

USDA  
NATURAL RESOURCES  
CONSERVATION SERVICE  
  
DELAWARE CONSERVATION  
PRACTICE STANDARD  
  
ANAEROBIC DIGESTER - AMBIENT  
TEMPERATURE

CODE 365  
(Reported by No.)

**DEFINITION**

An unheated waste treatment impoundment.

**PURPOSES**

To biologically treat waste as a component of a waste management system to:

- Produce biogas and capture for energy.
- Improve air quality.
- Reduce greenhouse gas emissions.

**CONDITIONS WHERE PRACTICE  
APPLIES**

This practice applies where:

- Biogas production and capture are components of a planned animal waste management system. Suitable geographic areas for energy recovery are shown in Figure 1.
- Existing waste impoundment(s) can be modified to the requirements of this standard or for new construction.

- The digester is in conjunction with a separate waste storage facility or where the digester and storage are congruent.
- Manure can be collected fresh and delivered to the digester with a total solids (TS) concentration in the influent waste of less than 2 percent.
- The operator has the interest and training to monitor and maintain processes or contracts with a consultant to provide these services.

**CONSIDERATIONS**

**Location.** In determining the location of the waste storage facility, consider elevation and distance from the covered digester to take advantage of gravity flow.

The covered digester should be located as near the source of manure as practicable and as far from neighboring dwellings or public areas (minimum distance of 300 ft.) as possible. Proper location should consider slope, distance of manure transmission, vehicle access, wind direction, neighboring dwellings, proximity of streams and flood plains, and visibility.

Using available gas to heat the digester can improve total solids destruction and further reduce greenhouse gas emissions.

The covered digester should be located near a suitable site for energy utilization equipment. Short distances for the transmission of methane through buried pipe are preferable.

**Waste Transfer Pipe.** The standard practice is to locate a cleanout immediately upstream of the digester. Influent from the waste collection pit discharges below the digester operating level and depending on the installation, solids tend to build up in the inlet pipe. The cleanout is also a good location for venting any gas that builds up in the transfer pipe.

**Visual Screening.** Analyze the visual impact of the digester within the overall landscape context. Screening with vegetative plantings, landforms,

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

or other measures may be implemented to alleviate a negative impact or enhance the view.

**Depth of Digester.** Improved digester performance and reduced cover cost (less area for given volume) can be realized with deeper digesters.

**Rainfall.** Rainfall on the digester cover can result in increased effluent discharge into the storage facility. For normal rainfall events this is probably not a problem. In locations subject to high rainfall events (thunderstorms and hurricanes), a ported riser on the outflow pipe should be considered to provide temporary storage and reduce outflow rate.

**Gas Transfer Pipe.** Exposed pipe conveying flammable gas is generally painted orange.

This practice has the potential to affect National Register listed cultural resources or eligible (significant) cultural resources. These may include archeological, historic, or traditional cultural properties. Care should be taken to avoid adverse impacts to these resources. Follow NRCS state policy for considering cultural resources during planning.

### **CRITERIA**

#### **Criteria Applicable to All Purposes**

**Laws and Regulations.** Waste treatment facilities must be planned, designed, and constructed to meet all federal, state, and local regulations.

**Manure Characteristics.** This practice is applicable to manure that is collected fresh, generally less than 7 days old. Manure shall be essentially free of soil, sand, stones, or fibrous bedding material (including clumps of straw), or processed to remove such material.

Ruminant's manure shall be treated with solid separation prior to entry into the digester.

**Rainfall Runoff.** Rainfall runoff shall be diverted away from the digester.

**Anaerobic Digester.** The digester shall meet the General Criteria for All Lagoons given in Practice Standard 359, Waste Treatment Lagoon,

as appropriate, and the following additional requirements:

1. **Minimum Treatment (Design Operating) Volume.** The design operating volume shall be based either on the daily volatile solids (VS) loading rate per 1,000 ft.<sup>3</sup> or the minimum hydraulic retention time (HRT) adequate for methane production, whichever is greater. The maximum daily VS loading rate shall be selected from the values listed on the map in Figure 2. The minimum HRT shall be selected from values listed on the map in Figure 3.
2. **Required Total Volume.** The required total volume of the digester shall be equal to the minimum treatment volume except where waste storage is included in the design. In these cases, the volume shall meet the additional criteria for Design Storage Volume in Practice Standard 313, Waste Storage Facility, as appropriate.  
  
