ADDENDA

ASHRAE Addendum s to
ASHRAE Guideline 36-2018

High Performance Sequences of Operation for HVAC Systems

Approved by ASHRAE on February 24, 2021.

This addendum was approved by a Standing Guideline Project Committee (SGPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the guideline. Instructions for how to submit a change can be found on the ASHRAE® website (https://www.ashrae.org/continuous-maintenance).

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FOREWORD

This addendum is to resolve the issues related to minimum outdoor airflow control for multiple zone air handling units with return fans. This addendum also provides clarification on building pressure control for return fans and adds informative text for the designer with respect to defining pressure zones.

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 s to Guideline 36-2018

(IP and SI Units)
Revise Section 5.16.2.3 as follows:

5.16.2.3 Supply air temperature shall be controlled to set point using a control loop whose output is mapped to sequence the heating coil (if applicable), outdoor air damper, return air damper, and cooling coil as shown in Figure 5.16.2.3~~-1~~.

The engineer must specify whether the unit has a return fan, relief damper or relief fans.

If there is a return fan, keep subsection (a) and delete subsection (b).

If there are relief damper or relief fans, keep subsection (b) and delete subsection (a).

Delete this flag note after selections have been made.

a. For units with return fans

1. Return air damper maximum position MaxRA-P is modulated to control minimum outdoor air volume (see Sections 5.16.4.5, 5.16.5.5 and 5.16.6.3).

b. For units with relief dampers or relief fans

1. Economizer damper minimum position MinOA-P and/or return air damper maximum position MaxRA-P are modulated to control minimum outdoor air volume (see Sections 5.16.4.5, 5.16.5.5 and 5.16.6.3).

~~1. Economizer damper maximum position MaxOA-P is limited for economizer high limit lockout (see Section 5.16.7).~~

The engineer must specify whether minimum outdoor air and economizer functions use separate dedicated dampers or a single common damper.

If there are separate dedicated dampers, keep subsection (~~b~~2) and delete subsection (~~c~~3).

If there is a single common damper, keep subsection (~~c~~3) and delete subsection (~~b~~2).

Note that a single common damper requires an outdoor air AFMS. It is not a valid choice if minimum outdoor air control is being done by DP (i.e., if - is being used).

Delete this flag note after selection has been made.

2. For units with a separate minimum outdoor air damper, economizer damper minimum position MinOA-P is 0%, and return air damper maximum position MaxRA-P is modulated to control minimum outdoor air volume (see Sections 5.16.4 and 5.16.5).

3. For units with a single common minimum outdoor air and economizer damper, return air damper maximum position MaxRA-P and economizer damper minimum position MinOA-P are modulated to control minimum outdoor air volume (see Section 5.16.6). Economizer damper maximum position MaxOA-P is limited during minimum outdoor air control (e.g. economizer lockout due to high OAT).

c. The points of transition along the x-axis shown and described in Figure 5.16.2.3~~-1~~ are representative. Separate gains shall be provided for each section of the control map (heating coil, economizer, cooling coil) that is determined by the contractor to provide stable control. Alternatively, the contractor shall adjust the precise value of the x-axis thresholds shown in Figures 5.16.2.3~~-1~~ to provide stable control. Damper control depends on the type of building pressure control system.

The engineer must specify whether the AHU has a return fan or relief fan(s)/damper(s), and, if a return fan, how it is controlled.

If there are relief fan(s) or damper(s), retain Figure 5.16.2.3-1, and delete Figures 5.16.2.3-2 and 5.16.2.3-3 and their associated explanatory notes. Rename Figure 5.16.2.3-1 as Figure 5.16.2.3 (delete "-1") to avoid confusion.

If there is a return fan controlled by airflow tracking, retain Figure 5.16.2.3-2, and delete Figures 5.16.2.3-1 and 5.16.2.3-3 and their associated explanatory notes. Rename Figure 5.16.2.3-2 as Figure 5.16.2.3 (delete "-2") to avoid confusion.

If there is a return fan controlled by direct building pressure, retain Figure 5.16.2.3-3, and delete Figures 5.16.2.3-1 and 5.16.2.3-2 and their associated explanatory notes. Rename Figure 5.16.2.3-3 as Figure 5.16.2.3 (delete "-3") to avoid confusion.

Delete this flag note after selection has been made.

~~*The engineer should indicate which of the following three diagrams apply and delete the others.*~~
~~*1. Relief damper or relief fan (Figure 5.16.2.3-1)*~~

~~*2. Outdoor air and return air dampers are sequenced rather than complementary (as per traditional sequences) to reduce fan power at part loads.*~~

~~*3*~~*2. Return fan control with airflow tracking (Figure 5.16.2.3-2)*

~~*4*~~*3. Return-fan control with direct building pressure controls (Figure 5.16.2.3-3)*

~~*For AHUs with relief fans, outdoor air and return air dampers are sequenced rather than complementary (as per traditional sequences) to reduce fan power at part loads.*~~

~~*For AHUs with return fans, the outdoor air damper remains fully open whenever the AHU is on, while the return air damper modulates to maintain supply air temperature and minimum outdoor airflow at set point. For return-fan systems using airflow tracking building pressure control logic, the relief/exhaust damper inversely tracks the return air damper. Outdoor air dampers on air handlers with return fans have no impact on the outdoor airflow rate into the mixing plenum. Instead, the return-fan and return-damper controls dictate outdoor air flow. See ASHRAE Guideline 16.*~~

For AHUs with relief fans, outdoor air and return air dampers are sequenced rather than complementary (as per traditional sequences) to reduce fan power at part loads.

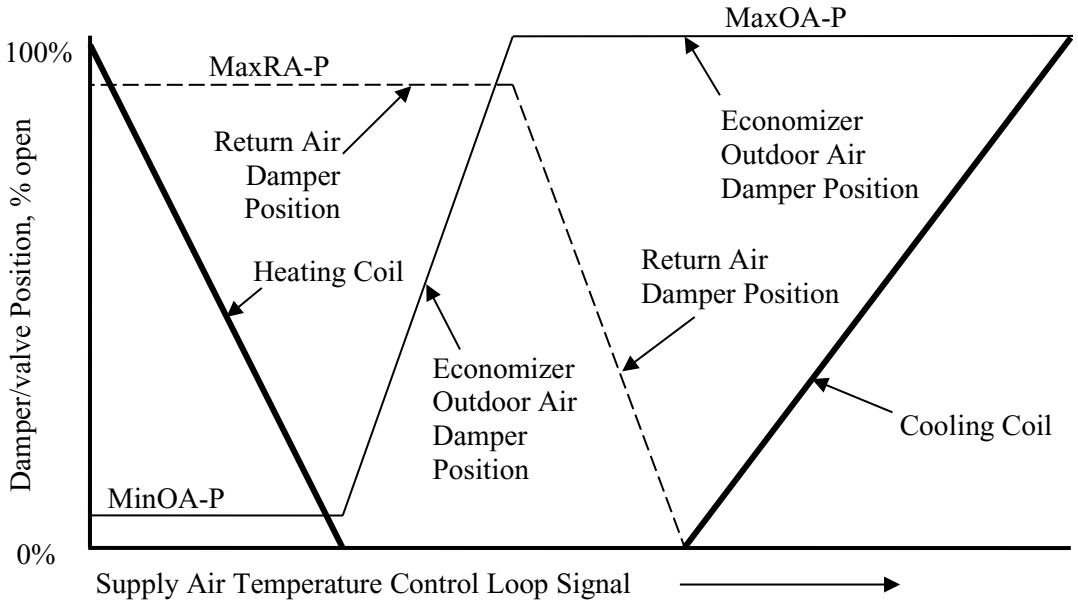

Figure 5.16.2.3-1 SAT loop mapping with relief damper or relief fan.

For AHUs with return fans and airflow tracking control, the SAT control loop makes the economizer outdoor air damper open fully whenever the AHU is on, while the return air

damper modulates to maintain supply air temperature as shown below. Relief/exhaust damper position tracks inversely with the return damper position.

Outdoor air dampers on air handlers with return fans have no impact on the outdoor airflow rate into the mixing plenum. Instead, the return-fan and return-damper controls dictate outdoor air flow. See ASHRAE Guideline 16.

Note that the economizer damper will close (if there is a separate minimum outdoor air damper) or modulate to minimum position (if there is a single outdoor air damper) whenever minimum outdoor air control is active. See logic for Minimum Outdoor Air Control below.

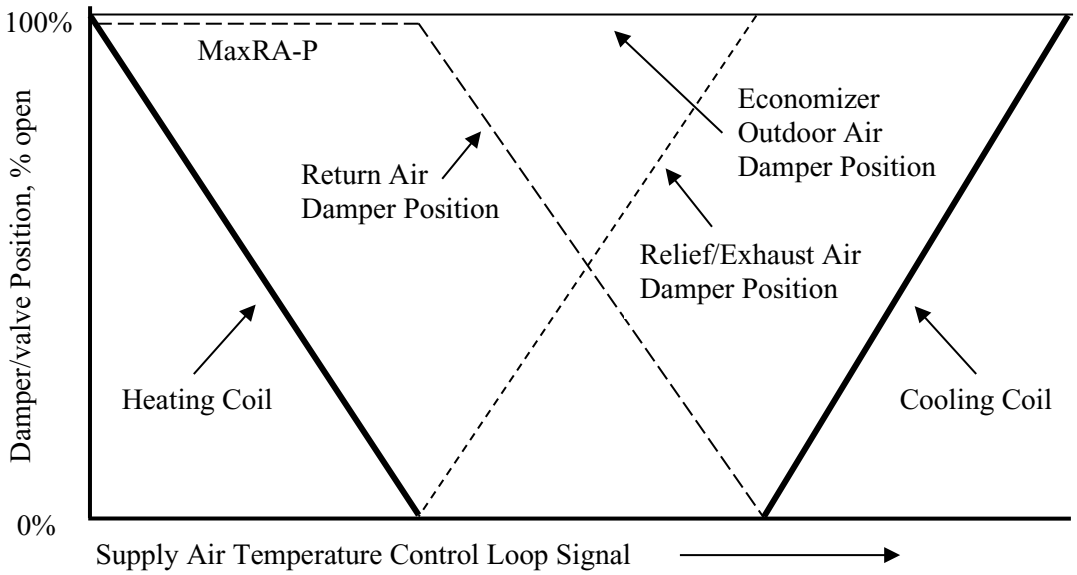

Figure 5.16.2.3-2 SAT loop mapping with return-fan control with airflow tracking.

