ADDENDA

ASHRAE Addendum h to
ASHRAE Guideline 36-2018

High Performance Sequences of Operation for HVAC Systems

Approved by ASHRAE on August 24, 2020.

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FOREWORD

Changes in this addendum:

1. Updated airflow setpoint tables in Sections 5.5 through 5.14.
2. Updated control logic figures 5.5.5 through 5.14.5 to be consistent with updated airflow setpoint tables.
3. Corrected Figure 5.13.5 for consistency with Section 5.13.
4. Updated control logic descriptions in Sections 5.5 through 5.14 to match updated terms.
5. For Dual Duct VAV Terminal Unit – Mixing Control with Discharge Airflow Sensor, removed hot duct static pressure reset requests based on airflow setpoint. Paragraphs 5.13.8.4.1 and 5.13.8.4.2.
6. For Dual Duct VAV Terminal Unit – Mixing Control with Discharge Airflow Sensor, changed the setpoint of the reverse-acting P-only maximum hot duct damper position limiting loop from Vheat-max to the heating maximum endpoint, which changes based on Zone Group Mode. Paragraph 5.13.1.3.b.

This addendum addresses these issues:

1. Distinguishes the differences between airflow setpoints which are determined by the designer and the endpoints used in control logic. This has been a source of confusion because the endpoints have similar names as the setpoints.

2. Corrects inconsistencies in Section 5.13 between variable names used in control logic and Figure 5.13.5.

3. Corrects inconsistencies in variable names throughout the guideline.

Note: **In this addendum, changes to the current guideline are indicated in the text by underlining (for additions) and strikethrough (for deletions) unless the instructions specifically mention some other means of indicating the changes.**

Addendum h to Guideline 36-2018

(IP and SI Units)

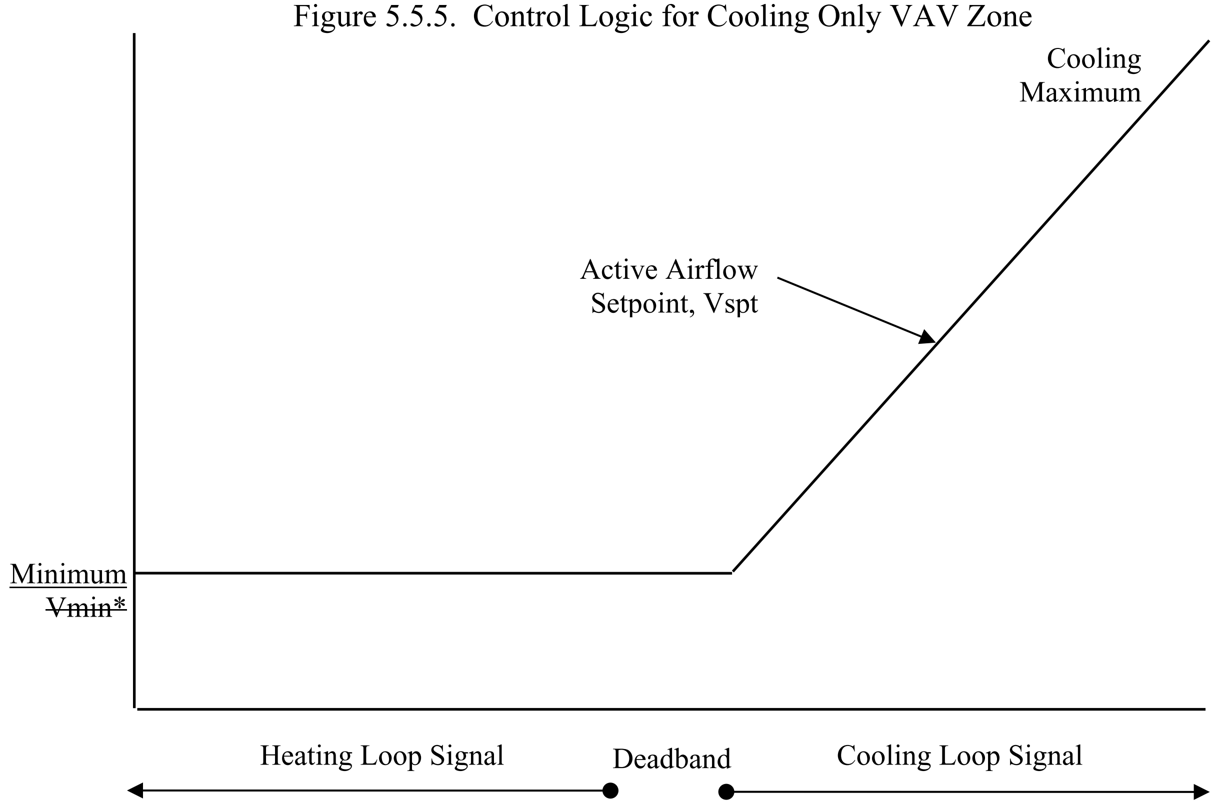
Revise Sections 5.5.4 and 5.5.5 as follows:

5.5.4 Active ~~maximum and minimum setpoints~~ endpoints used in the control logic depicted in Figure 5.5.5 below shall vary depending on the Mode of the Zone Group the zone is a part of:

Endpoint ~~**Setpoint**~~	**Occupied**	**Cool-down**	**Setup**	**Warm-up**	**Setback**	**Unoccupied**
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	Vmin*	0	0	0	0	0
Heating maximum	Vmin*	0	0	0	0	0

5.5.5 Control logic is depicted schematically in Figure 5.5.5 below and described in the following sections. ~~Relative levels of various setpoints are depicted for Occupied Mode operation.~~

Figure 5.5.5. Control Logic for Cooling Only VAV Zone



5.5.5.1 When the Zone State is Cooling, the Cooling Loop output shall be mapped to the active airflow setpoint from the minimum endpoint to the cooling maximum endpoint~~airflow setpoints~~.

1. If supply air temperature from the air handler is greater than room temperature, the active ~~cooling supply~~ airflow setpoint shall be no higher than the minimum endpoint.

5.5.5.2 When the Zone State is Deadband~~ or Heating~~, the active airflow setpoint shall be the minimum endpoint~~airflow setpoint~~.

Add Section 5.5.5.3 as follows:

5.5.5.3 When the Zone State is Heating, the active airflow setpoint shall be the minimum endpoint.

Revise Sections 5.6.4 and 5.6.5 as follows:

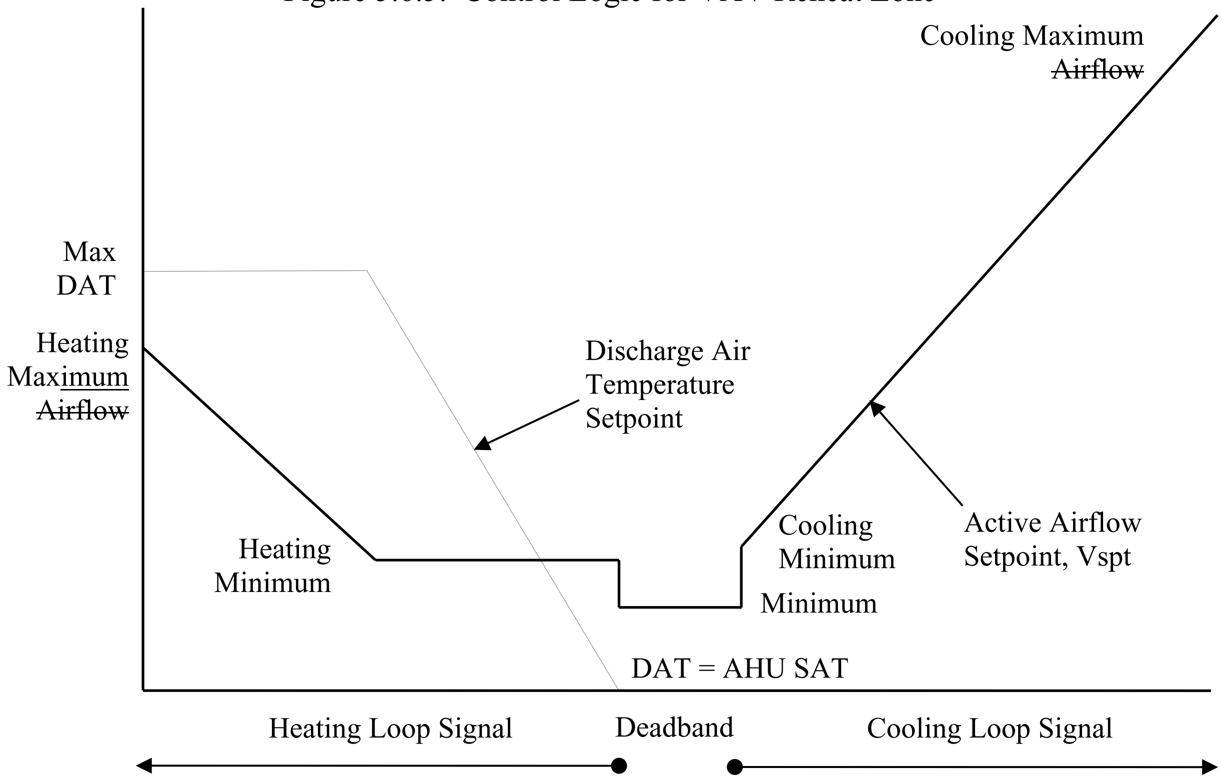
5.6.4 Active ~~maximum and minimum setpoints~~ endpoints used in the control logic depicted in Figure 5.6.5 below shall vary depending on the Mode of the Zone Group the zone is a part of:

Endpoint ~~**Setpoint**~~	**Occupied**	**Cool-down**	**Setup**	**Warm-up**	**Setback**	**Unoccupied**
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Cooling minimum	Vmin*	0	0	0	0	0
Minimum	Vmin*	0	0	0	0	0
Heating minimum	Max(Vheat-min, Vmin*)	Vheat-min	0	Vheat-max	Vheat-max	0
Heating maximum	Max(Vheat-max, Vmin*)	Vheat-max	0	Vcool-max	Vcool-max	0

These sequences use different maximum airflow setpoints for heating and cooling. This "dual max" logic allows the minimum airflow setpoint to be lower than in a conventional sequence where the minimum airflow equals the heating airflow.
Heating endpoints are~~is~~ non-zero in Cool-down to allow for individual zones within a Zone Group that may need heating while the Zone Group is in Cool-down.
The Warm-up and Setback minimum endpoints are~~setpoint is~~ set to zero to ensure spaces that do not want heat during these modes receive no air; since the supply air temperature can be warm in these modes if the AHU has a heating coil, any minimum could cause overheating. The heating minimum endpoint is set to Vheat-max and the heating maximum endpoint is set to Vcool-max to provide faster response. This also ensures non-zero flow for the first half of the heating loop, avoiding instabilities.

5.6.5 Control logic is depicted schematically in Figure 5.6.5 below and described in the following sections.~~ Relative levels of various setpoints are depicted for Occupied Mode operation.~~

Figure 5.6.5. Control Logic for VAV Reheat Zone



5.6.5.1 When the Zone State is Cooling, the Cooling Loop output shall be mapped to the active airflow setpoint from the cooling minimum endpoint to the cooling maximum endpoint~~airflow setpoints~~. Heating coil is disabled unless the discharge air temperature is below the minimum setpoint [see 5.6.5.4 below].

1. If supply air temperature from the air handler is greater than room temperature, the active~~cooling supply~~ airflow setpoint shall be no higher than the minimum endpoint.

5.6.5.2 When the Zone State is Deadband, the active airflow setpoint shall be the minimum endpoint~~airflow setpoint~~. Heating coil is disabled unless the discharge air temperature is below the minimum setpoint [see 5.6.5.4 below].

5.6.5.3 When the Zone State is Heating, the Heating Loop shall maintain space temperature at the heating setpoint as follows:

The purpose of the following heating sequence is to minimize the reheat energy consumption by first increasing the SAT while maintaining minimum flow, and only increasing the total airflow if needed to satisfy the zone.

1. From 0-50%, the Heating Loop output shall reset the discharge temperature setpoint from the current AHU SAT setpoint to a maximum of Max” T above space temperature setpoint. The active airflow setpoint shall be the heating minimum endpoint.

Standard 90.1-2016 limits overhead supply air to 11°C (20°F) above space temperature (e.g., 32°C (90°F) at 21°C (70°F) space temperature setpoint) to minimize stratification.

2. From 51%-100%, if the discharge air temperature is greater than room temperature plus 3°C (5°F), the Heating Loop output shall reset the active airflow setpoint from the heating minimum endpoint~~airflow setpoint~~ to the heating maximum endpoint~~airflow setpoint~~.

3. The heating coil shall be modulated to maintain the discharge temperature at setpoint. (Directly controlling heating off the zone temperature control loop is not acceptable).

5.6.5.4 When the airflow setpoint is pulse width modulated per 5.2.2, the heating coil and PID loop shall be disabled with output set to 0 during closed periods.

Revise Sections 5.7.4 and 5.7.5 as follows:

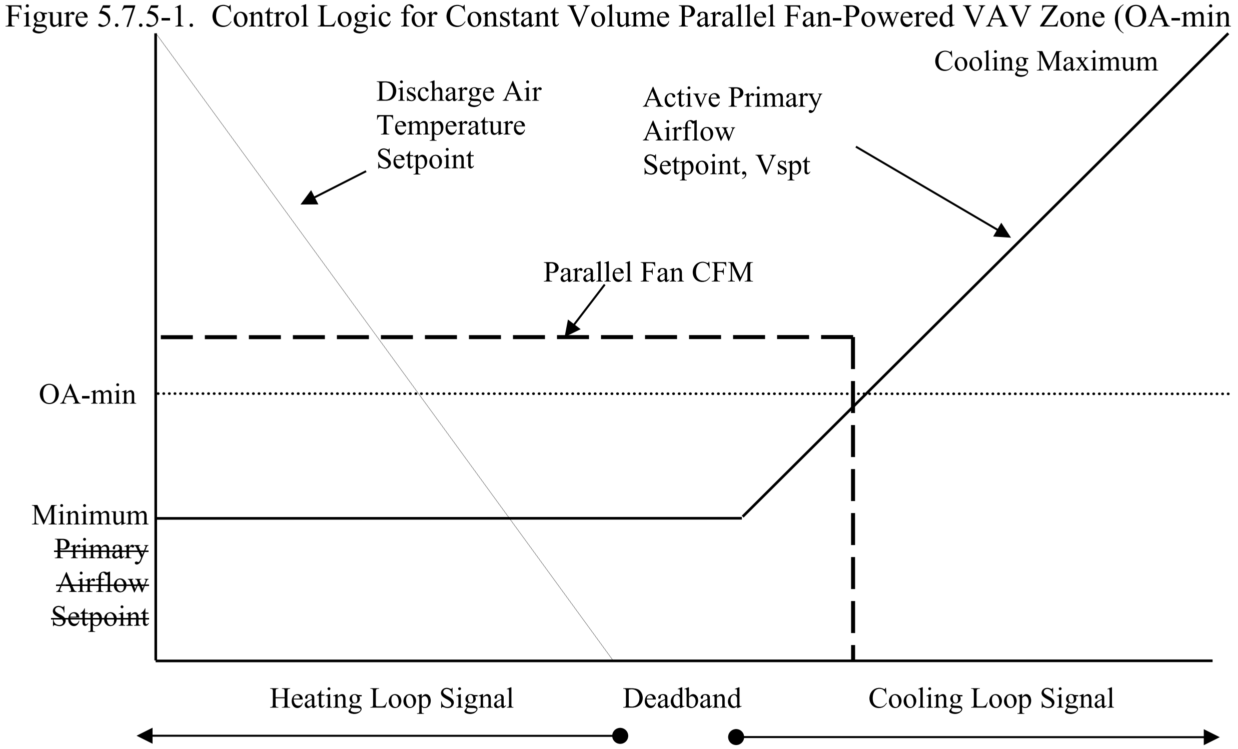
5.7.4 Active ~~maximum and minimum primary air setpoints~~ endpoints used in the control logic depicted in Figures 5.7.5-1 and 5.7.5-2 below shall vary depending on the Mode of the Zone Group the zone is a part of:

Endpoint ~~**Setpoint**~~	**Occupied**	**Cool-down**	**Setup**	**Warm-up**	**Setback**	**Unoccupied**
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	Vmin*	0	0	0	0	0

5.7.5 Control logic is depicted schematically in figures 5.7.5-1 and 5.7.5-2 below and described in the following sections. In the figures below, OA-min is Voz (if using ASHRAE Standard 62.1 ventilation logic) or Zone-Abs-OA-min (if using Title 24 ventilation logic).

