NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

BUILDING ENVELOPE IMPROVEMENT

(No.)

CODE 672

DEFINITION

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

PURPOSE

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

Implement recommendations of the Type 2 On-Farm Energy audit as they pertain to building envelope improvement.

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.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service State Office, or download it from the Field Office Technical Guide for your state.

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

Commercial Doors and Windows

Windows and doors installed to improve building envelope efficiency shall be labeled in accordance with US Environmental Protection Agency (USEPA) Energy Star or shall 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 shall be prepared for each site or planning unit according to the criteria.

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

- Plan drawing and/or 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.
- Results of the Type 2 On-Farm Energy Audit conducted as per the American Society of Agricultural and Biological Engineers (ASABE) S612.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed that is consistent with the purposes of this practice, its intended life and safety requirements. The plan shall 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. 2008. Heating, Ventilating and Cooling Greenhouses. ANSI/ASAE EP 406.4 Jan 2003 (R2008). St. Joseph, MI.

American Society of Agricultural and Biological Engineers. Guideline for the Use of Thermal Insulation in Agricultural Buildings. ANSI/ASABE EP 401.2 FEB 1993 (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/.

NATURAL RESOURCES CONSERVATION SERVICE

GEORGIA

OPERATION AND MAINTENANCE REQUIREMENTS

BUILDING ENVELOPE IMPROVEMENT

(NO.)

CODE 672

Land Owner/Operator_____

County_____SWCD_____

Prepared by_____ Date_____

Practice Location_____ Farm/Tract No._____
(Latitude/Longitude or UTM Coordinates)

OPERATION AND MAINTENANCE ITEMS

The modification or retrofit of the building envelope of an existing agricultural structure was installed to reduce energy use by regulating heat transfer. The estimated life span of this installation is at least 20 years. The life span of this practice can be assured and usually increased by developing and carrying out a systematic operation and maintenance program.

You are required to perform inspections and O&M activities in order for this practice to achieve the intended function, benefits, and design life. Failure to operate and maintain this system could result in actions to reclaim cost share and/or loss of any future financial or technical assistance.

This practice will require periodic maintenance and may also require operational items to maintain satisfactory performance. Your operation and maintenance program includes:

- Inspecting all installations on a routine basis as recommended by the manufacturer.
- Check for leaks in the building envelope, especially along the 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.
- Retain and update records for a minimum of three years from the installation of the building envelope improvement.
- Records shall include the following:
  - utility bills, fuel purchases, and yield of agricultural commodities produced in the building.
  - documentation of inspection and or maintenance conducted on the building envelope improvement and related components or devices.

Additional Operation and Maintenance Requirements Specific to this Plan:

CONTACT YOUR LOCAL NRCS OFFICE FOR ANY ADDITIONAL TECHNICAL ASSISTANCE YOU MIGHT NEED FOR IMPLEMENTATION OF THIS O&M PLAN FOR YOUR CONSERVATION PRACTICE.

This O&M Plan was discussed and a copy provided to the landowner/operator.

Signed by the Producer Date

Signed by the Responsible NRCS employee/Conservation Partner Date

United States Department of Agriculture
NRCS Natural Resources Conservation Service

Building Envelope Improvement

(Insulating Poultry Houses)

Georgia Job Sheet No. GA672

Definition

Proper exterior insulation of a poultry house provides an improved bird rearing environment and ensures minimal heat losses, thereby saving the poultry farmer on their utility bill. Proper insulation can also add to the "tightness" of a poultry house; improving ventilation, moisture control, and bird health.

General Information

The ceiling of a poultry house should be the first consideration during an insulation retrofit. Ceiling insulation problems must be corrected first. Sidewalls of older poultry houses can have very little insulation (curtain houses) or minimal insulation (lumber). Techniques have been developed to insulate these type walls to provide insulation values in the R-8 to R-12 range. Farmers cannot receive federal funds from two sources to pay for insulation.

Installation

For older high-ceiling, open truss poultry houses make sure the ceiling is tight. Sealing the ridge cap and the underside of the exterior eave juncture and repairing missing or damaged board insulation are probably the only affordable retrofits. In drop ceiling houses, insulation may have shifted or settled resulting in excess heat loss. For these houses it is imperative to get a complete blanket of insulation (blown fiberglass) in the ceiling that gives a minimum R-19 protection.

