ASPE
CLEVELAND OH CHAPTER

DESIGN OF SPECIAL WASTE PIPING AND NEUTRALIZATION SYSTEMS

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Single Wall Piping Systems

Special Waste

Special Waste Piping Materials

- **CODES**

  2007 Ohio Plumbing Code

  - **Table 702.1 Above Ground Drainage and Vent Pipe**
    - **Polyolefin Pipe (CSA B131.3)**
  - **Table 702.2 Under Ground Building, Drainage and Vent Pipe**
    - **Polyolefin Pipe (ASTM F1412,CSA B131.3)**

      B181.3 Canadian Companion to F1412

Special Waste Piping Materials

- **CODES**

  2007 Ohio Plumbing Code

  - **Table 702.4 Pipe Fittings**
    - **Nothing on Polyolefin**

Special Waste Piping Materials

- **CODES**

  2007 Ohio Plumbing Code

  - **702.5 Chemical waste system.** A chemical waste system shall be completely separated from the sanitary drainage system. The chemical waste shall be treated in accordance with Section 803.2 before discharging to the sanitary drainage system. Separate drainage systems for chemical wastes and vent pipes shall be of an approved material that is resistant to corrosion and degradation for the concentrations of chemicals involved.

Special Waste Piping Materials

- **CODES**

  2007 Ohio Plumbing Code

803.2 Neutralizing device required for corrosive wastes.

Corrosive liquids, spent acids or other harmful chemicals that destroy or injure a drain, sewer, soil or waste pipe, or create noxious or toxic fumes or interfere with sewage treatment processes shall not be discharged into the plumbing system without being thoroughly diluted, neutralized or treated by passing through an approved dilution or neutralizing device. Such devices shall be automatically provided with a sufficient supply of diluting water or neutralizing medium so as to make the contents noninjurious before discharge into the drainage system. The nature of the corrosive or harmful waste and the method of its treatment or dilution shall be approved prior to installation.

Special Waste Piping Materials

- **Materials Currently Used**
  - **We will be discussion polyolefins and/or polymer materials for this seminar. Other valid and widely used materials for special waste piping systems (glass, high silica iron pipe, stainless steel) are excluded only due to the topic as presented and should also be considered depending upon system discharge application.**

Special Waste Piping Materials

- **Materials Currently Used**
  - **Polypropylene**
  - **Polyvinylidene Fluoride (PVDF)**
  - **CPVC**

Special Waste Piping Materials

- **Polypropylene**
  - Flame Retardant and Non-Flame Retardant Material (Not Plenum Rated)
  - Temperature Rating to 212º F (intermittent)
  - Joined by Electro fusion, Butt Fusion, Socket Fusion and Mechanical Joint Method

Special Waste Piping Materials

- **Polyvinylidene Fluoride (PVDF)**
  - Plenum Rated Product (UL/FM)
  - Temperatures to 280º F
  - Joined by Electro fusion and Mechanical Joint Method

Electro fusion Joining

Mechanical Joint Method

Special Waste Piping Materials

- **CPVC**
  - Plenum Rated per ULC
  - Serviceable to 210º F (220°)
  - Joined by Solvent Cementing

Design of Single Wall Systems

- When Designing Special Waste Systems for Plastic Piping, Attention Should Be Given To:

Design of Single Wall Systems

- Chemical Makeup of Flow Stream
  - Complete Review of Chemical Compatibility Chart Must Be Made By The Design Engineer Prior To Choosing:
    - Approved Material of Construction
    - Approved Joining Method For Particular Installation

Design of Single Wall Systems

- PIPE SUPPORT SPACING
  - PVDF PIPING SYSTEMS WILL REQUIRE MORE SUPPORT THAN PP OR CPVC
    - 4” PP @ 73° F – 6 ¾’
    - 4” CPVC – 7 ½’
    - 4” PVDF @ 68° F – 60”

Design of Single Wall Systems

- Temperature
  - ΔT of Waste Stream and/or Ambient Temperature Changes
    - Possible Linear Expansion of Piping System

Double Containment

Outline

I. Why Double Containment
II. Material Selection
III. System Design
IV. Thermal Expansion/Contraction
V. Leak Detection
VI. System Layout
VII. System Installation
VIII. System Inspection & Testing
IX. Current Suppliers

Why Double Containment?

- U.S. Environmental Protection Agency (EPA) Regulations Require:
  - All Hazardous fluids as defined in Code of Federal Regulations (CFR), Title 40, part 281
  - All Underground Storage Tanks (USTs) and related piping with 10% or more of its volume underground. (Title 40, part 280)

Why Double Containment?

- 40 CFR 280 Requirements:
  - All releases must be contained or diverted to a proper collection system.
  - Containment may be via a trench, dike or DC Piping & Tanks.
  - Must contain leaking product for a minimum of 30 days.
  - Must be inspected (monthly or continuously) via manual or automatic Leak Detection.

Material Selection

A majority of the DC systems installed are constructed of Thermoplastic material because of its ease of installation & wide range of Chemical compatibility.

- Stainless Steel
- Fiberglass
- PVC
- CPVC
- Polypropylene
- Polyethylene
- PVDF

Material Selection

- The primary (inner) pipe material is selected based on common piping practices using the following:
  - What is the media the line is carrying?
  - What are the concentration of the the chemicals in the media?
  - What will the operating pressure & temperature be?
  - What is the flow of the media?

Material Selection

- The secondary (outer) pipe material is selected based on many factors that are different than those used for the primary:
  - Loading (Static & Live) for buried applications
  - Hanging requirements for above ground applications
  - Leak Detection requirements
  - Operating Pressure
  - UV Requirements

System Design

- There are two principles to follow:
  - Basic Piping Design Principles remain unchanged. The system must be designed according to the standard rules & codes of single wall piping.
  - The shear size of the DC piping system takes up much more space than single wall piping and proper clearances must be accounted for in the layout to insure fast, simple joining of the components.

System Design

- Systems must be designed, fabricated, installed, inspected & tested to the applicable codes and regulations.
  - Drainage
    - No ASTM standard exist
  - Pressure
    - ANSI/ASME B31.3 applies

System Design

- There are three differences between design of primary and secondary piping components:
  - The secondary components are designed to be used only in the event of a failure of the primary system.
  - The secondary components must take into account any and all interactions between the two systems.
  - The secondary components must be able to vent & drain the system if there is a failure of the primary system.

Thermal Expansion/Contraction

- Based on the operational criteria, thermal expansion/contraction must be considered.
- For systems that will maintain a consistent temperature, compensation for thermal expansion/contraction may not be required.
- Two basic thermal relationships may be present:
  - When only one system (primary or secondary) experience thermal expansion/contraction.
  - When both systems (primary & secondary) experience different magnitudes of thermal expansion/contraction.

Thermal Expansion/Contraction

- This differential thermal expansion is usually accommodated by one of two methods:
  - Floating System
    - In this system the primary pipe is allowed to expand within the secondary pipe. Expansion loops are provided to prevent overstress of the primary pipe and sufficient space is provided at elbows to accommodate lengthwise movement of the primary pipe relative to the secondary pipe.


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Thermal Expansion/Contraction

- Restrained System
  - In this system the primary pipe is rigidly attached to the secondary pipe in the lengthwise direction.
- Thermal expansion of the primary pipe in this system is accommodated in one of two ways:
  - If the system is buried or otherwise restrained so the secondary pipe cannot stretch (due to soil friction and the anchoring effects of appurtenances, branches and changes in direction), the expansion of the primary pipe is completely offset by the elastic/plastic compression of it.
  - If the system is above ground and not anchored, the thermal expansion is accommodated by deformation of both the primary and secondary pipe, depending on relative stiffness.

Leak Detection

All buried applications of DC piping must be leak detected per the 40 CFR 280 regulation.

- Pressure systems are required to have automatic monitoring with a method to automatically restrict the flow of the media if a leak is detected.
- Drainage systems only require monthly manual inspections for a media leak.

