DESIGN DATA SHEET
DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND

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VACUUM COLLECTION, HOLDING, AND TRANSFER (VCHT) SYSTEMS - COLLECTION PIPING

CONTENTS

593-1-a. Scope

This document establishes standards for the design and installation of Vacuum, Collection, Holding and Transfer (VCHT) sewage system collection piping.

593-1-b. Collection Piping Installation Guidelines

593-1-b.1 Piping and Valving

The VCHT collection piping transports sewage from waterclosets and urinals to the VCHT tank. The collection piping is under a vacuum. For proper and efficient operation all of the air admitted into the system should propel sewage. Therefore, the vacuum sewage piping shall be designed to minimize the possibility of breakup of the sewage slugs. Similarly, the vacuum sewage piping shall be properly designed to reform that portion of the sewage slug which remains in the piping. A reformed slug is propelled by the air admitted during a flush. Finally, the vacuum piping shall adequately conduct a vacuum signal to the waterclosets and vacuum interface valves since these devices depend upon vacuum power for operation and control. Improper piping design can result in enough static vacuum loss that some waterclosets near the end of the sewage line may never flush. The normal amount of energy available for sewage transfer is 18 inches mercury (Hg). The minimum amount of energy needed is 12 inches mercury (Hg). The optimal operational energy at the waterclosets is from 14-16 inches mercury (Hg), therefore, vacuum losses of 2 to 4 inches mercury (Hg) are the maximum allowable in a sewage line. The accumulation of large sewage slugs within a sewage line reduces the response time of a system and reduce the capability to transfer the sewage at the proper rate.

Two inch nominal diameter pipe shall be the basic size for vacuum sewage piping. One and a half inch piping may be used where a main is very short and does not serve more than two waterclosets.

Each individual watercloset shall be connected to a main or branch main by a 1-1/2 inch flexible connector. Where 2 or more waterclosets are located in a series, the waterclosets shall be mounted on a common line installed above the deck to necessitate only one deck penetration. (See Figures 1 and 2).

Urinal drain piping shall be 1-1/2 inches from urinal to vacuum main. The urinal shall drain by gravity to the inlet of the Vacuum Interface Valve (VIV). No trap is required in the gravity drain piping. The vacuum interface valves shall be located in the same space as the urinals, mounted below and as close as possible to the urinals.

Watercloset and urinal branch lines shall be connected to VCHT mains through Y-branch fittings. Where branch lines directly serve waterclosets or vacuum interface valves, the Y-branch fittings shall be installed so that the branch enters the VCHT main from above (see Figure 3).

Turns of 90 degrees in mains, branches, or service laterals shall be made using a long turn (long radius) 90 degree elbow or two 45 degree elbows.

All horizontal runs of vacuum piping shall be installed with no pitch or with a slight pitch (1/4 inch per foot) toward the direction of flow. In no case shall the pitch be against the true direction of flow.

When a lift is required within the run of a sewage main, a small (3 inch) reforming pocket or trap shall be placed in the line at the bottom of the vertical pipe. The pocket shall be of the same diameter piping as the main with 1-1/2 inch vertical pipe rising from the pocket. Maximum lift shall be 3 feet. (See Figure 4.)

Generally, when waterclosets or vacuum interface valves are required to discharge to a vacuum sewage main which is located overhead, the lift shall be made immediately after each watercloset or vacuum interface valve. A small pocket (trap) shall be located in the piping immediately after any watercloset. This pocket shall be of 1-1/2 inch size pipe with a 1-1/2 inch vertical riser to the main. Maximum lift shall be 8 feet. (See Figure 5).

An overhead main shall have sufficient vacuum volume to accept a flush from a watercloset. The main shall have not less than ten times the volume of the vertical riser pipe in that portion of the main downstream of the riser connection. If other waterclosets are connected into the same main, then a full port non-clogging swing check valve shall be installed at the top of the lift or in the main. (See Figure 5).

The vacuum sewage piping shall be adequately supported and braced horizontally and vertically to prevent thrust movement or sagging of the piping.

A reformer pocket shall be located in a sewer main at a maximum of 100 linear pipe feet from the furthest watercloset or vacuum interface valve. This pocket permits sewage slugs to reform for further transfer. The pocket shall be at least 1-1/2 pipe diameters in depth. (See Figure 6.)

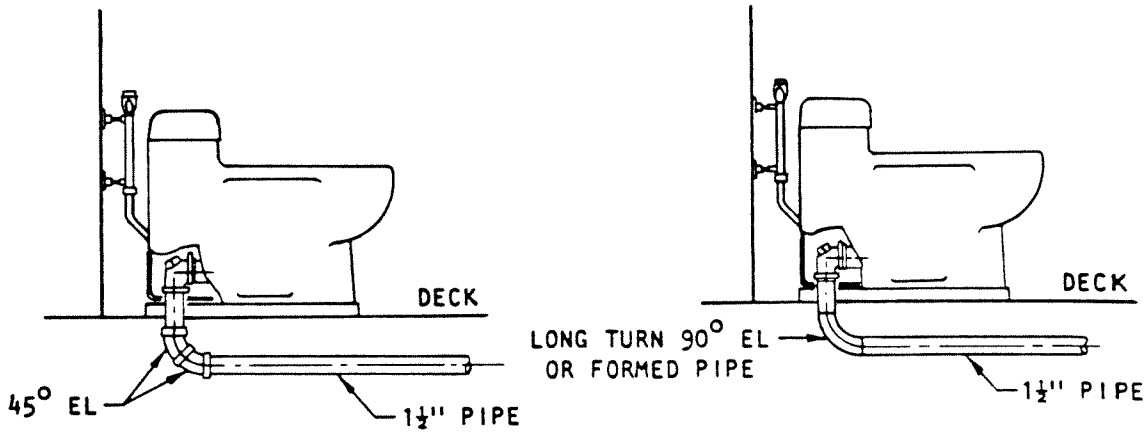
Where a vacuum sewer main is required to avoid an interference, installation under the interference is recommended. Installation under small interference (3 feet maximum span) can be accomplished as shown in Figure 7. Where large interferences (over 3 feet) are encountered, a reformer pocket must be located at the end of the interference just prior to lifting back to a high level. The reformer pocket shall be at least 1-1/2 pipe diameters in depth. (See Figure 8).

593-1-b.2 Clean-out Accesses

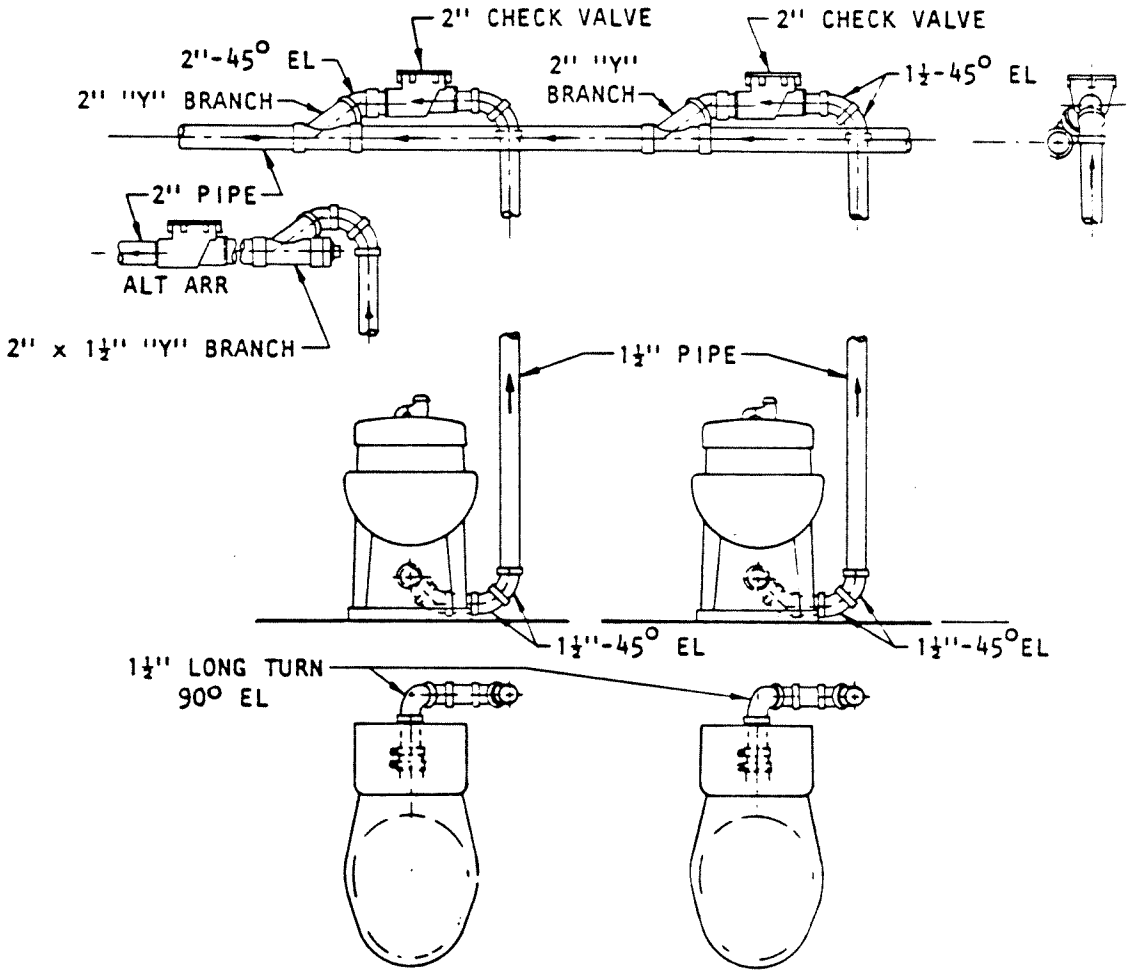
Clean-outs shall be located at 20 to 40 foot intervals in horizontal vacuum lines. A clean-out shall be located at the end of all vacuum mains and at the end of a branch unless the branch line serves a single fixture which discharges into the main from above. Clean-outs shall be located at the inlet to reforming pocket unless the pockets are immediately adjacent to a fixture. Vacuum lines installed in the overhead shall have clean-outs turned downward (as shown in figures 7 and 8). Vacuum lines installed near the deck shall have clean-outs turned upward (as shown in figure 6). Clean-outs shall always be located and oriented to permit accessibility for maintenance purposes.

593-1-b.3 Vacuum Interface Valve

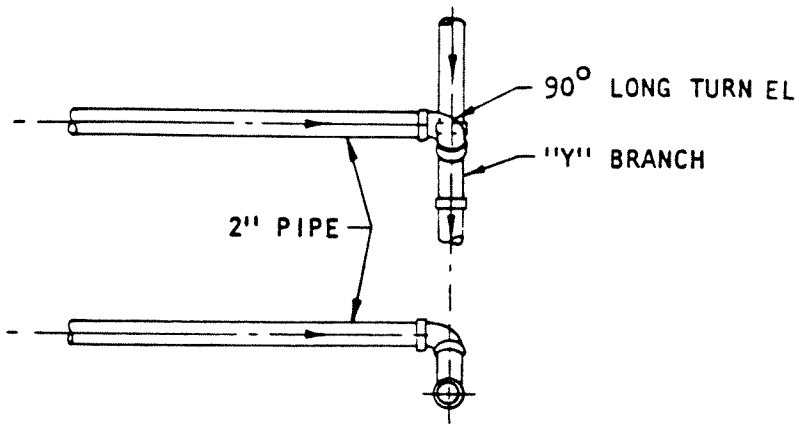
The vacuum interface valve automatically emits sewage from gravity urinal drains into the vacuum sewage piping. The inlet shall be piped to the urinal(s) gravity drain. A 2 inch vent shall be installed if additional air for transporting the waste is required for proper vacuum interface valve operation. The vent shall be installed upstream of the VIV, terminating at the weather. When the waste reaches a set level, the vacuum interface valve opens for a period of 3 to 5 seconds. Atmospheric air propels the sewage through the vacuum interface valve into the vacuum sewage piping. Each valve assembly shall be supported and secured to resist the reactive forces which are characteristic of vacuum transport. The assemblies shall be accessible for inspection and service.



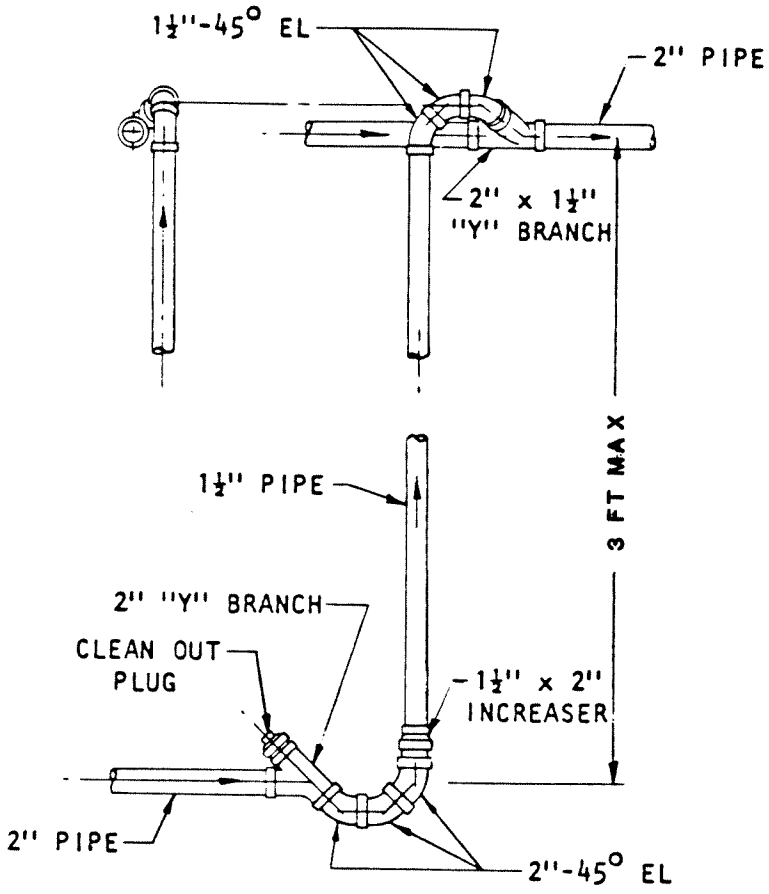

VACUUM TOILET PIPING
Figure 1



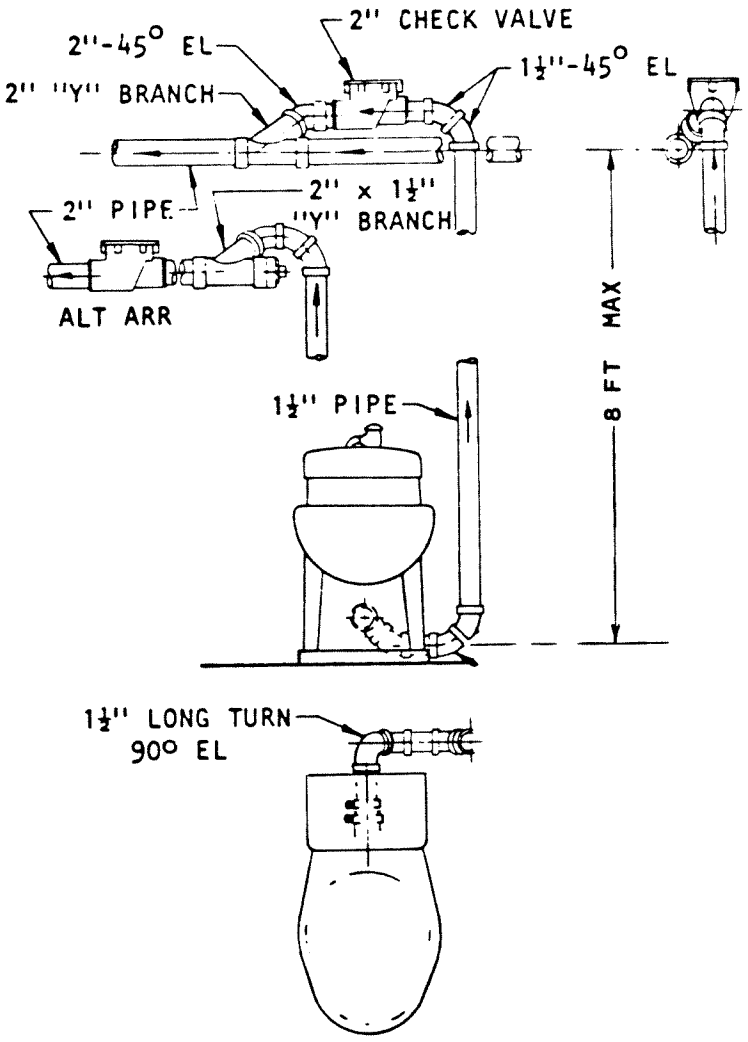

TWO TOILET HOOK-UP ABOVE DECK
Figure 2



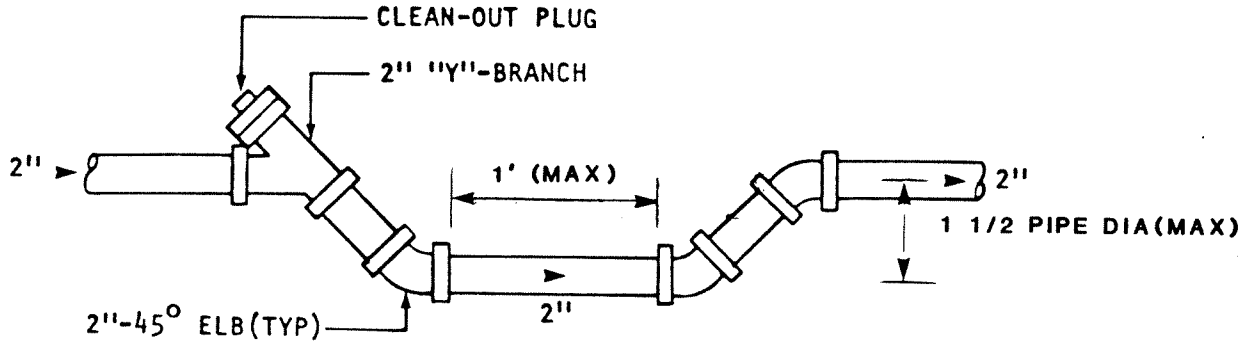

BRANCH CONNECTION
Figure 3



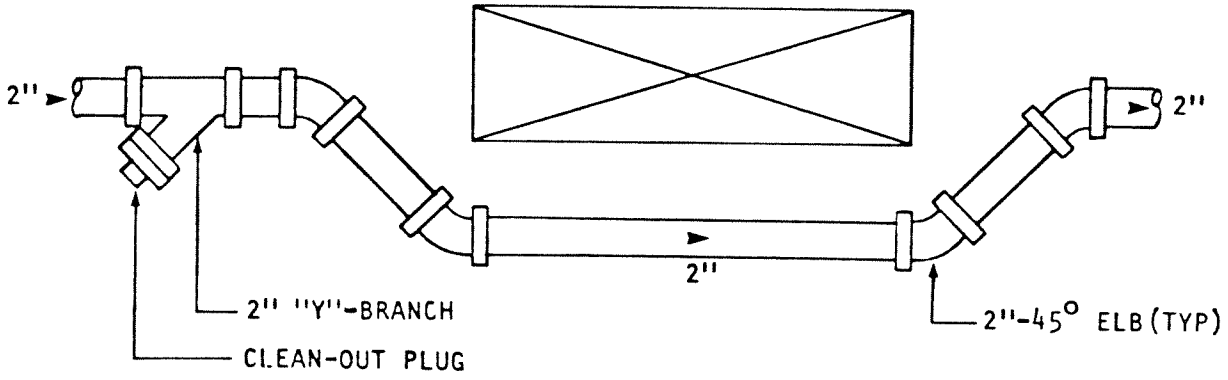

