NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

BUILDING ENVELOPE IMPROVEMENT

(Number)

CODE 672

DEFINITION

Modification or retrofit of the building envelope of an existing agricultural structure.

PURPOSES

This practice may be applied as part of a conservation management system to reduce energy use by regulating heat transfer.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to any agricultural facility which is climate controlled at least part of the time with a completed energy analysis that complies with the guidelines for a Type 2 on-farm energy audit per the American Society of Agricultural and Biological Engineers (ASABE) S612. The audit will have at a minimum addressed the major activities of ventilation, air heating and air cooling that exist in the building.

CRITERIA

General Criteria Applicable to All Purposes

Use of this standard requires compliance with all applicable federal, state, and local laws and regulations.

Implement recommendations of the Type 2 On-Farm Energy audit as they pertain to building envelope improvement. If not detailed in the audit, provide the baseline energy use of the building.

Seal cracks with an appropriate sealant according to audit recommendations. Refer to the American Society of Heating, Refrigerating and Air conditioning Engineers (ASHRAE) Handbook - Fundamentals for appropriate sealant material and application methods.

Ensure the building envelope meets all applicable building codes. Ensure that U-values of the improved walls and ceiling of the building envelope are equal to or less than the U values provided in Table 1 and Figure 1 of ASABE ANSI/ASAE S401.2, Guidelines for Use of Thermal Insulation in Agricultural Buildings.

Insulation and vapor retarders

Select insulation material based on temperature extremes, moisture conditions in the building and expected UV light exposure.

Select insulation or covering materials that are durable, moisture resistant, non-toxic to humans or livestock and consistent with applicable Federal Drug Administration regulations.

Ensure insulation materials and vapor retarders exposed to the interior of the building will meet specifications described in ANSI/ASABE S401.2.

Insulation materials not meeting the requirements specified in the above paragraph and any insulation materials located directly adjacent to electrical panels, devices, and welding operations must be separated from the interior of the building by an ignition or thermal barrier in accordance with ANSI/ASABE S401.2.

Insulation must be compatible with electrical wiring of the structure.

Install insulation according to manufacturer's recommendations and in a manner that will maintain the thermal properties of the insulation.

Install insulation so that a reasonably uniform insulation value exists over the entire insulated area.

Install a vapor retarder with the insulation that provides a permanent resistance to water vapor of 14.3 ng/Pa-s-m^2 (0.25 US perms) or less when installed. Evaluate and install the vapor retarder in accordance with the latest edition of ASHRAE Handbook of Fundamentals.

Greenhouse Glazing and Hoop House Cover

Select greenhouse glazing materials based on their light transmittance, heat transfer characteristics and durability that meet or exceed the performance of materials recommended in the on-farm energy audit. Refer to Table 3 in ASAE EP 460, Commercial Greenhouse Design and Layout for properties of typical glazing materials.

Utilize multiple layers, such as double polyethylene, structured sheet modified acrylic or energy screens where practical to reduce heat transfer between the interior and the exterior of the greenhouse or hoop house. In heated greenhouses covered with polyethylene, the inner layer should have infrared retention (IR) and anti-condensate (AC) properties to reduce heat loss. As a minimum use a 6 mil greenhouse grade, UV resistant copolymer cover.

Greenhouse Energy Screen

Select energy/shade screens based on intended use: heat retention, day time shading or both.

Energy/shade screens will be either gutter-to-gutter (screen pulled flat across the structure at gutter height) or truss-to-truss (screen pulled between adjacent trusses.

Select screen materials based on ability to fold compactly, durability, and functionality.

Screen materials will have firebreaks to limit screen-to-screen fire spread and will be flame retardant in accordance with local fire codes.

Commercial Doors and Windows

Windows and doors installed to improve building envelope efficiency will be labeled in accordance with US Environmental Protection Agency (USEPA) Energy Star or will meet the minimum requirements of the International Code Council (ICC) International Energy Conservation Code (IECC). Install doors, windows and skylights in accordance with manufacturer's instructions and recommendations based on the minimum requirements set forth in ASTM E2112.