Leak Detection

The following methods are acceptable per the regulations:

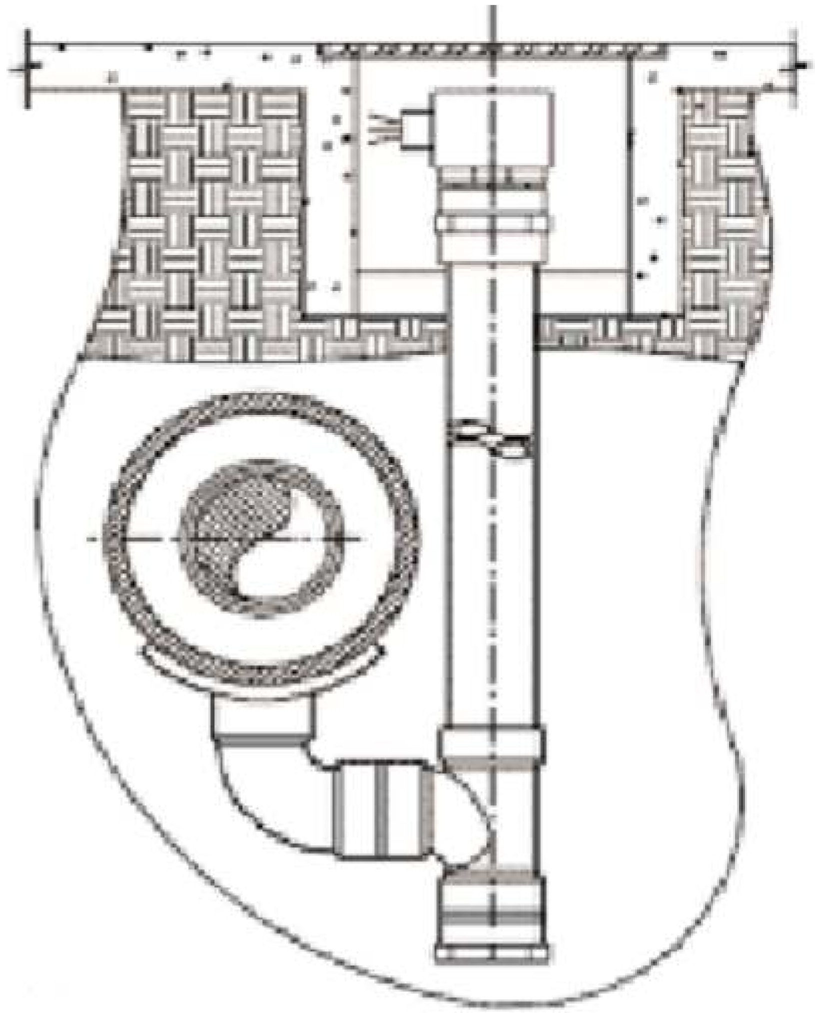
- Low Point probes
- Continuous cable
- Visual (drainage only)

Leak Detection

Low Point:

- Simple design.
- Probes are placed at strategic locations within the system that allow quick identification of leak location.
- Always more practical to use a few more probes on the front end than to have a leak and not be able to pinpoint its location later.

Low Point

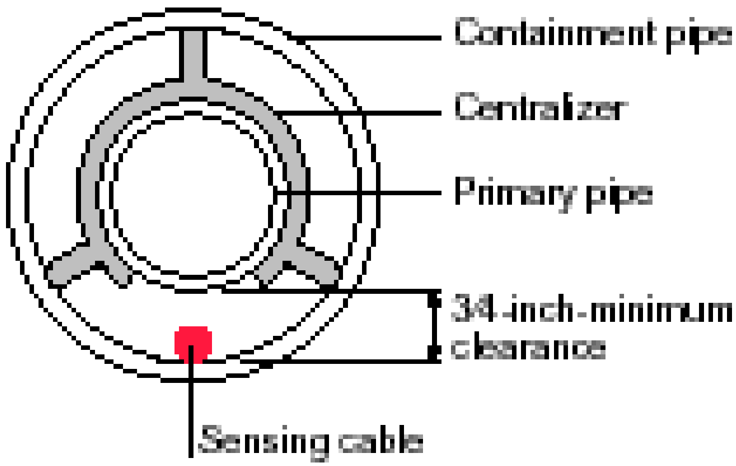


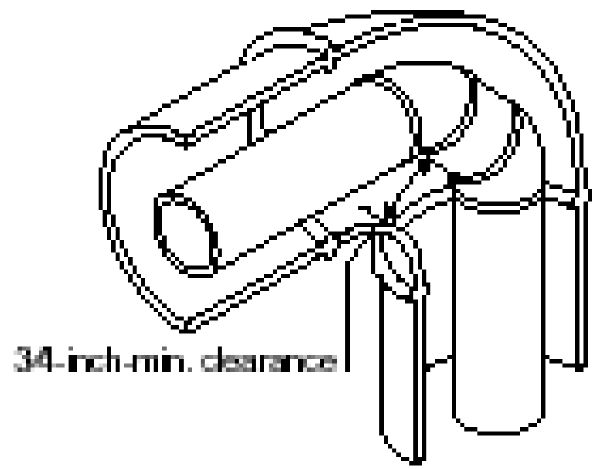
Leak Detection

Continuous Cable:

- Most accurate method of leak detection.
- Most systems can pinpoint leak within 6”.
- Must have a minimum of 3/4” of annular space to pull the cable through the system.
- Must specify for a pull rope to be installed by the manufacturer.
- Entire system can be mapped out, installed, and fed back to an easy to understand control panel.

Continuous Cable



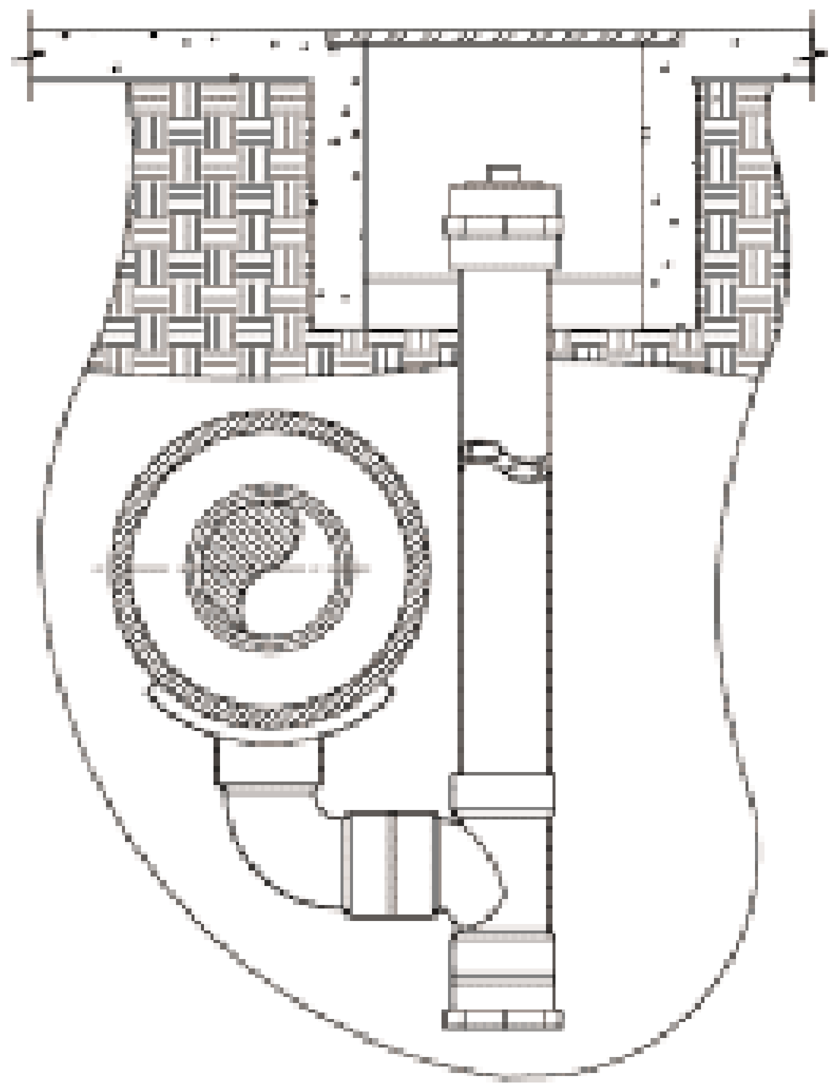


Leak Detection

Visual:

