CONSERVATION PRACTICE STANDARD

ROOFS AND COVERS

(Number)

CODE 367

DEFINITION

A rigid, semi-rigid, or flexible manufactured membrane, composite material, or roof air quality improvement and odor reduction structure placed over a waste management facility, agrichemical handling facility, or an on-farm secondary containment facility.

PURPOSES

Provide a roof or cover to:

- protect clean water from dilution in waste water in an existing or planned animal waste handling or storage area
- improve waste management and utilization to protect nearby surface water quality
- capture biogas emissions from an existing or planned animal waste storage facility to reduce the net effect of greenhouse gas emissions, improve air quality, and reduce odor as a result of:
  - biological treatment with composite cover material
  - combustion by flare
  - combustion by engine generator for energy production
- protect clean water by excluding it from a chemically contaminated area.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- Precipitation should be excluded from contaminated areas, such as animal feeding and management areas, facilities for waste storage, animal mortality, composting, waste transfer or waste treatment, and agrichemical handling.
- Biotreatment of emissions using a porous cover on a wastewater storage facility is needed to improve air quality, limit odors, and moderate the net effect of greenhouse gas emissions.
- A cover is needed to exclude precipitation from a wastewater storage facility. Auxiliary elements of the cover will also capture and manage biogas emissions, improve air quality, limit odors, and reduce the net effect of greenhouse gas emissions.
- Biogas capture for energy production is a component of an existing or planned waste management system. Biogas capture and utilization will also improve air quality, limit odors, and reduce the net effect of greenhouse gas emissions.

This practice does not apply to Indiana (IN) Field Office Technical Guide (FOTG) Standard (325) High Tunnel System.

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.

Indiana NRCS FOTG – January 2018
CRITERIA

General Criteria Applicable to All Purposes

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

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

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

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

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

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

Any materials exposed to biogas will be resistant to corrosion. Equipment will be suitable for use within a potentially explosive environment.

**Loads.** Include all anticipated loads in the structural design for facility components that serve as part of the foundation or support for a roof or cover. See section below, Additional Criteria for Rigid and Semi-rigid Roofs and Covers, and Flexible Covers.

**Design.** Refer to structural design criteria outlined in IN FOTG Standards (313) Waste Storage Facility (309) Agrichemical Handling Facility for the design of foundations associated with these respective practices.

Design roofs and covers according to the criteria in the current editions of the following material references as appropriate:

- Steel: Steel Construction Manual, AISC, American Institute of Steel Construction.
- Concrete non-liquid tight: “Building Code Requirements for Structural Concrete, ACI 318,” American Concrete Institute.

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

**Venting.** For an enclosed roof structure located over animals, manure storage, or petroleum product storage, provide ridge or end vent openings of at least 2 inches per 10-foot-width of building. This prevents buildup of moisture and gases in the attic area.

For enclosed buildings, provide mechanical (exhaust fans) or natural (adequate openings) ventilation in order to maintain a safe working environment when human entry is intended.

**Safety.** Provide safety features, including fences and warning signs, as appropriate, to prevent undue hazards from biogases and drowning. Refer to American Society of Agricultural and Biological Engineers’ (ASABE’s) document, ASAE EP470.1, Manure Storage Safety for guidance.

Design covers and grating over openings such that livestock or humans cannot accidentally displace them and fall into the facility.

Provisions will be included to prevent the unintentional conveyance of biogas to connected facilities as a result of the roof or cover placement.

**Rigid and Semi-rigid Roofs and Covers.** Rigid and semi-rigid roofs and covers will 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. Design roofs, covers and associated support systems to resist snow and wind loads as specified in the current version of American Society of Civil Engineers (ASCE), Standard 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. The minimum live load values for covers contained in ASABE ASAE EP378.3, Floor and Suspended Loads on Agricultural Structures Due to Use, and in ASAE EP393.3, Manure Storages, will be the minimum used. For tank wagons having more than a 2,000 gallon capacity, the actual axle load will be used.

