# Non-RCRA Tanks, Containers, and Buildings

**Industrial and Extractive Branch**
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## DISCLAIMER AND ACKNOWLEDGEMENTS

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The use of the terms "extraction," "beneficiation," and "mineral processing" in this document is not intended to classify any waste streams for the purposes of regulatory interpretation or application. Rather, these terms are used in the context of common industry terminology.

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## I. Introduction

This report was prepared to determine the availability and cost of tanks, containers, and buildings suitable for storing hazardous mineral processing secondary materials prior to recycling. These mineral processing secondary materials can be solids, sludges, or wastewaters. Facility level generation rates can range from a few tons per year to 45,000 metric tons per year (mt/yr) for solids and 1 million mt/yr for wastewaters. These materials usually exhibit the hazardous characteristic of toxicity (i.e., these materials meet or exceed the TC metals limit for arsenic, barium, cadmium, chromium, lead, mercury, selenium, or silver) or corrosivity (pH less than 2 or greater than 12.5). Examples of secondary materials from mineral processing include the following:

- Copper acid plant blowdown, a corrosive slurry which contains several metals above TC limits. The average facility generation rate of this material is 530,000 mt/yr.
- Cast house dust from aluminum production, a solid containing cadmium and mercury above TC levels. The average facility generation rate of this material is 830 mt/yr.
- Process wastewater from production of rare earths, a wastewater which contains lead above the TC level and may be corrosive. The average facility generation rate of this material is 7,000 mt/yr.
- APC dust/sludges from synthetic rutile production, a solid which may contain chromium or lead above TC levels. The average facility generation rate of this material is 30,000 mt/yr.

There are many types of appropriate storage units that are available across the country, including steel drums, plastic drums, small metal containers, plastic containers, large metal containers, roll-off containers, filtering containers, small movable tanks, stationary metal tanks, fiberglass tanks, single walled tanks, double walled tanks, large field-erected tanks, hazardous material sheds, warehouse type buildings, dome buildings, and fabric structures. In addition, both secondary containment and a corrosion resistant coating can be added to most of these units. Selection of a specific type of unit will depend on the quantity and physical state and specific hazardous characteristics of the material to be stored, the need to comply with applicable state regulations or industry standards, and waste handling concerns.

This report reviews state regulations that apply to these types of storage units as well as applicable industry standards. The report then discusses our methodology for gathering information on these types of units, and presents our findings about the availability and cost of storage units. This report focuses on tanks, containers, and buildings that would be best suited for storing hazardous mineral processing secondary materials, especially those units that conform with appropriate design standards. For instance, moderate volumes of noncorrosive liquid secondary mineral processing wastes are likely to be stored in aboveground storage tanks (ASTs) that comply with UL 142, an industry standard for flammable and combustible liquids, because most tank manufacturers, as a matter of course, produce tanks that comply with this standard.

Underground storage tanks (USTs) were the only unit specifically omitted from consideration in this report. While a mineral processing facility operator could install and use an UST to store secondary material, this is unlikely because the primary advantage of underground tanks, when compared with ASTs, is the ability of USTs to prevent fire. Because most mineral processing wastes

are not ignitable, the significant added expense of USTs would not be justified. Therefore, this report focuses on those storage units most likely to be used to store mineral processing wastes: metal and plastic drums, roll-off containers, tanks, and bulk storage buildings.

## II. Regulatory Requirements

Several regulatory programs and industry groups have developed requirements for the design, construction, and use of tanks, containers, and buildings for the storage of a wide variety of materials. As such, many of the manufacturers of these types of storage units design their products to comply with one or more of these sets of standards. This section of the report reviews several states' regulations on aboveground storage tanks, as well as an overview of common industry standards for these types of storage units. While there are no centralized federal regulations for storage units, several federal programs do contain regulations that address these types of units when they are employed in certain applications. These federal regulations are summarized in Appendix A.