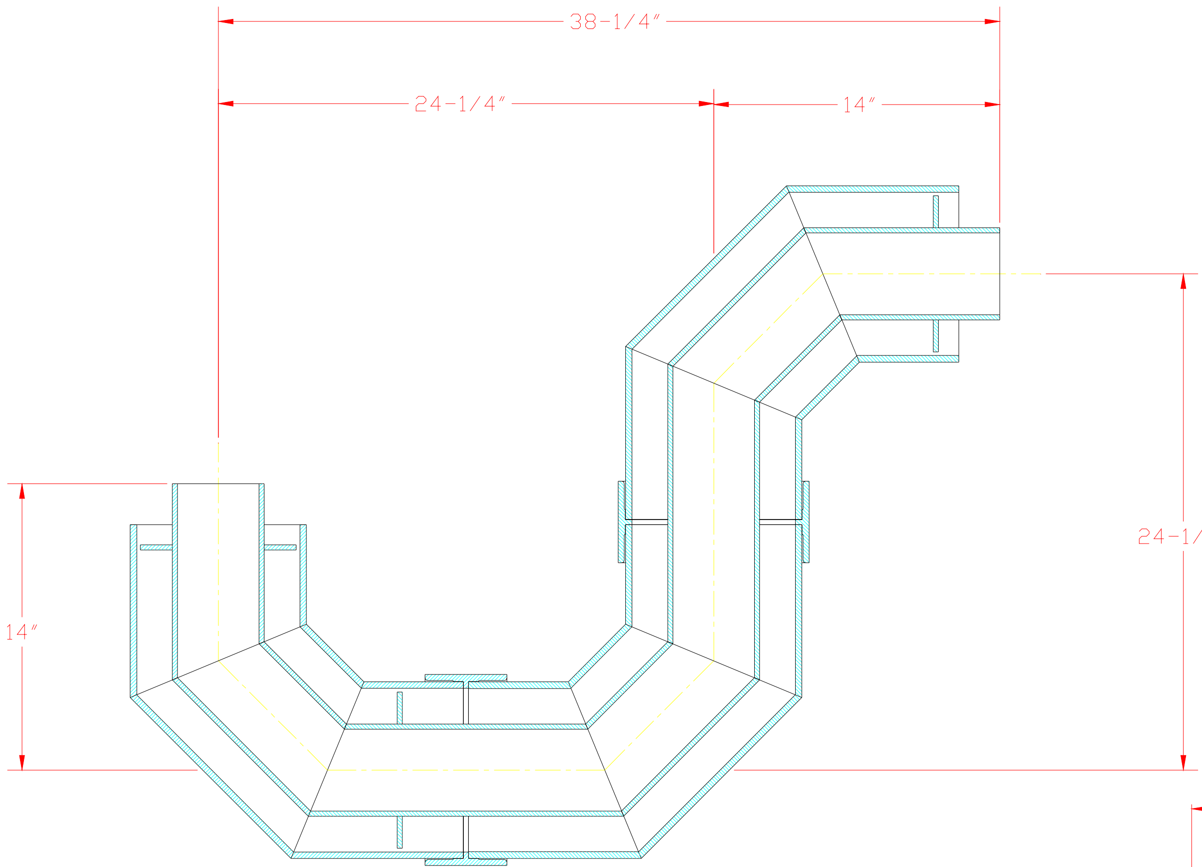
- – Low point wells are installed at strategic locations.
- – Wells can be opened, and a visual inspection for leaking media can be preformed monthly.
- – Basins can be placed at the end of the lines and visual inspection preformed monthly.
- – DRAINAGE Applications only.

Visual



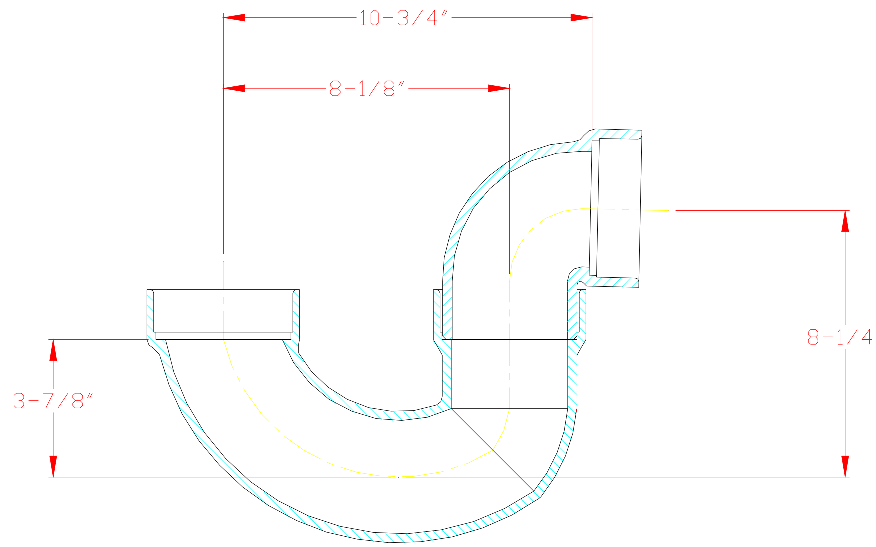
System Layout

- There are three MAJOR issues that must be considered:
  - Overall size of the DC components.