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

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

**Treated Wood.** When exposed to waste or elements that deteriorate wood, 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). Treated wood in contact with animal wastes or as critical components that are difficult to replace, should meet AWPA UC4B or equivalent for heavy-duty ground contact.

Allowable preservatives include but are 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), CA-A, CA-B and CA-C (Copper Azole Types A, B and C), MCA (Micronized Copper Azole), μCA (Dispersed Copper Azole).

Aluminum fasteners, connectors, or cladding must not be used in direct contact with treated wood unless specifically allowed by the preservative manufacturer. Use hot-dipped galvanized or stainless steel bolts, washers, nuts, nails, and other hardware which meet American Society for Testing and Materials (ASTM) specifications A153 for fasteners and ASTM A653 coating designation G185 for sheet metal connectors, or ASTM A240 for Type 304 or 316 stainless steel, except as noted below. Fasteners and connectors of other materials may be used if specifically allowed by the preservative manufacturer. All fasteners, connectors, and any other metal in contact with ACQ, CA, MCA, or μCA-C treated wood will be stainless steel if AWPA Use Category UC4B applies or if constant, repetitive, or long periods of wet conditions may occur. All fasteners, connectors, and any other metal in contact with wood treated with ACZA or any other preservative containing ammonia must be stainless steel.

**Repair.** Use of sectional replacement repair for rigid or semi-rigid roof and cover material is allowable.

**Flexible Covers.** For fabrication of flexible membrane inflated and floating covers, use only membrane materials which have been certified by the manufacturer as suitable for the intended application.

**Table 1.** Flexible geomembrane cover materials.

<table>
<thead>
<tr>
<th>Type for</th>
<th>Minimum Thickness Criteria</th>
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</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>Contain Biogas</td>
</tr>
<tr>
<td>HDPE</td>
<td>40 mil</td>
</tr>
<tr>
<td>LLDPE</td>
<td>40 mil</td>
</tr>
<tr>
<td>LLDPE-R</td>
<td>36 mil</td>
</tr>
<tr>
<td>PVC</td>
<td>40 mil</td>
</tr>
<tr>
<td>EPDM</td>
<td>45 mil</td>
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<tr>
<td>FPP</td>
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<tr>
<td>FPP-R</td>
<td>36 mil</td>
</tr>
<tr>
<td>PE-R</td>
<td>NR</td>
</tr>
</tbody>
</table>

- 1 mil = 1/1000 of an inch
- HDPE – High Density Polyethylene Geomembrane
- LLDPE – Linear Low Density Polyethylene Geomembrane
- LLDPE-R – Reinforced Linear Low Density Polyethylene Geomembrane
- PVC – Polyvinyl Chloride Geomembrane
- EPDM – Ethylene Propylene Diene Terpolymer Geomembrane
- FPP – Flexible Polypropylene Geomembrane
- FPP-R – Reinforced Flexible Polypropylene Geomembrane PE-R – Reinforced, Slit –Film, Woven Polyethylene Geomembrane
- NR – Not Recommended

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

Design floating covers to fluctuate with rising and falling liquid levels to properly manage the waste storage facility.

Include floatation materials on floating membrane covers as necessary for proper cover performance, and operation and maintenance tasks.
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 the biogas handling system with the capacity to handle the large range in gas production that can occur as a result of changing ambient temperatures and substrate conditions.

Inflated covers must be equipped with a warning system to notify operator of blower failure for mechanically forced air systems and provided with a support system to limit cover collapse.

**Repair.** Flexible roof and cover material will be readily repairable by solvent, adhesive, thermoplastic welding, or according to manufacturer’s recommendation.

**Additional Criteria to capture biogas emissions from an existing or planned animal waste storage facility.**

**Biogas Emissions.** The cover system will 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 Biogas and Control/Utilization**

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

**Bio-reduction and Treated Release**

- The cover will 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. Maintenance of the cover media will be required for the life of the practice to ensure proper biofilter operation.

