cold air is supplied to the fan section, less warm air is induced from the ceiling space or plenum.

4. When the room temperature exceeds the set point by 2°F or more, cold airflow is maintained at the maximum setting. The maximum setting is the same as the total fan volume setting.

5. On a decrease in room temperature, the thermostat sends a signal to decrease the flow of cold primary air.

6. As less cold air is supplied to the fan section, more warm air is induced from the ceiling space.

7. When the room temperature and thermostat output signal reach the thermostat set point, the cold airflow is at its minimum limit (usually zero) and the fan is supplying the maximum volume of induced air.

8. If room temperature continues to drop, an optional heating coil may be energized.

9. When the optional airflow switch is supplied, and the central system is turned off (night-time or weekend), the series terminal fan is shut down upon loss of primary air.

Pneumatic Options

1. Night Shutdown (Airflow Switch). Accessory code: QK.

An airflow switch de-energizes fan upon loss of primary (central) air (indirect fan interlock). The terminal fan will remain off until the primary air is restored.

2. Night Shutdown (P.E. Switch). Accessory code: QL.

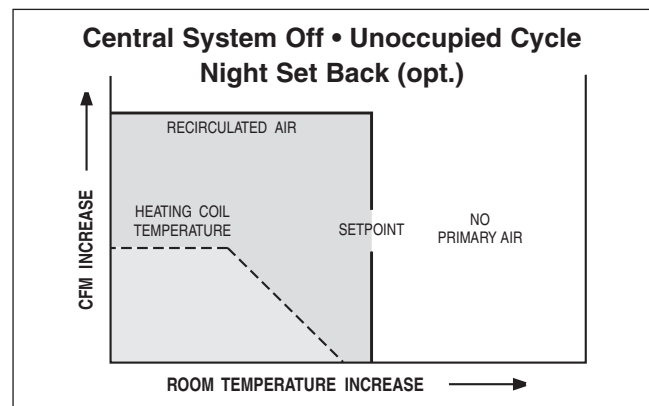
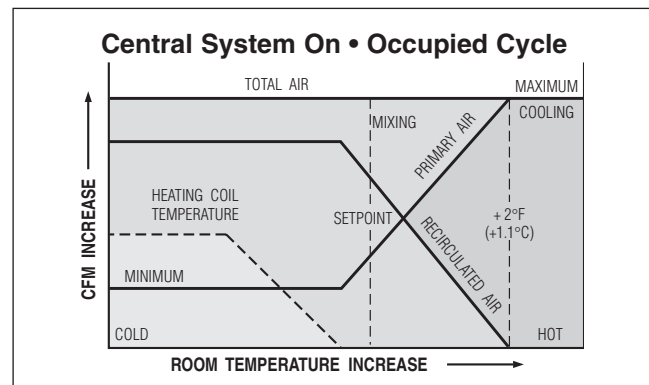
A pneumatic electric switch de-energizes the fan upon loss of main air. Primary air fan must be shut down. The terminal fan will remain off until the main air is restored. Units with electric heat require reverse acting thermostats to prevent heat operation when terminal fan is off.

3. Night Setback (P.E. and Airflow Switch). Acc. code: QM.

Airflow switch de-energizes fan upon loss of primary (central) air. A P.E. switch overrides the airflow switch upon a call for heating and will cycle the unit fan followed by the supplementary heat intermittently in response to the night setback thermostat.

4. Night Setback (Two P.E.'s). Accessory code: QN.

A P.E. switch de-energizes fan upon loss of main air. Primary air fan must be shut down. A second P.E. switch provides an override upon a call for heating and will cycle the unit fan and supplementary heat in response to a separate pneumatic signal or night setback thermostat.