4"x8" P-Trap

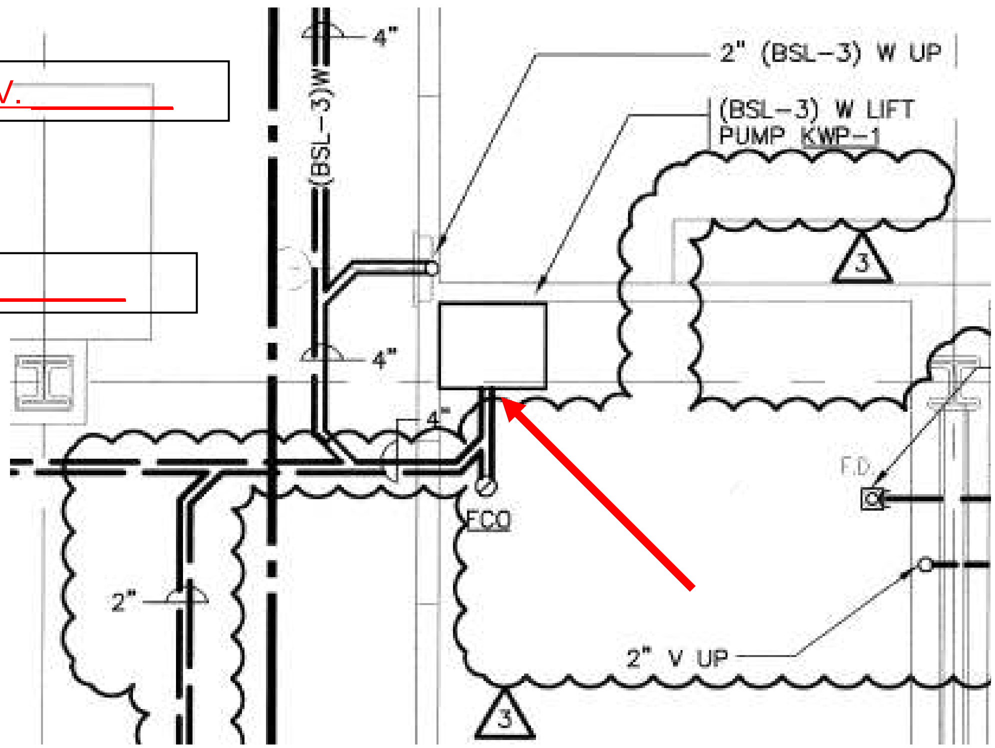
4" P-Trap



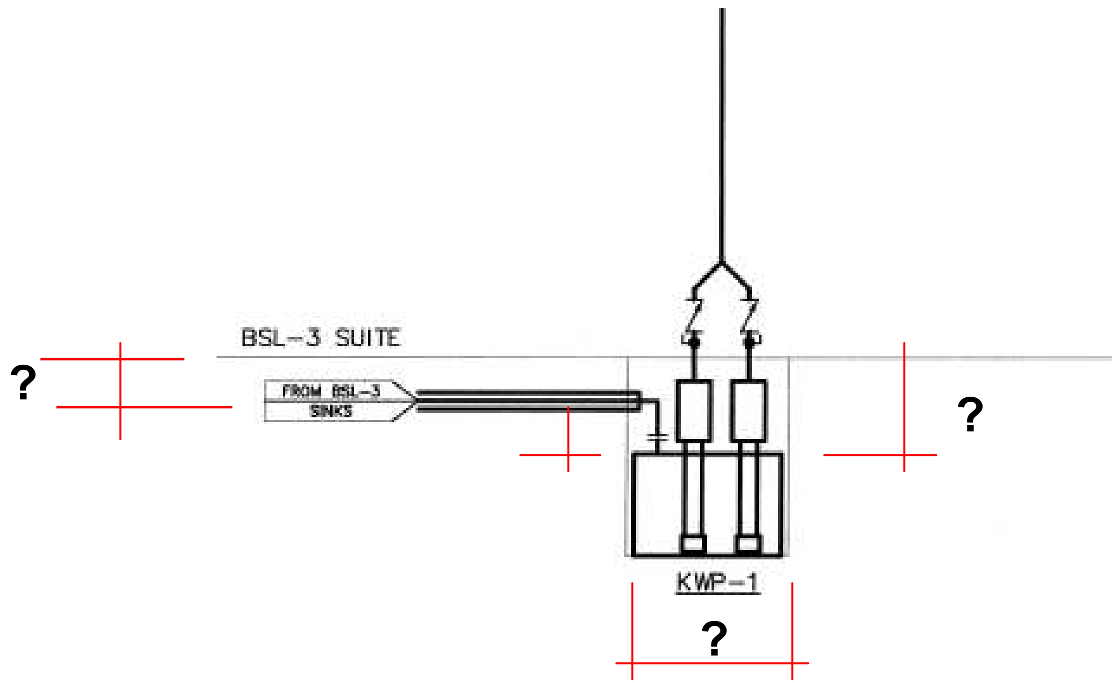
System Layout

FIN. FL. OVER AT ELEV. ________

SLAB THICKNESS = ________



System Layout



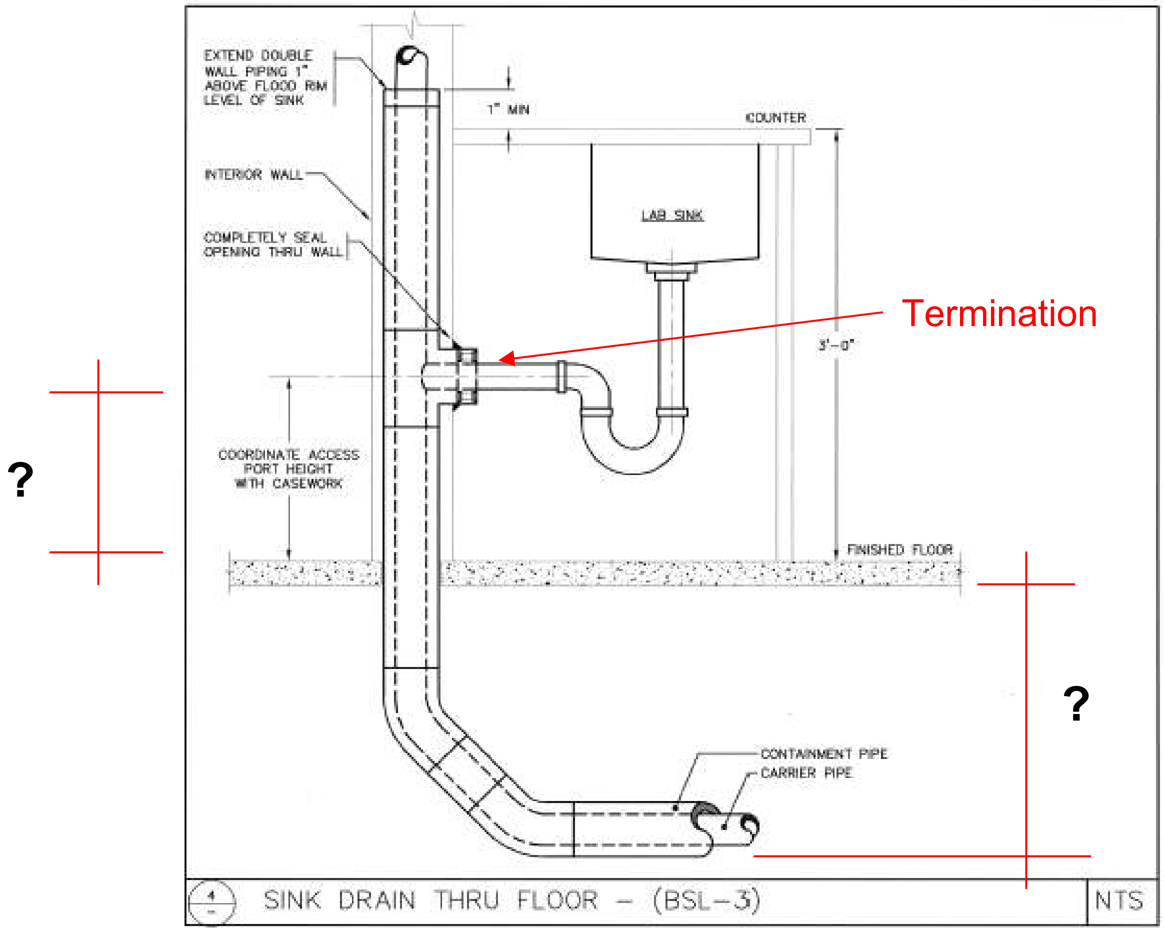
System Layout

- There are three MAJOR issues that must be considered:
  - Proper venting & draining of the system (both primary & secondary).

System Layout

- There are three MAJOR issues that must be considered:
  - Termination of the secondary system at transition points, floor drains, cleanouts, etc.

System Layout



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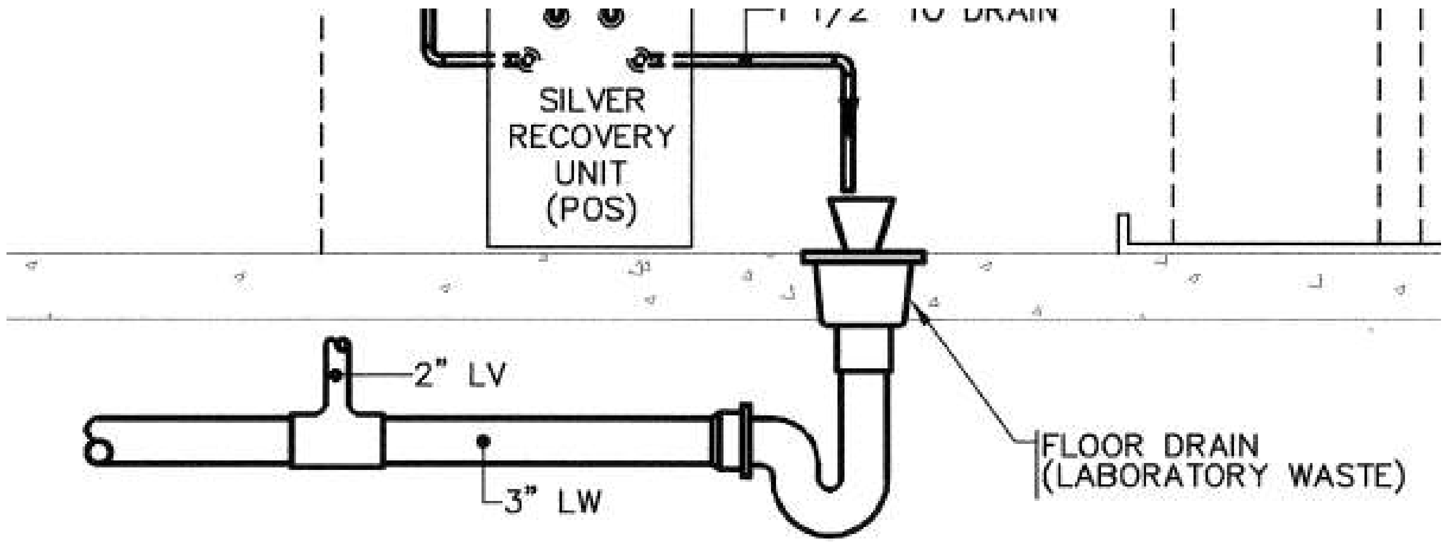

