NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

MANURE TRANSFER
(No.)
CODE 634

DEFINITION

A conveyance system using structures, conduits, pumps, valves, or equipment to transfer manure, milkhouse or other agriculture waste.

SCOPE

This standard establishes the minimum acceptable requirements for design, construction, and operation of waste transfer system components.

It includes mechanical pumping, siphons, or gravity systems.

PURPOSE

To transfer animal manure (bedding material, spilled feed, process and wash water, and other residues associated with animal production may be included) through a hopper or reception pit, a pump (if applicable), and a conduit to;

- a manure storage/treatment facility,
- a loading area, and
- to agricultural land for final utilization. This includes application of manure to the utilization area.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

1. It is a component of a system prepared according to Practice Standard (312) Waste Management System.

2. Waste is generated by livestock production or processing and a conveyance system is necessary to transfer waste from the source to a storage/treatment facility and/or a loading area, and/or from storage/treatment to an area for utilization.

3. It can be installed without polluting air or water resources.

4. The equipment, labor and other resources are available to operate the system.

Where an irrigation system is to be used, the collection system and pump should be addressed, but the pipe and delivery system should be covered under Irrigation Water Conveyance (430) and the applicable Irrigation System.

The practice does not apply to push off platforms on scraping alleys or loading and unloading pads which are covered under Practice Standard (313) Waste Storage Facility.

It also does not apply to waste handling systems such as gutter cleaners, alley scrapers, or gravity gutters within the barn.

CRITERIA - ALL SYSTEMS

1. General

Manure transfer components shall comply with all federal, state, and local laws, rules and regulations.

Reception pits, hoppers, manure pumps, valves, pipelines and gravity drop structures must be liquid tight.

All concrete structures and structural components shall be designed in accordance with Practice Standard 313, Waste Storage Facility, including those which provide a work area around piston pumps. These structures shall be designed to withstand the anticipated static and dynamic loads.

The minimum thickness of component elements of concrete structures shall also be in accordance with Practice Standard 313. When needed, covers shall be designed to support the anticipated dead and live loads. When curbs are needed in conjunction with structures, they shall be constructed of either concrete or wood. Curbs shall be of sufficient height to insure total manure flow into the structure and be adequately anchored.

2. Inlet Openings

Openings to structures to receive manure from alley scrape collection shall be a minimum of nine square feet with one dimension no smaller than four feet. The opening shall be equipped with a grate designed to support the anticipated loads. Openings in grates shall be less than six inches across.

3. Reception Pit/Hopper

The reception pit or hopper shall be located to provide acceptable access for the scraping and cleaning equipment. The design shall consider the safety of humans and animals during construction and operation. Excavation depths near or under building foundations should be the minimum required. Support for the foundation may be necessary to protect the building and workers during construction.

4. Pipelines

Design of pipelines shall be in accordance with Practice Standard 430, Irrigation Water conveyance. The minimum pipeline capacity from collection facilities to storage/treatment facilities shall be the maximum flow anticipated on a daily basis. The minimum pipeline capacity from storage/treatment facilities to utilization areas shall insure the storage/treatment facilities can emptied within the time limits stated in the management plan for manure utilization. Pipelines shall be designed to have a minimum of two feet per second and a maximum of 6 feet per second velocity except where ruminant manure is transferred in a gravity system; in which case velocities can be reduced if a minimum of five feet of head is provided on the pipe system.

Clean-out access shall be provided for gravity pipelines at a maximum interval of 200 feet for lines carrying non-bedded manure. For pipelines carrying bedded manure the maximum interval shall be 150 feet. Gravity pipelines shall not have horizontal curves or bends except minor defections (less than 10 degrees) in the pipe joints unless special design considerations are used.

Pipelines should be installed more than 25 feet from a well or reservoir and more than one half foot above bedrock and/or groundwater.