For AHUs with return fans and direct building pressure controls, the SAT control loop makes the economizer outdoor air damper open fully whenever the AHU is on, while the return air damper modulates to maintain supply air temperature as shown below. Relief/exhaust damper position tracks inversely with the return damper position.

Outdoor air dampers on air handlers with return fans have no impact on the outdoor airflow rate into the mixing plenum. Instead, the return-fan and return-damper controls dictate outdoor air flow. See ASHRAE Guideline 16.

Note that the economizer damper will close (if there is a separate minimum outdoor air damper) or modulate to minimum position (if there is a single outdoor air damper) whenever minimum outdoor air control is active. See logic for Minimum Outdoor Air Control below.

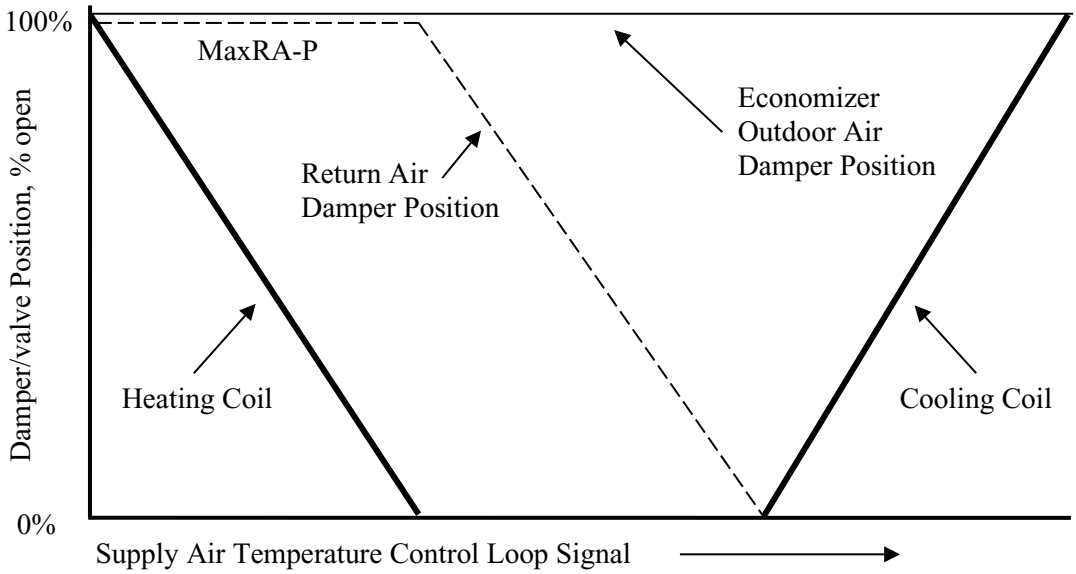

Figure 5.16.2.3-3 SAT loop mapping with return-fan control with direct building pressure controls.

Revise Section 5.16.4.4 as follows:

5.16.4.4 Outdoor Air and Return Air Dampers

The engineer must specify whether the unit has a return fan, relief damper or relief fans.

If there is a return fan, keep subsection (a) and delete subsection (b).

If there are relief damper or relief fans, keep subsection (b) and delete subsection (a).

Delete this flag note after selections have been made.

a. For units with return fans

Minimum outdoor air control is enabled when return damper position exceeds MRA-P because it cannot be assumed that the combination of the minimum and the economizer outdoor air dampers are providing sufficient outdoor air under these conditions.
The 20% threshold can be increased to ensure minimum outdoor airflow will be maintained but at the expense of fan energy. This threshold could be determined empirically during TAB work as well.

1. When the supply air fan is proven on and the system is in occupied mode and MinDPsp is greater than zero, the system shall calculate MRA-P. The value of MRA-P shall scale from 95% when supply fan speed is at 100% design speed proportionally down to 20% when the fan is at minimum speed. When MRA-P is not being calculated for any reason, it shall be set to 100%.

2. Minimum outdoor air control shall be enabled when the unit is in Occupied Mode and either of the following conditions are true for 10 minutes:

    a. The economizer high limit conditions in Section 5.1.17 are exceeded.

    b. When the minimum outdoor air damper is open and the return air damper position is greater than MRA-P.

