Arthur D Little

23 - Passenger Operations

Arthur D Little

Appendix A: Health Risk Assessment and Risk Management for Sewage Disposal from Amtrak Trains

Appendix B: Manufacturers' Technical Brochures

Draft Final Report to Federal Railroad Administration

1990

Arthur D. Little, Inc.
Acorn Park
Cambridge, Massachusetts
02140-2390

Reference 60719-71

Appendix A

HEALTH RISK ASSESSMENT AND RISK MANAGEMENT FOR SEWAGE DISPOSAL FROM AMTRAK TRAINS

Amtrak collects human waste from on-board toilet facilities in holding tanks which are emptied at waste stations into municipal sewage systems. Employees who transfer the waste material may be exposed to infectious agents or other harmful material. Therefore, it is appropriate to characterize the nature and degree of risk and to recommend appropriate protective measures.

The following discussion is an assessment of the risks posed by the waste handling operations. The structure of the discussion is divided into four sections: hazard identification, hazard assessment, exposure assessment, and risk characterization.

This risk assessment is followed by a discussion of risk management, focusing on prevention of exposure and its adverse consequences.

Hazard Identification

The holding tanks will contain human sewage which may incorporate pathogenic biological agents. The tanks may also contain toxic chemicals and physically harmful materials such as hypodermic needles. While the focus of this assessment will be biological agents, we are concerned about the potential accumulation of toxic or asphyxiating gases (e.g., hydrogen sulphide or ammonia) in the tank or in sumps and subsequent exposure during the unloading process and recommend that the potential for such exposure be evaluated.

The infectious agents could include bacteria, viruses, protozoa, and fungi. These organisms would be derived primarily from the gastrointestinal tract, but bloodborne pathogens may also be present in the sewage. Among the enteric viruses, hepatitis A is a principal concern. There are a variety of infectious and/or endotoxin producing bacteria including leptospira interrogans, legionella pneumophila, Salmonella, Aeromonas hydrophila, and Mycobacterium xenopi. Aspergillus fumigatus is an allergenic fungus that has been associated with sewage and compost operations. There are two parasitic protozoa, Entamoeba histolytica and Giardia lamblia, that are potential hazards. Finally, Hepatitis B (HVB) and the Human Immunodeficiency Virus (HIV) are bloodborne pathogens that could be present in the waste material.

Hazard Assessment

The pathogenicity of microorganisms and their by-products depends upon the susceptibility of the person being exposed, the mode of transmission, the portal of entry, and the infectivity or toxicity of the organism.

Human resistance to disease and responsiveness to biologic toxins and allergens varies considerably from individual to individual and, even for a particular

individual, depends upon factors such as age, immune status, and preexisting illnesses.

Many microorganisms which are common in the environment and are normally considered to be benign can cause serious, and even fatal, illnesses in susceptible people. On the other hand, there are other microorganisms which can represent a more constant and serious hazard. HVB and HIV are threats to healthy workers. Also, there are exotic viruses such as Acute Hemorrhagic Fever Viruses, which have occasionally caused outbreaks of illness in the United States.

Hepatitis B or serum hepatitis is a bloodborne virus which represents a major occupational hazard for healthcare workers. The virus is spread through breaks in the skin, mucous membranes, sexually, or from mother to infant at birth. It is highly infectious. One milliliter of blood from an infected individual may contain up to 100 million infectious doses of virus. The virus has been shown to survive on dry surfaces for up to a week at room temperature; however, it does not survive well in feces.

The Human Immunodeficiency Virus (HIV) is associated with the Acquired Immunodeficiency Syndrome (AIDS). Transmission has been shown to occur through sexual contact and parenteral exposure to blood. The virus has been identified in a wide variety of biologic media including urine, but in epidemiologic studies has only been shown to transmit AIDS through blood, semen, vaginal secretions, and possibly breast milk. There is no evidence of transmission by insects. The HIV virus is much less resistant than the Hepatitis B virus to environmental conditions, and it will not survive for very long outside of the body.

The other enteric viruses, the protozoa, and fungi can cause a variety of respiratory, gastrointestinal, and dermatologic illnesses, and in some cases, can survive for long periods of time in hostile environments. Generally, they are less infectious than HVB. For example, in an experiment, 14 volunteers were exposed to Salmonella typhi. No one was affected by exposure to 10^3 organisms while one person was resistant to 10^9 organisms.

Exposure Assessment

There are four main routes of transmission for infectious diseases: (1) contact, (2) vehicle, (3) airborne, and (4) vectorborne. Contact transmission could be, for example, direct transmission from a contaminated hand to the mouth. Vehicle transmission involves exposure through contamination of objects such as food or water. Airborne transmission involves the dispersion of biologic material on dust particles or droplets. Vectorborne transmission involves transfer of biologic material by insects or animals.

The culmination of these transmission routes is the portal of entry or exposure which may be the respiratory tract by inhalation, the gastrointestinal tract by ingestion, the skin and mucous membranes by penetration or through breaks in the tissue, and the blood by direct inoculation or systematic spread.

In the specific case of sewage holding tanks, Amtrak employees may be exposed to small amounts of residual waste material which is retained in the transfer pipe or spilled in the surrounding area. Large exposures may occur during spills resulting from failures in the pipe or its connectors. The portals of entry could include inhalation, ingestion, and skin absorption. Less direct exposure via vehicles or vectors are also possible, particularly if hygiene is poor.

Risk Characterization

Risk Characterization involves combining the assessment of potential exposure with the hazard assessment to estimate the nature and severity of the risk. In the case of cancer risk assessment, this usually involves an expression of the probability that extra cases over background will occur over a year or lifetime. For chronic disease, risk is expressed in terms of a threshold of exposure which, if exceeded, can result in disease. The degree of risk is expressed in terms of the extent to which the threshold is exceeded. For biological material, dose-response data are limited and thresholds vary depending upon individual susceptibilities, the infectivity of the organisms, and the dose. It is appropriate to state that the risk for Amtrak employees is real and potentially severe. It is also possible to eliminate or substantially reduce the risk by implementing preventive measures.

The literature on the occupational health risks associated with municipal waste water and solid waste operations includes environmental monitoring and epidemiologic studies and suggests that the risks are real and controllable. In a review of this literature, Herbert R. Pahren of the U.S. Environmental Protection Agency states that:

> "Persons exposed to relatively low densities of microorganisms in the air near wastewater operations showed no significant adverse health effects, but infections were sometimes found at high densities. Also, when operations were conducted indoors, to microbial densities tended to be much higher than outdoors, resulting in illnesses to a number of workers."[1]

Reference?

Recommendations for Risk Management

Preventive measures may be primary, in terms of preventing exposure; secondary, in terms of preventing infections when exposure occurs; and tertiary, in terms of effective diagnosis and treatment. All three approaches have relevance for Amtrak employees.

Primary prevention involves establishing safe and hygienic work practices which will reduce the risk of exposure. Employees should be trained to recognize the hazards and their consequences and to use protective practices. Compliance with preventive programs should be monitored. Employees should also be supplied with and trained in the use of protective equipment including work clothes and gloves. If possible, face shields would provide an extra level of protection in the case of

[1]CRC Critical Reviews in Environmental Control Vol. 17, Issue 3; 187-228, 1987

leaks or spills.

Secondary prevention also involves good hygiene including training in and facilities for cleaning up spills. It also involves vaccination. Healthcare workers are routinely vaccinated against HVB, and when exposure is likely to involve HVB post-exposure prophylaxis with Hepatitis B immune globulin may also be provided. Medical personnel should encourage routine vaccination for polio and tetanus and should not place individuals with immune system deficiencies in this occupation. In order to understand the likelihood of the risk, we recommend that Amtrak test the sewage material to characterize the microbial population. Amtrak should also survey medical operations in other sewage handling occupations to understand the state of the art.

Finally, Amtrak medical personnel should be trained to diagnose and treat illnesses that may result from exposure and employees should be encouraged to report illnesses that might result from sewage exposure.

Appendix B

MANUFACTURERS' TECHNICAL BROCHURES

The following manufacturers have provided technical documentation concerning their toilet systems for the railroad environment:

- Aqua-Sans
- GARD
- Microphor
- Monogram Sanitation
- Railtech

EVAC was unable to provide technical documentation. However, they sent a videotape which is available upon request.

Aqua-sans

Introducing

THE PERFECT FLUSH ™

Aqua-Sans® Zero-Discharge
Sewage Disposal System

☐ PARKS AND RECREATIONS AREAS

☐ OFFICE BUILDINGS AND FACTORIES

☐ RESIDENTIAL

☐ HIGHWAY COMFORT STATIONS

☐ CONSTRUCTION SITES

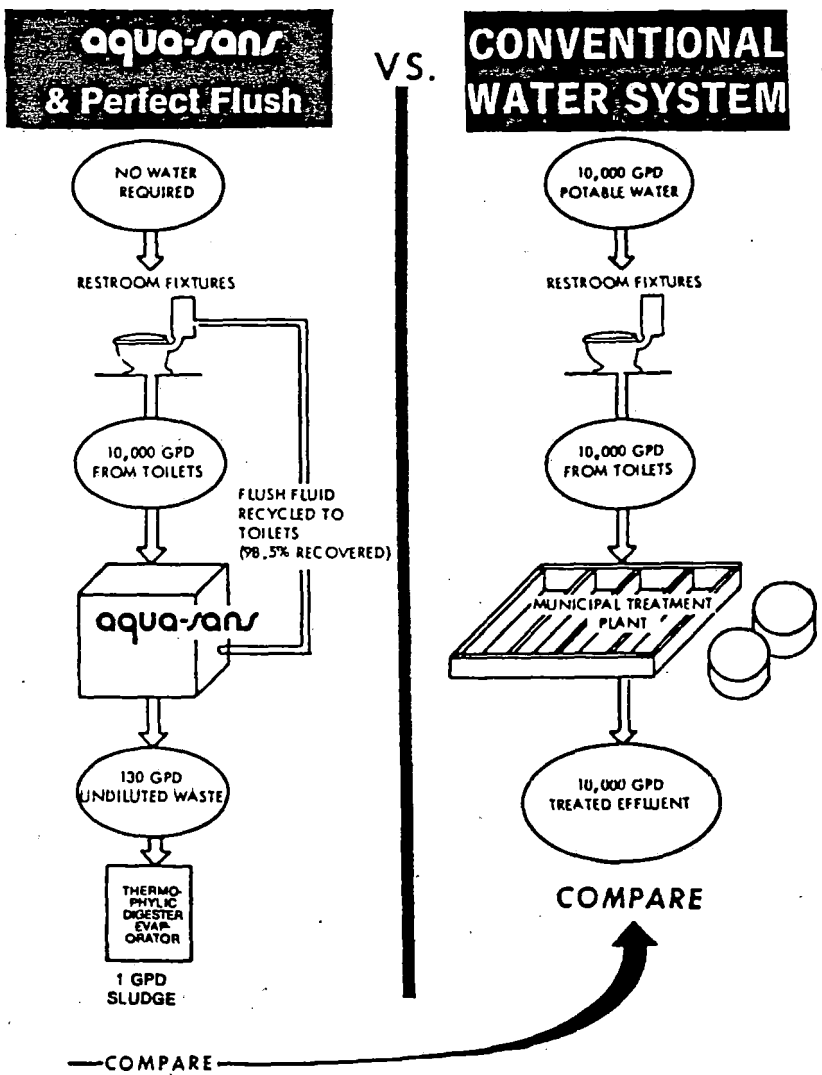
☐ MARINE AND OFFSHORE

THE "AQUA-SANS" WATERLESS, ZERO-DISCHARGE TOILET SYSTEM.

After many years of research, development and field-testing, the Aqua-Sans technology has evolved into a revolutionary sanitation system designed for today's pressing environmental needs. The Aqua-Sans toilets utilize a clear, odorless, non-reactive fluid for flushing. This fluid looks exactly like water; but, unlike water, it is used over and over again continuously in each system to carry wastes to a special tank where the wastes are separated from the flush fluid. The flush fluid is conditioned and returned to the toilets for flushing. The wastes are transferred to our recently developed "digester-evaporator" where the wastes are mineralized by bacteria and the associated water (96 to 98% of normal wastes) is evaporated. The resulting sludge, approximately 3 gallons per person per year, is easily removed about once or twice a year and can be disposed of in several convenient methods.

What does "AQUA-SANS" really mean? It means that waste problems are over in areas where conventional sewer lines and centralized treatment plants are inadequate, impractical, or economically unfeasible. It means that areas may now be developed where septic tanks are either prohibited outright, operate poorly, or where fresh water is too valuable to waste flushing ordinary toilets. It means that modern sanitation facilities can be provided wherever needed. It means that we do not have to depend upon sewers!

HYDRAULIC FLOW COMPARISON



Advantages

- No Discharge
- Conserves Water
- Automatic or Manual Operation
- Uses Conventional Toilets
- Meets Federal and State Laws
- Modular Construction
- Reliable
- Simple Maintenance
- Can Be Scaled To Your Requirements
- Mobile Systems Available

Where It Has Applications

- Water Shortage
- Poor Soil Percolation
- High Water Table
- Rigid Enforcement Of Pollution Control
- Overloaded Municipal Treatment Plant
- Temporary Encampments

STOP USING DRINKING WATER TO TRANSPORT BODY WASTES.

The benefits for public sanitation are enormous.

First, 80 to 90% of the water used for public sanitation (as compared to up to 50% of the water used in the home) is utilized to flush toilets. THUS, 80 TO 90% OF THE WATER PRESENTLY USED FOR PUBLIC SANITATION WOULD BE SAVED! No more costly flushing away of our constantly diminishing reserves of drinkable water — a gigantic benefit to individuals and society as a whole.

Secondly, highly contaminated toilet wastes would no longer pollute our lakes, rivers and oceans. No more harmful bacteria breeding where pure lakes and rivers used to be.

Finally, the need for complex and expensive sewage treatment plants or troublesome septic tanks would be greatly reduced. No more cries that remoteness has made proper treatment of sewage impossible.

But how can all of this be accomplished and still provide the kind of flushing toilet services to which modern society has become accustomed? AQUA-SANS!

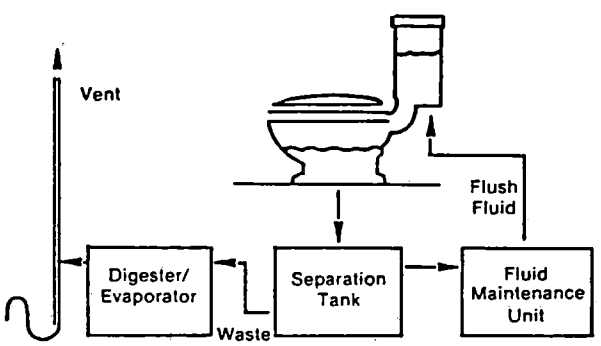
WITH "AQUA-SANS" THE FUTURE IS SEWERLESS!

For nearly a century, one of the world's most inefficient inventions has been playing a major role in the ever-increasing pollution of the earth's dwindling supply of pure fresh water. That invention: the water flush toilet.

Each and every one of us, whether served at home, work or play by public sewers or septic tanks, uses an average of 13,000 gallons of drinking-quality water EACH YEAR just to flush toilets — pure water that carries off our individual annual production of a mere 165 gallons or less of body waste. In the case of sanitary sewers, this 165 gallons of annual body waste is carried to complex and costly centralized treatment plants. There, depending on the level and type of treatment system, only 40 to 90 percent of the harmful matter we introduce into otherwise perfectly drinkable water is removed. Ordinary septic tanks do even less.

The remainder of the contaminants — including pathogenic viruses not always eliminated by conventional sewage treatment — may find their way back into the environment. The result: further degradation of our invaluable pure water supplies. Government sources cite the bacteria from human digestive waste — fecal coliform bacteria — as the single largest contaminant in the waters of the United States and the world.

Each year about 50% of our personal wastes are deposited in some form of public sanitation facility away from home (i.e. factories, offices, schools, restaurants, gas stations, parks, etc.). Aqua-Sans can eliminate the waste discharge, including hand washing water, from these facilities.



AQUA-SANS FLUSH FLUID

The flushing fluid is a clear, water white, very low freeze point, mineral-derived liquid. It is not harmful if accidently ingested or if it comes in contact with the skin. It lasts indefinitely. In normal operation, a small amount of the fluid may be lost each year. A 20 person system contains less than 100 gallons of fluid while a 600 person system contains only 1000 gallons of fluid.

AQUA-SANS WET-BOWL TOILETS

The wet-bowl toilet fixture is visibly similar to a conventional water flush toilet and differs only by a coating of * TEFLON® on the inside of the bowl. Flushing and refill is even quieter than with a water flush toilet. Waste instantaneously sinks to the bottom of the bowl beneath the flush fluid sealing off obnoxious odors so common in ordinary toilets. Thus, the Aqua-Sans toilet is far more pleasant to use than a standard water flush toilet. Optional Aqua-Sans urinal fixtures are also available.

* TEFLON is a registered trademark of E.I. DuPont de Nemours & Co.

HYGIENE

No discernible bacteria of any type are found in the toilet and urinal bowl fluid or on the sides of the bowl, making the Aqua-Sans toilet and urinal much more hygenic than a water flush system. (Test reports from independent labratories are available.)

SEPARATION TANK

This tank receives flush fluid plus black waste by gravitational flow from toilets and/or urinals. The tank is usually located below the toilets; however, a small lift station may be used where this is not possible. The flush fluid and waste separate upon entering the tank. The flush fluid flows to a separate compartment where it accumulates until needed to resupply the flush cycle. A small pump moves the oil from the compartment back to the toilets/urinals for flushing automatically on demand.

FLUID MAINTENANCE UNIT

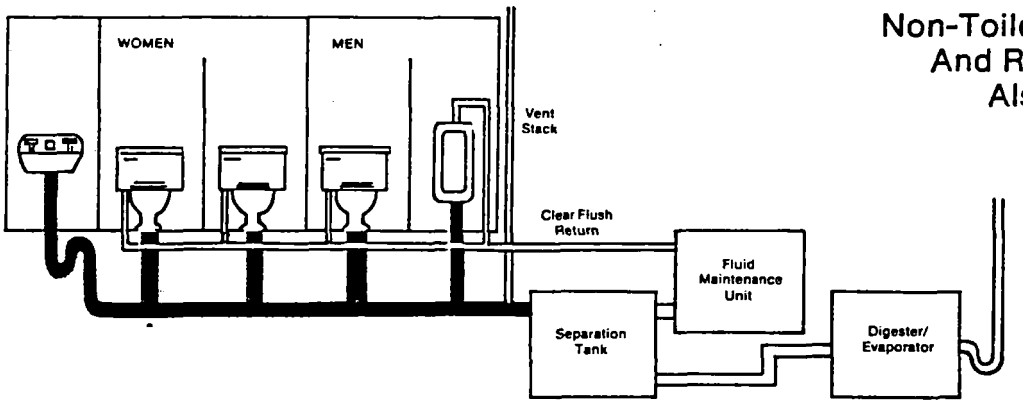
The fluid maintenance unit consists of a small pump that continuously moves a small amount of the fluid from the separation tank through a series of purification elements and returns it to the separation tank. These elements are replaced every few months during a routine servicing cycle. They keep the fluid in a like new condition for trouble-free service.

DIGESTER/EVAPORATOR

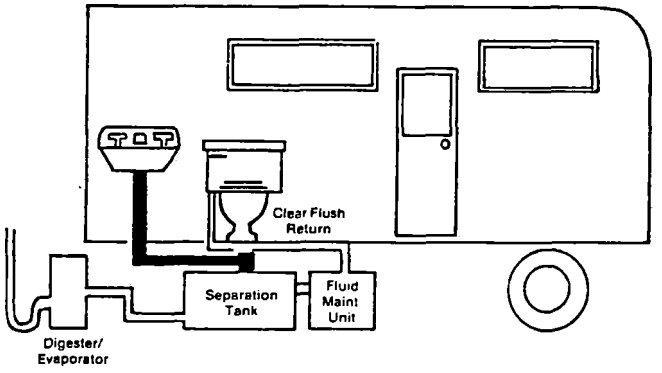
The waste is moved from the separation tank to the digester/evaporator by a unique air-lift pump which serves the dual function of liquefying the waste and moving it to the digester/evaporator on a continuous basis, minimizing the waste in the separation tank. The digester/evaporator is an aerated/heated tank that heats the waste to about 140 degrees F. where disease causing bacteria and viruses are killed. A special, non-harmful bacteria naturally present in our waste thrive at this temperature and digest the waste material. Air is supplied to the tank for the bacteria to live and this air carries away the water by evaporation. Less than one percent of the waste remains in the form of a harmless sludge requiring removal about once or twice a year.

Permanently Installed

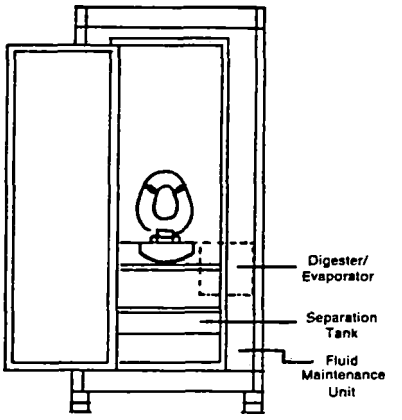
Systems Available In All Sizes
And Configurations.
Non-Toilet Water Treatment
And Recycle Systems
Also Available



Semi-Permanent



Portable Installations



OWNER/USER RESPONSIBILITY

The user/owner can have no responsibility whatsoever in normal daily operation of an Aqua-Sans system if a maintenance contractor is available. All periodic maintenance can be performed by the user or a qualified servicing company.

Housekeeping chores normally associated with water flush toilets have been all but eliminated. There is no mineral or fecal matter buildup on the toilet bowl. The combination of the TEFLON coating and Aqua-Sans fluid prevent these conventional water flush toilet and urinal problems from occuring.

AQUA-SANS®
A Division of
Key Marine Services, Inc.

~~P.O. Box 1891 • Gretna, Louisiana 70054-1891 • Telephone (504) 525-6701~~

REPRESENTED BY:

(415) 348-0748

G. L. Murdock, P.E.
Civil Engineer

Railroad Specialist

110 Park Road
Burlingame, CA. 94010

aqua-aire®
SEWAGE TREATMENT SYSTEM

REPRESENTIVE LIST OF INSTALLATIONS

MODEL	LOCATION	OPERATIONAL	REMARKS
D	RICHMOND, VA.	MAY 1977	FOUR UNITS ON I-64 IN NEW KENT COUNTY, VA. FOR VIRGINIA HIGHWAY DEPT.
A	LITTLE ROCK, ARKANSAS	MARCH 1977	CORPS OF ENGINEERS MOTOR VESSEL, "SHORTY BAIRD"
AB-2	ROSYTH, SCOTLAND	1978	ONE UNIT FOR BRITISH ROYAL NAVY ON HMS LONDONDERRY
D	CHARLOTTESVILLE, VIRGINIA	SUMMER 1978	FOUR UNITS ON I-64 NEAR CHARLOTTESVILLE, VA. FOR VIRGINIA HIGHWAY DEPT.
AB-2	COOK INLET, AK	JUNE 1977	ONE UNIT FOR ARCO OFFSHORE PLATFORM WITH INCINERATOR
B	COOK INLET, AK	JUNE 1977	ONE UNIT FOR ARCO OFFSHORE PLATFORM WITH INCINERATOR
B	COOK INLET, AK	JUNE 1977	ONE UNIT FOR MARATHON OIL OFFSHORE PLATFORM
B	COOK INLET, AK	JUNE 1977	TWO UNITS FOR UNION OIL OFFSHORE PLATFORMS
D	OLYMPIC VALLEY, CALIFORNIA	AUGUST. 1977	ONE UNIT AT MOUNTAIN TOP RESTAURANT SQUAW VALLEY SKI CORP. HARDY HERDER
A	POOLE, DORSET, ENGLAND	DECEMBER 1977	ONE UNIT AT HAMWORTHY PUMP AND COMPRESSOR DIV. FACTORY
D	MONROE, MICHIGAN	MARCH 1978	ONE UNIT AT CARLTON REST STOP ON I-275 NEAR YPSILANTI, MICH FOR MICHIGAN HIGHWAY DEPT.
N	BARROW, AK	APRIL 1978	ONE UNIT AT ARCTIC SLOPE REGIONAL HEADQUARTERS OFFICE BUILDING
B	KENAI, AK	JULY 1978	ONE UNIT AT SALAMATOF SEAFOODS, INC. FACTORY
AB-2	Barrow, AK	October 1980	One unit at Barrow Regional Service Center (police station).
N	Barrow, AK	September 1981	One unit at North Slope Borough Administration Building.

