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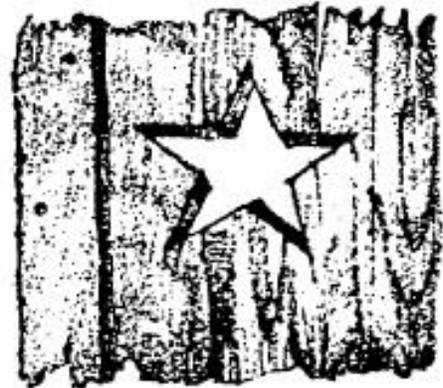
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# GUIDELINES FOR SELECTING AN ODOR-FREE TOILET



# GUIDELINES FOR SELECTING AN ODOR-FREE TOILET



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## INTRODUCTION

San Dimas Technology and Development Center published a 59-page manual in 1991 titled 'In-Depth Design and Maintenance Manual for . . . Vault Toilets'. For an in-depth explanation of the design principles necessary to have an odor free toilet, please refer to the above manual. This manual is currently available from:

USDA Forest Service  
444 East Bonita Ave.  
San Dimas, CA 91773  
Phone (909) 599-1267  
FAX (909) 592-2309  
DG Pubs:W07A

This publication addresses (in abbreviated form) the same principles necessary to determine if a building meets all of the requirements to be odor free. The theory behind an odor free toilet is simple. Get the air to flow into the building's user compartment, down the toilet riser, through the vault, and up out of the vent stack. Prevent the adsorption of odors by using non-porous construction materials. The building should also be easy to clean and maintain, vandal resistant, and fully accessible.



Figure 1—Smoke bomb demonstration of correct air flow.

Many manufacturers of prefabricated vault toilet buildings are following most of the correct principles, but may be omitting some too. Some prefabricated buildings that are correctly designed

are being installed in locations where they will not work as intended. This publication reviews all the correct principles and, if followed, will result in an odor free toilet.

## DEFINITIONS

**Chimney effect:** The tendency of air in a vertical passage to rise when it is heated because its density is lower than that of the surrounding air.

**User's Compartment:** The inside of a toilet building.

**Vault Vent Stack:** A vertical pipe, 12 to 14 inches (0.3 to 0.36 m) in diameter, that extends from the toilet vault to three or more feet (1 m+) above the highest point of the building roof.

**Wall Vent:** An opening in the wall that allows outside air to enter the building's user compartment.

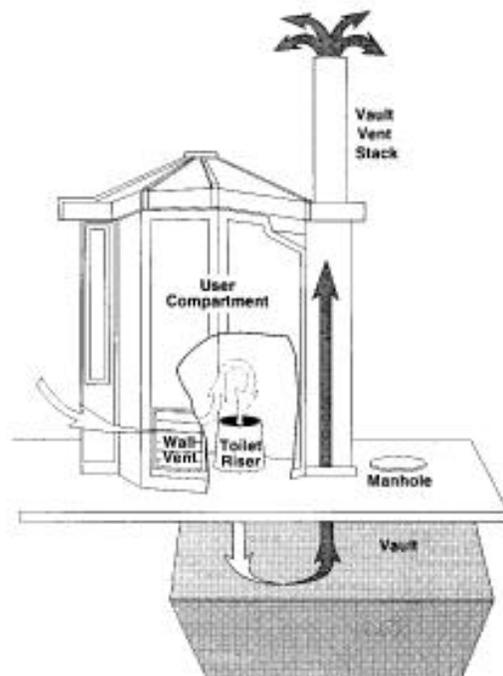


Figure 2—Vault toilet diagram.

## AIR FLOW

The primary concern for passive building ventilation is air flow. Wind currents and solar radiant energy are the natural forces that cause air to move. A 2-mph (3.2 km/h) wind will ventilate a

toilet building that is designed to fully use the wind currents for odor control. Solar radiant energy can cause a chimney effect in dark vent stacks oriented to receive the maximum sun light. The chimney effect can be increased by building a dark-colored metal shroud around the vent stack. Every effort should be made to take full advantage of the energy from both the wind and the sun.

Solar radiant energy is only effective for that part of the day that the vent stack is in sunlight. Wind currents are effective anytime. In those situations when a building cannot be oriented to take maximum advantage of both sources of energy, the wind's energy contribution usually should be maximized.

Avoid installing passively ventilated vault toilets in locations that do not receive either sunlight or wind, such as in dense brush and heavy tree canopy. The vault toilet will need another form of energy to keep it odor free when sunlight and wind are not available. A solar electric panel and fan mounted above the tree canopy is one alternative.

**AIR VENT FOR THE BUILDING'S USER COMPARTMENT**

A wall vent is necessary to let air into the building's user compartment. The objective is to cause an increased pressure in the user compartment, forcing air down the toilet riser. When placing the vent in the building wall, always consider where to put the vent to let the most air into the building.

1. There shall be only one vent opening into a building's user compartment.

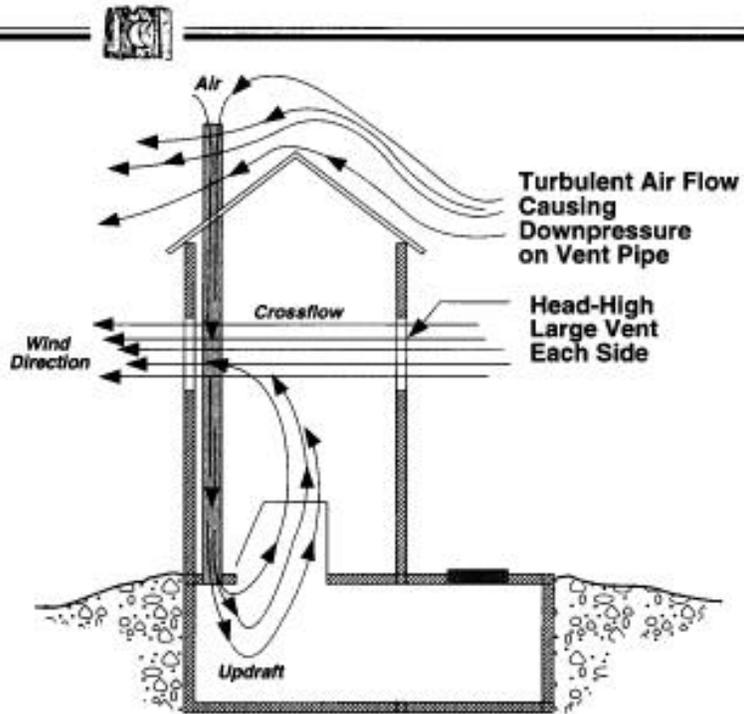


Figure 3—NEVER PUT TWO WALL VENTS IN A BUILDING'S USER COMPARTMENT. Cross-flow through the user compartment can cause an updraft on the toilet riser, resulting in odor in the user compartment.

2. The vent shall be placed on the side of the building that faces the prevailing wind. The required vent location shall be specified after building orientation and prevailing wind patterns are known.

3. If there is a predominant prevailing wind, the vent can be installed at the top of the building wall facing the prevailing wind. This will help prevent heat buildup inside the compartment. If there are fluctuating winds, the vent should be placed low on the building wall facing the side that still gets the prevailing wind. Do not put the air vent in the door and then build a privacy screen around the door. ALWAYS CONSIDER HOW TO GET THE MOST WIND INTO THE BUILDING'S USER COMPARTMENT.

4. The size of the vent shall be approximately 120 sq. in. (77470 sq. mm) of free area. Screened vents should be 12" X 12" (0.3 m X 0.3 m) to account for the space the screen takes up. The vent shall be of a heavy duty material, such as expanded metal, to prevent vandalism.

5. Every user compartment shall have a separate wall vent exposed to the prevailing wind.

6. Trim brush away from the vent to allow unrestricted air movement.



### VENT TO ASPIRATE ODORS OUT OF THE VAULT

A vent stack is necessary to remove air from the toilet vault and exhaust it to the atmosphere. The vent stack must extend high enough above the building roof to avoid the turbulent air caused by the roof. A smooth air flow across an open vent stack will create a negative pressure in the stack, drawing air out.

1. The vault vent stack shall be a MINIMUM of 12 inches (0.3 m) in diameter. Each vault shall have a separate vent stack.
2. The vent stack shall extend a MINIMUM height of 3 feet (1 m) above the highest point of the roof, to avoid turbulent air flow.

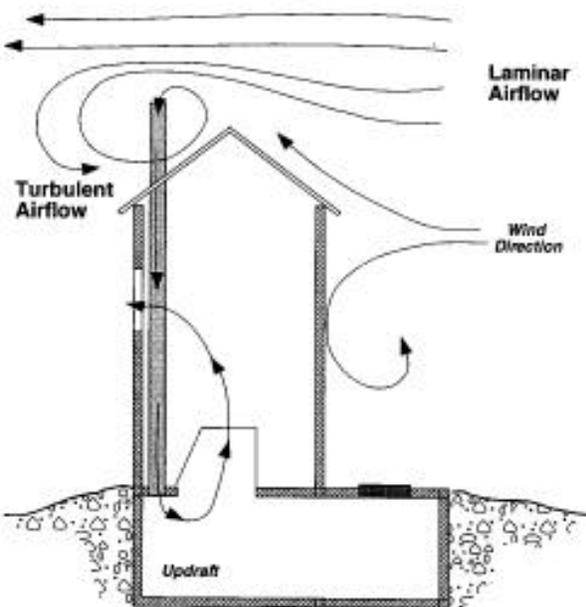


Figure 4—Turbulent air movement caused by building can cause air to flow down vent stacks that do not extend high enough above the roof.

3. The vent stack shall be a dark color to take advantage of the chimney effect created as the sun heats the pipe.
4. The top of the vent stack shall remain uncovered and unscreened. If a cover is absolutely necessary, use a flat plate placed a pipe diameter (12 in (0.3 m)) above the pipe and connected with thin metal rods so as not to interfere with the aspiration effects of the wind blowing over the open top pipe.

At locations where there is little wind, increasing the size of the vent stack to 14 inches (0.36 m) will help increase draft. At locations with much underbrush, or where the downwind flow from the vent stack will drift over use areas, raise the pipe five to ten feet (1.5 m to 3 m) above the highest point of the roof to better disperse the odor.

### THE VAULT

The vault must be leak-proof, easy to pump, durable, and impervious to harsh chemicals.

1. There shall be one vault for each toilet riser.

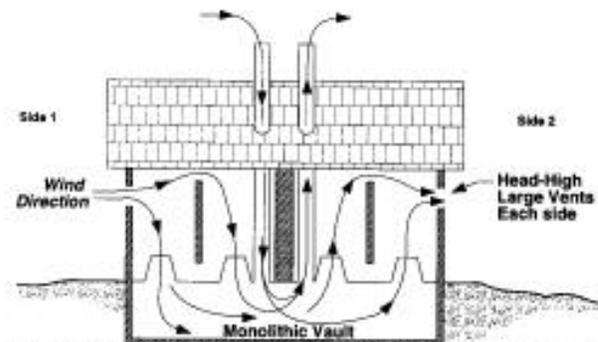


Figure 5—Cross-connection can cause a user compartment on the lee side of the building to be filled with odor.

2. The vault shall have a bottom slope of 8% from under the toilet riser to the outside manhole so that the waste can be more easily removed and very little waste remains after pumping.
3. The vault shall have a 24-inch (0.6 m) diameter (minimum) lightweight manhole cover installed to the rear of the building. Raise the cover so the surrounding concrete can slope away from the cover with a minimum slope of 4%. The cover must form a tight seal so that no air or water can enter.
4. The depth of the vault shall be no deeper than 4-1/2 to 5 feet (1.4 to 1.5 m), to allow for removal of large debris.
5. The vault or vault liner shall be impervious and corrosion proof.
6. The vault should have a black or dark interior to help conceal the waste.



7. If a concrete vault is used, the following conditions shall be adhered to:

- a. All interior surfaces of the concrete vault-bottom, sides, and top-shall be completely sealed with a black or dark coating material that will withstand the corrosive elements of the waste and remain sealed. Remember, the contractor who pumps the vaults will allow the 4 to 6 inch (101.6 to 152.4 mm) hose end to drop into the vault. The hose end is usually steel and can damage the interior coating.
- b. The upper walls of the vault shall be completely sealed to the bottom of the floor slab so no air or water can seep in between.
- c. All holes cut or formed in the floor slab shall be sealed so no odor is absorbed by the concrete.
- d. The area where the vent stack goes through the floor shall be sealed so no air can enter the vault except down through the toilet riser.
- e. The concrete shall be alkaline resistant in case a leak does occur in the coating material.

Following these principles will prevent vault odor from entering the building's user compartment. The building's interior must be constructed to prevent odor adsorption and allow easy, thorough cleaning. Unsealed surfaces will adsorb odor from spills.

#### **BUILDING INTERIOR**

Finish the building interior to prevent odor adsorption. Make the building interior as easy to clean and maintain as possible. Design the interior of the building to conform to the Uniform Accessibility Standard (UFAS). Clean, well-maintained buildings are also subjected to less vandalism.

#### **FLOOR SURFACE**

1. The floor shall be completely sealed to prevent any staining or odor absorption.

2. The building floor shall slope from the rear of the toilet to the front door and shall follow all UFAS requirements for floor slopes.

3. The floor shall have a non-slip surface only in the walkway area. Keep the area next to the walls smooth. This makes cleaning easier.

4. Bevel and seal the floor-to-wall joint. This prevents waste material or cleaning material from accumulating in the joint.

5. The interior floor shall join the outside concrete so there is no lip or sill at the door to hinder the people with disabilities from entering.

#### **WALLS AND CEILING**

1. All interior surfaces shall be non-porous to facilitate cleaning and prevent odor adsorption.

2. Wall finishes shall be designed for easy and frequent cleaning.

3. Walls shall be free of unnecessary ledges, angles, and shelves so less dirt accumulates and cleaning is easier.

4. Do not use ceiling materials that allow condensation.

5. Each building shall have an insulated ceiling to help prevent heat buildup in the building interior. Buildings with concrete roofs do not require insulation.

6. Reinforce walls for the installation of grab bars, urinals, and toilet paper holders.

#### **LIGHTING**

1. Do not install skylights where they can direct light down the toilet riser and illuminate the waste. Skylights are difficult to keep clean and frequently leak.

2. Use polycarbonate (Lexan) glazing in place of glass for all windows. Use frosted or translucent glazing to maintain privacy.



## MISCELLANEOUS TOILET BUILDING MATERIALS

### TOILET RISER

1. The toilet riser shall have no cracks or crevices on the inside or outside for odorous material to collect in.
2. The riser shall have a heavy duty, open-front seat and cover assembly that does not seal the air out when closed.
3. The riser shall be easy to clean and impervious to oxidizing cleaning agents.
4. The riser shall be vandal resistant.
5. The riser shall be white in color, or stainless steel.

### TOILET PAPER DISPENSER

Toilet paper dispensers shall restrict (not prevent) the free flow of the paper but shall meet all requirements of ADA.

Following these principles to keep vault odor out of the user compartment, and preventing odors from permeating the building's interior surfaces, will allow the interior of the building to be odor free. Proper placement of the building on the site is critical to make these principles function properly. The air leaving the vent stack still has the same odor associated with outdoor vault and pit toilets. Placement of the building on the site is critical to prevent the odor that leaves the building from adversely effecting surrounding use areas.

### PLACEMENT OF THE BUILDING

A site evaluation must be completed before selecting a toilet type. The site evaluation should identify critical items like prevailing wind direction, toilet access from use areas, available building locations, amount of brush and tree canopy, etc. Passive ventilation principles will not work in all areas.

After choosing a passive ventilation vault toilet, and insuring that all the principles are correct pertaining to the building design, make sure the building is placed correctly on the ground.

1. Place the building to take advantage of the energy from the wind or sun or, preferably both. When selecting a site and an orientation for the building, think about how to have the prevailing wind blow against the building vent or how to have the wind blow across the top of the vent stack. If there is very little wind at a particular site, consider how to have the sun shine on the back of the toilet building to heat the black pipe and/or the metal shroud (surrounding the pipe).

2. Install the building's wall vent on the correct side of the building.

3. Never place two buildings in line with each other if one building will block the prevailing wind from hitting the other building. Offset the buildings so the wind will hit both buildings equally.

4. Place the building so the odors emitted from the vent stack will not effect campgrounds, picnic areas, boat launch areas, or visitor information areas.

5. **DO NOT** place passively ventilated vault toilet buildings:
  - a. In a hollow
  - b. Beneath an overhang
  - c. On the lee side of a ridge
  - d. Immediately next to a dense tree line
  - e. In dense brush or trees
  - f. In a depression where surface water will accumulate

6. In dense brush or tree cover, trim limbs and/or foliage to the same height as the top of the vent stack. Remove foliage that blocks the prevailing wind path to the vent stack.

Passive ventilation toilet buildings will not work in some locations. If the building must be placed in an area that receives neither wind nor sun, consider using a fan in the vent stack and offset the solar panel so that the sun will strike the panel. A gas flame in the vent stack, a filter and fan in the vent stack, or venting off-site (piping the vault odors away from the use area) are additional alternatives



to minimize the odor impact from a vault toilet. Venting off-site requires a fan to be placed in the pipe. If electricity is not available, consider installing solar power.

If a toilet building must be located at a particular spot but the odor from the vent stack is going to cause a problem with a surrounding use area, consider a composting or biological conversion toilet instead. The odor from this type of toilet is negligible.



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## MANUFACTURERS

### NAMES AND ADDRESSES FOR THE MOST COMMON ITEMS

The following list of suppliers is a guide for items normally associated with vault and pit type toilets. This is not a complete list of suppliers.

No prices are given because of frequent price fluctuation. Contact the manufacturers and tell them what you need and let them recommend their best product for your purpose.

### Complete Vault Toilet Systems (Building included)

CXT ENVIRONMENTAL P. O. Box 14918 Spokane, WA 99214 Phone 509-924-6699	Concrete Toilets
J&R PRECAST P.O. Box 178 Three Forks, MT 59752 Phone 406-285-3372	Concrete Toilets
MISSOULA CONCRETE CONSTRUCTION P.O. Box 3362 Missoula, MT 59806 Phone 406-549-9682	Concrete Toilets
ROMTEC, INC 18240 North Bank Road Roseburg, OR 97470 Phone 503-496-3541	Mortarless Concrete Block Toilets, Cross-Linked Polyethylene Toilets, Wooden Toilets
UNIVERSAL BUILDING CONTRACTORS P. O. Box 1027 Blackfoot, ID 83221-1027 Phone 208-785-6126	Concrete Toilets

### Prefabricated Vaults

ROMTEC INC. 18240 North Bank Road Roseburg, OR 97470 Phone 503-496-3541	Cross-Linked Polyethylene Vaults
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### Synthetic Liners for Concrete Vaults