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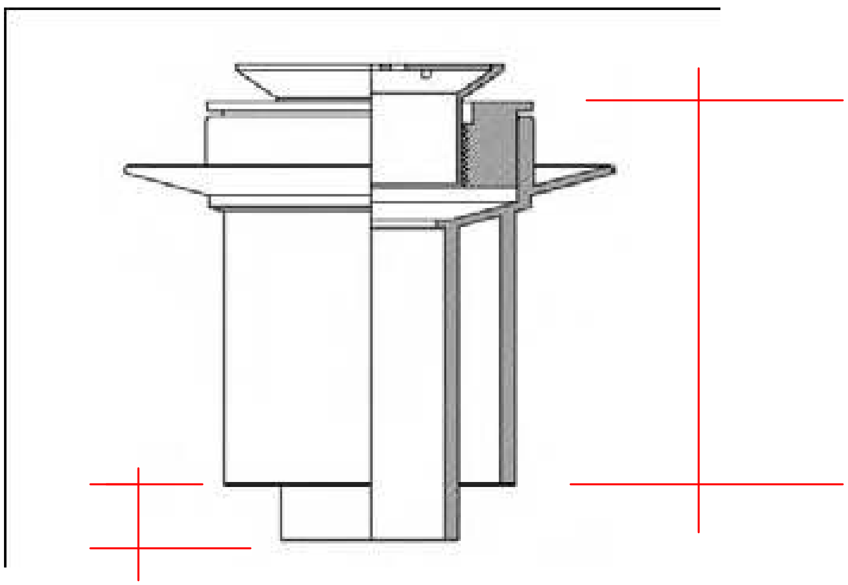

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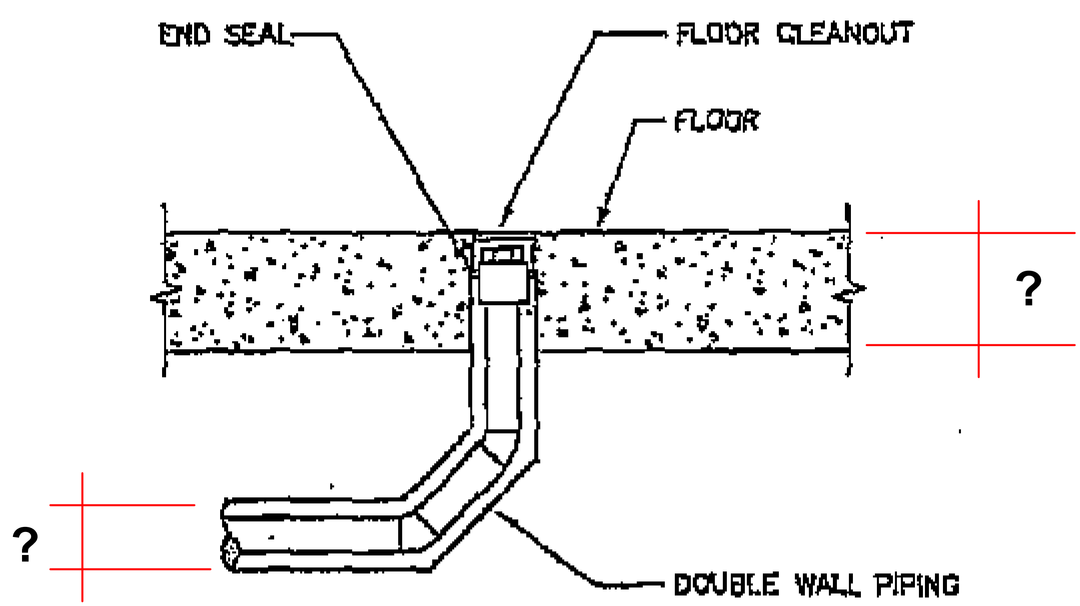

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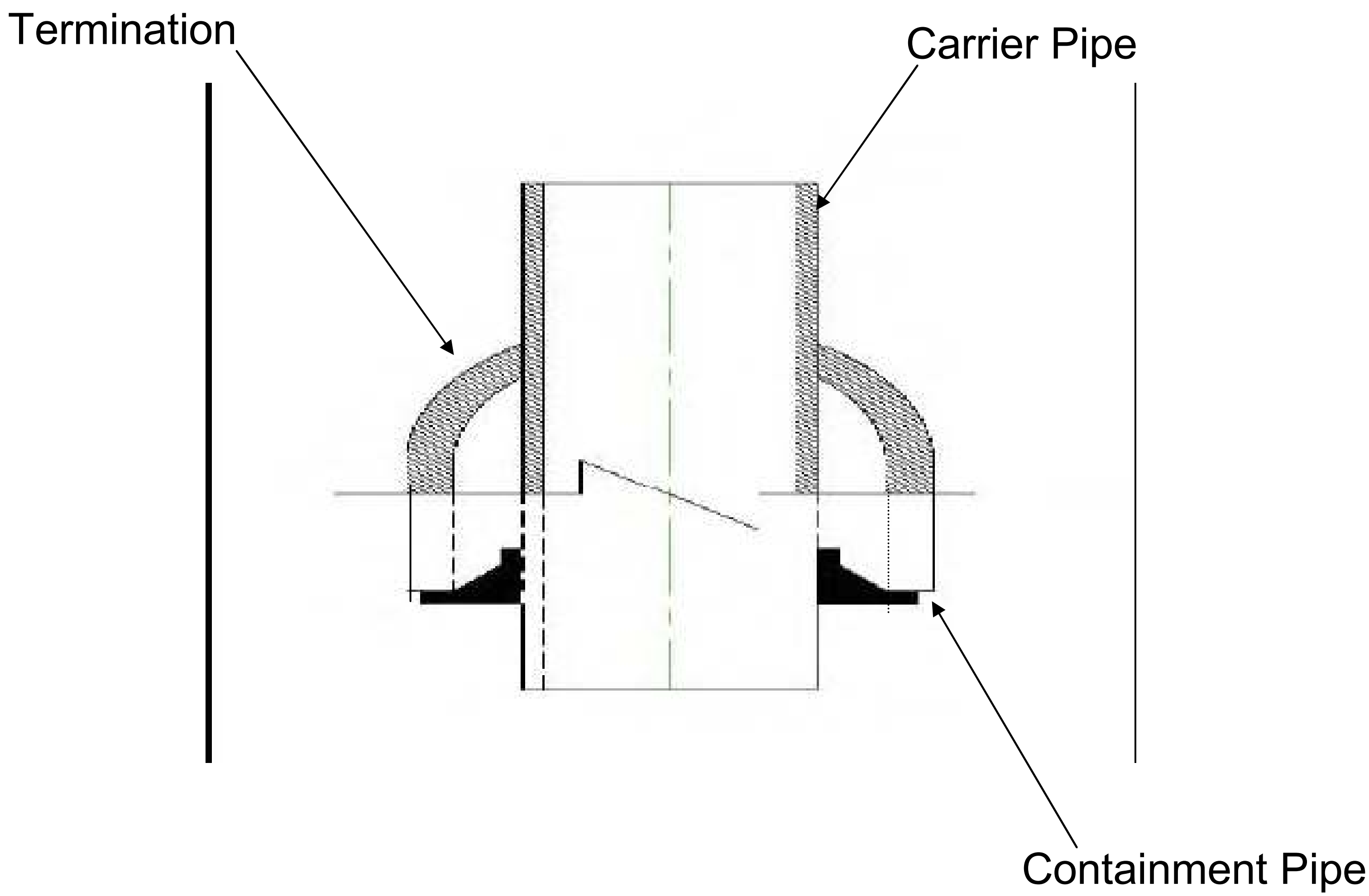