3. When minimum outdoor air control is enabled, the normal sequencing of economizer outdoor air and return air dampers per Section 5.16.2 shall be suspended per the following sequence:

    a. Fully open return air damper; and

Economizer outdoor air damper is closed when minimum outdoor air control is enabled to ensure a good signal across the minimum outdoor air damper.

    b. Wait 15 seconds, then close the economizer outdoor air damper; and

    c. Wait 3 minutes, then release return air damper position for control by the SAT control loop in Section 5.16.2. Economizer outdoor air damper remains closed.

    d. The maximum return air damper position endpoint MaxRA-P shall be modulated from 100% to 0% to maintain DP across the minimum outdoor air damper at set point MinDPsp.

4. Minimum outdoor air control shall be disabled when the unit is no longer in Occupied Mode, or both of the following conditions are true for 10 minutes:

    a. The economizer high limit conditions in Section 5.1.17 are not exceeded.

    b. The minimum outdoor air damper is closed or the return air damper position is 10% below MRA-P.

5. When minimum outdoor air control is disabled:

    a. Economizer outdoor air damper shall be fully opened.

    b. MaxRA-P shall be set to 100%.

    c. Economizer and return air damper positions shall be controlled by the SAT control loop per Section 5.16.2.

b. For units with relief dampers or relief fans

Minimum outdoor air control is enabled when economizer damper position is less than MOA-P because it cannot be assumed that the combination of the minimum and the economizer outdoor air dampers are providing sufficient outdoor air under these conditions.

Minimum outdoor air control is disabled when return damper position is less than MRA-P, because the economizer damper has been closed to enable an accurate airflow measurement through the minimum outdoor air damper.
The 20% and 80% thresholds can be increased/decreased to ensure minimum outdoor airflow will be maintained but at the expense of fan energy. This threshold could be determined empirically during TAB work as well.

1. When the supply air fan is proven on and the system is in occupied mode and MinDPsp is greater than zero, the system shall calculate MOA-P. The value of MOA-P shall scale from 5% when supply-fan speed is at 100% design speed proportionally up to 80% when the fan is at minimum speed. When MOA-P is not being calculated for any reason, it shall be set to 0%.

2. When the supply air fan is proven on and the system is in occupied mode and MinDPsp is greater than zero, the system shall calculate MRA-P. The value of MRA-P shall scale from 95% when supply fan speed is at 100% design speed proportionally down to 20% when the fan is at minimum speed. When MRA-P is not being calculated for any reason, it shall be set to 100%.

3. Minimum outdoor air control shall be enabled when the unit is in Occupied Mode and either of the following conditions are true for 10 minutes:

    a. The economizer high limit conditions in Section 5.1.17 are exceeded.

    b. When the minimum outdoor air damper is open and the economizer outdoor air damper position is less than MOA-P.

4. When minimum outdoor air control is enabled, the normal sequencing of economizer outdoor air and return air dampers per Section 5.16.2 shall be suspended per the following sequence:

    a. Fully open return air damper; and

Economizer outdoor air damper is closed when minimum outdoor air control is enabled to ensure a good signal across the minimum outdoor air damper.

    b. Wait 15 seconds, then close the economizer outdoor air damper; and

    c. Wait 3 minutes, then release return air damper position for control by the SAT control loop in Section 5.16.2. Economizer outdoor air damper remains closed.

    d. The maximum return air damper position endpoint MaxRA-P shall be modulated from 100% to 0% to maintain DP across the minimum outdoor air damper at set point MinDPsp.

5. Minimum outdoor air control shall be disabled when the unit is no longer in Occupied Mode, or both of the following conditions are true for 10 minutes:

    a. The economizer high limit conditions in Section 5.1.17 are not exceeded.

b. The minimum outdoor air damper is closed or the return air damper position is 10% below MRA-P.

6. When minimum outdoor air control is disabled:

a. MaxRA-P shall be set to 100%.

b. Economizer and return air damper positions shall be controlled by the SAT control loop per Section 5.16.2.

~~1. Return air damper minimum outdoor air control is enabled when the minimum outdoor air damper is open and the economizer outdoor air damper is less than MOA-P, where MOA-P is 5% when supply-fan speed is at 100% design speed proportionally up to 80% when the fan is at minimum speed.~~

~~2. Return air damper minimum outdoor air control is disabled when the minimum outdoor air damper is closed or the economizer outdoor air damper is 10% above MOA-P as determined above.~~

~~*The economizer outdoor air damper enabling set point assumes the minimum outdoor air can be maintained by a combination of outdoor air coming through the economizer outdoor air damper as well as the minimum outdoor air damper. Higher damper position set points ensure minimum outdoor airflow will be maintained but at the expense of fan energy. These set points could be determined empirically during TAB work as well.*~~

~~3. When enabled, the maximum RA damper set point MaxRA-P is modulated from 100% to 0% to maintain DP across the minimum outdoor air damper at set point MinDPsp.~~

Revise Section 5.16.5.3 as follows:

~~5.16.5.3 Minimum Outdoor Air Control Loop~~

~~a. Minimum outdoor air control loop is enabled when the supply fan is proven ON and in occupied mode, and disabled and output set to zero otherwise.~~

~~b. The minimum outdoor airflow rate shall be maintained at the minimum outdoor air set point MinOAsp by a reverse-acting control loop whose output is 0% to 100%. From 0% to 50% loop output, the minimum outdoor air damper is opened from 0% to 100%.~~

~~c. Return air dampers~~

~~1. Return air damper minimum outdoor air control is enabled when the minimum outdoor air damper is 100% open and the economizer outdoor air damper is less than MOA-P, where MOA-P is 5% when supply-fan speed is at 100% design speed proportionally up to 80% when the fan is at minimum speed.~~

~~*The economizer outdoor air damper enabling set point assumes the minimum outdoor air can be maintained by a combination of outdoor air coming through the economizer outdoor air damper as well as the minimum outdoor air damper. Higher damper position set points ensure minimum outdoor airflow will be maintained but at the expense of fan energy. These set points could be determined empirically during TAB work as well.*~~

~~2. Return air damper minimum outdoor air control is disabled when the minimum outdoor air damper is less than 100% open or the economizer outdoor air damper is 10% above MOA-P, as determined above.~~

~~When enabled, the maximum RA damper set point, MaxRA-P, is reduced from 100% to 0% as the minimum outdoor air loop output rises from 50% to 100%.~~

5.16.5.3 Open minimum outdoor air damper when the supply fan is proven ON, the AHU is in Occupied Mode and MinOAsp is greater than zero. Minimum outdoor air damper shall be closed otherwise.

Revise Section 5.16.5.4 as follows:

5.16.5.4 Outdoor Air and Return Air Dampers

The engineer must specify whether the unit has a return fan, relief damper or relief fans.

If there is a return fan, keep subsection (a) and delete subsection (b).

If there are relief damper or relief fans, keep subsection (b) and delete subsection (a).

Delete this flag note after selections have been made.

a. For units with return fans

Minimum outdoor air control is enabled when return damper position exceeds MRA-P because it cannot be assumed that the combination of the minimum and the economizer outdoor air dampers are providing sufficient outdoor air under these conditions.
The 20% threshold can be increased to ensure minimum outdoor airflow will be maintained but at the expense of fan energy. This threshold could be determined empirically during TAB work as well.

1. When the supply air fan is proven on and the system is in occupied mode and MinOAsp is greater than zero, the system shall calculate MRA-P. The value of MRA-P shall scale from 95% when supply fan speed is at 100% design speed proportionally down to 20% when the fan is at minimum speed. When MRA-P is not being calculated for any reason, it shall be set to 100%.

2. Minimum outdoor air control shall be enabled when the unit is in Occupied Mode and either of the following conditions are true for 10 minutes:

    a. The economizer high limit conditions in Section 5.1.17 are exceeded.

b. When the minimum outdoor air damper is open and the return air damper position is greater than MRA-P.

3. When minimum outdoor air control is enabled, the normal sequencing of economizer outdoor air and return air dampers per Section 5.16.2 shall be suspended per the following sequence:

a. Fully open return air damper; and

Economizer outdoor air damper is closed when minimum outdoor air control is enabled to ensure a good signal across the minimum outdoor air damper.

b. Wait 15 seconds, then close the economizer outdoor air damper; and

c. Wait 3 minutes, then release return air damper position for control by the SAT control loop in Section 5.16.2. Economizer outdoor air damper remains closed.

d. The maximum return air damper position endpoint MaxRA-P shall be modulated from 100% to 0% to maintain airflow across the minimum outdoor air damper at set point MinOAsp.

4. Minimum outdoor air control shall be disabled when the unit is no longer in Occupied Mode, or both of the following conditions are true for 10 minutes:

a. The economizer high limit conditions in Section 5.1.17 are not exceeded.

b. The minimum outdoor air damper is closed or the return air damper position is 10% below MRA-P.

5. When minimum outdoor air control is disabled:

a. Economizer outdoor air damper shall be fully opened.

b. MaxRA-P shall be set to 100%.

c. Economizer and return air damper positions shall be controlled by the SAT control loop per Section 5.16.2.

b. For units with relief dampers or relief fans

Minimum outdoor air control is enabled when economizer damper position is less than MOA-P because it cannot be assumed that the combination of the minimum and the economizer outdoor air dampers are providing sufficient outdoor air under these conditions.
Minimum outdoor air control is disabled when return damper position is less than MRA-P, because the economizer damper has been closed to enable an accurate airflow measurement through the minimum outdoor air damper.
The 20% and 80% thresholds can be increased/decreased to ensure minimum outdoor airflow will be maintained but at the expense of fan energy. This threshold could be determined empirically during TAB work as well.

1. When the supply air fan is proven on and the system is in occupied mode and MinOAsp is greater than zero, the system shall calculate MOA-P. The value of MOA-P shall scale from 5% when supply-fan speed is at 100% design speed proportionally up to 80% when the fan is at minimum speed. When MOA-P is not being calculated for any reason, it shall be set to 0%.

