

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
CONNECTICUT**

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 (e.g. barnyard, feedlot or exercise area), composting facilities, 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:

- A roof or cover is a component of an approved comprehensive nutrient management plan (CNMP)
- 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 of emissions from an existing or planned animal waste management, storage, or

treatment system will improve air quality and/or reduce the net effect of greenhouse gas emissions

- Bio-treatment of emissions from an existing or planned waste storage or treatment facility will improve air quality and/or reduce the net effect of greenhouse gas emissions
- Biogas production and capture for energy are components of an existing or planned waste management system

CRITERIA

General Criteria Applicable to All Purposes

Laws and Regulations. All Federal, state, and local laws, rules, and regulations, including local inland wetland agency regulations, governing the construction and use of this practice as well as setbacks from wells, surface water and property boundaries shall be followed. Planned work shall comply with all federal, state, and local laws and permit conditions and requirements. **The landowner shall obtain all necessary permits prior to construction or any land clearing activities.**

Service Life. The roof or cover along with any necessary appurtenances shall be designed to provide a life span in accordance with Section IV of the Connecticut FOTG.

Materials. The type, thickness and material properties of the roof or cover and any supporting members shall account for all loads and stresses due to operational, environmental, and climatic conditions.

The roof or cover manufacturer and/or installer

shall provide maintenance instructions and/or certify that the roof or cover is properly installed.

Flexible membrane materials, used for fabrication of inflated and floating covers, shall be certified by the manufacturer as suitable for the intended application.

The minimum material thickness for flexible or composite geomembrane covers shall be:

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

Any materials exposed to biogas shall be resistant to corrosion. Equipment shall 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, all loads shall be considered in the structural design.

Where applicable, the membrane cover and support system shall be designed to resist snow and wind loads as specified in ASCE 7-10, Minimum Design Loads for Buildings and Other Structures.

Design. Refer to structural design criteria outlined in Connecticut NRCS Standard 313, Waste Storage Facility 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).

Aluminum fasteners shall not be used 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. All fasteners, connectors, and any other metal contacting ACZA, ACQ or CA treated wood shall be stainless steel.

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

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

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

Provisions shall be included 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

Rigid and semi-rigid roofs and covers shall be designed 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. Roofs, covers and associated support systems shall be designed to resist snow and wind loads as specified in the current version of ASCE 7, Minimum Design Loads for Buildings and Other Structures.

Covers intended for vehicle, equipment and/or livestock traffic shall be designed to withstand anticipated dead and live loads. 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, shall be the minimum used.

Tank wagons having more than a 2,000 gallon capacity shall include an appropriate allowance for impact loading.

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

Roof structures shall be designed to prevent waste located under the roof from becoming a pollution problem. Structural practices for collecting roof runoff shall follow criteria outlined in Connecticut NRCS Standard 558, Roof Runoff Structure. All outside surface water shall be diverted from the roofed area.

Additional Criteria For Flexible Covers

Floating membrane covers shall be supplemented with floatation materials as necessary for proper function, operation, and maintenance.

Floating covers shall be designed to fluctuate with the liquid level as necessary to properly manage the storage facility.

Impermeable floating covers shall be designed with a biogas collection, transfer, and control system to provide protection for the cover and convey biogas to a flare, release or control point.

Inflated covers shall 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.

Flexible membrane cover systems shall be designed to resist snow, wind, and wind uplift loads as appropriate.

Additional Criteria For Biogas Control/Utilization

Biogas Emissions. The cover system shall 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

The cover system shall be designed to capture biogas emissions and transfer to point of discharge without mixing with air. The point of discharge shall be equipped with a flare or utilization equipment as appropriate.

Bio-reduction and Direct Release

The cover shall 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

The cover system is designed for rainfall exclusion and not to specifically capture biogas. For systems which generate biogas, designs shall provide for the safe handling and transfer of the biogas.

Anchorage. The cover anchorage system shall be designed in a manner to resist internal gas pressures, corrosive environment, wind loads or other forces as appropriate to the cover system.

Repair. New and aged flexible cover materials shall be readily repairable by solvent, adhesive, or thermoplastic welding. Semi-rigid cover material shall be repairable by sectional replacement.

Precipitation. Impermeable covers shall direct precipitation to collection points for removal by pumping or by controlled release to suitable grassed or otherwise stabilized areas for discharge.

Access. Covers shall be removable or otherwise provided with suitable equipment access as necessary for normal operation and maintenance of the waste facility.

