

Evaporative Cooling - Code Compliance Brief

Overview:

The intent of this brief is to provide code-related information about evaporative cooling to help ensure that the measure will be accepted as being in compliance with the code. Providing notes for codes officials on how to plan review and conduct field inspections can help builders or remodelers with proposed designs and provide jurisdictional officials with information for acceptance. Providing the same information to all interested parties (e.g., code officials, builders, designers, etc.) is expected to result in increased compliance and fewer innovations being questioned at the time of plan review and/or field inspection.

Evaporative cooling (a.k.a., "swamp coolers") is a technology that takes advantage of water evaporation to cool incoming air. Energy is required to change water from a liquid to a vapor (i.e., the heat of vaporization), and in doing so, the sensible air temperature of the air is reduced. The amount of cooling provided is driven by the "dryness" (i.e., the wet bulb temperature) of the incoming air; hence, evaporative cooling is best suited for hot, dry climates.

In general, there are three types of evaporative cooling systems: 1) direct, 2) indirect and 3) direct/indirect. For residential applications, direct systems are by far in the most commonly used technology. In direct systems, outside air is drawn across media that is continually saturated with water. The net effect to the conditioned space is lower supply air temperature but also higher humidity. It should be noted that direct evaporative systems are "one-pass" or 100% outside air systems; therefore, it is important that careful attention be paid to the location of any exhaust vents or anything else that could introduce odors or pollutants into the home. Even though evaporative cooling systems use 100% outside air, codes still require ductwork to be insulated and air sealed. This brief discusses the provisions in the 2015 International Energy Conservation Code (IECC) and International Residential Code (IRC) related to evaporative cooling.

Plan Review:

Per the **2015 IECC/IRC, Section R103.3/R106.3, Examination of documents**. The code official/building official must examine, or cause to be examined, construction documents for code compliance.

This section lists the applicable code requirements followed by details helpful for plan review regarding the provisions to meet the requirement for evaporative cooling.

Construction Documentation. Review the construction documents to identify the equipment, system controls, design, and ventilation choices to the equipment.

- **2015 IECC/IRC, Section R103.2/N1101.5 Information on construction documents.** Construction documents should include:
 - Insulation materials and their R-values
 - Mechanical system design criteria
 - Mechanical system equipment types, sizes and efficiencies
 - Equipment and system controls
 - Duct sealing, duct and pipe insulation and location
 - Air sealing details
 - Flashing and moisture control
- **General Installation Provisions.** Review the construction documents for equipment installation and mounting.
 - **2015 IRC, Section M1413.1 General.** Evaporative cooling equipment and appliances should comply with UL¹ 1995 or UL/CSA/ANCE 60335-2-40 and should be installed:
 1. In accordance with the manufacturer's instructions
 2. On level platforms in accordance with Section M1305.1.4.1
 3. So openings in exterior walls are flashed in accordance with Section R703.4
 4. To protect the potable water supply in accordance with section P2902
 5. So air intake openings are located are in accordance with section R303.5.1.
- **Mounting.** Verify equipment is correctly supported and installed in the structure.
 - **2015 IRC, Section M1305.1.4.1 Ground Clearance.** Equipment and applications supported from the ground should be level and firmly supported on a concrete slab or other approved material extending not less than 3 inches (76 mm) above the adjoining ground. Such support should be in accordance with the manufacturer's installation instructions. Appliances suspended from the floor should have a clearance of not less than 6 inches (152 mm) from the ground.
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- **Flashing/Moisture Control.** Verify that the design and specification of the weather-resistive covering, water-resistive barrier, flashing, and drainage are specified on the construction documents and meet applicable codes.
 - **2015 IRC, Section R303.6 Outside Opening Protection.** Air exhaust and intake openings that terminate outdoors should be protected with corrosion-resistant screens, louvers, or grills having a minimum opening size of ¼ inch (6 mm) and a maximum opening size of ½ inch (13 mm), in any direction. Openings should be protected against local weather conditions. Outdoor air exhaust and intake openings should meet the provisions for exterior wall opening protectives in accordance with this code.
 - **2015 IRC, Section R703.4 Flashing.** Approved corrosion-resistant flashing should be applied shingle-fashion to prevent water from entering into wall cavities or from penetrating into building structural framing components. Self-adhered flashing must comply with AAMA 711. Fluid-applied membranes used as flashing in exterior walls should comply with AAMA 714. The flashing should extend to the surface of the exterior wall finish or to the water-resistive barrier. For this code, approved corrosion-resistant flashings should be installed at all wall and roof intersections.
- **Potable Water System Protection.** Verify that potable water connections to the equipment are correct. In general, most evaporative coolers have built-in backflow protection devices.
 - **2015 IRC, Section P2902.1 General.** A potable water supply system should be designed and installed as to prevent contamination from non-potable liquids, solids, or gases being introduced into the potable water supply. Connections should not be made to a potable water supply in a manner that could contaminate the water supply or provide cross-connection between the supply and a source of contamination except where approved methods are installed to protect the potable water supply. Cross-connections between an individual water supply and a potable public water supply should be prohibited.
- **Intake Openings.** Verify that the location and orientation of intake openings for the evaporative cooler itself meet the applicable code for distances and clearances.
 - **2015 IRC, Section R303.5.1.** Mechanical and gravity outdoor air intake openings should be located a minimum of 10 feet (3048 mm) from any hazardous or noxious contaminant, such as vents, chimneys, plumbing vents, streets, alleys, parking lots, and loading docks.

