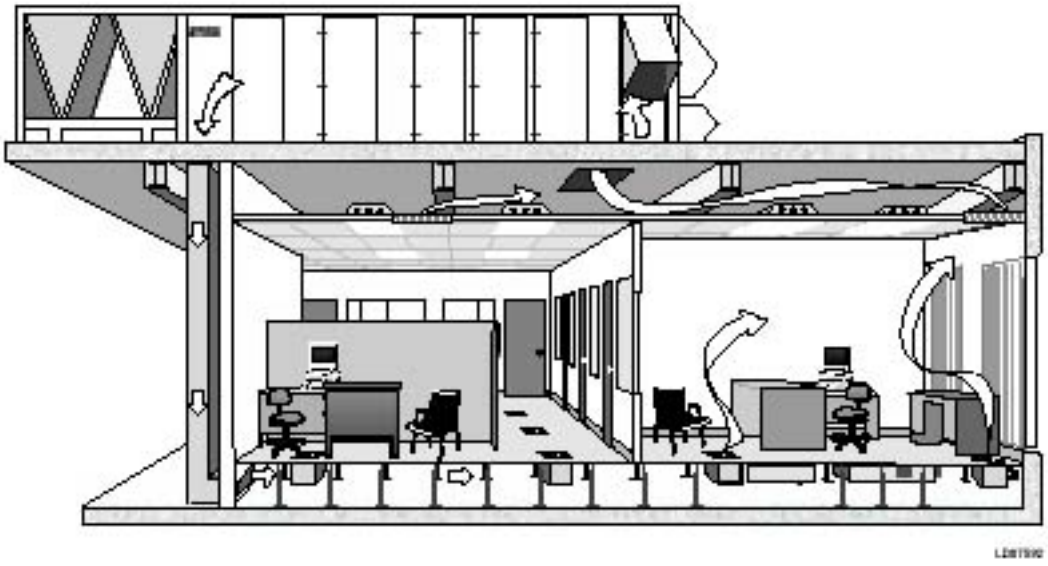
YORK®

eco2™

FlexSys Configured Packaged Rooftop Air Conditioning Units



BUILDINGS ALLY

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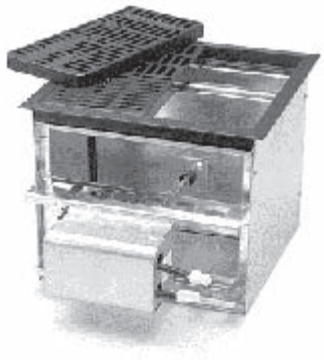
TOTAL INTEGRATED HVAC SYSTEM

eco² Packaged Rooftop Unit

00566VIP

Packaged DX rooftop unit optimized for chlorine free HFC-407C and R22 refrigerants. Available in sizes from 50-100 tons.

FlexSys MIT Terminals



00641VIP

Modular integrated air distribution terminal designed for underfloor VAV applications. The complete model line allows a wide range of specific air distribution application needs to be met in an optimum manner.

Modular Plug & Play Cabling

00642VIP

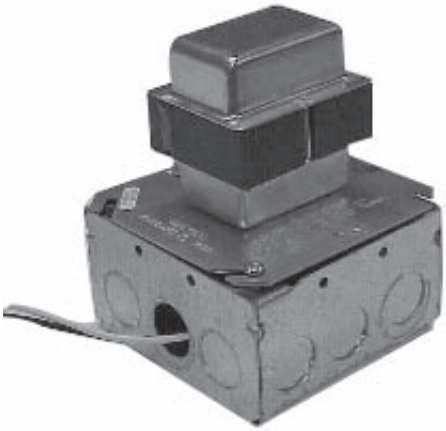
Bundled lengths of control cabling for interconnection of Zone Controls/MIT boxes; available in various lengths to accommodate any application.

Zone Controls

00643VIP

A complete range of integrated control systems, from stand-alone to LON compliant, with the capability of controlling all cooling/heating functions of various MIT boxes.

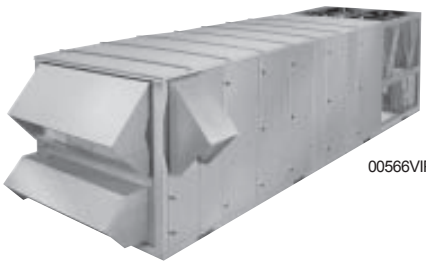
Power Control Module

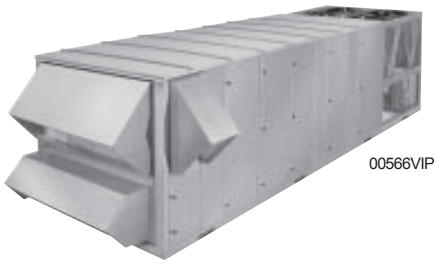


00644VIP

Power control modules provide power and control for MIT VAV applications, use with plug and play cable for a complete system install.

An Integrated Solution

	FLEXSYS	eco² PACKAGED ROOFTOP
	 00641VIP	 00566VIP
LOWER INSTALLED COSTS	• Elimination of the majority of supply air ductwork that is normally located above the ceiling. • Reduced floor-to-floor height in new construction when compared to conventional overhead systems.	• Each unit is subjected to a series of quality assurance checks as well as an automated quality control process before being run-tested. Fans and drives are balanced at the factory during testing. The factory run-test ensures safe, proper operation when the unit is installed and reduces installation and commissioning time. • All control points and devices within the unit are factory-installed, wired and tested. The OptiLogic controller is factory-configured for the FlexSys underfloor air operation. Single point power connection reduces installation time. All unit interiors are cleaned and vacuumed prior to shipment. Units are shrink-wrapped to ensure arrival at the jobsite in factory fresh condition.
INDOOR AIR QUALITY (IAQ)	• Cooled, filtered air supplied from an underfloor plenum benefits building occupants first, rather than the ceiling tiles. • The overall floor to ceiling airflow pattern effectively removes contaminants from the occupied part of the space. • Supply air is discharged from the underfloor plenums at a relatively “dry” state (60-65°F and 65-80% RH) as opposed to conventional systems (typically 55°F/100% RH).	• A double-sloped inclined stainless steel drain pan facilitates removal of evaporator condensate. By reducing the possibility of condensate collecting inside the unit, the potential for bacterial growth is eliminated. The drain pan is accessible for periodic cleaning required by IAQ standards. • Rigid double-wall construction throughout provides ease of cleaning and protects against insulation fiber entrainment in the breathable air. • The economizer introduces fresh outside air into the building providing a healthier and more comfortable building environment.

	FLEXSYS	eco² PACKAGED ROOFTOP
	 00641VIP	 00566VIP
LOWER OPERATING COST	• The low pressure requirements of an underfloor air system equates to less static pressure for the rooftop unit supply fan, resulting in a reduction in fan energy. • Underfloor systems use variable air volume control. This adjustment of supply fan operation results in a reduction in fan energy. • Underfloor systems provide higher temperature (typically 60-65°F) supply air than overhead systems. This increases the number of hours that the system can use the economizer, or “free cooling” mode. • The standard floor tile mounted air discharge terminals (MIT) are relocated quickly and easily. The system provides maximum flexibility and lowers costs associated with building reconfiguration, a major advantage in today’s rapidly changing workspace. • Underfloor systems may require less outside air than conventional systems for the same ventilation effectiveness. A reduction in outside air quantity in turn reduces the amount of mechanical cooling required for dehumidification purposes.	• First packaged RTU that meets ASHRAE 90.1 2001 with both R22 and R-407C Refrigerants, for all model sizes. • Variable frequency drives provide the HVAC designer with a high-efficiency, quiet and more reliable means of variable air volume control from a packaged rooftop. ASHRAE 90.1-2001 standard specifies part load efficiency requirements that make VFDs the cost-effective solution for meeting the standard. VFDs can save up to 40% of the energy costs compared to inlet guide vanes offered on competitive units. • Multiple steps of control offer superior off- design energy performance, while maintaining precise control of occupant comfort. • The economizer provides energy savings in free cooling mode, by using outside air to cool the space instead of mechanical cooling. • Premium-efficiency motors are available for optimum energy efficiency. All motors used on the eco² Packaged Rooftop air conditioner meet U.S. EPACT 1992 minimum requirements.

Introduction

The YORK FlexSys Underfloor Air System provides a cutting edge, cost competitive alternative to conventional overhead air distribution systems based on the performance and system flexibility benefits that it can provide. When combined with a YORK eco^2 Packaged Rooftop Unit, the system offers a complete package that provides an optimum solution for building comfort control.

