How YCCS Zoning Works

The YCCS zoning control system converts single-zone constant volume rooftop packaged HVAC units into variable air volume/variable temperature multiple zone systems. The Zone Coordinator calculates the heating and cooling requirements for each zone based on real time information received from each Zone Controller/Damper. The Zone Coordinator then directs the HVAC unit to provide the appropriate amount of heating, cooling, and ventilation to satisfy each zone's requirements. A bypass damper controlled by a static air pressure sensor modulates to maintain constant duct pressure.

The YCCS zoning system uses a simple approach to controlling the system:

- Voting Zones
- Adaptive Tuning

This system works in an integrated fashion to maintain proper control of the equipment and effective control of comfort in the zone.
What Is Unique About YCCS?

YCCS is unique because it has many features not found on other systems. These features include:

Integrated Equipment Design

YCCS is not just controls and it’s not just equipment. Its truly an integrated system with components that are factory installed and programmed at the manufacturing location. This ensures minimal commissioning and start-up time. More important, it allows a contractor with limited controls experience to easily install the YCCS system.

Pre-Engineered Software

All programming is done at the factory using pre-designed and tested applications for the equipment controls. No special commissioning tools needed.

One System for Zoned or Single Zone Systems

Not only does YCCS provide a networked zone control system for one or multiple zoned HVAC units, you can also connect individual single zone units to the system eliminating the need to use programmable thermostats.

Easy to Configure

Since YCCS components are grouped into packages, configuring a system has been simplified. This reduces the chance of ordering errors and makes system layout effortless!

User Friendly Set Up

Since the YCCS system is designed for simple, menu driven configuration, system setup is simple. Default parameter values are programmed into permanent memory so the system can be operational at start-up. Specialized training is not required.

True Network Communications

The YCCS controllers use an industry standard open protocol, BACnet MS/TP. This is a three wire, RS-485 loop for communication between all controllers in the system. This provides a very reliable form of communication with flexibility of installation. Many other zoning systems utilize “home run” wiring that requires all communication cables to be brought back to a central point adding additional cost to the project and complicating wiring.

Advanced DDC Controllers

All controllers in the YCCS system are start of the art direct digital controllers. This is what gives the YCCS system powerful features and capabilities not found in other systems. Self tuning control loops and advanced diagnostics provide simple and easy start-up. Facility tenants can rest assured that the controls will respond quickly and efficiently as environmental conditions change.

Stand-Alone Systems

All YCCS systems are true stand-alone and do not require a computer to operate. DDC controllers maintain their own control loops and setpoints.

Menu Driven Operators' Interface

All YCCS systems have an innovative color touch-screen interface. This gives you access to system status and parameter values without the need for a computer. Intuitive navigation screens ensure operating the system does is simple for operating and maintenance personnel. In addition, the interface panel is password protected to keep unauthorized users from modifying the system.

Modulating, Heavy Duty Actuators

All YCCS actuators utilize true modulating control unlike many systems, which are two position. This gives the system-improved control, which translates, to better comfort levels.

Commercial Grade Round Damper

YCCS zone damper assemblies only uses commercial grade dampers, not cheap, flimsy, “light commercial” or “residential” style dampers like many other manufacturers. The damper assemblies are delivered with all control components factory mounted, wired, and programmed.
What Is Unique About YCCS?

Color Touch-Screen User Interface

Each YCCS system includes a 7" diagonal color touch-screen which acts as the primary local user interface. Menus screens are easily navigated by simply touching your finger on navigation buttons displayed in the display. All zones and equipment are monitored through this panel. Schedules can be added or modified and setpoints can be tailored to specific building requirements. An array of diagnostic information is available including detailed equipment alarms and critical trend information. Alarm information can be transmitted to e-mail systems via the onboard Ethernet connection or sent to pagers with the onboard modem. All this is available without the use of a computer.

Remote Web Browser Interface

Included within the System Manager or Zone Coordinator is a remote web server which allows remote connections to the facility using a simple web browser. There is no special software required on the remote PC other than a simple web browser (i.e. Internet Explorer). All site functions can be monitored remotely through the browser window. Screen layouts are almost identical to the local interface so you don't have to become familiar with a new software package.