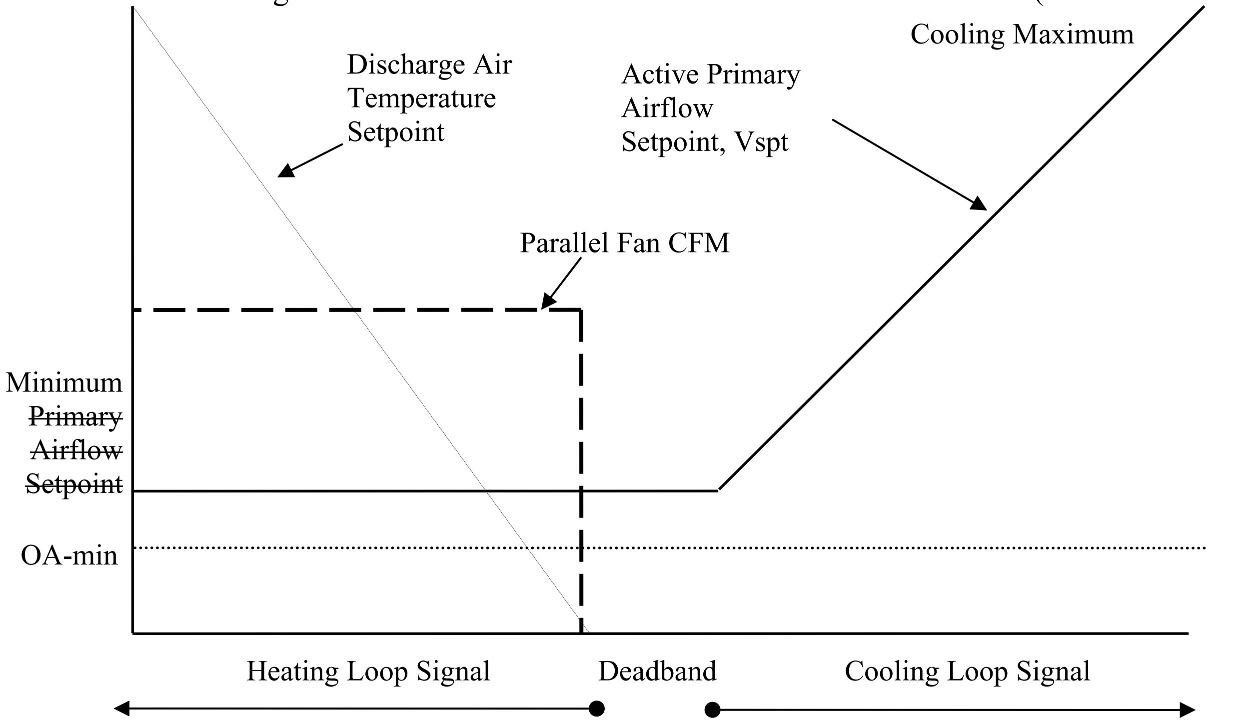
If OA-min > Vmin:

Figure 5.7.5-1. Control Logic for Constant Volume Parallel Fan-Powered VAV Zone (OA-min >Vmin)



If OA-min < Vmin:

Figure 5.7.5-2. Control Logic for Constant Volume Parallel Fan-Powered VAV Zone (OA-min <Vmin)



5.7.5.1 When the Zone State is Cooling

1. The Cooling Loop output shall be mapped to the active primary airflow setpoint from the minimum endpoint to the cooling maximum endpoint~~airflow setpoints~~.

   a. If supply air temperature from the air handler is greater than room temperature, the active~~cooling supply~~ airflow setpoint shall be no higher than the minimum endpoint.

2. Heating coil is off.

5.7.5.2 When the Zone State is Deadband

1. The active primary airflow setpoint shall be the minimum endpoint~~airflow setpoint~~.

2. Heating coil is off.

5.7.5.3 When Zone State is Heating

1. The active primary airflow setpoint shall be the minimum endpoint.

2. As the Heating Loop output increases from 0 to 100%, it shall reset the discharge temperature from the current AHU SAT setpoint to a maximum of Max” T above space temperature setpoint.

Standard 90.1-2016 limits overhead supply air to 11°C (20°F) above space temperature (e.g., 32°C (90°F) at 21°C (70°F) space temperature setpoint) to minimize stratification.

3. The heating coil shall be modulated to maintain the discharge temperature at setpoint. (Directly controlling heat off zone temperature control loop is not acceptable).

Revise Sections 5.8.4 and 5.8.5 as follows:

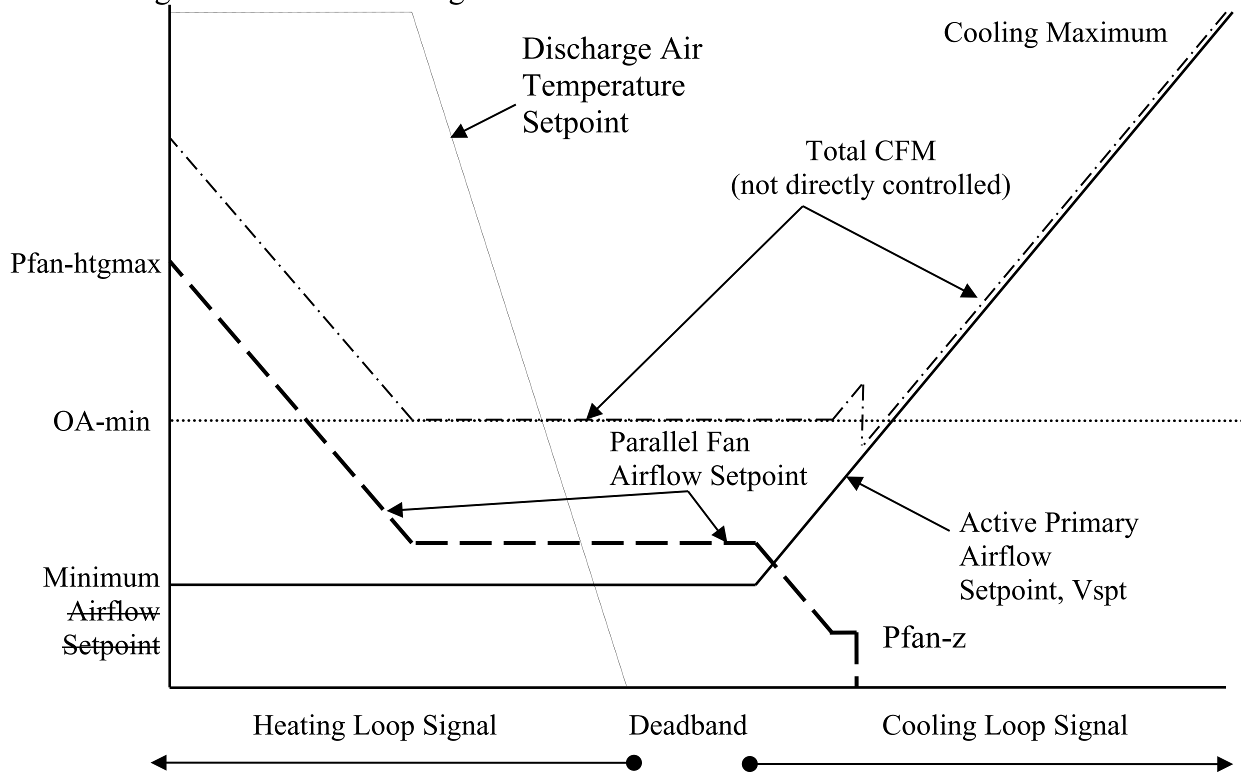
5.8.4 Active ~~maximum and minimum primary air setpoints~~endpoints used in the control logic depicted in Figure 5.8.5 below shall vary depending on the Mode of the Zone Group the zone is a part of:

Endpoint ~~**Setpoint**~~	**Occupied**	**Cool-down**	**Setup**	**Warm-up**	**Setback**	**Unoccupied**
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	Vmin*	0	0	0	0	0

5.8.5 Control logic is depicted schematically in figure 5.8.5 below and described in the following sections. ~~Relative levels of various setpoints are depicted for Occupied Mode operation.~~ In the figure below, OA-min is Voz (if using ASHRAE Standard 62.1 ventilation logic) or Zone-Abs-OA-min (if using Title 24 ventilation logic).

In the heating zone state, the logic keeps the fan airflow rate low while supply air temperature is increased as the first heating stage. This presumes that the temperature of the air the fan is supplying is neutral or below the space temperature, as it would be if the fan draws air directly from the space and as it might be if the fan draws air from a return air plenum that is cooled by roof and wall heat losses. In the past, return air plenums were warmed by recessed light fixtures, but pendent lights are more and more common, so the potential for "free" heating from the plenum is smaller than it once was. Since there is the potential that the plenum is colder than the space due to envelope loads, the logic leads with the supply air temperature rather than with an increase in fan speed. If the designer is confident that the plenum will always be warmer, the logic can be reversed.

Figure 5.8.5. Control Logic for Variable Volume Parallel Fan-Powered VAV Zone



5.8.5.1 When the Zone State is Cooling

1. The Cooling Loop output shall be mapped to the active airflow setpoint from the minimum endpoint to the cooling maximum endpoint~~airflow setpoints~~.

   a. If supply air temperature from the air handler is greater than room temperature, the active primary~~cooling supply~~ airflow setpoint shall be no higher than the minimum endpoint.