REPRESENTIVE LIST OF INSTALLATIONS

MODEL	LOCATION	OPERATIONAL	REMARKS
A	CHRYSLER FACILITY NEW ORLEANS, LA.	FEBRUARY 1974	UNIT AT NASA'S MICHOUD ASSEMBLY FACILITY
C	ANNAPOLIS, MARYLAND	NOVEMBER 1973	U.S. NAVY RESEARCH AND DEVELOPMENT CENTER BARRACKS SERVING 150 PERSONNEL, SUCCESSFULLY COMPLETED.
A	NEW YORK HARBOR AREA	MARCH 1972	DUNBAR & SULLIVAN DREDGING CO. TUGBOAT "R.H. GOODE" WITH A CREW OF 6 TO 10
A	FORT BELVOIR, VIRGINIA	OCTOBER 1972	U.S. ARMY MOBILITY EQUIPMENT RESEARCH AND DEVELOPMENT CENTER. EQUIPMENT TO BE RELOCATED TO ANOTHER SITE.
B	ALBANY, NEW YORK	APRIL 1973	LOCATED AT THE FIVE-RIVER ENVIRONMENT EDUCATION CENTER
B	WICHITA FALLS, TEXAS	DECEMBER 1973	TWO UNITS ON TEXAS HIGHWAY U.S. 281 AT BURKBURNETT, TEXAS
C	TAMPA, FLORIDA	JULY 1973	TRAILERIZED LATRINE FOR CONSTRUCTION SITE
A	MOBILE, ALABAMA	APRIL 1974	CORPS OF ENGINEERS SNAGBOAT "ROS", 28-MAN CREW
B	BUTTE, MONTANA	JUNE 1975	TWO UNITS ON INTERSTATE HIGHWAY 90, HOMESTAKE REST AREA
A	NEW ORLEANS, LOUISIANA	1974	FOUR UNITS ON THERIOT, INC. OCEAN-GOING TUGS (12-MAN CREWS) BUILT BY MAIN IRON WORKS
A	NEW ORLEANS, LOUISIANA	STARTING IN 1974	SEVEN UNITS ON THERIOT, INC. OCEAN-GOING TUGS (12-MAN CREWS) BUILT BY EQUITABLE EQUIPMENT CO.
B & C	NEWCOMB, NEW YORK	DECEMBER 1974	THREE UNITS AT LAKE HARRIS PUBLIC CAMPSITE IN THE ADIRONDACK MOUNTAINS.
A	FORT BELVOIR, VIRGINIA	JANUARY 1975	ARMY LCU
B	TACOMA, WASHINGTON	JANUARY 1975	BRINKERHOFF MARINE DRILLING OFFSHORE PLATFORM
B	STARKVILLE, MISSISSIPPI	SUMMER 1975	ONE UNIT ON U.S. 82 SPECIFIED BY MISSISSIPPI HIGHWAY DEPARTMENT
S-20	BAY ST. LOUIS, MISSISSIPPI	APRIL 1975	ST. STANISLAUS BOYS CAMP
S-20	CASCADE DAM, IDAHO	FALL 1976	THREE UNITS AT RECREATION AREA
S-50	TETON DAM, NEWDALE, IDAHO	TBD	TWO UNITS AT RECREATION AREA
S-20 S-50	PALISADES DAM, IDAHO	SUMMER 1976	ONE OF EACH SIZE AT RECREATION AREA
A	LaROSE, LOUISIANA	APRIL 1976	ONE UNIT ON AMERICAN GULF SHIP BUILDING TUG

aqua-sans®
Division of Key Marine Services
4450 General DeGaulle Drive, Suite 1203
New Orleans, Louisiana 70131
Phone (504) 392-5947
Fax (504) 392-5946

PROPOSAL TO PROVIDE A ZERO DISCHARGE TOILET WASTE TREATMENT SYSTEM FOR RAILROADS AND OTHER TRANSPORTATION VEHICLES

BACKGROUND:

The Aqua-Sans Oil Flush Toilet System development began over twenty years ago at Chrysler Corporation under a contract sponsored by The United States Navy. The system was designed to provide zero toilet discharge into the sea when ships were near shore.

This system has been thoroughly tested to meet the requirements of safety and human factors aboard ships, offshore oil rigs, in homes, offices and public rest rooms. The commercial development of this concept was discontinued by Chrysler after ten years because of the lack of enforcement of environmental regulations by the Federal and State agencies and public apathy to environmental problems. These factors eroded the market for such a system.

During this period several systems were built and installed nationwide and some of these early systems still exist. Aqua-Sans, now under the direction of the original inventor, has improved and begun manufacturing and installing the new oil flush toilet systems. The most recent installations have been for the Virginia Department of Transportation at rest stops on Interstate Highway 64. These installations are significant because they replaced Aqua-Sans systems installed by Chrysler Corporation some thirteen years ago. The new larger systems were necessary due to increased usage. The new systems are designed to accommodate 10,000 uses per day, and are housed in the same buildings even though they have been updated with new innovations.

To supplement these large units, Aqua-Sans technology is now being incorporated into small units. Units to accommodate six live in persons with average use of 6.5 flushes per person per day or with expanded storage for as many people that could use a commode.

Description:

The Aqua-Sans Oil Flush Toilet utilizes mineral oil as the flush fluid instead of water. In a standard toilet 98% of what goes down the sewer is potable water before being used to flush. Only 2% is human waste (urine, feces, toilet paper and other flushable materials). By using mineral oil, there is no reduction in flushing quality and waste transport. At the same time there has been a 98% reduction in sewage volume requiring treatment. In the smaller systems, such as those for use on trains, Aqua-Sans uses a specially designed toilet fixture to reduce the volume required for flushing due to their compact size.

In the standard configuration the toilet waste is transported by pipes to the separation tank where the mineral oil and the waste separates due to the difference in their specific gravities. Because oil and water are immiscible, the two fluids remain separate. Human waste consists of urine (98% water) and feces (86% water) along with the toilet paper which tends to remain in the water phase.

The oil being lighter than water (specific gravity 0.83), rises to the top and overflows a weir into a storage reservoir. The oil is continuously filtered and cleaned to remain like new. Chlorine is added to the oil in a form that will not enter the water phase and prevents the oil from being biodegraded. The oil from the reservoir is then returned for use in flushing the toilet. Very little oil is lost from this system, therefore, the initial filling can last for years needing only minor replentishment. The mineral oil is classified as a technical grade, the same type used in cosmetics and baby oil. It is water clear and has a viscosity near that of water.

The waste material sinks to the bottom of the separation tank where it is broken up and constantly mixed with air in a patented configuration that biodegrades the wastes aerobically. No chemicals or biological inhibitors are added, therefore, accummulations of waste in the system may be discharged into any sanitary sewer system. The waste remains in an aerobic condition which reduces noxious odors from the system. Aerobic digestion tends to destroy pathogenic organisms and with the digester evaporator, which may be added to the system, further reduces the waste volume. The elevated temperature in the digester with time destroys both viruses and pathogenic organisms. There is no addition of waste volume from this toilet system due to the flush fluid and the digester can reduce the already low volume of waste by an additional 95%.

Summary:

The Aqua-Sans Flush Toilet system has been in development and use for over twenty years. Although this concept is cost competitive in many situations it has not been widely marketed. The small size, minimum volume of waste and the simplicity of the system makes it ideally suited for installation aboard trains, buses, ferrys and boats.

The experience gained over the twenty years of use make this a proven technology. The oil flush toilet concept can be configured to fit almost any space and energy requirements are minimal. The Aqua-Sans Systems are cost competitive where pollution abatement and or water conservation are truly desired and enforced.

GARD

GATX

GARD, INC.
7449 North Natchez Ave.
Niles, IL 60648
312-647-9000

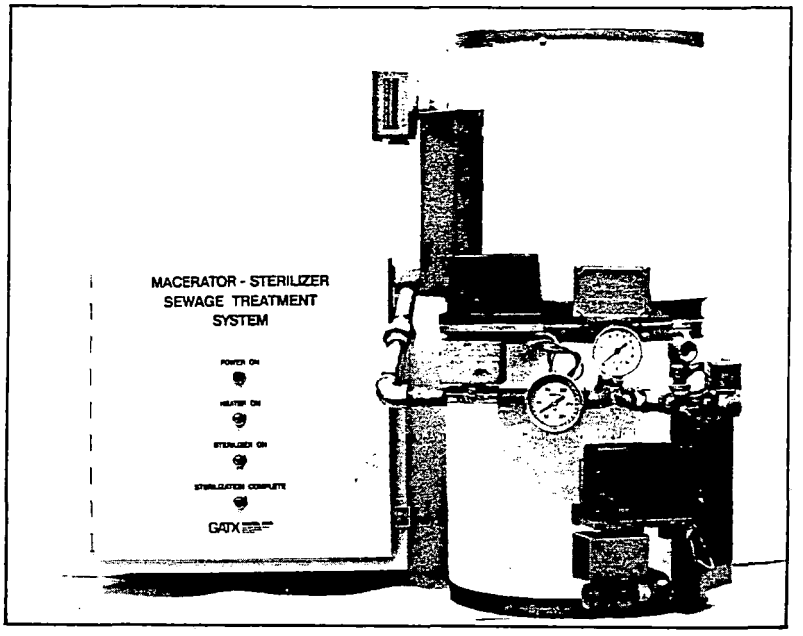
Suite 1000
1100 - 17th St. N.W.
Washington DC 20036
202-293-5310

MACERATOR STERILIZER SEWAGE TREATMENT SYSTEM

The GARD/GATX Macerator Sterilizer Sewage Treatment System (MSS)* is a flow-through system that treats the sewage by heating to 250°F for 15 minutes to effect a complete sterilization, i.e., no viable organisms present in the wastes to be discharged. This system, designated as Model MSS-I is certified by the U.S. Coast Guard as a Type I MSD, USCG Certification No. 159.15/1012/2/I.

The essential criterion of the performance of the MSS is meeting the USCG and EPA discharge standards for treated effluent. Current regulations require that the effluent will not have a fecal coliform bacterial count of greater than 1000/100 ml, nor visible floating solids. Field tests showed that the effluent from the MSS results in a fecal coliform count of zero; this more than meets the current regulations. The MSS is being upgraded to meet Type II regulations, which state that the effluent will not have a coliform count greater than 200/100 ml, nor total suspended solids greater than 150 mg/l.

Macerator Sterilizer Systems are currently in operation on U.S. Army Corps of Engineers' Dredges "Harding" and "Pacific," and on American Steamship Company's MV "Belle River."



GARD's MSS:

- Meets the current USCG and EPA discharge regulations.
- Operates automatically with no servicing requirements.
- Requires no additives; thus, no stocking and handling of chemicals are necessary, and no materials other than sterilized human sewage will be discharged with the effluent.

*U.S. Patent 4,012,322

SYSTEM OPERATION

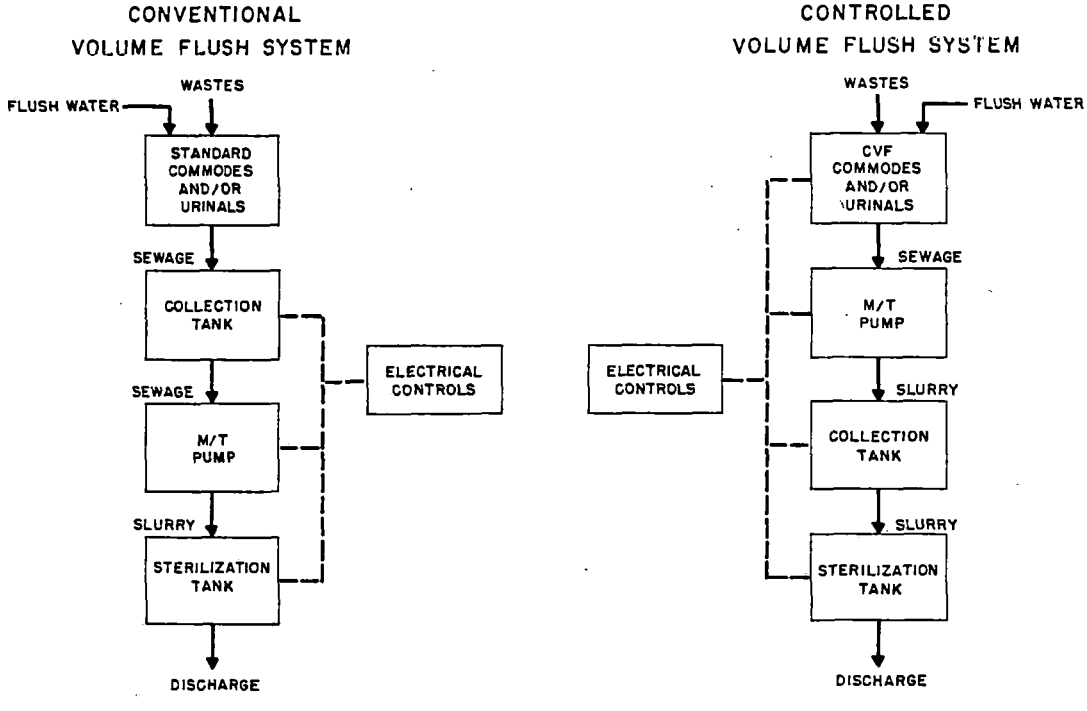
The Macerator Sterilizer System operates on repetitive automatic cycles. A batch of wastes is ground up by a macerator/transfer (M/T) pump and directed to the sterilizer tank. Electric heaters in the sterilizer tank raise the temperature of the sewage to 250°F under 15 psig steam pressure. After holding at 250°F for 15 minutes, sterilization is completed and the sewage is discharged overboard when the vessel is operating in waters where discharge of sterilized wastes is permitted. A lockout switch in the control circuit prevents discharge of wastes in restricted waters. The MSS can be used with either Controlled Volume Flush (CVF) commodes or standard flushing commodes (see schematic diagrams), but in order to limit power consumption CVF commodes are preferred.

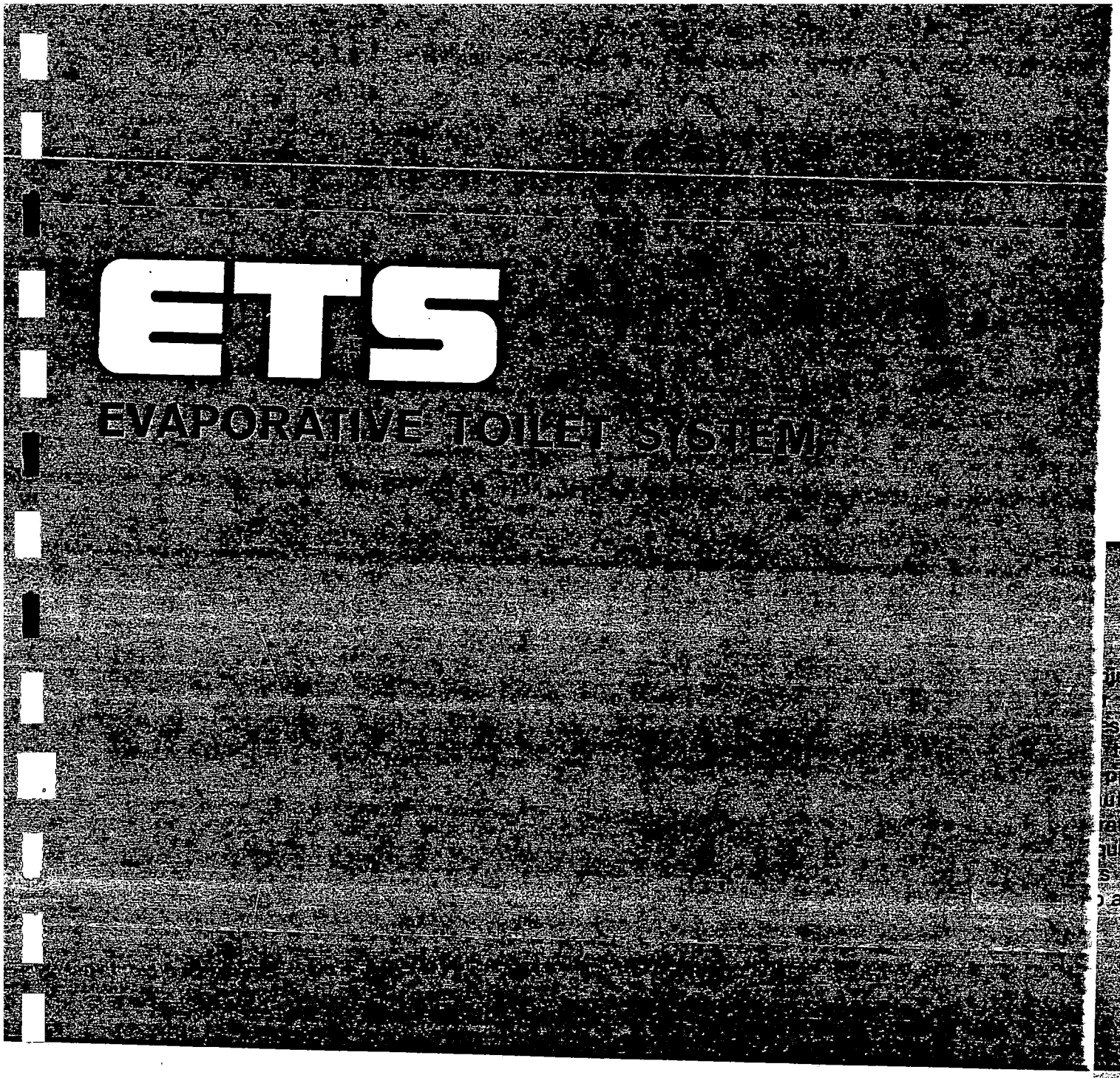
POWER REQUIREMENTS

An average of 0.8 KWH is required per man-day to heat sterilize the sewage from controlled or low volume flush toilets; with conventional flush toilets, the power required is approximately 16 KWH per man-day. The M/T pump requires 2 KW during a short duty cycle, and controls including motorized valves require 500 watts. The pumps and sterilizer heaters operate from 460 volt, 3 phase, 60 Hz; control voltage is 120 volt, 1 phase, 60 Hz.

SPACE REQUIREMENTS

Sterilizer sizes vary from 10 to 120 gallons with processing rates up to 1800 gallons per day, depending upon individual requirements. The largest component of the system, the 120-gallon sterilizer tank, is 36 inches in diameter and 72 inches high. Pumps are approximately 10 inches in diameter and 15 inches long. Controls are housed in a 20-inch by 20-inch by 6-inch deep NEMA 12 splashproof box. The system is modular, thus each component can be mounted in its most convenient location.

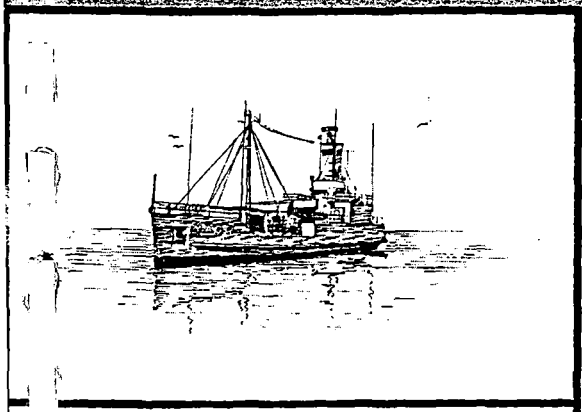


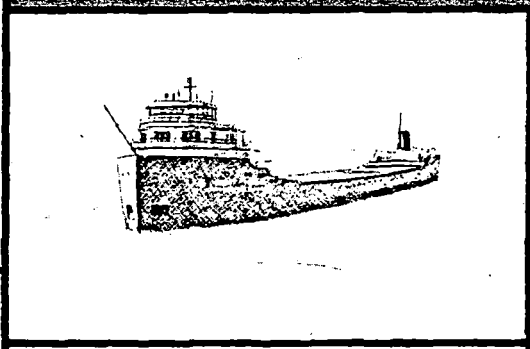


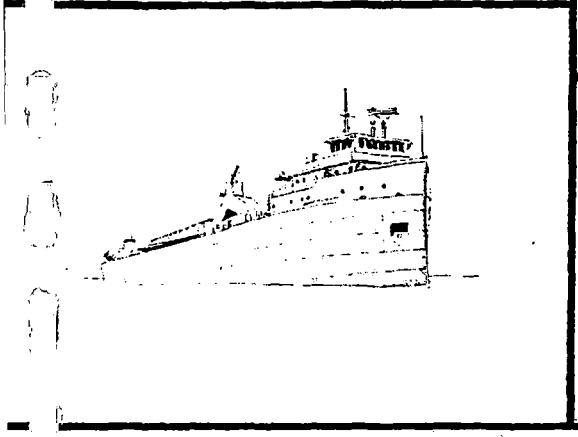
GARD, INC.

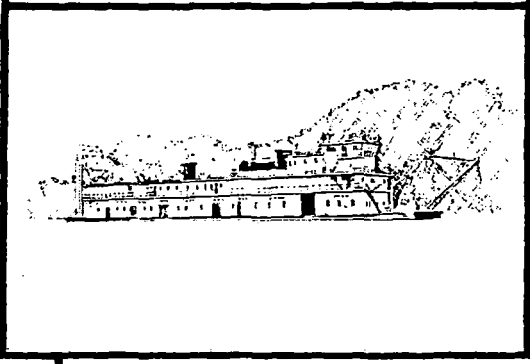
A SUBSIDIARY OF
GATX CORPORATION

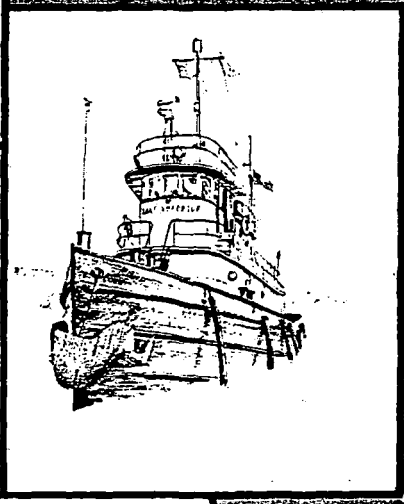
TYPICAL INSTALLATIONS

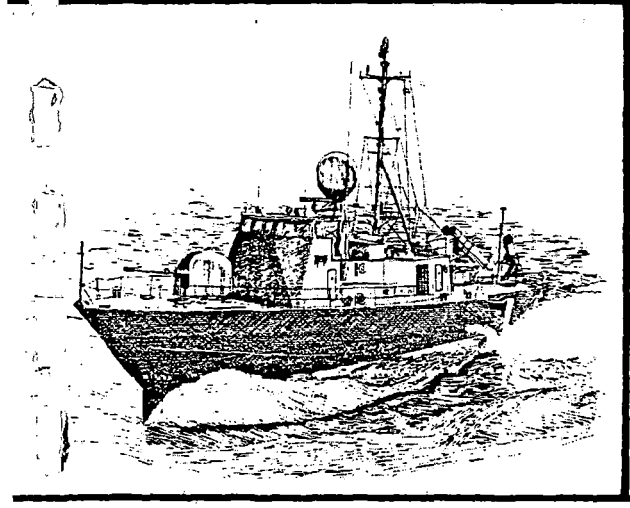


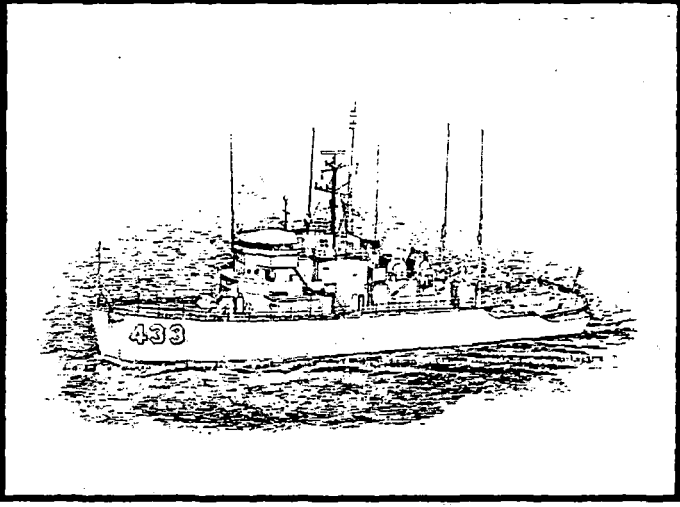












GENERAL INFORMATION:

- **STANDARD SIZES:**
  75-man system, or equivalent loadings for around-the-clock use. 16 days of operation before pump-out.

- **SERVICE HOURS REQUIRED (Average Monthly):**
  Tank Pump-Out and Cleaning—4 hours.
  During Normal Operation—None, fully automatic.

- **REQUIREMENTS FOR SYSTEM SUPPORT:**
  AC power for pumps and controls.
  AC or DC power for evaporator.
  Fresh or salt water at minimum of 30 psig for flushing.

- **CERTIFICATION:**
  Approved under U.S. Coast Guard standards for marine installation —
  Model ETS-II: #159.15/1012/1/III.

TECHNICAL SPECIFICATIONS:

SYSTEM PARAMETERS (based on 25-man crew)

- ***Electrical Demand:***

  Evaporator — 8 KW (approximately 24 hours per day)

  Macerator/Transfer (M/T) Pumps — 1.4 KW each (approximately 15 seconds per flush)

  Controls — 0.3 KW each (continuous)

- ***Sewage Volume Per Day:*** 48 gallons (average)
- ***Rate of Evaporation:*** 2 gallons per hour
- ***Service Interval:*** 16 days

SYSTEM COMPONENTS

- ***Evaporator:***

  Size — 80 gallon capacity, height 60", diameter 40"

  Materials — Stainless steel tank with Teflon inner lining, fiberglass insulation

  Level Sensors — High and low, ball float type

  Inputs — 1¼" sewage line from M/T Pumps and 1" fresh water tank rinse line

  Outputs — 1½" vapor exhaust line and 2" sludge discharge line

  Operation — Heaters (5.5 KW) controlled by low level sensor to evaporate liquids. Solids build-up detected by decrease in thermal demand. M/T Pumps inactivated when liquid rises to high level sensor.

- ***Vapor Treatment System:***

  Size — Height 30", diameter 18"

  Materials — Stainless steel with insulation lagging

  Operation — Heater (1.8 KW) controlled by thermostat and air flow

- ***Automatic Controls:***

  Cabinet Size — Height 20", depth 11", width 20"

  Circuitry — Functions to control operation of M/T Pumps, monitor liquid levels, solids accumulation, and system status for servicing

  Service Status — Four control panel lights indicate system status: Power On, Evaporator Heaters On, Evaporator Full, and Evaporator Service

- ***Macerator/Transfer Pump:***

  Capacity — 1½ HP, 50 foot head at 30 gpm

  Power Options Available — 115 VAC — single phase, 208 VAC — three phase, 230 VAC — single phase, 440 VAC — three phase, all 60 HZ.