State regulations and industry standards can be used in selecting storage units in two ways. First, if compliance with the regulations is mandatory, then the choice of storage units is limited to the subset which comply with the standard or regulation. Second, conformance with these regulations may be voluntary, in which case a facility operator can use part or all of these standards and regulations as a guide to selecting equipment appropriate to his/her storage needs. Because most state regulations and industry standards we reviewed applied to storage of petroleum or hazardous chemicals in tanks, mandatory compliance does not appear to pertain to short term storage of mineral processing secondary materials destined for recycling at this time.

### A. Non-RCRA Requirements - State Regulations

State regulations for above ground storage tanks exist in several different stages of development ranging from adoption of federal standards to no provisions at all. Some states have developed their own regulations while others are developing position statements. We reviewed the regulations in four states, Florida, New Jersey, New York, and Pennsylvania. These states represent the various stages of development of state regulations for aboveground storage tanks. There did not seem to be any state regulations that pertained to containers or containment buildings, except for states that have adopted the federal RCRA standards into their own regulations.

#### Florida State Regulations

Florida's only regulation for above ground storage tanks containing hazardous wastes or materials is a registration requirement for tanks with a capacity greater than 110 gallons. Florida does have above ground storage tank regulations that apply only to petroleum, ammonia pesticides, and their derivatives.

#### New Jersey State Regulations

New Jersey has regulations for tanks containing hazardous waste, hazardous substances, and petroleum. The regulations differ depending on what is in the tank and the volume stored. Above ground storage tanks are regulated by 4 departments. The Right to Know Program requires facilities to annually report what is stored in tanks. The Toxic Catastrophe Prevention Act (TCPA) requires manufacturers storing "extra hazardous substances" to report the existence of all chemical storage tanks being used for this purpose.

#### New York State Regulations

New York State has aboveground storage tank (AST) regulations for the bulk storage of petroleum as well as for chemical bulk storage. These regulations are found in 6 NYCRR Parts 612 through 614 and 6 NYCRR Parts 595 through 599, respectively. This section outlines the New York State regulations for petroleum bulk storage and then chemical bulk storage. A copy of relevant sections of these regulations can be found in Appendix B.

*Petroleum Bulk Storage*

Petroleum bulk storage regulations apply to all aboveground and underground facilities with a combined capacity of over 1,100 gallons. The petroleum bulk storage regulations include the following provisions:

1) New aboveground tanks (614.9)

Design and construction standards

- Must be constructed of steel
- Must meet or exceed one of the following design and manufacturing standards[1]: Underwriters Laboratory Standard No. 142 (UL 142), Underwriters Laboratory Standard No. 58 (UL 58), American Petroleum Standard No. 650 (API 650), American Petroleum Institute Standard No. 620 (API 620), Underwriters Laboratory of Canada No. CAN4-S601-M84, or Underwriters Laboratory of Canada No. CAN4-S630-M84

Cathodic protection for tank bottoms

- Must use sacrificial anodes or an impressed current system which is designed, fabricated, and installed in accordance with recognized engineering practices
- Must provide 30 years of protection
- Must have a monitor for owner/operator to check adequacy

Painting of exterior tank surfaces

- Must have a primer coat, a bond coat, and two or more final coats

2) Impermeable barriers under tank bottoms (614.10)

- Must be constructed with a double bottom or be underlain by an impervious barrier which has a permeability rate to water equal to or less than $1x10^{-6}$ cm/sec and must not deteriorate in an underground environment or in the presence of petroleum

3) Monitoring systems for new aboveground tanks ( 614.11)

- Must have equipment for monitoring between the tank bottom and the impermeable barrier

4) Repairing and reconditioning of aboveground storage tanks (614.12)

Permanent repairs

[1] Industry Standards are discussed in detail in the next section of this report.