Pneumatic Sequence (Pressure Independent)			Code
Thermostat Action	Damper Fail Position	Electric or Hot Water Heat Option	
D.A.	NO	Yes	1P3
R.A.	NO	Yes	2P3
D.A.	NC	Yes	3P3
R.A.	NC	Yes	4P3

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FAN POWERED TERMINAL UNITS

Control Operation

35S, 35SST, 37S and 37SST Series • Series Flow Analog Electronic Sequences

Description	Code
Cooling (continuous operation)	A1
Cooling w/morning warm-up (continuous operation)	A2
Cooling w/staged electric, auxiliary or on-off hot water heat (continuous operation)	A3
Cooling w/proportional heat (continuous operation)	A4
Cooling w/night cycle	A5
Cooling w/morning warm-up and night cycle	A6
Cooling w/staged electric, auxiliary or on-off hot water heat and night cycle	A7
Cooling w/proportional heat and night cycle	A8
Cooling w/auto night shutdown	B1
Cooling w/morning warm-up and auto night shutdown	B2
Cooling w/staged electric, auxiliary or on-off hot water heat and auto night shutdown	B3
Cooling w/proportional heat and auto night shutdown	B4
Cooling w/auto night setback cycle	B5
Cooling w/morning warm-up and auto night setback cycle	B6
Cooling w/staged electric, auxiliary or on-off hot water heat and auto night setback cycle	B7
Cooling w/proportional heat and auto night setback cycle	B8
Cooling w/staged electric, auxiliary or on-off hot water heat, auto night setback cycle and morning warm-up	B9
Cooling w/proportional heat, auto night setback cycle and morning warm-up	B10
Cooling w/staged electric, auxiliary or on-off hot water heat and morning warm-up (continuous operation)	B23
Cooling w/proportional heat and morning warm-up (continuous operation)	B24
Cooling w/staged electric, auxiliary or on-off hot water heat, auto night shutdown and morning warm-up	B25
Cooling w/proportional heat, auto night shutdown and morning warm-up	B26
Cooling w/auto changeover (continuous operation)	B13
Cooling w/staged electric, auxiliary or on-off hot water heat and auto changeover (continuous operation)	B17
Cooling w/proportional heat and auto changeover (continuous operation)	B18
Cooling w/auto changeover and auto night shutdown	B15
Cooling w/staged electric, auxiliary or on-off hot water heat, auto changeover and auto night shutdown	B16
Cooling w/proportional heat, auto central heating changeover and auto night shutdown	B22

Sequence Notes:

Morning Warm-Up

A duct stat is mounted in the terminal inlet. Upon sensing a central system supply air temperature above 77°F (25°C), the primary air damper drives to a full open position. Optional terminal supplementary heat is locked out. Upon sensing cool air, the terminal reverts to daytime operation.

Auxiliary or On-off Hot Water Heat

Control relay provides a 24 Vac output signal for operation of valve (10 VA maximum by others).

Proportional Hot Water Heat

Thermostat heating output provides an 0 – 10 Vdc reverse acting control signal to proportional valve (by others). Closed at 0 Vdc and fully open at 10 Vdc (10 mA maximum).

Night Cycle

An airflow switch de-energizes fan upon loss of primary (central system) air. Upon a call for heat, the thermostat will override the airflow switch and cycle the unit fan followed by any supplementary heat intermittently to maintain day set point temperature.

Auto Night Shutdown

An airflow switch de-energizes fan upon loss of primary

(central system) air and locks out any optional supplementary heat.

Auto Night Setback

An airflow switch de-energizes fan upon loss of primary (central system) air and activates the night side of the thermostat. Primary air damper cycles closed. Upon a call for heat, the thermostat will override the airflow switch and cycle the unit fan and optional supplementary heat intermittently to maintain a lower energy saving setback temperature.

Auto Changeover

(Central Heat/Cool Systems)

These sequences incorporate a duct stat and heat/cool thermostat. Upon sensing a central system supply air temperature above 77°F (25°C), the heating side of the thermostat is activated and the damper throttling action is reversed. Warm central air is modulated between minimum and maximum set points.

Optional Strategies

Night setback, night shutdown and primary damper overrides may be initiated by external 24 Vac inputs and/or dry contact closures.

Consult your Nailor representative for non-standard control sequences.

Control Operation

35N Series • Parallel Flow (Variable Volume)

Pressure Dependent

Pneumatic

The actuator and fan respond directly to a signal from the room thermostat.

P.E. switches are furnished to sequentially activate fan and optional hot water heat upon demand (electric heat is not available with pressure dependent controls).

Pressure Independent

Pneumatic and Analog Electronic

Occupied Cycle

1. Upon start-up of the central system, cold air is delivered to the space through the primary air section at the flow rate dictated by the thermostat. The reset controller compensates for any variation in inlet static pressure. The fan remains off. A backdraft damper at the fan outlet prevents cold air from flowing back through the fan into the ceiling space.