Advanced Technology DDC Controllers

YCCS Zone, Bypass, and Rooftop Unit (RTU) controllers all use the latest in direct digital technology. Patented control algorithms are embedded in every controller and allow each to continuously auto-tune the equipment operation. This allows the controllers to adjust automatically for seasonal changes in environment, maximize energy efficiency, and minimize operator intervention. All of this happens automatically while maintaining optimum environmental conditions.

Integration with Equipment

Unlike other systems in the past that required field installation of the controls, all YCCS components are available as factory mounted assemblies. Rooftop units are shipped with the control components mounted, wired, and programmed. Zone and bypass dampers are shipped with the controller and actuator mounted wired and programmed. This greatly reduces installation complexity. In addition, the YCCS controls and RTU safety board communicate directly to each other. This ensures quick notification of alarm condition in the event the primary HVAC equipment encounters an abnormal state.

Zoning Systems Versus True VAV Systems

General

Even though there are some similarities between zone control systems and Variable Air Volume (VAV) systems, there are some major differences. In many cases systems will be called VAV when in fact they are really a zoning system or are referred to as a zoning system when they are really a VAV system. Always make sure that you do not try to adapt a zoning system to a VAV design system. Understanding the differences will help you to prevent misapplication of the YCCS zoning system. In the paragraphs that follow we will try to explain the differences, advantages and disadvantages of each and explain their operation.

VAV Systems

These systems consist of an HVAC unit that is generally a cooling only unit and VAV terminal units located in the downstream ductwork that are used to control the amount of constant temperature air delivered to the various building zones. Sometimes the HVAC unit may have gas or electric heat, but it is typically sized and applied for morning warm-up purposes. The HVAC unit is designed to vary the volume of air that is supplied to the duct system by using either inlet vanes or an electronic variable frequency drive. These devices modulate to control the air flow through the supply fan in response to the static pressure in the duct system. VAV systems typically use high velocity VAV terminal units to distribute the air to the zones. As the various VAV terminal units in the different zones open and close to supply the constant temperature air to the spaces, the HVAC unit varies the volume of constant temperature air based on the static pressure in the ductwork. The HVAC unit is designed to maintain a constant cold supply air temperature regardless of the air flow volume in the system. It typically runs continuously based on a schedule. For perimeter zones requiring heat, reheat coils (electric or hot water) located in the terminal units are used to supply heated air to the space. Many times fan powered terminal boxes are used and in many cases also incorporate electric
or hot water heating coils to provide perimeter zone heating. In summary a true VAV system uses a variable volume fan supplying constant temperature air to the system with variable volume terminal units used to control the volume of constant temperature air delivered to the space. Generally these systems use pressure independent damper control.

With the zoning system the zone dampers are generally pressure dependent. Pressure independent operation is available but is not very common. Reheat and/or fan powered terminal units can be used but aren’t commonly part of the typical zoning system.

**YCCS Zoning Systems**

The YCCS zoning system is completely different in operation and design from the VAV system previously discussed. One of the major differences between the zoning system and a true VAV system is that the HVAC unit used on a zoning system utilizes a constant volume fan. Air volume control of the zoning system is achieved by bypassing air from the HVAC unit supply duct back into the HVAC unit return air duct on the unit inlet. This bypass air is controlled based on a static pressure sensor located in the supply air duct downstream of the unit supply air discharge. The bypass damper modulates open and closed based on the static pressure in the duct. The temperature at the HVAC unit discharge varies in relation to the demand from the zones. Typically the HVAC units used for the zoning system will have both heating and cooling capabilities. The fan supplies a constant volume of cold or hot air to the duct system which is then fed to the individual zones by modulating zone dampers. Each zone controller relays its heating or cooling demand to the HVAC unit controller. The HVAC unit controller determines its mode of operation (heating, cooling or vent mode) depending on the demand from the zone controllers. The unit controller utilizes a voting system to determine the correct mode of operation. Each zone controller determines (based on its heating and cooling setpoints) whether or not to use the air being supplied by the HVAC unit. For example, one of the zones is calling for cooling when the temperature in the duct is above the zones cooling setpoint. This zone will move to its minimum cooling position to prevent warm air being introduced into the space.

**Conclusion**

In some cases VAV systems go over budget because of the increased cost of a VAV HVAC unit and the expensive VAV controls associated with the system. Many times the system can be redesigned to a zoning system using YCCS controls with a significant cost savings when compared to a VAV system. Be sure to follow the instructions in this design guide for your zoning system.

