

**DIVISION OF BUILDING SAFETY
APPLICATION FOR REVIEW OF A PROPOSED STATEWIDE AMENDMENT
TO STATE ADOPTED CODES
2015 Code Adoption Cycle**

Log# _____
(Office Use Only)

PLEASE FOLLOW INSTRUCTIONS ON PAGE FIVE

1. State Building Code to be Amended:

<input type="checkbox"/> International Building Code	<input checked="" type="checkbox"/> International Energy Conservation Code
<input type="checkbox"/> International Residential Code	<input type="checkbox"/> International Mechanical Code
<input type="checkbox"/> International Fuel Gas Code	<input type="checkbox"/> National Electrical Code
<input type="checkbox"/> International Existing Building Code	<input type="checkbox"/> IDAPA
<input type="checkbox"/> Idaho State Plumbing Code	

Section: C403.3.1 (2012) or C403.3 (2015) **Pages:** C-52 (2012) C-61 (2015)

2. Applicant Name (Specific local government, organization or individual):

Code Collaborative Subcommittee

3. Signed:

	City of Boise Building Official	4-14-16
Proponent	Title	Date

4. Designated Contact Person:

Jason Blais	City of Boise Building Official
Name	Title

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Office Phone	Cell	Fax

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5. Proposed Code Amendment. Use ‘legislative format’ including both old and new language. See instructions on page five for specific details. Please attach a separate sheet for each separate proposal.

IECC	C403.3.1 (2012) or C403.3 (2015)	C-52 (2012) C-61 (2015)
Code	Section	Pages

Please note number of additional pages: 6

Depending on which edition of the Energy Code is adopted.

Add an additional exception to 2012 IECC Section C403.3.1 Economizers to read as follows:

7. Unusual outdoor air contaminate conditions – Systems where special outside air filtration and treatment for the reduction and treatment of unusual outdoor contaminants, makes an air economizer infeasible.

OR

Add an additional exception to 2015 IECC Section C403.3 Economizers (Prescriptive) to read as follows:

10. Unusual outdoor air contaminate conditions – Systems where special outside air filtration and treatment for the reduction and treatment of unusual outdoor contaminants, makes an air economizer infeasible.

Supporting Data for Statewide Amendment Proposals. This information is required for all statewide amendment proposals. **Attach supporting documentation, as necessary; incomplete proposals will not be accepted.**

The governing boards require supporting data on any amendment proposal to show:

1. That it meets basic criteria – See Part I to specify how this proposal meets the criteria for code amendment.
2. The intended effect – See Part II to describe the purpose of the proposed amendment, including the benefits and the problems addressed.
3. The potential impacts or benefits to business – See Part III/Types of Construction, to explain how methods in construction businesses, industries and services would be affected.
4. The potential impacts on enforcement procedures, See Part III/Types of Services Required, to provide some analysis of the impacts on code enforcement in local jurisdictions.
5. Economic costs and benefits – Use the Table in Part IV of this form to estimate the costs and benefits of the proposal on construction practices, users and/or the public, the enforcement community, and operation and maintenance.

Part I ♦ Background information on amendment.

Code references: IECC C403.3.1 (2012) C403.3 (2015) Title: International Energy Conservation Code

Related Codes: None

(Does this amendment change other related codes?)

Proponent: Jason Blais

Phone: 384-3807

Date: 4/14/16

NOTE: Amendments to the state building code must be based on one of the following criteria; please indicate the pertinent rationale for the proposed amendment by selecting from the list below:

- The amendment is needed to address a critical life/safety need.
- (2) The amendment is needed to address a specific state policy or statute.
- (3) The amendment is needed for consistency with state or federal regulations.
- (4) The amendment is needed to address a unique character of the state.
- (5) The amendment corrects errors and omissions.

Part II ♦ Amendment Benefit:

PROBLEM(S) ADDRESSED (Describe the intended effect of the proposed code amendment):

This particular issue was brought to light from a Code Collaborative member who is a mechanical engineer.

