SEPTIC TANKS

For Oregon Rural Homes

By M. G. HUBER

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Septic Tanks for Oregon Rural Homes

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A SANITARY sewage disposal system is necessary in the farm and suburban home to complete a running water and modern bathroom installation. It is usually planned and installed at the same time that running water is installed, thus bringing the full advantage of water and sanitary waste disposal to the rural home at the turn of a faucet.

The rapid increase in rural electric lines making available automatic pressure water systems has increased the desire and need for a highly satisfactory method of household waste disposal.

The Oregon plumbing code requires that all domestic sewage be disposed of in either a community sewer system, a septic tank, or a cesspool. The rules and regulations of the State Board of Health are that such wastes shall not be discharged untreated into any ravine, ditch or gutter, onto any street or highway, or into any waters of the state unless subjected to some recognized treatment approved by the State Board of Health. The septic tank is considered the cheapest, safest, and most satisfactory method of sewage disposal for farmers and ranchers. The cesspool is a covered pit into which raw sewage is discharged, and although low in first cost, has a high maintenance cost and often becomes a nuisance. Under certain soil conditions, a cesspool may give fairly satisfactory results.

A septic tank is a long water-tight digestion chamber in which sewage is digested and flows into the disposal system. The minimum length of time that sewage should remain in the tank is 24 hours. Anaerobic bacteria attack the solids of this slow moving sewage. In this digestion or breaking down process, the heavy particles settle to the bottom as sludge; the lighter particles float as scum and the remainder passes through the outlet as effluent into the disposal field where it is deposited in the soil at a depth of 20 to 24 inches by the disposal system. This upper soil layer contains a large number of bacteria that attack the fine particles of sewage carried by the effluent and change them into chemical forms suitable for plant food. These bacteria live and work only in well-aerated soil containing oxygen. Effluent discharged deep in the soil, or not properly distributed in the disposal system, does not receive the benefits of this purifying action.

Principal parts of the septic tank sewage disposal system are:

1. The house sewer that carries the household wastes to the septic tank.

The plans in this publication for a septic tank and disposal system comply with the minimum requirements of the Oregon State Board of Health.

2. The septic tank that is the digestion chamber where the solid matter is broken up into gases, liquids and mineral solids by the bacteria.
3. The disposal system that consists of a series of tile lines.

THE HOUSE SEWER

The house sewer pipe to the septic tank should not be less than a 4-inch diameter cast iron soil pipe with leaded joints. It should be run in a generally straight line. Bends should be avoided wherever possible. Slight changes in direction may be made with one-sixteenth or one-eighth bend fittings. If sharp bends are necessary, a manhole should be installed. The slope should be at least 1 inch in 4 feet.

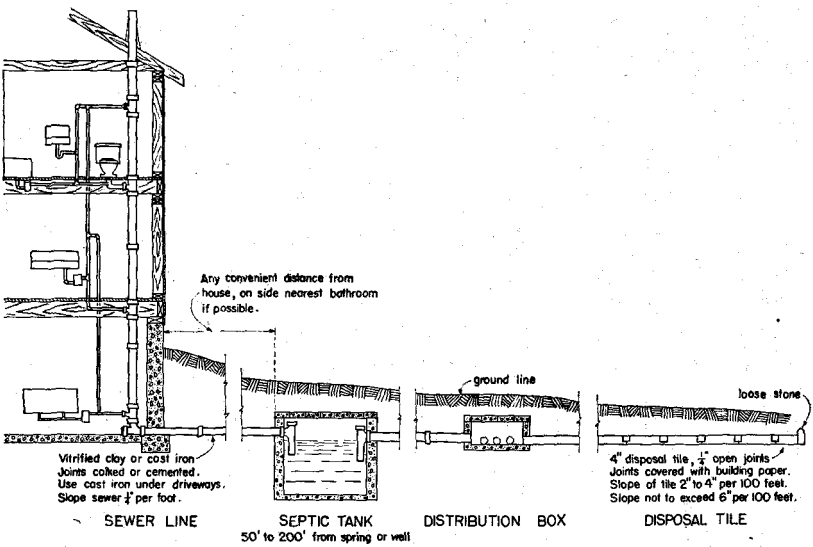


Figure 1. Plan of a septic tank system.

THE SEPTIC TANK

Select location carefully

The proper location of the septic tank is important. First, it must be located so as not to endanger any adjacent water supply. Disposal fields of effluent should, if possible, be located at least 100 feet and downhill from any well, spring, or stream used for a water supply. The Oregon State plumbing code specifies that no septic tank, disposal field, or cesspool be located within 50 feet of any well and preferably at a lower elevation. A contaminated water supply

may take a long time, maybe years, to clear up, even if the source of contamination is removed. Generally it is desirable to locate the tank as near the house as practical unless conditions prohibit it. Where a ledge may prevent digging to the required depth, dirt may be hauled over the tank and the tile leading to the house. It is also possible to build a shallower tank by using a special form. A shallower tank may be used where high water tables or ledges are encountered. Such a tank should be longer, but not wider, and should have the same capacity as recommended for the regular tanks described in this bulletin. This plan should not be used, however, unless absolutely necessary. In the colder areas where deep freezing occurs, the house sewer or the disposal drain should not run under a driveway. The tank site should be selected to insure the necessary slope for the house sewer where a minimum grade of $\frac{1}{4}$ inch per foot is recommended. Figure 7 illustrates the method of establishing the house sewer grade. On level ground it may not be possible to have fixtures in the basement. Where the ground slopes so that the surface of the ground a short distance from the house is on a level with the basement floor, it is possible to have fixtures in the basement.

Selecting the size

The size of the tank is determined by the number of people it serves. In general, this is based on the average number of persons in the household regularly using the tank. The danger lies in selecting too small a tank. The advantages in selecting a large size are that the tank will go longer without cleaning and more time is given for complete bacterial action when on occasion the tank is put to greater use. The additional cost of a large tank over a small one is relatively negligible. In deciding which size tank to build, it is always wise to choose the larger one. The dimensions recommended in Table 1 are based on an average production of 50 gallons of sewage per day per person.

Table 1. CAPACITIES, DIMENSIONS, AND CONCRETE MATERIALS FOR SEPTIC TANKS FOR DIFFERENT SIZE FAMILIES

Maximum number of persons served	Liquid Capacity of tank in gallons	Recommended inside dimensions				Materials for concrete 1:2½:4 mix		
		Width	Length	Liquid depth	Total depth	Cement	Sand	Gravel
						Sacks	*Cubic yards*	*Cubic yards*
4 or less ..	500	3′-0″	6′-0″	4′-0″	5′-0″	16	1¼	2¼
6	600	3′-0″	7′-0″	4′-0″	5′-0″	17	1⅜	2¾
8	750	3′-6″	7′-6″	4′-0″	5′-0″	19	2	3
10	900	3′-6″	8′-6″	4′-0″	5′-0″	21	2¼	3¼
12	1,100	4′-0″	8′-6″	4′-6″	5′-6″	24	2½	3½
14	1,200	4′-0″	9′-0″	4′-6″	5′-6″	25	2½	3¾
16	1,500	4′-6″	10′-0″	4′-6″	5′-6″	28	2¾	4¼

Where more than 16 persons are served, a double-chamber tank is recommended. Information on constructng these tanks may be obtained by writing to the Oregon State College Extension Service at Corvallis.

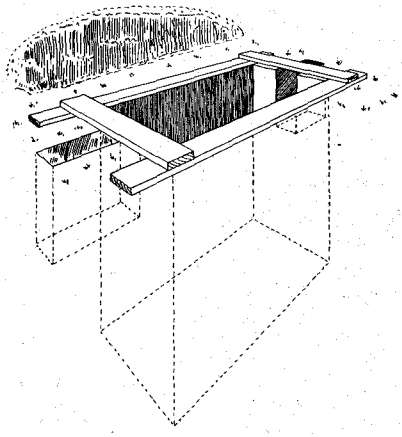


Figure 2. A good method of outlining a septic tank excavation on the ground surface.

The end of the tank should be at right angles to the sewer line and enter in the top middle as shown on the plan. A good method is to use a 2-inch plank support around the edges of the pit the exact size of the outside dimensions of the tank. (Figure 2.) The planks serve as a guide in digging and also help to keep the edges of the soil from crumbling. The sides and ends of the hole must be dug true to dimensions all the way down and the corners must be plumb and square. The earth is used for the outside form. This should be cut smooth and to size so that a full 6-inch concrete wall will be on all four sides. A concrete floor of 4 to 6 inches is of sufficient thickness. The size of excavation for tanks is given in Table 2.

Table 2. EXCAVATION DIMENSIONS FOR SEPTIC TANKS

Tank size, inside dimensions	Length	Width	Approximate depth
Feet	*Feet*	*Feet*	*Feet*
3 x 6	7	4	7
3 x 7	8	4	7
3½ x 7½	8½	4½	7
3½ x 8½	9½	4½	7
4 x 8½	9½	5	7
4 x 9	10	5	7
4½ x 10	11	5½	7

Building and installing the form

The plan for the form is called a collapsible or reusable form plan. The cost of building this form is about the same as the cost for building a form that can be used only once. The collapsible form may be reused by neighbors, sold, or rented.

The form is built in 4 sections consisting of 2 sides and 2 ends with "loose boards" at the top of the end pieces. Matched lumber is

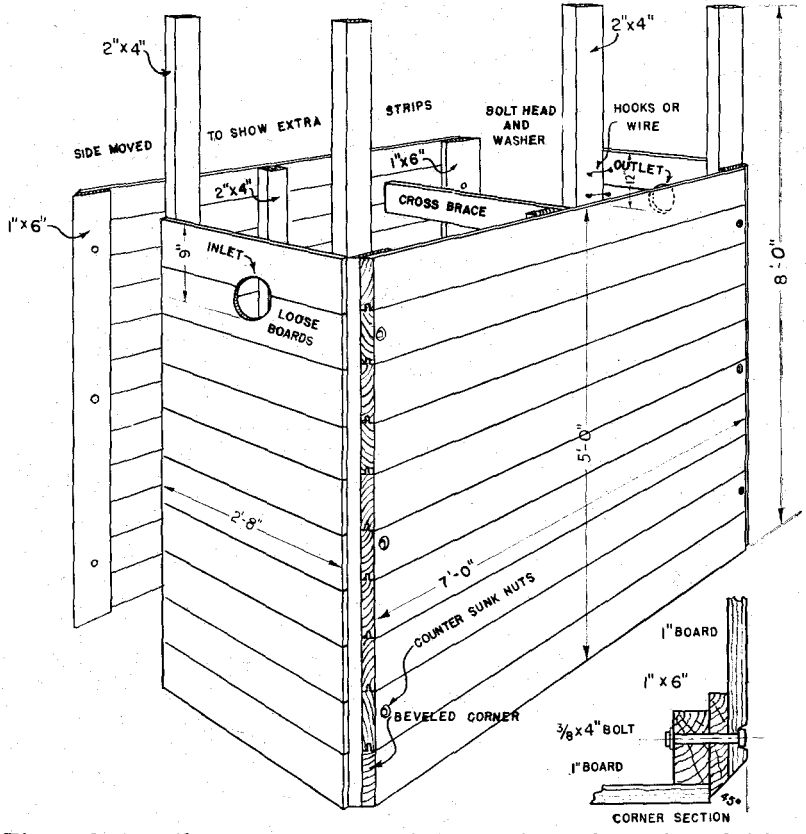


Figure 3. Details of community tank form. Plywood, rough or finished lumber may be used.

shown in the plan, but unmatched finished lumber or ½-inch waterproof plywood is satisfactory.

For the end sections, lay 2 pieces, 8′ x 2″ x 4″ on edge, 2 feet 4¾ inches apart. (Width is determined by the size of septic tank being built, and in this instance a 6-person size tank is visualized for illustration.) The end boards are cut 2′ x 8″ long for a tank having an inside width of 3 feet. The 4 inches of additional width needed are provided by the sides of the form.

Miscellaneous widths of lumber may be used, however. At the inlet and outlet ends, board widths should be used so that the loose boards that are cut to fit around the tile or pipe will have sufficient width and strength to hold the concrete. The holes for the inlet and outlet should be about 5½ inches in diameter. The bottom of the holes

are 9 and 12 inches down from the top of the form for the inlet and outlet. The loose end boards are held in place by either lightly nailing or by hooks or wire. The sides are made by nailing the long boards (7-feet long for a 6-person size tank) on two 1" x 6" boards at both ends and on one 2" x 4" at the center. The nails should be driven about 2½ inches from the ends so that when sawing the bevel they will not interfere.

After the ends of the side sections are beveled, temporarily nail the corners of all 4 sections together with the end sections projecting about ¼ inch beyond the beveled corners of the side sections. This will facilitate the removal of the side sections from the finished tank. Square and plumb the form and bore three ⅜-inch holes in each corner, spaced as shown in the illustration. (Figure 3.) Place the bolts, ⅜" x 4" square head, in the holes with the heads inside the form and the nuts projecting on the concrete side. Use washers on each end of the bolt.

A good painting of old crankcase oil or linseed oil and kerosene will prevent the form from sticking to the concrete when it is being removed.

The forms are suspended from stringers placed across the pit. The form is leveled both crosswise and lengthwise, leaving a clearance in the bottom from 4 to 6 inches for the floor as illustrated. (Figure 4.) Two cross braces are used in the center of the form, one at the bottom and the other near the top. They should be nailed so as to hold a person because the floor is finished while kneeling on the lower cross brace.

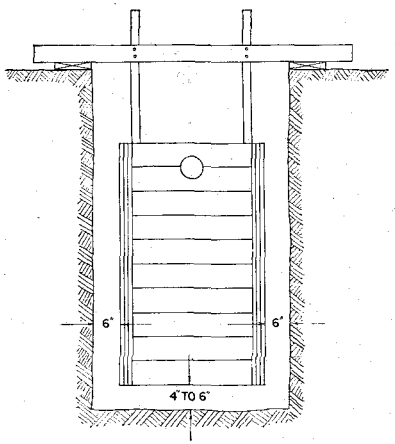


Figure 4. End view of form supported in excavation

Concrete mixing and placing

One of the essential features of a septic tank is that it should be watertight. In order to be reasonably sure of this, one should take care in choosing good materials and mixing and placing concrete. It never pays to guess at quantities of materials for use in making concrete. Good concrete is made by carefully measuring all materials—water, cement, sand, and gravel. If too much water, or too little cement is used, the cement paste will be diluted and a weak porous con-

crete will result. A mixture of 1-part cement, 2½-parts sand, and 4-parts gravel mixed to a good plastic mix is desired. The sand and gravel should be free from organic matter and silt. If bank run gravel is used, the proportions of sand and gravel should be determined by screening through a ¼-inch screen. All material passing through the ¼-inch screen is sand, and larger material not passing is gravel. Gravel larger than 1½ to 2 inches should not be used. If the proportion of gravel to sand is low or vice versa, additional screened material should be added to produce the desired proportion. The amount of water must be as carefully proportioned as the other ingredients. If the sand and gravel is dust dry, use 5½ gallons of water to each sack of cement. If the sand and gravel is moist or wet, the amount of water should be reduced to 4½ gallons per sack of cement. Under no conditions should a mix be soupy. A trial mix should be made to determine if a workable mix is possible under the conditions and with materials on hand. The amount of water should not be increased. If the aggregate is moist or wet, decrease the amount of water. If very dry, decrease the aggregate in proportion.

Bank run gravel or sand may be used without screening, but more cement is required to produce a good strong concrete. The use of additional cement may be cheaper than obtaining the desirable proportion of sand and gravel. The following procedure should be followed when using bank run gravel or sand. The same conditions apply regarding the water-cement ratios as above. Make a trial mix, keeping an accurate record of the aggregate to be added for the following mixes.

The concrete should be placed in uniform layers around the form so that the form will not be shifted. Each layer of freshly placed concrete should be lightly tamped to insure smooth, dense

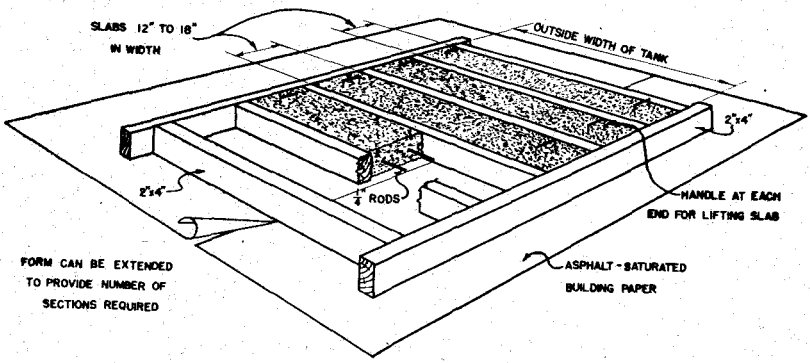


Figure 5. Form for casting concrete slabs for the cover.

walls. As soon as the concrete reaches the level of the holes in the form, place the sanitary tees. Place concrete around them to hold in place. When the sides have been filled, float off the top of the concrete level with the top edge of the inside form.

Finish the floor of the tank, being careful not to place the concrete higher than the bottom edge of the form, otherwise, the forms may be hard to remove without breakage of the bottom edges. A wood float is preferred for leveling all surfaces. The floor is finished by working from both ends to the bottom center brace which may be used for support.

The cover slats should be poured at the same time. The form is illustrated in Figure 5. They may be made about $3\frac{1}{2}$ to 4 inches thick, equal in length to the outside width of the septic tank and 12 to 18 inches wide. When too wide, they are heavy and difficult to handle. The covers need to be reinforced. Two $\frac{1}{4}$-inch or $\frac{3}{8}$-inch iron rods per slab laid 1 inch from the bottom are adequate. Old iron bands, wagon tires, heavy fencing or small piping may also be used. Hand holds should be placed in each end to facilitate handling. Horseshoes or any iron bent to shape will serve this purpose. Cover the freshly poured concrete with damp bags and keep damp for at least one day. An inspection hole placed in the cover slab located near the inlet end is desirable. This may be used for pumping out

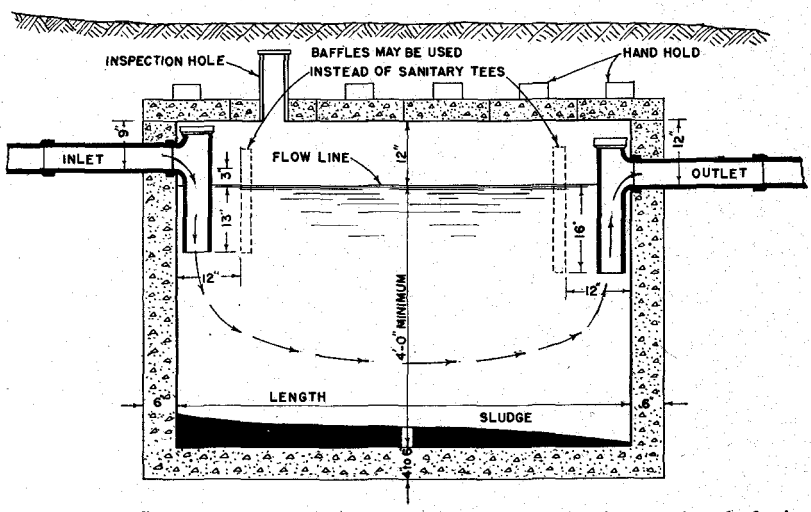


Figure 6. Cross section of a septic tank. Note the inspection hole in the cover slab that is used to pump out the sludge without removing the cover slab. Submerged inlets and outlets are necessary to reduce disturbance and prevent scum from passing out with the effluents. Straight inlets are subject to clogging and are not recommended.

the sludge and will eliminate the removal of the cover quite so often. The cover section should be placed on the tank in the same order as cast to insure a close fit.

Removing the form

During warm weather, allow two or three days for the concrete to set. In cool weather, more time is required, usually up to a week. Remove the center braces, the bolts, and loosen or unfasten the loose end boards around the inlet and outlet pipes. Pull the end sections toward each other at the top. Place a block toward the bottom of the end section between the concrete and form to pry against and push the bottom out beyond the 1" x 6" pieces on the sides. This will bring the ends in the clear so the can be lifted out. The side sections can now be removed and pulled straight upward. Remove the

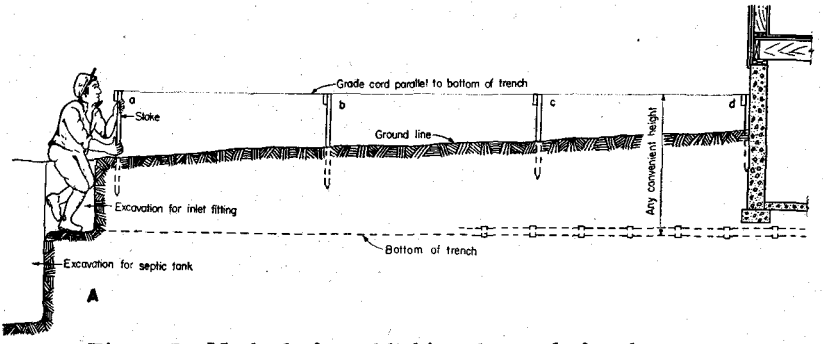
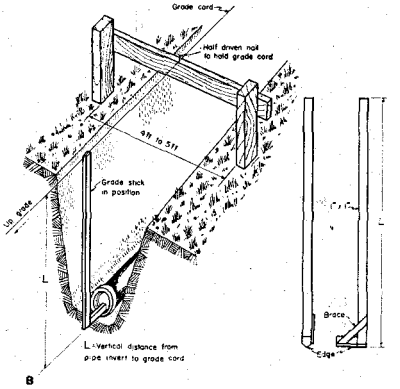


Figure 7. Method of establishing the grade for the sewer.

A. Stakes are set at not over 50-foot intervals between a, the septic tank and d, the house wall. See diagram A above. Stakes, preferably 2" x 4", are set at each side of the trench at locations a, b, c, and d. A board is nailed horizontally at d at a convenient height above the bottom of the trench where the sewer line leaves the house. A board is nailed at a the same height above the inlet to the tank as d is above the bottom of the trench at the house. Boards are then nailed on the remaining stakes in line with the tops of the boards at a and d.



B. This illustration shows how the grade is obtained by measuring from the grade cord, using a grade stick which is the length point d (in Figure A) is above the bottom of the trench.

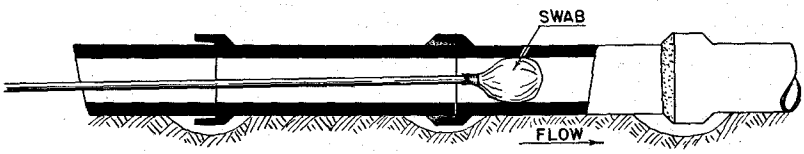


Figure 8. A homemade swab used to remove any joint material forced through the inside of the pipe. When laying terra cotta sewer pipe oakum is used to center the pipe and to hold the cement. Note dug-out space under bells for workman's hands.

loose end boards and place them back on the end sections, oil the surfaces and store ready for another use.

Connecting to house sewer

The digging of the trench leading to the house sewer should be the next step. The Oregon State plumbing regulations require that all soil or waste pipes, underground to a point 5 feet beyond the building line, must be cast iron sewer pipe.

Beyond 5 feet from the house wall, except when the septic tank is located close to the source of water supply, concrete or tile sewer pipe may be used. The hubs or bells should point toward the house. In connecting the tank inlet pipe to the next length of clay tile, a double end hub or a cast of a cement ring around the ends of the 2 pipes may be used. The joints should be lead-caulked in case of cast iron pipes and cemented when using clay or concrete tile.

A minimum grade or slope of $\frac{1}{4}$ inch per foot should be provided whenever possible.

The grade of the building sewer for 10 feet immediately preceding the tank should not exceed $\frac{1}{4}$ inch per foot. Location on a terrace of steep slopes can be solved by putting a drop straight down from the outlet or in between the tank and building but making this drop 10 feet or more from the tank.

DISPOSAL SYSTEM

The beginning of the disposal field should be a safe distance from the well; usually 100 feet is considered a minimum distance, although this is no assurance that contamination will not occur.

The width and depth of trench and spacing of tile lines must be carefully selected. (Figure 11.) Four-inch, open-jointed agricultural drain tile is ordinarily used. Perforated fiber drain pipes, recently introduced, show a promise of satisfactory service and are available in 4-foot lengths. Bell and spigot pipes either concrete or tile may be used also.

The disposal tile should not be more than 20 to 24 inches below the surface. Table 3 may be used for estimating the feet of tile needed in any particular soil type. A percolation test is the most satisfactory method for determining the amount of tile required. Making at least two representative percolation tests at different locations on the disposal field, the test is made as follows:

1. Excavate a hole 1 foot square to the depth of the proposed disposal trench.
2. Thoroughly wet sides and bottom of hole, and while the bottom is still moist, fill the hole with 6 inches of water.
3. Record the time, in minutes, required for the water to seep completely away. Divide the time by 6 to obtain the average seepage time for 1 inch of water.
4. Determine from table the seepage area (in square feet) required per person.

Judgment is required in determining how soil conditions at the time of test vary from the year-around average. When soil is exceptionally dry, the test should be repeated. Tests should not be made in water-filled or frozen ground.

Table 3. DETERMINING TILE-DISPOSAL FIELD REQUIREMENTS FROM PERCOLATION TESTS*

Minutes required for water to fall 1 inch	Effective absorption area required, per person, in bottom of disposal trenches	Minutes required for water to fall 1 inch	Effective absorption area required, per person in bottom of disposal trenches
	Square feet		*Square feet*
2 or less	26	10	52
3	30	15	63
4	36	30	90
5	40	60†	120

* A minimum of 150 square feet should be provided, equal to 100 feet of 18-inch trench.
† If more than 60 minutes, use special design with seepage pits or sand filter trenches.

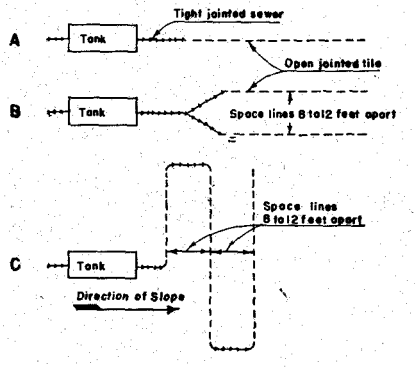


Figure 9. Arrangement for tile disposal field using one or two tile lines.
A. Plan for single line.
B. Plan for two lines using a Y to divide the effluent into the two branches. The Y must be laid level for equal division of the effluent.
C. Method for laying a single disposal field line on a slope. The open-jointed tile are laid on the contour. The drop between the disposal lines should have tight-jointed sewer pipe.

In light soil where 1 or 2 tile lines will give adequate absorption, the plans in Figure 9 may be used. A Y-tile is used (see plan B, Figure 9) to divide the effluent into the two lines. In no case should absorption lines be over 100 feet in length. Plan C, Figure 9, shows the method for laying a single absorption line on a slope.

When more than 2 absorption lines are required, the plans in Figure 11, using a distribution box, are used. Each field lateral line should be connected separately to the distribution box and shall not be subdivided. The outlets from the distribution box shall be level and the inlet should be 1 inch above the outlets.

The pipe used for the line between the septic tank and the distribution box, on all lines within 10 feet of dwellings, under paved areas, or driveways, and on all main laterals from distribution box in fields constructed on sloping ground, should be bell and spigot vitrified clay or concrete with watertight joints.

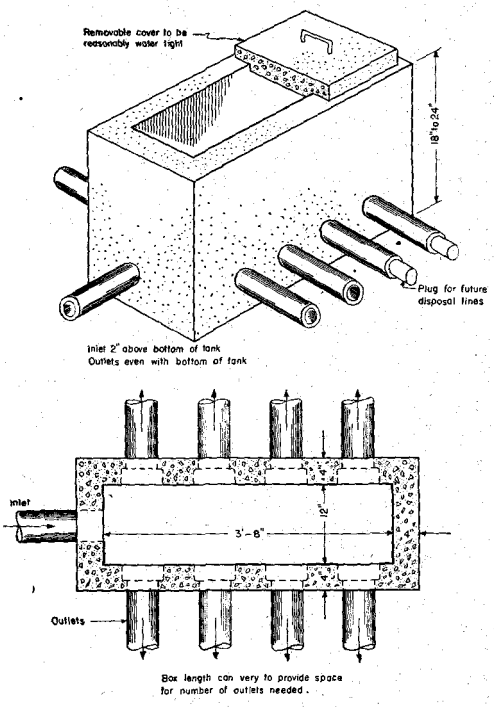
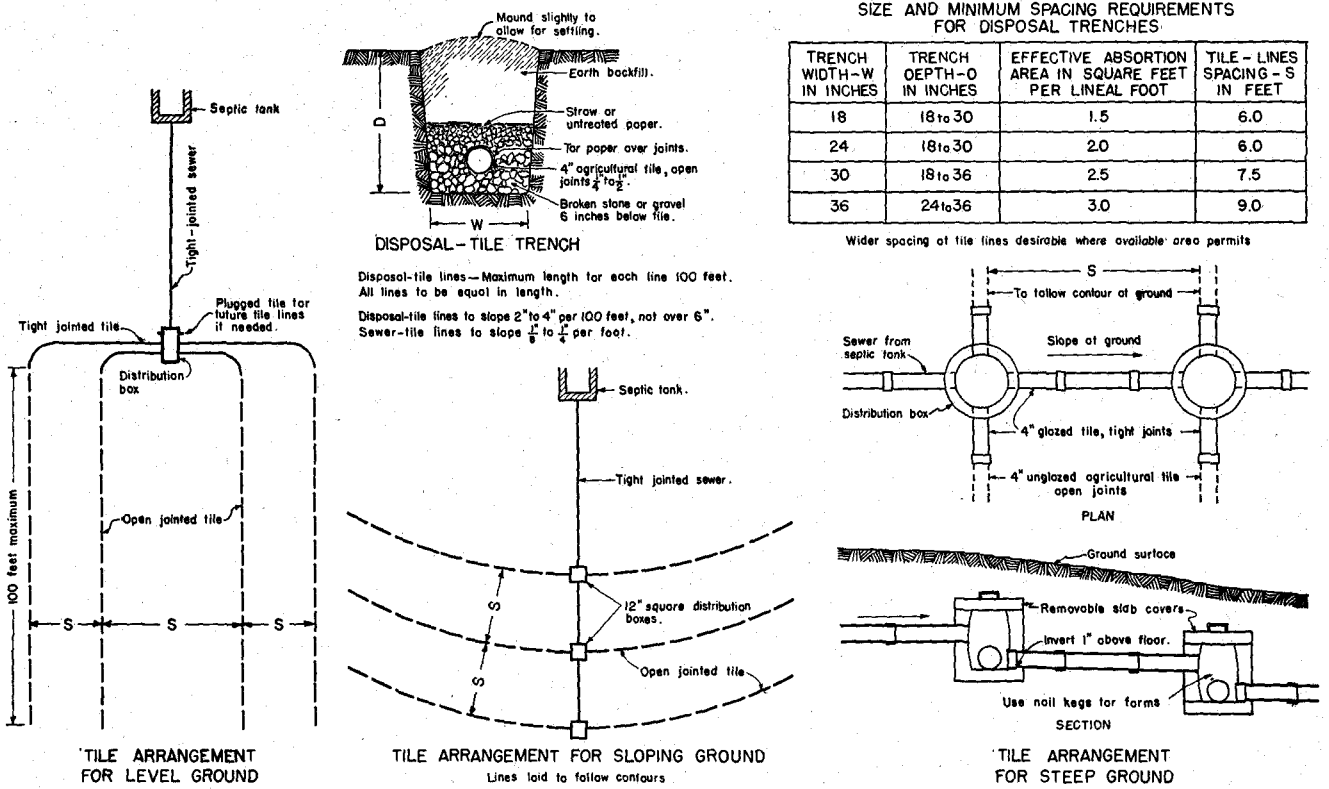


Figure 10. A distribution box.

In areas where ground freezing occurs, no tile line of the system should be laid under a driveway, path or road unless laid below the frost line.

Field tile used in the disposal field should not be less than 4 inches and laid $\frac{1}{4}$-inch, open joints. The open joints should be protected on top by strips of asphalt treated building paper 10 inches long and about 4 inches wide. Bends in the disposal field should have one tight joint at each end of the bend. Bell and spigot vitrified or concrete tile in 2-foot lengths do not require protection with paper over the joints, since the bell affords sufficient protection.

The filter material in the bottom of the trench may be crushed rock, gravel, clean cinders or slag, varying in sizes from $\frac{1}{2}$ to $2\frac{1}{2}$



SIZE AND MINIMUM SPACING REQUIREMENTS FOR DISPOSAL TRENCHES

TRENCH WIDTH-W IN INCHES	TRENCH DEPTH-D IN INCHES	EFFECTIVE ABSORTION AREA IN SQUARE FEET PER LINEAL FOOT	TILE-LINES SPACING-S IN FEET
18	18 to 30	1.5	6.0
24	18 to 30	2.0	6.0
30	18 to 36	2.5	7.5
36	24 to 36	3.0	9.0

Wider spacing of tile lines desirable where available area permits

Figure 11. Disposal field arrangements requiring more than 2 disposal lines where distribution boxes are required.

inches. The filter material should cover the tile. A board staked on edge in the bottom center of the trench at the desired slope will make it possible to do a neat job of laying the tile. The board is not removed. It should permit the adding of the desirable depth of filter material in the trench. It is a good plan to place a layer of common building paper over the filter material before refilling the trench with dirt because this will prevent the fine soil sifting into the tile until it is packed by settling.

If the disposal field is laid in an area that may be wet part of the year, the ground will not absorb the effluent. In some cases this may be overcome by laying drain tile parallel to the disposal tile at least eight feet from the tile and a foot or two deeper. The drain tile may empty into any convenient open outlet. The drain tile will lower the water table, making possible the effluent absorption in the soil.

The following points are summarized below because of their importance in obtaining a satisfactory disposal system:

1. Maximum length of individual lines.....100 feet
2. Minimum width at bottom of trench.....18 inches
3. Maximum depth of cover of tile lines.....36 inches
4. Preferred depth of cover of tile lines.....18 inches
5. Maximum grade of tile lines.....6 inches per 100 feet
6. Preferred grade of tile lines.....2 to 4 inches per 100 feet
7. Size and spacing of trenches.....See Table, Figure11
8. Minimum filter material under tile.....6 inches
9. Minimum filter material over tile.....2 inches
10. Use at least 12 inches or more filter material when within 10 feet of large trees or dense shrubbery. If possible, avoid going near trees or shrubbery.

Care of septic tank

The septic tank shown in this bulletin has had over twenty-five years service and has proved very satisfactory, requiring very little attention when properly installed. The amount of trouble that will be experienced is largely dependent upon the practices within the home. Excessive grease should be deposited with the garbage. A tank of proper size will handle soapy solutions from the average home.

To keep the system working properly, the tank should be inspected and cleaned at regular intervals, usually five years for a tank of proper size. A tank too small will require cleaning as much as once a year or more. The 4-inch inspection hole in the cover slab will permit inspections and pumping out the sludge without removing the cover slabs. Occasionally, it will harden to the extent that it cannot be removed by pumping. When this occurs it is necessary to

remove the cover, loosen and agitate the sludge with a pole, hoe or rake, and bail it out.

Do not use matches or an open flame to inspect the septic tank, because the gases produced may explode.

SEPTIC TANK TROUBLES

One of the most common troubles in sewage disposal is the clogging of the disposal tiles. This may be caused by: (1) failure to clean the tank regularly; (2) a tank too small for the volume of sewage; (3) an improperly designed tank that does not provide slow flow or permits sludge and scum to pass out the disposal lines; or (4) an incorrectly built or inadequate disposal field.

A clogged disposal field must be dug up and the tile cleaned and relaid in a new trench at least four feet to either side of the old trench. Sometimes it may be possible to flush the tile if not too badly clogged.

Roots may also clog the pipes. The tile lines must be relaid from the roots, the trees or shrubs removed or use root tight joints past the source of trouble, or a deep filter bed.

GREASE TRAPS

Grease traps are not recommended for the average rural septic tank used on the farm. They are, however, recommended for boarding houses and camps where large quantities of grease are produced. Plans for grease traps are available from the Oregon State College Extension Service at Corvallis.

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