All pipelines shall have a minimum cover of 3.0 feet and be properly bedded, using bedding materials or installation technique consistent with the pipe manufacturer's recommendation for the grade or quality of pipe. Proper backfill methods shall be used as recommended by the pipe manufacturer to ensure that the pipe will not be damaged, misaligned, or allowed to creep. The outlet end of the pipe shall be sufficiently anchored to prevent movement or separation of the last section. Elbows or bends in the pipe alignment greater than 5 degrees shall be made with manufactured fittings and supported by thrust blocks or deadman anchors.

5. Other Conduits

Concrete lined ditches shall be designed in accordance with Practice Standard 428A, Irrigation Water Conveyance-Non-reinforced Concrete Ditch and Canal Lining. A minimum design velocity of 1.5 feet per second shall be used.

6. Pipe

The pipe must meet or exceed the applicable specification rating listed in Table 1. The manufacturer's recommendations for deflection in the joints must be followed.

All pipe for pump or direct transfers systems must meet the pressures and dynamic loads generated by the system and installation as specified by the pump manufacturer. All pipe must withstand the earth, live load, and dead load pressures. All pipes shall have a minimum internal pressure rating as shown in Table 1 or two times the maximum operating pressure, whichever is less.

7. Valves

Valves shall be installed in pipelines where there is a positive working head for emergencies and to service the system. As a minimum, a valve shall be located immediately before entering the storage facility.

A second valve shall be required near the pump if the storage facility is not readily accessible for emergency operation or if it is needed to service the pump without emptying the pipeline. All the valves shall be positive seating, guillotine valves that can be operated by hand and are readily accessible for operation and service.

8. Equipment

Pumps installed for manure transfer shall meet the requirements of Practice Standard 533, Pumping Plant for Water Control. Pumps shall be sized to transfer manure at required system head and volume. Type of pump shall be based on the consistency of manure. Consideration for pump installation shall be based on manufacture's recommendations.

9. Safety

The system design will include measures to protect the safety of humans and animals during construction and operation. Open structures will be provided with covers or barriers such as gates and fences. Ventilation and warning signs must be provided, as necessary, to prevent explosion, poisoning or asphyxiation. Auxiliary pipelines from enclosed buildings, such as milk house drains, will be provided with a water-sealed trap and vent or similar devices as necessary to control gas entry into buildings.

Tractors or other vehicles used to tow manure spreaders or tank wagons shall be sized to reduce the danger of roll-over.

10. Odors

A transfer system pipe shall enter a storage facility at or near the bottom of the storage facility unless precluded by the site conditions. This will minimize the surface disturbance and allow a crust to form where possible to further minimize odors.

CRITERIA - GRAVITY TRANSFER SYSTEMS

1. General

The operation of a gravity transfer system depends on the consistency of the manure and the overall hydraulics of the system. Consistency is affected by the type of manure, bedding or other materials, and the amount of water or other liquids present. Table 2 gives criteria for gravity systems.

Gravity systems should have a source of water or waste liquids available to flush the system, if needed.

2. Systems for Dairy and Veal Operations

Wastes from lactating dairy herds are generally suitable for gravity pipeline systems. The amount and type of bedding used could affect the performance of the system. Bedding amounts up to 3 lb. per head, per day, of chopped hay or straw, sawdust, or newspapers can be used. Bedding amounts beyond this level could result in a consistency problem with the waste in the gravity transfer system. Long stem hay or straw and frozen materials should be avoided. The addition of water could overcome these problems, provided it was added in a gutter chain or other mixing system prior to entering the gravity transfer system.

Unless special provisions are made the use of ground rock or sand as bedding should be avoided with gravity transfer systems.

3. Systems for Swine Operations

There tends to be a solid separation with this type of waste. Therefore it is important that gravity systems transferring this type of waste maintain minimum grades to insure that solids and liquids do not separate within the system and are not allowed to accumu-late at any point. This can be addressed with collection hoppers that act in support of flush systems, allowing all the wastes to transfer at one time. Also, the pipelines shall be kept at grades no steeper than 1% where the systems will be a continuous flow type. Outlets for such systems should be positioned so that solid accumulations within the storage or near the outlets do not block the pipe. It is recommended that there be at least two feet from the invert of the pipe to the bottom of the storage or other reception pits, as a minimum. Additional clearance may need to be added if more accumulations of solids may be expected.

