

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

ROOFS AND COVERS

(No.)

Code 367



DEFINITION

A rigid, semi-rigid, or flexible manufactured membrane, composite material, or roof structure placed over a waste management facility.

PURPOSE

To provide a roof or cover for:

- water quality improvement
- diversion of clean water from animal management areas (i.e. barnyard, feedlot or exercise area) and/or waste storage facilities
- capture of biogas for energy production
- reducing net effect of greenhouse gas emissions
- air quality improvement and odor reduction

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- Exclusion of precipitation from an outdoor animal management area, waste storage facility or waste treatment facility will improve management of an existing or

planned animal waste handling system or eliminate a pollution concern.

- Capture and controlled release or flaring of emissions from an existing or planned agricultural waste storage facility will improve air quality.
- Bio-treatment of emissions from an existing or planned waste storage or treatment facility will improve air quality.
- Biogas production and capture for energy are components of an existing or planned animal waste system.

CRITERIA

General Criteria Applicable to All Purposes

Laws and regulations. Plan, design, and construct roof and cover systems for animal waste facilities to meet all federal, state, local, and tribal laws and regulations.

Impact to cultural resources, wetlands and Federal and state protected species shall be evaluated and avoided or minimized to the extent practicable during planning, design and implementation of this conservation practice in accordance with established National and Florida policy, General Manual (GM) Title 420-Part 401; Title 450-Part401, Title 190-Parts 410.22 and 410.26, National Planning Procedures Handbook (NPPH) Florida Supplements to Parts 600.1 and 600.6, National Cultural Resources Procedures Handbook (NCRPH), National Food Security Act Manual (NFSAM), and the National Environmental Compliance Handbook (NECH).

Service life. Design the roof or cover along with any necessary appurtenances to provide a service life of not less than 10 years.

Materials. When specifying the type, thickness and material properties of the roof or cover and

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

any supporting members, account for all loads and stresses due to operational, environmental, and climatic conditions.

Ensure that the roof or cover manufacturer and/or installer will provide maintenance instructions and certify that the roof or cover is properly installed.

Specify in the design that the flexible membrane materials, used for fabrication of inflated and floating covers, to be certified by the manufacturer as suitable for the intended application.

Specify the minimum material thickness for flexible or composite geomembrane covers to be:

- 40 mils for non-reinforced material
- 36 mils for reinforced materials

Specify any materials exposed to biogas to be resistant to corrosion. Specify equipment to be suitable for use within a potentially explosive environment.

Loads. For facility components that serve as part of the foundation or support for a roof or cover, include all applicable loads in the structural design analysis.

Design. Refer to structural design criteria outlined in Florida NRCS conservation practice standard Waste Storage Facility, Code 313 for the design of foundations associated with animal waste storage facilities. Design roofs and covers according to the criteria in the current editions of the following material references as appropriate:

- Steel: Steel Construction Manual, American Institute of Steel Construction.
- Timber: "National Design Specifications for Wood Construction," American Forest and Paper Association.
- Concrete: "Building Code Requirements for Structural Concrete, ACI 318," American Concrete Institute.
- Liquid-Tight Concrete Slabs and Walls: "Code Requirements for Environmental Engineering Concrete Structures and Commentary, ACI 350," American Concrete Institute.
- HDPE/LLDPE Geomembrane: "HDPE and LLDPE Geomembrane Installation

Specification," International Association of Geosynthetic Installers.

Treated Wood. When exposed to waste or elements, use preservative-treated wood that meets the requirements in the applicable American Wood Protection Association (AWPA) Standards or in an evaluation service report prepared by an organization recognized by the International Code Council (ICC). A listing of allowable preservatives includes but is not limited to CCA (Chromated Copper Arsenate), ACQ-C (Alkaline Copper Quat Type C), ACQ-D Carbonate (Alkaline Copper Quat Type D, Carbonate formulation), CuN (Copper Naphthenate), ACZA (Ammoniacal Copper Zinc Arsenate), CBA-A and CA-B (Copper Azole Types A and B).

Do not use aluminum fasteners when they are in direct contact with treated wood. Use galvanized or stainless steel bolts, washers, nuts, nails, and other hardware which meet ASTM Specifications A153 for fasteners and A653 Class G185 sheet metal for connectors, Type 304 or 316 (stainless) steel, or other type of material or coating as approved by the preservative manufacturer. Use stainless steel fasteners, connectors, and any other metal contacting ACZA, ACQ or CA treated wood.

Precipitation. For impermeable covers, direct precipitation to collection points for removal by pumping or by controlled release to suitable grassed or otherwise stabilized areas for discharge or infiltration.