- All repairs must be permanent in nature and equal to or better than the standards of original construction

Cleaning of tank prior to repair

- Tanks must be cleaned in accordance with generally accepted standards prior to repair
- Accumulated sludge must be removed, transported, and disposed of in a manner consistent with all applicable state and federal requirements for waste disposal

Coating (lining) specifications

- May be any non-corrodible epoxy-based resins, isophthalic polyester-based resins, or equivalent coating
- Must be applied as soon as possible but no later than 8 hours after sandblasting and cleaning of the internal surface
- Must maintain a permanent bond to the tank and be of sufficient thickness, density, and strength to form a hard impermeable shell which will not crack, soften, or separate from the interior surface of the tank
- Coefficient of thermal expansion must be compatible with steel so that stress due to temperature changes will not be detrimental to the soundness of the coating
- Must be chemically compatible with petroleum products and product additives
- Must be applied and cured in strict accordance with manufacturer's specifications
- Bottom coatings must extend up the side of the tank a minimum of 18 inches

Inspection of coating

- Must be checked for blisters, air pockets, and pinholes with an Elcometer Thickness Gauge or equivalent and a Barcol Hardness Tester or equivalent and defects must be repaired

Manufacturers guarantee

- Manufacturer must guarantee that the coating will not leak the product specified in storage and the lining will not deteriorate for 10 years

5) Installation of aboveground facilities (614.13)

Application of New York State Uniform Fire Prevention and Building Code

- Must be installed in a manner consistent with New York State Uniform Fire Prevention and Building Code, 9 NYCRR, sections 1002 and 1171.2 and NFPA No. 30, sections 2-5.1, 2-5.2, 2-5.3, 2-5.4, and 2-5.5

Foundation design

- Must be supported on a well drained stable foundation which prevents movement, rolling, or settling of the tank and is designed to minimize corrosion of the tank bottom

Avoiding traffic hazards

- Must not be located along highway curves or otherwise exposed to traffic hazards

Testing of new tanks

- Must be tested for tightness and inspected in accordance with API Standard 650 before being placed in service

Notification of code enforcement official

- Installer of tank must apply to Uniform Fire Prevention and Building Code authority for any building permit required
- Must give at least 24 hours notice to the local building or fire code enforcement official prior to commencement of installation and the official must be given a copy of the permanent facility registration certificate

*Chemical Bulk Storage*

The chemical bulk storage regulations apply to:

1. Aboveground tanks with a capacity of 185 gallons or greater which are used to store hazardous substances or mixtures of hazardous substances,
2. Underground tanks storing hazardous substances or mixtures of hazardous substances, and
3. Non-stationary tanks used to store 1,000 kilograms or more of a hazardous substance or a mixture of hazardous substances for 90 or more consecutive days.

Hazardous substances include hazardous and acutely hazardous substances as defined in Part 597. Storage of petroleum and hazardous wastes are not covered under the chemical bulk storage regulations. The chemical bulk storage regulations include the following provisions:

1) New Aboveground Tanks (599.8)

Tanks subject to scouring or wear

- Must be equipped with wear plates, diffusers, or alternate means to prevent localized wear or corrosion

Tank design

- Must be of sufficient structural strength to withstand normal handling and use
- Must be chemically compatible with the substance being stored
- Must be protected from or resistant to internal and external wear, vibration, shock, and corrosion
- Must have a stable foundation under all operating conditions
- Must be protected from fire, heat, vacuum, and pressure
- Must be protected from physical damage by moving machinery
- Must have a useful life of 30 years
- Must be designed, constructed, and installed in accordance with one of the following standards[2]: API 650, API 620, CAN4-S601-M84, CAN4-S630-M84, American Society for Testing Material Designation D4097-88 (ASTM D4097-88), American Society for Testing Material Designation D3299-88 (ASTM D3299-88), or a comparable consensus code, standard, or practice developed by a nationally recognized association or independent testing laboratory

Tanks subject to melting

[2] Industry Standards are discussed in detail in the next section of this report.