Exceptions:

1. The 10-foot separation is not required where the intake opening is located 3 feet or greater below the contaminant source.
2. Vents and chimneys serving fuel-burning appliances should be terminated in accordance with the applicable provisions of Chapters 18 and 24.
3. Clothes dryer exhaust ducts should be terminated in accordance with Section M1502.3.

For the purpose of this section, the exhaust from dwelling unit toilet rooms, bathrooms, and kitchens should not be considered as hazardous or noxious.

- **Insulation.** Review the construction documents and confirm the specified R-value of insulation for air ducts.
 - **2015 IECC/IRC, Section R403.3.1/N1103.3.1 Insulation.**
 - Supply and return ducts installed in attics should be insulated to R-8 if ducts are ≥3 inches in diameter or to R-6 if ducts are <3 inches in diameter.
 - Supply and return ducts installed in other portions of the building should be insulated to R-6 if ducts are ≥3 inches in diameter R-4.2 if ducts are <3 inches in diameter.

Exception: Ducts or portions thereof located completely inside the building thermal envelope

- **Duct Leakage/Air Sealing.** Review the construction documents and confirm that the appropriate level of duct sealing is used based on the code to be applied. Be aware that current codes require that duct tightness beyond just mechanical sealing of joints and seams be verified with field testing, and supporting documentation be provided to the code official. The code official should consider transmitting the jurisdictional requirements during the plan review phase.
 - **2015 IECC/IRC, Section R403.3.2/N1103.2.2 Sealing.** Ducts, air handlers and filter boxes should be sealed. Joints and seams should comply with the International Mechanical Code or IRC, Section M1601.4.1, as applicable.

Exceptions:

- Air-impermeable spray foam products should be permitted to be applied without additional joint seals.
- For ducts having a static pressure classification of less than 2 inches of water column (500 Pa), additional closure systems should not be required for continuously welded joints and seams, and locking-type joints and seams of other than the snap-lock and button-lock types.

¹UL (Underwriters Laboratory) is a global independent safety science company that certifies, validates, tests, inspects, audits, and advises and trains.

Field Inspection:

Per the **2015 IECC, Section R104, Inspections**, construction or work for which a permit is required is subject to inspection. Construction or work is to remain accessible and exposed for inspection purposes until approved. Required inspections include footing and foundation, framing and rough-in, plumbing rough-in, mechanical rough-in, and final inspection.

Per the **IRC, Section R109, Inspections**, the wording is somewhat different in that for onsite construction, from time to time the building official, upon notification from the permit holder or his agent, can make, or cause to be made, any necessary inspections. Further details are provided for inspections regarding foundation, plumbing, mechanical, gas and electrical, floodplain, frame and masonry, and final inspection. Any additional inspections are at the discretion of the building official.

This section provides details for inspecting to the specific provisions for evaporative cooling systems where one or more specific type of inspection per the IECC or IRC may be necessary to confirm compliance. Inspections should provide verification in the following areas:

- Evaporative cooler is properly located and mounted, and connections are made per approved plans. Proper clearances are maintained for hazardous or noxious fumes.
- All intake and exhaust openings are properly flashed to prevent moisture incursion.
- Duct insulation is installed in accordance with manufacturer's installation instructions, the manufacturer's R-value mark is readily available, and meets the approved R-value per construction documents.
- Joints and seams in ductwork are properly sealed, and the duct tightness report is complete and has been submitted per jurisdictional requirements.

Technical Validation(s):

This section provides additional information and helpful resources.

- Building America Guide for Evaporative Cooling: <https://basc.pnnl.gov/resource-guides/evaporative-cooling> [1]
- "AAMA 711 Voluntary Specification for Self-Adhering Flashing for Exterior Wall Fenestration installation," American Architectural Manufacturers Association (AAMA), 2013. <http://www.aamanet.org/news/1/10/0/all/969/aama-releases-specification-for-self-adhering-flashing-for-exterior-wall-fenestration-installation> [2]
- "AAMA 714 Voluntary Specification for Liquid Applied Flashing Used to Create a Water-Resistive Seal around Exterior Wall Openings in Buildings," 2015. <http://www.aamanet.org/news/1/10/0/all/1190/aama-releases-updated-specification-for-liquid-applied-flashing-for-creating-water-resistive-seals> [3].
- "Evaporative Cooling Appliances Installation Requirements," Home Owners Network, <http://www.homeownersnetwork.com/booktopic/evaporative-cooling-appliances-installation-requirements/> [4].
- "New Evaporative Cooling Systems: An Emerging Solution for Homes in Hot Dry Climates with Modest Cooling Loads Openings," Southwest Energy Efficiency Project. January, 2007. http://www.builditsolar.com/Projects/Cooling/Evaporative_Cooling_Systems.pdf [5].
- "UL 1995 Heating and Cooling Equipment," Underwriter Laboratories (UL), http://ulstandards.ul.com/standard/?id=1995_4 [6].