4. Systems for Dairy Replacements and Beef

This type of manure does not generally lend itself for gravity pipe transfer systems because of the consistency of the manure itself and the lack of additional liquids. Systems can be planned and designed for use under certain conditions, such as freestalls during the summer months, where limited bedding will be used. Provisions for an alternate system must be planned for when freezing or drying conditions make the waste too solid to transfer in these systems.

5. Flush Systems

These systems accumulate the waste in a hopper or temporary storage structure at the head of the system. The waste is then transferred through a pipe at one time by opening a valve and releasing the wastes suddenly. These systems tend to move solids more efficiently, especially when the pipelines are on steeper grades.

They can be used to alter the consistency of some waste by adding solids and liquids separately and allowing them to mix naturally in the hopper or temporary storage. An agitator can be added to mechanically agitate the waste before it is transferred, if necessary.

6. Hoppers

Collection hoppers are needed at the head of all gravity pipe systems to collect and direct the waste into the pipelines. The hopper can consist of an existing storage or tank. Minimum volume of a hopper shall be 100 cubic feet or one-half day's accumulation of waste, whichever is less. The minimum depth of the hopper is (8) eight feet, unless the waste is of a liquid consistency and then the minimum depth should be (4) four feet. All hoppers should have a smooth finish on the inside. Fillets to reduce sharp corners and significant head losses at the pipe inlet are recommended. The bottom of the hopper shall be sloped to match the grade of the pipe exiting the hopper. All hoppers should have a safety grate or shroud to restrict access to the hopper.

A concrete curb which is a minimum of six inches high and five inches wide, or a wooden curb which is 12 inches (nominal) high, is required across from the loading side of the grate to insure total manure flow into the drop structure, when applicable. These curbs must be adequately anchored to the barn floor or the drop structure. Hoppers should be covered to minimize freezing and drying problems. A warning sign should be posted near hoppers and reception pits describing the hazards associated with the hopper and accumulated gases.

7. Gates

Gates can be installed on gravity transfer stems at the hoppers to convert them to flush type systems. These gates can be ball valves, guillotine slide gates, or globe valves which do not restrict the opening to the pipe when fully opened. The gate action should be smooth and relatively quick. Screw type valve operating mechanisms are not to be used for flush type systems.

8. Pipelines

All gravity pipe shall have smooth interiors; the pipelines shall be completely and uniformly bedded to one foot over the top of the pipe. The pipe diameters, lengths, and slopes shall be as shown in Table 2.

The diameter of the pipeline should be considered when determining the amount of time the waste will travel within the system. Waste that enters the pipe should exit within 48 hours. Where sawdust and chopped paper are used for bedding, shorter periods should be considered to avoid the formation of a dry plug.

Wherever possible, milk house waste water or another source of water should be added at the hopper or reception pit to facilitate manure flow. The transfer pipe should exit into a storage facility at the bottom or through the bottom for freezing protection, unless it is a hog or veal system or sand bedding, and then it should be off the bottom accordingly to allow for solid accumulations.

9. Vents

A vent should be considered in the gravity transfer system at a location beyond the entrances to the pipeline to alleviate air locking of the system. The minimum size of vents shall be one inch.

10. Hydraulics

The overall hydraulic components of the system include the working head, the losses due to entrances and friction head and the size of the collection hoppers and pipelines. The minimum head between the highest point where the system will be loaded at the top of the hopper and the maximum level of the waste in the storage shall be no less than the values in Table 2. All entrances to the pipes shall be made with a smooth, square edge. Vertical changes in direction in a pipeline should not be made in greater than 45° angles at any one time. All changes in vertical direction should be made with manufactured water tight fittings compatible with the type of pipe being used. Changes in horizontal direction should be made in drop structures or manholes.