Access. For enclosed facilities, as the result of a roof or cover, provide suitable access, as necessary, for normal operation and maintenance of the waste facility.

Safety. Design roof and cover systems to include safety features, including fences and warning signs, as appropriate, to prevent undue hazards.

Include provisions to prevent the unintentional conveyance of biogas to connected facilities as a result of the roof or cover placement.

Additional Criteria For Rigid and Semi-rigid Roofs and Covers

Design rigid and semi-rigid roofs and covers to withstand all anticipated loads including, but not limited to, internal and external loads, uplift pressure, concentrated surface and impact loads and load combinations in compliance with this standard. Design roofs, covers and

associated support systems to resist wind loads as specified in the current version of ASCE 7, Minimum Design Loads for Buildings and Other Structures.

Design covers intended for vehicle, equipment and/or livestock traffic to withstand anticipated dead and live loads. As a minimum, include the live load values for covers contained in ASAE EP378.3, Floor and Suspended Loads on Agricultural Structures Due to Use, and in ASAE EP393.3, Manure Storages. For tank wagons having more than a 2,000 gallon capacity, use the actual axle load.

Equip openings in covered tank with grills or secure covers for safety, and for odor and vector control.

Design roof structures to prevent waste located under the roof from becoming a pollution problem. For structural practices for collecting roof runoff, follow criteria outlined in Florida NRCS conservation practice standard Roof Runoff Structure, Code 558. Where applicable, divert all outside surface water from the roofed area.

Additional Criteria For Flexible Covers

Design floating membrane covers to be supplemented with floatation materials as necessary for proper function, operation, and maintenance.

Design flexible roof and cover material to be readily repairable by solvent, adhesive, thermoplastic welding, or according to manufacturer's recommendation. Design rigid or semi-rigid roof and cover material to be repairable by sectional replacement.

Design floating covers to fluctuate with the liquid level as necessary to properly manage the storage facility.

Design impermeable floating covers with a biogas collection, transfer, and control system to provide protection for the cover and convey biogas to a flare, release or control point.

Design inflated covers to be:

- Equipped with a warning system to notify operator of blower failure for mechanically forced air systems.
- Provided with a support system to limit cover collapse.

Design flexible membrane cover systems to resist wind and wind uplift loads as appropriate.

Additional Criteria For Biogas Control/Utilization

Biogas Emissions. Design the cover system to provide for capture and control or utilization of biogas, bio-reduction and direct release of gaseous emissions, or contain and release of gaseous emissions, as appropriate.

Capture and Control/Utilization

Design the cover system to capture biogas emissions and transfer to point of discharge without mixing with air. Equip the point of discharge with a flare or utilization equipment as appropriate.

Bio-reduction and Direct Release

Specify the cover to be fabricated of a permeable composite membrane designed to promote biological treatment of gaseous emissions which pass through the membrane for direct release to the atmosphere.

Contain and Release

Design the cover system for rainfall exclusion and not to specifically capture biogas. For systems which generate biogas, specify in the designs to provide for the safe handling and transfer of the biogas.

Anchorage. Design the cover anchorage system in a manner to resist internal gas pressures, corrosive environment, wind loads, air tightness (as necessary), or other forces as appropriate to the cover system.

Pressure. For roofs and covers associated with biogas production, include provisions for fail safe pressure relief when interior pressures can exceed design operating pressures. Specify the maximum pressure not to exceed manufacturer's recommendations

Biogas Capture. Design the cover materials and all appurtenances such as weights and floats to capture and convey biogas to the gas collection system. Design the cover to provide for the following:

1. Air Exclusion. Design the cover system and appurtenances, including perimeter soil slopes above the water line for in-ground digesters, to exclude the entrance of air under all operating conditions.
2. Gas Collection, Control, and Utilization. Design the collection, control, and utilization of biogas to meet appropriate criteria in

Florida NRCS conservation practice standard Anaerobic Digester, Code 366.

Biogas Safety. As a minimum for all roofs and covers that contain or control biogas, post the following warning sign:

As a minimum for all covers, include the following:

- “Warning Flammable Gas”
- “No Smoking”
- And when necessary:
“Do Not Enter – Hazardous Gases”.

Where biogas is captured, design the gas collection and control system in accordance with standard engineering practice for safely handling a flammable gas including safety criteria noted in Florida NRCS conservation practice standard Anaerobic Digester, Code 366.

CONSIDERATIONS

When designing the gas handling system, consider the large range in gas production that can occur as a result of changing climate and/or substrate conditions.

Consider storage of biogas when installing flexible covers over waste storage facilities or waste treatment lagoons to attenuate gas supply for end use or controlled release.

To further improve water quality, consider eliminating or reducing feedlot areas when placing livestock under roof.