- Must be protected from fire and located so that any spill or release will not expose persons, buildings, or the environment

Corrosion protection

- Tanks must be protected from corrosion by corrosion materials or a cathodic protection system with a 30 year life and insulated sacrificial anodes, an impressed current, or another method specified in a consensus code, standard, or practice developed by a nationally recognized association or independent testing laboratory
- The cathodic protection system must be equipped with a monitoring system to allow for annual review of adequacy
- External coatings must be fiberglass-reinforced-plastic, epoxy, or other suitable dielectric material with a minimum thickness of 10 mils after curing
- External coatings must have a coefficient of thermal expansion compatible with that of steel and be firmly bonded to the steel
- Application of the coating must be in strict accordance with the instructions of the supplier and form a hard, impermeable shell that will not crack, wick, wear, soften, flake, or separate
- Coatings must be inspected for air pockets, cracks, blisters, and pinholes, and must be electrically tested for coating short circuits or coating faults

Manways

- Tanks with a storage capacity of 5,000 gallons or more must have an access lid or manhole

Painted exterior surfaces

- Surface must be prepared to Steel Structure Painting Council "Steel Structure Painting Manual, Chapter 2 - Surface Property Specifications Commercial Blast Cleaning (SSPC SP #6), protected by an inhibitive primer coat, an intermediate inhibitive coat, and two or more final coats of paint, or have an equivalent or better surface coating or protective system

Impermeable barriers under tank bottoms

- Must be constructed with a double bottom or underlain by an impervious barrier with a permeability rate to the substance stored equal to or less than $1x10^{-6}$ cm/sec and must not deteriorate in an underground environment or in the presence of the substance being stored

Explosion protection

- Must be protected from explosion in accordance with generally accepted engineering practices

2) Secondary containment (599.9)

- Similar to RCRA except that New York State requires secondary containment systems to be capable of containing 110% of the capacity of the largest tank or connected manifold tanks.

3) Monitoring systems (599.10)

- Similar to RCRA

4) Installation (599.11)

- Similar to RCRA, but also includes provisions specific to aboveground tanks, such as support requirements for horizontal tanks, avoiding traffic hazards, separation of incompatible substances, and emergency response equipment.

5) Operating standards (598.5, 598.7 - 598.11)

Deadlines for upgrading existing tank systems
Inspections
- Daily
- Monthly
- Annual
- Five-year

Recordkeeping
- Recordkeeping
- Reporting

Maintenance and repair
Closure and change-in-service
Financial responsibility

**Pennsylvania State Regulations**

Pennsylvania is in the process of adopting aboveground storage tank standards. The public comment period recently ended, and final regulations are scheduled to be promulgated in April of 1997. These tank standards would apply to regulated substances, including petroleum products and hazardous substances (primarily substances on the CERCLA hazardous substances list). These standards include design, construction, and installation requirements, corrosion and deterioration prevention requirements, release prevention and leak detection standards, inspection schedule, and closure requirements. The design standards incorporate industry standards by reference. That is, tanks must be designed and constructed in accordance with "an appropriate code of practice developed by nationally recognized associations such as UL, ACI, API, ASME, ASTM or NACE." (25 PA Code 245.521(a)) The proposed regulation is included in Appendix B.

**B. Industry Standards**

There are numerous industry standards that apply to the construction, design, and inspection of aboveground storage tanks, as shown in Table 1. In researching relevant industry standards, we found that 1) there are literally hundreds of relevant or potentially relevant standards; and 2) each standard tends to reference other standards, creating a complex web of engineering guidelines, the overall scope of which is not easily discernible. The following section provides detail on the most common standards, starting with the universally referenced Underwriters Laboratories 142 - Steel Aboveground Storage Tanks for Flammable and Combustible Liquids and the American Petroleum Institute's 650 - Welded Steel Tanks for Oil Storage. Additionally, we provide short summaries for other related or relevant standards. A complete in-depth review of all relevant standards is, however, beyond the scope of this report.