**Basics of Designing A Zoning System**

This is a summary of the key items you need to consider for the design and layout of a successful zoning system.

*It is important that you study the design guide for a more in depth understanding of proper system design.*

By following the design guide and these tips you can eliminate many unnecessary headaches that occur when the basic rules of zoning are not followed. Always contact your York Unitary applications group at 1-877-UPG-SERV if you have any questions.

- *Always group zones with similar load profiles on the same HVAC unit.*
- *Never mix perimeter zones with interior zones on the same HVAC unit.*
• "Each zoned HVAC unit should have a minimum of 3 to 4 zones. Any less and you should consult the factory.

• "Each zoned HVAC unit can support a maximum of 24 voting zones.

• "Never attempt to use a zone control system on a true VAV application. See "Zoning Systems Versus True VAV Systems" on page 9 of this guide for detailed information.

• "Bypass dampers should always be sized for 60%-70% of the HVAC units rated CFM.

• "Even though the YCCS system has certain features to help protect your equipment, never override or disconnect any safety devices associated with the HVAC unit.

Design Considerations

Load Diversity

A zoning system is designed to improve tenant comfort by dynamically rebalancing the air distribution when used with a typical constant volume rooftop heating/cooling unit. If zones with extremely different load conditions are serviced by a single rooftop unit, the result will be poor control and excessive wear due to cycling of the equipment.

It is especially important to avoid mixing interior zones (which require cooling all year) with exterior zones (which may require constant heat during winter months).

Group similar loads on an individual unit and use more than one zoned unit if required. Any special loads can be handled by using separate constant volume units.

The YCCS system offers the designer considerable flexibility by allowing both multiple-zoned units and single-zone units to be connected within a single simple system.

Cooling - Partial Load Conditions

The engineer must be aware of several potential problems when applying a zoning system for cold weather operation.

1. Low Ambient Temperature Lockout. During very cold weather it is common for mechanical systems to have "low temperature lockouts" which protect equipment from damage if operated under these conditions. YCCS also provides user programmed lockouts for protection purposes, although mechanical safety devices should always be used as the final stage of protection.

If the rooftop unit services interior zones with thermal loads, which require cooling when outside temperatures are below the safe operating limits for your equipment, you should seriously consider installing an economizer on your rooftop unit. The YCCS control system is designed to take advantage of an economizer if it is installed. The use of an economizer will save money on utilities and provide comfort under conditions when it is not possible to operate the mechanical cooling system.

2. Low Supply Air Temperatures. Under lightly loaded conditions much of the supply air may be bypassed back into the return air side of the HVAC unit. This bypassing will result in the lowering of the supply air temperature, which may result in the supply air temperature reaching the low temperature safety limit. If the supply air low temperature safety limit is exceeded, the control system will "cut off" the mechanical cooling to protect it from damage. Excessive cycling of the mechanical system will result if this condition persists. Comfort may also suffer if the system cannot run long enough to satisfy cooling demands.

A number of things can be done to reduce this problem. Some of these things depend upon the type of installation.

Avoid oversizing the unit. Do your all load calculations carefully. Since the zoning system directs the heating or cooling to the zones which require it, you may find that you can use a smaller unit in many cases. Oversizing is the number one cause of excessive low supply air temperature cycling.

Use an economizer. Although this is not a cure-all, it greatly improves operation during cool weather when cooling loads are minimal. Using an economizer also improves ventilation and lowers operating costs.

Increase cooling minimum airflow. Increase your cooling minimum airflow or damper position settings to allow more air during cooling operation. Be careful to avoid minimum settings that are so high they may cause over cooling of the spaces.

Bypass the air into the ceiling plenum. If you have a system without ducted return, bypass the air into the ceiling plenum instead of into the return air intake. Be careful if you use this method since you may get "dumping" of cold air from your return air grilles. This method works best with plenum returns. Do not use this method with ducted returns.

Increase your static pressure setpoint. This will help reduce the amount of air being bypassed. Be aware of increased noise levels and the cost of operation if you use excessive static pressures. This will not work if you are using pressure independent zone controllers, since they will maintain a constant flow of air to the zones regardless of duct
static pressure. This technique will likely cause over cooling of the spaces due to increased airflow at minimum positions.