2. Heating coil is off.

3. If ventilation is according to ASHRAE Standard 62.1-2016: In Occupied Mode only, parallel fan starts when primary airflow drops below Voz minus one half of Pfan-z and shuts off when primary airflow rises above Voz. Fan airflow rate setpoint is equal to Voz minus the active~~current~~ primary airflow setpoint.

4. If ventilation is according to California Title 24: In Occupied Mode only, parallel fan starts when primary airflow drops below Zone-Abs-OA-min minus one half of Pfan-z and shuts off when primary airflow rises above Zone-Abs-OA-min. Fan airflow rate setpoint is equal to Zone-Abs-OA-min minus the active~~current~~ primary airflow setpoint.

The designer must ensure that the sum of the indirect ventilation provided by the fan plus the ventilation provided by the primary air at minimum setpoint meet Standard 62.1 requirements.

5.8.5.2 When the Zone State is Deadband

1. The active primary airflow setpoint shall be the minimum endpoint~~airflow setpoint~~.

2. Heating coil is off.

3. If ventilation is according to ASHRAE Standard 62.1-2016, parallel fan runs if the active primary airflow setpoint is below Voz. Fan airflow rate setpoint is equal to Voz minus the active~~current~~ primary airflow setpoint.

4. If ventilation is according to California Title 24: In Occupied Mode only, parallel fan runs if the active primary airflow setpoint is below Zone-Abs-OA-min. Fan airflow rate setpoint is equal to Zone-Abs-OA-min minus the active~~current~~ primary airflow setpoint.

> *The designer must ensure that the sum of the indirect ventilation provided by the fan plus the ventilation provided by the primary air at minimum setpoint to meet Standard 62.1 requirements.*

5.8.5.3 When Zone State is Heating

> *For systems with electric reheat, ensure that the minimum airflow provided by the parallel fan at minimum speed exceeds the minimum required airflow for the electric heater.*

1. The active primary airflow setpoint shall be the minimum endpoint.

2. Parallel fan shall run.

3. From 0-50%, the Heating Loop output shall reset the discharge temperature from the current AHU SAT setpoint to a maximum of Max" T above space temperature setpoint.

> *Standard 90.1-2016 limits overhead supply air to 11°C (20°F) above space temperature (e.g., 32°C (90°F) at 21°C (70°F) space temperature setpoint) to minimize stratification.*

4. From 50%-100%, the Heating Loop output shall reset the parallel fan airflow setpoint from the airflow setpoint required in Deadband (see above; this is Pfan-z if Deadband setpoint is less than Pfan-z) proportionally up to the maximum heating fan airflow setpoint (Pfan-htgmax).

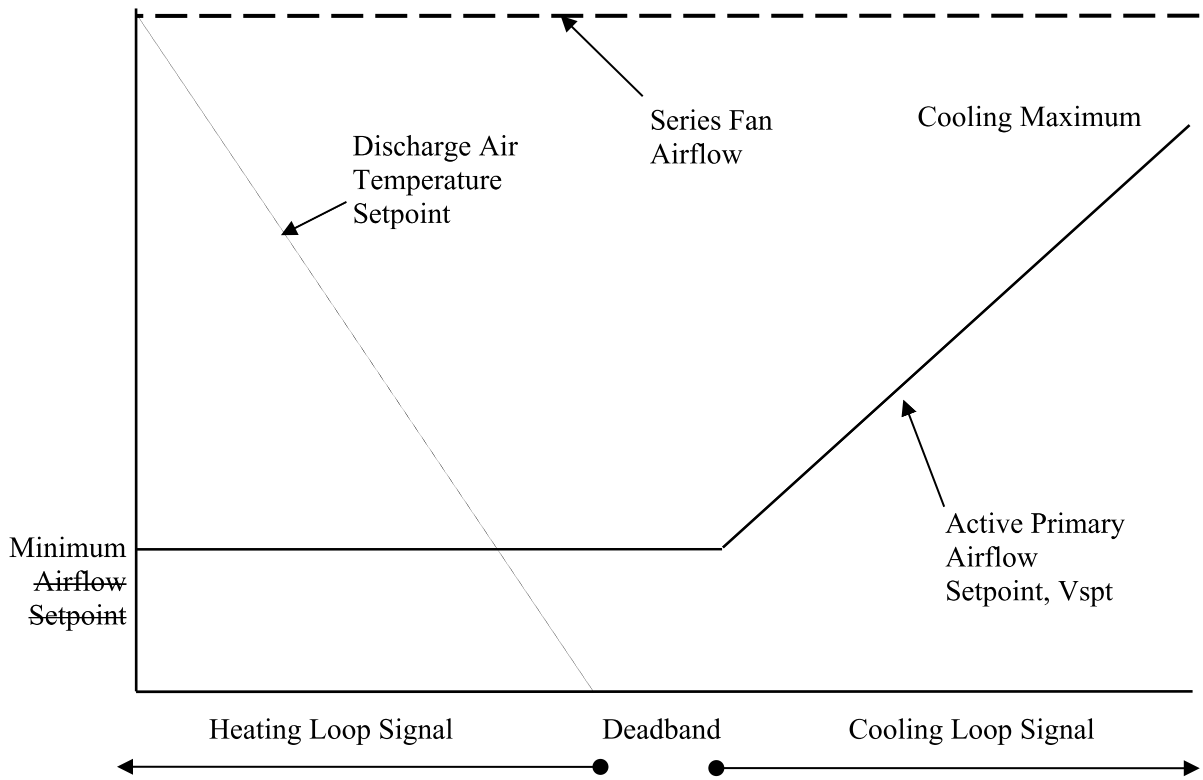
Revise Sections 5.9.4 and 5.9.5 as follows:

5.9.4 Active ~~maximum and minimum primary air setpoints~~endpoints used in the control logic depicted in Figure 5.9.5 below shall vary depending on the Mode of the Zone Group the zone is a part of:

Endpoint ~~**Setpoint**~~	**Occupied**	**Cool-down**	**Setup**	**Warmup**	**Setback**	**Unoccupied**
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	Vmin*	0	0	0	0	0

5.9.5 Control logic is depicted schematically in the figure below and described in the following sections.

Figure 5.9.5. Control Logic for Constant Volume Series Fan-Powered VAV Zone



5.9.5.1 When the Zone State is Cooling

1. The Cooling Loop output shall be mapped to the active primary airflow setpoint from the minimum endpoint to the cooling maximum endpointairflow setpoints.

   a. If supply air temperature from the air handler is greater than room temperature, the active primarycooling supply airflow setpoint shall be no higher than the minimum endpoint.

2. Heating coil is off.

5.9.5.2 When the Zone State is Deadband

1. The active primary airflow setpoint shall be the minimum endpointairflow setpoint.

2. Heating coil is off.

5.9.5.3 When Zone State is Heating

Standard 90.1-2016 limits overhead supply air to 11°C (20°F) above space temperature (e.g., 32°C (90°F) at 21°C (70°F) space temperature setpoint) to minimize stratification.

1. The active primary airflow setpoint shall be the minimum endpoint.

2. The Heating Loop shall reset the discharge temperature from the current AHU SAT setpoint to a maximum of Max” T above space temperature setpoint.

3. The heating coil shall be modulated to maintain the discharge temperature at setpoint. (Directly controlling heating off zone temperature control loop is not acceptable).

Revise Sections 5.10.4 and 5.10.5 as follows:

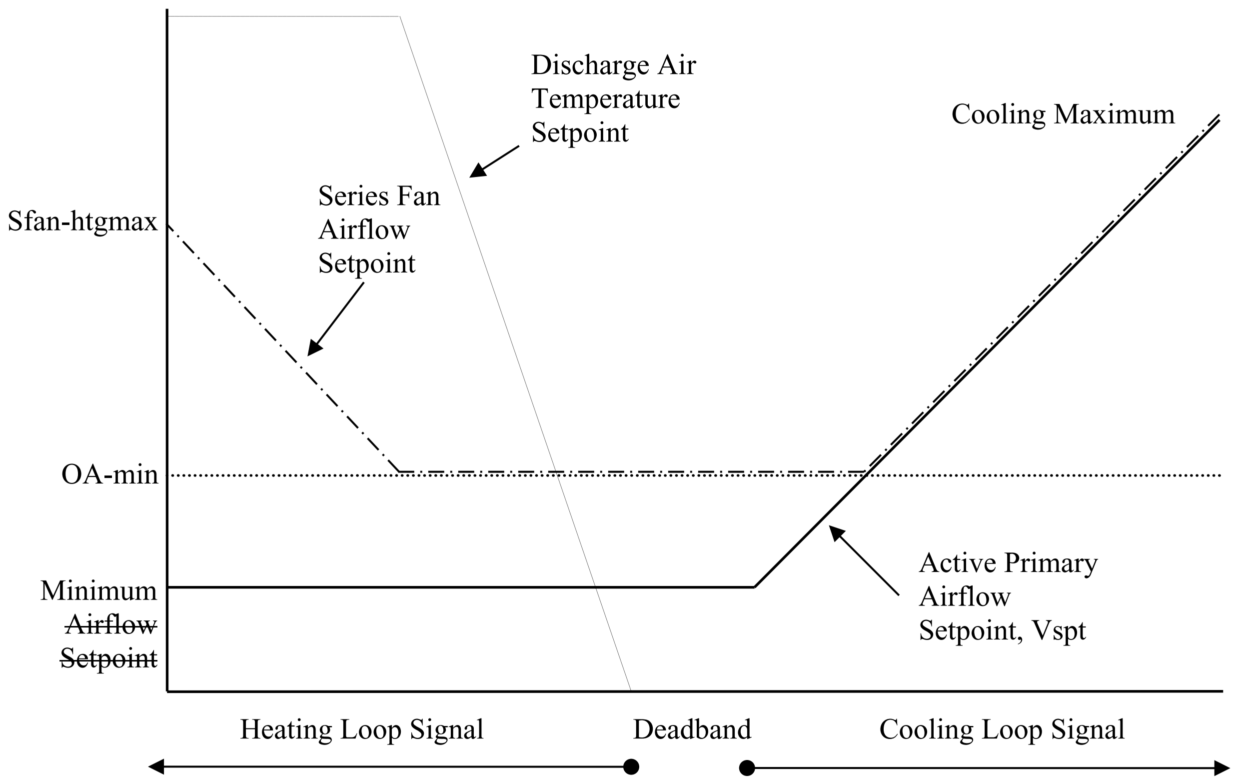
5.10.4 Active ~~maximum and minimum primary air setpoints~~endpoints used in the control logic depicted in Figure 5.10.5 below shall vary depending on the Mode of the Zone Group the zone is a part of:

Endpoint ~~**Setpoint**~~	**Occupied**	**Cool-down**	**Setup**	**Warm-up**	**Setback**	**Unoccupied**
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	Vmin*	0	0	0	0	0

5.10.5 Control logic is depicted schematically in figure 5.10.5 below and described in the following sections. ~~Relative levels of various setpoints are depicted for Occupied Mode operation.~~ In the figure below, OA-min is Voz (if using ASHRAE Standard 62.1 ventilation logic) or Zone-Abs-OA-min (if using Title 24 ventilation logic).

> *In the heating zone state, the logic keeps the fan airflow rate low while supply air temperature is increased as the first heating stage. This presumes that the temperature of the air the fan is supplying is neutral or below the space temperature, as it would be if the fan draws air directly from the space and as it might be if the fan draws air from a return air plenum that is cooled by roof and wall heat losses. In the past, return air plenums were warmed by recessed light fixtures, but pendant lights are more and more common so the potential for "free" heating from the plenum is smaller than it once was. Since there is the potential that the plenum is colder than the space due to envelope loads, the logic leads with the supply air temperature rather than with an increase in fan speed. If the designer is confident that the plenum will always be warmer, the logic can be reversed.*

Figure 5.10.5. Control Logic for Variable Volume Series Fan-Powered VAV Zone



5.10.5.1 When the Zone State is Cooling

1. The Cooling Loop output shall be mapped to the active primary airflow setpoint from the ~~cooling~~ minimum endpoint to the cooling maximum endpoint~~airflow setpoints~~.

   a. If supply air temperature from the air handler is greater than room temperature, the active primary airflow setpoint shall be no higher than the minimum endpoint and the series fan airflow setpoint shall be no higher than OA-min.

2. The series fan airflow setpoint shall be the larger of OA-min and the active primary airflow setpoint.

3. Heating coil is off.

5.10.5.2 When the Zone State is Deadband

1. The active primary airflow setpoint shall be the minimum endpoint~~airflow setpoint~~.

2. The series fan airflow setpoint shall be equal to OA-min.

3. Heating coil is off.

5.10.5.3 When Zone State is Heating

Standard 90.1-2016 limits overhead supply air to 11°C (20°F) above space temperature (e.g., 32°C (90°F) at 21°C (70°F) space temperature setpoint) to minimize stratification.

1. From 0-50%, the Heating Loop output shall reset the discharge temperature setpoint from the current AHU SAT setpoint to a maximum of Max" T above space temperature setpoint. The active primary airflow setpoint shall be the minimum endpoint~~airflow setpoint~~, and the series fan airflow setpoint shall be OA-min.

2. From 50-100%, the Heating Loop output shall reset the series fan airflow setpoint from OA-min to a Sfan-htgmax. The active primary airflow setpoint shall be the minimum endpoint~~airflow setpoint~~.

3. The heating coil shall be modulated to maintain the discharge temperature at setpoint. (Directly controlling heating off zone temperature control loop is not acceptable).

Revise Sections 5.11.4 and 5.11.5 as follows:

5.11.4 Active ~~maximum and minimum setpoints~~endpoints used in the control logic depicted in Figures 5.11.5-1 and 5.11.5-2 shall vary depending on the Mode of the Zone Group the zone is a part of:

Endpoint ~~**Setpoint**~~	**Occupied**	**Cool-down**	**Setup**	**Warm-up**	**Setback**	**Unoccupied**
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	Vmin*	0	0	0	0	0
Heating maximum	Vheat-max	0	0	Vheat-max	Vheat-max	0

5.11.5 Control logic is depicted schematically in figures 5.11.5-1 and 5.11.5-2 below and described in the following sections. ~~Relative levels of various setpoints are depicted for Occupied Mode operation.~~

Figure 5.11.5-1. Control Logic for Snap-Acting Dual Duct VAV Zone (Transition to Cooling)

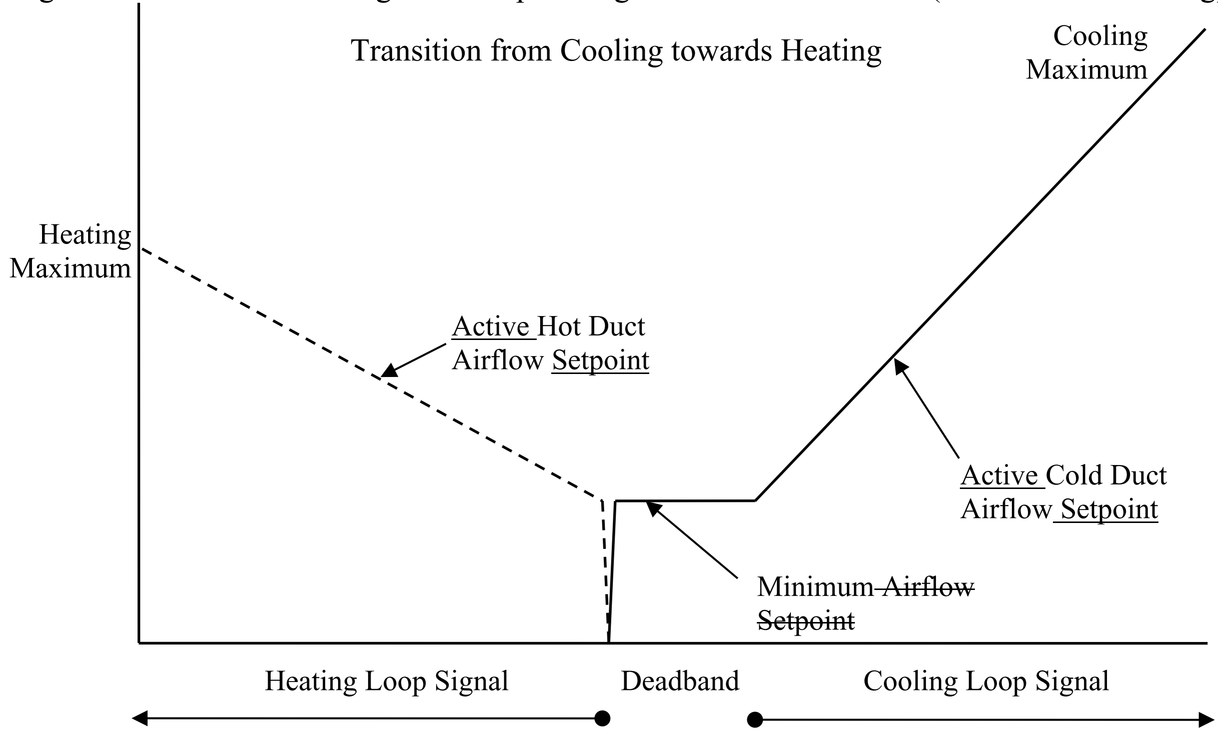
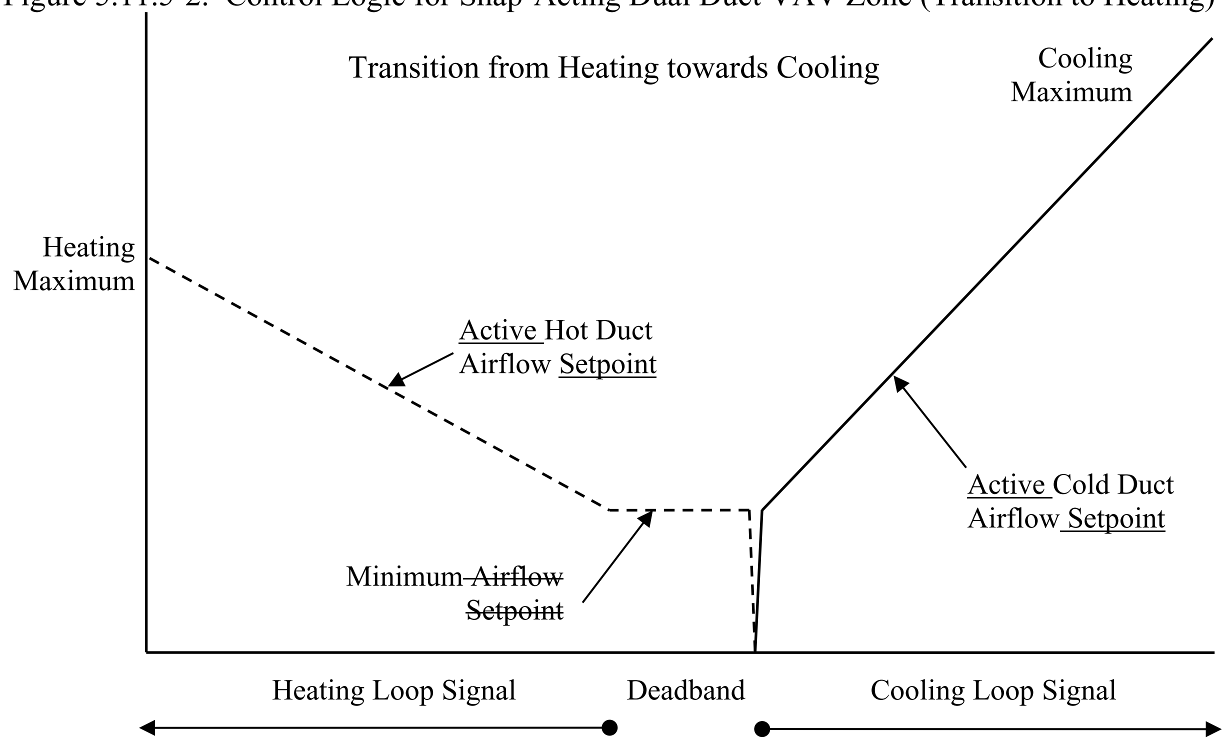