**API 650: Welded Steel Tanks for Oil Storage**

This standard, published by the American Petroleum Institute, covers all the major aspects of steel aboveground storage tanks for storage of petroleum: materials, design, fabrication, erection, and inspection. API 650 is a technical guide for tank design, such that an engineer could specify a number of variables (e.g., material properties and quantity) and, using the guidelines established herein, design a tank to store the given substance. There is, however, no generic tank design that must be used - each tank can be engineered in a variety of ways to best satisfy the situation at hand. For example, the steel plating used to construct the tank's walls must meet requirements based two factors: the properties of the material contained and the grade of the steel used. Thickness of the shell is determined using computers or other methods of calculation whereby the material stored, the strength of the steel, and environmental stresses (e.g., temperature extremes or precipitation) are considered.

**Table 1. Relevant Industry Standards by Topic**

| Design and Construction | Installation | Corrosion Control | Leak Detection | Inspection, Maintenance, and Repair |
|---|---|---|---|---|
| ANSI B31.3<br>ANSI B31.4<br>AWWA D100-84.<br>AWWA D115-95<br>AWWA D120-R84<br>API 12B<br>API 12D<br>API 12F<br>API 620<br>API 650<br>ASME B96.1<br>ASTM D1998-95<br>ASTM D3299-88<br>ASTM D4907-88<br>STI F911<br>STI F921<br>UL 142<br>UL 2085 | API RP 12R1<br>STI R912<br>STI R931 | API 651<br>API 652<br>NACE RPO181-94<br>NACE RPO193-93<br>NACE RPO196-96<br>NACE RPO376-76<br>NACE RPO592-92<br>STI R893 | API Publ 306<br>API Publ 307<br>API 2350<br>ASTM currently developing standards | API RP 12R1<br>API 653<br>API Publ 2015<br>API Publ 2026<br>API Publ 2027<br>API Publ 2207<br>API Publ 2217A<br>NACE RPO188-90<br>NACE RPO288-94<br>NACE RPO288-94 |

Adapted from: *The Aboveground Storage Tank Guide*. Thompson Publishing Group, 1994.

In sum, this standard represents a technical tool advising engineers on the proper design of storage tanks depending on the substance stored. There is no simple generic formula for tank design - construction requirements must be determined on a case by case basis. API's standard assists engineers in determining which factors must be examined and how to make the requisite calculations. The following is an outline of the major sections of API 650:

Scope [Section 1] - This standard provides material, design, fabrication, erection, and testing requirements for vertical, cylindrical, aboveground, closed- and open-top, welded steel storage tanks in various sizes and capacities. Section 1 also discusses methods for verifying manufacturers' compliance with API Standard 650.

Materials [Section 2]
The section lists specifications for materials used in the construction of tanks including: plates, sheets, structural shapes, piping and forging, flanges, bolting, and welding electrodes. If other specifications are used, the material must be certified to meet all the requirements of a material specification listed in this section.

Design [Section 3] - The section contains design criteria for tank joints, bottom plates, annular bottom plates, shell design, shell openings, shell attachment and tank appurtenances, top and intermediate wind girders, tank roofs, and wind load. Also, the section provides both general and special design considerations for purchasers.

Fabrication [Section 4] - The section outlines standards for fabrication of API Standard 650 tanks including, methods for finishing plate edges and shaping of shell plates. In addition, the section contain requirements for marking, shipping, and shop inspection.

Erection [Section 5] - The section contains general requirements for welding tank bottoms, shells and roofs. In addition, the section provides criteria for the inspection, testing and repair of welds, and specifies dimensional tolerances.

Methods of Inspecting Joints [Section 6] - The section outlines several methods of inspecting joints specifically: radiographic, magnetic particle, ultrasonic, liquid penetrant, and visual examination. Also, the section provides criteria for repairing defects in radiographic welds. Radiographic inspection is required for shell butt welds, annular-plate butt welds, and flush-type connections with butt welds. All methods of examination must be conducted in accordance with Section V of the ASME Code.