Replacing un-insulated curtains with solid insulated sidewalls can be a complicated process. It is especially difficult in steel truss houses with post supports on 10 ft. centers. Dropped ceiling houses with posts on 4 or 5 ft. centers make it easier to create cavities in the wall for insulation. When insulation batting is used, exterior metal siding must be installed over the curtains. Insulation batting is placed in the wall with a 4-6 mil vapor barrier and covered with pressure treated wood, OSB (not in contact with the litter), or plastic sheathing (blown cellulose in wall is not recommended since it can slip down over time).insulation of end walls may be needed too. Always ensure that cracks and leaks are properly sealed.

Poultry houses that are properly sealed and insulated should be able to achieve a static pressure of 0.15 inches of water when vacuum tested.

Operation and Maintenance

Ceiling insulation should be visually inspected at least yearly for shifting or excess settlement.
Infrared cameras (if available) can pinpoint problems with insulation. Occasional vacuum checks on the house can insure house "tightness" and help pinpoint leaks.

References

NRCS GA Conservation Practice Standard, Code 672– Building Envelope Improvement

Poultry House Energy Retrofits for Fuel & Cost Savings, Newsletter no. 43, National Poultry Technology Center, Auburn University, September 2006.

Controlling Sidewall Energy Losses, Newsletter no. 46, National Poultry Technology Center, Auburn University, March 2007.

Is Shifting Ceiling Insulation Running Up Your Gas Bill?, Newsletter no. 63, National Poultry Technology Center, Auburn University, January 2010.

Choosing Sidewall Insulation, Newsletter no. 75, National Poultry Technology Center, Auburn University, January 2012.

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BUILDING ENVELOPE IMPROVEMENT

Poultry Farmer:_____**County:**_____**Date:** _____
Integrator:_____**No. of houses:**_____ **Farm No.:**_____**Tract No.:**_____
Designed:_____**Checked:**_____**Approved:**_____**JAA:**_____

HOUSE NO(S)._____(Add more sheets as needed)

Design

Crack Sealing: (Type as required by Energy Audit)

Building Perimeter: _____ft. (Side Wall Ln.) +_____ft. (End Wall Ln.) + _____ft. (Side Wall Ln.) +_____ft. (End Wall Ln) =_____ft. Length to seal. Type of Sealant_____

Ceiling Insulation:

Area of attic:_____ft. (Length) x_____ft. (Width) =_____sq.ft; Insulation Added:_____in.;
Type Required:_____ Provide detail drawings as necessary on additional sheets.
Number of Buildings:_____Are all buildings the same? ( ) yes ( ) no If yes:
Total Insulation of Attic =_____(# of Buildings) x_____sq.ft. (Area of Attic) =_____sq.ft.
If no, make the same calculations for each house and record on additional sheets.

Wall Insulation: (Batt Only) – **ATTACH DRAWING**

WALL NO.	AREA, Sq. Ft. Length, ft. x Height, ft.	SUM OF NON-INSULATED AREAS* Sq. Ft.	AREA INSULATED Sq. Ft.
1			
2			
3			
4			
TOTAL			

*Note: Non-insulated zones include fans, panels, doors, etc.

Total Area of side walls to be insulated:_____sq.ft.
Are all houses the same ( ) yes ( ) no. If no, make the same calculations for each house and record on additional sheets.

Total Quantities Installed

Ceiling:_____sq.ft. Side Walls:_____sq.ft. Length of Crack:_____ft.

Certification

Farmer Certification:

I certify that I am not receiving other federal funds for insulation (USDA RD Rural Energy for America Program) for these poultry houses.

_____
Name Date

Installer Certification:

I certify that the work done to these poultry houses on this farm was completed according to this design and sound industry standards; and that the quantities installed are as certified installed above.

_____
Name Date

Designer Certification:	**As Built Certification:**
I certify that this project was designed according to the applicable NRCS standards.	I certify that this project was constructed according to the design.

Signature Date Signature Date

Quality Assurance Plan (QAP)

Landowner/Project: _____ **Engineering Job Class[1/]:** ____

Service Center: _____ **County** _____

Conservation Practice(s) & Engineering Job Class Included in this Job: Building Envelope Improvement, 672

QAP Prepared By: _____ **Job Approved By** _____

Est. Construction Start Date: _____ **Est. # Site Visits:** ____ **Est. # QA Hours:** _____

[1/] The engineering job class for a given job will is based on the most restrictive element or conservation practice included in the job.