  Interface Requirements — Input 3" or 4" diameter line, output 1¼" diameter pressure line

  Foreign Objects Accepted—Shop rags, pocket combs, ball point pens, etc.

  Installation — Hung from deck or flooring below toilet when space is available (allows for more than one toilet per pump in this configuration). Or, mounted above deck or floor adjacent to toilet where space is not available below the toilet.

- ***Controlled Volume Flush Toilet:***

  Flush Volume — One pint per urination and two to three pints per defecation

  Toilet Space Requirement—1. Pump below deck: 15" wide, 24½" deep; 2. Pump on same deck: 26" wide, 32" deep

  Toilet Size & Materials — Standard size and height vitreous china bowl

- ***Controlled Volume Flush Urinal:***

  Flush Volume—One pint

  Urinal Size & Materials — Standard marine size, vitreous china

For additional information write:

GATX

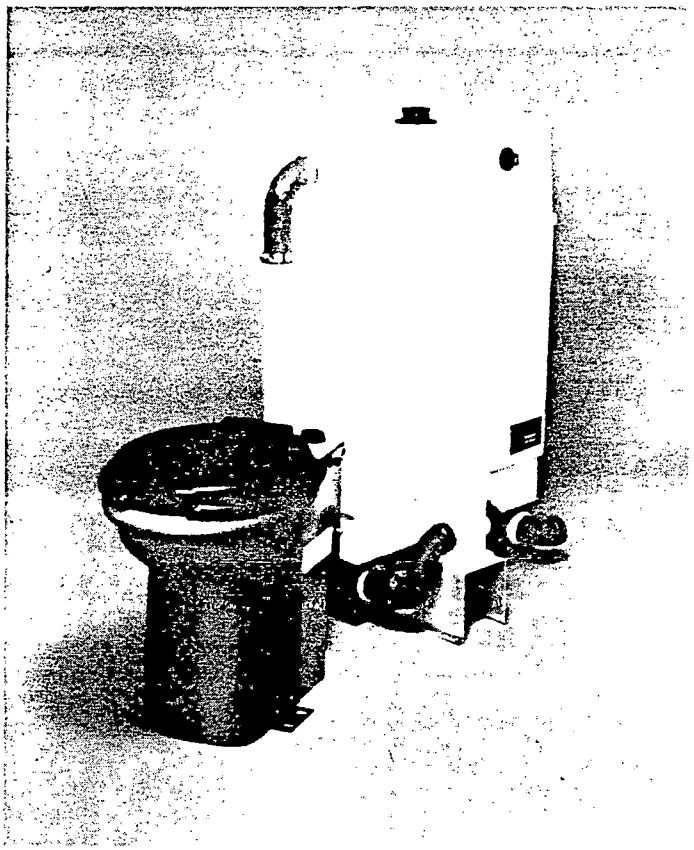
GARD, INC.
7449 North Natchez Ave.
Niles, IL 60648
312-647-9000

Suite 1000
1100 - 17th St. N.W.
Washington DC 20036
202-293-5310

Microphor

MICROPHOR®

ON-BOARD SEWAGE TREATMENT SYSTEMS



MICROPHOR®

Quality Railroad Products

Microphor, Inc., P.O. Box 1460, 452 East Hill Road, Willits, CA 95490, USA.
Telephone: (800) 358-8280. In California: (707) 459-5563
Telex: 271283 (MICROPHOR WLLT) FAX: (707) 459-6617

Microphor Export Corp., 2 South Street, Hythe, Southampton, SO4 6EB, England. Telephone: 0703/849495. Telex: 47288 (PCSUPP G)

Microphor Europe GmbH, Postfach 80 03 59, Huttenstrasse 45, 4320 Hattingen, West Germany. Telephone: (0 23 24) 29-5546
Telex: 8229974 (THH D)

HOW THE SYSTEM WORKS

1. The Microphor toilet and sewage treatment system is a bacteriological type system for disposing of human waste products.

2. The system includes choice of either stainless steel or vitreous china two quart flush toilets with integral or wall mount flushing mechanism and waste treatment tank with chlorinator and secondary.

3. Treatment tank (or tanks) can be mounted inside the car or engineered to fit under the car depending on space available and can be insulated and electrically heated if necessary to prevent freezing in winter, heating also maintains the biological action within the treatment tank.

4. The Microphor toilet is flushed by depressing the integral or wall mount lever or button. This supplies a compressed air signal to shift the air and water sequence valve to allow water to start flowing into the toilet bowl and flapper to open to accept waste into the lower evacuation chamber.

5. Flapper stays open for approximately six seconds and then closes and hermetically seals off the lower evacuation chamber. The chamber is then pressurized with air and waste is evacuated into the treatment tank. While this action is taking place the toilet bowl level is replenished with two quarts of fresh water for the next use.

6. Once the waste and liquids have entered the treatment tank the liquids are gravity filtered through a series of fibre filter columns mounted in a dam in the lower portion of the treatment tank. The liquid then passes through the chlorinator unit where it is chlorinated by solid

Continued

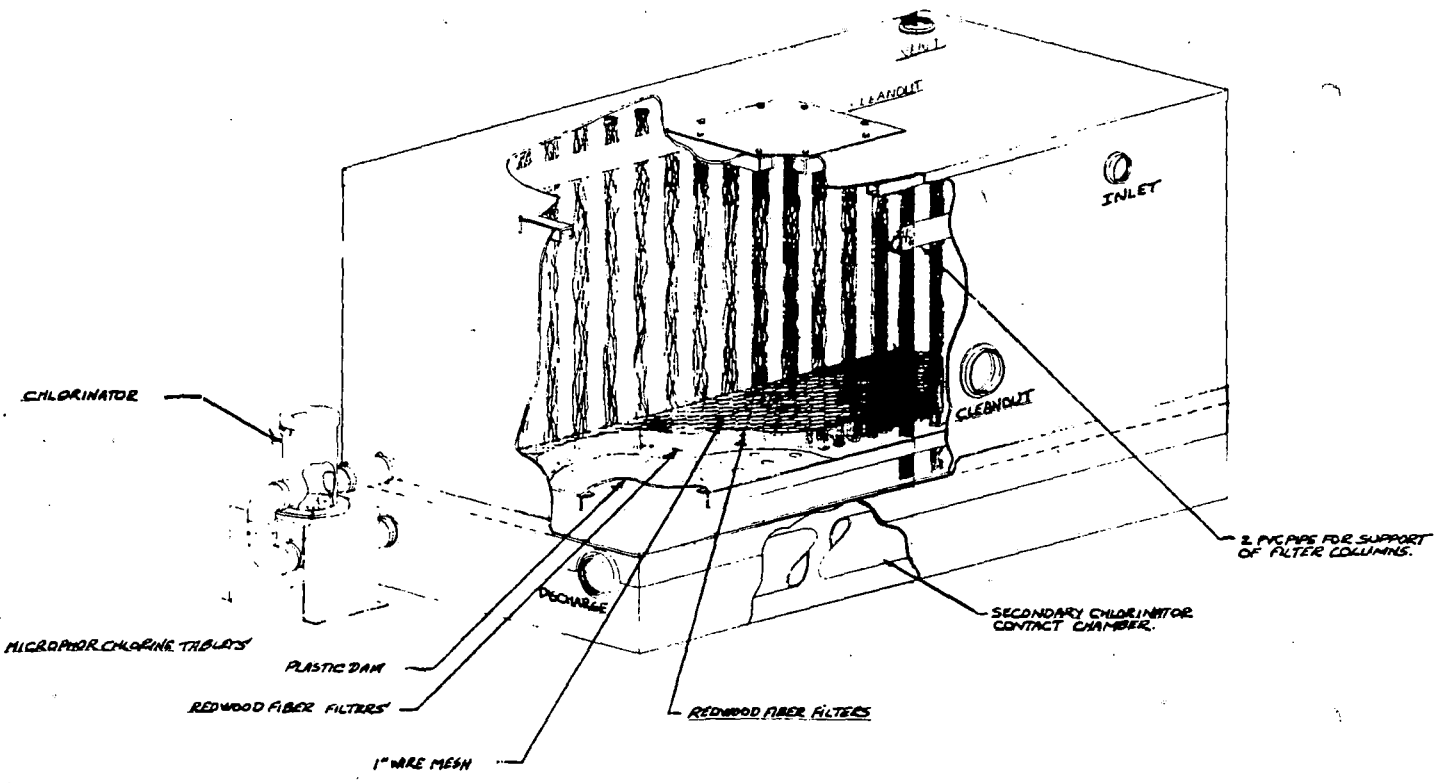
chlorine tablets. From there it flows into the secondary.

7. In the secondary the chlorinated liquid flows through a series of baffles thus allowing the chlorine time to reduce the coloform bacteria count to 0, before being allowed to drain onto the trackbed via a drain port on the bottom of the tank.

8. The solid waste still remaining in the treatment tank is broken down bacteriologically by microbes, which live within the treatment tank, to a liquid (which drains off as described above) and to a carbon dioxide which escapes through the tank vent port.

9. In order to maintain the optimum efficiency of the Microphor system, every effort should be made to keep antibacterial cleaners and foreign objects away and out of the system.

INTERIOR VIEW OF TREATMENT TANK



OPERATIONAL REQUIREMENTS

1. To operate, the system must have air at 60 pounds pressure and water at 1-50 pounds pressure. The toilet will not work without both air and water.

2. To adjust air and water, cover must be removed. The hex head needle valve adjusting screw extends to the left, out of the lower cap of the valve body. Using two 3/8" open end wrenches, hold hex head with one wrench and loosen lock nut with other 3/8" wrench. Turning hex head clockwise on the needle valve will give a longer flush cycle, turning counterclockwise will give a shorter flush. The water should cover the flapper in the bottom of the bowl. The air evacuation blast should be approximately 5-7 seconds. Always retighten lock nut on needle valve when through with adjustment.

3. The Regulator-Filter-Oiler is located in the air line ahead of the air controlled valve. A check should be made at the start of every trip to make sure the oiler has oil to the full mark. If oil is needed, turn off air and then remove oil fill plug on top of oiler and fill with Microphor light oil (part #24704). The oiler has been factory set to use one drop of oil per flush. If adjustment is needed, turning the slotted adjustment screw clockwise increases the amount of oil, counterclockwise for less oil. The regulator filter has an automatic dump device. If for some reason moisture collects in the bottom of the filter unit, it can be dumped manually by pushing exhaust pin in bottom of filter.

4. If the toilet becomes plugged, shut off the water supply, shut off the air supply, press the valve button several times to bleed off the air pressure. When air pressure is out of the valve, the flapper in the bottom of the toilet can be pushed open. Use a plunger (plumber's friend) as with any standard toilet. If the plunger does not clear the toilet, check to see if the restriction can be removed with a hooked wire, being careful not to damage the rubber seal on the flapper or the mating surface on the hopper. When the passage becomes clear, turn on the air and water and press flush button to start flush cycle. In the discharge line from the toilet to the treatment tank, there is a clean-out wye or tee which can be opened to assist in cleaning obstructions from the line.

5. To clean Microphor toilets, use non-abrasive, bio-degradable cleaners such as Fantastic, Ivory Snow, Formula 409, Mr. Clean and Janitor in a Drum. Sanitizers in general are not to be used. The carbolic or kreosote base sanitizers when they are flushed into the treatment tank stop the biological action, to clean exterior bowl use Microphor #24690 Stainless Steel Cleaner.

6. In the Microphor process, the effluent from the treatment tank flows through the chlorinator which is full of chlorine tablets. The solid waste is broken down by biologic action and becomes liquid and carbon dioxide. Chlorinators are located next to the treatment tank. The treatment tank can be plastic or

Continued

metal, inside the car, or bolted on under the car. Locate the treatment tank and then find the chlorinator. (Some large tanks may have more than one chlorinator.) Locate and check the chlorinator at the start of every run. The lid of the chlorinator should be removed and filled with Microphor tablets (part #24706).

7. This toilet is designed for disposal of human waste and toilet tissue only. Do not put any other item, material or liquid into this toilet.

SIZING A TREATMENT SYSTEM ?

Because of the many variable factors involved when sizing a system for railroad applications the following procedure is recommended.

First contact your Microphor representative, if you are not sure who this is contact Microphor directly and we will assist you. Please be able to tell us the number of people using the car daily and for how many hours daily. Also, the length of each trip in addition to how many stops the train makes along the way. These applications usually fall into several catagories.

1. Commuter
2. Long Distance
3. Crew Equipment
4. Private Car

Taking these factors into account the representative will probably require a trip to your location to determine the number of toilets involved and how much space is available inside or under the car for treatment tanks of the proper size.

If this is not possible then a complete set of undercar and interior drawings may provide the necessary information to allow a quotation to you. If drawings are sent they should denote all pertinent information in English please.

NOTE !

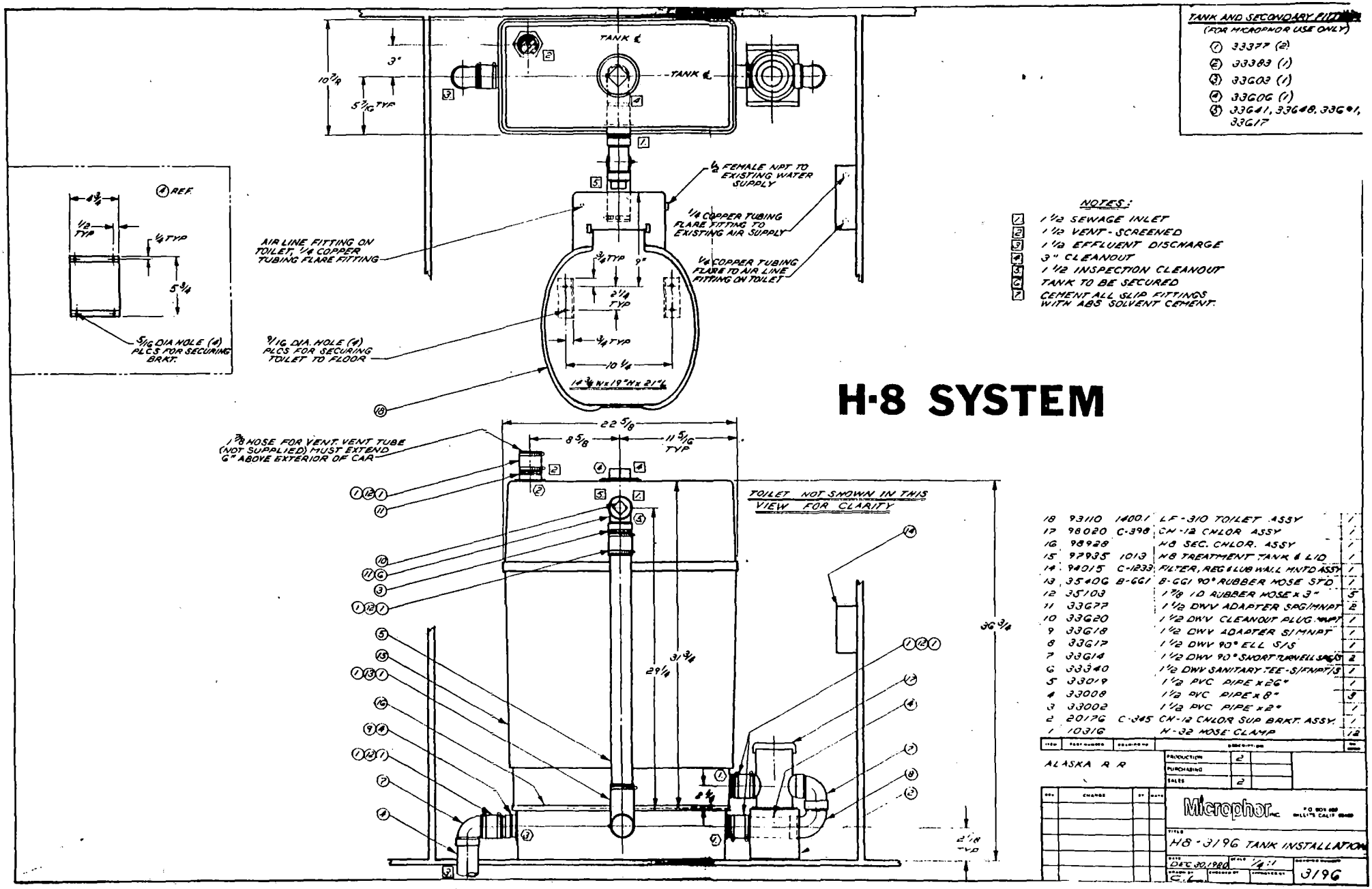
The following drawings are representative type systems which Microphor has done in the past and are intended for reference only!

Please notice the various sizes of the treatment tanks and the different types of toilets, as well as the various layouts which depend on the space available, customer preference and load factors.

The first drawing is an isometric cutaway view showing a typical treatment tank construction which is common to all of our tanks regardless of size. The H8 and H12 plastic tanks noted are standard and require only the correct porting before they can be shipped out. All references to dimensions are American standard inches. If however, we supply approval drawings to the European market they will always contain metric millimeters as reference.

Thank You.

H-8 SYSTEM



TANK AND SECONDARY FITTINGS
(FOR MICROPHOR USE ONLY)

- (1) 33377 (2)
- (2) 33383 (1)
- (3) 33G03 (1)
- (4) 33G06 (1)
- (5) 33G41, 33G48, 33G91, 33G17

NOTES:

1. 1 ½ SEWAGE INLET
2. 1 ½ VENT - SCREENED
3. 1 ½ EFFLUENT DISCHARGE
4. 3" CLEANOUT
5. 1 ½ INSPECTION CLEANOUT
6. TANK TO BE SECURED
7. CEMENT ALL SLIP FITTINGS WITH ABS SOLVENT CEMENT.

18	93110	1400.1	LF-310 TOILET ASSY	1
17	98020	C-398	CN-12 CNLOR ASSY	1
16	98928		H8 SEC. CHLOR. ASSY	1
15	97935	1013	H8 TREATMENT TANK & LID	1
14	94015	C-1233	FILTER, REG & LUB WALL MNTD ASSY	1
13	3540G	B-GG1	8-GG1 90° RUBBER HOSE STD	1
12	35103		1 7/8 I.D RUBBER HOSE x 3"	5
11	33G77		1 ½ DWV ADAPTER SPG/MNPT	2
10	33G20		1 ½ DWV CLEANOUT PLUG MNPT	1
9	33G18		1 ½ DWV ADAPTER S/MNPT	1
8	33G17		1 ½ DWV 90° ELL S/S	1
7	33G14		1 ½ DWV 90° SHORT TURNELL SPG/S	2
6	33340		1 ½ DWV SANITARY TEE-S/S/FNPT/S	1
5	33019		1 ½ PVC PIPE x 26"	1
4	33008		1 ½ PVC PIPE x 8"	3
3	33002		1 ½ PVC PIPE x 2"	1
2	20176	C-345	CN-12 CNLOR SUP BRKT. ASSY.	1
1	10316		M-32 HOSE CLAMP	12

ALASKA R R

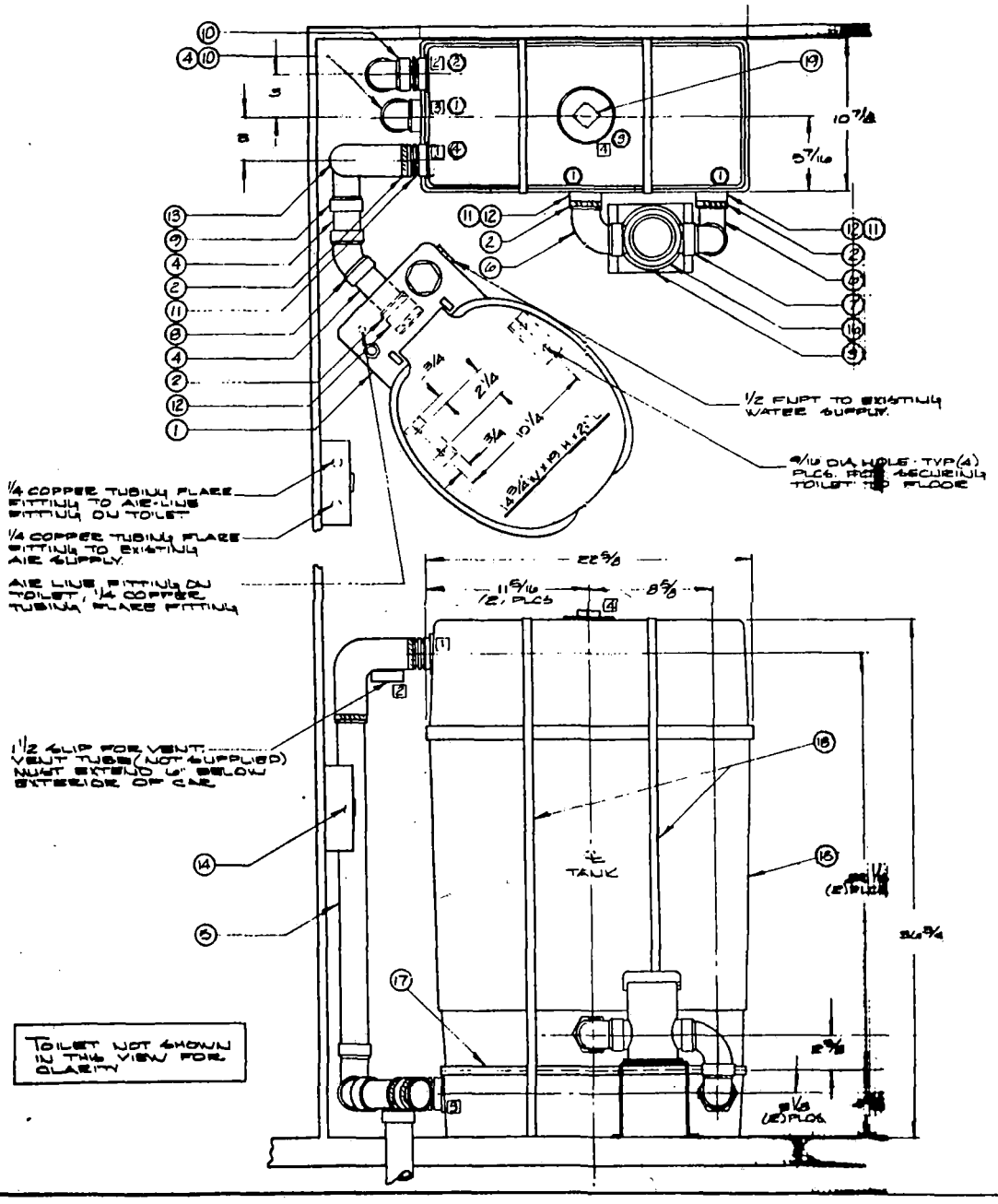
PRODUCTION	2	
PURCHASING		
SALES	2	

NO.	CHANGE	BY	DATE

Microphor INC. P.O. BOX 368 WILLITS CALIF 95490

TITLE: H8-3196 TANK INSTALLATION

DATE: DEC 30, 1980 SCALE: 1/4:1 DRAWING NO. 3196



PRINT DISTRIBUTION	
ENGINEERING	
MARKETING	1
CUSTOMER	
MACHINE SHOP	
PLASTIC SHOP	
SHEET METAL SHOP	
PRODUCTION	2
SHIPPING	
QUALITY CONTROL	1

TANK & SECONDARY FITTINGS (FOR MICROPHOR USE ONLY)

1. 33603, 33609 (2)
2. 33588, 33609 (1)
3. 33606 (1)
4. 33603, 33609, 33602, 33610

Note:

1. 1 1/2 SEWAGE INLET
2. 1 1/2 VENT
3. 1 1/2 EFFLUENT DISCHARGE
4. 3" CLEANOUT
5. TANK TO BE SECURED
6. CEMENT ALL SLIP FITTINGS WITH ABS SOLVENT CEMENT

H-8 SYSTEM

A	33051		3" CLEANOUT PLUG	1
18	M5824		1/2" SAUERIG STRAP 100°LG	2
17	99928		H-8-3339 SEC CHLORINATOR	1
16	78080	398	CH-8 CHLOR. ASSY	1
15	97995		H-8-3339 TANK & LID ASSY	1
14	9740M	1238	FILTER, REG & LUB WALL ASSY	1
13	33462		1"ID 90° RUBBER HOSE	1
12	35103		1"ID x 9"LG BREAKER HOSE	3
11	33677		1 1/2 DWV ADAPTER - SPIGOT/HUB	3
10	33679		1 1/2 DWV 90° SHORT TURN ELL - H/H	2
9	33017		1 1/2 DWV 90° ELL - S/S	1
8	33610		1 1/2 DWV 45° ELL - S/S	1
7	33614		1 1/2 DWV 90° SHORT TURN ELBOW	1
6	33613		1 1/2 DWV 90° ELL - SPIGOT	2
5	33021		1 1/2 PVC PIPE 30"LG	1
4	33006		1 1/2 PVC PIPE 10"LG	3
3	EC1720	346	CH-8 CHLOR OUTLET ASSY	1
2	10816		H-38 HOSE CLAMP	8
1	93111	1402	LT-310 & TANK ASSY	1