BURKE RUBBER COMPANY 2250 South 10th ST. San Jose, CA 95112 Phone 800-669-7010	45 MIL "Hypalon", 5 Ply
C. W. NEAL CORP. 1501 Lana Way Hollister, CA 95023 Phone 408-636-4633	45 MIL "Hypalon", 5 Ply
FRED B. RIVAS CO. P.O. Box 67 Tuckerton, NJ 08087 Phone 800-233-7176	45 MIL "Hypalon", 3 Ply

### Manhole covers

(Manhole covers come with the cross-linked polyethylene vaults.)

THE BILCO COMPANY P.O. Box 1203 Newhaven, CT 06505 Phone 203-934-6363	Hinged, Rectangular, Aluminum Covers
DEXTOL PLASTICS, INC. P.O. Box Drawer R Tuscaloosa, AL 35404 Phone 205-556-1777	ABS Plastic Manhole Covers
DUR-RED PRODUCTS 4900 Cecelia St. Cudahy, CA 90201 Phone 213-771-9000	Hinged, Rectangular Covers
ROMTEC, INC. 18240 North Bank Road Roseburg, OR 97470 Phone 503-496-3541	Cross-Linked Polyethylene Covers



## Coatings for Concret Vaults and Building Floor Surfaces

GARLAND FLOOR CO.  
4500 Willow Parkway  
Cleveland, OH 44125  
Phone 800-321-2395

For Building Floor Surfaces Only

GARON PRODUCTS, INC.  
1924 Highway 35, CN20  
Wall, NJ 07719  
Phone 800-631-5380

Decorproxy Available In Black For  
Vault Interiors, And Tiger Bond 221,  
"Concord" For Building Floors

HYDRODINE INC.  
9264 Bay Drive  
Surfside, FL 33154  
Phone 305-866-6141

This Is A New Coating Material That  
Is Called Chemical Bond Ceramic  
(CBC). CBC Floor Is A Water Based  
Product

OMNITECH INDUSTRIES, INC.  
1771 East 58th ST. Suite D  
Denver, CO 80216  
Phone 303-293-8580

For Building Floor Surfaces Only  
Use "Omniuff"

PORTER INTERNATIONAL  
CORPORATE OFFICE  
400 South 13th St  
Louisville, KY 40203-1714  
Phone 502-588-9200

Blackcoal Tar Epoxy Resin For Vault  
Interiors, And Clear Or Grey  
Coat For Building Floors

RAINGUARD PRODUCTS, INC.  
818 West Hyde Park  
Inglewood, CA 90302  
Phone 310-671-9100

Products Available In Black For  
Vault Interiors, And Clear Or Grey  
For Building Floors

TORGINOL, INC.  
710 Forest Ave.  
Sheboygan Falls, WI 53085  
Phone 414-467-2471

For Building Floor Surfaces Only  
Use "Toriginal"



## Wall Surfacing Materials for Building Interiors

ALLIANCE WALL CORP.  
P.O. Box 920488  
Norcross, GA 30092  
Phone 404-447-5043

Porcelain Enamel Steel Panel

GARON PRODUCTS, INC.  
1924 Highway 35, CN20  
Wall, NJ 07719  
Phone 800-631-5380

Durapoxy

HYDRODINE INC.  
9264 Bay Drive  
Surfside, FL 33154  
Phone 305-866-6141

CBC Floor (also for concrete walls)

KEMPLITE COMPANY, INC.  
23525 West Eames St.  
Channahon, IL 60410  
Phone 815-467-8600

Kemply

OMNITECH INDUSTRIES, INC.  
1771 E. 58th St. Suite D  
Denver, CO 80216  
Phone 303-293-8580

Epoxy Wall Tile Coating

SANTANA PRODUCTS CO.  
301 -11 Cuff St.  
Scranton, PA 18503  
Phone 800-386-5002

Plastic Panels