Certification Statements

I certify that the items, intensity, and inspection requirements listed in Table 1 is adequate quality assurance (QA) for this project.

_____ _____

Approver of Engineering Plans (Signature) *Date*

I certify that _____ has the experience necessary to perform the construction inspection for the items shown in Table 1 and has the qualifications as shown in Table 2 for this project. I support this individual as the construction inspector and will allow the individual adequate staff time to perform the QA inspection for this project.

_____ _____

Line Supervisor (Signature) *Date*

I certify that I have reviewed the engineering plans and specifications and fully understand the QA requirements of the subject project. I will contact the Project Approver if I have any questions or concerns regarding the QA activities and will notify and obtain approval from the Project Approver if there is need to make any changes to the plans and/or specification during construction.

_____ _____

QA Inspector (Signature) *Date*

Quality Assurance Plan (QAP)
Table 1 - Items to be Inspected and Verified

Items [2/]	Intensity [3/]	Inspection Requirements [4/]
Preconstruction Meeting	NA	Meet with landowner and contractor, discuss project, sign and date documents; provide all applicable documents including drawings and specifications.
Permits	NA	Verify that the landowner has obtained all required permits prior to construction.
Pollution Control	P/F	Inspect to verify construction debris has been disposed of properly.
Quantity Computation	P/F	Perform quantity computations for payment purposes as per the payment schedule and specifications. Quantity computations shall be recorded on standard NRCS forms or NRCS-ENG-523A and checked and initialed by a second person.
Photographs	P	Take photographs of the site, before, during and after construction.
As-built Drawings	P	Keep drawings current during construction and prepare as-built drawings within 14 days of final construction.
Survey Notes	P	All construction checks taken including periodic measurements shall be recorded on loose leaf survey notes (form ENG 28, 29) or in a bound survey field book.

[2/] Include items that require quality assurance.
[3/] Intensity of inspection: NA – Not Applicable, C – Continuous, P – Periodic, F– Final. The inspector shall immediately notify the approver of the job if continuous inspection is required and cannot be performed with available staff.
[4/] Inspection requirements shall be to the degree necessary to certify that the project is installed in accordance with the plans and specifications.

Table 2 – Required QA Qualifications for Construction Inspector

QA Qualifications
1. Appropriate EJAA for the engineering job class for construction of the conservation practices to be installed.
2. Knowledgeable of the following references: a) National Engineering Manual (NEM) Part 512 – Construction b) National Engineering Handbook, Part 645, Construction Inspection

STATEMENT OF WORK
Building Envelope Improvement (672)
NRCS, GA

These deliverables apply to this individual practice. For other planned practice deliverables refer to those specific Statements of Work.

Licensure

Georgia Code Title 43, Professions and Businesses, Chapter 15, Professional Engineers and Land Surveyors, regulates the practice of engineering in Georgia and provides the definition of engineering in Chapter 15 §2(11). Technical assistance for this engineering conservation practice may be considered the practice of engineering and subject to licensure requirements of Georgia Code Chapter 15. It is the responsibility of the individual providing technical assistance to determine and verify whether this practice is subject to Georgia Code Chapter 15.

DESIGN

Deliverables:

1. Design documents that demonstrate criteria in NRCS practice standard have been met and are compatible with planned and applied practices
    a. Practice purpose(s) as identified in the conservation plan.
    b. List of required permits to be obtained by the client and regulations to be met
    c. List of facilitating practices
    d. Practice standard criteria-related computations and analyses to develop plans and specifications including but not limited to:
        i. Insulation R-value
        ii. Building U-value
        iii. Energy star rating of doors or windows
        iv. Additional performance rating values for all installed components
        v. Emission reductions requirements, if needed
2. Written plans and specifications including sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits.
3. Operation and maintenance plan
4. Certification that the design meets practice standard criteria and comply with applicable laws and regulations
5. Design modifications during installation as required

INSTALLATION

Deliverables

1. Pre-installation conference with client
2. Verification that client has obtained required permits
3. Installation guidance as needed
4. Facilitate and implement required design modifications with client and original designer
5. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation
6. Certification that the installation process and materials meets design and permit requirements

CHECK OUT

Deliverables

1. Records of application
    a. Extent of practice units applied
    b. Actual materials used
    c. As Built Drawings as appropriate.
2. Certification that the application meets NRCS standards and specifications and is in compliance with permits
3. Progress reporting

REFERENCES

- NRCS Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard Building Envelope Improvement - 672
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook