

13.4.6 Factory Air Economizer Certification Procedure

Air economizer acceptance testing is required by the 2013 California Building Energy Efficiency Standards (Title 24 Part 6) Section 120.5(a)4: "Air economizers shall be tested in accordance with NA7.5.4 Air Economizer Controls." The purpose of this test is to assure that economizers work per the intent of the Title 24 standards section 140.4(e) Economizers. The requirements of this acceptance test are described in the Reference Appendices to the Title 24 Building Efficiency Standards Section NA7.5.4 Air Economizer Controls. A detailed description of the test is located in Chapter 10 of the Nonresidential Compliance Manual: NA7.5.4 Air Economizer Controls Acceptance: "At-A-Glance" and "Test Procedure."

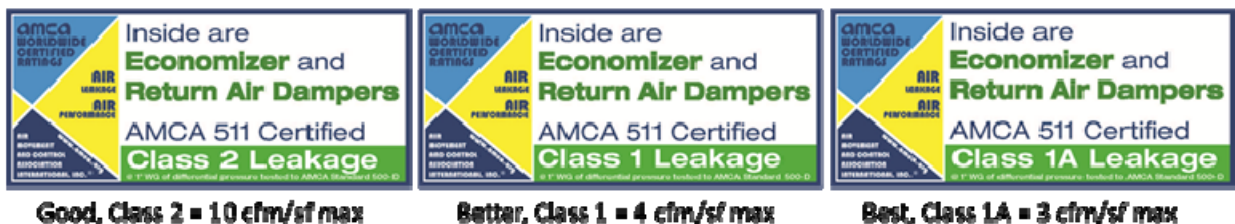
Air economizers installed by the HVAC system manufacturer and certified to the CEC as being factory installed, calibrated and tested are exempted from the Air Economizer Controls acceptance test as described in the Nonresidential Standards Reference Appendix NA7.5.4. The following sections describe the requirements of a "factory installed and calibrated economizer" certification and how to apply for California Energy Commission approval of a certification program.

Certification Requirements

Inspection

- Minimum outside air damper position can be adjusted and outside and return air dampers modulate as necessary to achieve the desired position.
- Outside air dampers completely close when the unit is off
- Outside air dampers move freely without binding
- Provide a 5 year manufacturer warranty of economizer assembly
- Provide an economizer specification sheet proving capability of at least 60,000 actuations
- Provide a product specification sheet proving compliance with AMCA Standard 500 damper leakage at 10 cfm/sf at 1.0 in. w.g. A product specification sheet showing the manufacturer's results after following the testing procedures of AMCA Standard 500 or AMCA certification by a third party under AMCA Publication 511 can be used to satisfy this requirement (Class 1A, 1, and 2 are acceptable).

AMCA 511 Certification Product Labels



Class 2, Class 1, & Class 1A Are All Acceptable

- System has return fan speed control, relief dampers, or dedicated exhaust fans to prevent building over pressurization in full economizer model
- Outdoor air, return air, mixed air, and supply air sensors shall be calibrated within the following accuracies:
 - Drybulb and wetbulb temperatures accurate to $\pm 2^{\circ}\text{F}$ over the range of 40°F to 80°F
 - Enthalpy accurate to ± 3 Btu/lb over the range of 20 Btu/lb to 36 Btu/lb
 - Relative humidity (RH) accurate to $\pm 5\%$ over the range of 20 percent to 80 percent RH

- Sensor performance curve is provided with economizer instruction material. In addition, the sensor output value measured during sensor calibration is plotted on the performance curve.
- If the high limit setpoint is fixed dry-bulb or fixed enthalpy + fixed dry-bulb then the control shall have an adjustable setpoint.
- Sensors used for the high limit control are located to prevent false readings, e.g. properly shielded from direct sunlight
- High limit shut-off setpoint shall be set to these default limit settings per Table 140.4-B as referenced in Section 140.4(e)3:

Device Type	Climate Zones	Required High Limit (Economizer Off When):
Fixed Dry Bulb	1, 3, 5, 11-16	$T_{OA} > 75^{\circ}\text{F}$
	2, 4, 10	$T_{OA} > 73^{\circ}\text{F}$
	6, 8, 9	$T_{OA} > 71^{\circ}\text{F}$
	7	$T_{OA} > 69^{\circ}\text{F}$
Differential Dry Bulb	1, 3, 5, 11-16	$T_{OA} > T_{RA}$
	2, 4, 10	$T_{OA} > T_{RA} - 2^{\circ}\text{F}$
	6, 8, 9	$T_{OA} > T_{RA} - 4^{\circ}\text{F}$
	7	$T_{OA} > T_{RA} - 6^{\circ}\text{F}$
Fixed Enthalpy + Fixed Drybulb	All	$h_{OA} > 28 \text{ Btu/lb}$ or $T_{OA} > 75^{\circ}\text{F}$

Fixed enthalpy, differential enthalpy, and electronic enthalpy are not allowed in any climate zones.