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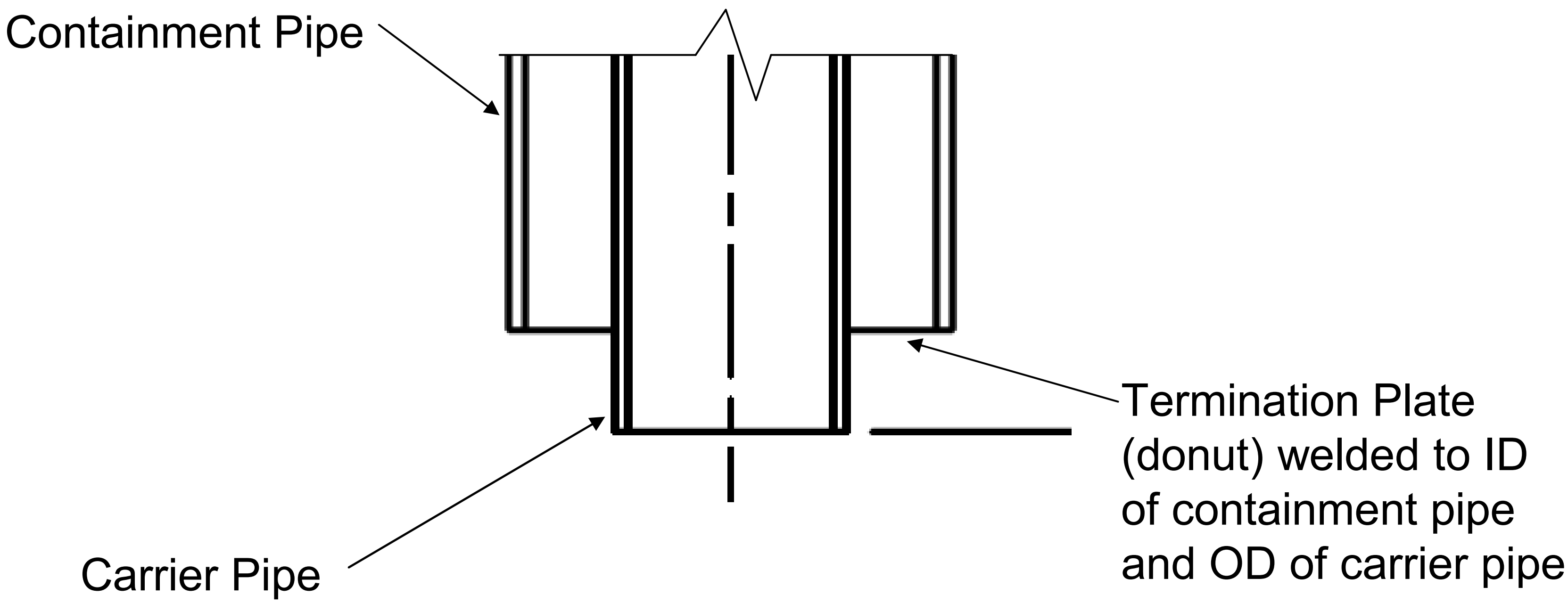

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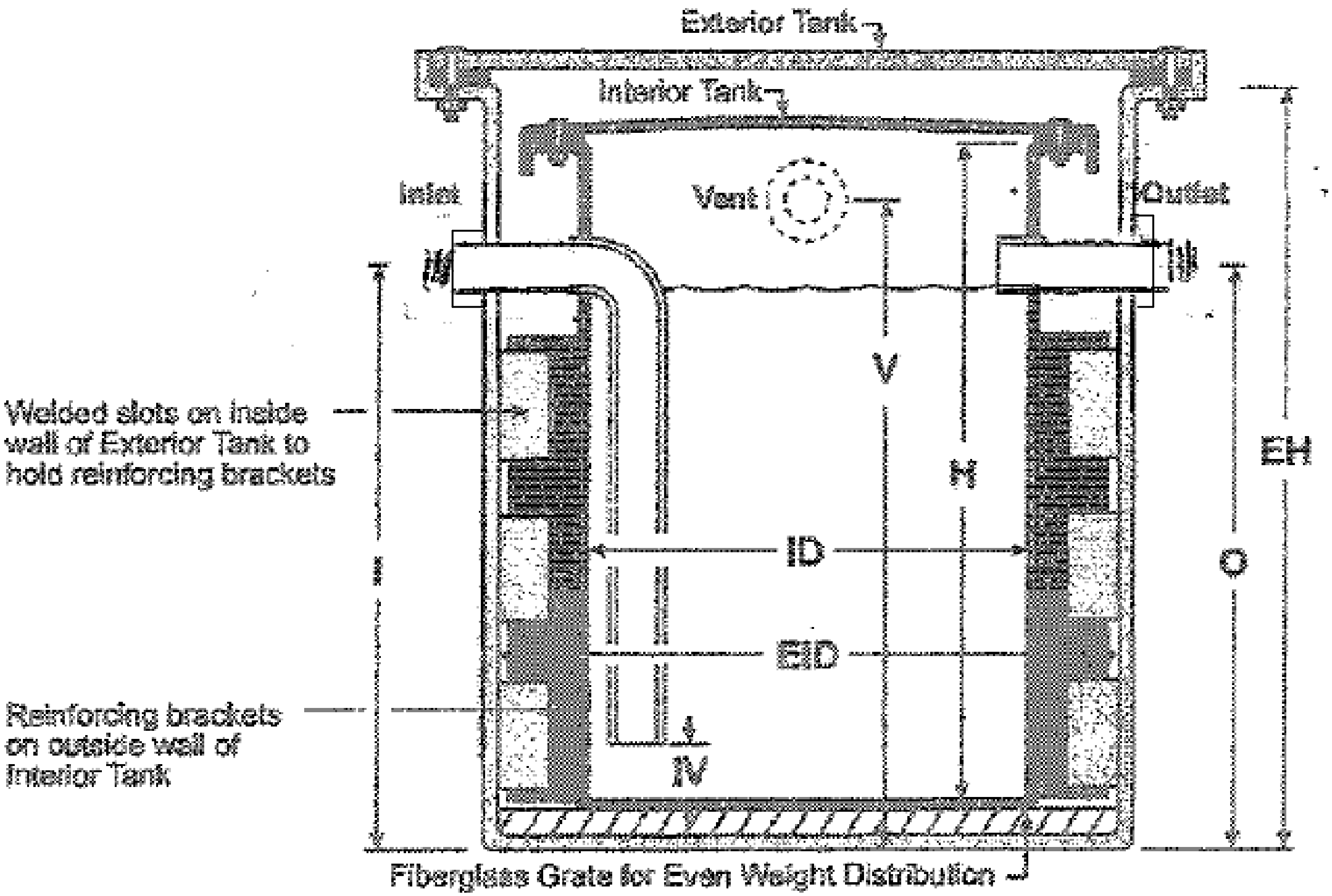


System Layout

System Layout

- Designers must understand the difference between:
  - Design Codes, which cover the mechanical design of the system
    - ASTM
    - ANSI/ASME
  - Plumbing Codes, which cover the operation of the system.
    - UPC
    - BOCA

System Installation

Designers should be familiar with the various methods of installing DC systems:

- Bonding
- Gasketing
- Butt Welding
- Socket Fusion
- Electro fusion
- Solvent Cement

System Installation

Each manufacturer should provide installation instructions and all installers should be trained & certified in those instructions.

System Inspection & Testing

The very nature of DC implies that added protection is need for the primary carrier.

- **Inspection** is a function that is performed by the owner of the system and is a process that is performed visually.
- **Testing** is a process of placing both the primary & secondary components under an internal pressure that is greater than the design pressure for a set period of time.

System Inspection & Testing

- Inspection Requirements:
  - Must be able to inspect the primary system joints before the secondary system is completed.
  - Verify pipe connections, fittings, internal alignment, etc.

System Inspection & Testing

- Testing Requirements:
  - – Sequence of testing must be considered. (primary then secondary)
  - – Primary system must be pressure or leak tested per the local or state code.
  - – Secondary system may only require a leak test.
    - If no code exist or requirement is stated, refer to manufactures procedures.

pH Neutralization Systems

pH Neutralization Systems

- What is pH Neutralization ?

  -The treatment of acid and caustic levels in special waste piping streams

  -pH is measured on a 0-14 scale

    -Low side of scale (acidic)

    -High side of scale (caustic)

    -Neutral (7 pH)

pH Neutralization Systems

- Municipality Requirements – Prohibited pH discharges into sanitary sewer/waterways
  - **Code of Regulations – Northeast Ohio Regional Sewer District – Section 2.0301 General Discharge Prohibitions:**
    - (c) Any wastewater having a pH less than 5.0 or higher than 12.5 or having any other corrosive property capable of causing damage or hazard to structures, equipment, or personnel of the system.