AT A&E LOCOMOTIVE

PRODUCTION
PURCHASING
SALES

NO.	CHANGE	BY	DATE
A	ECO 334		

Microphor INC

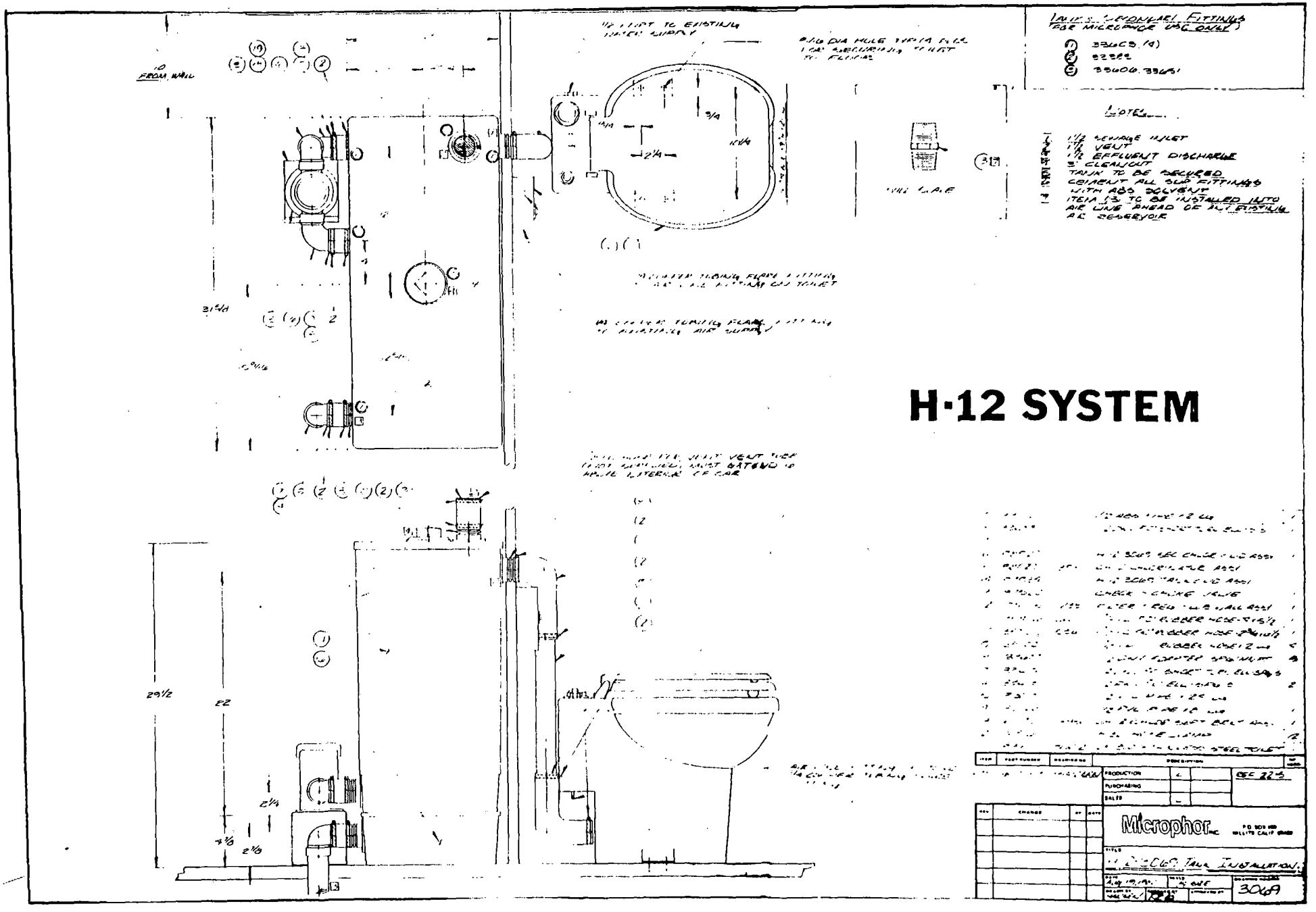
TITLE: Assy No. B5036 Testing Unit Specs

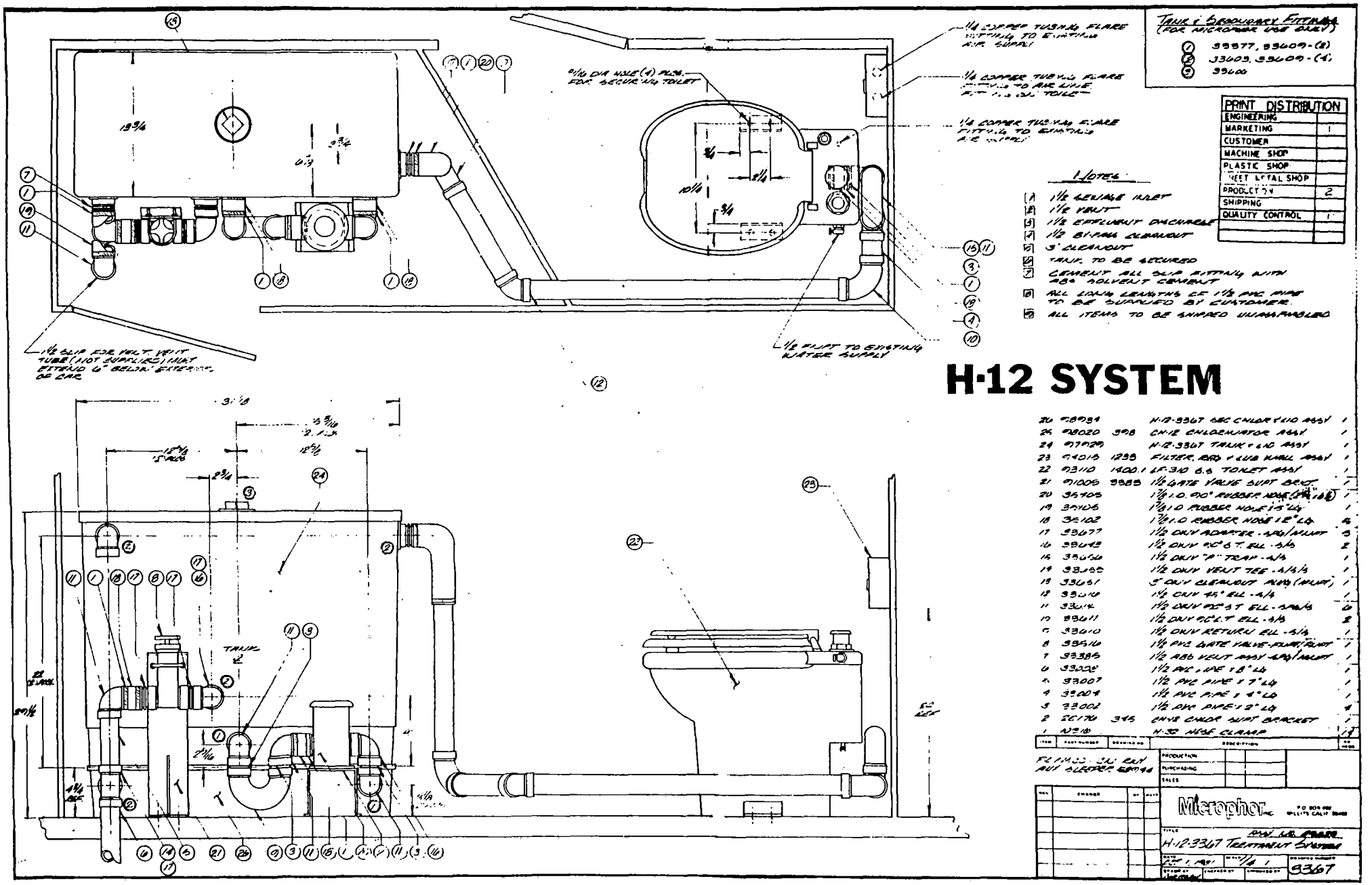
SCALE: NONE | SIZE: A4 | 1

DATE: SEPT. 14, 1981

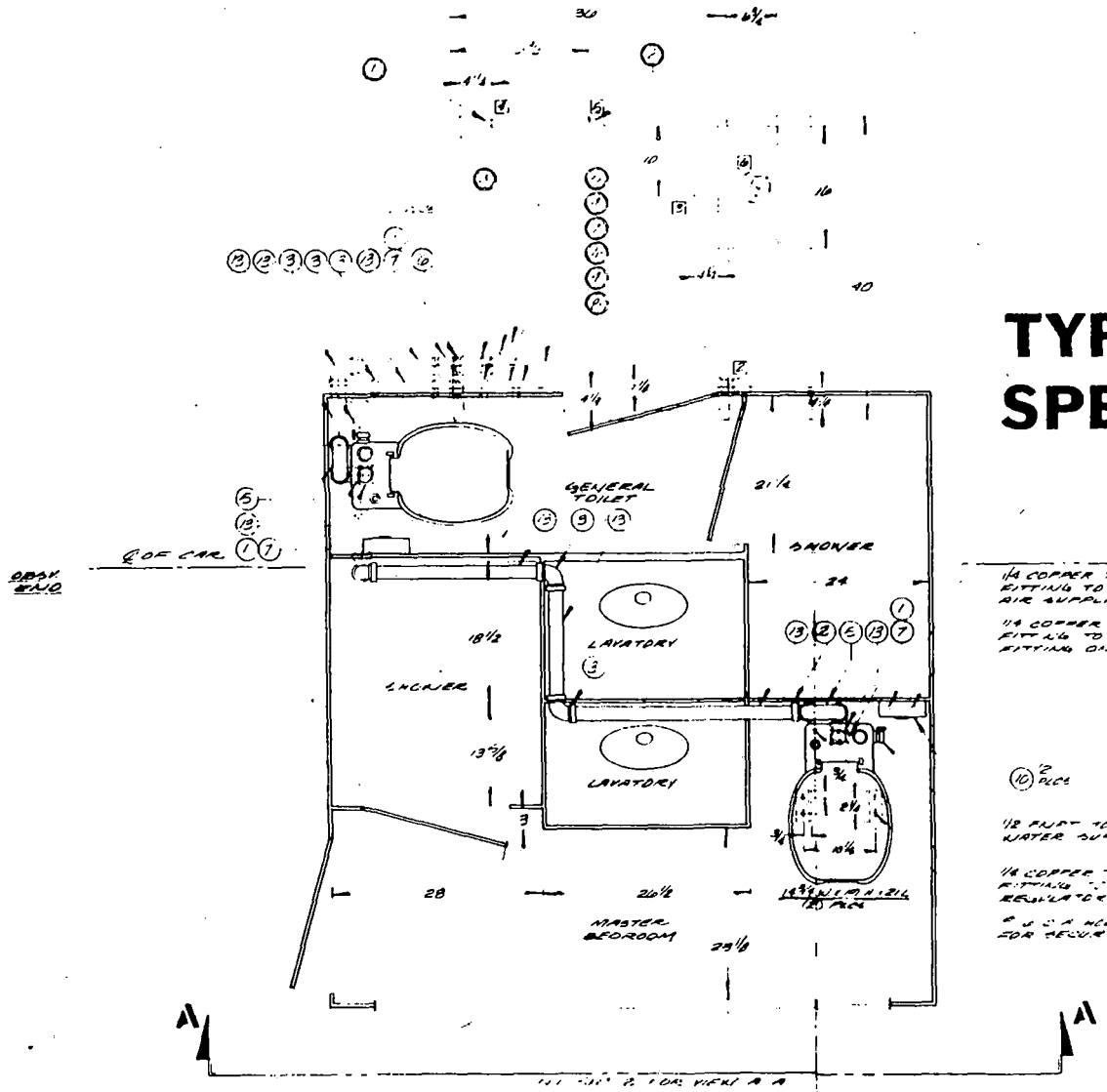
3359

H-12 SYSTEM




TANK & BOUNDARY FITTINGS
(FOR MICROPHOR USE ONLY)
33577, 33609-(2)
33609, 33609-(4)
33600
PRINT DISTRIBUTION
ENGINEERING
MARKETING 1
CUSTOMER
MACHINE SHOP
PLASTIC SHOP
SHEET METAL SHOP
PRODUCTION 2
SHIPPING
QUALITY CONTROL 1
NOTES
1½ LEVAGE INLET
1½ VENT
1½ EFFLUENT DISCHARGE
1½ BI-PASS CLEANOUT
3" CLEANOUT
TANK TO BE SECURED
CEMENT ALL SLIP FITTING WITH ABS SOLVENT CEMENT
ALL LOOSE LENGTHS OF 1½ PVC PIPE TO BE SUPPLIED BY CUSTOMER.
ALL ITEMS TO BE SHIPPED UNASSEMBLED
1½ SLIP FOR VENT VENT TUBE (NOT SUPPLIED) INSERT FITTING 6" BELOW EXTERIOR OF CAB
1½ JOINT TO EXISTING WATER SUPPLY
1½ COPPER TUBING FLARE FITTING TO EXISTING H.W. SUPPLY
1½ COPPER TUBING FLARE FITTING TO AIR LINE AT TOILET
1½ COPPER TUBING FLARE FITTING TO EXISTING H.C. SUPPLY
⅞" DIA HOLE (4) PLACES FOR SECURING TOILET
TANK
TOILET
H-12 SYSTEM
20 70791 H-12-3367 SEC CHLOR ASSY 1
26 78020 398 CHLORINATOR ASSY 1
24 77029 H-12-3367 TANK ASSY 1
23 74015 1238 FILTER, BRD ASSY 1
22 73110 1400 LF-310 6.6 TOILET ASSY 1
21 71005 3989 1½ GATE VALVE SLIP BRKT 1
20 35705 1½ I.D. 90° RUBBER HOSE (1½" I.D.) 1
19 35705 1½ I.D. RUBBER HOSE 12" LG 1
18 35102 1½ I.D. RUBBER HOSE 8" LG 4
17 33677 1½ DWV ADAPTER - SPG/SPIGOT 3
16 33645 1½ DWV 90° S.T. ELL - S/S 2
15 33656 1½ DWV "P" TRAP - S/S 1
14 33650 1½ DWV VENT TEE - S/S/S 1
13 33651 3" DWV CLEANOUT ASSY (SPIGOT) 1
12 33610 1½ DWV 45° ELL - S/S 1
11 33612 1½ DWV 90° S.T. ELL - SPG/S 6
10 33611 1½ DWV 90° S.T. ELL - S/S 8
9 33610 1½ DWV RETURN ELL - S/S 1
8 33616 1½ PVC GATE VALVE-SLIP/SLIP 1
7 33385 1½ ABS VENT ASSY SPG/SPIGOT 1
6 33008 1½ PVC PIPE x 8" LG 1
5 33007 1½ PVC PIPE x 7" LG 1
4 33004 1½ PVC PIPE x 4" LG 1
3 33002 1½ DWV PIPE x 2" LG 1
2 2C170 345 CHV-8 CHLOR SLIP BRACKET 1
1 N218 H-30 HOSE CLAMP 17
FURNISH ONE SET ANTI SIEZE COMPOUND
PRODUCTION
PURCHASING
SALES
Microphor
H-12-3367 TREATMENT SYSTEM
1/4 1
93367

TYPICAL SPECIAL UNDER CAR SYSTEM



1/4 COPPER TUBING FLARE FITTING TO EXISTING AIR SUPPLY

1/4 COPPER TUBING FLARE FITTING TO NEW VALVE FITTING ON TOILET

(10) 2 PLCS

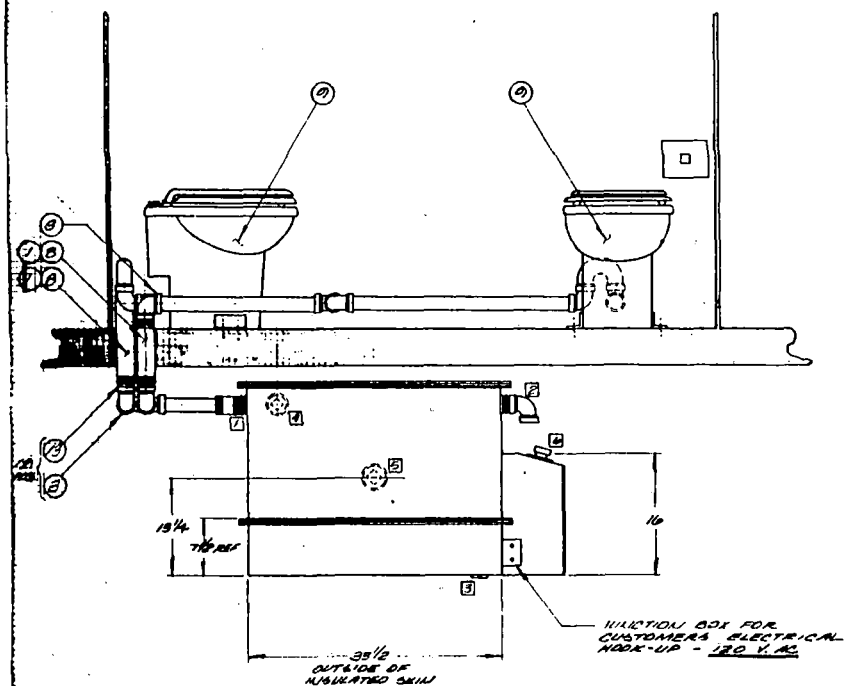
1/2 PIPE TO EXISTING WATER SUPPLY

1/4 COPPER TUBING FLARE FITTING TO NEW REGULATOR WITH LUBRICATOR AND 3/8 I.D. HOSE, 2 REQ'D FOR RECIRCULATING TOILET

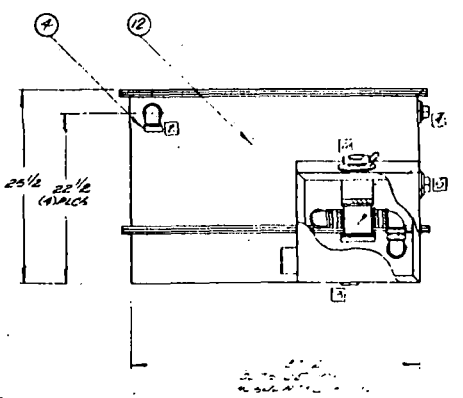
			12 PIPE CUT TO SUIT	
2			SPECIAL TREATMENT	
11				1
			FLUSH VALVE WITH SWING ARM	2
			30 SQ TOILET PAN	2
			3/8 I.D. RUBBER HOSE 12" LG	2
			3/8 I.D. RUBBER HOSE 13" LG	2
			2 CHV ADAPTER SPUD/NUT	2
			2 CHV P-TRAP	2
			2 CHV 90° WASTE ELBOW	1
			2 CHV 90° ELL 3/8	7
			2 CHV 90° ELL SPUD	1
			32 HOSE CLAMP	12

BART No 8E037
RENTAL CAR
3404.1

WALLS NOT SHOWN IN THIS VIEW FOR CLARITY



VIEW A-A
TAKEN FROM SHT. 1

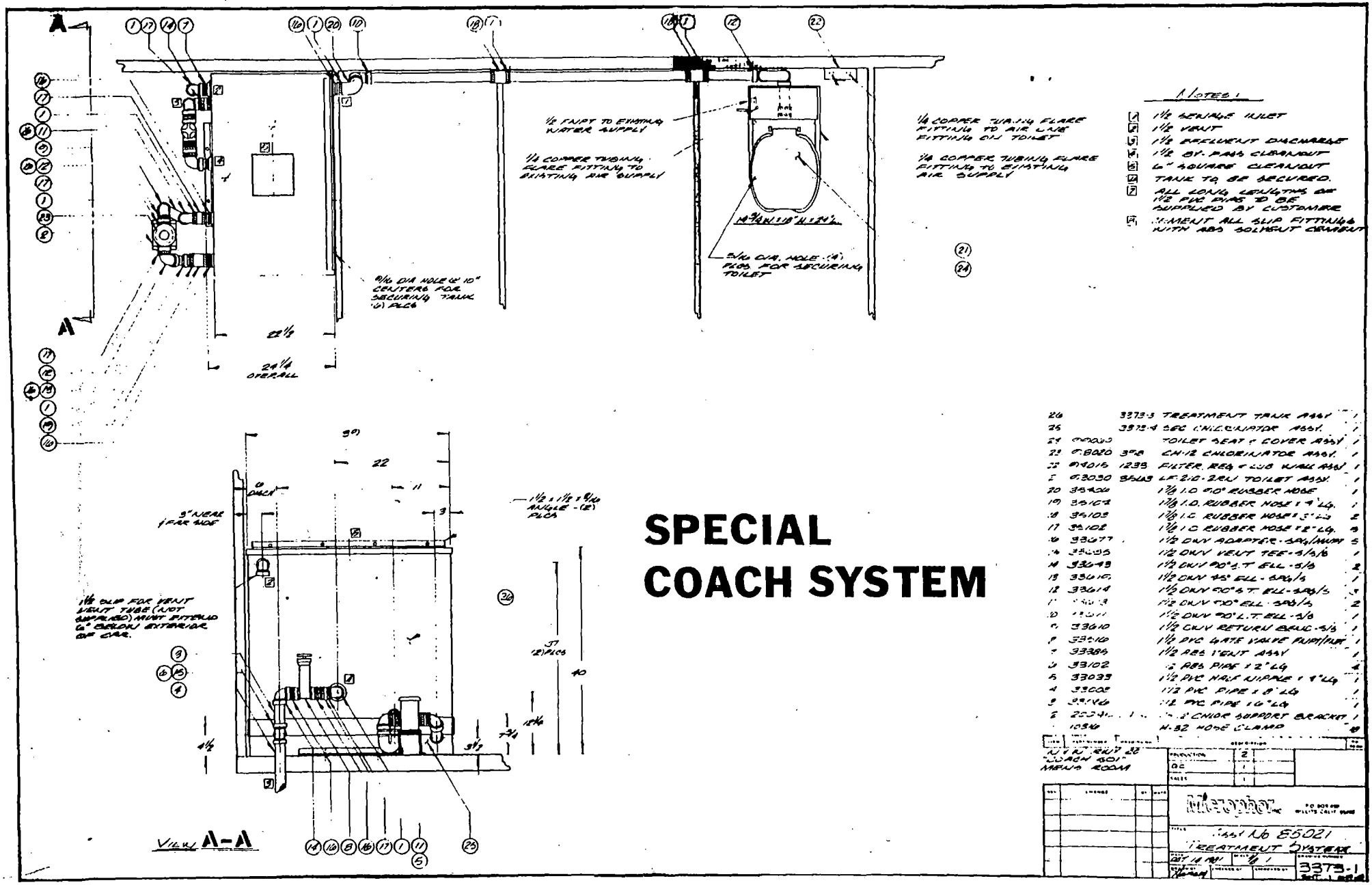


SEE SHT 1 FOR PARTS LIST

Murphy

Lic. No 95031
TREATMENT SYSTEM

3404-2



SPECIAL COACH SYSTEM

26		3373-3	TREATMENT TANK ASSY	1
25		3373-4	SEC CHLORINATOR ASSY.	1
24	0700J3		TOILET SEAT & COVER ASSY	1
23	0.8020	3"R	CH-12 CHLORINATOR ASSY.	1
22	0.9016	1235	FILTER, REG & LUB WALL ASSY	1
21	0.8030	3543	LF 2.0-2RV TOILET ASSY.	1
20	35400		1 1/2 I.D. 4.0" RUBBER HOSE	1
19	35104		1 1/2 I.D. RUBBER HOSE x 9" LG.	1
18	35103		1 1/2 I.C. RUBBER HOSE x 5" LG	2
17	35102		1 1/2 I.C. RUBBER HOSE x 2" LG.	3
16	33677		1 1/2 CNV ADAPTER - SPG/MNPT	5
15	35005		1 1/2 CNV VENT TEE - S/S/S	1
14	33643		1 1/2 CNV 90° S.T ELL - S/S	2
13	33616		1 1/2 CNV 45° ELL - SPG/S	1
12	33614		1 1/2 CNV 90° S.T ELL - SPG/S	5
11	[illegible]		1 1/2 CNV 90° ELL - SPG/S	2
10	[illegible]		1 1/2 CNV 90° L.T. ELL - S/S	1
9	33610		1 1/2 CNV RETURN BEND - S/S	1
8	33010		1 1/2 PVC GATE VALVE FLUSH/NPT	1
7	33384		1 1/2 ABS VENT ASSY	1
6	33102		2 ABS PIPE x 2" LG	4
5	33033		1 1/2 PVC NIPPLE x 4" LG	1
4	33002		1 1/2 PVC PIPE x 8" LG	1
3	[illegible]		1 1/2 PVC PIPE x 16" LG	1
2	25241	1	2" CHLOR SUPPORT BRACKET	1
	10340		H-52 HOSE CLAMP	10

NEW RAIL 82 "COACH 601" MENS ROOM

DRAWING	2	
QC	1	
SALES	1	

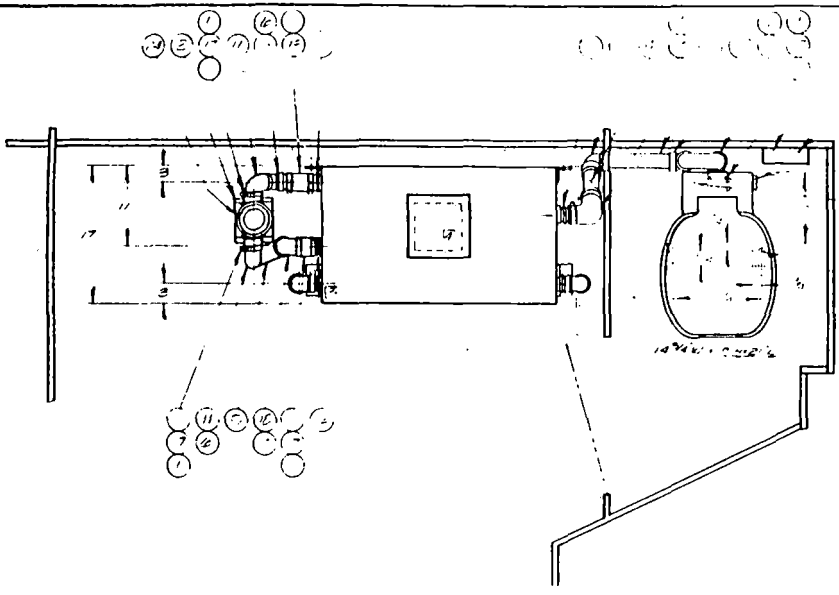
Allegheny

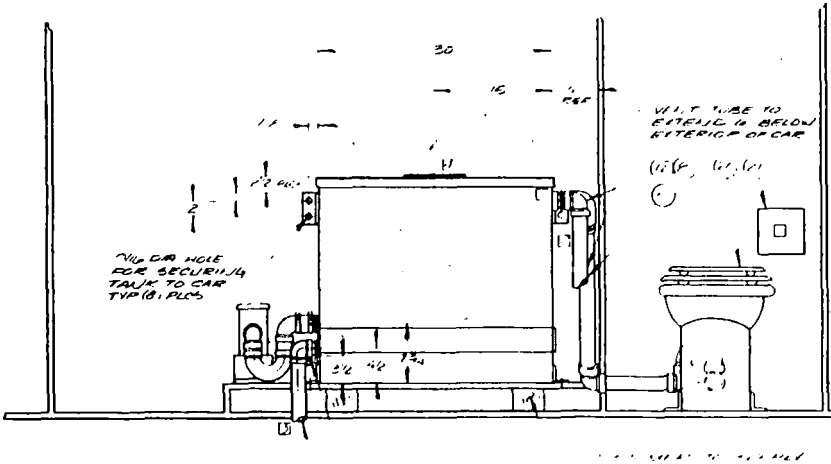
P.O. BOX 250 WILLOW CREEK, INDIANA

ASSY No E5021

TREATMENT SYSTEM

SCALE 1/4" = 1" | SHEET 1 | 3373-1




VENT TUBE TO EXTEND 12 BELOW EXTERIOR OF CAR
1/16 DIA HOLE FOR SECURING TANK TO CAR TYP (8) PLCS

1/4 COPPER TUBING FLARE FITTING TO EXISTING AIR SUPPLY.

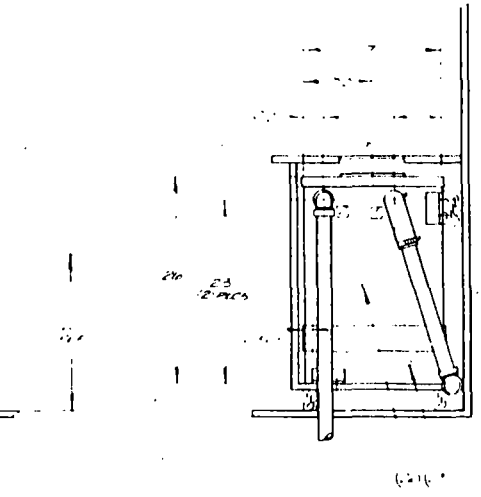
1/4 COPPER TUBING FLARE FITTING TO AIR LINE FITTING ON TOILET

1/2 PAINT TO EXISTING WATER SUPPLY

1/4 COPPER TUBING FLARE FITTING TO AIR SUPPLY

7/16 DIA HOLE - FOR SECURING TOILET - TYP 14. PLCS

CREW CAR SLEEPER SYSTEM



23	7A626	BPE	2W 2 CIRCULATOR ASSY	1
22	89003	3226-2	W-3226 SEC CHLOR ASSY	1
21	0.7006	3225-2	H-3225 TOILETTIC ASSY	1
20	0.9016	1233	FILTER REG & LUB ASSY	
19	0.212	1800	LF-3/0 2 3 TOILET ASSY	
18	25474		1/2 I.D. RC RUBBER HOSE 4 FT	1
17	35.06		3/4 I.D. RUBBER HOSE 3 3/4 LG	
16	35.02		1 1/2 - I.D. C.C. RUBBER HOSE 2' LG	4
15	43477		2 CLASS ADAPTER 300 INLET	2
14	4.4.26		2 CLASS 90 TEE 3 3	
13	44.018		2 CLASS 90 ELBOW & PLUG 23	
12	3.4.3		2 CLASS 45 ELL & PLUG	
11			2 CLASS 90 ELL 2 2	2
10			2 CLASS 90 ELBOW & PLUG 22	2
9			2 CLASS 90 ELBOW 3 3 3	
8	4.3.1		2 CLASS 45 ELL & PLUG 22	
7	44.3.4		2 ADAPTER 3 3 LG	
6	3.4.2		2 CLASS 90 ELL 2 2 LG	
5	44.2.6		2 ADAPTER 2 2 LG	2
4	4.4.1		2 CLASS 90 ELBOW & PLUG 2 2	1
3	44.1.4		1/2 I.D. 2 CLASS 90 ELL 2 LG	2
2	3.4.1.4		2 CLASS 90 ELL 2 2 LG	1
1	21.4.4	2450	4 1/2 - 2 CHAIR HOIST BRACKET	
	11.1.1		2 3/8 HOLE PLATE	2

		3225-1

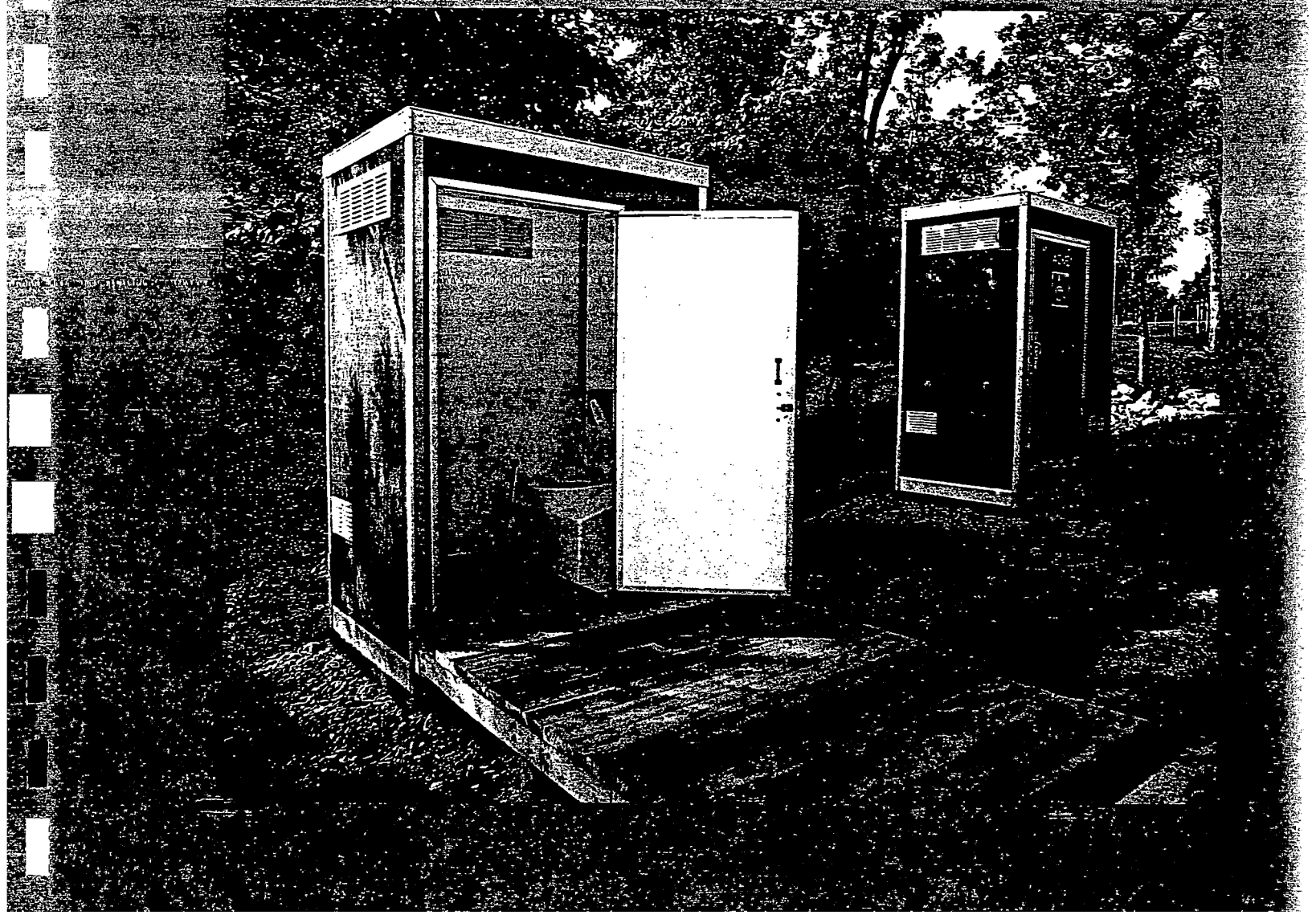
Monogram Sanitation

Monogram

SANITATION

800 W. Artesia Blvd., P.O. Box 9057, Compton, CA 90224-9057
(213) 638-8445 FAX: 638-8458

PORTABLE, FLUSHING TOILET SYSTEMS — Durable, quality sanitation for wherever there is the need.



From Monogram Sanitation A NORTEK COMPANY

We offer you:

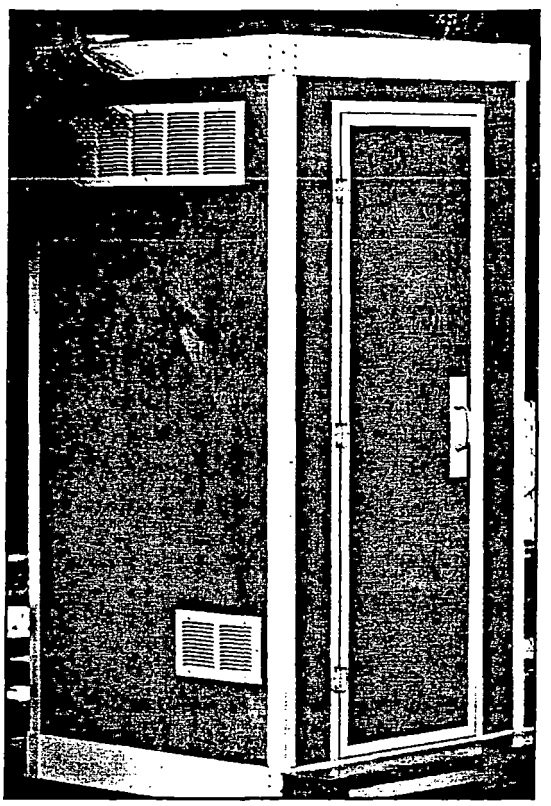
JET-O-MATIC® Toilet systems for remote areas that require no connections to:

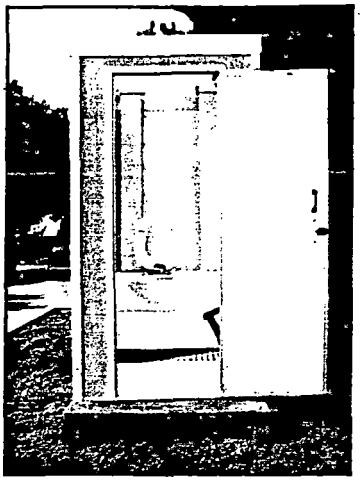
- ☐ water
- ☐ sewer
- ☐ power

The Jet-O-Matic® product line provides self-contained sanitation products for remote areas without access to conventional sewage systems. Self-contained implies that these products are not dependent on the availability of water, power or sewer lines for their usage.

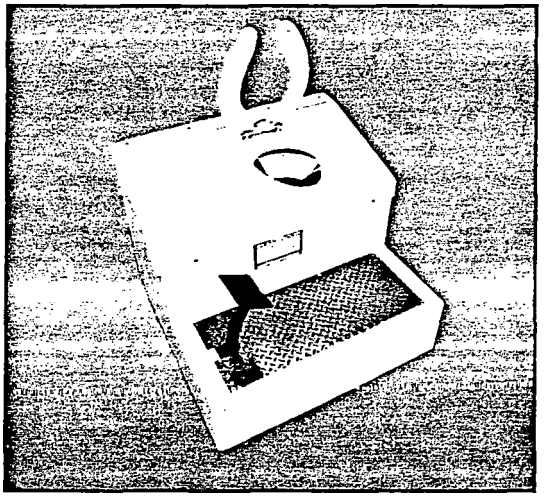
These self-contained retention type products are an outgrowth of and similar to the type in use by virtually all commercial aircraft. They were introduced by Monogram about two decades ago.

We at Monogram Sanitation have consistently maintained the lion's share of the world's commercial aircraft sanitation market for over two decades. Further, we are a dominant factor in surface transportation as well as selected other sectors in the field of sanitation.

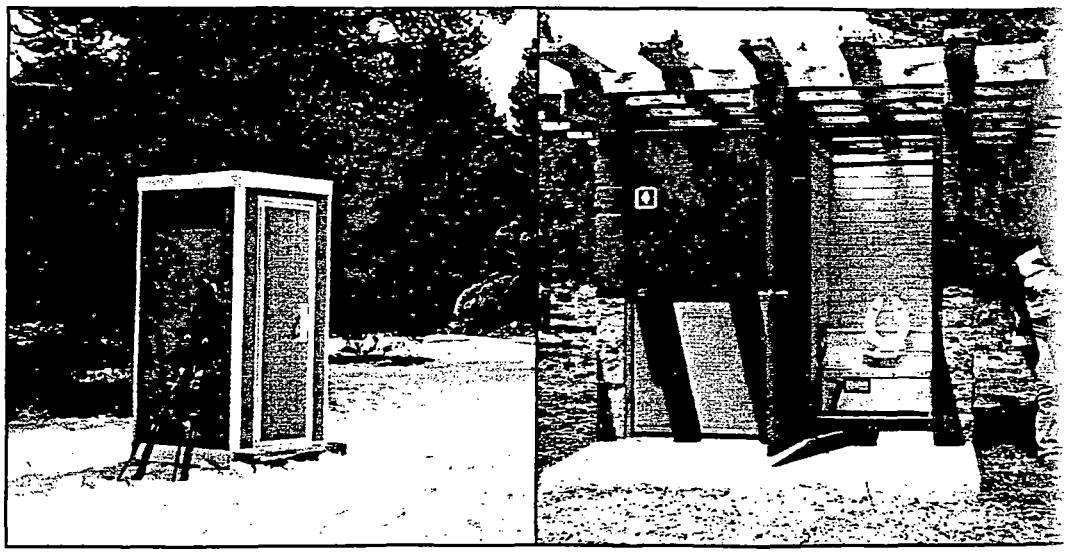


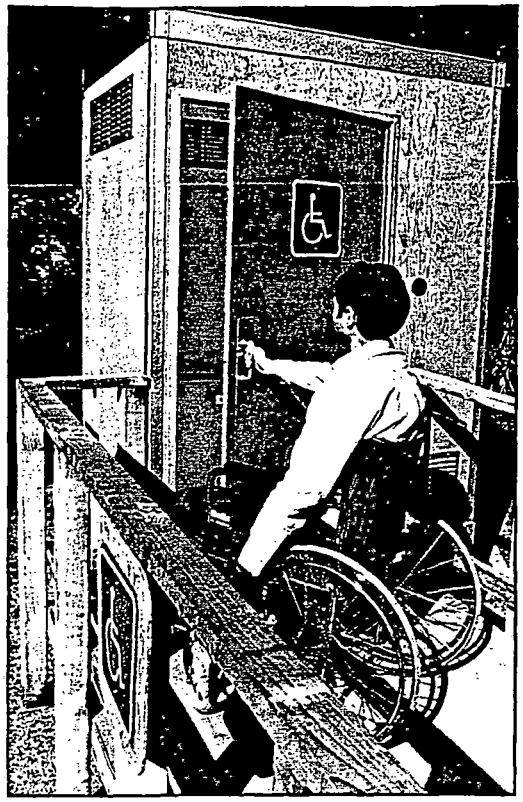


MODEL 625, Chemical Recirculating, Flushing Toilet housed in a vandal resistant cabana featuring 3/4" thick replaceable wall panels, skylight roof, chemical metering pump, polished stainless steel bowl and self closing bowl flapper valve. May be anchored as permanent or moved as a portable.

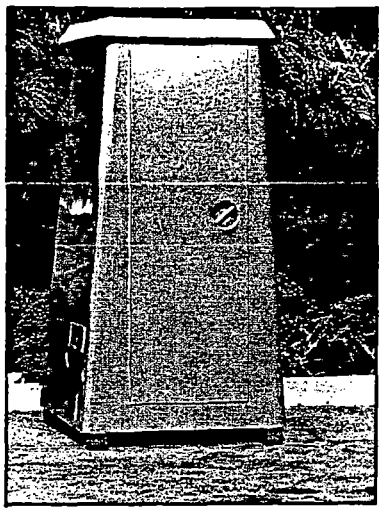


MODEL 626, Top Service Bench and Top Service Drain Valve, Available for all the large capacity Jet-O-Matic® Sanitation Systems. Hinged bench top rises to provide access to the unit's tank interior. Simplifies service, parts replacement and everyday cleanout procedures. For installation in new or existing buildings.

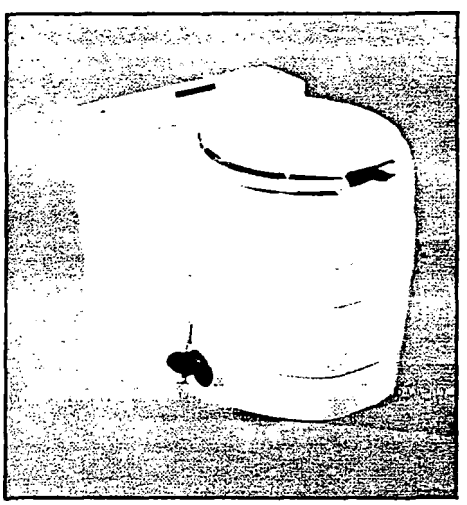




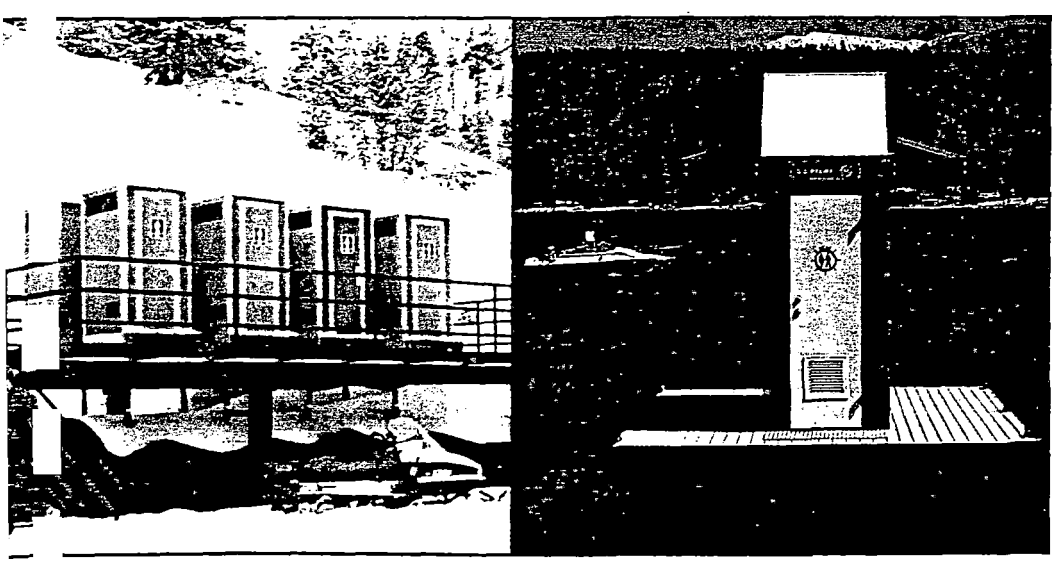
MODEL 703, High Capacity Dual Purpose Portable Restroom. Chemical recirculating flushing toilet with larger cabana combine general public use along with wheelchair accessibility. Hand operated flush, spray rinse, backrest and grab bars are all standard.



MODEL 631, Chemical Recirculating, flushing toilet housed in an all fiberglass cabana. 1000 use capacity, skid mounted for portability.



MODEL 601 (15000-001), Medium Capacity, Chemical Recirculating Flushing Toilet. Flushes by foot pedal. Widely used in toll stations, watch towers, draw bridges, rural offices, maintenance stations, guard houses, ski lift monitor stations, buses, ferry boats, excursion boats and tug boats, to name a few.



HOW IT WORKS

1. Self-contained – The Jet-O-Matic® system has all elements necessary for use, operation, fluid recycling and waste storage. Chemical reservoir and pump system automatically meters exact amount of chemical with each flush. Holding tank retains waste until pump-out or transfer to underground storage vault.

2. Recirculating – When flush pump is activated, fluid from holding tank is combined with a measured amount of chemical from reservoir. Fluid is then recirculated through bowl to holding tank.

3. Odor control – Treated waste accumulates in holding tank. Chemicals released into holding tank control odor.

4. Waste disposal – Large capacity Jet-O-Matics have two discharge ports – one for direct pump-out by service trucks; an optional method is to release the material directly into an underground vault. After waste removal, the Jet-O-Matic holding tank is hosed down, then recharged with water. Chemical reservoir is also refilled at this time.

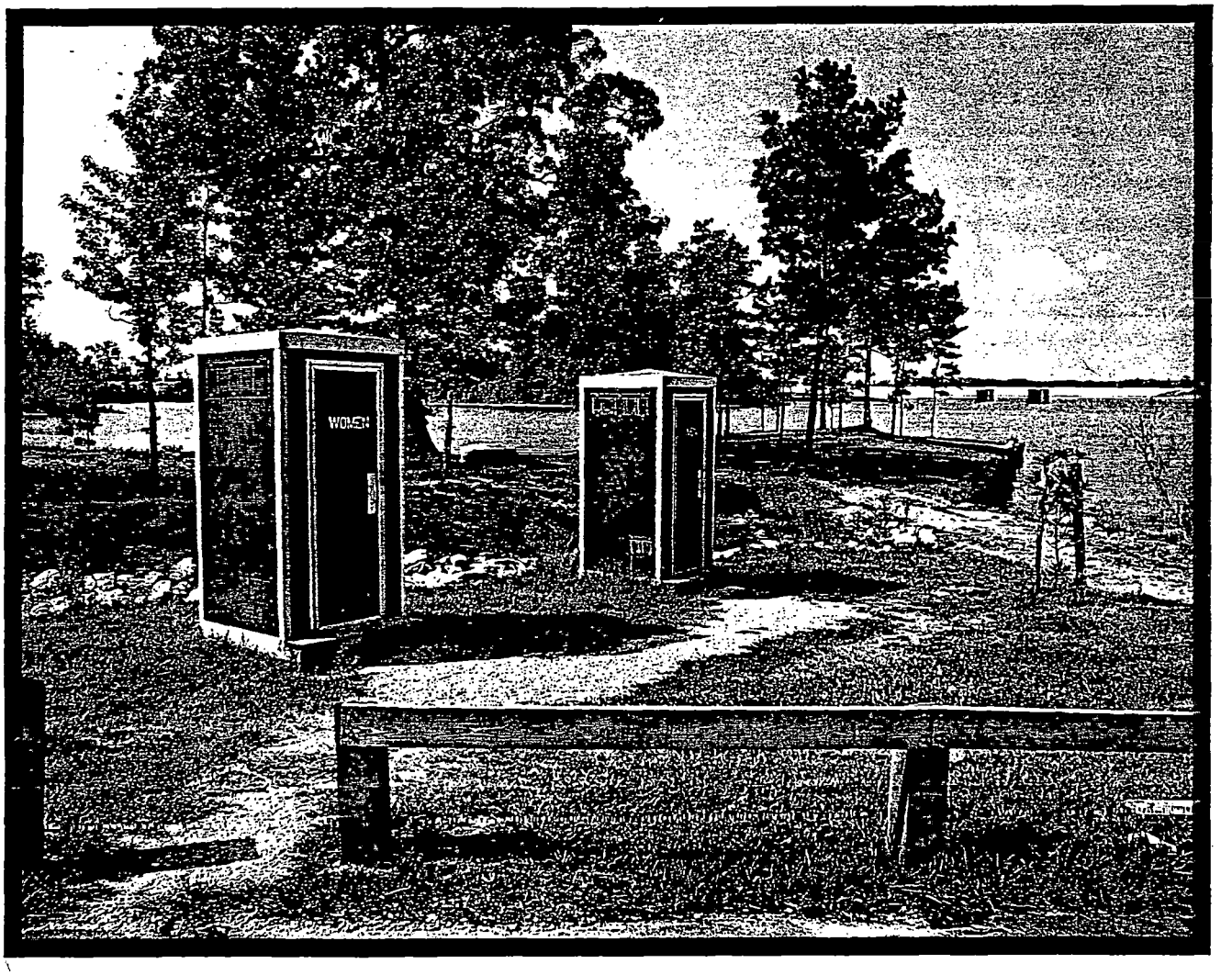
5. Simplicity and durability – Jet-O-Matics are highly reliable and trouble free; built to take extensive user wear, all climate fluctuations and temperature extremes.

CHEMICALS

JET-O-MATIC® odor control chemicals for recirculating and static toilets, waste storage vaults and pit toilets:

- MC-1000® – liquid chemical in easy to handle, 5 gallon high impact, D.O.T. approved containers or more economical 55 gallon drums
- MC-2000™ – non-formaldehyde base liquid chemical in 5 gallon container or 55 gallon drum
- MC-500™ – powdered chemical packaged in 32 oz. high impact plastic bottles marked off in 2 oz. increments

Additives of various kinds are also available.