FlexSys technology uses the open space between the structural concrete slab and the underside of a raised access floor system to deliver conditioned air directly into the occupied zones of office and other commercial buildings. This underfloor plenum incorporates the air distribution system with the building power, telecom, and data cabling in one easily accessed service plenum. The raised access floor concept is a proven design ideal for office buildings that house today's modern business that relies on critical information technologies to maintain high productivity levels. The unmatched flexibility offered by raised floor systems allows for significant costs savings and reduced downtimes when a fast-paced economy demands office space reconfiguration.

System Description

The following will illustrate the concept of an underfloor air distribution system and highlight the differences from conventional ceiling-based air distribution systems. Figures 1 and 2 show schematic diagrams of an overhead system and an underfloor system, respectively, for a cooling application in an open floor plan office building.

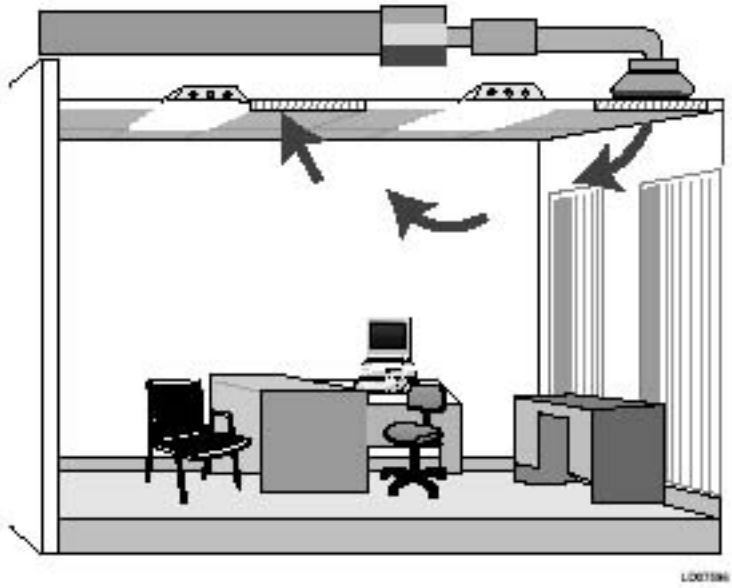


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FIG. 1 – TRADITIONAL OVERHEAD AIR DELIVERY SYSTEM

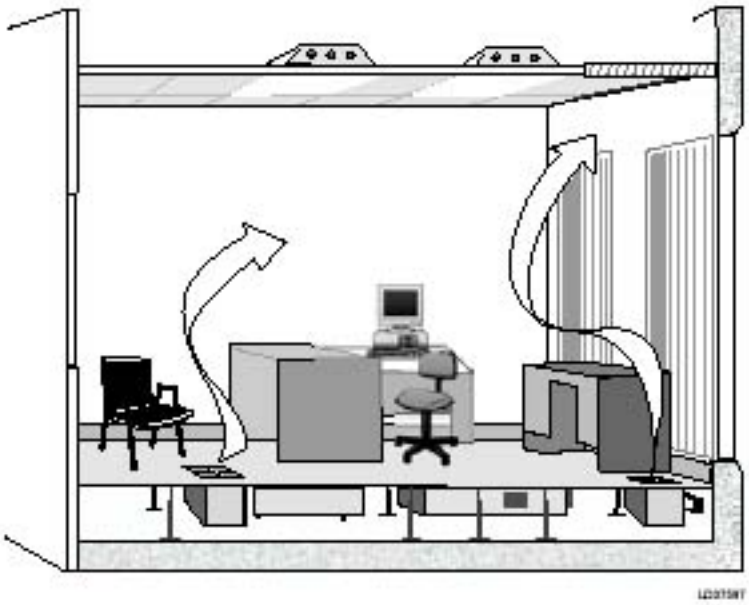

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FIG. 2 – YORK FLEXSYS UNDERFLOOR AIR DELIVERY

The traditional approach to HVAC design in commercial buildings has been to supply conditioned air through extensive overhead duct networks to an array of diffusers spaced evenly in the ceiling. In Figure 1, the conditioned air is both supplied and returned at ceiling level. Ceiling plenums must be designed large enough to accommodate the supply ducts that run through them. Return air is typically configured as ceiling plenum return without any ductwork. This type of air distribution, known as the "well-mixed" type, is the most common system in use. This conventional HVAC system is designed to promote complete mixing of supply air with room air, thereby maintaining the entire volume of all air in the space (from floor to ceiling) at the desired space setpoint temperature. In addition, to meet IAQ requirements, an adequate supply of fresh outside air must be introduced to this mix. A key disadvantage to this control strategy is that it has no provisions to accommodate different temperature preferences among the building occupants or to provide preferential ventilation in the occupied zone.

With the YORK FlexSys Underfloor Air System, conditioned air from the air handling unit (AHU) is ducted to the underfloor plenum. As shown in Figure 2, this conditioned air flows freely throughout the plenum to individual supply discharge outlets. Unlike the larger single supply duct outlets typical of overhead systems, underfloor systems are configured to have a large number of smaller supply outlets, in close proximity to the building occupants. These adjustable outlets provide an opportunity for nearby occupants to have some amount of control over thermal comfort conditions in their local environment. Air is returned from the room at ceiling level (unducted plenum return is shown). The resulting overall floor-to-ceiling air flow pattern takes advantage of the natural buoyancy produced by heat sources in the space and more efficiently removes heat loads and contaminants from the space, particularly for cooling applications. In fact, some of the most important advantages of underfloor systems over ceiling-based systems occur during cooling conditions, which are required year-round in the vast majority of interior office space in many parts of the United States.

Application Data

FLEXSYS UNDERFLOOR AIR DISTRIBUTION SYSTEM

- Traditional Underfloor plenum air distribution systems have been divided into three typical designs:
  - Pressurized plenum with a central packaged rooftop unit providing air to the plenum; air reaches the conditioned space through passive grills/diffusers incorporated in the floor tiles.
  - A zero pressure plenum; air delivered into the conditioned space via local fan-powered (active) supply outlets.
  - Ducted air supply through the underfloor plenum to terminal devices and supply grills/diffusers serving the conditioned space.

- As part of the FlexSys Underfloor Air Design, YORK has developed the Modular Integrated Terminal (MIT), an active device to provide for floor supply of conditioned air. The MIT supply air grilles provide high induction mixing of the conditioned supply air with room air, reducing variances in temperature within the occupied space. Orientation of the grille can be user-adjusted for maximum comfort. Each MIT is designed to meet the cooling requirement of an area occupied by one or more persons. As such, individuals have control over their own environment, providing a truly personalized air conditioning solution.
- The FlexSys MIT line includes a multitude of models, each designed for a specific application: cooling only, perimeter heating, pressure dependent, pressure independent, etc. This variety ensures a complete system solution is available for any type of application.
- A complete range of control devices and schemes is available, each engineered to complement the MIT capabilities.
- MITs can be placed anywhere in the raised floor system to accommodate specific room layouts. If the room configuration needs to change, the MITs can simply be relocated as necessary.
- For more detailed information on FlexSys MIT application and features, please refer to YORK Form 130.15-EG2 (YORK MIT Convection Enhanced Ventilation Technical Manual).

Factory Supplied / Installed Sensors (See Fig. 4)

- **FlexSys Mixed Supply Air Temperature (MSAT) –** This sensor measures the temperature of the supply air leaving the FlexSys configured rooftop unit. This is essentially the same as the SAT on the standard VAV rooftop unit.
- **Evaporator Discharge Air Temperature (SAT) –** This sensor measures the DX evaporator coil leaving air temperature.
- **Return Air Temperature (RAT) –** This sensor measures the temperature of the return air stream.

Factory Supplied / Field Installed Sensors (See Fig. 4)

- **FlexSys UnderFloor Relative Humidity (FLEXRH) –** This sensor is located in the underfloor plenum and measures the relative humidity of the underfloor air. The OptiLogic Controller uses the value from this sensor to calculate the dewpoint of the air in the underfloor plenum. If the dewpoint of the underfloor air is approaching the temperature of the underfloor slab, the controller will reset the evaporator discharge air temperature to a lower value (see next).
- **FlexSys UnderFloor Slab Temperature (SLABTEMP) –** This sensor is located on the concrete slab which makes up the bottom of the underfloor plenum, and measures the temperature of this slab. The OptiLogic Controller uses the value from this sensor in conjunction with the FLEXRH to calculate the dewpoint of the air in the underfloor plenum. If the dewpoint of the underfloor air is approaching the temperature of the underfloor slab, the controller will reset the evaporator discharge air temperature to a lower value.