Safety. The cover shall include safety features, including fences and warning signs as appropriate to prevent undue hazards.

As a minimum all covers shall include the following:

- “Warning Flammable Gas” and “No Smoking” signs shall be posted.

Where biogas is captured, the gas collection and control system shall be designed in accordance with standard engineering practice for safely handling a flammable gas.

Flares shall be grounded or otherwise protected to minimize the chance of lightning strikes.

A flame trap device shall be provided in the gas line between the flare and the waste facility.

The location of underground gas lines shall be marked with signs to prevent accidental disturbance or rupture.

Pressure. Roofs and covers associated with biogas production shall include provisions for fail safe pressure relief when interior pressures can exceed design operating pressures. Maximum pressure shall not exceed manufacturer’s recommendations.

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

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

1. Air Exclusion. The cover system and appurtenances, including perimeter soil slopes above the water line for in-ground

digesters, shall be designed to exclude the entrance of air under all operating conditions.

2. Gas Collection, Control, and Utilization. The collection, control, and utilization of biogas shall meet appropriate criteria in Connecticut NRCS Standard 366, Anaerobic Digester.

Biogas Safety. As a minimum for all roofs and covers that contain or control biogas, the following warning signs shall be posted:

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

Where biogas is captured, the gas collection and control/utilization system shall be designed in accordance with standard engineering practice for safely handling a flammable gas including safety criteria noted in Connecticut NRCS Standard 366, Anaerobic Digester..

Additional Criteria for Inflated Covers

Covers inflated and supported by forced air from mechanical means shall be:

- Equipped with a warning system to notify operator of blower failure.
- Provided with a support system to limit cover collapse in the event the blower fails and for access of equipment.
- Provided with a suitable access port for normal maintenance equipment.

Additional Criteria for Floating Covers

Floating membrane covers shall be supplemented with floatation materials as necessary for proper function, operation, and maintenance.

Minimum membrane or composite membrane thickness shall be 40 mils.

Additional Criteria for Composting Facility Cover

Composting facility covers may be used in lieu of a roof structure to exclude precipitation. The covers shall be made from "non-woven" synthetic fibers which provides moisture control, sheds at least 90% of the precipitation

and/or snow-melt off a compost pile while remaining completely permeable to oxygen, carbon dioxide, and water vapor. Covers shall be manufactured specifically for this purpose and have life span of at least four years.

Additional Criteria for Energy Production

The cover materials and all appurtenances such as weights and floats shall be designed to capture and convey biogas to the gas collection system. The cover design shall provide for the following:

1. Air Infiltration. The cover system and appurtenances, including perimeter soil slopes above the water line for in-ground digesters, shall be designed to exclude the entrance of air under all operating conditions.
2. Material. The minimum material thickness for flexible geomembrane covers shall be:
 - 40 mils for non reinforced material
 - 36 mils for reinforced materials
3. Gas Collection, Control, and Utilization. The collection of biogas and flaring or other end use shall meet appropriate criteria in Connecticut NRCS Standard 366, Anaerobic Digester.

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.

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.

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

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared 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, the plans and specifications shall provide 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.

To the extent practical, specifications shall conform to NRCS National Engineering Handbook Part 642.

AS-BUILT DRAWINGS

As-built drawings shall be prepared showing all pertinent elements and elevations as actually installed. As-built data and drawings will be provided to the owner/operator, regulatory state agency, local fire officials, and participating partners upon construction completion.

OPERATION AND MAINTENANCE

An Operation and Maintenance (O&M) plan shall be prepared for, reviewed and signed by the landowner or operator. The plan shall specify that the treated areas and associated practices are inspected annually and after significant storm events to identify repair and maintenance needs.

The O&M plan shall provide specific instructions for proper operation and maintenance of each component of this practice and shall detail the level of repairs needed to maintain the effectiveness and useful life of the practice.

When gas storage is included in the system design, the plan shall contain instructions as to limits of cover ballooning and emergency procedures if control equipment fails.

Warranties. The cover manufacturer and or installer shall warrant the cover for the intended use and design life, provide maintenance instructions, and certify that the cover is properly installed

Develop an emergency action plan for covered systems associated with biogas production. The plan shall contain 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 NIOSH (National Institute for Occupational Safety and Health) for working in confined spaces including but not limited to using a positive-pressure self-contained breathing apparatus, safety line, and standby personnel.

REFERENCES

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