Functional Testing

Factory installed and calibrated economizer certification shall document that the following conditions are met:

- During a call for heating, outside air dampers close to minimum ventilation position & return air dampers open
- Demonstrate proper integration between economizer and compressor:

Step	Description	Purpose
1	Simulate OAT to 45°F and RAT to 75°F	
2	Generate call for cooling and increase OAT such that economizer damper modulates to position between minimum and 50% open with no mechanical cooling.	Test partial economizing at low OAT.
3	Verify economizer position is correct (between minimum and 50%) and stable with no hunting, compressor is not enabled, and heating is disabled. Record the OAT and economizer damper position.	
4	Increase the OAT such that economizer damper modulates to position between 50% to 100% open with no mechanical cooling.	Test partial economizing.
5	Verify economizer modulates open to a larger degree, is stable with no hunting, the return air damper modulates more closed, and the compressor is not enabled. Record	

	the OAT and economizer damper position.	
6	Increase the OAT such that the compressor turns on and the economizer damper modulates more closed.	Test partial economizing and compressor integration.
7	Verify the compressor is enabled. Record the OAT at high limit and the economizer damper position.	
8	Verify the compressor turns off and the economizer damper modulates to 100% open.	Test full economizing.
9	Record the compressor run time (minutes)	
10	Repeat Steps 7-8 when the compressor turns on again. Also verify the economizer damper modulates more closed.	Test partial economizing and compressor integration.
11	Record the compressor off time between cycles (minutes)	
12	Slowly increase the OAT such that mechanical cooling is enabled and the economizer damper modulates to minimum position	Test minimum ventilation and compressor integration.
13	Verify economizer and return air damper positions are correct and stable with no hunting, compressor is enabled, and heating is disabled.	

- Demonstrate economizer high limit control and deadband using the following process:

Step	Description	Purpose
1	Simulate RAT to 80°F; OAT to 72°F	
2	Generate a call for cooling	
3	Verify that economizer is at minimum position	Test minimum ventilation above the high limit setpoint.
4	Incrementally lower the OAT	
5	Verify that economizer stays at minimum position until ambient air conditions are less than high limit setpoint then opens to 100%	Test the high limit setpoint from above.
6	Reverse the process	Test the deadband.
7	Incrementally raise the OAT	
8	Verify that economizer stays at maximum position until ambient air conditions are higher than high limit setpoint then closes to minimum position	Test the high limit setpoint from below.

9	<p>Test passes if:</p> <p>i.) economizer controller will utilize a deadband between economizer enable/disable operation of no greater than 2°F and</p> <p>ii.) high limit control meets the requirements of Table 140.4-C as referenced in Title 24 Section 140.4(e)3</p>	
---	---	--

Documents to accompany Factory Installed and Calibrated Economizer Certificate

- Installation instructions. For systems with cooling capacities greater than 54,000 Btu/hr, instructions shall include methods to assure economizer control is integrated and is providing cooling even when economizer cannot serve the entire cooling load.
- Sensor performance curve for high limit shut-off sensors and instructions for measuring sensor output. Performance curve shall also contain test points during calibration plotted on the curve. Curve details shall be accurate enough to show increments of 1°F and 1 Btu/lb.
- Economizer specification sheet proving capability of at least 60,000 actuations.
- Provide a product specification sheet proving compliance with AMCA Standard 500 damper leakage at 10 cfm/sf at 1.0 in. w.g. A product specification sheet showing the manufacturer’s results after following the testing procedures of AMCA Standard 500 or AMCA certification by a third party under AMCA Publication 511 can be used to satisfy this requirement (Class 1A, 1, and 2 are acceptable).

Application for Factory Installed and Calibrated Economizer Certification

Manufacturers who wish to label their economizers as factory installed and calibrated must provide the following information to the California Energy Commission:

- Brief description of test method including:
 - Method of placing equipment in heating and cooling mode
 - Method of calibrating high limit sensor
 - Method of testing control and damper
- Model numbers of products to be certified
- Sample of Factory Installed and Calibrated Economizer documentation that would accompany each qualifying economizer.
- Name and contact information of lead staff in charge of certification

Send the application materials to:

Building Standards Development Office
California Energy Commission
1516 Ninth St., MS 37
Sacramento, CA 95814

Sample Certificate Factory Installed and Calibrated Economizers

This document certifies that this economizer has been factory installed and calibrated according to the requirements of the California Energy Commission. As a result, this economizer is exempted from the functional testing requirements (but not the construction inspection requirements) as described in Standards Appendix NA7.5.4 “Air Economizer Controls” and on the MECH-5 acceptance testing form.