FlexSys Controller Parameters

- **FlexSys Max. Dewpoint Differential –** This setpoint is used by the controller to determine if the Evaporator Discharge Air Temperature Setpoint should be reset to a value between the VAV High and Low Setpoints for cooling.
- **FlexSys Mixed Supply Air Temperature (MSAT) Setpoint –** This setpoint is the value the controller shall maintain the supply air temperature to on a FlexSys configured unit, (60°F adjustable).
- **FlexSys Dewpoint Reset Enable –** This indicates to the control that the FlexSys Underfloor Humidity (FLEXRH) and Underfloor Slab Temperature sensors are present and enabled for use. If enabled, the setting indicates to the controller that Evaporator Discharge Air Temperature Reset capability should be enabled. In addition, this setting shall be used for alarm purposes. Enabling this setting requires that both the FLEXRH and SLABTEMP sensors must be installed and reliable; or nuisance alarms shall be generated.

FlexSys Bypass Duct Design

Two key considerations to the design of the FlexSys bypass return air ductwork:

1. Location of Ductwork
2. Ductwork Internal Static Pressure Drop

Location of Ductwork

The design of the eco^2 Packaged Rooftop Unit with FlexSys configuration provides for a bypass return air opening in the floor of the unit, underneath the supply air fan. This design necessitates that the bypass return ductwork enters the unit from the bottom. Examples of field installed ductwork are shown in Figure 3.

Ductwork Internal Static Pressure Drop

In order to allow for proper unit air balance on the jobsite, the bypass return air ductwork design must ensure that the internal pressure drop of the duct is equal to the unit internal pressure drop. The ductwork should be sized for 40% of the supply cfm. Using the pressure drop charts, in Tables 1 and 2, unit internal static pressure drop can be calculated. The bypass return ductwork is then sized accordingly (make sure to include the bypass damper pressure drop in the calculations).

RETURN AIR BYPASS DUCT UNDERNEATH ROOF

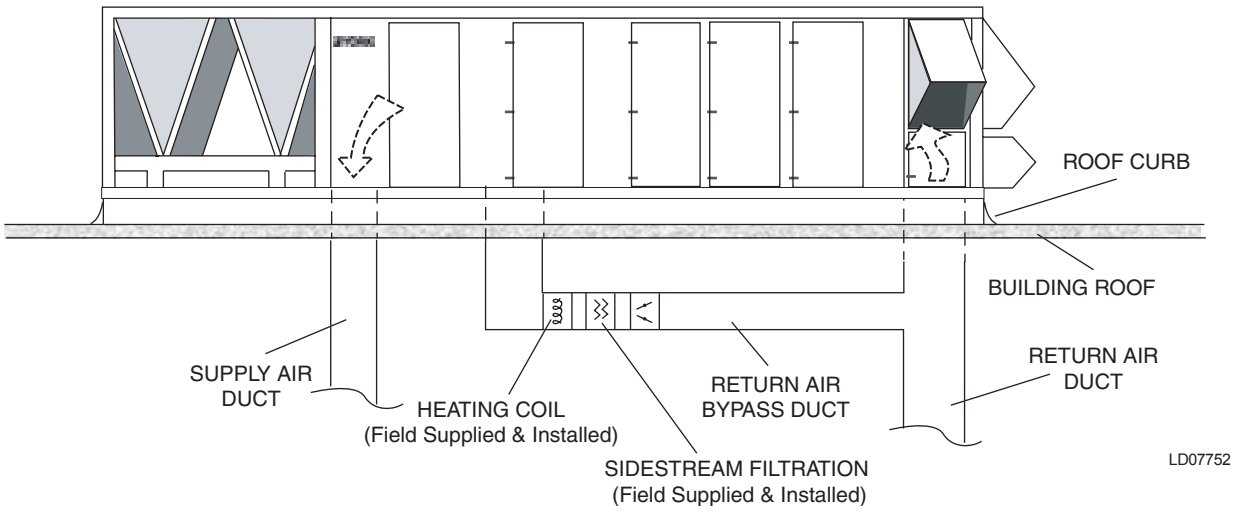
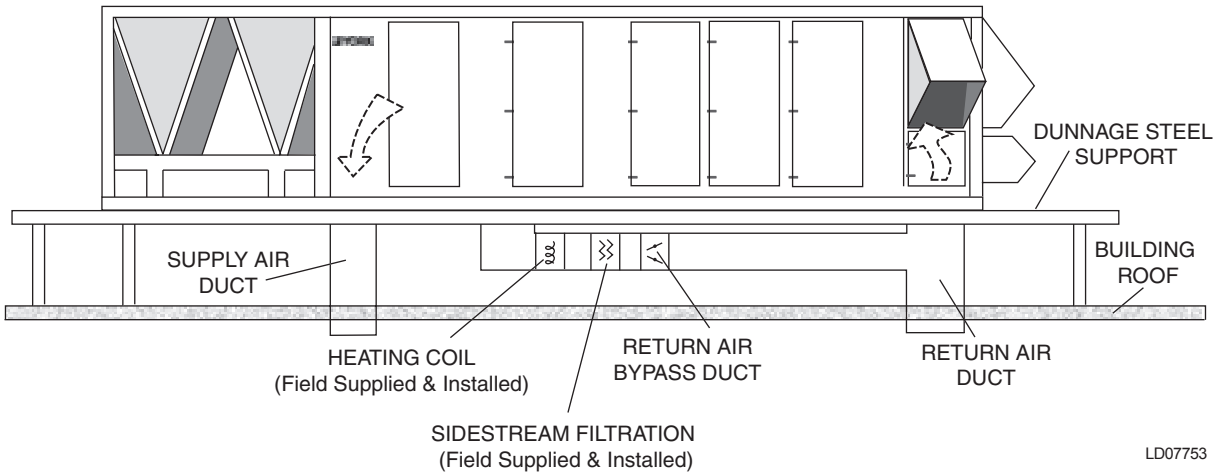


FIG. 3 – TYPICAL APPLICATIONS

RETURN AIR BYPASS DUCT WITH DUNNAGE STEEL MOUNT



RETURN AIR BYPASS DUCT INSIDE CUSTOM HEIGHT ROOF CURB

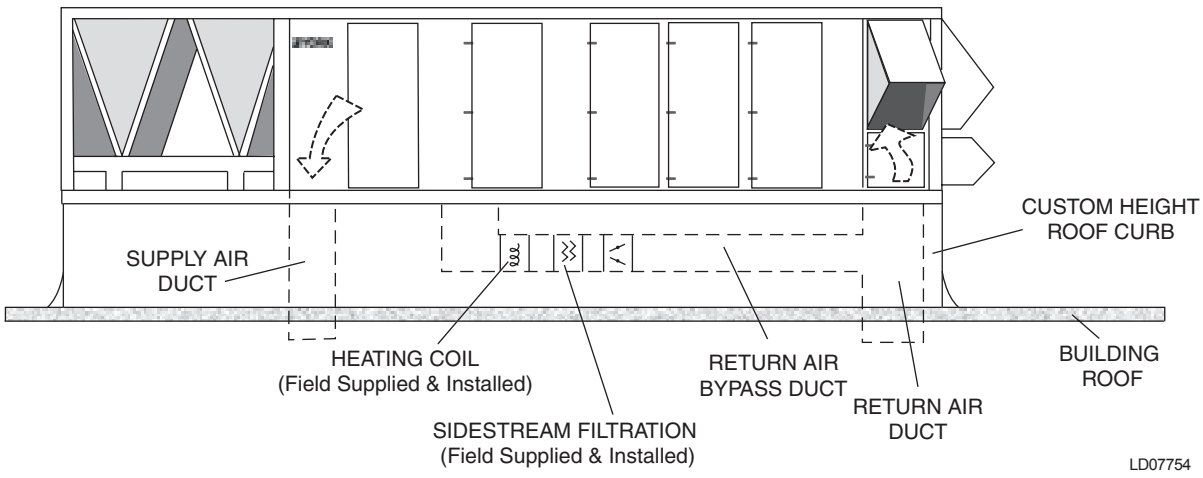


FIG. 3 – TYPICAL APPLICATIONS (CONT'D)