In specific applications, i.e server rooms and clean rooms that may be present in hospitals, industrial processes, and research facilities, it is not cost effective to filter the outside air from an economizer so that it is safe for these environments. The additional upfront costs for the additional filtration equipment and ducting may cost more than the potential energy savings could save. This is particularly true when existing buildings are adding capacity to server rooms and or clean rooms where access and/or space is limited. Because of the high degree of filtration needed it may be more cost effective to add additional cooling used a closed system (ductless).

Ductless systems can be much more efficient than roof top systems and may be a cost effective option if outdoor air (economizers) are not required.

The State of Washington has added the following exception to their state energy code which warrants being proposed in Idaho.

"Exception - Unusual outdoor air contaminate conditions – Systems where special outside air filtration and treatment for the reduction and treatment of unusual outdoor contaminants, makes an air economizer infeasible."

PRIMARY REASON FOR AMENDMENT: (Describe how the amendment meets one of the criteria listed above)

See reasoning noted above for justification. Doing so will address a safety component and correct errors or omissions with the code and the practical application of economizers in these specific noted cases. The Code Collaborative had short discussion on this.

TYPE OF BENEFITS PROJECTED:

Part III ♦ Amendment Impacts or Benefits:

TYPES OF CONSTRUCTION: New Construction Alteration/Tenant Improvement/Repair
 Residential-Single Family Residential-Multi Family Commercial Industrial

List businesses/industries affected by amendment:

Manufacturers: _____
 Specific Construction Contractors & Trades: Mechanical Contractors
 Construction Supply Industry: Economizer/HVAC suppliers
 Specialty Trades: _____
 Types of Buildings: Commercial
 Fire Protection Industry: _____

Types of Services Required:

Reporting: Brief Description _____
 Record Keeping: Brief Description _____
 Other: Brief Description _____
 Indirect Cost to Industry: Indicate whether there are multiple sources to obtain the equipment, material or service required by this proposal. If not, provide a justification of the benefit versus small business impact.

Part IV ♦ Amendment Costs and Benefits

Building Type	Construction ¹			Enforcement ²			Operations & Maintenance ³		
	Co sts	% impact ⁴	Benefits ⁵	Costs	% Impact	Benefits	Costs	% impact	Benefits
Residential									
Single family									
Multi-family									
Commercial/ Retail	Reduce	0%	No install.	None	0%	N/A	None	0%	N/A
Industrial	↓	↓	↓	↓	↓	↓	↓	↓	↓
Institutional	↓	↓	↓	↓	↓	↓	↓	↓	↓

1 \$ / square foot of floor area or other cost. Attach data. Construction costs are costs prior to occupancy, and include both design and direct construction costs that impact the total cost of the construction to the owner/consumer.
 2 Cost per project plan. Attach data. Enforcement costs include governmental review of plans, field inspection, and mediated litigation required for enforcement.
 3 Cost to building owner/tenants over the life of the project.
 4 Cost differential over a specific size project or range of projects as determined by the proponent. Provide sufficient cost and benefit detail to clarify the impact to the Council. All data should be created and referenced to third party reputable sources for verification.
 5 Note sectors with measurable benefit from Part II, including benefits to a) the user, b) the public, c) the industry, and/or d) the economy; use e) for all of the above.



WHAT IS THE PURPOSE OF THIS REQUIREMENT?

Economizing refers to the use of outdoor air to provide building cooling. This approach reduces the annual hours of mechanical cooling system operation. There are two types of economizer systems – air economizer and water economizer. Proper application of these systems can significantly reduce mechanical cooling energy used by air conditioning systems.

Fundamentals of air economizer

An air economizer is an integrated system of outside air and return air dampers, linkages, actuators, sensors and controllers in an air handling system. Operational controls provide the capability of automatically modulating outside and return air dampers to provide 100% of the design supply air as outside air to reduce or eliminate the need for mechanical cooling.

There are two methods of economizer control:

- > **Comparative Dry Bulb** – Employs standard temperature sensing in both return and outside air streams.
- > **Differential Enthalpy** – Uses enthalpy sensors to compare energy content of return and outside air streams.