Monogram Sanitation

800 W. Artesia Blvd., P.O. Box 9057, Compton, CA 90224-9057
(213) 638-8445 FAX: 638-8458

FAX: (213) 643-7478

1180

MONOGRAM SANITATION

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(213) 638-8445 FAX: 638-8458

ADVANCING THE STATE OF THE ART

...Aircraft Vacuum Toilets and Waste Systems for the 1990's and Beyond.

RELIABILITY: OUR NUMBER ONE OBJECTIVE

Monogram Sanitation — the industry leader in aircraft lavatory systems for over twenty-five years. Monogram is standard equipment for the majority of production aircraft from a Beech King Air to a Boeing 747. Our established worldwide Product Support Group has been an essential element to our success.

Only Monogram can combine its extensive aircraft sanitation experience with the vacuum toilet technology we developed for use on over 600 highly sophisticated rail cars. Working closely with current operators of aircraft vacuum toilet systems, Monogram focused attention on those areas requiring improvements to develop a second generation vacuum toilet system. The result: the most reliable, advanced aircraft vacuum lavatory system available.

Monogram is particularly pleased to have been selected to supply the complete Vacuum Toilet Waste System for the Airbus A-320 as well as the Vacuum Toilet Assembly for the Boeing 767 and 747-400 aircraft.

VACUUM TOILET LEADING CHARACTERISTICS

Flush Valve

- A unique electromechanical flush valve.* Straight through flow minimizes noise and prevents clogging.
- Toilet flush valve operation completely independent of vacuum supply. Opening of valve to full diameter of waste line is insured.
- Flush valve mechanism completely sealed from the waste line preventing corrosion and contamination.
- Controllable opening of flush valve produces gradual increases in sound level without explosive peaks.

*Pat. Pend.

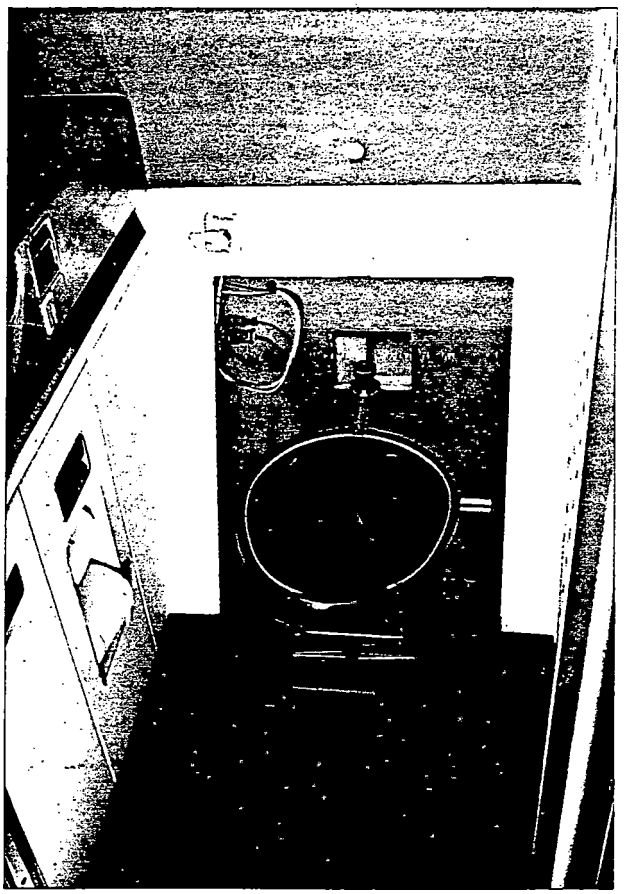
Rinse Valve/Vacuum Breaker

- Simplified, reliable floating poppet type vacuum breaker meets US-PHS requirements.
- Self-draining, floating plunger rinse valve.
- Only one moving part, no adjustments, no springs.

Reliability and Maintenance

- The only electric control module with "BITE" (Built In Test Electronics).
- All stainless steel structure and components.
- Modular design approach improves reliability and reduces service time.
- Manual shut off valve operates independently of motorized flush valve.
- Toilet assembly easily converts from right to left hand configuration minimizing inventory level.
- Lightweight design.

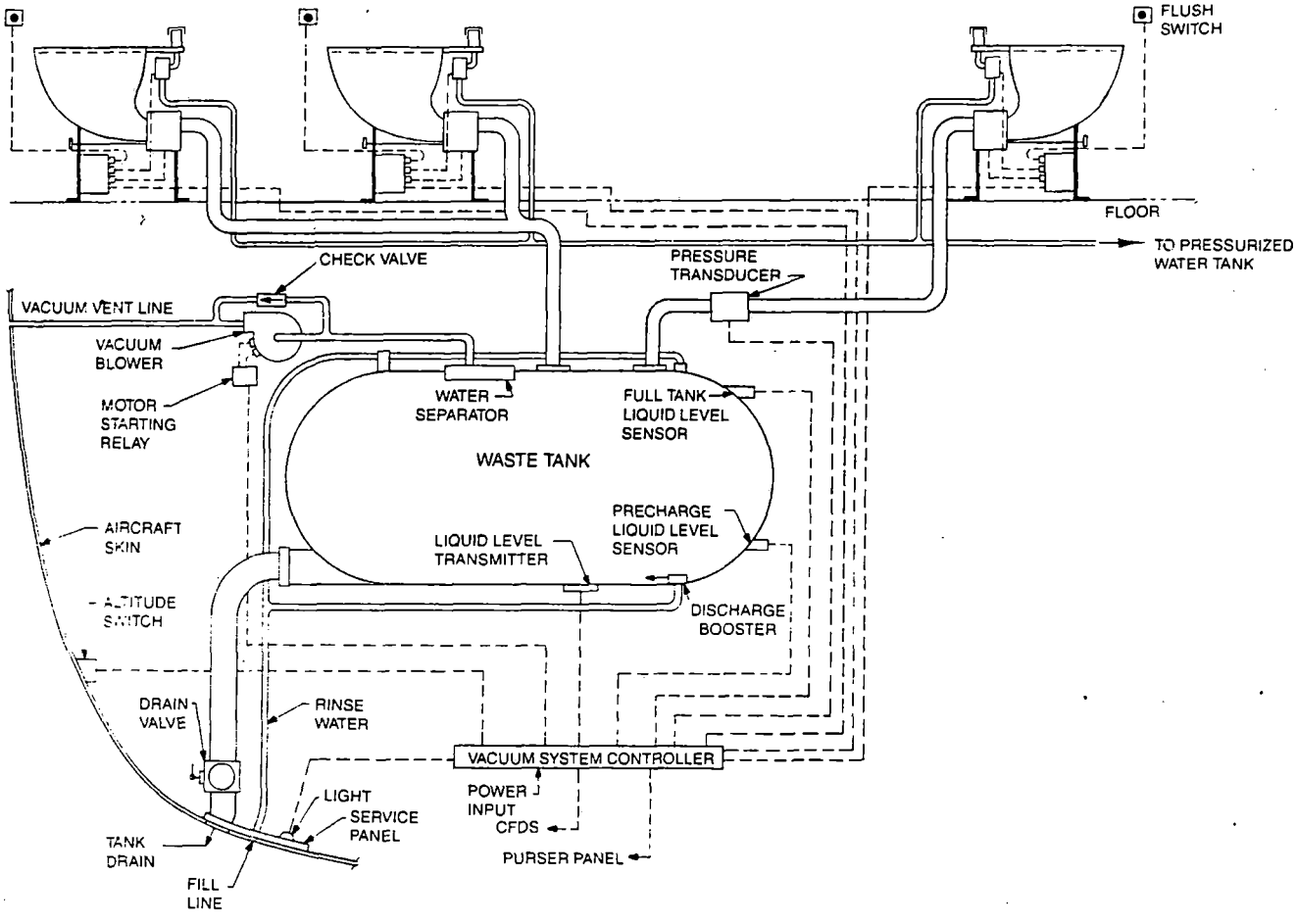
A TYPICAL 767 INSTALLATION



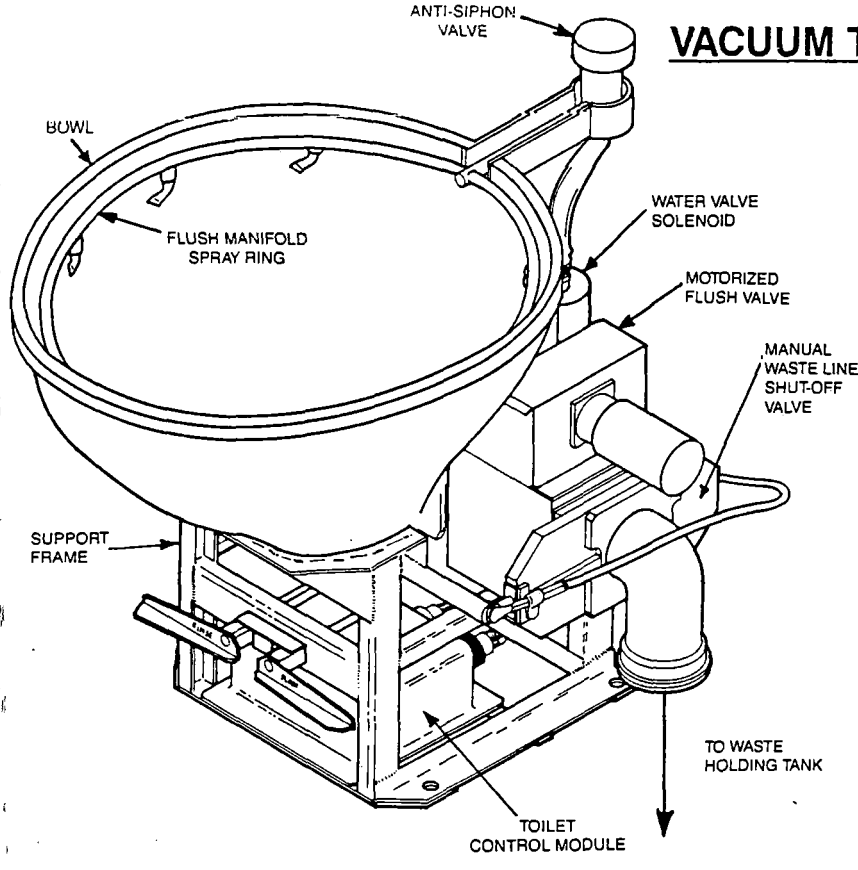
At Monogram our quest for performance goes beyond talk and statistics. Monogram has engaged in a successful flight test program to prove our concepts and designs. The experience has been nearly flawless. Flight test units were placed in daily service onboard regularly scheduled aircraft to demonstrate the reliability and quality of the design. In a twelve month period these units have accumulated over 2500 flight hours.

ADVANCED SECOND GENERATION VACUUM TOILETS AND VACUUM WASTE SYSTEMS

VACUUM WASTE SYSTEM SCHEMATIC



VACUUM TOILET ASSEMBLY



OPERATION

The system utilizes differential pressure (vacuum) to transport waste material from the toilet bowl to a central holding tank. A key element of the system is a unique electromechanical valve which positively controls evacuation of the bowl without reliance on the vacuum supply for its own activation. Fresh water (8 oz. or less) obtained from the aircraft pressurized potable water system is utilized to rinse the toilet bowl and aid in the evacuation of waste during the flush cycle.

The flush control microcomputer is a modular electronic assembly designed to control the operation of the toilet assembly by timing and sequencing various components during the flush cycle.

Monogram
SANITATION
A NORTEK COMPANY

Quality on Board!

MONOGRAM is standard equipment on:

Boeing	737-300
	747-200/-300
	757
	767
Airbus	A300
	A310
	A320

McDonnell Douglas MD-80

Fokker	F-100
	F-50

ATR 42
BAE 125-800
CN 235
Dash 8
EMB 120
Falcon 900
Gulfstream IV
SF 340

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A Nortek Company

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(213) 638-8445 FAX: 638-8458

Telephone: (213) 643-5957
Telex: 69-1243
Fax: (213) 643-7478

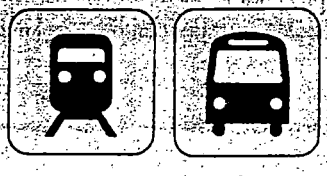
NEWMATIC® I RETENTION TYPE FLUSHING TOILETS

Monogram, the world's leading manufacturer of self-contained sanitation systems, is pleased to offer you two choices in the Newmatic® I family of retention type flushing toilets.

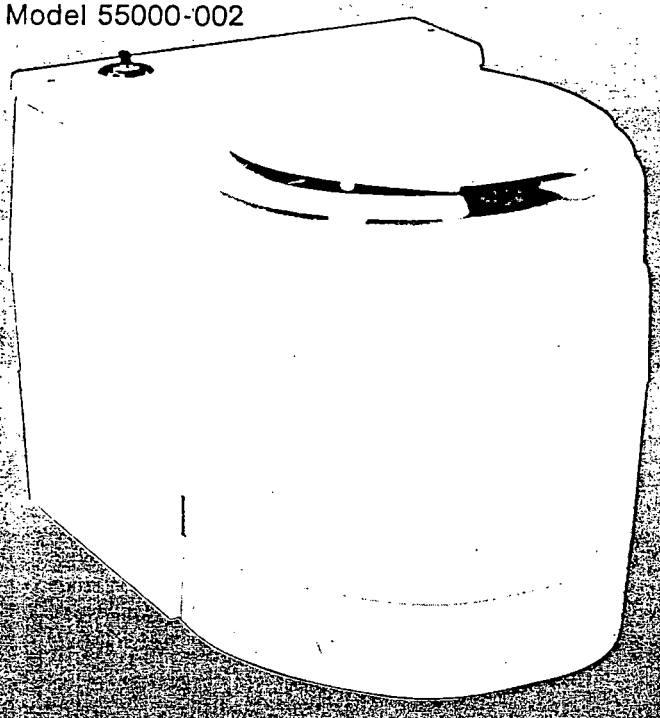
Both models utilize the most advanced technology and materials in a combination of stainless steel and injection molded ABS plastic for an attractive and scratch resistant finish. They feature a patented clog-free filter pump, a stainless steel toilet bowl and injection molded ABS plastic toilet seat and lid.

These models require an initial charge of 3 gallons of water and one packet of Monogram's specially formulated toilet chemical. Discharge is through the bottom drain valve to either service equipment or directly to existing sewer inlets. Leak-proof and freeze-proof, they meet environmental standards world wide.

FOR USE ON:

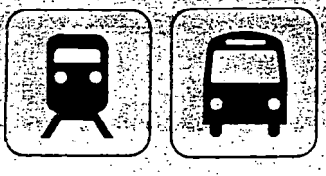


Model 55000-002

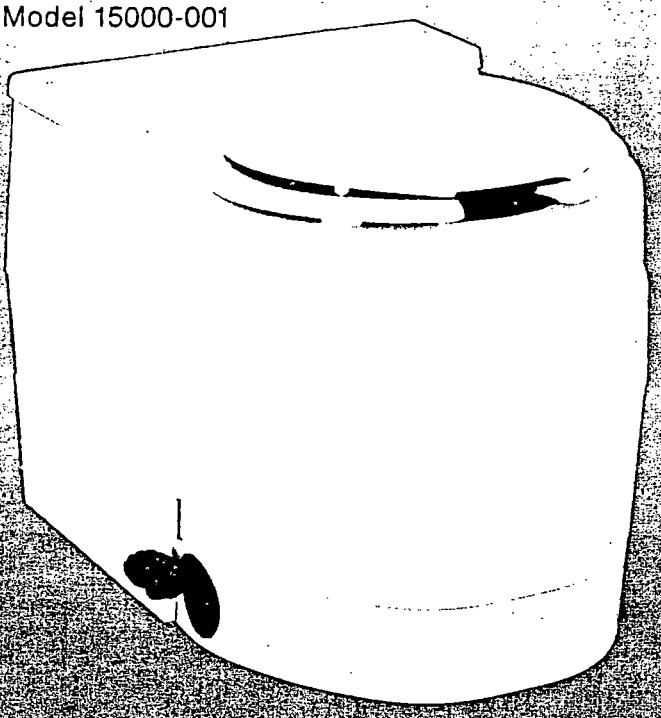


- Automatically timed flush cycle
- Pushbutton activated
- Air-operated to produce a strong swirling flush pattern
- Completely odor controlled
- Built and backed by the world leader in commercial transportation sanitation

FOR USE ON:



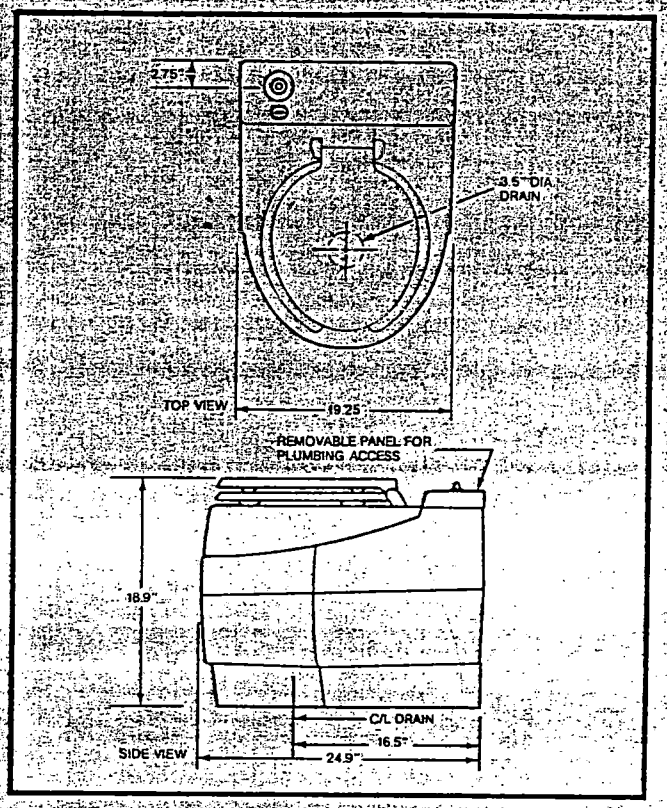
Model 15000-001



- Requires no power source
- Operates anywhere
- Foot pedal activated
- Completely odor controlled
- Built and backed by the world leader in commercial transportation sanitation

Monogram Industries, Inc.

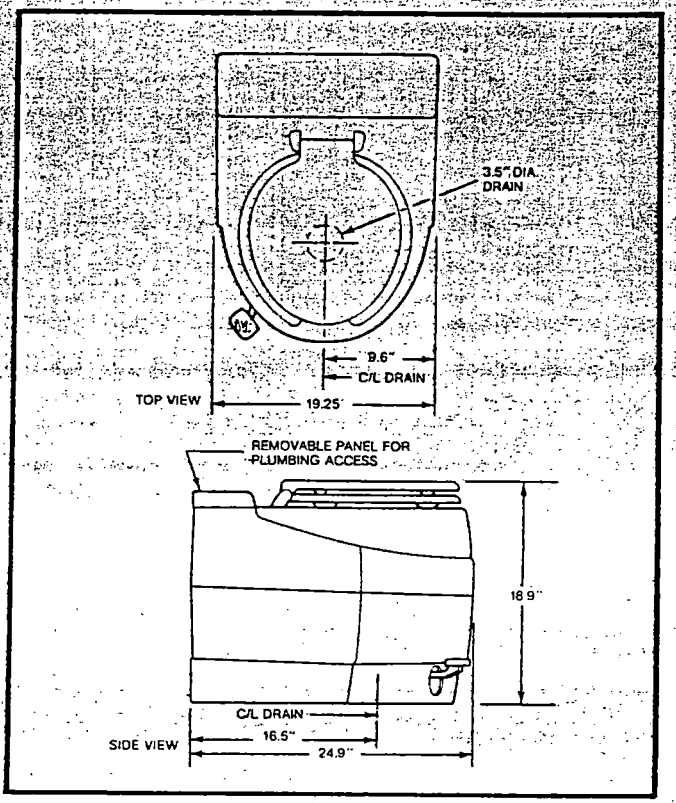
NEWMATIC® I RETENTION TYPE FLUSHING TOILETS



SPECIFICATIONS:

NEWMATIC® MODEL 55000-002

Weight (empty)	40 lbs.	18 kg
Dimensions	19.25" wide	490 mm
	18.9" high	480 mm
	24.9" deep	632 mm
Tank Capacity	14 gallons	76 l.
Holding Tank and Tank Cover	High Impact Plastic	
Toilet Bowl	Stainless Steel	
Toilet Seat	Plastic	
Filter Pump Assembly	High Impact Plastic, Neoprene rubber, Noryl plastic and stainless steel	
Flush Actuator Assembly	Anodized aluminum push button actuated with pressure reducer/regulator	
Disposal Outlets	Bottom spring loaded drain valve (fits 3" toilet floor flanges)	
Power Requirements	Compressed air Consumption: 2 Standard cubic feet	



SPECIFICATIONS:

NEWMATIC® MODEL 15000-001

Weight (empty)	45 lbs.	20.5 kg
Dimensions	19.25" wide	490 mm
	18.9" high	480 mm
	24.9" deep	632 mm
Tank Capacity	14 gallons	76 l.
Holding Tank and Tank Cover	High Impact Plastic	
Toilet Bowl	Stainless Steel	
Toilet Seat	Plastic	
Filter Pump Assembly	High Impact Plastic, Neoprene rubber, Noryl plastic and stainless steel	
Flush Actuator Assembly	Cast iron foot lever	
Disposal Outlets	Bottom spring loaded drain valve (fits 3" toilet floor flanges)	

MONOGRAM SANITATION
P.O. Box 9057
800 West Artesia Blvd.
COMPTON, CA 90224-9057
213-638-8445 (FAX) 213-638-8458

Our New Address

Railtech

ON BOARD SEWAGE HANDLING SYSTEM

WTS 8300

GENERAL DESCRIPTION

RAILTECH® LTD.
325 LEE AVENUE
BAIE D'URFÉ, QC
CANADA H9X 3S3

(514) 457-4760
FAX: (514) 457-7111

WASTE DISPOSAL SYSTEM

1. INTRODUCTION

1.1 This document describes in brief the operation as well as some of the outstanding features designed into the system, making it imminently suitable for application and use by railcar manufacturers and operators.

2. FUNCTION

2.1 The function of the ''On Board Sewage Handling System'' is to provide Water Flushed Commodes. The individual effluents are macerated, treated, and transferred to a remotely located storage tank. Figure 1 represent a typical system. Disposition of the effluent from the retention tank can be in either of the following modes:

2.1.1 Rapid flow through and onto the roadbed at pre-determined train speeds.

2.1.2 Retention through areas designed as ''No Dumping'' regardless of the train speeds.

3. SPECIFICATIONS

3.1	Voltage (Input)	72 V.D.C.
3.2	Power/Flush	100 Watts
3.3	Water Pressure	20 P.S.I.G. $\pm$ 1/2 P.S.I.G. Dynamic (While flushing)
3.4	Water Volume/Flush	1 Qt
3.5	Air Pressure	40 - 45 Dynamic P.S.I.G.
3.6	Maceration Air Pressure	120 P.S.I. (Dynamic)
3.7	Air Quantity/Flush	11.5 S.C.F.M. Max.
3.8	Cycle Time - Flush	10 Sec. Max.
3.9	Cycle Time - macerate treat, transfer	83 Seconds $\pm$ 2 Seconds
3.10	Macerated Size	To Digested Particles
3.11	Power - Heating	540 Watts Ref.
3.12	Waste Retention Tank	99 Flushes
3.13	Liquid Anti-bacterial	2^3 in. (approx)
3.14	Voltage for heater assembly	115 V.A.C.

4. SYSTEM COMPONENTS

4.1 Logic Circuit

The logic circuit consists of solid state electronic components mounted on a glass epoxy circuit board. Selection of these components was made with consideration given to reliability, costs, and useful life encountered in rail type vehicles.

The operating characteristics of this logic circuit are represented in Figure 2.

4.2 Commode (See Figure 3)

4.2.1 Bowl Assembly. The waste receiving bowl is of polished stainless steel construction, complete with flush rim and bottom flapper valve. This assembly may be mounted within a metal frame or shield as required by the specific installation.

4.2.2 Processing Tank. The processing tank is made of polyurethane especially molded for this application. The tank has as an integral part of its construction a macerating chamber. The macerating chamber is comprised of a series of rings. Within the rings are teeth and serrations which project inward. These aid in reducing the effluent to the smallest digested particles during the macerating cycle.

4.2.3 Closure Assembly. Below the macerating chamber is a closure assembly to prevent the outflow of effluent during macerating and treatment.

The closure assembly contains a molded elastic sleeve mounted in a housing. During operation air under pressure is directed to the annular cavity between the sleeve and the housing. The sleeve then collapses inwardly toward the center. Due to its unique design this results in a drip-tight seal. There are no links, levers, pivots or seats to either wear or become misaligned. The elastic sleeve will seal drip tight even if foreign debris becomes entrapped within it.

When the pressure is removed, the sleeve returns to the open position. The opening is large enough to release the treated effluent, and any objects that may inadvertently be thrown into the toilet bowl.

4.2.4 Retention Tank. The effluent passed through the closure assembly can be accumulated in a lower retention tank with minimum capacity for 99 flushes. The tank is additionally fitted with an in-line pinch valve closure to allow the emptying of the retention tank at selected intervals or locations.