Date of economizer testing:	Model Number:
Supervisor:	Serial Number:
Technician:	Rated Cooling Capacity:
Economizer fully integrated? YES NO	

Type of high limit control and setpoint (check appropriate control strategy):

Device Type	Control Type & Setpoint	Climate Zones	Required High Limit (Economizer Off When):	
			Equation	Description
Fixed Dry Bulb	<input type="checkbox"/> —	1, 3, 5, 11-16	$T_{OA} > 75^{\circ}\text{F}$	Outdoor air temperature exceeds 75°F
	<input type="checkbox"/> —	2, 4, 10	$T_{OA} > 73^{\circ}\text{F}$	Outdoor air temperature exceeds 73°F
	<input type="checkbox"/> —	6, 8, 9	$T_{OA} > 71^{\circ}\text{F}$	Outdoor air temperature exceeds 71°F
	<input type="checkbox"/> —	7	$T_{OA} > 69^{\circ}\text{F}$	Outdoor air temperature exceeds 69°F
Differential Dry Bulb	<input type="checkbox"/> —	1, 3, 5, 11-16	$T_{OA} > T_{RA}$	Outdoor air temperature exceeds return air temperature
	<input type="checkbox"/> —	2, 4, 10	$T_{OA} > T_{RA} - 2^{\circ}\text{F}$	Outdoor air temperature exceeds return air temperature minus 2°F
	<input type="checkbox"/> —	6, 8, 9	$T_{OA} > T_{RA} - 4^{\circ}\text{F}$	Outdoor air temperature exceeds return air temperature minus 4°F
	<input type="checkbox"/> —	7	$T_{OA} > T_{RA} - 6^{\circ}\text{F}$	Outdoor air temperature exceeds return air temperature minus 6°F
Fixed Enthalpy + Fixed Drybulb	<input type="checkbox"/> —	All	$h_{OA} > 28 \text{ Btu/lb}$ or $T_{OA} > 75^{\circ}\text{F}$	Outdoor air enthalpy exceeds 28 Btu/lb of dry air or Outdoor air temperature exceeds 75°F

Note to installer: Economizer high limit setpoint must be reset if needed based on climate zone and device type.

Outside Air Calibration

Outside air conditions during calibration test from reference measurement: $T_{OA} =$ _____ $h_{OA} =$ _____

Outside air sensor output during calibration test: $T_{OA} =$ _____ $h_{OA} =$ _____ Units (V, mA etc) _____

Sensor measured value from sensor performance curve: $T_{OA} =$ _____ $h_{OA} =$ _____

Are sensor measurements within 2°F or 3 Btu/lb of reference measurement?

(Yes, No, N/A) $T_{OA} =$ _____ $h_{OA} =$ _____

___ Sensor output plotted on sensor performance curve

___ Sensors used for the high limit control are properly shielded from direct sunlight

Return Air Calibration (for differential dry bulb controls only)

Return air temperature during calibration test from reference measurement: $T_{return} =$ _____

Return air sensor output during calibration test: Units (V, mV, etc) _____

Sensor measured value from sensor performance curve $T_{return} =$ _____

Are sensor measurements within 2°F of reference measurement?

(Yes, No, N/A) $T_{OA} =$ _____

Sensor output plotted on sensor performance curve

Functional Tests under Simulated Temperature Conditions

- During a call for heating, outside air dampers to close to a minimum outside air setting and return air dampers open
- During a call for full cooling and ambient conditions below the high limit shut-off setpoint, before mechanical cooling is enabled, outside air dampers open 100% and return dampers fully close
- For systems with cooling capacities greater than 54,000 Btu/h, during a call for full cooling, ambient conditions below the high limit shut-off setpoint and economizer cannot provide full cooling, mechanical cooling is modulated to maximize economizer cooling,
 N/A system cooling capacity < 54,000 Btu/h
- During a call for cooling and the measured ambient air condition is greater than the high limit shut-off setpoint, outside air dampers to close to a minimum outside air damper position and return air dampers open
- Minimum outside air can be adjusted
- Outside air dampers close when the unit is off
- Outside air dampers move freely without binding

Accompanying Documents

- Installation instructions.
- For systems with cooling capacities greater than 54,000 Btu/hr instructions shall include methods to assure economizer control is integrated and is providing cooling even when economizer cannot serve the entire cooling load. N/A system cooling capacity < 54,000 Btu/h
- Economizer specification sheet proving capability of at least 60,000 actuations.
- Provide a product specification sheet proving compliance with AMCA Standard 500 damper leakage at 10 cfm/sf at 1.0 in. w.g. A product specification sheet showing the manufacturer's results after following the testing procedures of AMCA Standard 500 or AMCA certification by a third party under AMCA Publication 511 can be used to satisfy this requirement (Class 1A, 1, and 2 are acceptable).
- Performance curve for high limit shut-off sensors and instructions for measuring sensor output.

The _____ Company certifies that all of the information on this Certificate for Factory Installed and Calibrated Economizers is true and that this economizer complies with all of the California Energy Commission requirements for Factory Installed and Calibrated Economizers.