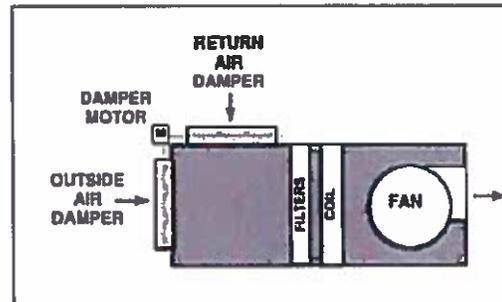


FIGURE 1 – Air Handler with Dampers for Economizer Controls

There are four operating modes in an air economizer system:

- > **Heating mode** – During cold weather, the outside air damper is adjusted to the minimum ventilation position to limit the amount of cold outdoor air that is mixed with the return air. The resulting mixed air is then heated to provide the necessary supply air temperature to heat the building.
- > **Modulated economizer mode** – During cool weather, outdoor air is mixed at varying percentages with return air so the resulting mixed air temperature is sufficient to condition the building. This is accomplished without mechanical heating or cooling. This is also referred to as "free cooling."
- > **Integrated economizer mode** – During moderate weather, outdoor air can provide a percentage of the required cooling but not enough to meet the building loads. The outside air damper is adjusted to full open position, the return air damper is fully closed, and the mechanical cooling system is then operated simultaneously.
- > **Mechanical cooling mode** – During hot weather, integrated economizer is disabled and the outside air damper is adjusted to the minimum ventilation position. The mechanical cooling system provides all necessary cooling. This mode is triggered by the high limit temperature where excess outdoor air would cause the air handling system to use more energy than if it did not have air economizer.



Economizer Fact Sheet

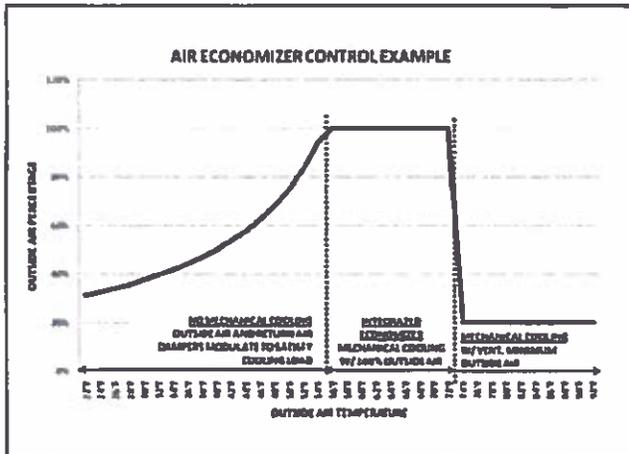


FIGURE 2 – Air Economizer Control Example

NOTE – Ventilation airflow and control requirements are prescribed in Chapter 4 of the *2009 International Mechanical Code with Washington State Amendments*.

It is important that all components of an air economizer system function properly. Outside air sensors must be installed where they can sense the true outdoor air temperature. Dampers, actuators and linkages need to respond correctly when the controller calls for damper position adjustment. At minimum a poorly functioning air economizer represents a loss of opportunity for mechanical cooling energy savings. Worst case it can significantly increase energy usage by introducing too much outdoor air during very cold and very warm outdoor conditions. Therefore it is important that air economizer systems be tested for proper performance when installed and serviced regularly to ensure all components continue to function optimally.

Fundamentals of water economizer

A water economizer is a system by which the supply air of a cooling system is cooled directly, indirectly or both, by evaporation of water or by other appropriate fluid in order to reduce or eliminate the need for mechanical refrigeration (WSEC 201). There are two primary types of water economizer - systems with chillers and systems without.

Water economizer systems without chillers are also referred to as air pre-cooling economizer. This approach uses a cooling tower or dry cooler to reduce condenser water system temperature below that required for cooling through the use of a supplemental cooling coil in the terminal units. This approach is most commonly used in packaged water-cooled data center equipment. It is occasionally used in hydronic heat pump systems, although several manufacturers no longer carry economizer coil options.