**WARNING**

If the fan system has the capability of producing static pressures which could damage ductwork you must provide a manual reset, high pressure limit switch (Cleveland AFS-460 or equal) to cut off the fan system in the event of high duct static. Do not use your YCCS zoning system as a safety device!

**Heating - Partial Load Conditions**

Heating difficulties are less common than cooling difficulties. They are similar in nature, however, and the cures are generally the same. Again, a number of things can be done to reduce the effects of this problem.

**Increase heating minimum airflow.** Increase your heating minimum airflow or damper position settings to allow more air during heating operation. Be careful to avoid minimum settings that are so high they may cause over heating of the spaces.

**Increase the static pressure.** Set the static pressure setpoint to be as high as practical. Increasing static pressure does not help if you are using pressure independent control operation.

**Avoid oversizing the unit.** Do your all load calculations carefully. Since the zoning system directs the heating or cooling to the zones which require it, you may find that you can use a smaller unit in many cases.

**Bypass the air into the ceiling plenum.** If you have a system without ducted return, bypass the air into the ceiling plenum instead of into the return air intake. This method works best with plenum returns. Do not use this method with ducted returns.

**Override Conditions**

After-hours overrides can produce aggravated partial load conditions in both the heating and cooling modes. A single zone being overridden for after-hours use most commonly causes the problem. This causes the rooftop equipment to operate for only one zone. The YCCS system offers an improved solution to this common problem by allowing a single override to trigger a group of zones via a "global" override. This allows the system to operate with sufficient load to reduce cycling caused by light load conditions.

**Building Pressurization**

If you are using an economizer, building pressurization must be addressed. Failure to properly handle building pressurization may result in doors remaining open when the economizer is operating. Pressurization problems can render economizer operation useless. The following will help to avoid potential problems.

**Use powered exhaust.** A power exhaust fan(s) must be used when the system utilizes ducted returns. The return duct pressure drop will cause most barometric relief dampers to function poorly or not at all. The York RTU has the ability to control a powered exhaust whenever the economizer is operating.

**Zoning Design Procedures**

**General**

There are six basic steps to designing an YCCS zoning system:

1. Determining the number and location of zones
2. Sizing the central unit
3. Duct Considerations
4. Room air motion and diffuser selection
5. Bypass damper sizing
6. Sizing the zone dampers

**Step #1 - Determining The Number And Location Of Zones**

A single air handler unit can have no more than 24 zones and no fewer than 3 zones.

The primary precaution to be taken in applying the YCCS zoning system is to select the zoning so that no zone will be at maximum (design) heating (or cooling) load when any other zone requires the opposite temperature air to satisfy its load. For example, depending on the wall, ceiling and floor material and location within the building (e.g. top or middle floor), a typical floor of a building usually has several distinct temperature or control zones that are affected uniquely by the outdoor load. These zones are depicted in Figure 1. Depending on the size of the building and partition layout, some of these zones may overlap or be insignificant from a zoning standpoint. For example, Zone 11 could be multiple conference or computer rooms where additional zoning would be required, or it could be as small as a corridor where no zoning is required. Similarly, zones 7 and 8 could have no external windows and no partitions between them and could be considered a single zone. Some zones could be divided into multiple offices with full partitions between them, thus requiring separate Zone Controllers because of different internal loads, but the same external load.
FIGURE 1 - ZONES AFFECTED BY THE OUTDOOR LOAD

Generally, the greater the number of individual zones, the greater the comfort. The designer will have to look at the specific building, balancing the costs of multiple zones with the added comfort possible with multiple zones, to match the owner's requirements.

It is important to recognize that there are purely internal zones, such as Zone 11 in Figure 1, which may contain separate offices/conference/computer rooms. These internal zones could easily have high cooling requirements while external zones (1,2,3, etc.) could be at or near design heating load. This is a misapplication of the YCCS zoning (or any heating/cooling change-over) system. The interior zones with cooling only loads should be served by a separate single zone rooftop HVAC unit (that could be zoned between multiple rooms with a similar load profile). System performance will generally be compromised and frequent change-over from the heating to the cooling mode will occur during the heating season if purely internal zones are combined on the same air-conditioning unit serving perimeter zones. The exposure to the sun has a large affect on the loading of the building. With the building zoned as shown below, for the best control, zones 6, 7, 8, 9 and 10 should be put on one HVAC unit, and zones 1, 2, 3, 4 and 5 on another HVAC unit. Zone 11 should be on a separate single zone constant volume HVAC unit.