MAIN LIFT APPLICATION
Figure 4



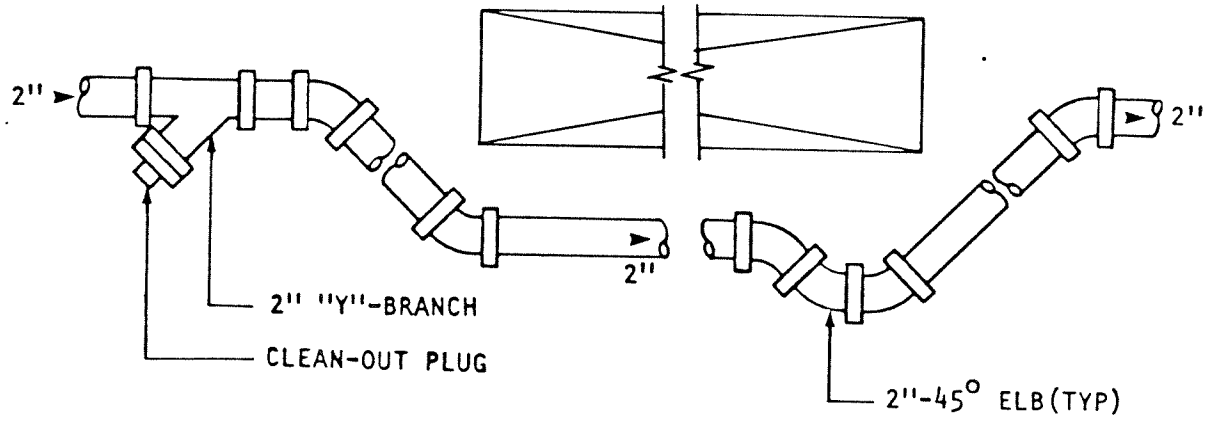

VACUUM TOILET LIFT APPLICATION
Figure 5




REFORMER POCKET
Figure 6




PIPING BY-PASS (SMALL OBSTRUCTION)
Figure 7




PIPING BY-PASS (LARGE OBSTRUCTION)
Figure 8