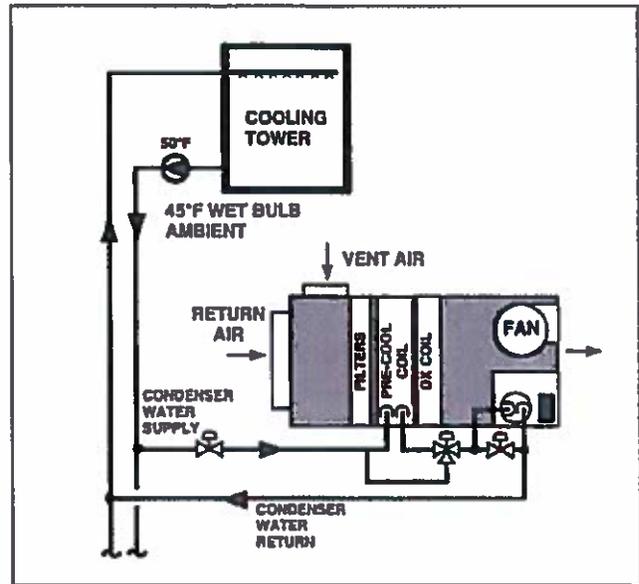


FIGURE 3 – Water Economizer - Supply Air Pre-Cooling

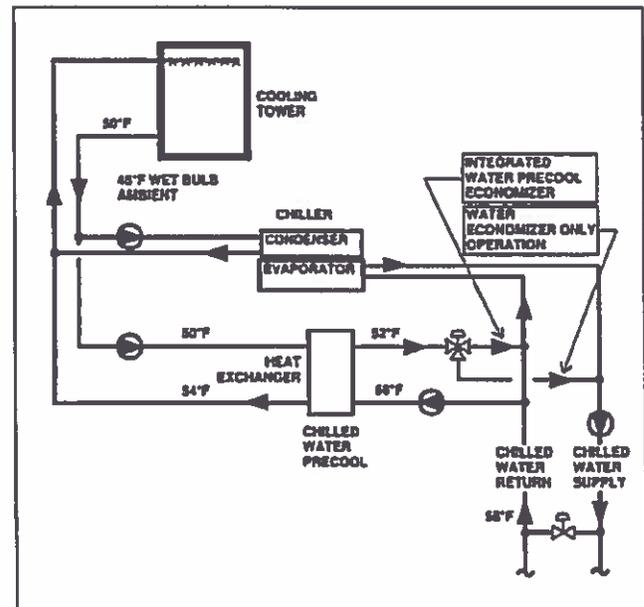


FIGURE 4 – Water Economizer in Chilled Water System

NOTE - This fact sheet discusses economizer requirements in a condensed and paraphrased fashion. The actual code requirements referred to herein must be read closely and in their entirety to correctly interpret the applicability of all provisions, due to the exacting details and complexities within all of the code economizer mandates.

WHAT DOES THE WSEC REQUIRE?

The WSEC defines application, operational requirements and exceptions for air and water economizer systems. As a general rule, full air economizer capability is required for all new systems. Air economizer requirements and exceptions for Simple Systems (WSEC 1424) are identical to those required for Complex Systems (WSEC 1433). Simple Systems refer to packaged unitary equipment.

Air Economizers

An air economizer system shall be capable of adjusting both outside air and return air dampers to the 100% outside air position when outdoor conditions are suitable to reduce or eliminate the need for mechanical cooling. This includes appropriate provisions for relief of this excess outside air to prevent building over-pressurization (WSEC 1413.1). Relief air dampers shall be motorized (WSEC 1412.4.1 with exceptions).

Air economizer controls shall be capable of integrated operation where economizer operation and mechanical cooling can occur simultaneously when needed to meet the cooling load. An exception is allowed for direct expansion units with a rated capacity less than 65,000 btu/h. (WSEC 1413.3)

NOTE – Economizer damper and control packages are available for small fan coils and can be controlled from appropriate stand alone thermostats. Building management systems are not required for cost effective and reliable economizer installations on small systems

If humidification equipment is needed to maintain minimum indoor humidity levels in a system with air economizer, then the humidifier shall be the adiabatic type (direct evaporative media or fog atomization type). Exceptions to this requirement apply to: specific health care facilities, 100% outside air systems, stand alone or duct mounted humidifiers serving no more than 10% of the air economizer capacity of all mechanical systems serving the building, or systems with water economizer. (WSEC 1413.4)

There are a variety of exceptions to the air economizer requirements under WSEC 1433. Some exceptions demonstrate alternative options that if applied within the parameters defined will likely provide similar energy savings to an equally sized system with air economizer. A few apply to unique situations where the air economizer would actually increase the energy used by the mechanical system. Many exceptions require that equipment have efficiency ratings that are better than the minimum requirements listed in mechanical equipment efficiency WSEC Tables 14-1A through 14-1G.