**Contain and Manage Biogas when Excluding Rainfall**

- Design the cover system for rainfall exclusion on the stored manure and organic wastes with auxiliary elements to manage any biogas produced. For storage cover systems which collect biogas, provide for the safe handling, transfer and combustion of the biogas.

Equipment and material exposed to biogas must be resistant to corrosion and suitable for use within a potentially explosive environment. Materials, controls, motors and their installation must conform to the National Electrical Code (NEC). Motors must be rated explosion proof and properly sealed.

Design of aboveground pipe for biogas transfer must include pipe with fittings for expansion and contraction effects.

Aboveground biogas transfer pipe intended for pressurized biogas systems must be of steel or plastic materials. Steel pipe must meet the requirements of AWWA Specification C-200 or ASTM A53/A211 for stainless steel. Plastic pipe must be HDPE meeting AWWA Specification C-906 or ASTM D-3350. PVC is only acceptable for aboveground biogas transfer when pipe meets ASTM D2241, is ultraviolet light inhibited and pipe material is modified for high impact strength.

**Anchorage.** The cover anchorage system will be designed 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.** Roofs and covers associated with biogas production will include provisions for fail safe pressure relief when interior pressures can exceed design operating pressures. Maximum pressure will not exceed manufacturer’s recommendations.

**Precipitation.** Impermeable covers will 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 will be designed to capture and convey biogas to the gas collection system. The cover design will provide for the following:

1. **Air Exclusion.** The cover system and appurtenances, including perimeter soil slopes above the water line for in-ground digesters, will 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 will meet appropriate criteria in IN FOTG Standard (366) Anaerobic Digester.
Biogas Safety. As a minimum for all roofs and covers that contain or control biogas, the following warning signs will 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 will be designed in accordance with standard engineering practice for safely handling a flammable gas including safety criteria noted IN FOTG Standard (366) Anaerobic Digester.

CONSIDERATIONS

The considerations section contains information that is optional to the planner.

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.

Maintain storage capacity and functionality of covered liquid waste storage by minimizing solids accumulation. Consider the use of manure management practices such as solid/liquid separation, IN FOTG Code 632, Waste Separation.

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

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying this practice to meet its intended purpose.

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

- Define the purpose, goals and objectives of the practice installation.
- Include information about the location and sequence of the phases of construction.
- Specify layout and location of agricultural waste storage and handling facility, or agrichemical handling facility.
- Include roof or cover footprint and any waste collection points and all planned access features.
- Grading plan showing excavation and fill. Include appropriate drainage features and revegetation plan as needed.
- Materials and structural details of the roof or cover including all necessary appurtenances as appropriate for the complete system.
- For flexible geomembrane cover systems with biogas combustion, include a listing of associated biogas collection and transfer equipment, and necessary appurtenances.
- Specify that the manufacturer or installer of the geomembrane cover system must certify the installation of the cover. Require the same manufacturer or installer to provide the project owner
with maintenance instructions for the cover material.

- Biosecurity measures during installation.
- Warning and safety signage placement.

OPERATION AND MAINTENANCE

An operation and maintenance (O&M) plan must be prepared and reviewed with the landowner or operator responsible for the application of this practice. The O&M plan will provide specific instructions for proper operation and maintenance of each component of this practice and will detail the level of repairs needed to maintain the effectiveness and useful life of the practice.

Address biosecurity concerns in all aspects of operation and maintenance.

Develop an emergency action plan for covered systems associated with biogas production. The plan will 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

American Concrete Institute. Building Code Requirements for Structural Concrete, ACI 318. ACI Committee 318. ACI, Farmington Hills, MI.


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. 2014. AWPA, Birmingham, AL.

International Association of Geosynthetic Installers. 2007. HDPE and LLDPE Geomembrane Installation Specification. IAGI, St. Paul, MN.