5. OPERATION

5.1 The operation of the system can best be described by referring to

the following illustrations and their captions:

Figure 3: Use

Figure 4: Flush

Figure 5: Macerate and Treat

Figure 6: Discharge

Figure 7: Retention

6. THEORY OF OPERATION

6.1 The System Ready for Usage (See Figure 1)

As can be seen in Figure 1, the flapper assembly is closed and a small quantity of water is retained in the bowl. The control switches are in the following position:

Speed sensor override, inhibit dump, and manual cycle are in normal position.

6.2 Waste System in Usage (See Figure 3)

As can be seen in Figure 3, the waste matter is retained in the bowl.

6.3 Flush Cycle (See Figure 4)

Figure 4 illustrates the system undergoing its flush cycle. The following operations take place sequentially after the flush switch has been depressed:

(a) Upper pinch valve closes.

(b) After the upper pinch valve is closed, the flapper assembly opens, the solution dispenser injects chemical, the water valve opens allowing water to flush effluent and clean bowl.

6.4 Treatment Cycle (See Figure 5)

Figure 5 illustrates a system during this cycle. Note that flapper assembly and solution dispenser have returned to the closed position. Air under pressure is injected into the chamber. This results in a violent blending of air, water, solution and effluent. This action continues for approximately 70 seconds.

6.5 Discharge Cycle (See Figure 6)

This figure illustrates the system after the maceration cycle. The upper pinch valve opens to expel the contents through the lower pinch valve to the outside. The expelled matter has been reduced in size to the smallest digested particles, and the coliform bacteria count has been reduced to zero.

6.6 Inhibit Dump Mode (See Figure 7)

The lower pinch valve is now closed and the effluent collects in the holding tank. The closing of the lower pinch valve either takes place automatically by means of the speed sensor control, or may be induced by manually actuating the Inhibit Dump Switch.

6.7 Interrupted Cycle.

It has been anticipated that a user will on occasion flush the toilet during a period in which a treatment cycle is in progress. This will cause no ill effects. The system has the capacity of accepting up to two flushes. Should this capacity be reached, a memory circuit in the electronic controls will automatically initiate a full cycle flush after the unit completes treating the second flush already in the processing tank.

7. Other characteristics that become apparent after a study of this proposal suggest the following:

7.1 Virtually no moving mechanical parts

7.2 Clog proof

7.3 Minimum maintenance

7.4 Light weight

7.5 Small and compact

7.6 Lower power consumption

7.7 Low initial cost

7.8 Low installation cost

7.9 Low operating cost

7.10 Reliable performance

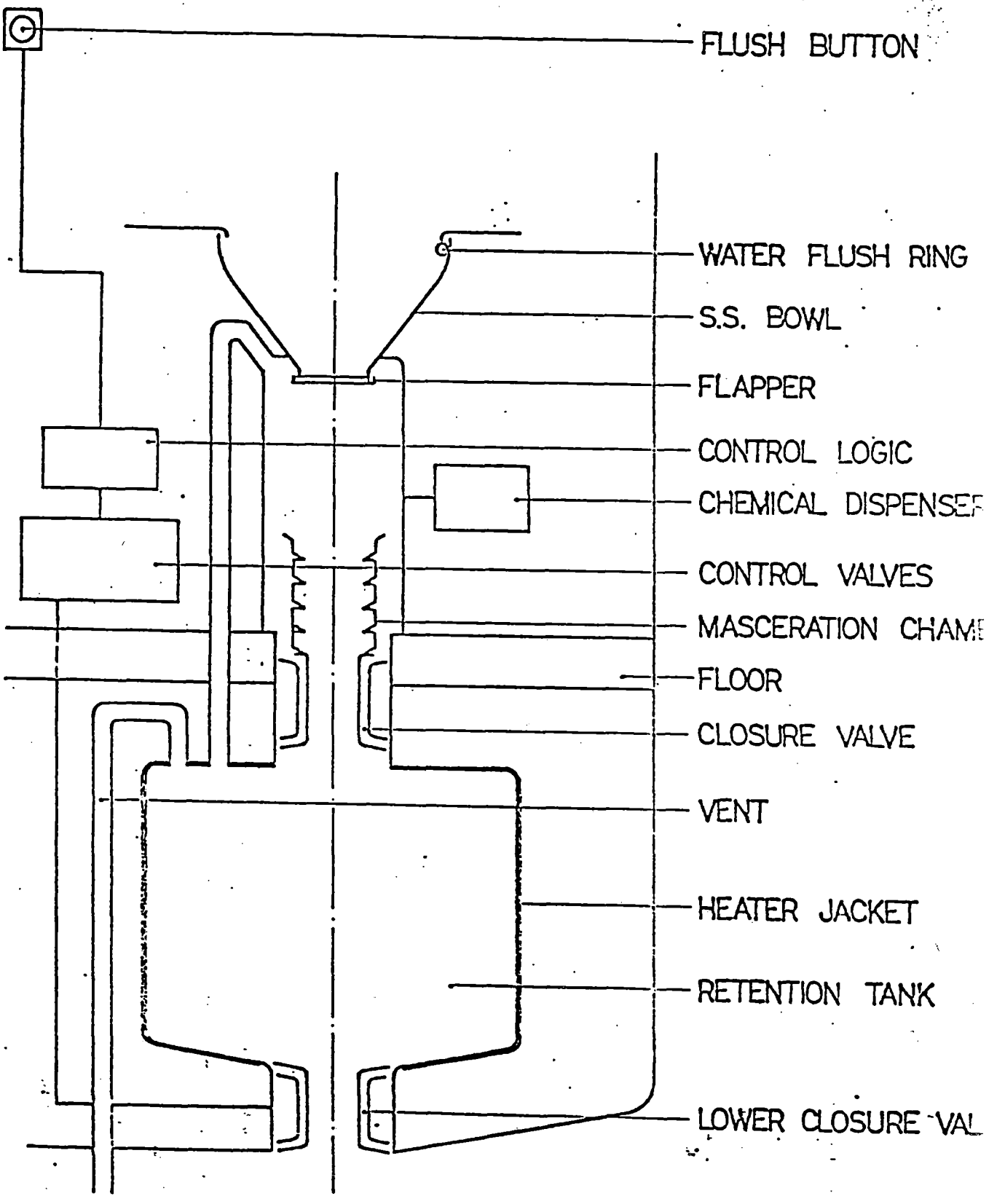

FLUSH BUTTON
WATER FLUSH RING
S.S. BOWL
FLAPPER
CONTROL LOGIC
CHEMICAL DISPENSER
CONTROL VALVES
MASCERATION CHAMB
FLOOR
CLOSURE VALVE
VENT
HEATER JACKET
RETENTION TANK
LOWER CLOSURE VAL

FIGURE 1

TREATMENT TANK TIMING CHART

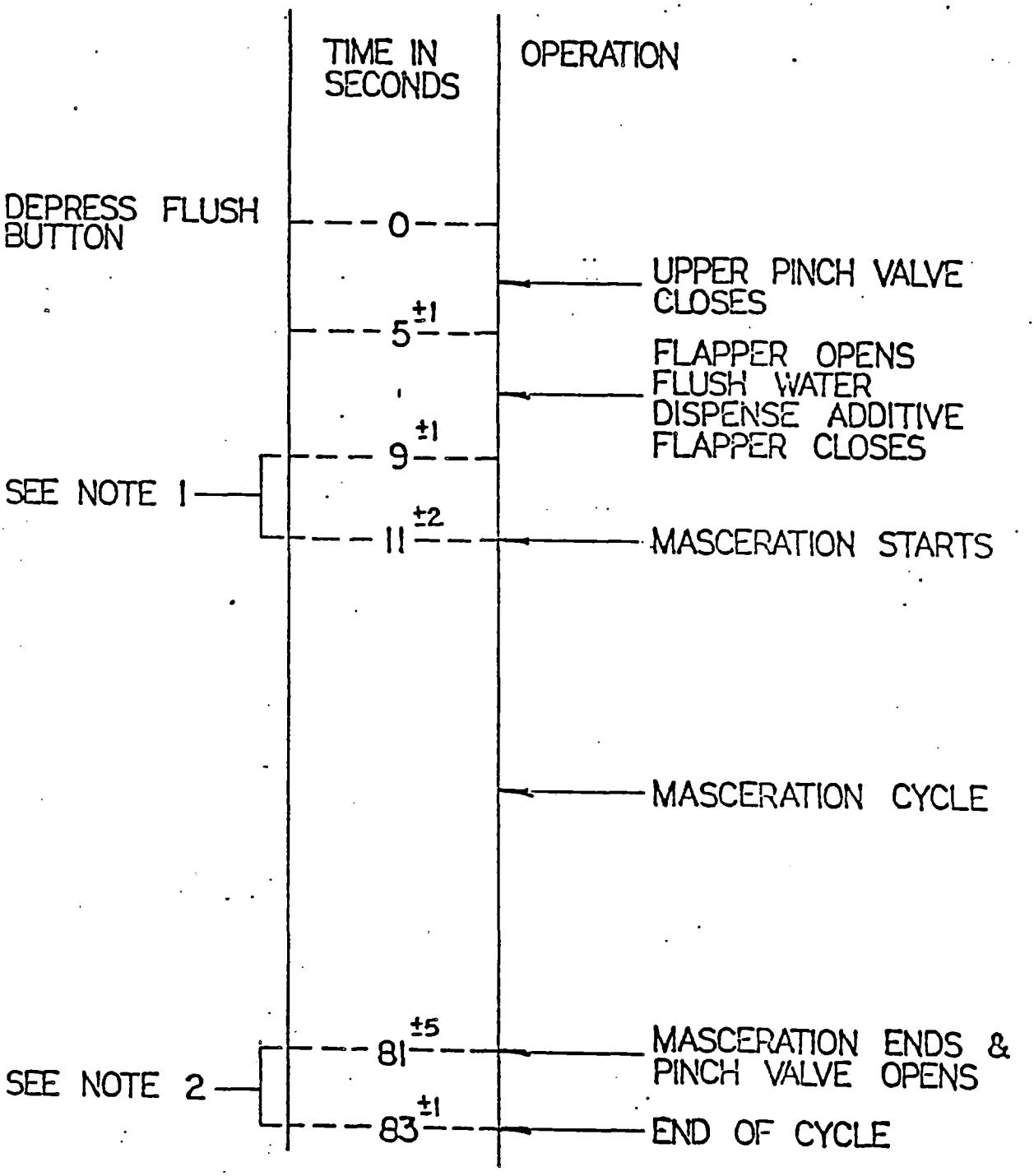


FIGURE 2
(TIMING CHART)

NOTES:

1. Maceration will not start until flapper has closed.
2. Delay to empty maceration chamber.

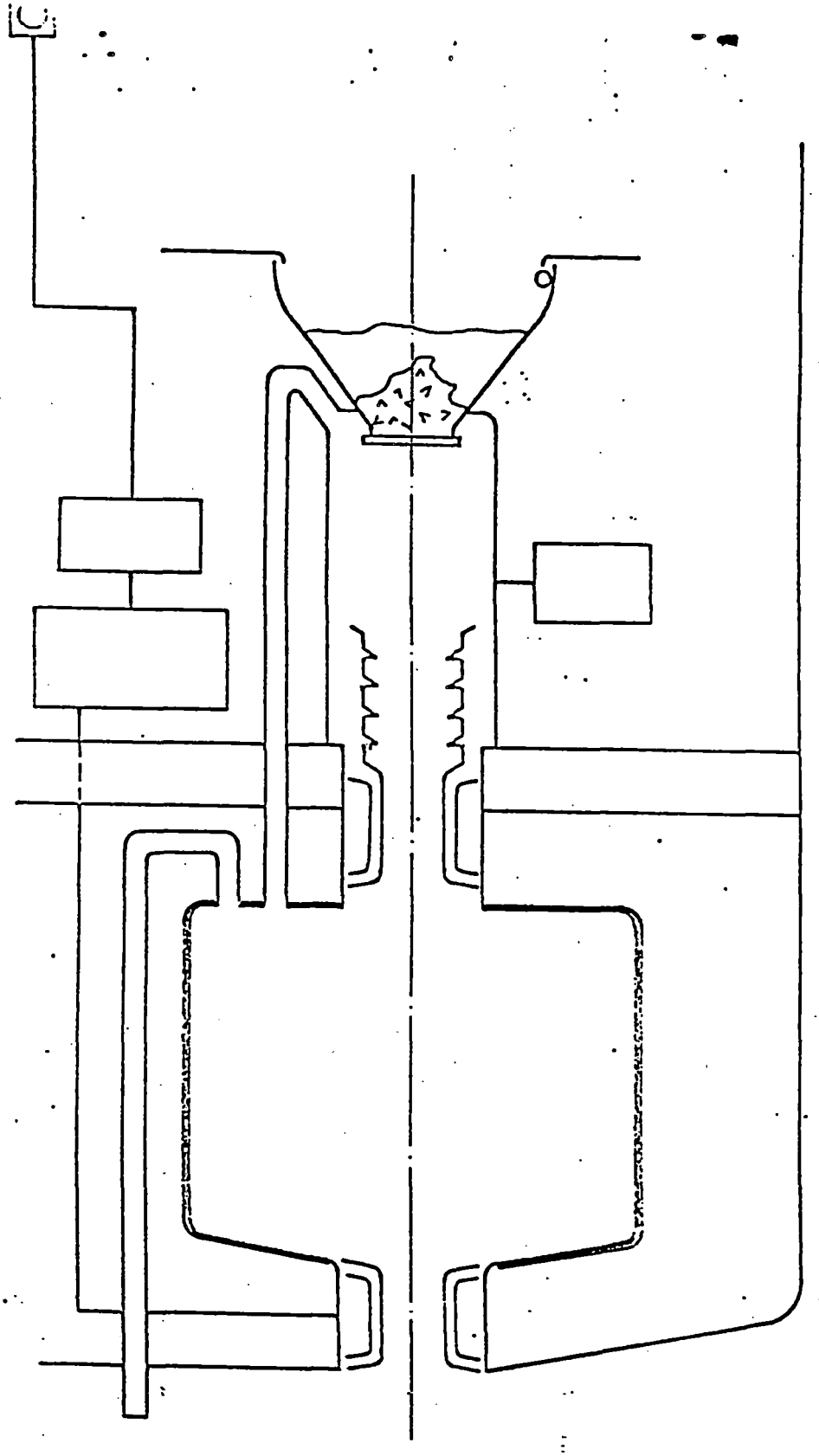


FIGURE 3

The illustration above represents the system after being used, just prior to depressing the flush button. Note that the effluent is contained in the upper bowl, very similar to that of a conventional toilet.

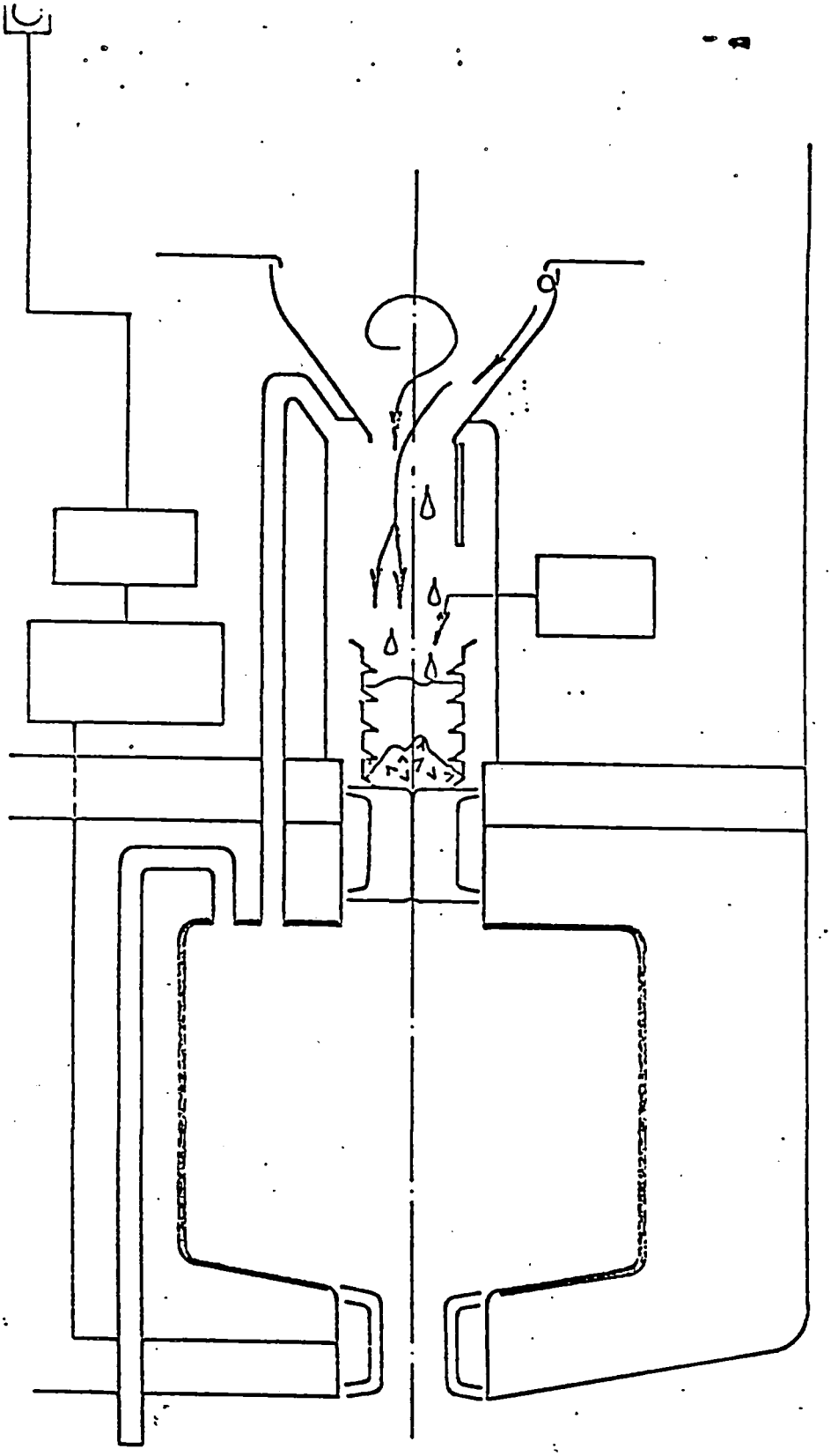


FIGURE 4

Figure 4 illustrates the system undergoing its flush cycle. The following events take place sequentially after the Flush Button has been depressed:

1. Pinch Valve closes
2. Flap Valve opens
3. Chemical is dispensed
4. Water Valve opens allowing flush water to clean bowl and flush waste

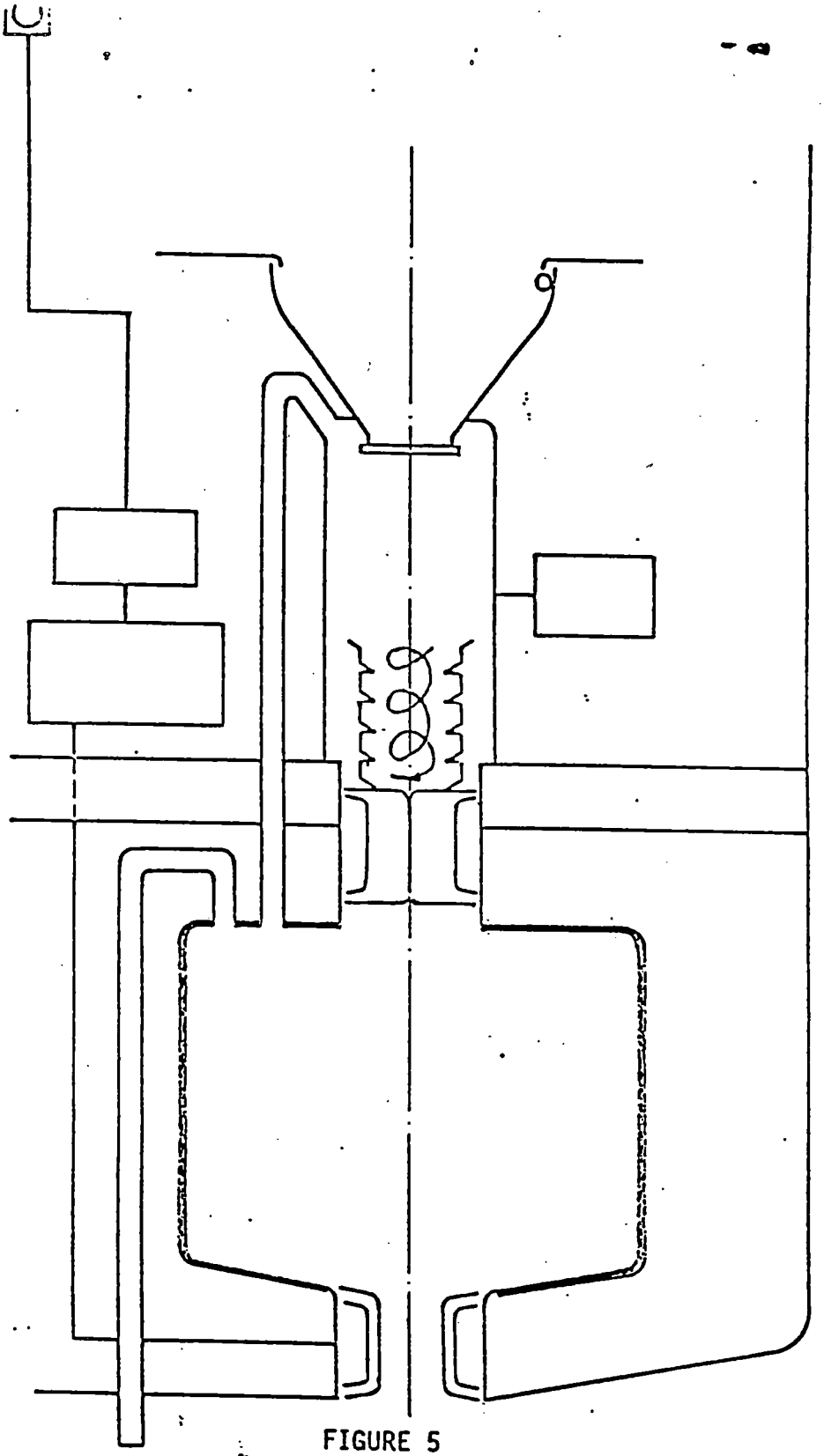


FIGURE 5

Figure 5 illustrates the system during the maceration and treatment cycle. Note that the Flap Valve is closed. Air under pressure is injected into the chamber. This results in a violent blending of air, water, chemical and waste. This action continues for approximately seventy (70) seconds.