The following represents a summary of the available exceptions to air economizer and the requirements of these exceptions:

- > **Qualifying small equipment – Exception 1**
Capacity of an individual unit can be no greater than 33,000 btu/h. Equipment must have SEER and EER values at least 15% better than the efficiency table values. In addition, the total capacity of all qualifying small systems in a building cannot exceed either 72,000 btu/h or 5% of the air economizer capacity of all mechanical systems serving the building, whichever is greater. This exception does not apply to unitary cooling equipment installed outdoors or located in any room that has an exterior building envelope element, be it wall, floor, or ceiling. This exception shall not be used for the shell-and-core permit or for the initial tenant improvement. It only applies to existing buildings with previous tenant improvement build-outs.
- > **Chilled water terminal units – Exception 2**
Applies to chilled water terminal units connected to systems with chilled water generation equipment with IPLV values that are at least 25% better than minimum part load efficiencies listed in WSEC Table 14-1C. The total capacity of all systems in the building that do not comply with air economizer requirements cannot exceed 480,000 btu/h or 20% of the air economizer capacity of all mechanical systems serving the building, whichever is greater. Additional limitations apply. This exception shall not be used for the shell-and-core permit or for the initial tenant improvement. It only applies to existing buildings with previous tenant improvement build-outs.
- > **Onsite energy – Exception 4**
Applies to a system where at least 75% of the annual energy it uses for mechanical cooling is being generated with site-recovered or site-solar energy sources. Recovered energy is defined as energy captured and utilized which would otherwise have been wasted. Solar energy sources are defined as natural daylighting and thermal, chemical or electrical energy derived directly from conversion of incident solar radiation.
- > **Unusual outdoor air contaminate conditions – Exception 5**
Systems where special outside air filtration and treatment, for the reduction and treatment of unusual outdoor contaminants, makes an air economizer infeasible. 
- > **Dehumidification – Exception 6**
Systems with dehumidification requirements where air economizer would increase overall building energy consumption.

Economizer Fact Sheet

- **Water source heat pump systems – Exception 7**
All required parameters must be met to be eligible. It shall consist of multiple water source heat pumps that are connected to a common loop. Heat pumps shall have a cooling EER and heating COP that are at least 15% better than the WSEC equipment efficiency table values. Air systems shall have at least 60% air economizer and a minimum of 50% heat recovery effectiveness. If provided with a boiler or furnace that is less than 199,000 btu/h, this equipment shall be rated to at least 90% AFUE.
- **Group R occupancy small system – Exception 8**
For equipment installed outdoors or in a room adjacent to the outdoors, cooling capacity of an individual unit can be no greater than 20,000 btu/h. For all other applicable equipment, cooling capacity of an individual unit can be no greater than 54,000 btu/h. For split systems, these limits are based on the cooling capacity of individual fan coils. Cooling units shall have SEER and EER values at least 15% better than listed in WSEC Tables 14-1A, 14-1B and 14-1D. Chillers with fan coil units or variable refrigerant flow (VRF) systems do not qualify for this exception as they are not covered in WSEC Tables 14-1A, 14-1B, and 14-1D.
- **Computer and data processing center cooling equipment – Exception 9, parts F and G**
Applies to equipment used to cool any dedicated server room, electronic equipment room or telecom switch room provided that they completely comply with Option 9a, 9b, or 9c in the Exception 9 Table below. This applies to equipment subject to the performance requirements of *ASHRAE Standard 127-2007 Method of Testing for Rating Computer and Data Processing Room Unitary Air-Conditioners*. EER and IPLV values shall be equal to or better than the WSEC equipment efficiency table values.