Here is another example of the building's exposure affecting the zoning. Figure 2 shows a building layout with 7 zones, it has 3 zones with an eastern exposure, 4 zones with a western exposure and two each north and south exposures. This building can be controlled from a single, constant volume air handler. All of the zones have exterior exposures and there are no totally internal zones, so they will have similar load requirements.

FIGURE 2 - ZONE LAYOUT WITH EXTERNAL ZONES ONLY

Figure 3 shows a building with 7 zones, 4 of the zones have a north exposure and the other 3 have a south exposure. Since there is a big difference in the affect on the building between north and south exposures, installation of two separate zoned HVAC units is recommended.

FIGURE 3 - ZONES WITH NORTH AND SOUTH EXPOSURE

Figure 4 shows a combination manufacturing facility and office area. The space temperature in the individual zones numbered 1 through 7, would all be controlled by a single HVAC unit. A single constant volume HVAC unit would be used for each of the zones 8 through 12.
Step #2 - Sizing the Central Unit

Because the zones are controlled with variable air volume, it is unlikely that all zones will be at design load at the same time. The zoning allows for the diversity of loads to be taken into account and will often provide better comfort with a smaller HVAC unit.

In sizing the system, the individual zone loads should be calculated using any dependable load estimating program. Because of diversity, the central unit should be selected for the instantaneous peak load, not the sum of the peak loads, as would be done with a constant volume single zone system. Consider the following when sizing the central unit.

- "Size the peak cooling load based on the month day hour of the greatest total building system load.
- "Heating should be sized for the lowest design temperature with an additional margin for morning "pickup". This margin is generally recommended to be 20 to 25 percent of base design.

Step #3 - Duct Design Considerations

The YCCS system uses a typical low pressure duct design. To reduce noise problems duct pressures should not exceed 1 inch W.C.

Primary trunk ducts should not be "undersized." This is especially true for "pressure dependent" systems. Pressure dependent refers to the typical YCCS Zone Damper Assembly without the airflow sensor. With larger trunk ducts, it is easier to assure relatively constant pressure to each zone. Runs should be as short as possible, and the trunk duct system kept as symmetrical as possible to facilitate system balancing. Wherever possible, run the trunk ducts above corridors and locate the zone dampers above corridors to reduce the noise in the space and facilitate service of the units. Trunk ducts should be sized for no more than 0.1 inch W.C. drop per 100 feet, and a maximum duct velocity of 2000 FPM.

Step #4 - Air Motion/Diffuser Selection

Air motion is a consideration for occupant comfort. The selection of diffusers for a YCCS zoning system requires more care than a constant volume system due to varying flow of air into the zones. Slot diffusers are recommended due to their superior performance at low airflows. Because the zone airflow is variable volume, lower cost round or rectangular diffusers that were satisfactory for constant volume may prove unsatisfactory with a YCCS zoning system. These diffusers may result in "dumping" of the cold air at low flows in the cooling mode, and insufficient room air motion at low air flows in the heating mode. Although high air motion in the heating mode can be undesirable, a slot diffuser with a high induction ratio generally helps to reduce room air "stratification" when the heating comes from a ceiling diffuser. Linear slot diffusers should be properly selected for the airflow and "throw" suited to the specific installation or zone.

Additional factors to consider in diffuser selection are sound level and throw at design flow. Generally, multiple diffusers will result in lower sound levels in the space, but this must be balanced with the additional hardware and installation costs. It is commonly recommended that slot diffusers be located near the perimeter or outside wall with the airflow directed into the room. Consult your diffuser supplier or catalog for proper diffuser sizing and location.

Step #5 - Bypass Damper Sizing

The function of the bypass damper is to allow a constant volume air handling unit to be used with variable volume zone dampers. The bypass damper modulates on a signal from a duct static pressure sensor to "bypass" air from the supply duct back into the return air duct. If the duct static pressure exceeds the adjustable setpoint, then the damper opens to bypass more air, and if the static pressure drops below the setpoint, it closes to bypass less air.