The digester storage volume does not need to account for rainfall except for partially covered digesters.
3. **A minimum of 2 feet of freeboard above the digester design water surface shall be provided except when rainfall is included in determining the operating volume, where only 1 foot of freeboard is required.**
4. **Length to Width Ratio.** The ratio of length to width of the digester is limited to 4:1 or less.
5. **Operating Depth.** The operating depth of the digester shall be at least 12 feet over 50 percent or more of the bottom area.
6. **Interior Slopes.** Interior slopes shall be as steep as permitted by soil properties and construction techniques.
7. **Waste Inlet and Outlet.** The inlet and outlet devices shall be located as far apart as practical to minimize "short circuiting."
8. **Inlet.** The inlet shall discharge a minimum of 12 inches below the digester water surface.

9. **Outlet.** The digester shall be equipped with an outflow device that maintains the digester water surface at its operating level. Except where the digester is designed to include storage, the outlet shall release directly to the waste storage facility without release of trapped gas.
10. **Digester Cover.** The digester cover, materials, anchorage, and all appurtenances, such as weights and floats, shall be designed to capture and convey biogas to the gas collection system. The digester cover and materials shall meet the requirements of Practice Standard 367, Waste Facility Cover.

**Separate Waste Storage Facility.** Separate waste storage facilities shall meet the requirements of Practice Standard 313, Waste Storage Facility. No storage credit shall be attributed to the digester in meeting the minimum storage requirements in Practice Standard 313, except for sludge volume reduction based on expected total solids (TS) removed or destroyed.

**Gas Collection, Transfer, and Control System.** The biogas collection, transfer, and control system shall be designed to convey captured gas from under the digester cover to gas utilization equipment or device (flare, boiler, engine, etc.).

**Gas Collection and Transfer.** Perforated pipe and other components under the digester cover shall be designed to exclude floating debris and waste residue and shall have a service life consistent with the expected cover life, but not less than 10 years.

Pipe and components under the cover shall be securely anchored to prevent displacement from normal cover forces.

The collection and transfer pipe shall be designed for wet biogas. In colder climates, the pipe shall be protected as necessary to prevent frost buildup. In no case shall the pipe size be less than 3-inch diameter.

Pipe used for transfer of gas can be buried or installed above ground and must include provisions for drainage of condensate, pressure and vacuum relief, and flame traps.

**Gas Control.** Gas control equipment and components shall be conveniently located and sheltered from the elements. A minimum distance of 30 feet shall separate the control facility from the digester.

Gas control equipment and components shall have a service life of not less than 2 years and shall be readily accessible for replacement or repair.

The size of equipment and connecting pipe shall be based on head loss, cost of energy, cost of components, and manufacturers' recommendations.

Where electrical service is required at the control facility, the installation and all electrical wire, fixtures and equipment shall meet the National Electrical Code and local and state requirements.

**Gas Utilization.** Gas utilization equipment shall be designed and installed in accordance with standard engineering practice and the manufacturer recommendations. As a minimum, the installation will include a flare to burn off collected gas.

The flare shall be equipped with automatic ignition and powered by battery/solar or direct connection to electrical service. The flare shall have a minimum capacity equal to the anticipated maximum biogas production.

Gas-fired boilers, turbines, and internal combustion engines, when a component of the system, shall be designed for burning biogas directly or shall include equipment for removing H<sub>2</sub>S and other contaminants from the biogas.

**Monitoring.** When the purpose is to produce and capture biogas for energy, equipment needed to properly monitor the digester and gas production shall be installed as part of the system. As a minimum, the following equipment is required:

1. A temperature sensor and readout device to measure internal temperature of digester.
2. Gas meter suitable for measuring biogas.

**Safety.** Methane is a flammable gas. The gas collection, control, and utilization system shall

be designed to incorporate measures to prevent undue safety hazards. As a minimum, “Warning Flammable Gas” and “No Smoking” signs shall be posted.

Flares shall be located a minimum distance of 95 feet from the biogas source and grounded or otherwise protected to minimize the chance of lightening strikes.

A flame trap device shall be provided in the gas line between the digester and points of use (flare, boiler, engine, etc.).

The location of underground gas pipe shall be marked with signs to prevent accidental disturbance or rupture. Mark exposed pipe to indicate whether it is a gas line or other.