104°F

pH Neutralization Systems

- Municipality Requirements – Prohibited pH discharges into sanitary sewer/waterways
  - **Code of Regulations – Northeast Ohio Regional Sewer District – Section 2.0304 Dilution:**
    - Section 2.0304 Dilution - No discharger shall increase the use of potable or process water in any way, nor mix separate waste streams with the result of or for the purpose of diluting a discharge as a partial or complete substitute for adequate treatment to achieve compliance with the standards set forth in this Title.

104°F

Design of pH Systems

- Design Criteria for pH Monitoring/Neutralization Systems

  -Proposed Flow Rate

  -Daily Hours of Operation/Discharge

  -Chemicals/Processes Discharging into the System

  -Possibility of Solids/Sludge/Lab Material in Influent Flow

Design of pH Systems

- **Design Criteria for Neutralization Monitoring Systems**
  - **-Tank Sizing**
  - **-Limestone Tank (Acid Waste)**
    - **-Based on Number of Sinks (Standard)**
  - **-System Tank (Automatic Acid/Caustic Feed)**
    - **-Based on Assumed GPM Flow Rate**
    - **-Sinks/Equipment Discharge**

Design of pH Systems

- **COMMOM MATERIALS FOR NEUTRALIZATION TANKS**

  -POLYPROPYLENE

  -POLYETHYLENE

  -FIBERGLASS

  -CERAMIC STONEWARE

  -STAINLESS STEEL

- **NOTE: LIMESTONE CHIPS SHALL BE 1”- 3” IN DIAMETER**

  -W/ 90% CALCIUM CARBONATE CONTENT

Design of pH Systems

- **SIZING OF LIMESTONE NEUTRALIZATION TANKS**

# OF SINKS	TANK SIZE	LBS OF LIMESTONE
2	5	50
4	15	150
8	30	200
10	55	500
25	100	1000
40	150	1750
55	180	2000
65	200	2500
80	275	3200
110	360	4500
150	500	6000

Design of pH Systems

- Design Criteria (Acid/Caustic Neutralization System)
  Tank shall have a holding capacity of 10 minute retention for maximum assumed GPM influent flow rate
  - -Tank Sizing Information
    - -Number of Fixtures (Lab Sinks/Cup Sinks)
    - -GPM Flow Rate of Equipment Discharge
  - -Tank Sizing Calculation
    - -Lab Sinks (1 GPM) x # of Sinks x Usage x 10
  - -Cup Sinks (.5 GPM) x # of Sinks x Usage x 10

Design of pH Systems

- **Design Criteria (Acid/Caustic Neutralization System) (Cont'd)**
  -Tank Sizing (example)
  -Bldg "A" 50 Lab Sinks (LS)/24 Cup Sinks (CS)
  50 x 1 (GPM ea.) = 50 x .5 (usage factor) x 10 (min)= 250
  24 x .5 (GPM ea)= 12 x .25 (usage factor) x 10 (min)= 3
  Total assumed Maximum GPM flow rate from sinks = 253
  Assume equipment discharge of 25 GPM Maximum = 25
  Total GPM requirement is approximately 278.
  We would need a system tank with a minimum holding capacity of 280 gallons.

Design of pH Systems

- **NEUTRALIZATION SYSTEMS**
  - **-pH MONITORING STATION**
  - **-pH NEUTRALIZATION SYSTEMS**
    - **-Acid Waste w/Monitoring**
    - **-High/Lo pH Treatment**

Design of pH Systems

- **pH MONITORING STATION**
  - -pH probe installed within effluent waste piping
    - -inline trap
    - -inline sampling sump
  - -Probe signals control panel
    - -Panel receives signal
    - -Records effluent pH levels
    - -Alarms out of spec conditions

Design of pH Systems

Design of pH Systems

- **pH Neutralization System (Acid Waste) w/Monitoring**
  - **-Limestone Tank**
    - **-brings low pH levels up**
  - **-pH probe installed within effluent waste piping**
    - **-inline p-trap**
    - **-inline sampling sump**
  - **-probe signals control panel**
    - **-same as pH monitoring**

Design of pH Systems

- **pH Neutralization System (High/Low pH Treatment)**
  - -System Tank
    - -pH Probe
    - -Mixer
    - -Acid and Caustic Reagent Discharge Ports
  - -Effluent pH Probe (Downstream of Tank)
    - -inline p-trap
    - -inline sump

Design of pH Systems

- **pH Neutralization System (Cont'd)**

  Control Panel

  - **-pH Analyzer (signal from tank)**
  - **-pH Analyzer (signal from Effluent)**
  - **-Circular Chart Recorder (effluent pH levels)**
  - **-Mixer H/O/A Switch**
  - **-System Lights and switches**