Figure 5.11.5-2. Control Logic for Snap-Acting Dual Duct VAV Zone (Transition to Heating)



The engineer must select between airflow sensor configuration options:

The following subsection "5.11.5.1" should be used if there are airflow sensors at both inlets to the box. If instead there is a single airflow sensor at the box discharge, delete subsection "5.11.5.1" and skip to subsection "5.11.5.2."

5.11.5.1 Temperature and Damper Control with dual inlet airflow sensors:

1. When the Zone State is Cooling, the Cooling Loop output shall reset the active cold duct ~~cooling supply~~ airflow setpoint from the minimum endpoint to cooling maximum endpoint~~setpoints~~. The cooling damper shall be modulated by a control loop to maintain the measured cooling airflow at the active cold duct airflow setpoint. The hot duct~~heating~~ damper shall be closed.

    a. If cold deck supply air temperature from air handler is greater than room temperature, the active cold duct~~cooling supply~~ airflow setpoint shall be no higher than the minimum endpoint.

2. When the Zone State is Deadband, the active cold duct and hot duct~~cooling and heating~~ airflow setpoints shall be their last setpoints just before entering Deadband. In other words, when going from Cooling to Deadband, the active cold duct~~cooling~~ airflow setpoint is equal to the ~~zone~~ minimum endpoint and the active hot duct airflow~~heating~~ setpoint is zero. When going from Heating to Deadband, the active hot duct~~heating~~ airflow setpoint is equal to the ~~zone~~ minimum endpoint and the active cold duct airflow~~cooling~~ setpoint is zero. This results in a snap-action switch in the damper setpoint as indicated in the figures above.

    With snap acting logic, the deadband airflow is maintained by the damper from the last mode, rather than always using the cold duct~~deck~~, as per the mixing sequences below. This is to avoid instability when transitioning from heating to deadband.

3. When the Zone State is Heating, the Heating Loop output shall reset the active hot duct~~heating supply~~ airflow setpoint from the minimum endpoint to the heating maximum endpoint~~setpoints~~. The hot duct~~heating~~ damper shall be modulated by a control loop to maintain the measured heating airflow at the active hot duct airflow setpoint. The cold duct~~cooling~~ damper shall be closed.

    a. If hot deck supply air temperature from air handler is less than room temperature, the active hot duct~~heating supply~~ airflow setpoint shall be no higher than the minimum endpoint.

The engineer must select between airflow sensor configuration options:

The following subsection "5.11.5.2" should be used if there is a single airflow sensor at the box discharge. If instead there are airflow sensors at both inlets to the box, delete subsection "5.11.5.2" and use subsection "5.11.5.1," above.

5.11.5.2 Temperature and Damper Control with a single discharge airflow sensor:

1. When the Zone State is Cooling, the Cooling Loop output shall reset the active~~discharge~~ airflow setpoint from the minimum endpoint to cooling maximum endpoint~~setpoints~~. The cold

ductcooling damper shall be modulated by a control loop to maintain the measured discharge airflow at the active cold duct airflow setpoint. The hot ductheating damper shall be closed.

2. When the Zone State is Deadband, the activedischarge airflow setpoint shall be the zone minimum endpoint, maintained by the damper that was operative just before entering Deadband. The other damper shall remain closed. In other words, when going from Cooling to Deadband, the cold ductcooling damper shall maintain the discharge airflow at the zone minimum endpointsetpoint and the heating damper shall be closed. When going from Heating to Deadband, the hot ductheating damper shall maintain the discharge airflow at the zone minimum endpointsetpoint and the cold ductcooling damper shall be closed. This results in a snap-action switch in the active damper airflow setpoint as indicated in the fFigures 5.11.5-1 and 5.11.5-2 above.

3. When the Zone State is Heating, the Heating Loop output shall reset the active hot ductdischarge airflow setpoint from the minimum endpoint to heating maximum endpointsetpoints. The hot ductheating damper shall be modulated by a control loop to maintain the measured discharge airflow at the active hot duct airflow setpoint. The cold ductcooling damper shall be closed.

This concludes the section where the airflow sensor configuration is selected.

When the sequences are complete, only one of subsection "5.11.5.1" and subsection "5.11.5.2" above should remain. The other subsection should be deleted, along with these flag notes.