2. When the supply air fan is proven on and the system is in occupied mode and MinOAsp is greater than zero, the system shall calculate MRA-P. The value of MRA-P shall scale from 95% when supply fan speed is at 100% design speed proportionally down to 20% when the fan is at minimum speed. When MRA-P is not being calculated for any reason, it shall be set to 100%.

3. Minimum outdoor air control shall be enabled when the unit is in Occupied Mode and either of the following conditions are true for 10 minutes:

    a. The economizer high limit conditions in Section 5.1.17 are exceeded.

    b. When the minimum outdoor air damper is open and the economizer outdoor air damper position is less than MOA-P.

4. When minimum outdoor air control is enabled, the normal sequencing of economizer outdoor air and return air dampers per Section 5.16.2 shall be suspended per the following sequence:

    a. Fully open return air damper; and

Economizer outdoor air damper is closed when minimum outdoor air control is enabled to ensure a good signal across the minimum outdoor air damper.

    b. Wait 15 seconds, then close the economizer outdoor air damper; and

    c. Wait 3 minutes, then release return air damper position for control by the SAT control loop in Section 5.16.2. Economizer outdoor air damper remains closed.

    d. The maximum return air damper position endpoint MaxRA-P shall be modulated from 100% to 0% to maintain airflow across the minimum outdoor air damper at set point MinOAsp.

5. Minimum outdoor air control shall be disabled when the unit is no longer in Occupied Mode, or both of the following conditions are true for 10 minutes:

    a. The economizer high limit conditions in Section 5.1.17 are not exceeded.

    b. The minimum outdoor air damper is closed or the return air damper position is 10% below MRA-P.

6. When minimum outdoor air control is disabled:

    a. MaxRA-P shall be set to 100%.

b. Economizer and return air damper positions shall be controlled by the SAT control loop per Section 5.16.2.

~~1. Return air damper minimum outdoor air control is enabled when the minimum outdoor air damper is open and the economizer outdoor air damper is less than MOA-P, where MOA-P is 5% when supply-fan speed is at 100% design speed proportionally up to 80% when the fan is at minimum speed.~~

~~2. Return air damper minimum outdoor air control is disabled when the minimum outdoor air damper is less than 100% open or the economizer outdoor air damper is 10% above MOA-P, as determined above.~~

~~*The economizer outdoor air damper enabling set point assumes the minimum outdoor air can be maintained by a combination of outdoor air coming through the economizer outdoor air damper as well as the minimum outdoor air damper. Higher damper position set points ensure minimum outdoor airflow will be maintained but at the expense of fan energy. These set points could be determined empirically during TAB work as well.*~~

~~3. When enabled, the maximum return air damper set point, MaxRA-P, is reduced from 100% to 0% as the minimum outdoor air loop output rises from 50% to 100%.~~

Revise Section 5.16.6.3 as follows:

5.16.6.3 Minimum Outdoor Air Control Loop

a. Minimum outdoor air control loop is enabled when the supply fan is proven ON and the AHU is in occupied mode, and disabled and output set to zero otherwise.

The engineer must specify whether the unit has a return fan, relief damper or relief fans.

If there is a return fan, keep subsection (b) and delete subsection (c).

If there are relief damper or relief fans, keep subsection (c) and delete subsection (b).

Delete this flag note after selections have been made.

b. For units with return fans:

The following logic limits the return damper position to ensure that minimum outdoor air is maintained at all times, while the actual return damper position is modulated by the SAT control loop.

1. The outdoor airflow rate shall be maintained at the minimum outdoor damper outdoor airflow setpoint MinOAsp by a direct-acting control loop whose output is mapped to the return air damper maximum position endpoint MaxRA-P.

The following logic directly controls the return damper position to ensure that exactly the minimum outdoor air – and no more – is provided when economizer lockout conditions are exceeded. When economizer lockout no longer applies, return damper control reverts to the SAT control loop.

2. While the unit is in Occupied Mode, if the economizer high limit conditions in Section 5.1.17 are exceeded for 10 minutes, outdoor air shall be controlled to the minimum outdoor airflow. When this occurs, the normal sequencing of the return air damper by the SAT control loop is suspended, and the return air damper position shall be modulated directly to maintain measured airflow at MinOAsp (i.e. return damper position shall equal MaxRA-P). The economizer damper shall remain open.

3. If the economizer high limit conditions in Section 5.1.17 are not exceeded for 10 minutes, or the unit is no longer in Occupied Mode, release return damper to control by the SAT control loop (i.e. return damper position is limited by MaxRA-P endpoint, but is not directly controlled to equal MaxRA-P).

c. For units with relief dampers or relief fans:

The following logic limits the return and economizer damper positions to ensure that minimum outdoor air is maintained at all times, while the actual damper positions are modulated by the SAT control loop.

1. The outdoor airflow rate shall be maintained at the minimum outdoor air set point MinOAsp by a reverse-acting control loop whose output is mapped to economizer damper minimum position MinOA-P and return air damper maximum position MaxRA-P as indicated in Figure 5.16.6.3.

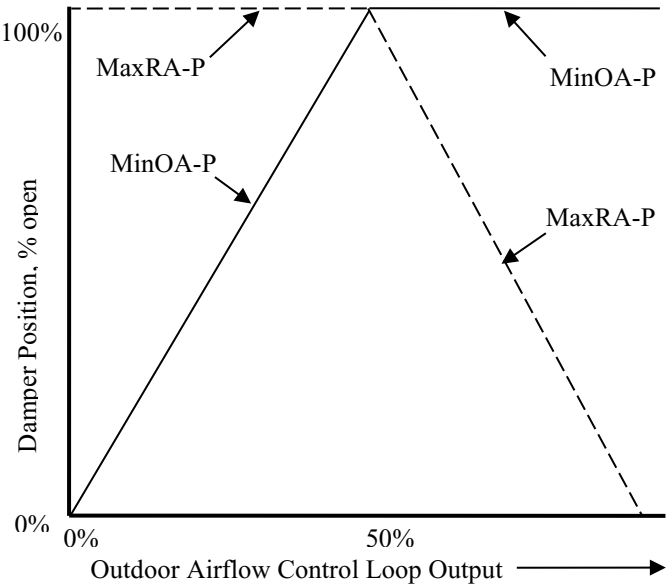

Figure 5.16.6.3 Minimum outdoor airflow control mapping with single damper.

The following logic directly the return and economizer damper positions to ensure that exactly the minimum outdoor air – and no more – is provided when economizer lockout conditions are exceeded. When economizer lockout no longer applies, return damper control reverts to the SAT control loop.

2. **While the unit is in Occupied Mode,** if the economizer high limit conditions in Section 5.1.17 are exceeded for 10 minutes, outdoor air shall be controlled to the minimum outdoor airflow. When this occurs, the normal sequencing of the return air damper by the SAT control loop is suspended:

   a. Fully open return air damper

   b. Wait 15 seconds, then set MaxOA-P equal to MinOA-P

   c. Wait 3 minutes, then modulate return air damper to maintain measured airflow at MinOAsp (i.e. return damper position shall equal MaxRA-P).

3. If the economizer high limit conditions in Section 5.1.17 are not exceeded for 10 minutes, or the unit is no longer in Occupied Mode, set MaxOA-P = 100% and release return damper to control by the SAT control loop (i.e. return damper position is limited by MaxRA-P endpoint, but is not directly controlled to equal MaxRA-P).

Delete Section 5.16.7 entirely and renumber subsequent sections. The content of 5.16.7 has been consolidated in 5.16.4.4 through 5.16.6.4

~~5.16.7 Economizer High-Limit Lockout~~

~~5.16.7.1 The normal sequencing of the economizer dampers in Sections 5.16.2 through 5.16.6 shall be disabled in accordance with Section 5.1.17.~~

~~5.16.7.2 When economizer is enabled, MaxOA-P = 100%.~~

~~5.16.7.3 Once the economizer is disabled, it shall not be reenabled within 10 minutes, and vice versa.~~

~~5.16.7.4 When the economizer is disabled,~~

~~a. return air damper shall be fully opened;~~

~~b. wait 15 seconds, then set MaxOA-P equal to MinOA-P; and~~

~~c. wait 3 minutes, then release return air damper for minimum outdoor air control.~~

~~*The return air damper is at first opened to avoid drawing the mixing plenum too negative. The 3-minute delay is because the minimum OA damper may be pressure controlled. In that case, delay allows time for the plenum pressure to stabilize so that the return damper loop does not become unstable chasing a fluctuating pressure reading.*~~

Revise Section 5.16.10 as follows:

5.16.10 Return-Fan Control − Direct Building Pressure

5.16.10.1 Return fan operates whenever the associated supply fan is proven ON and shall be off otherwise.

5.16.10.2 Return fans shall be controlled to maintain return-fan discharge static pressure at set point (Section 5.16.10.5).

~~5.16.10.3 Exhaust dampers shall only be enabled when the associated supply and return fans are proven ON and the minimum outdoor air damper is open. The exhaust dampers shall be closed when disabled.~~

~~5.16.10.4~~5.16.10.3 Building static pressure shall be time averaged with a sliding 5-minute window and 15 second sampling rate (to dampen fluctuations). The averaged value shall be that displayed and used for control.

~~d.~~a. Where multiple building pressure sensors are used, the highest of the averaged values for sensors within a pressure zone shall be used for control.

Due to the potential for interaction between the building pressurization and return-fan control loops, extra care must be taken in selecting the control loop gains. To prevent excessive control-loop interaction, the closed-loop response time of the building pressurization loop should not exceed 1/5 the closed-loop response time of the return-fan control loop. This can be accomplished by decreasing the gain of the building pressurization control loop.