### **SPECIFICATIONS**

Plans and specifications for this practice shall be prepared in accordance with the previously listed criteria. Plans and specifications shall contain sufficient detail to ensure successful implementation of this practice. Documentation shall be in accordance with the section "Supporting Data and Documentation" in this standard.

### **OPERATION AND MAINTENANCE**

An operation and maintenance (O&M) plan shall be developed and reviewed with the owner prior to construction. The O&M plan shall be consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design. The plan shall list operation and maintenance requirements including but not limited to:

1. Proper loading rate of the digester and total solids content of influent.
2. Proper operating level of the digester.
3. Estimates of biogas production, methane content, and potential energy recovery.
4. A description of the planned startup procedures, normal operation, safety issues, and normal maintenance items.
5. Alternative operation procedures in the event of equipment failure.
6. Instructions for safe use and/or flaring of biogas.
7. Cover and gas collection system maintenance.
8. Daily inspection of the following:
  - a. Cover material – check for cracks, tears, or points of distress around perimeter.
  - b. Check for excessive ballooning of cover or presence of odor.
  - c. Check for excess rainwater on cover.
  - d. Check gas control panel, regulators, pressure gages, electrical power, flowmeter, flare igniter, and flare operation.
9. Frequency of measuring and recording digester inflow, operating temperatures, biogas yield, and/or other information as appropriate.

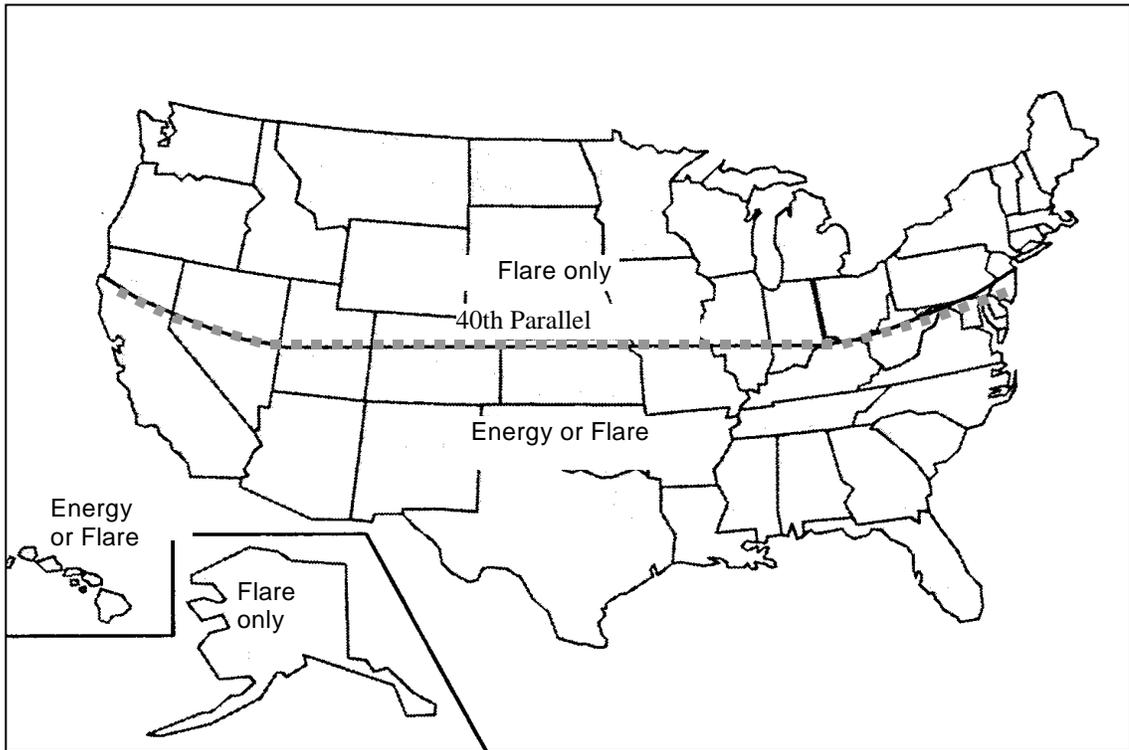


Figure 1. Ambient temperature digester. Locations suitable for energy production generally fall below the 40th parallel.

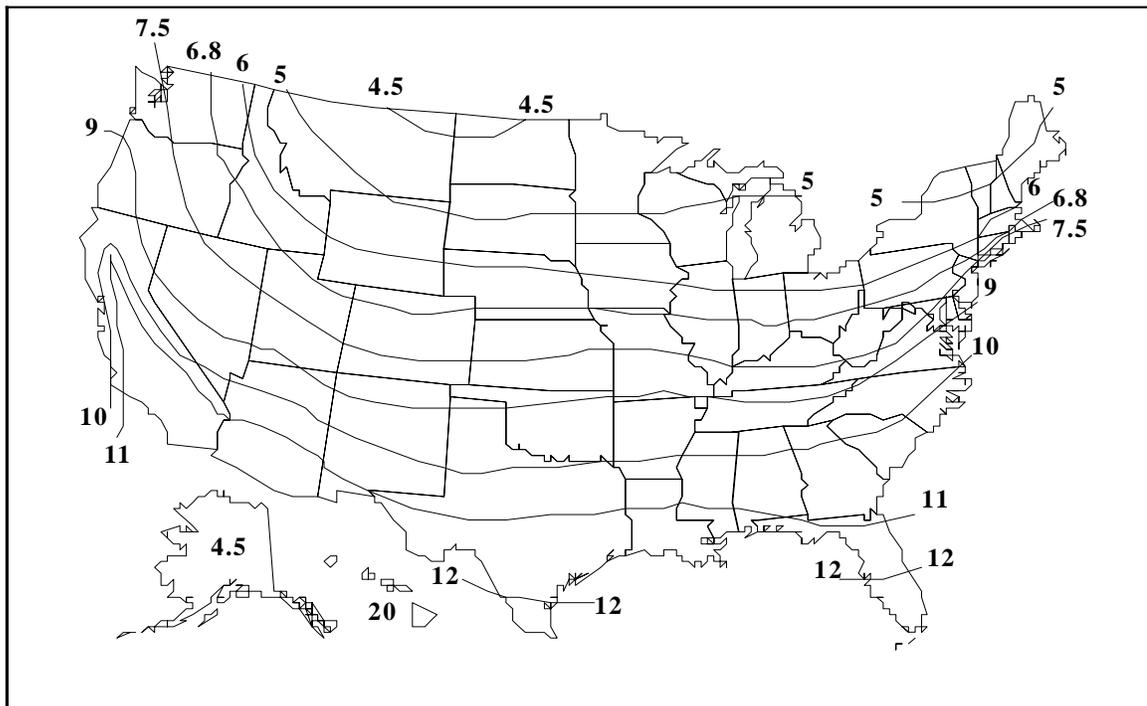


Figure 2. Covered anaerobic digester maximum loading rate (lb VS/1,000 ft<sup>3</sup>/day)