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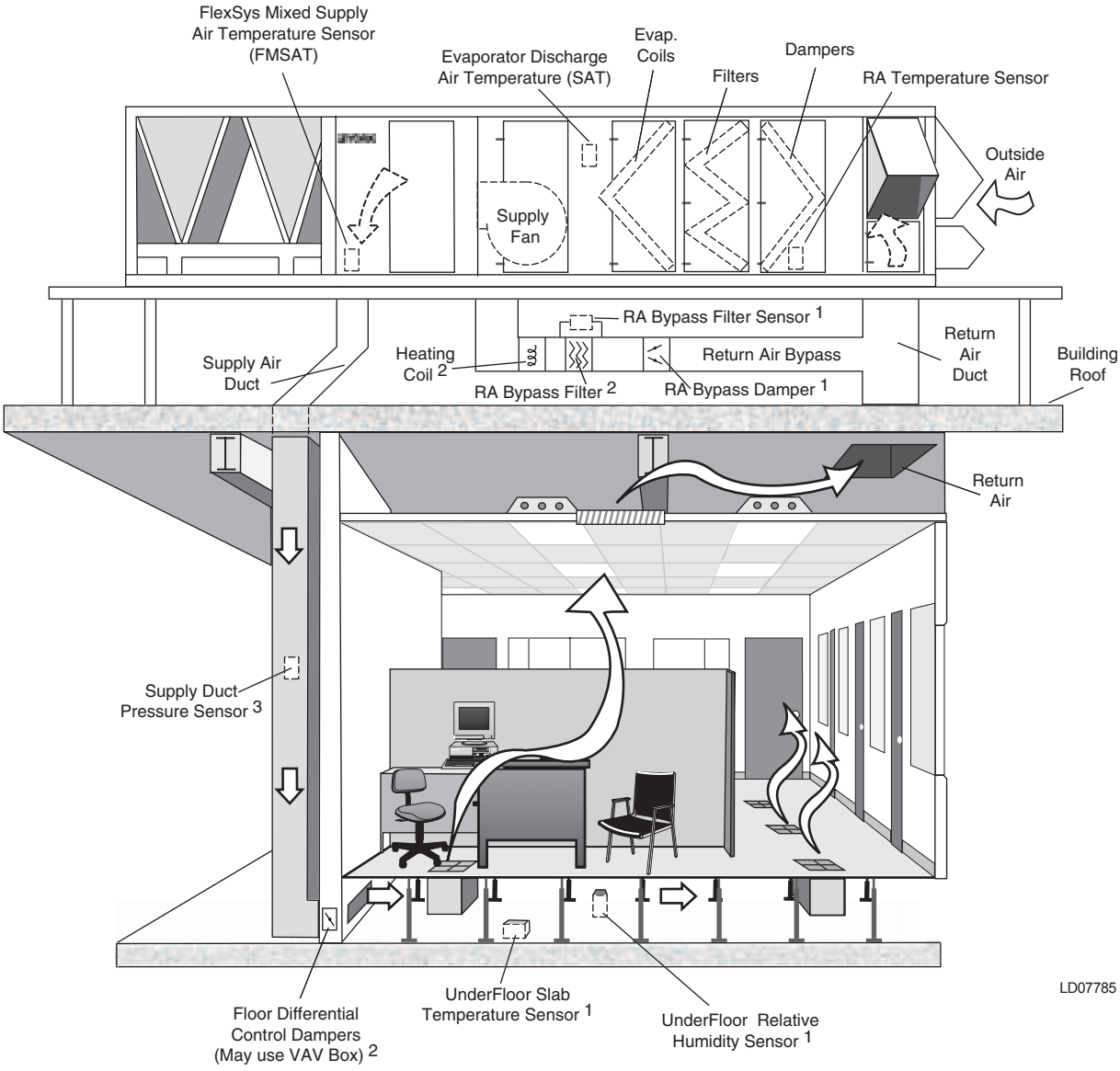


NOTES:

1. Factory Supplied, Ships Loose for Field Installation
2. Field Supplied and Installed
3. Factory Installed Transducer in Unit, Field Supplied and Installed Plastic Tubing and Static Probes

FIG. 4 – FLEXSYS ROOFTOP UNIT CONFIGURATION

FLEXSYS VAV OPTION OPERATION

The FlexSys VAV Option is a Stand-Alone VAV option and does not require a thermostat or zone temperature sensor for operation. Only occupancy input (Binary Input, Internal Scheduling, or BAS) is required for operation.

The FlexSys-configured eco^2 rooftop utilizes warm building air in a bypass arrangement mixed with conditioned air from the evaporator coil in order to provide the recommended 60-65°F dehumidified air. This application takes advantage of recovering energy from the occupied space by bringing bypass air into the rooftop unit downstream of the evaporator coil as shown in Figure 4.

The control of the FlexSys-configured rooftop is very similar to a rooftop configured for overhead VAV in that the same basic VAV control sequences are followed with the exception of the cooling modes. This is required to properly account for and control the bypass airflow.

The control sequences below show how the eco^2 rooftop unit configured for FlexSys controls to the correct discharge air temperature for an underfloor air VAV system

.

Supply Fan and Duct Pressure Control

The OptiLogic™ controls the supply fan on for occupied and off for unoccupied mode. With the fan operating, the OptiLogic™ controller monitors the static pressure within the supply duct system and controls the speed of the supply fan to maintain the Duct Static Pressure setpoint with a factory-mounted supply fan Variable Frequency Drive (VFD).

Application Note: For multiple story applications, the static pressure of the duct is maintained to help ensure proper airflow distribution between floors. For a single story application, the duct static pressure sensor can be used to control the eco^2 rooftop supply fan to the underfloor air pressure. In this case, the rooftop is controlling to the floor plenum pressure rather than the duct pressure. Consult YORK for technical application assistance.

This is the same duct static pressure control sequence as an overhead VAV system. The primary difference is that this system is floor plenum which requires a lower static pressure than an overhead VAV application and reduces fan energy requirements.

FlexSys Control Algorithm for Cooling

The OptiLogic™ controller maintains the discharge air temperature of the unit by modulating the bypass airflow for the right mixture of conditioned air from the evaporator coil, and the bypassed air from the return.

The OptiLogic™ controller monitors the discharge air temperature from the unit (MSAT) and from the air leaving the evaporator coil (SAT). It can also monitor the slab temperature and the underfloor air dew point temperature to determine if further dehumidification control is necessary.

Cooling stages are modulated to maintain a constant SAT to condition the air, while the bypass damper allows the appropriate amount of bypassed air to mix with the conditioned air to maintain the MSAT. During normal operation, the SAT is controlled to maintain the VAV High Temperature setpoint. If dehumidification is required, the current mode of operation is temporarily overridden and the SAT is controlled to the VAV Low Temperature setpoint.

Economizer Operation

Economizer functions and/or mechanical cooling are engaged as necessary to maintain these setpoints.

Unoccupied and Morning Warm Up Modes

During the Unoccupied Modes of operation or during Morning Warm-Up, the bypass damper is driven to full open.

Dehumidification Control

During normal operation, the SAT is controlled to the VAV Cool High Temp setpoint. The SAT is reset to the VAV Cool Low Temp setpoint if either of the following conditions exist: a reset signal from a remote binary input is received by the OptiLogic™ controller, or if the dew point of the underfloor air is approaching the slab temperature. A temperature sensor input is provided in the eco^2 rooftop control cabinet for the slab temperature.

The dew point of the underfloor air is calculated by the OptiLogic™ controller using a field installed relative humidity sensor and the MSAT. For optimum control, the underfloor air relative humidity sensor should be installed near the supply air duct to the floor plenum.

OPTIONAL CONTROL SEQUENCES

Supply Air Tempering

On units with heating options (gas, electric, hot water or steam heat), the OptiLogic™ controller can provide Supply Air Tempering control when all of the following are true: the MSAT is ten degrees below the setpoint, no compressors are operating, the SAT is greater than or equal to five degrees lower than current control setpoint (VAV High or Low Temperature Setpoint), and the bypass damper is fully open.

Once tempering begins, the Bypass damper is fixed at full open and the SAT is allowed to float. The heat is modulated to control to the MSAT. Supply air tempering is disabled when the MSAT plus an offset is satisfied.

RECOMMENDED FIELD-INSTALLED COMPONENTS

Side Stream Filtration

In certain applications, it is desired to filter the bypass airflow. For applications where this is utilized, the OptiLogic controller can accommodate a dirty filter switch for the bypass filters. Field wiring connection is shown in Figure 5.