**UL 142: Steel Aboveground Storage Tanks for Flammable and Combustible Liquids**

UL 142 is a set of design standards for aboveground storage tanks, as is API 650. However, while API 650 focuses on petroleum storage, UL 142, published by Underwriters Laboratory, pertains to flammable and combustible liquids.

Introduction - The standard applies to steel atmospheric tanks intended for aboveground storage of noncorrosive, stable, flammable, and combustible liquids that have a specific gravity not exceeding that of water. The standard does not apply to API Standard 650, 12D, and 12F tanks.

Primary Containment Tank [Glossary] - A steel, single-wall atmospheric tank intended for stationary installation having a liquid capacity exceeding 60 US gallons for aboveground storage (primary containment) of flammable and combustible liquids. Primary containment aboveground tank types include: horizontal cylindrical, vertical cylindrical, and rectangular.

Secondary Containment Aboveground Tank - A primary containment aboveground tank contained within a steel secondary containment shell forming an interstitial space, which is capable of being monitored for leakage into the space from either the interior or exterior walls. Secondary containment aboveground tank types include: horizontal cylindrical, vertical cylindrical, and rectangular.

Diked Aboveground Tank - A primary containment aboveground tank within a steel dike intended to contain product resulting from a spill, tank leak, or rupture. Diked aboveground tank types include: closed top dike and open top dike.

Construction -- All Tanks - This section provides general tank construction specifications that address capacities and dimensions, materials, joints, tank connections, venting, manholes, fill, drain and gauge openings, and painting.

Primary Containment Tanks [Part I] - This part provides construction criteria for primary containment horizontal cylindrical, vertical cylindrical and rectangular tanks. Specifically, Part I provides criteria for: capacities and dimensions, steel thickness, head and head joints, and compartment tank construction for horizontal cylindrical constructions; capacities and dimensions, tank top, tank bottom, and weak shell-to-roof joint construction for vertical cylindrical constructions; and provides construction and performance criteria for primary containment rectangular tanks.

Secondary Containment Tanks [Part II] - This part provides construction requirements for secondary containment for horizontal, vertical and rectangular tank constructions.

Diked Tanks [Part III] - This part addresses open and closed top dike tanks and contains requirements for dike construction, capacity, access and egress devices, and performance tests. Also, specifies that the actual capacity of the dike shall be 110 percent of the actual capacity of the tank.

Tank Supports [Part IV] - This part provides requirements for material, construction and performance tests for tank supports such as saddles, skirts, and legs.

Tank Accessories, Components, and Special Constructions [Part V] - This part provides requirements for optional tank accessories and components including, ladders, stairs, runways, heating coils and hot wells and sumps.

Performance Test Methods - The section specifies performance test methods including, tank leakage test, hydrostatic strength test, top load test, buoyancy test, hydrostatic load test and tank support load test.

Manufacturing and Production Tests - The section requires primary, secondary containment, and diked tanks to be tested before painting. Also, requires that each dike tank shell be inspected for welding defects by a dye penetrant, magnet flux or other acceptable non-destructive testing method.

Markings - The section requires that tanks be marked with the manufacturer's name, trade name, trademark or other descriptive marking to identify the organization responsible for the product. Also, provides additional marking requirements for compartment tanks, secondary containment tanks, diked tanks and rectangular tanks and describes the appropriate marking method and where the marked nameplate shall be placed.

Appendix A
Capacity and Wetted Area Tables

**Other Industry Standards**

In addition to API 650 and UL 142, there are numerous other standards applicable to the design, construction, maintenance and inspection of aboveground storage tanks. We list here a variety of the more common standards, including short descriptions, grouped by purpose: design and construction; installation; corrosion control; leak detection; and inspection, maintenance, and repair. These standards apply not only to tanks but also to appurtenances such as piping. In addition, there is often more than one means to each end, such as corrosion control achieved through different coatings or various methods of cathodic protection. We have tried to capture as many of these secondary standards as possible.