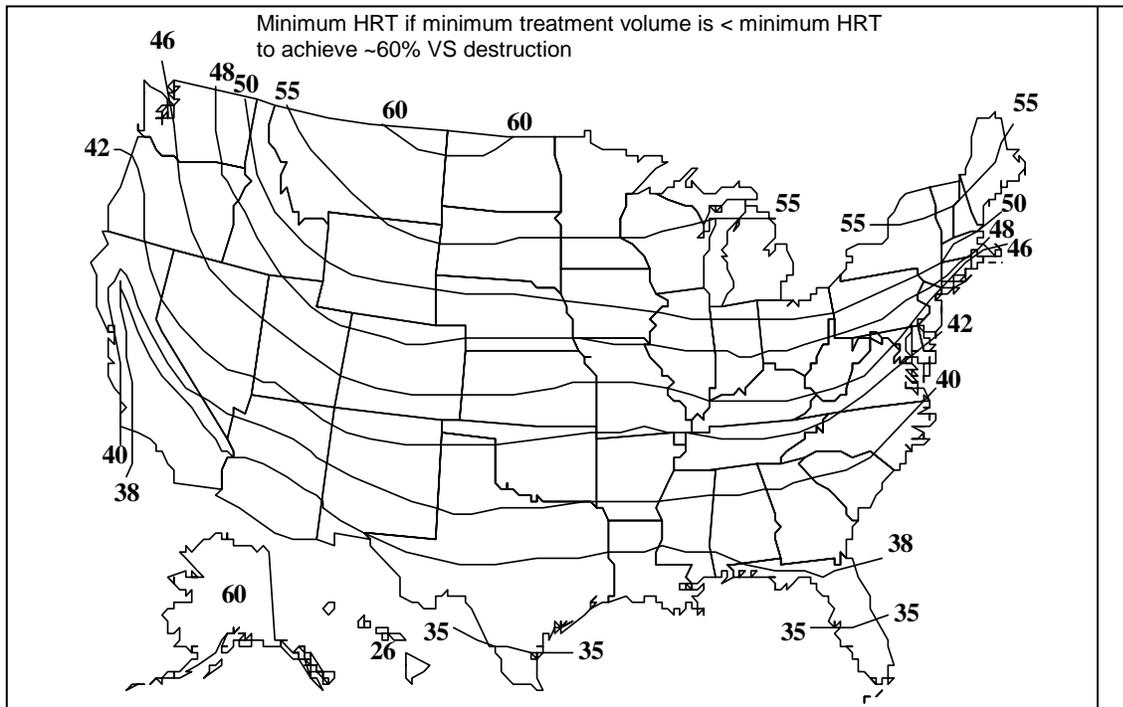


Figure 3. Covered anaerobic digester minimum hydraulic retention times (MINHRT) in days.

**SUPPORTING DATA AND DOCUMENTATION**

The following is a list of the minimum data and documentation to be recorded in the case file:

1. Location the practice on the conservation map.
2. Assistance notes. The notes shall include dates of site visits, name or initials of the person who made the visit, specifics as to alternatives discussed, decisions made, and by whom.

**Field Data and Survey Notes**

The following is a list of the minimum data needed:

1. Plan view sketch.
2. Soil borings with depth to water table identified.
3. Type, size, and number of animals the structure is designed to serve.
4. Topographic survey as needed for the siting of the structure and its appurtenances.
5. Profile and cross-section of the site if a grading plan is needed.

**Design Data**

Record on appropriate engineering paper. For guidance on the preparation of engineering plans see Chapter 5 of the Engineering Field Handbook - Part 650. The following is a list of the minimum required design data:

1. Determine soil type and any special restrictions.
2. Determine the type of digester that will be constructed.
3. Design the digester in accordance with this Practice Standard, and in accordance with Practice Standard 359, Waste Treatment Lagoon, or by other approved methods.

4. Layout of livestock facilities, waste collection points, waste transfer pipe, digester, and storage pond.
5. Location of all digester influent pipes and devices.
6. Details of pipe material, size, and grade.
7. All digester and storage pond dimensions, type of lining material, and other parameters as appropriate.
8. Digester cover material and dimensions of covered surface. Means of rainfall removal or details of drainage.
9. Details of digester cover anchorage (ex: location and width of trench, depth, backfill material, and compaction of fill).
10. Details of the gas collection system, including type of pipe, devices, sizes, location, material, and grades.
11. Details of gas control facility, piping layout, components, electrical service if required, and protection from the elements.
12. Appropriate gas safety equipment or protective measures.
13. Include the Miss Utility notification statement.
14. Show job class on the plan.
15. Plan view sketch and final grading plan as required.
16. References to components supplied by others (pumps, etc.).
17. Maximum and minimum operating levels (elevations).
18. Seeding, fertilizing, and mulching requirements.

**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.

### **Utilities Notification**

1. Forms ENG-5 and ENG-6 can be used to assist in tracking utility notifications.
2. Document on CPA-6 initial discussion about his or her responsibility to notify Miss Utility.
3. Document on CPA-6 any information from the landowner about the existence and location of known utilities.
4. Document on CPA-6 assurances from the landowner that Miss Utility has been notified, including staking by the utilities.

### **Construction Check Data/As-Built Plans**

Record on survey notepaper, NRCS-ENG-28, or other appropriate engineering paper. Survey data will be plotted in red on the as-built plans. Document approval by the designer of any changes from the drawings or specifications before implementation of the change.

The following is a list of minimum data needed for as-built documentation:

1. Documentation of site visits on CPA-6. The documentation shall include the date, who performed the inspection, specifics as to what was inspected, all alternatives discussed, and decisions made and by whom.
2. Check notes recorded during or after completion of construction showing dimensions and elevations of the structure, as appropriate.
3. Statement on seeding and fencing.
4. Final quantities and documentation for quantity changes. Material certifications as appropriate.
5. Sign and date check notes and plans by someone with appropriate approval authority. Include statement that practice meets or exceeds plans and NRCS practice standards.