11. Milking Center Wastes

Milking center wastes shall first be collected at the drain exiting the milkhouse, using a manhole or clean-out assembly. If the drains carry waste water from a milking parlor, a settling tank with at least two days volume shall be provided if the pipe length will exceed 100 feet. The pipe shall enter a storage facility at a location which will be free draining. If outleted below the maximum fill elevations for a storage facility provisions shall be made to protect the outlet from clogging and facilitate cleanings.

12. Slopes and Chutes

Slopes and chutes to transfer waste shall be 2:1 or steeper**.** The waste should be dropped on a slope a minimum of 5.0 feet. The waste should be confined in a channel as much as possible to maintain depth and velocity.

13. Gravity Unload Systems

Due to the potential hazards and management requirements, gravity unload systems are generally not recommended. They are permitted only with pipe diameters eight inches or less and where no bedding is in the storage.

If a gravity system is used it should have a minimum of two (2) independently operated valves which shall be manually operated. The valves must be commercially manufactured and guaranteed to be water tight at twice the maximum operating head. The area where this pipeline is to discharge shall be enclosed to impound a minimum volume equal to twice the size of the receiving system or spreader.

CRITERIA - DIRECT TRANSFER SYSTEMS

1. General.

These types of systems collect the waste and transfer it directly without temporary storage. These systems are generally furnished and installed by vendors servicing the industry for this type of handling equipment.

2. Ram Pumps

These systems may include a ram or plunger oscillating in a chamber. There is a hopper to direct the waste to the chamber. The system is power driven, usually with electric motors. The systems are available in various sizes and

capacities. The plunger head and pipeline size are directly related to capacity. The systems are limited by working head and pipeline distance. A general working guide for these types of installations is shown on Table 3. All Manufacturer's recommendations and limitations shall be followed in design and installation.

3. Elevators and Conveyors

These systems consist of a chain, belt, or auger operating in a chute or housing. The waste is usually dropped or moved directly into the system without a hopper or collection system. These systems may be used to extend present waste handling equipment to transfer the wastes to storage or another transfer system. Working height and distances are limited and exposure to freezing weather may affect their performance and maintenance requirements. All manufacturer's recommendations and limitations shall be followed in design and installation.

CRITERIA - PUMP TRANSFER SYSTEMS

1. General

These types of systems utilize a temporary storage and pump to transfer the waste. The temporary storage collects and stores the wastes and serves as a pumping port or platform. Pumps are used to agitate and transfer the waste. These systems are limited by working head and pipeline distances, as well as available power sources.

A general working guide for these types of pump systems is shown in Table 3. All manufacturer's recommendations and limitations shall be followed in design and installation.

2. PTO Driven Pumps

These pumps are driven through the Power Take-off (PTO) from another power source. Pumps may be mounted on the storage structure or portable. They may operate in a vertical or angled position. They are rated in horsepower and capacity for pumping.

Agitating takes additional power requirements and may be located separately. The minimum available horsepower should be 80 hp on the PTO. These pumps may be used for loading and unloading storage.

The discharge nozzles can be directed for agitating, loading, or transferring wastes to a pipeline.

3. Waste Water Pumps

These pumps are installed in the temporary storage tank and are powered with electric motors. The equipment must be compatible with the type of waste water being transferred. Acids, detergent, manure, or other wastes may affect the performance and life span of these pumps. The manufacturer's recommendations will verify the environment and condition for which these pumps are applicable.

Sludge build-up in the reception pits could be a problem and should be eliminated as much as possible by agitating or routine maintenance. The temporary storage size is important to the performance of this type of system in that it dictates the cycle time of the pump.