5.11.3 Overriding above logic (to avoid backflow from one duct to the other)

1. If heating air handler is not proven on, the heating damper shall be closed.

2. If cooling air handler is not proven on, the cooling damper shall be closed.

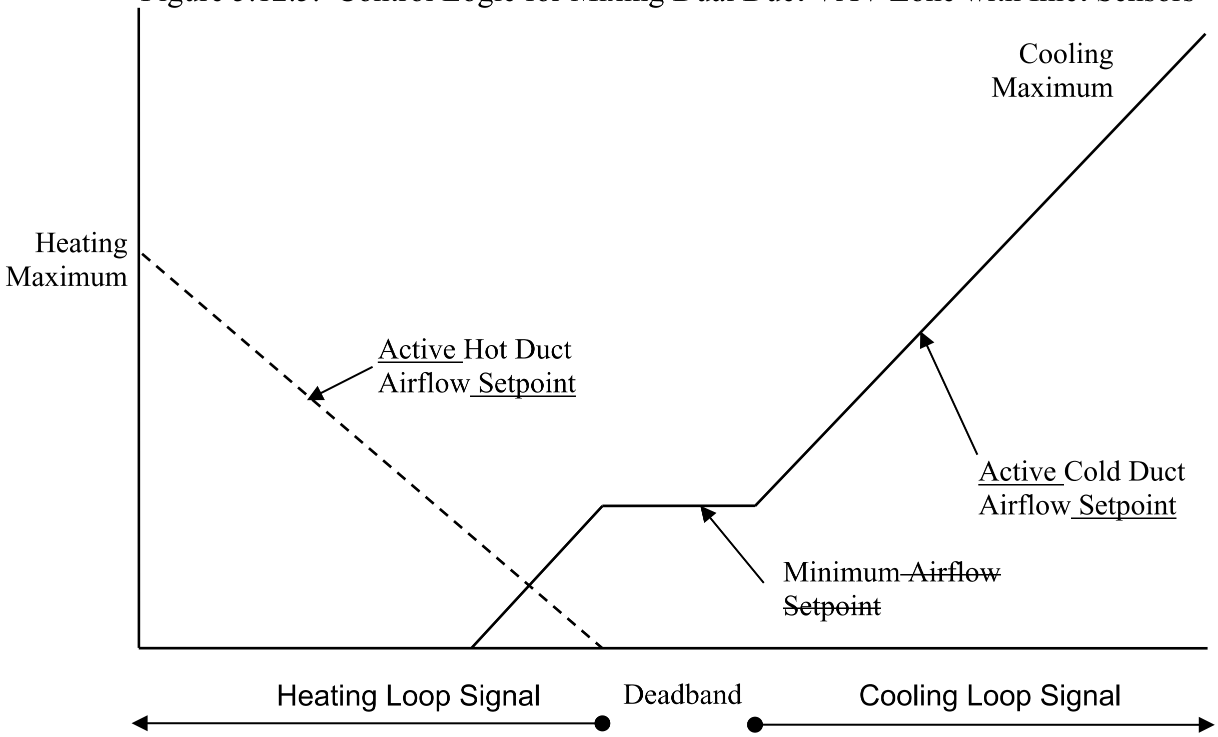
Revise Sections 5.12.4 and 5.12.5 as follows:

5.12.4 Active maximum and minimum setpointsendpoints used in the control logic depicted in Figure 5.12.5 below shall vary depending on the Mode of the Zone Group the zone is a part of:

Endpoint Setpoint	**Occupied**	**Cool-down**	**Setup**	**Warmup**	**Setback**	**Unoccupied**
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	Vmin*	0	0	0	0	0
Heating maximum	Vheat-max	0	0	Vheat-max	Vheat-max	0

5.12.5 Control logic is depicted schematically in the figures below and described in the following sections. Relative levels of various setpoints are depicted for Occupied Mode operation.

Figure 5.12.5. Control Logic for Mixing Dual Duct VAV Zone with Inlet Sensors



5.12.5.1 Temperature Control

1. When the Zone State is Cooling, the Cooling Loop output shall reset the active cold duct~~cooling supply~~ airflow setpoint from minimum endpoint to the cooling maximum endpoint~~maximum cooling setpoint~~. The cooling damper shall be modulated by a control loop to maintain the measured cold duct~~cooling~~ airflow at active cold duct airflow setpoint.

   a. If cold duct~~deck~~ supply air temperature from air handler is greater than room temperature, the active cold duct~~cooling supply~~ airflow setpoint shall be no higher than the minimum endpoint.

2. When the Zone State is Deadband, the active cold duct~~cooling~~ airflow setpoint shall be the minimum endpoint~~setpoint~~. The cooling damper shall be modulated by a control loop to maintain the measured cooling airflow at the active cold duct airflow setpoint. The hot duct~~heating~~ damper shall be closed.

The deadband airflow is maintained by the cooling damper since the cooling system has a definite source of ventilation. With dual fan dual duct, the heating fan generally has no direct ventilation source; typically, ventilation is indirect via return air from interior zones that are over-ventilated due to the outdoor air economizer.

3. When the Zone State is Heating, the Heating Loop output shall reset the active hot duct~~heating supply~~ airflow setpoint from zero to the ~~maximum~~ heating maximum endpoint~~setpoint~~. The heating damper shall be modulated by a control loop to maintain the measured hot duct~~heating~~ airflow at the active hot duct airflow setpoint. The cold duct~~cooling~~ damper shall be controlled to maintain the sum of the measured inlet airflows at the minimum endpoint~~airflow setpoint~~.

   a. If hot deck supply air temperature from air handler is less than room temperature, the active hot duct~~heating supply~~ airflow setpoint shall be no higher than the minimum endpoint.

5.12.5.2 Overriding above logic (to avoid backflow from one duct to the other)

1. If heating air handler is not proven on, the heating damper shall be closed.
2. If cooling air handler is not proven on, the cooling damper shall be closed.

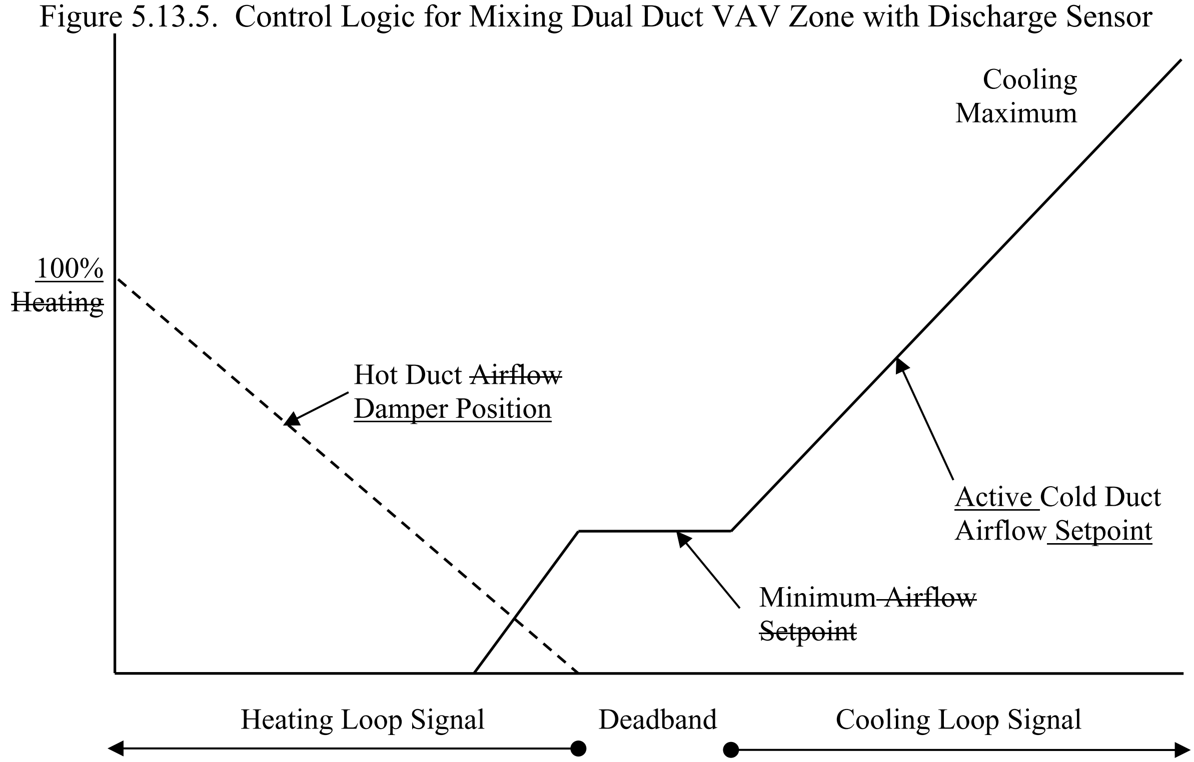
Revise Sections 5.13.4 and 5.13.5 as follows:

5.13.4 Active ~~maximum and minimum setpoints~~endpoints used in the control logic depicted in Figure 5.13.5 below shall vary depending on the Mode of the Zone Group the zone is a part of:

Endpoint ~~**Setpoint**~~	**Occupied**	**Cool-down**	**Setup**	**Warm-up**	**Setback**	**Unoccupied**
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	Vmin*	0	0	0	0	0
Heating maximum	Vheat-max	0	0	Vheat-max	Vheat-max	0

5.13.5 Control logic is depicted schematically in figure 5.13.5 below and described in the following sections. ~~Relative levels of various setpoints are depicted for Occupied Mode operation.~~

Figure 5.13.5. Control Logic for Mixing Dual Duct VAV Zone with Discharge Sensor



5.13.5.1 Temperature Control

> *Because there is only a single airflow sensor on the combined discharge, typical pressure-independent control will not work for both dampers. Instead, the cold duct~~cooling~~ damper is controlled using pressure independent control while the hot duct~~heating~~ damper position equals the Heating loop signal (i.e., pressure dependent control).*

1. When the Zone State is Cooling, the Cooling Loop output shall reset the active cold duct ~~cooling supply~~ airflow setpoint from minimum endpoint to the ~~maximum~~ cooling maximum endpoint~~setpoint~~. The cold duct~~cooling~~ damper shall be modulated by a control loop to maintain the measured cold duct~~cooling~~ airflow at the active cold duct airflow setpoint.

    a. If cold deck supply air temperature from air handler is greater than room temperature, the active cold duct~~cooling supply~~ airflow setpoint shall be no higher than the minimum endpoint.