2. On a rise in room temperature, the thermostat sends a signal to increase the flow of primary air.

3. When the room temperature exceeds set point by 2°F or more, cold airflow is maintained at the maximum setting.

4. On a decrease in room temperature, the thermostat sends a signal for less cooling to the flow controller and cold airflow begins to decrease.

5. When the room temperature is at or below the thermostat set point, cold airflow is at its minimum limit.

6. If room temperature continues to drop, the fan section is energized to supply warm ceiling plenum air.

7. If room temperature drops further still, an optional supplementary heating coil may be energized.

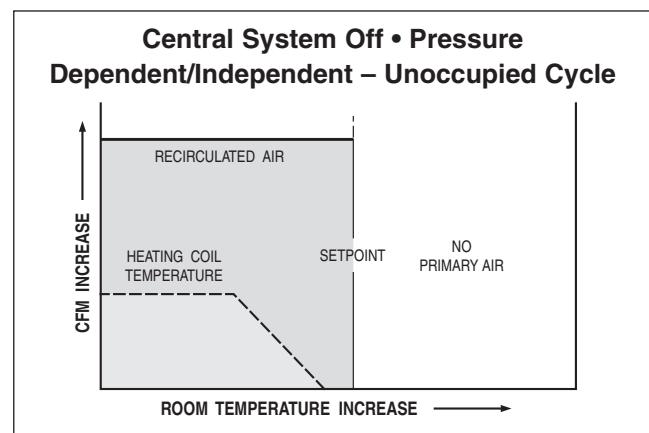
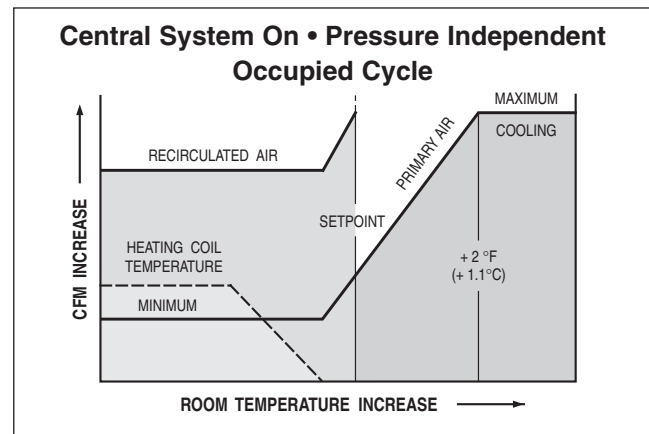
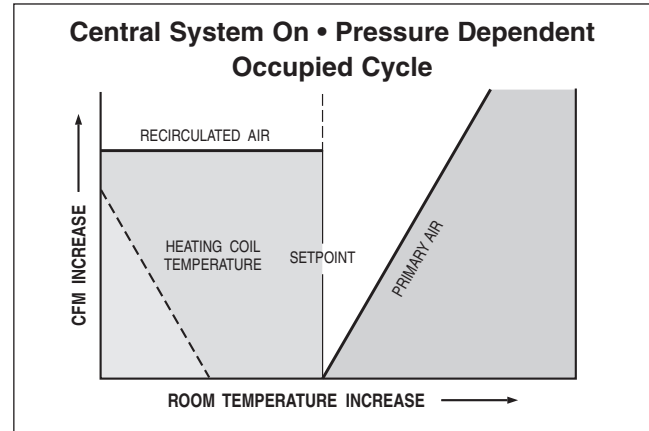
8. When the central system is turned off (night-time or weekend operation), the fan and optional heat can be energized by the room thermostat on an intermittent basis on a call for heating.

Pneumatic Options

1. Night Setback

The space temperature may be reset to a lower setting through a change in main air pressure. The fan and optional heat will be energized through the P.E. switch furnished with the unit while the central system remains off.

2. A normally open damper configuration may be utilized for a central morning warm-up sequence by removing main air to the terminal.