Using a load calculation program, the bypass damper should be sized to give you the maximum CFM of air to be bypassed, typically 60 to 70 percent of the HVAC units rated capacity.
To size the damper, select a damper from the table based on calculated bypass CFM and a maximum velocity between 1750-2250 FPM. When determining the bypass duct size, be sure to take into account any transition fittings and associated pressure drops. (See Tables 1-1 & 1-2: Damper Sizing Charts)

Whenever possible, use a single bypass damper and round duct for the bypass. If space limitations or total airflow requires it, a rectangular damper may be used. For proper control of the Bypass Damper, the static pressure sensor location is very important. Refer to Figures 7 Thru 9 for proper sensor installation location information and guidelines.

If the trunk ducts are properly sized for minimum pressure drop, the location of the static pickup probe is not particularly critical. It should ideally be located at right angles to the airflow in a straight section of the supply duct approximately 2/3 the distance of the total length of the supply duct. Also the probe should be located not less than 3 duct diameters downstream and 2 duct diameters upstream of any elbow or take-off. See Figure 7.

Since the "ideal" location is often difficult to find in an installation, a location in the main trunk where the tip is not in a "negative pressure area" (e.g. just downstream of the inside curve of an elbow) or an area where the tube opening is directly impacted by the velocity of the supply air. See Figure 8.

If the supply duct comes directly from the unit and immediately splits in opposite directions, the pressure pickup should be located ahead of the split, or as close to it as possible, even if the bypass damper(s) are located downstream of the split.
Step #6 - Sizing the Zone Damper

Use a load program to determine the peak load for each zone. These calculations will be used in selecting the appropriate zone damper sizes.

Using the maximum acceptable velocity for a branch duct (typically 1000-1250 FPM for minimal noise), find the smallest damper that will deliver the required CFM as determined by the load program.

Locate the branch velocity used in the duct design program on the left hand column of the damper sizing chart (Table 1). Move across the chart and find the damper which will provide the acceptable CFM to meet your specific zone requirements.

NOTE: Compare the damper size selected against the duct size to determine if the next size up or down will provide acceptable performance without requiring a transition fitting.

Pressure Dependent Dampers

With pressure dependent (PD) dampers, the minimum and maximum airflow is set based on damper position. During the final commissioning of the system, each zone is typically balanced with a flow hood and the min/max position is fixed either mechanically or the preferred method, in the controller software. Since this min/max setting is based only on position, as the static pressure fluctuates it will cause the actual airflow at the zone damper to increase or decrease. Therefore the name, pressure dependent since the airflow is dependent on the static pressure. Pressure dependent dampers are available in round or rectangular configurations. See Figure 10 for a diagram of a typical pressure dependent zone damper.

FIGURE 10 - PRESSURE DEPENDENT DAMPER
### Table 1: Round Damper Selection Data

<table>
<thead>
<tr>
<th>Damper Size (Area - SqFt)</th>
<th>6&quot; (0.188)</th>
<th>8&quot; (0.338)</th>
<th>10&quot; (0.532)</th>
<th>12&quot; (0.769)</th>
<th>14&quot; (1.05)</th>
<th>16&quot; (1.375)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air Velocity Through Damper (FPM)</strong></td>
<td>Zone Damper Airflow - CFM (PS inches W.C. With Air Damper Full Open)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>750 FPM - Zone</td>
<td>141 (0.03)</td>
<td>254 (0.02)</td>
<td>399 (0.01)</td>
<td>577 (0.02)</td>
<td>788 (0.01)</td>
<td>1031 (0.01)</td>
</tr>
<tr>
<td>1000 FPM - Zone</td>
<td>188 (0.05)</td>
<td>338 (0.03)</td>
<td>532 (0.02)</td>
<td>769 (0.03)</td>
<td>1050 (0.02)</td>
<td>1375 (0.01)</td>
</tr>
<tr>
<td>1250 FPM - Zone</td>
<td>235 (0.07)</td>
<td>423 (0.04)</td>
<td>665 (0.03)</td>
<td>961 (0.04)</td>
<td>1313 (0.03)</td>
<td>1717 (0.02)</td>
</tr>
<tr>
<td>1500 FPM - Bypass Only</td>
<td>282 (0.09)</td>
<td>507 (0.06)</td>
<td>798 (0.04)</td>
<td>1154 (0.05)</td>
<td>1575 (0.04)</td>
<td>2062 (0.03)</td>
</tr>
<tr>
<td>1750 FPM - Bypass Only</td>
<td>329 (0.12)</td>
<td>592 (0.08)</td>
<td>931 (0.06)</td>
<td>1346 (0.06)</td>
<td>1838 (0.05)</td>
<td>2405 (0.04)</td>
</tr>
<tr>
<td>2000 FPM - Bypass Only</td>
<td>376 (0.15)</td>
<td>676 (0.10)</td>
<td>1064 (0.07)</td>
<td>1538 (0.07)</td>
<td>2100 (0.07)</td>
<td>2749 (0.05)</td>
</tr>
<tr>
<td>2250 FPM - Bypass Only</td>
<td>423 (0.18)</td>
<td>761 (0.13)</td>
<td>1197 (0.09)</td>
<td>1730 (0.09)</td>
<td>2363 (0.08)</td>
<td>3094 (0.06)</td>
</tr>
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</table>