Screening with vegetative plantings, landforms, or other measures may be implemented for aesthetic purposes.

To maintain storage capacity and functionality by minimizing solids accumulation, manure management methods such as solid/liquid separation should be considered.

For organic applications, consider using special construction material such as qualifying lumber as documented by an evaluation service recognized by the ICC. Other application considerations may also need to be made to address organic issues.

For areas where energy production is an option, consider adding energy recovery or production to the gas handling system. Energy recovery or production can offset additional air emissions from reduced fossil fuel combustion.

Waste facility covers which capture biogas may increase the nutrient content of the manure stored. Consider the effect this may have on the nutrient management plan.

Waste facility covers which capture biogas may increase the odor nuisance during agitation, pump out, and land application. Consider the effect this may have on the surrounding area and management options. Consider wind direction and possible affect on downwind surroundings.

Animal waste storage facilities can release large amounts of biogas at certain times of the year. The cover and gas collection system should be designed for release of this gas.

Consider storage of biogas when installing flexible covers over storage impoundments (lagoons) to attenuate gas supply for end use or controlled release.

PLANS AND SPECIFICATIONS

Prepare plans and specifications in accordance with the criteria of this standard. Define the purpose, goals and objectives of the practice. Include information about the location and construction sequence.

As a minimum, include in the plans and specifications the following:

1. Layout and location of waste management facility with roof or cover including waste collection points and planned access.
2. Grading plan showing excavation, fill, and drainage, as appropriate.
3. Materials and structural details of the roof or cover including all necessary appurtenances as appropriate for the complete system.
4. For roof and cover systems with gas collection and control include a listing of material, equipment, and necessary appurtenances.
5. Safety features, fencing, and safety signs.
6. Temporary erosion control measures during construction.
7. Location of utilities and notification requirements.

OPERATION AND MAINTENANCE

Prepare and review an operation and maintenance (O&M) plan with the landowner or

operator responsible for the application of this practice. Provide in the O&M plan specific instructions for proper operation and maintenance of each component of this practice and detail the level of repairs needed to maintain the effectiveness and useful life of the practice.

Develop an emergency action plan for covered systems associated with biogas production. Include in the plan instructions as to limits of cover performance and emergency procedures if control equipment fails.

For enclosed waste facilities, exercise caution and care during cover removal or access. If opening of the cover is required for facility management, include provisions to prevent exposure of workers to hazardous gases.

If personnel are or may be required to enter an enclosed waste facility, include safety provisions recommended by National Institute for Occupational Safety and Health (NIOSH) for working in confined spaces including but not limited to using a positive-pressure self-contained breathing apparatus, safety line, and standby personnel.

REFERENCES

- American Concrete Institute. 2008. Building Code Requirements for Structural Concrete, ACI 318-08. ACI Committee 318. ACI, Farmington Hills, MI
- American Concrete Institute. Code Requirements for Environmental Engineering Concrete Structures. ACI Committee 350. ACI, Farmington Hills, MI
- American Forest and Paper Association. 2005. National Design Specifications for Wood Construction. AF&PA, Washington, DC
- American Society for Testing and Materials. Annual Book of ASTM Standards. Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, A 653. ASTM, Philadelphia, PA
- American Institute of Steel Construction. 2005. Steel Construction Manual, 13th Edition. AISC, Chicago, IL
- American Society of Agricultural and Biological Engineers. Floor and Suspended Loads on Agricultural Structures Due to Use, ASAE EP378.3. ASABE, St. Joseph, MI
- American Society of Agricultural and Biological Engineers. Manure Storages, ASAE EP393.3. ASABE, St. Joseph, MI
- American Society of Civil Engineers. Minimum Design Loads for Buildings and Other Structures, ASCE/SEI 7-05. ASCE, Reston, VA
- American Wood Protection Association. AWPA, Birmingham, AL
- Florida NRCS Conservation Practice Standards: Anaerobic Digester, Code 366
Roof Runoff Structure, Code 558
Waste Storage Facility, Code 313
General Manual
Title 420-Part 401
Title 450-Part401
Title 190-Parts410.22 and 410.26
- International Association of Geosynthetic Installers. 2007. HDPE and LLDPE Geomembrane Installation Specification. IAGI, St. Paul, MN
- International Building Code. 2009. International Code Council (ICC). ICC, Whittier, CA
- International Code Council Evaluation Service. International Code Council (ICC). ICC, Whittier, CA
- National Cultural Resources Procedures Handbook
- National Environmental Compliance Handbook
- National Food Security Act Manual
- National Institute for Occupational Safety and Health (NIOSH),
- National Planning Procedures Handbook