Supplemental Heating Coil

In certain applications, cooling only eco^2 units may be applied to underfloor designs. It is recommended that a careful review of building design be completed to evaluate the potential for low occupancy periods, morning warm-up or other situations that may require a supplemental heating source to augment the perimeter heating solution. This supplemental source must be field supplied, installed and controlled. Consult YORK for technical application assistance.

eco² FLEXSYS CONFIGURATION

Wiring Notes:

1. Wiring shown indicates typical wiring. Refer to the IOM manual for more detailed wiring methods and options.
2. All wiring is Class 2, low voltage.
3. Maximum power available from the 24VAC terminal is 40VA.
4. Use shielded wire where shown.

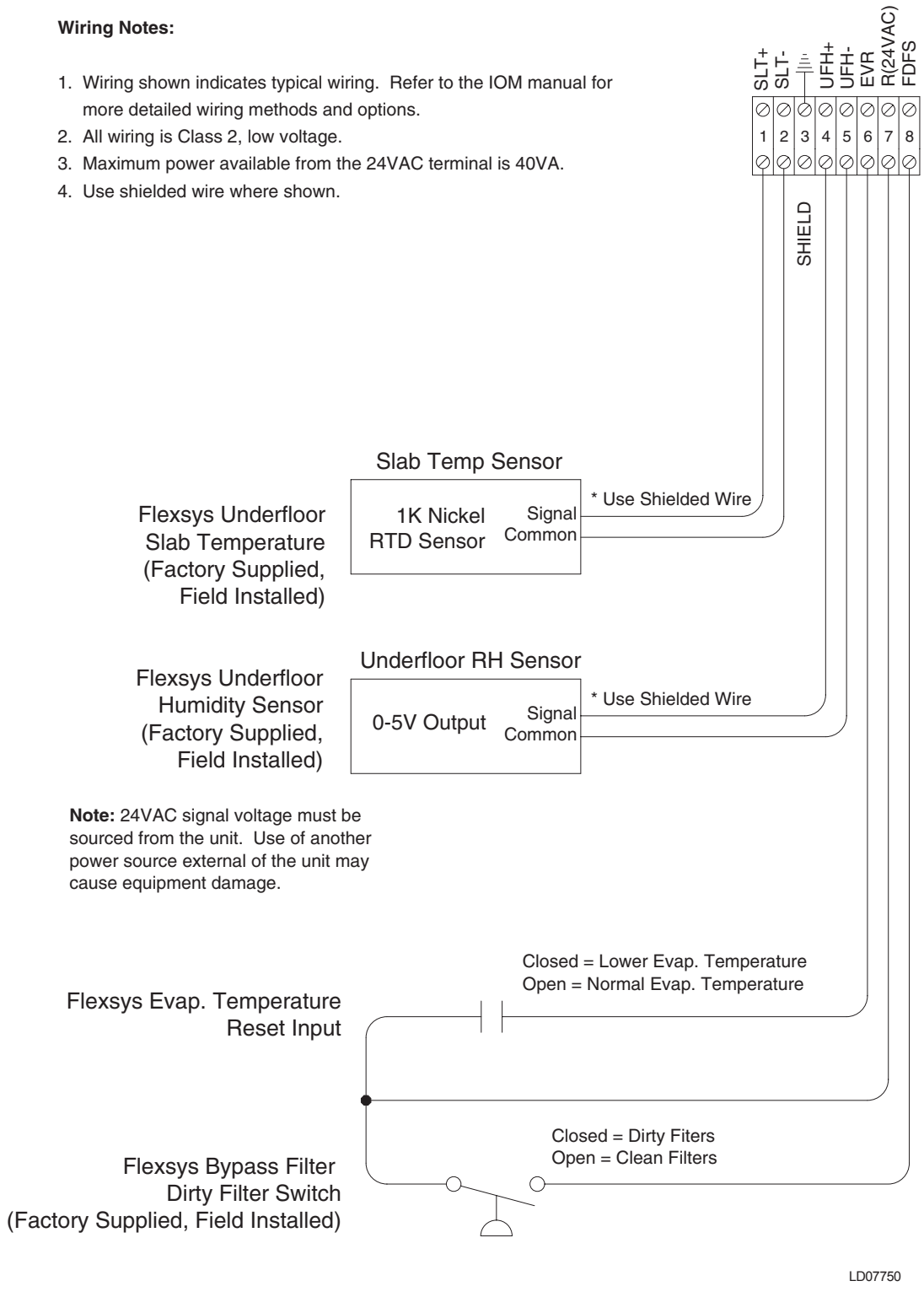


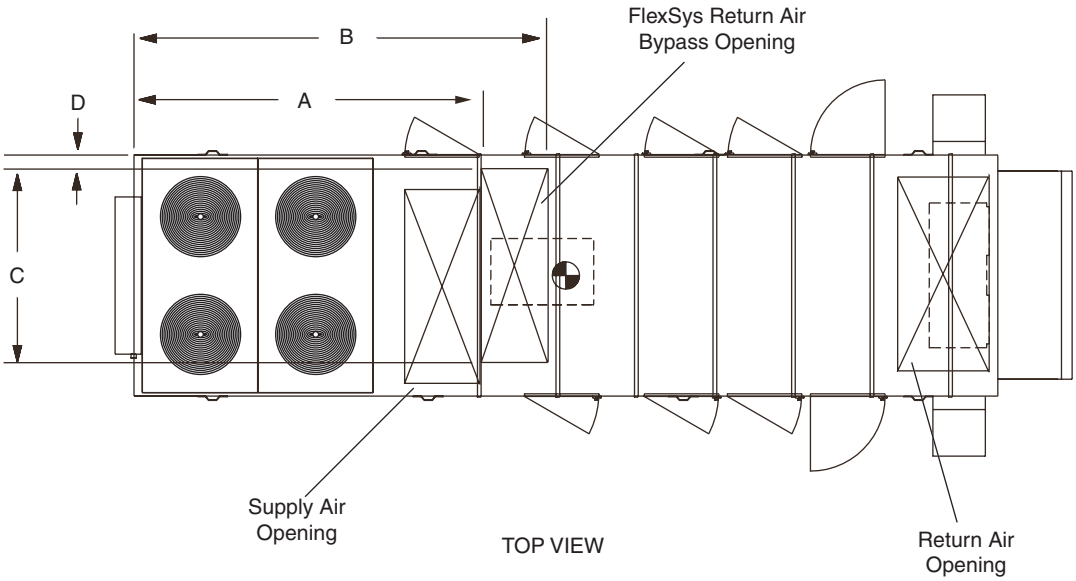
FIG. 5 – eco² FLEXSYS CONFIGURATION

FlexSys Configuration Options

eco^2 PACKAGED ROOFTOP UNIT FLEXSYS OPTIONS

- **FlexSys Unit Option** –The FlexSys Unit Option is the main component of the eco^2 Packaged Rooftop Unit FlexSys Option. This option consists of factory-installed modifications and ship loose items to provide a FlexSys compatible unit. In addition to standard VAV component modifications, the eco^2 unit includes the necessary control components and unit physical changes as follows:
  - Modify Control Software for FlexSys Configuration
  - Factory-installed FlexSys Mixed Supply Air Temperature Sensor (MSAT)
  - Factory-installed Evaporator Discharge Air Temperature Sensor (SAT)
  - Factory-installed, Bottom Return Air Bypass Opening, Located Immediately Underneath the Supply Air Fan
  - Factory Supplied, Ship Loose for Field Installation Underfloor Slab Temperature Sensor
  - Factory Supplied, Ship loose for Field Installation Underfloor Humidity Sensor
  - Factory Supplied, Ship Loose for Field Installation Bypass Air Dirty Filter Switch
- **FlexSys Roof Curb Option** – For FlexSys systems provided with roof curbs, the following optional curb configurations are available to facilitate field-installation:
- **14" FlexSys Roof Curb** – Open Condenser end with bypass damper and control actuator: this option consists of a 14" roof curb and the necessary curb crossmembers to provide a bypass return air opening. A ship loose bypass control damper and electric actuator are provided for field-installation. Note that the curb is shipped unassembled for field installation.
- **14" FlexSys Roof Curb** – Full Perimeter with bypass damper and control actuator: this option consists of a 14" roof curb and the necessary curb crossmembers to provide a bypass return air opening; the curb features a full perimeter design. A ship loose bypass control damper and electric actuator are provided for field-installation. Note that the curb is shipped unassembled for field-installation.
- **14" FlexSys Roof Curb** – Open Condenser end, no bypass damper or control actuator: This option consists of a 14" roof curb and the necessary curb crossmembers to provide a bypass return air opening. Note that the curb is shipped unassembled for field-installation.
- **14" FlexSys Roof Curb** – Full Perimeter, no bypass damper or control actuator: This option consists of a 14" roof curb and the necessary curb crossmembers to provide a bypass return air opening; the curb features a full perimeter design. Note that the curb is shipped unassembled for field-installation.
- **14" FlexSys Roof Curb Kit with Damper and Actuator** – consists of only the necessary curb crossmember to modify an existing 14" high roof curb with a bypass return air opening. A ship loose bypass control damper and electric actuator are provided for field-installation.
- **14" FlexSys Roof Curb Kit with No Damper or Actuator** – consists of only the necessary curb crossmembers to modify an existing 14" high roof curb with a bypass return air opening.

FLEXSYS CONFIGURED PACKAGED ROOFTOP



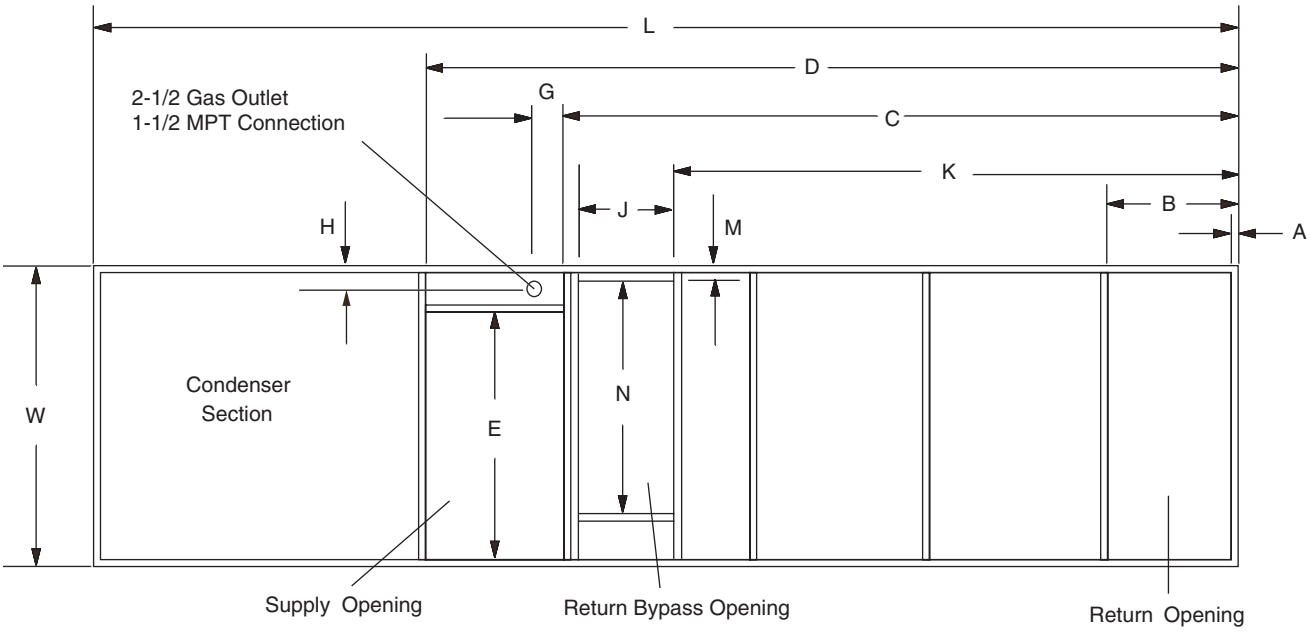
MODEL	A	B	C	D
50 - 65	150-1/2	174-5/8	72-1/4	6-1/2
70 - 85	208-1/2	238-5/8	72-1/4	6-1/2
90 - 95	213-1/2	249-5/8	72-1/4	6-1/2

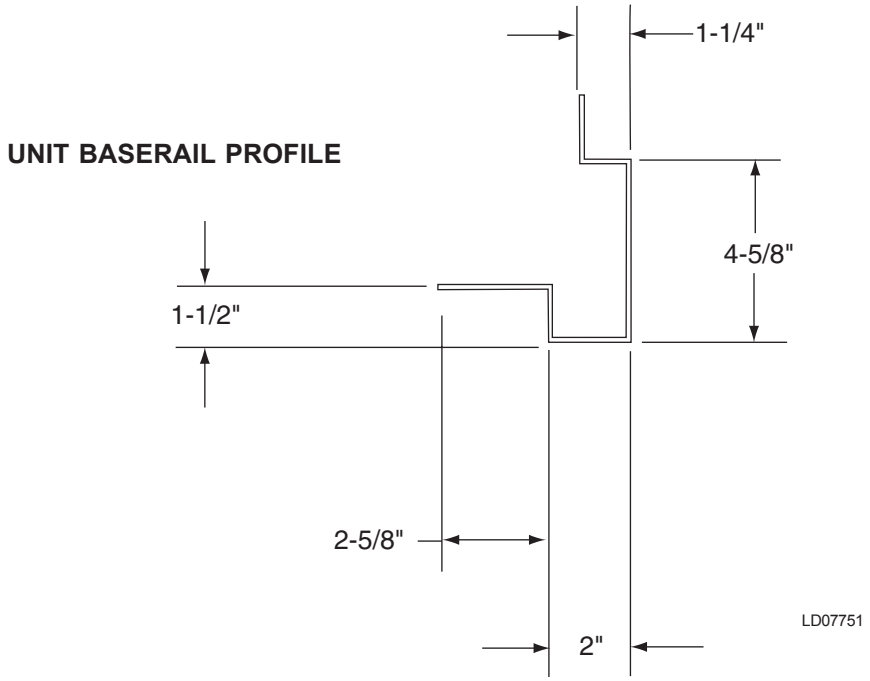
NOTES:

1. FlexSys Return Air Bypass Opening Located in Unit Floor Underneath Supply Fan.
2. Bottom Return/Bottom Supply Unit Shown, Other Arrangements Typical.

FIG. 6 – FLEXSYS RETURN AIR BYPASS OPENING LOCATION

FLEXSYS CURB LAYOUT DRAWING





MODEL	A	B	C	D	E	G	H	J	K	L	M	N	W
50 - 65	2	37-3/4	195	235	71-9/16	16	10-1/4	24-1/8	166-7/8	339	4	72-1/8	87
70 - 85	2	50	247	290	71-9/16	18	10-1/4	30-1/8	212-7/8	449	4	72-1/8	87
90 - 95	2	56-1/4	276	324	71-9/16	24	10-1/4	36-1/8	235-7/8	483	4	72-1/8	87

FIG. 7 – FLEXSYS CURB LAYOUT DRAWING

Component Static Pressure Drops

TABLE 1 – COMPONENT STATIC PRESSURE DROPS (INCHES OF WATER COLUMN)

SIZE	AIR FLOW CFM STD. AIR	EVAPORATOR COILS		RETURN AIR OPENING			FILTERS			
		WET	DRY	BOTTOM	FRONT	SIDE	2" THROWAWAY	2" CLEANABLE	2" PLEATED	2" CARBON
50	10000	0.10	0.07	0.04	0.06	—-	0.05	0.01	0.04	0.08
	12000	0.13	0.10	0.06	0.09	—-	0.07	0.02	0.06	0.11
	14000	0.17	0.12	0.08	0.12	—-	0.09	0.03	0.07	0.14
	16000	0.21	0.15	0.11	0.15	—-	0.11	0.04	0.09	0.16
	17500	0.24	0.18	0.13	0.18	—-	0.12	0.05	0.10	0.19
	18000	0.25	0.19	0.13	0.19	—-	0.13	0.05	0.10	0.19
	20000	0.29	0.22	0.17	0.24	—-	0.15	0.06	0.12	0.2
	21000	0.32	0.24	0.18	0.26	—-	0.16	0.07	0.13	0.24
	22000	0.34	0.26	0.20	0.29	—-	0.17	0.08	0.14	0.26
	24000	0.39	0.30	0.24	0.34	—-	0.19	0.09	0.16	0.29
55	12000	0.17	0.13	0.06	0.09	—-	0.07	0.02	0.06	0.11
	14000	0.22	0.17	0.08	0.12	—-	0.09	0.03	0.07	0.14
	16000	0.27	0.21	0.11	0.15	—-	0.11	0.04	0.09	0.16
	18000	0.32	0.25	0.13	0.19	—-	0.13	0.05	0.10	0.19
	19250	0.36	0.28	0.15	0.22	—-	0.14	0.06	0.12	0.21
	20000	0.38	0.30	0.17	0.24	—-	0.15	0.06	0.12	0.2
	22000	0.44	0.35	0.20	0.29	—-	0.17	0.08	0.14	0.26
	24000	0.50	0.40	0.24	0.34	—-	0.19	0.09	0.16	0.29
60	14000	0.40	0.25	0.08	0.12	—-	0.09	0.03	0.07	0.14
	16000	0.48	0.31	0.11	0.15	—-	0.11	0.04	0.09	0.16
	18000	0.56	0.37	0.13	0.19	—-	0.13	0.05	0.10	0.19
	20000	0.65	0.44	0.17	0.24	—-	0.15	0.06	0.12	0.22
	21000	0.70	0.47	0.18	0.26	—-	0.16	0.07	0.13	0.24
	22000	0.74	0.51	0.20	0.29	—-	0.17	0.08	0.14	0.26
	24000	0.84	0.58	0.24	0.34	—-	0.19	0.09	0.16	0.29
	26000	0.93	0.66	0.28	0.40	—-	0.21	0.11	0.19	0.32
	27000	0.98	0.70	0.30	0.43	—-	0.23	0.12	0.20	0.34
65	14000	0.37	0.25	0.08	0.12	—-	0.09	0.03	0.07	0.14
	16000	0.45	0.32	0.11	0.15	—-	0.11	0.04	0.09	0.16
	18000	0.53	0.38	0.13	0.19	—-	0.13	0.05	0.10	0.19
	20000	0.62	0.45	0.17	0.24	—-	0.15	0.06	0.12	0.22
	21000	0.66	0.49	0.18	0.26	—-	0.16	0.07	0.13	0.24
	22000	0.71	0.53	0.20	0.29	—-	0.17	0.08	0.14	0.26
	24000	0.80	0.61	0.24	0.34	—-	0.19	0.09	0.16	0.29
	26000	0.90	0.69	0.28	0.40	—-	0.21	0.11	0.19	0.32
	27000	0.95	0.73	0.30	0.43	—-	0.23	0.12	0.20	0.34
70	14000	0.20	0.12	0.04	0.07	0.12	0.06	0.02	0.05	0.10
	16000	0.24	0.15	0.06	0.09	0.16	0.08	0.02	0.06	0.12
	18000	0.29	0.18	0.07	0.11	0.20	0.09	0.03	0.07	0.14
	20000	0.33	0.22	0.09	0.14	0.25	0.11	0.04	0.09	0.16
	22000	0.38	0.26	0.11	0.17	0.30	0.12	0.05	0.10	0.19
	24000	0.44	0.30	0.13	0.20	0.35	0.14	0.06	0.12	0.21
	26000	0.49	0.34	0.15	0.23	0.41	0.15	0.07	0.13	0.24
	28000	0.55	0.38	0.18	0.27	0.48	0.17	0.08	0.15	0.26
	30000	0.61	0.43	0.20	0.31	0.55	0.19	0.09	0.16	0.2
75	14000	0.33	0.20	0.04	0.07	0.12	0.06	0.02	0.05	0.10
	16000	0.39	0.25	0.06	0.09	0.16	0.08	0.02	0.06	0.12
	18000	0.46	0.30	0.07	0.11	0.20	0.09	0.03	0.07	0.14
	20000	0.53	0.35	0.09	0.14	0.25	0.11	0.04	0.09	0.16
	22000	0.61	0.41	0.11	0.17	0.30	0.12	0.05	0.10	0.19
	24000	0.68	0.47	0.13	0.20	0.35	0.14	0.06	0.12	0.21
	26000	0.76	0.54	0.15	0.23	0.41	0.15	0.07	0.13	0.24
	28000	0.84	0.61	0.18	0.27	0.48	0.17	0.08	0.15	0.26
	30000	0.92	0.68	0.20	0.31	0.55	0.19	0.09	0.16	0.29

NOTES: *Includes 2" pleated filters. ** Power exhaust pressure drops are for sizing supply fan.

FILTERS			ECONOMIZER	ECONOMIZER		POWERED
RIGID FILTER RACK, NO MEDIA	12" RIGID, 65%*	12" RIGID, 95%*	FRESH AIR OPENINGS	MANUAL OR 2-POSITION	0-100% MODULATION	EXHAUST
0.09	0.21	0.30	0.07	0.03	0.11	0.01
0.12	0.28	0.38	0.11	0.04	0.16	0.01
0.15	0.34	0.46	0.15	0.05	0.21	0.02
0.18	0.42	0.55	0.20	0.07	0.26	0.03
0.20	0.47	0.62	0.24	0.08	0.31	0.03
0.21	0.49	0.65	0.25	0.09	0.32	0.03
0.25	0.58	0.74	0.31	0.11	0.39	0.04
0.27	0.62	0.79	0.35	0.12	0.42	0.04
0.28	0.66	0.84	0.38	0.13	0.46	0.05
0.32	0.75	0.95	0.46	0.15	0.54	0.06
0.12	0.28	0.38	0.11	0.04	0.16	0.01
0.15	0.34	0.46	0.15	0.05	0.21	0.02
0.18	0.42	0.55	0.20	0.07	0.26	0.03
0.21	0.49	0.65	0.25	0.09	0.32	0.03
0.23	0.54	0.71	0.29	0.10	0.36	0.04
0.25	0.58	0.74	0.31	0.11	0.39	0.04
0.28	0.66	0.84	0.38	0.13	0.46	0.05
0.32	0.75	0.95	0.46	0.15	0.54	0.06
0.15	0.34	0.46	0.15	0.05	0.21	0.02
0.18	0.42	0.55	0.20	0.07	0.26	0.03
0.21	0.49	0.65	0.25	0.09	0.32	0.03
0.25	0.58	0.74	0.31	0.11	0.39	0.04
0.27	0.62	0.79	0.35	0.12	0.42	0.04
0.28	0.66	0.84	0.38	0.13	0.46	0.05
0.32	0.75	0.95	0.46	0.15	0.54	0.06
0.36	0.84	1.06	0.55	0.18	0.62	0.07
0.38	0.89	1.11	0.59	0.20	0.67	0.07
0.15	0.34	0.46	0.15	0.05	0.21	0.02
0.18	0.42	0.55	0.20	0.07	0.26	0.03
0.21	0.49	0.65	0.25	0.09	0.32	0.03
0.25	0.58	0.74	0.31	0.11	0.39	0.04
0.27	0.62	0.79	0.35	0.12	0.42	0.04
0.28	0.66	0.84	0.38	0.13	0.46	0.05
0.32	0.75	0.95	0.46	0.15	0.54	0.06
0.36	0.84	1.06	0.55	0.18	0.62	0.07
0.38	0.89	1.11	0.59	0.20	0.67	0.07
0.10	0.24	0.33	0.08	0.05	0.12	0.01
0.12	0.29	0.39	0.11	0.07	0.15	0.01
0.14	0.34	0.46	0.14	0.09	0.19	0.02
0.17	0.40	0.53	0.17	0.11	0.23	0.02
0.19	0.45	0.60	0.21	0.13	0.27	0.02
0.22	0.51	0.67	0.25	0.15	0.31	0.03
0.25	0.58	0.75	0.30	0.18	0.36	0.03
0.28	0.64	0.82	0.35	0.21	0.41	0.04
0.31	0.71	0.90	0.40	0.24	0.47	0.04
0.10	0.24	0.33	0.08	0.05	0.12	0.01
0.12	0.29	0.39	0.11	0.07	0.15	0.01
0.14	0.34	0.46	0.14	0.09	0.19	0.02
0.17	0.40	0.53	0.17	0.11	0.23	0.02
0.19	0.45	0.60	0.21	0.13	0.27	0.02
0.22	0.51	0.67	0.25	0.15	0.31	0.03
0.25	0.58	0.75	0.30	0.18	0.36	0.03
0.28	0.64	0.82	0.35	0.21	0.41	0.04
0.31	0.71	0.90	0.40	0.24	0.47	0.04

Component Static Pressure Drops *(continued)*

TABLE 1 – COMPONENT STATIC PRESSURE DROPS (INCHES OF WATER COLUMN)