CONSIDERATIONS

Choose and install insulation material to discourage entrance and chewing by rodents, pecking by birds, infestation by insects or damage by livestock.

Multiple screens can be installed in greenhouses to increase heat retention or provide for multiple uses such as energy savings and shading.

Buildings with general public access, such as retail spaces may require more stringent building codes.

It may be necessary to move or modify electrical wiring, water pipes, fuel supply pipes, light fixtures, or other infrastructure for installation of the practice.

Automatic temperature and/or moisture sensors and controls can improve the efficiency of moveable greenhouse screens.

Where relative humidity within the agricultural building is maintained above 85%, refer to ASAE EP475 or other appropriate guidelines.

Tinted windows may be used in some cases to control building temperature. Tinting has no effect on the U-factor of a window, but it reduces solar gain. This may be a benefit in the summer and a liability in the winter, depending on local climate conditions.

PLANS AND SPECIFICATIONS

Specifications for application of this practice will be prepared for each site or planning unit according to the criteria.

As a minimum, the plans and specifications will provide the following:

- Plan drawing and description of the existing building envelope, and the modified or retrofitted building envelope and related components or devices, if applicable.
- Description and characteristics of materials to be applied to the building envelope.
- Details of ventilation and sealing provisions associated with the practice.
- Requirements for disposal of replaced materials, if applicable.

Documentation requirements to determine energy savings associated with practice installation based on current heating/cooling requirements of the agricultural building.

OPERATION AND MAINTENANCE

An operation and maintenance plan will be developed that is consistent with the purposes of this practice, its intended life and safety requirements. The plan will include recommended guidelines for maintaining the system. Periodic maintenance items include

- Check for leaks in the building envelope, especially along edges of energy screen seals
- Regularly inspect insulation to ensure it evenly covers building envelope spaces and repair damaged material and components as necessary.
- Periodically check for tears and repair or replace torn vapor barrier or energy screen material.
- Identify critical control devices associated with the building envelope system. Inspect regularly and perform maintenance as necessary.

Maintain records to document the implementation of energy improvements. Retain and update records for a minimum of three years from the installation of the building envelope improvement. Recommended records to be retained include:

- Utility bills, fuel purchases, and yield of agricultural commodities produced in the building.

Documentation of maintenance conducted on the building envelope improvement and related components or devices.

REFERENCES

American Society of Heating, Refrigeration and Air Conditioning Engineers. 2010. ASHRAE Handbook – Fundamentals.

American Society of Agricultural and Biological Engineers. 2011. Design and Management of Storages for Bulk, Fall-Crop, Irish Potatoes. ASAE EP475.1 JUN1996 (R2011). St. Joseph, MI.

American Society of Agricultural and Biological Engineers. Guidelines for the Use of Thermal Insulation in Agricultural Buildings. ANSI/ASABE S401.2 FEB1993 (R2008). St. Joseph, MI.

American Society of Agricultural and Biological Engineers. 2008. Heating, Ventilating and Cooling Greenhouses. ANSI/ASAE EP 406.4 Jan 2003 (R2008). St. Joseph, MI.

American Society of Agricultural and Biological Engineers. 2009. Performing On-Farm Energy Audits. ANSI/ASABE S612 JUL2009. St Joseph, MI.

American Society for Testing and Materials. 2012. Standard Practice for Installation of Exterior Windows, Doors and Skylights. ASTM E2112-07. Subcommittee: E06.51, Book of Standards, Vol. 04.12. West Conshohocken, PA.

International Code Council, Inc. 2011. International Energy Conservation Code. IECC-12. Country Club Hills, IL.

U.S. Environmental Protection Agency and U.S. Department of Agriculture. ENERGY STAR. http://www.energystar.gov/.