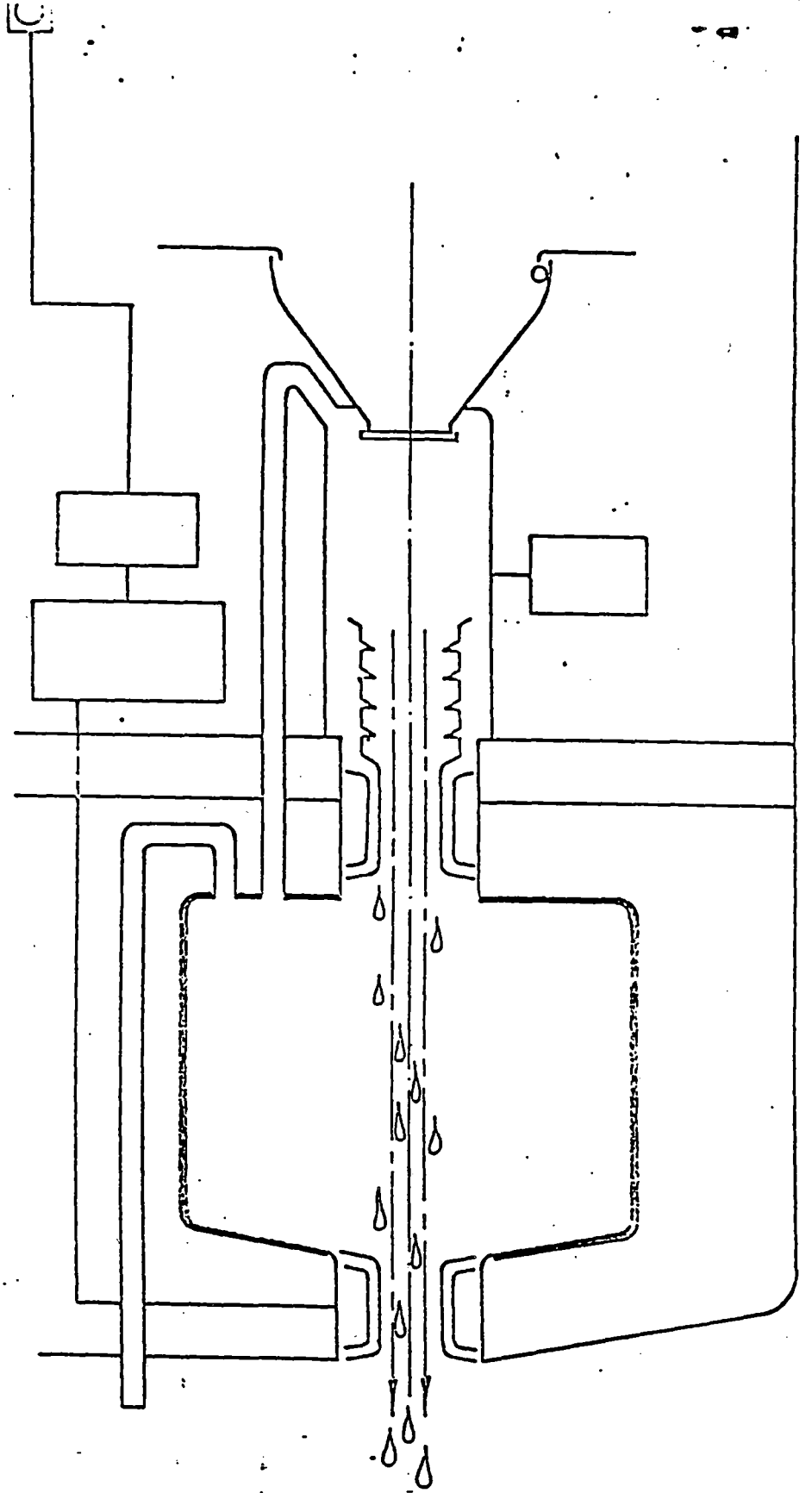


FIGURE 6

Figure 6 illustrates the system at the end of the maceration and treatment cycle. The Pinch Valve opens and expels the treated effluent onto the roadbed. The resulting matter is a liquid/liquid slurry with the solids reduced to digested particles

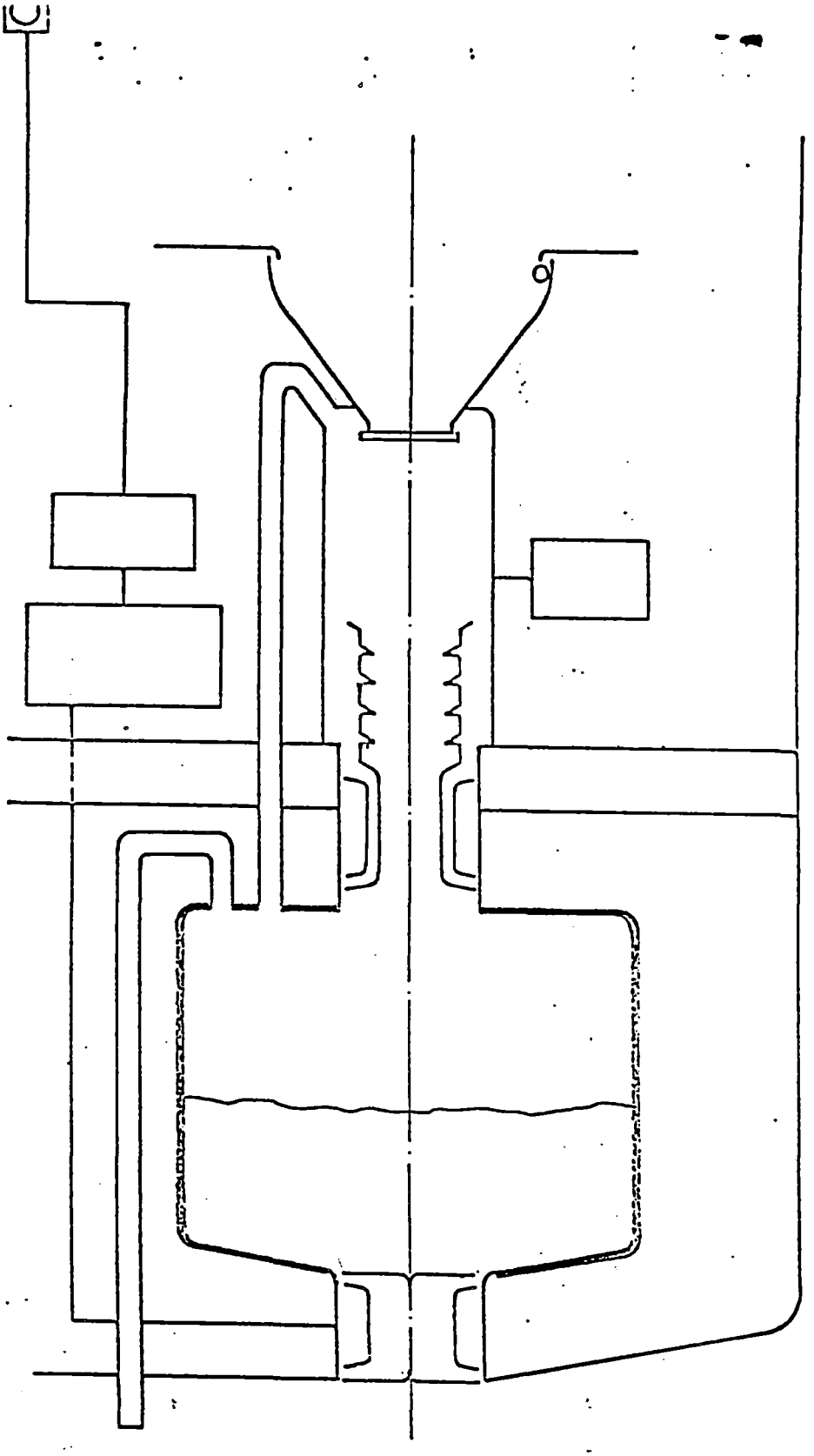
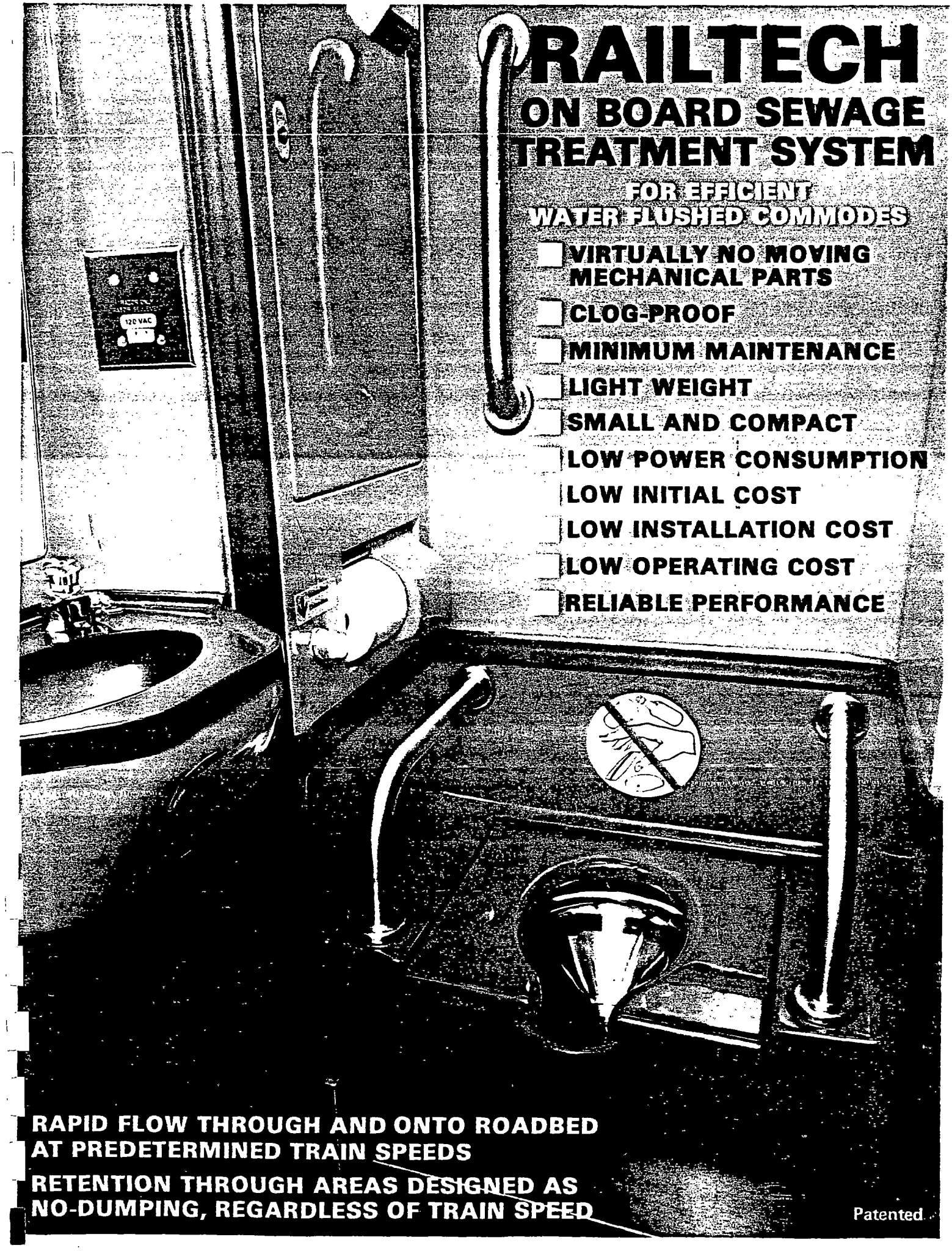


FIGURE 7

Figure 7 illustrates the system accumulating the treated effluent in the retention tank when the car is in the station or under a ''No Dump'' restriction.

The effluent will be discharged automatically when the restriction is removed.



RAILTECH
ON BOARD SEWAGE TREATMENT SYSTEM

FOR EFFICIENT WATER FLUSHED COMMODES

- VIRTUALLY NO MOVING MECHANICAL PARTS
- CLOG-PROOF
- MINIMUM MAINTENANCE
- LIGHT WEIGHT
- SMALL AND COMPACT
- LOW POWER CONSUMPTION
- LOW INITIAL COST
- LOW INSTALLATION COST
- LOW OPERATING COST
- RELIABLE PERFORMANCE

RAPID FLOW THROUGH AND ONTO ROADBED AT PREDETERMINED TRAIN SPEEDS

RETENTION THROUGH AREAS DESIGNED AS NO-DUMPING, REGARDLESS OF TRAIN SPEED

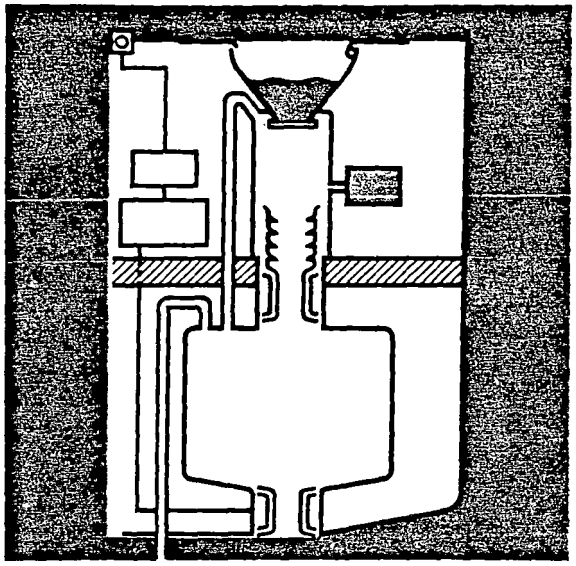
Patented

OPERATION OF

When toilet is flushed, the effluent goes into a small maceration chamber directly under the bowl where it is macerated, treated so all bacteria is killed and then dumped to trackside.

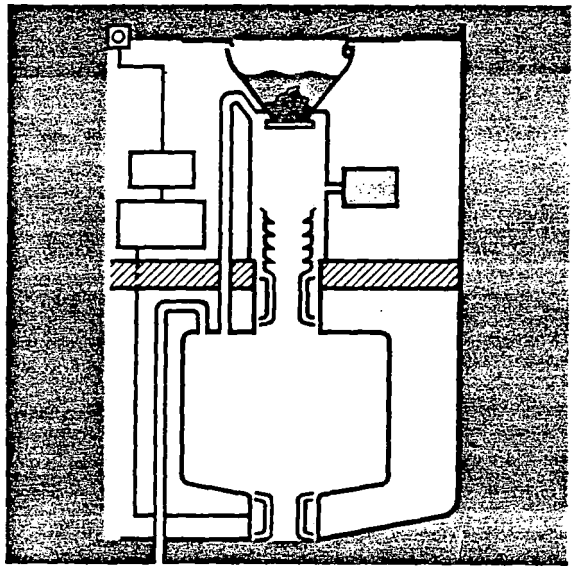
If train stops or travels at less than 35 k/hr, the effluent goes into small holding tank until train reaches 35 k/hr, then effluent is dumped tc trackside.

Completely protected for cold weather operatior



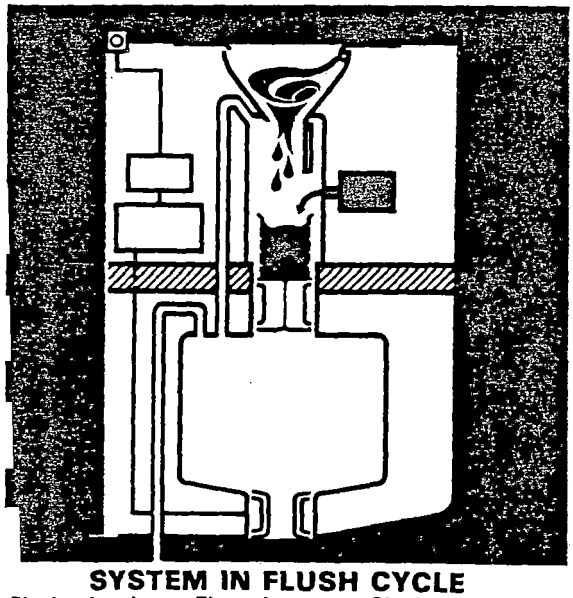
SYSTEM READY FOR USE

Flapper assembly closed and small quantity of water in bowl.



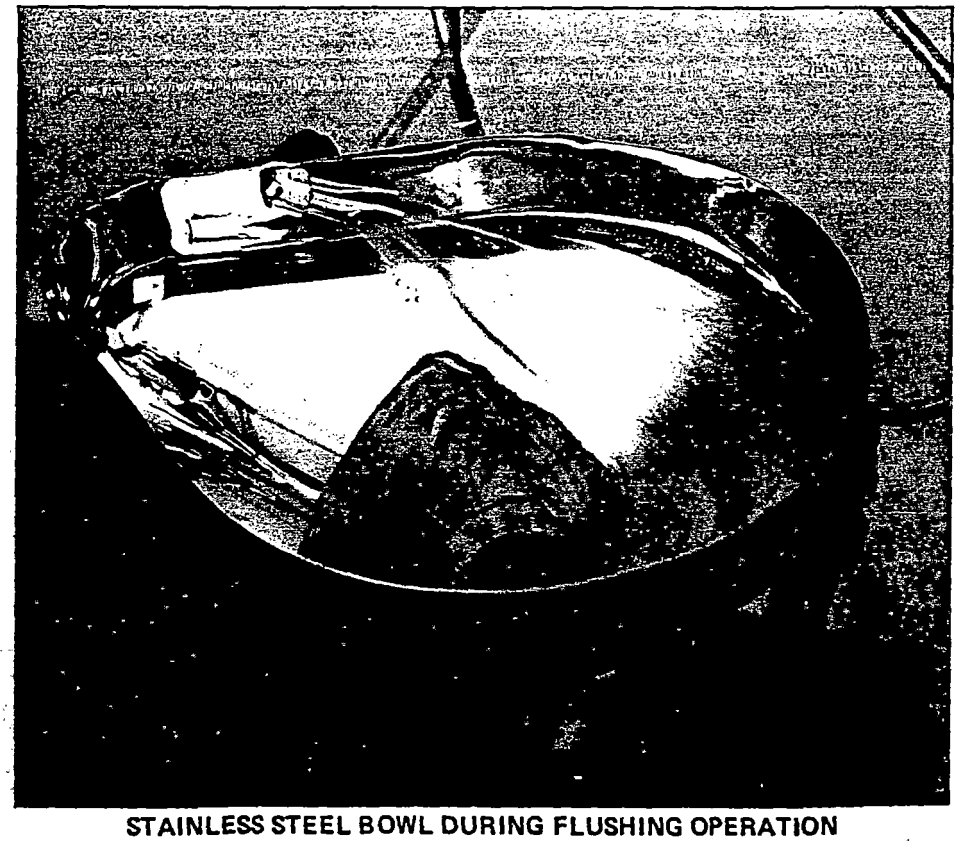
SYSTEM IN USE

The system has just been used, prior to depressing the flush button. Effluent is contained in upper bowl, similar to conventional toilet.



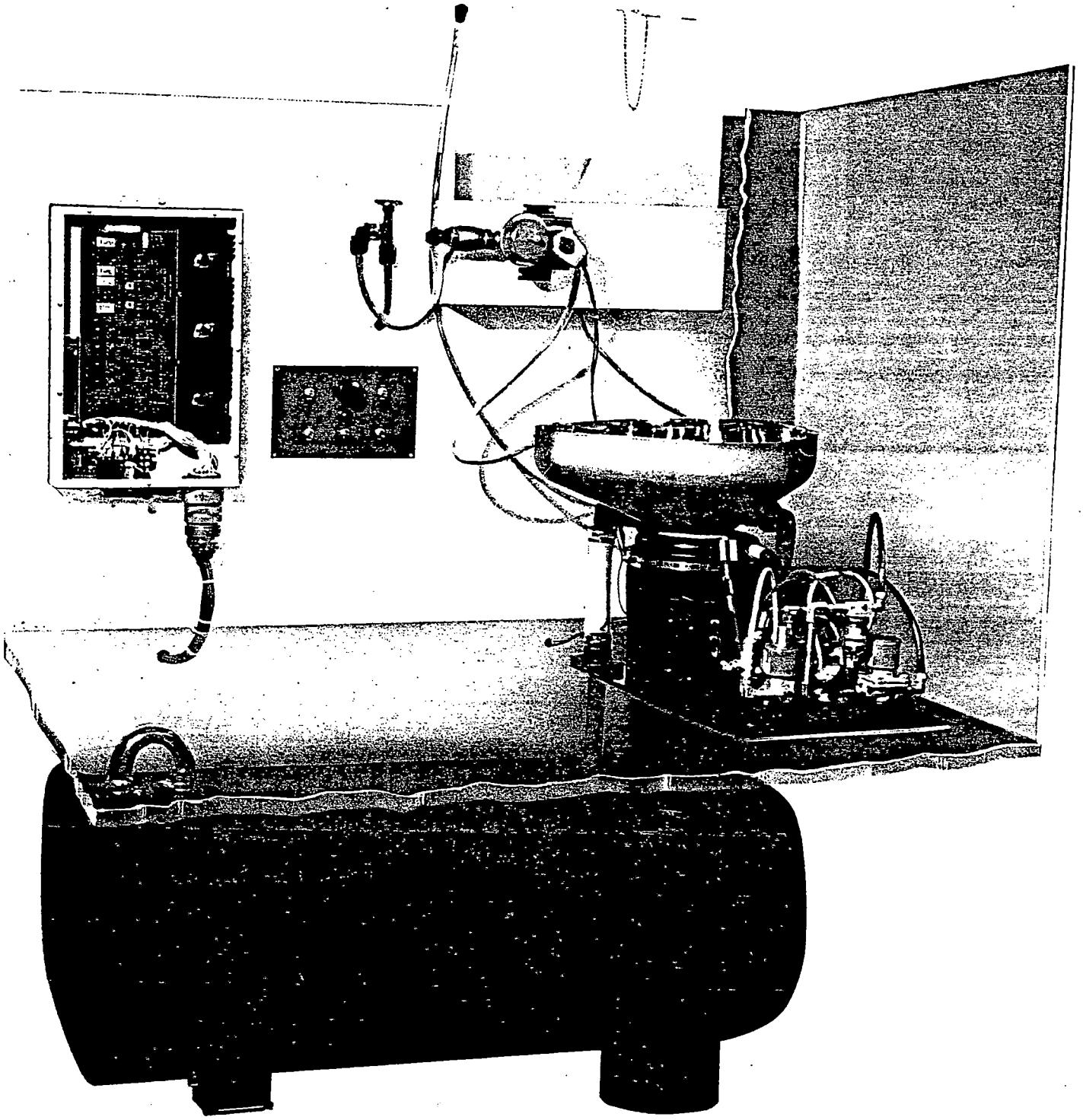
SYSTEM IN FLUSH CYCLE

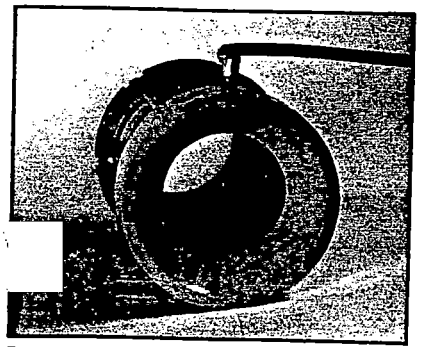
Pinch valve closes. Flap valve opens. Chemicals dispensed. Water valve opens allowing flush water to clean bowl and flush waste.



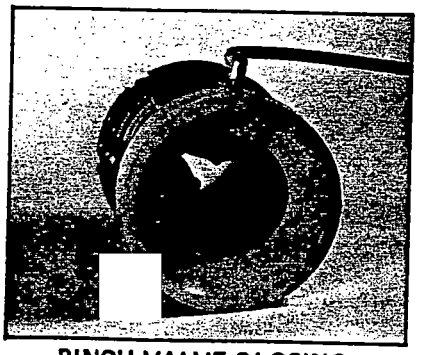
STAINLESS STEEL BOWL DURING FLUSHING OPERATION

ILTEC H ON BO RD SEWAGE T E

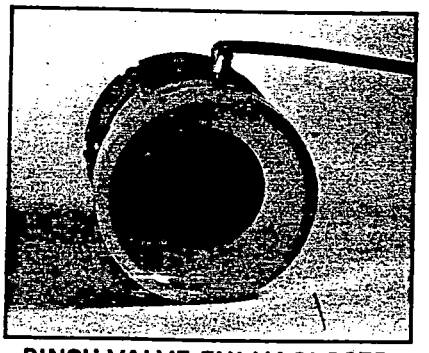




PINCH VALVE IN OPEN POSITION

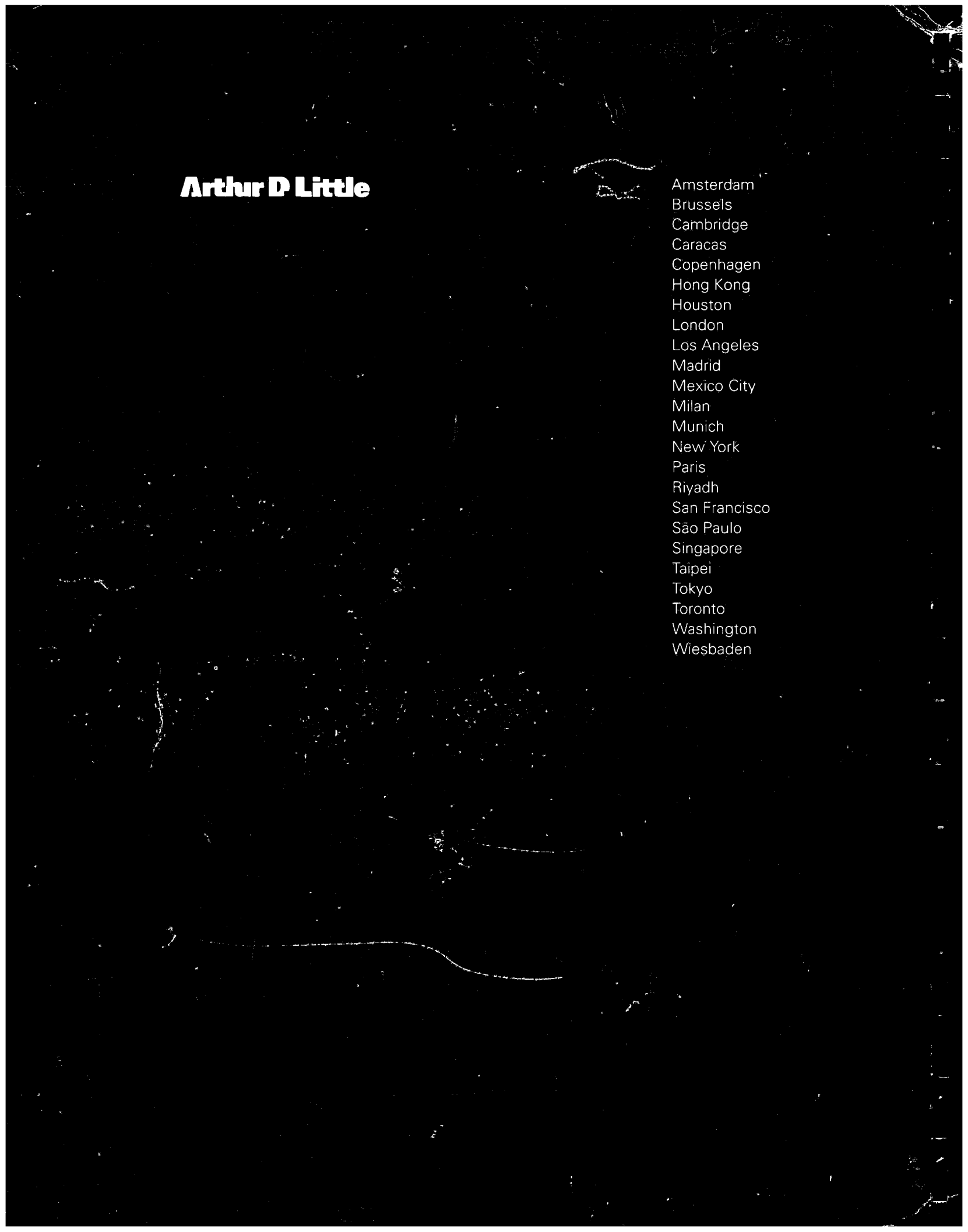


PINCH VALVE CLOSING



PINCH VALVE FULLY CLOSED

Appendix A: Health Risk Assessment and Risk Management for Sewage Disposal from Amtrak Trains, Appendix B: Manufacturers' Technical Brochures, Arthur D Little, 1990 -23-Passenger Operations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