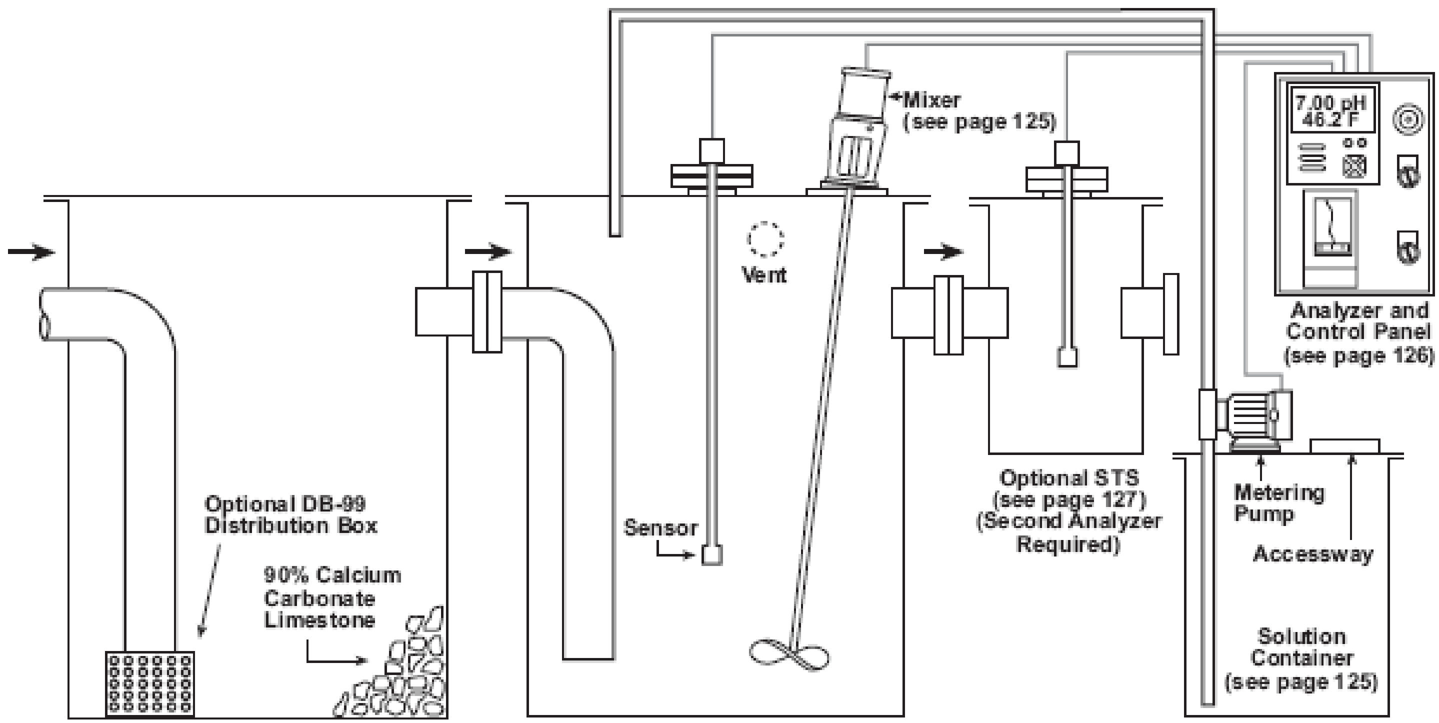
  Metering Pumps

  - **-Acid and Caustic**

Design of pH Systems

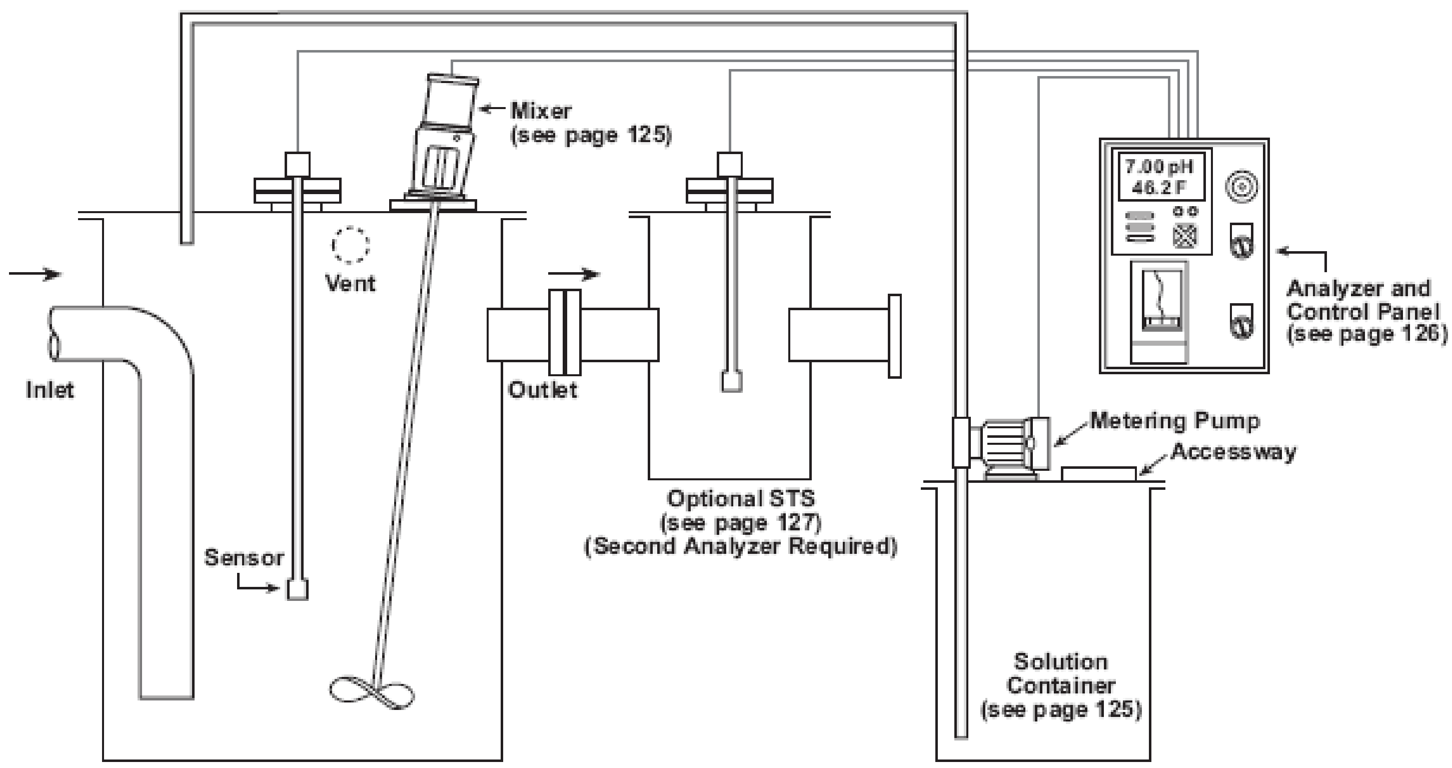
- **TWO STAGE SYSTEMS**
  - **-CONSIDERED WHEN SYSTEM INFLUENT**
    - **-HAS HIGH GPM FLOW RATE**
    - **-HAS HIGH CONCENTRATIONS OF ACID**
    - **OR**
    - **-HAS HIGH CONCENTRATIONS OF CAUSTIC**

Design of pH Systems



Courtesy Schier Products

Design of pH Systems



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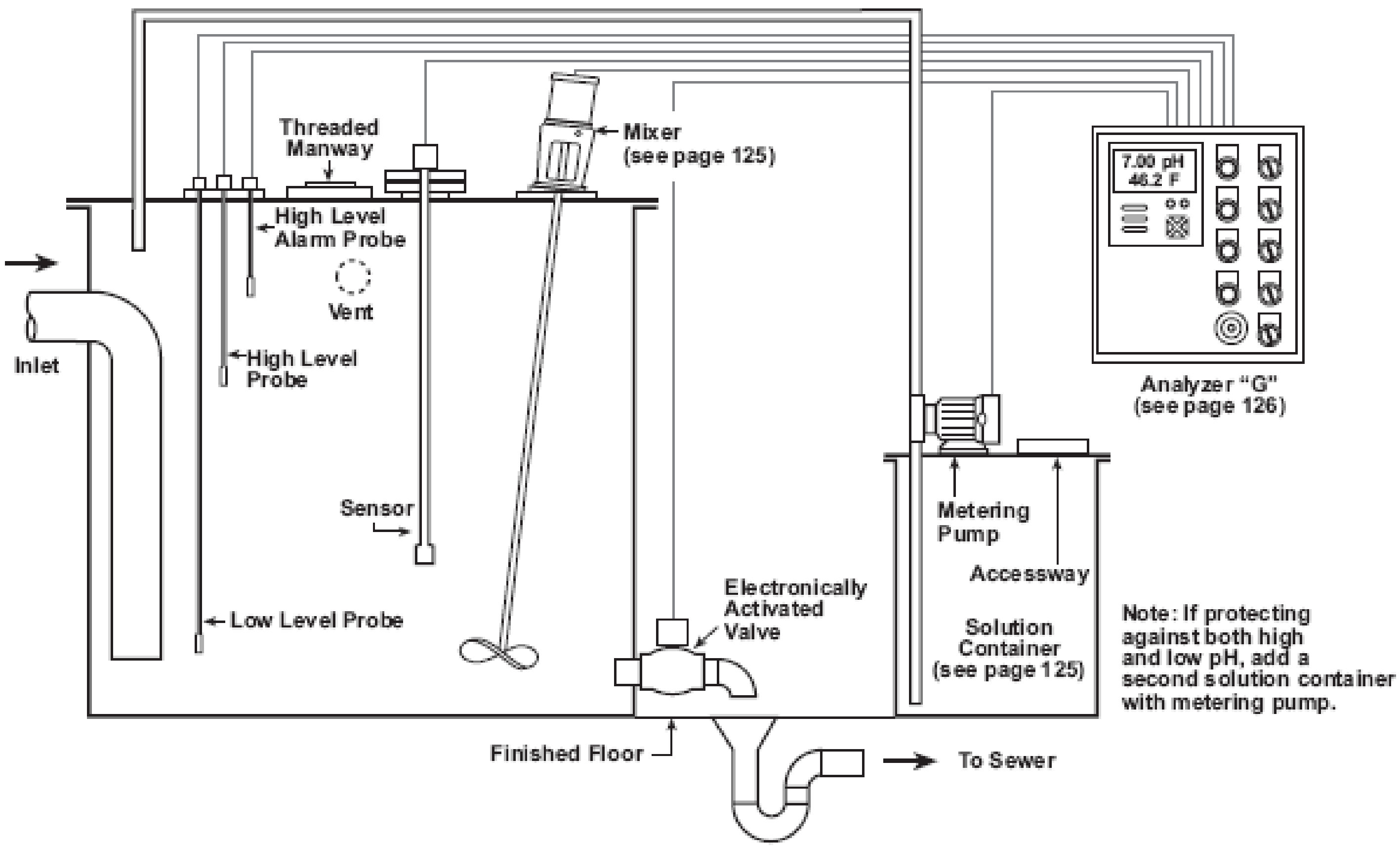
Design of pH Systems



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Design of pH Systems

- **BATCH TREATMENT SYSTEM**
  - **-KNOWN "CONTROLLED" INFLUENT RATE**
  - **-SINGLE TANK APLICATION**
    - **-TANK SIZED TO CONTAIN "BATCH" VOLUME(S)**
    - **-TANK EFFLUENT CONTROLLED BY ACTUATION**
    - **-ONLY DISCHARGES WHEN IN SPEC**