2. When the Zone State is Deadband, the active cold duct ~~cooling~~ airflow setpoint shall be the minimum endpoint~~setpoint~~. The cold duct~~cooling~~ damper shall be modulated by a control loop to maintain the measured cold duct~~cooling~~ airflow at the active cold duct airflow setpoint. The hot duct~~heating~~ damper shall be closed.

    > *The deadband airflow is maintained by the cooling damper since the cooling system has a definite source of ventilation. With dual fan dual duct, the heating fan generally has no direct ventilation source; typically, ventilation is indirect via return air from interior zones that are over-ventilated due to the outdoor air economizer.*

3. When the Zone State is Heating, the Heating Loop output shall be mapped to the hot duct~~heating~~ damper position. The cold duct~~cooling~~ damper is modulated to maintain measured discharge airflow at the minimum endpoint~~airflow setpoint~~.

    a. If hot duct~~deck~~ supply air temperature from air handler is less than room temperature, hot duct~~heating~~ damper shall be closed.

    b. Maximum hot duct~~heating~~ airflow shall be limited by a reverse-acting P-only loop whose setpoint is the heating maximum endpoint~~Vheat-max~~ and whose output is maximum hot duct~~heating~~ damper position ranging from 0% to 100%.

    > *Since the hot duct~~heating~~ damper is operating on a pressure-dependent manner, a loop must be added to limit hot duct~~heating~~ damper position to the heating maximum endpoint~~Vheat-max~~. When this comes into play, the only air going through the discharge airflow sensor is heating air.*

5.13.5.2 Overriding above logic (to avoid backflow from one duct to the other)

1. If heating air handler is not proven on, the heating damper shall be closed.

2. If cooling air handler is not proven on, the cooling damper shall be closed.

Revise Section 5.13.8.4 as follows:

5.13.8.4 Hot Duct Static Pressure Reset Requests

1. If the measured airflow is less than 50% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 3 Requests,

2. Else if the measured airflow is less than 70% of setpoint while setpoint is greater than zero and the damper position is greater than 95% for 1 minute, send 2 Requests,

1.3. IfElse if the Damper position is greater than 95%, send 1 Request until the Damper position is less than 85%,

2.4. Else if the Damper position is less than 95%, send 0 Requests

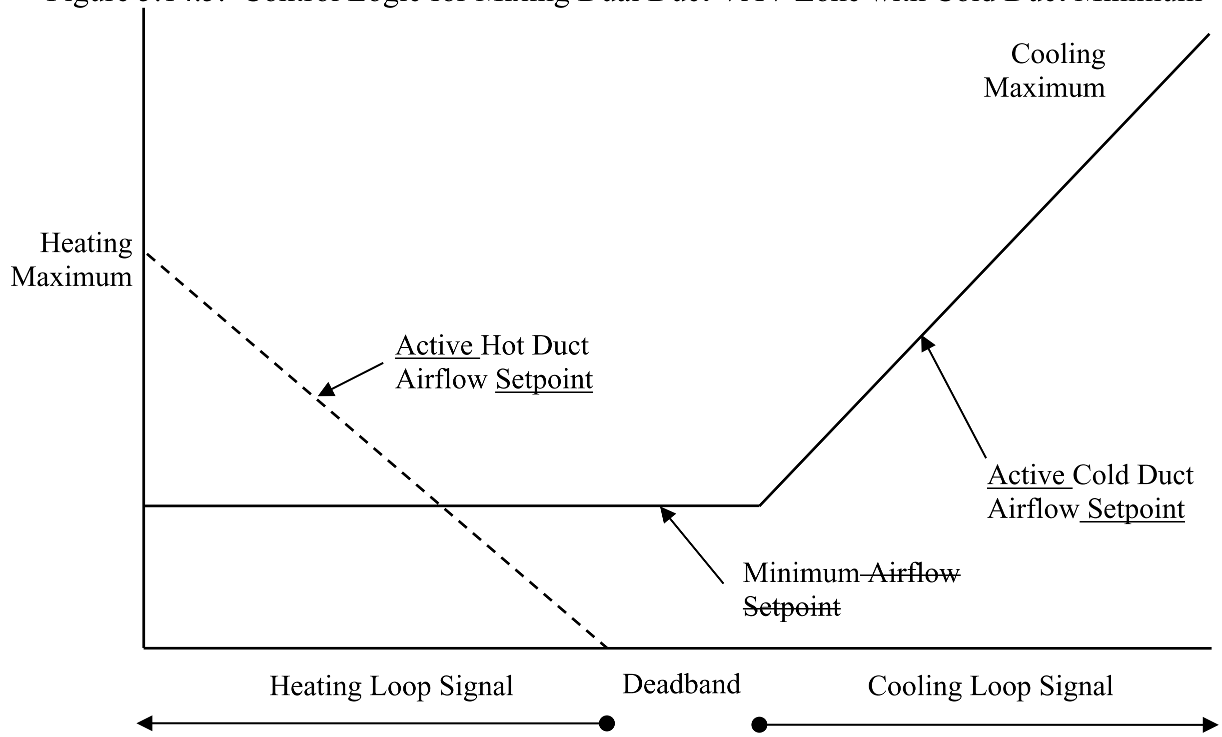
Revise Sections 5.14.4 and 5.14.5 as follows:

5.14.4 Active maximum and minimum setpointsendpoints used in the control logic depicted in Figure 5.14.5 below shall vary depending on the Mode of the Zone Group the zone is a part of:

Endpoint **Setpoint**	**Occupied**	**Cool-down**	**Setup**	**Warm-up**	**Setback**	**Unoccupied**
Cooling maximum	Vcool-max	Vcool-max	Vcool-max	0	0	0
Minimum	Vmin*	0	0	0	0	0
Heating maximum	Vheat-max	0	0	Vheat-max	Vheat-max	0

5.14.5 Control logic is depicted schematically in figure 5.14.5 below and described in the following sections. Relative levels of various setpoints are depicted for Occupied Mode operation.

Figure 5.14.5. Control Logic for Mixing Dual Duct VAV Zone with Cold Duct Minimum



5.14.5.1 Temperature and Damper Control:

1. When the Zone State is Cooling, the Cooling Loop output shall reset the <u>active cold duct</u>~~cooling supply~~ airflow setpoint from the minimum <u>endpoint</u> to cooling maximum <u>endpoint</u>~~setpoints~~. The <u>cold duct</u>~~cooling~~ damper shall be modulated by a control loop to maintain the measured <u>cold duct</u>~~cooling~~ airflow at <u>the active cold duct airflow</u> setpoint. The <u>hot duct</u>~~heating~~ damper shall be closed.

    a. If cold <u>duct</u>~~deck~~ supply air temperature from air handler is greater than room temperature, <u>the active cold duct</u>~~cooling supply~~ airflow setpoint shall be no higher than the minimum <u>endpoint</u>.

2. When the Zone State is Deadband, the <u>active cold duct</u>~~cooling~~ airflow setpoint shall be the minimum <u>endpoint</u>~~setpoint~~. The <u>cold duct</u>~~cooling~~ damper shall be modulated by a control loop to maintain the measured <u>cold duct</u>~~cooling~~ airflow at <u>the active cold duct airflow</u> setpoint. The <u>hot duct</u>~~heating~~ damper shall be closed.

3. When the Zone State is Heating,

    a. The Heating Loop output shall reset the <u>active hot duct</u>~~heating supply~~ airflow setpoint from zero to heating maximum <u>endpoint</u>~~setpoint~~. The <u>hot duct</u>~~heating~~ damper shall be modulated by a control loop to maintain the measured <u>hot duct</u>~~heating~~ airflow at <u>the active hot duct airflow</u> setpoint.

    b. The <u>active cold duct</u>~~cooling~~ airflow setpoint shall be the minimum <u>endpoint</u>~~setpoint~~. The <u>cold duct</u>~~cooling~~ damper shall be modulated by a control loop to maintain the measured <u>cold duct</u>~~cooling~~ airflow at <u>the active cold duct airflow</u> setpoint.

c. If hot ductdeck supply air temperature from air handler is less than room temperature, the hot ductheating damper shall be closed.

5.14.5.2 Overriding above logic (to avoid backflow from one duct to the other)

1. If heating air handler is not proven on, the heating damper shall be closed.
2. If cooling air handler is not proven on, the cooling damper shall be closed.

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

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As an industry leader in research, standards writing, publishing, certification, and continuing education, ASHRAE and its members are dedicated to promoting a healthy and sustainable built environment for all, through strategic partnerships with organizations in the HVAC&R community and across related industries.

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