# Cooling Measures

# Weatherization Energy Auditor Single Family

Learning Objectives

By attending this session, participants will be able to:

* Discuss allowable cooling measures and general guidelines for recommending them.
* Describe the benefits, qualities, and applications of solar film (also called window film) and other shading options.
* Explain how air sealing and insulating the home and sealing and insulating ducts in unconditioned areas conserves energy.
* State the benefits and qualities of reflective roof coating.
* Describe cleaning, tune-up and replacement strategies for a variety of air cooling appliances.

Key Terminology

Albedo

Angle of incidence

Cementitious

Condenser

Design load

Dry bulb

Elastomeric

Evaporator

Manual J

Refrigerant

Shading coefficient (SC)

Solar absorption

Solar exposure

Solar film

Solar gain

Solar reflectance

Subcooling

Superheat

Thermal emittance

Total solar energy rejected

U-factor

Wet bulb

Supplemental Materials

Handouts & Resources

Florida Solar Energy Center. “Window Orientation and Shading.” 2007. <www.fsec.ucf.edu>.

Francisco, Paul W. and Larry Palmiter. “Flow Control Gains in Accuracy.” *Home Energy* Mar./Apr. 2002. <www.homeenergy.org>.

Kinney, Larry. “Modern Evaporative Coolers.” *Home Energy* Sept./Oct. 2004. <www.homeenergy.org>.

Legates, Charlotte. “Refreshing Evaporative Coolers.” *Home Energy* Sept./Oct. 2001. <www.homeenergy.org>.

MacPhaul, David and Christy Etter. “HVAC System Design for Humid Climates.” WBDG.org.National Institute of Building Sciences. <www.wbdg.org>.

Parker, Danny, and Steve Barkazi. “Saving Energy with Reflective Roof Coatings.” *Home Energy* May/June 1994. *<*www.homeenergy.org>.

Proctor, John, and Peggy Albright. “Sizing Air Conditioners: If Bigger is Not Better, What Is?” *Home Energy* Sept./Oct. 1996. <www.homeenergy.org>.

Robinson, Liz. “Affordable Cooling at its Peak.” *Home Energy* July/Aug. 2001. <www.homeenergy.org>.

Springer, David. “Kicking the Air Conditioner Habit.” *Home Energy* July/Aug. 2003. <www.homeenergy.org>.

Sterner, Tamasin. *Chapter 10: Cooling Measures*. *Winter Relief Assistance Program Standards*. Pennsylvania Power & Light, 2007.

U.S. Department of Energy. Low Pitch Cool Roof Calculator: <www.ornl.gov>.

U.S. Department of Energy. Seattle Regional Office and Energy OutWest.“Evaluating Refrigerant Charge.” *Energy Out West Weatherization Field Guide*. 2005. Copyright Saturn 2009. <www.azcommerce.com>.

U.S. Department of Energy. Seattle Regional Office and Energy OutWest. “Measuring and Evaluating System Airflow.” *Energy Out West Weatherization Field Guide*. 2005. Saturn 2009. <www.azcommerce.com>.

U.S. Department of Energy. Steep Slope Cool Roof Calculator: <www.ornl.gov>.

U.S. Department of Energy. Weatherization Assistance Program. “Air Conditioner Replacement Video.” 2009. <www.waptac.org>.

U.S. Environmental Protection Agency. “Reducing Urban Heat Islands: Compendium of Strategies.” <www.epa.gov>.

Walker, Iain, and Max Sherman. “An Easier Way to Measure Duct Leaks.” *Home Energy* Sept./Oct. 2002. <www.homeenergy.org>.

Online Platform Lessons

Use these on-line interactive training modules as pre-requisites before students attend the course or as in-class computer lab sessions. To access, users must first create an account at [www.nterlearning.org](http://www.nterlearning.org).

a- 9.1 Measuring Duct Leakage with a Blower Door   
<https://www.nterlearning.org/web/guest/course-details?cid=248>

a- 9.2 Pressure Pan Testing <https://www.nterlearning.org/web/guest/course-details?cid=248>

a- 9.3 Dominant Duct Leakage <https://www.nterlearning.org/web/guest/course-details?cid=248>

c- 10.4 Identifying Cooling Equipment <https://www.nterlearning.org/web/guest/course-details?cid=247>

Relevant Standard Work Specifications

5.3002.2 – Equipment Installation, Heating and Cooling Controls

5.3003.1 – Equipment Maintenance, Testing and Repair, Data Plate Verification

5.3003.4 – Equipment Maintenance, Testing and Repair, Evaluating Electrical Service

5.3003.5 – Equipment Maintenance, Testing and Repair, Refrigerant Line Inspection

5.3003.8 – Equipment Maintenance, Testing and Repair, Evaporative Cooler Maintenance and Repairs

5.3103.1 – Equipment Maintenance, Testing and Repair, Controls – Thermostat Replacement

Classroom Props & Activities

Sample tools and materials, including:

* Window film
* Louvers or awning samples (if used in local program)
* Reflective roof coating painted on typical roofing material
* A/C filter material
* Solar Pathfinder
* Inspection mirror
* Coil cleaner
* Fin comb
* Refrigerator gauge set (if local program auditors evaluate refrigerant charge)
* Flow hood, duct blower, and/or flow pan and manometer

**Temperature/Color Demonstration**: Instructor will need an infrared camera; thermometer; two boxes of the same size and material, except that one is dark and the other light (matte black and glossy or reflective white work best); and a heat source (halogen light will work). When discussing the reflective roof coating, let students look at the boxes through the IR camera to demonstrate that lighter colors truly do reduce surface temperatures. Measure internal temperatures as well as surface temperatures to illustrate the potential difference in indoor temperatures due to the surface color. Insulated boxes will vary less than uninsulated ones, showing that homes with roofs that leave little-to-no room for insulation have more to gain from reflective coatings.

**Determining Solar Exposure:** Take students outside and discuss the shading effects of roof overhangs and landscape on the training center or other nearby buildings. Stress the seasonal change in the sun’s path and how that affects shading throughout the year. Demonstrate the use of a Solar Pathfinder to evaluate seasonal shading of a property.Indicate windows(or create them by taping borders if none are conveniently located) and have students determine if they will be shaded in the middle of the winter, in mid-summer, and so on.

Hands-On Props

**Room A/C Unit**: These are most common to the clients served by the WAP. Let students take off the housing and removable grille to inspect and become familiar with the parts of the appliance. Have students locate and identify the compressor, filter, coils, and condensate drain.

Class Overview

* Use the presentation to introduce students to the cooling measures allowed within the WAP. Focus on measures common to the region.
* During the section about window shading/films, pass around sample materials to demonstrate their shading properties. Hold them up to a nearby window or shine a light through them. Introduce the concept of seasonal changes in the path of the sun and how that affects the solar exposure of windows. Take students outside to determine the solar exposure of nearby buildings.
* During the roof coating section of the presentation, demonstrate the effect of color on surface and internal temperatures with the “temperature/color demonstration” outlined above. Use the DOE cool roof calculators to estimate the cost-effectiveness of reflective coating on a hypothetical house in the area. Compare the difference in potential savings and heating penalties between a low-sloped and a steep-sloped residence. Discuss the angle of incidence and how a lower angle means less heat is absorbed.
* With the presentation, introduce the principles of air conditioning appliances and tune-up measures. Let students disassemble a room A/C unit (or a larger central unit if available) in the lab and identify the various parts.