	Equipment Type	Higher Equipment Efficiency	Part-Load Control	Economizer
Option 9a	Table 14-1A and 14-1B ^a	+15% ^b	Required Over 85,000 Btu/h ^c	None Required
Option 9b	Table 14-1A and 14-1B ^a	+5% ^d	Required Over 85,000 Btu/h ^c	Waterside Economizer
Option 9c	ASHRAE Standard 127 ^e	+0% ^g	Required Over 85,000 Btu/h ^c	Waterside Economizer

WSEC 1433 - Exception 9 Table

- **Variable refrigerant flow (VRF) systems – Exception 10**
System shall be capable of serving multiple zones in both heating and cooling mode simultaneously by transferring energy from one zone to the other. System shall serve

at least 20% internal and 20% perimeter zones for load diversity. Outdoor unit shall be a reverse-cycle heat pump with variable speed compressor and condenser fan with at least 65,000 btu/h in total capacity. This exception is limited to buildings of 60,000 SF or less. It cannot be applied to portions of buildings

Water Economizers

A water economizer system may be provided in lieu of an air economizer system when allowed under WSEC 1132.2 Exception 1 or WSEC 1433 Exceptions 3 and 9. When selected as an alternative to air economizer, the water economizer system shall be capable of providing the total concurrent cooling load served by the connected terminal equipment lacking air economizer. This concurrent load is calculated based on outside air temperatures of 50°F dry-bulb/45°F wet-bulb and below. For this calculation all load factors including solar gain and internal loads (such as occupant and plug loads) shall be based on load peaks, except for the outside temperatures (WSEC 1413.1). Specific documentation requirements for this system type are defined in WSEC 1413.2. System controls shall be capable of integrated operation similarly to air economizer systems. The only exception to the integrated operation requirement is for water-cooled water chillers.

Under WSEC 1433, the two exceptions that allow water economizer systems are:

- **Chilled beams and chilled ceiling systems – Exception 3**
Applies to water-cooled refrigeration equipment serving chilled beams and chilled ceiling (space cooling) systems only, which are provided with a water economizer meeting the requirements of WSEC 1413. Maximum capacity of this system shall not exceed 500 tons. Terminal chilled water units other than chilled beams and chilled ceilings do not qualify under this exception.
- **Cooling equipment serving dedicated server rooms, electronic equipment rooms or telecom switch rooms – Exception 9, parts A through E**
Applies to equipment used to cool any dedicated server room, electronic equipment room or telecom switch room provided that they completely comply with option 9a, 9b, or 9c in the Exception 9 Table. In addition to the water economizer requirements described above, this equipment shall be served by a dedicated condenser water system. A non-dedicated condenser water system may be approved if it can provide appropriate water temperatures during hours when waterside economizer cooling is available. Under this exception the total allowed capacity of cooling systems without economizers shall not exceed 240,000 btu/h or 10% of the air economizer capacity of all mechanical systems serving the building. Additional requirements apply.

Existing Mechanical System Additions, Alternation and Repairs

New mechanical systems installed in an existing building, or existing mechanical systems that are altered or replaced, shall comply with all requirements of WSEC Chapter 14 Mechanical Systems. This includes all economizer performance and integrated operation requirements identified in WSEC 1413, 1423 and 1433. Refer to WSEC 1132.2 Alterations and Repairs, Mechanical Systems for complete requirements.

Alterations to existing mechanical cooling systems cannot decrease the existing economizer capacity unless provisions are included that make the system eligible for an economizer exception. Such systems applying for economizer exceptions have to comply with individual equipment sizing limits and whole building capacity limits based on the air economizer capacity of all mechanical systems serving the building. For existing mechanical cooling systems that do not comply with WSEC 1413 and either WSEC 1424 or 1433, including individual unit size limits and total building capacity limits, the alteration shall then comply with WSEC Table 11-1.

There are three categories per equipment type in WSEC Table 11.1. Under each category unique exceptions to WSEC 1433 requirements are listed.

> **Replacement unit of the same type with the same or smaller output capacity**

In general, if the replaced unit did not have economizer, economizer will not be required with certain caveats such as high efficiency required for compressorized gear.

> **Replacement unit of the same type with a larger output capacity**

In general, if the replaced unit did not have economizer, and was originally installed prior to 1991, economizer may not be required with certain caveats. Otherwise, full compliance with WSEC 1433 is required.

> **New equipment added to existing system or replacement unit of a different type**

If new terminal equipment is added to particular pre-1991 central systems, economizer may not be required with certain caveats. Otherwise, full compliance with WSEC 1433 is required.