The maximum cycle for these types of pumps shall not be more than one per 12-hour period. Effluent type pumps with 3/4 inch solid capacity should be only be used in conjunction with a dilute waste water that has passed through a separate settling facility with a

minimum of two days flow volume. If a separate settling facility is not provided, a sewage rated pump with at least 1 1/2 inch solids capacity shall be used. A general working guide for these types of pump systems is shown in Table 3.

Waste water pumps shall be selected and specified based on discharge capacity, total head and solids capacity. The pumps shall be equipped with float switches and an alarm, and be wired directly into a power circuit.

4. Reception Pits/Temporary Storage

These are temporary storage tanks to accommodate a pump transfer system. They must be sized according to the waste production and the capacity and working requirements of the pumps. Reception pits shall be sized to contain one full days manure production. Openings and access to these reception pits must be located and sized to accommodate the pumps and operational needs of the system. These storage facilities shall meet the requirement of Waste Storage Facility (313).

5. Sumps

Sumps may be needed in some pumping systems in order to completely empty reception pits or other storages. The sump is recessed below the floor to allow for waste to drain to a low point and for the pump assemblies to reach the floor elevations. The minimum manure sump size shall be 1.0 feet deep and 2.0 feet in diameter or square or as necessary to accommodate the pump.

6. Vacuum Systems

Some pump systems operate by collecting the waste on the vacuum side of a pump and then transferring it under pressure. These systems are limited to a suction head and should not be used when the bottom of the storage or collection point is more than 12 feet lower than the highest point in the system, before it reaches the pump. A general working guide for these pumps is shown in Table 3.

CRITERIA - SAFETY

Warning signs, ladders, guard rails, shields and other devices shall be provided, as appropriate, to insure the safety of humans and livestock. Fences shall comply with Practice Standard 382 (Fence).

Ventilation and warning signs must be provided for enclosed waste holding structures, as necessary, to prevent explosion, poisoning, or asphyxiation. No safety shields or devices supplied with equipment shall be removed or altered in any way.

Warning signs should be posted near hoppers and reception pits describing the hazards associated with the hopper and accumulated gases.

CRITERIA IN SUPPORT OF THE PURPOSE OF LAND APPLICATION

Manure shall be applied to the utilization area in amounts and at a time consistent with the manure management plan and Practice Standard 633, Waste Utilization.

Sprinklers or sprinkler systems shall be designed in accordance with Practice Standard 442, Irrigation System, Sprinkler. Sprinkler system design capacity shall be adequate to apply the required volume of manure at a rate and uniformity that shall prevent runoff and meet the nutrient needs of the plants. Nozzle size shall be appropriate for the consistency of the manure applies. Sprinkler applied, manure contaminated water, shall normally

contain less than two percent solids unless provisions are made for straining or filtering before application.

Manure spreaders and/or tank wagons shall have adequate capacity to insure the emptying of storage/treatment facilities within appropriate time periods as stated in the system operation and maintenance plan.

Gated pipe and other appurtenances used in conjunction with gravity application shall be designed to insure uniform application amounts.

CRITERIA FOR ESTABLISHING VEGETATION

When there is earth disturbance for the installation of a waste transfer system, vegetation shall be established to protect the area.

Seedbed preparation, seeding, fertilizing, and mulching shall be as stated in the standard for Critical Area Planting (342), or the Penn State Agronomy or Erosion Control Guide.

CONSIDERATIONS

1. General

The following waste transfer systems can be considered for handling wastes:

1) Gravity systems which include a hopper or inlet system, a pipeline and outlet, slopes, gutters or chutes.

2) Mechanical, direct transfer systems which may include a hopper, ram pump, chute, chain, valves and pipeline.

3) Storage and pump or siphon system which include a storage, reception pit or collection tank, pump, or siphon, valves and pipeline.

2. Location

The waste transfer system must be located near, and have direct access to the source of the waste such as gutter cleaners, pushoffs, sumps or drains. It must be accessible for operation and maintenance. The system should take a direct path from the source of the waste to its final destination. A straight line with as few bends in alignment as possible is the most efficient and best considering operation, maintenance and cost.

3. Topography

The elevation differences between the source of the waste and its final location play a significant role in deciding which system can be used. Gravity systems must have sufficient working head to be feasible. Mechanical and pumping systems are limited to the height and head loss based on the capabilities of the equipment.

4. Environmental Protection

Waste transfer systems shall be liquid tight and be protected from accidental damage or failure which would result in an uncontrolled discharge of waste and possible contamination of domestic water systems, ground water, and surface water.

5. Subsurface Conditions

Depth of bedrock, water table, etc. need to be evaluated in the selection of any proposed system. Foundations for hoppers, reception pits, pipelines, etc. may need to be addressed for their proximity for environmental hazards and ability to support or deflect the anticipated loads.

6. Capability

The waste transfer system needs to be compatible with other components of the waste management system. The system must also have the capacity to meet the loading and unloading requirements as outlined in the Waste Management System (312). Loading and unloading of storage facilities, as well as tying into collection and spreading equipment, including irrigation systems may need to be considered. The type of waste and its consistency along with farm management and experience should also be considered.

7. Other Considerations

Provisions for cleaning out solids deposition in ditches:

Pipe pressure rating adjustments required based on manure temperature. Corrosion resistance and water tightness in the selection of pipe materials and joints;

Need for appropriate check valves, anti-siphon protection and open air breaks; Sanitation needs of all conveyance equipment that leaves the farm in order to prevent the spread of disease;

Potential for salt (struvite) deposits in smaller diameter pipe.

Management flexibility should be considered where dry or frozen manure may be a problem. Alternative transfer methods, supplemental water and temporary stacking or mixing capacity should be considered.

OPERATION AND MAINTENANCE

Site specific operation and maintenance requirements shall be developed for each system and shall be provided to and reviewed with the operator/owner. These requirements shall be consistent with The Practice Standard Waste Storage Facility (313), Waste Management System (312), the Nutrient Management Plan (490) or Waste Treatment Lagoon (359) and equipment manufacturer's requirements and recommendations for equipment or components.

Plans that include gravity systems shall include instructions to add water to the system when it appears to function slower or when material has been added which could affect the consistency of waste and performance of the system. The water shall be added at the bottom of the hoppers.

Frozen or dried manure can cause plugging of the transfer system. Frozen manure should be piled or stacked until thawed before loading into the transfer system. Dried manure should have water added, or be mixed with liquid manure before loading into the system. A source of water should be available for each transfer pipe.

As a minimum, the O&M plan shall contain items related to maintenance of the system, integrity, operational procedures, safety requirements, and a contingency or emergency procedure to be followed in the event of accidental spill or seepage or unforeseen circumstances. A copy of the plan shall be immediately available at all times. In the event the landowner or operator has his/her storage facility emptied by a custom operator, it shall be his/her (landowner/ operator) responsibility to review the plan with the applicator prior to operating the system.

PLANS AND SPECIFICATIONS

Plans and specifications for waste transfer systems shall be in accordance with this standard and shall describe the requirements for applying the practice to achieve this

intended purpose. The plans must show all features required for the proper installation and functioning of the practice, including (but not limited to): plan view; profiles subgrades, inverts and type of pipelines; cross sections with details such as bedding, fasteners, joint seals; pipes; drainage; erosion/sediment control; access; safety devices; and foundation requirements.

DOCUMENTATION

A waste transfer system shall not be reported as complete until adequate documentation, showing proper installation, has been prepared.

The as-built drawings shall be signed and dated by the person with installation approval authority to indicate that the structure was installed as designed, except as noted by red-line changes.

In addition, the as-built drawings shall include name of the installer, manufacturer, and date of completion of each transfer system and/or component. The as-built records shall also include any applicable "Statement of Conformance" presented or certified by suppliers of structures or equipment. The design folder, as-built drawings, certifications and specifications shall be filed in the Waste Management System plan.