Control Operation

35N Series • Parallel Flow (Variable Volume)

Pneumatic Control Combinations

Pressure Dependent	Pressure Independent	Thermostat Action	Terminal Damper	Primary Air Cooling Range Max. – Min.	Suggested Range Settings			Code		
					Fan P.E. Switch**		Electric Heating Coil P.E. Off – On			
					Off - On Setting	Normal Position	1st Stage		2nd Stage	3rd Stage
✓		D.A.	N.C.	15 – 10 psi	12 – 10/N.C.		10 - 8	9 - 7	8 - 6	D1
✓		R.A.	N.O.	5 – 10 psi	9 – 11/N.O.		11 - 13	12 - 14	13 - 15	D2
	✓	D.A.	N.O.	13 – 8 psi	10 – 8/N.C.		8 - 5	7 - 4	6 - 3	1P3
	✓	R.A.	N.O.	3 – 8 psi	6 – 8/N.O.		8 - 11	9 - 12	10 - 13	2P3
	✓	D.A.	N.C.	13 – 8 psi	10 – 8/N.C.		8 - 5	7 - 4	6 - 3	3P3
	✓	R.A.	N.C.	3 – 8 psi	6 – 8/N.O.		8 - 11	9 - 12	10 - 13	4P3

Notes: ** A normally closed (N.C.) P.E. switch fails on. A normally open (N.O.) P.E. switch fails off. Hot water coil valves (by others) should be selected to modulate through the desired heating range in sequence with the cooling range.

Analog Electronic Sequences

Description	Code
Cooling w/night cycle	A1
Cooling w/morning warm-up and night cycle	A2
Cooling w/staged electric, auxiliary or on-off hot water heat and night cycle	A3
Cooling w/proportional heat and night cycle	A4
Cooling w/auto night shutdown	B1
Cooling w/morning warm-up and auto night shutdown	B2
Cooling w/staged electric, auxiliary or on-off hot water heat and auto night shutdown	B3
Cooling w/proportional heat and auto night shutdown	B4
Cooling w/auto night setback cycle	B5
Cooling w/morning warm-up and auto night setback cycle	B6
Cooling w/staged electric, auxiliary or on-off hot water heat and auto night setback cycle	B7
Cooling w/proportional heat and auto night setback cycle	B8
Cooling w/staged electric, auxiliary or on-off hot water heat, auto night setback cycle and morning warm-up	B9
Cooling w/proportional heat, auto night setback cycle and morning warm-up	B10
Cooling w/staged electric, auxiliary or on-off hot water heat and morning warm-up	B23
Cooling w/proportional heat, morning warm-up and night cycle	B24
Cooling w/staged electric, auxiliary or on-off hot water heat, auto night shutdown and morning warm-up	B25
Cooling w/proportional heat and morning warm-up	B26
Cooling w/auto changeover	B13
Cooling w/staged electric, auxiliary or on-off hot water heat and auto changeover	B17
Cooling w/proportional heat and auto changeover	B18
Cooling w/auto changeover and auto night shutdown	B15
Cooling w/staged electric, auxiliary or on-off hot water heat, auto changeover and auto night shutdown	B16
Cooling w/proportional heat, changeover and auto night shutdown	B22

Sequence Notes:

Morning Warm-Up

A duct stat is mounted in the terminal inlet. Upon sensing a central system supply air temperature above 77°F (25°C), the primary air damper drives to a full open position. Fan and optional supplementary heat are locked out. Upon sensing cool air, the terminal reverts to daytime operation.

Night Cycle

Upon a call for heat, the thermostat will cycle the unit-fan followed by any supplementary heat intermittently to maintain day set point temperature.

Auto Night Setback

An airflow switch senses central system shutdown upon loss of primary air and activates the night side of the thermostat. Primary air damper cycles closed. Upon a call for heat, the thermostat will cycle the unit fan

and optional supplementary heat intermittently to maintain a lower energy saving setback temperature.

Auto Changeover

(Central Heat/Cool Systems)

These sequences incorporate a duct stat and heat/cool thermostat. Upon sensing a central system supply air temperature above 77°F (25°C), the heating side of the thermostat is activated and the damper throttling action is reversed. Warm central air is modulated between minimum and maximum set points. Terminal fan and optional supplementary heat are locked out.

Optional Strategies

Night setback, night shutdown and primary damper overrides may be initiated by external 24 Vac inputs and/or dry contact closures. Consult your Nailor representative for non-standard control sequences.