Recommendations for optimal long-term economizer performance

Economizer commissioning procedure

- > *Observe damper position at various outdoor air temperatures and compare to the design intent (high limit settings, low-limit lockout).*
- > *Set up false temperature readings through the building management system or by increasing the temperature at outdoor air temperature sensor (electric hair dryer or similar approach). Compare the response of the economizer damper to the design intent.*
- > *Install temperature data-loggers or use building management system (BMS) trend logging capabilities to measure the outside air, return air, supply air, and mixed air streams. Monitor dataloggers or BMS trending for a minimum period of two weeks.*
- > *If post occupancy, look for large peaks compared to historical billing data in energy use during summer & winter.*

Economizer recommended maintenance

- > *As air flows over the outside-air damper and into the building, dirt and moisture accumulate on the damper and its linkages. Unless regularly cleaned and lubricated, these components can eventually corrode and lock up.*
- > *Check for burned out damper motors.*
- > *Check for actuators that come loose from their mounting position with difficulty transferring torque to the damper.*
- > *Check and calibrate temperature sensors.*
- > *Annually re-commission the economizer. Run a functional performance test to demonstrate proper operation of the physical components of the system.*

Additional Resources

- > *Energy Design Resources, Economizers Design Brief – <http://www.energydesignresources.com/resources/publications/design-briefs/design-brief-economizers.aspx>*
- > *Trane Engineers Newsletter Edition 35-2, Air Economizers – http://www.trane.com/commercial/uploads/pdf/673/admapn020en_0406.pdf*
- > *NREC Compliance Forms, MECH-ECO Economizer Flowchart – www.nec.net/energy <<http://www.nec.net/energy>> codes*
- > *PECI Functional Testing for Air Handlers – Chapter 3: Economizer and Mixed Air*
- > *CED Engineering Economizers in Air Handling Systems*
- > *ASHRAE 90.1 – 2007 User's Manual*

Technical content contributed by:

RUSHING



Northwest Energy Efficiency Council Resources



Several technical resources are available in support of the 2009 Washington State Non-Residential Energy Code (NREC).

Refer to the NEEC website under the Energy Codes tab – <http://www.NEEC.net/energycodes>

All of these resources are available for download from our website.

COMPLIANCE FORMS

NREC compliance forms have been designed as tools to help designers comply with the Energy Code, and to assist building officials, plans reviewers and inspectors with enforcement of the Energy Code. The following forms are available:

- > *Building Envelope Compliance Forms*
- > *Lighting Compliance Forms*
- > *Energy Metering Compliance Forms*
- > *Mechanical Systems Compliance Forms*

WEBINARS

Recorded webinars are available for the following topics

- > *NREC Chapter 13 – Building Envelope*
- > *NREC Chapter 14 – Mechanical System*
- > *NREC Chapters 12 & 15 – Lighting and Energy Metering*
- > *NREC Compliance Forms Instructions*
- > *Continuous Insulation*

RESIDENTIAL ENERGY CODE TECHNICAL SUPPORT

NEEC provides technical support for the Non-Residential sections of the Energy Code, which includes Multi-Family Residential buildings. For Energy Code technical support for Single-Family Residential buildings contact the Washington State University Energy Extension Office – <http://www.energy.wsu.edu/BuildingEfficiency/EnergyCode.aspx>

FACT SHEETS

Detailed fact sheets are available for several key topics in the NREC that provide context to Code requirements and perspective from industry experts.

- > *Air Barrier Management*
- > *Continuous Insulation*
- > *Daylighting Controls*
- > *Economizer*
- > *Energy Recovery*
- > *Solar Gain Management*

ADDITIONAL RESOURCES

- > *2009 NREC Technical Reference Manual – This manual provides useful guidance and information for the Energy Code by various industry experts.*
- > *Classroom Training Presentation – NEEC presented classroom trainings around the state that provided a summary of updates and additions to the NREC from the 2006 to the 2009 Energy Code edition. Presentation material is available.*
- > *Air Leakage Test Protocol for Measuring Air Leakage in Buildings – The 2009 NREC has requirements for air pressurization/depressurization testing for some buildings. The U.S. Army Corps of Engineers has published an air leakage test protocol that may be helpful to those needing more information on this procedure.*