SIZE	AIR FLOW CFM STD. AIR	EVAPORATOR COILS		RETURN AIR OPENING			FILTERS			
		WET	DRY	BOTTOM	FRONT	SIDE	2" THROWAWAY	2" CLEANABLE	2" PLEATED	2" CARBON
80	16000	0.23	0.16	0.06	0.09	0.16	0.08	0.02	0.06	0.12
	18000	0.27	0.19	0.07	0.11	0.20	0.09	0.03	0.07	0.14
	20000	0.32	0.23	0.09	0.14	0.25	0.11	0.04	0.09	0.16
	22000	0.36	0.27	0.11	0.17	0.30	0.12	0.05	0.10	0.19
	24000	0.41	0.31	0.13	0.20	0.35	0.14	0.06	0.12	0.21
	26000	0.47	0.35	0.15	0.23	0.41	0.15	0.07	0.13	0.24
	28000	0.52	0.39	0.18	0.27	0.48	0.17	0.08	0.15	0.20
	30000	0.58	0.44	0.20	0.31	0.55	0.19	0.09	0.16	0.29
	32000	0.63	0.49	0.23	0.35	0.63	0.21	0.10	0.18	0.30
85	16000	0.32	0.21	0.06	0.09	0.16	0.08	0.02	0.06	0.12
	18000	0.38	0.25	0.07	0.11	0.20	0.09	0.03	0.07	0.14
	20000	0.44	0.30	0.09	0.14	0.25	0.11	0.04	0.09	0.16
	22000	0.51	0.35	0.11	0.17	0.30	0.12	0.05	0.10	0.19
	24000	0.58	0.40	0.13	0.20	0.35	0.14	0.06	0.12	0.21
	26000	0.65	0.46	0.15	0.23	0.41	0.15	0.07	0.13	0.24
	28000	0.72	0.52	0.18	0.27	0.48	0.17	0.08	0.15	0.26
	30000	0.80	0.58	0.20	0.31	0.55	0.19	0.09	0.16	0.29
	32000	0.88	0.65	0.23	0.35	0.63	0.21	0.10	0.18	0.30
90	18000	0.34	0.23	0.06	0.11	0.16	0.07	0.02	0.06	0.11
	20000	0.40	0.27	0.07	0.14	0.20	0.08	0.03	0.06	0.13
	22000	0.46	0.32	0.09	0.17	0.24	0.09	0.03	0.08	0.14
	24000	0.53	0.36	0.10	0.20	0.28	0.11	0.04	0.09	0.16
	26000	0.60	0.41	0.12	0.23	0.33	0.12	0.05	0.10	0.10
	28000	0.66	0.47	0.14	0.27	0.39	0.13	0.05	0.11	0.20
	30000	0.74	0.52	0.16	0.31	0.44	0.15	0.06	0.12	0.22
	32000	0.81	0.58	0.18	0.35	0.51	0.16	0.07	0.14	0.24
	34000	0.89	0.64	0.21	0.40	0.57	0.18	0.08	0.15	0.27
	36000	0.97	0.70	0.23	0.45	0.64	0.19	0.09	0.16	0.2
95	18000	0.46	0.29	0.06	0.11	0.16	0.07	0.02	0.06	0.11
	20000	0.53	0.34	0.07	0.14	0.20	0.08	0.03	0.06	0.13
	22000	0.61	0.40	0.09	0.17	0.24	0.09	0.03	0.08	0.14
	24000	0.70	0.46	0.10	0.20	0.28	0.11	0.04	0.09	0.1
	26000	0.78	0.52	0.12	0.23	0.33	0.12	0.05	0.10	0.18
	28000	0.87	0.58	0.14	0.27	0.39	0.13	0.05	0.11	0.20
	30000	0.97	0.65	0.16	0.31	0.44	0.15	0.06	0.12	0.22
	32000	1.06	0.73	0.18	0.35	0.51	0.16	0.07	0.14	0.24
	34000	1.16	0.80	0.21	0.40	0.57	0.18	0.08	0.15	0.27
	36000	1.26	0.88	0.23	0.45	0.64	0.19	0.09	0.16	0.29

NOTES: *Includes 2" pleated filters. ** Power exhaust pressure drops are for sizing supply fan.

FILTERS			ECONOMIZER	ECONOMIZER		POWERED
RIGID FILTER RACK, NO MEDIA	12" RIGID, 65%*	12" RIGID, 95%*	FRESH AIR OPENINGS	MANUAL OR 2-POSITION	0-100% MODULATION	EXHAUST**
0.12	0.29	0.39	0.11	0.07	0.15	0.01
0.14	0.34	0.46	0.14	0.09	0.19	0.02
0.17	0.40	0.53	0.17	0.11	0.23	0.02
0.19	0.45	0.60	0.21	0.13	0.27	0.02
0.22	0.51	0.67	0.25	0.15	0.31	0.03
0.25	0.58	0.75	0.30	0.18	0.36	0.03
0.28	0.64	0.82	0.35	0.21	0.41	0.04
0.31	0.71	0.90	0.40	0.24	0.47	0.04
0.34	0.78	0.98	0.46	0.27	0.52	0.05
0.12	0.29	0.39	0.11	0.07	0.15	0.01
0.14	0.34	0.46	0.14	0.09	0.19	0.02
0.17	0.40	0.53	0.17	0.11	0.23	0.02
0.19	0.45	0.60	0.21	0.13	0.27	0.02
0.22	0.51	0.67	0.25	0.15	0.31	0.03
0.25	0.58	0.75	0.30	0.18	0.36	0.03
0.28	0.64	0.82	0.35	0.21	0.41	0.04
0.31	0.71	0.90	0.40	0.24	0.47	0.04
0.34	0.78	0.98	0.46	0.27	0.52	0.05
0.07	0.29	0.40	0.11	0.06	0.16	0.01
0.08	0.34	0.46	0.13	0.07	0.19	0.01
0.09	0.39	0.52	0.16	0.09	0.22	0.02
0.11	0.45	0.59	0.20	0.10	0.26	0.02
0.12	0.50	0.65	0.23	0.12	0.30	0.02
0.13	0.56	0.72	0.27	0.14	0.34	0.03
0.15	0.61	0.79	0.31	0.16	0.39	0.03
0.16	0.67	0.86	0.36	0.18	0.44	0.03
0.18	0.74	0.93	0.41	0.20	0.49	0.04
0.19	0.80	1.01	0.46	0.23	0.54	0.04
0.07	0.29	0.40	0.11	0.06	0.16	0.01
0.08	0.34	0.46	0.13	0.07	0.19	0.01
0.09	0.39	0.52	0.16	0.09	0.22	0.02
0.11	0.45	0.59	0.20	0.10	0.26	0.02
0.12	0.50	0.65	0.23	0.12	0.30	0.02
0.13	0.56	0.72	0.27	0.14	0.34	0.03
0.15	0.61	0.79	0.31	0.16	0.39	0.03
0.16	0.67	0.86	0.36	0.18	0.44	0.03
0.18	0.74	0.93	0.41	0.20	0.49	0.04
0.19	0.80	1.01	0.46	0.23	0.54	0.04

Component Static Pressure Drops *(continued)*

TABLE 2 – BYPASS AIR PRESSURE DROPS

SIZE	AIR FLOW CFM STD. AIR	MIT BYPASS DAMPER	MIT BYPASS OPENING IN UNIT
50	4000	0.01	†
	6000	0.02	0.01
	8000	0.03	0.01
	10000	0.05	0.02
	12000	0.06	0.03
55	4000	0.01	†
	6000	0.02	0.01
	8000	0.03	0.01
	10000	0.05	0.02
	12000	0.06	0.03
	14000	0.08	0.04
60	4000	0.01	†
	6000	0.02	0.01
	8000	0.03	0.01
	10000	0.04	0.02
	12000	0.05	0.02
	14000	0.07	0.03
65	4000	0.01	†
	6000	0.02	0.01
	8000	0.03	0.01
	10000	0.05	0.02
	12000	0.06	0.03
	14000	0.08	0.04
70	6000	0.01	†
	8000	0.02	0.01
	10000	0.03	0.01
	12000	0.04	0.02
	14000	0.05	0.02
	16000	0.07	0.03
75	6000	0.01	†
	8000	0.02	0.01
	10000	0.03	0.01
	12000	0.04	0.02
	14000	0.05	0.02
	16000	0.07	0.03
80	6000	0.01	†
	8000	0.02	0.01
	10000	0.03	0.01
	12000	0.04	0.02
	14000	0.05	0.02
	16000	0.07	0.03
85	6000	0.01	†
	8000	0.02	0.01
	10000	0.03	0.01
	12000	0.04	0.02
	14000	0.05	0.02
	16000	0.06	0.03
90	6000	0.01	†
	8000	0.01	0.01
	10000	0.02	0.01
	12000	0.03	0.01
	14000	0.04	0.02
	16000	0.05	0.02
	18000	0.06	0.03
95	6000	0.01	†
	8000	0.01	0.01
	10000	0.02	0.01
	12000	0.03	0.01
	14000	0.04	0.02
	16000	0.05	0.02
	18000	0.06	0.03

† Indicates pressure drop is below 0.005 in. w.c.

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