~~5.16.10.5~~5.16.10.4 A single P-only control loop for each pressure zone shall modulate to maintain the building pressure at a setpoint of 12 Pa (0.05 in. of water) with an output ranging from 0% to 100%. The loop shall be enabled when the supply and return fans for any unit within the pressure zone are proven ON and the minimum outdoor air damper is open. The exhaust dampers shall be closed with loop output set to zero otherwise. All exhaust damper and return fan static pressure setpoints for units in an associated pressure zone shall be sequenced based on building pressure control loop output signal, as shown in Figure 5.16.10.5.~~When exhaust dampers are enabled, a control loop shall modulate exhaust dampers in sequence with the return-fan static pressure set point, as shown in Figure 5.16.10.5, to maintain the building pressure at a set point of 12 Pa (0.05 in. of water).~~

A pressure zone is defined as an enclosed area with interconnected return air paths. All operating relief dampers and return fans that serve a pressure zone shall be controlled as if they were one system, using the same control loop, even if they are associated with different AHUs.

The appropriate boundaries for pressure zones, establishing which return fans run together, will need to be determined by the engineer based on building geometry.

a. From 0% to 50%, the building pressure control loop shall modulate the exhaust dampers from 0% to 100% open.

b. From 51% to 100%, the building pressure control loop shall reset the return-fan discharge static pressure set point from RFDSPmin at 50% loop output to RFDSPmax at 100% of loop output. See Section 3.2.1.4 for RFDSPmin and RFDSPmax.

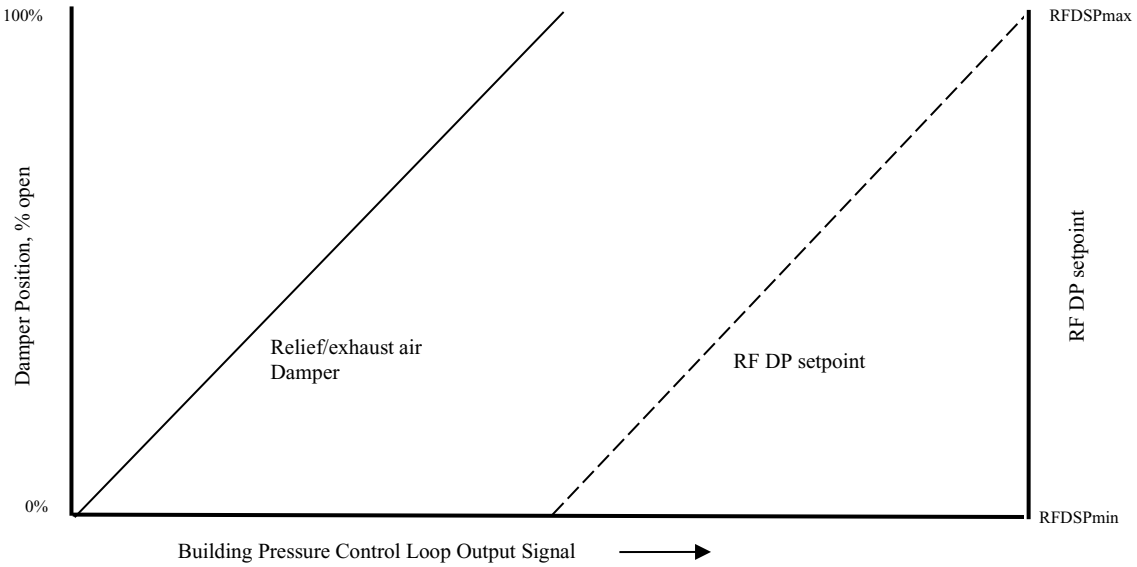

Figure 5.16.10.5 Exhaust damper position and return-fan DP reset

Revise Section 5.16.11.3 as follows:

5.16.11.3 Return-fan speed shall be controlled to maintain return airflow equal to supply airflow less differential S-R-DIFF*. Where multiple air handling units share a common return fan (i.e. dual fan dual duct), return fan speed shall be controlled to maintain return airflow equal to total supply airflow of all associated units less differential S-R-DIFF*.

The following logic will keep supply airflow from exceeding the capability of the return fan, which is often designed to be smaller than the supply fan, which can result in excess outdoor air intake. This becomes an issue when S-R-DIFF is zero during Warmup, Cooldown, Setback, and Setup Modes because the supply air fan can be at full speed due to VAV boxes operating at Vcool-max during these modes.*

Revise Section 5.16.11.5 as follows:

5.16.11.5 Relief/exhaust dampers shall be enabled when the associated supply and return fans are proven ON and closed otherwise. Exhaust dampers shall modulate as the inverse of the return air damper per Section 5.16.2.3.

Airflow tracking requires a measurement of supply airflow and return airflow. ~~Figure 6.9~~Appendix A-9 shows AFMS at both fans. These are actually not mandatory, although they may improve accuracy if properly installed. The supply airflow can be calculated by summing VAV box airflow rates. Return airflow can be approximated by return-fan speed if there are no dampers in the return air path (the geometry of the return air system must be static for speed to track airflow.)
S-R-DIFF is determined empirically during the TAB phase. If there are intermittent or variable-flow exhaust fans, this set point should be dynamically adjusted based on exhaust fan status or airflow/speed.

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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.

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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.

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