### Table 2: Rectangular Damper Selection Data

<table>
<thead>
<tr>
<th>Damper Size W x H inches (Area - SqFt)</th>
<th>8 x 12 in. (0.42)</th>
<th>8 x 14 in. (0.5)</th>
<th>8 x 16 in. (0.58)</th>
<th>10 x 16 in. (0.77)</th>
<th>10 x 20 in. (1.00)</th>
<th>14 x 18 in. (1.33)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air Velocity Through Damper (FPM)</strong></td>
<td>Zone Damper Assembly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>750 FPM</td>
<td>315</td>
<td>375</td>
<td>435</td>
<td>478</td>
<td>750</td>
<td>998</td>
</tr>
<tr>
<td>1000 FPM</td>
<td>420</td>
<td>500</td>
<td>580</td>
<td>770</td>
<td>1000</td>
<td>1330</td>
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<td>1250 FPM</td>
<td>525</td>
<td>625</td>
<td>725</td>
<td>963</td>
<td>1250</td>
<td>1633</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Damper Size W x H inches (Area - SqFt)</th>
<th>14 x 12 in. (0.83)</th>
<th>16 x 16 in. (1.36)</th>
<th>20 x 20 in. (2.25)</th>
<th>30 x 30 in. (5.44)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air Velocity Through Damper (FPM)</strong></td>
<td>Bypass Damper Assembly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1500 FPM</td>
<td>1245</td>
<td>2040</td>
<td>3375</td>
<td>8160</td>
</tr>
<tr>
<td>1750 FPM</td>
<td>1453</td>
<td>2380</td>
<td>3938</td>
<td>9520</td>
</tr>
<tr>
<td>2000 FPM</td>
<td>1660</td>
<td>2720</td>
<td>4500</td>
<td>10880</td>
</tr>
<tr>
<td>2250 FPM</td>
<td>1868</td>
<td>3060</td>
<td>5063</td>
<td>12240</td>
</tr>
</tbody>
</table>
System Installation

Mounting Of Controllers

All YCCS round dampers or rectangular damper assemblies have the required controllers, actuators etc. factory mounted in an indoor rated control enclosure. Most local codes require these components be mounted in an enclosure. Mounting location for the controllers should not violate any local, state or national codes.

All YCCS rooftop units are available with factory mounted controllers. These controllers allow the integration of the rooftop unit with the rest of the YCCS components.

The System Manager (SM) and Zone Coordinator (ZC) are field mounted. Follow the guidelines below when mounting these components:

- "Ensure the mounting surface can support the SM or ZC and any user-supplied enclosure.
- "Mount the SM or ZC Controller on an even surface whenever possible.
- "Use shims or washers to mount the unit securely on the mounting surface.
- "Mount the SM or ZC in areas free of corrosive vapors and observe the environmental limitations listed in the Technical Specifications section.
- "Do not mount the SM or ZC controller on surfaces prone to vibration, such as duct work, or in areas where electromagnetic emissions from other devices or wiring can interfere with controller communication.
- "Allow sufficient space for cable and wire connections (minimum of 50 mm [2 in.] in each direction).

System Wiring

Wiring requirements for YCCS systems can be broken down into four main categories:

1. Power Wiring
2. Communications Wiring
3. Controller Wiring
4. Sensor Wiring

Each category should be thoroughly understood and implemented in order to have a trouble free installation.

Power Wiring

All YCCS control devices are powered by 24 VAC. It is possible to power the system using one or more common transformers or individual transformers for each device. Possible problems you may encounter using common transformers to power multiple devices are:

- "If polarity is not maintained between devices, shorting of the transformer will occur resulting in damage to the electronics.
- "When using one transformer to power multiple devices it is possible to lose most or all of your system if the transformer fails.
- "It is important when powering multiple devices from one transformer that total VA load and wiring voltage drops be taken into account for proper sizing of the transformer and wire. (See Figure 1-16 on page 26)

It is therefore recommended that in most installations individual transformers be installed for each device. This will greatly reduce the possibility of errors and possible damage to the system.

Power wiring should always be done in accordance with any local, state, or national codes.

Communication Wiring

The YCCS system utilizes two different communications buses. The System Bus uses a BACnet MS/TP 38400 baud RS485 communications bus. The Zone Bus also uses a BACnet MS/TP 38400 baud RS485 communications bus.

JCI requires that all communication wire be 22 gauge (0.6mm) stranded, three wire twisted shielded cable.

The loop must be connected in a daisy chain configuration, meaning the communication trunk is connected from one controller to another. It is not necessary to sequentially address the zone controllers in relation to their location on the loop.

Remember, the best communications loop wiring is the one which utilizes the minimum number of ends while using the shortest wiring path.

Communication Wiring terminals on YCCS controllers are marked "+", "," and "GND" (Note: instead of SHLD the Zone Coordinator and System Manager are marked "x"). All wiring should be connected + to +, - to - and GND to GND through-
Controller Wiring

All controller wiring should be in accordance with all local, state, and national codes. It is recommended that all wire be a minimum of 22 AWG unless otherwise specified in the charts below. Controller connections and wire sizing is as follows:

**System Manager / Zone Coordinator**

- **Power**
  - 24 VAC Supply Voltage (10 VA)
  - (2) Conductors

- **Communications Trunk**
  - (3) conductor 22 gauge (0.6mm) stranded, twisted shielded cable.

**Bypass Damper Assembly**

- **Power**
  - 24 VAC Supply Voltage (2 VA)
  - (2) Conductors

- **Communications Trunk**
  - (3) conductor 22 gauge (0.6mm) stranded, twisted shielded cable.

**Zone Damper Assembly**

- **Power**
  - 24 VAC Supply Voltage (3 VA)
  - (2) Conductors

- **Communications Trunk**
  - (3) conductor 22 gauge (0.6mm) stranded, twisted shielded cable.

- **Zone Sensor Cable**
  - (4) conductor 22 gauge (0.6mm) stranded, twisted cable.

**Universal RTU Controller**

- **Power**
  - 24 VAC Supply Voltage (3 VA)
  - (2) Conductors

- **Communications Trunk**
  - (3) conductor 22 gauge (0.6mm) stranded, twisted shielded cable.

- **HVAC Unit Control**
  - (6) Conductors 24 gauge minimum R (Common), G (Fan), Y1 (Cool 1), Y2 (Cool 2), W1 (Heat 1), W2 (Heat 2)
FIGURE 11 - YCCS SYSTEM COMMUNICATION LOOP WIRING
Application Notes:

Zoning 25, 30 and 40 Ton Units

When using large HVAC units for zoning applications, several rules must be considered to prohibit potential problems.

Because of the large air flow capacities of the 30 and 40 ton units, great care must be taken in sizing zone and bypass dampers.

Use these guidelines to help keep you out of trouble:

• “Generally you should use constant volume units in your zoning system design.

• “Bypass dampers should be sized for 60 to 70% of the rated CFM of the unit. Because of the large air volumes involved, rectangular dampers should be used instead of round dampers. Consult the rectangular damper sizing guide (Table 2), for CFM ratings.

• “Bypass dampers should be located towards the END of the main supply duct run to prevent bypassing large amounts of conditioned air.

• “Large units should always have a minimum of 6 zones due to the high air flow capacities.

• “To prevent excessive noise in the system, zone damper total minimum airflow settings should be equal to or preferably greater than 30% of the units rated CFM.

• “As an added precaution, we recommend a high duct static safety switch be installed (Cleveland Model AFS-460 or equal) to prevent over pressurization of the ductwork.