**Design and Construction**

American National Standards Institute (ANSI) Standards:

ANSI B31.3: *Chemical Plant and Petroleum Piping* describes use, design, fabrication, examination, and testing of piping systems. Covers systems that handle all fluids, including fluid dyes and solids. Applies to raw, intermediate, and finished chemicals, oil and petroleum products, gas, steam, air, water, and refrigerants.

ANSI B31.4: *Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols* includes information on engineering requirements for safe design and construction, materials specifications, requirements for assembling and testing piping, maintenance procedures, and corrosion protection.

American Petroleum Institute (API)

Spec 12B: *Specifications for Bolted Tanks for Storage of Production Liquids* covers material, design and erection requirements for vertical, cylindrical aboveground bolted steel tanks in nominal capacities of 100 to 10,000 barrels for production service.

Spec 12D: *Specifications for Field Welded Tanks Storage of Production Liquids* covers material, design and erection requirements for vertical, cylindrical aboveground, welded steel tanks in nominal capacities of 500 to 10,000 barrels for production service.

Spec 12F: *Specifications for Shop Welded Tanks Storage of Production Liquids* covers material, design and erection requirements for vertical, cylindrical aboveground, shop-welded steel tanks in nominal capacities of 90 to 500 barrels for production service.

API 620: *Design and Construction of Large, Welded, Low Pressure Storage Tanks* covers the design and construction of large, welded, low-pressure carbon steel aboveground storage tanks (including flare-bottom tanks) that have a single vertical axis of revolution. The tanks described in this standard are designed for metal temperatures not greater than 250E F and with pressures in their gas or vapor spaces not greater than 15 psig.

American Society of Mechanical Engineers (ASME)

ASME B96.1: *Welded Aluminum Alloy Storage Tanks* covers the design and fabrication of welded aluminum alloy storage tanks.

Steel Tank Institute (STI)

STI F911: *Standard for Diked Aboveground Steel Tanks* addresses aboveground fabrication specifications for construction of steel diked secondary containment of products stored in ASTs and covers manufacture, inspection and testing of open top diked secondary containment tanks as well as requirements for drain openings and valves, tank anchoring, handling, inspection, and testing.

STI F921: *Standard for Aboveground Storage Tanks with Integral Secondary Containment* addresses the manufacture, inspection and testing of secondary containment tanks. This standard, available in horizontal and vertical configurations, features a double wall, tight-wrap system for providing secondary containment on shop-fabricated tanks.

Underwriter Laboratories (UL)

UL 142: *Steel Aboveground Tanks for Flammable and Combustible Liquid* - See above.

**Installation**

American Petroleum Institute (API)

RP 12R1: *Recommended Practice for Setting, Maintenance, Inspection, Operation and Repair of Tanks in Production Service* contains guidelines for new tank battery installations and for revamping existing batteries should this be necessary.

Steel Tank Institute (STI)

STI R912: *Installation Instructions for Factory Fabricated Aboveground Storage Tanks* covers foundation preparation, air testing, handling, labeling, and secondary containment installation requirements for primary storage tanks built to UL 142.

STI R931: *Double Wall Aboveground Storage Tank Installation and Testing Instructions* detail the handling and testing procedures for double wall ASTs upon arrival to the site. The standard applies specifically to stationary, factory-assembled, vertical and horizontal double wall ASTs for the storage of stable, flammable, and combustible liquids at normal atmospheric pressures.

**Corrosion Control**

American Petroleum Institute (API)

API 651: *Cathodic Protection of Aboveground Petroleum Storage Tanks* describes the corrosion problems characteristic in aboveground steel storage tanks and associated piping systems and provides a general description of the two methods currently used to provide cathodic protection against corrosion.

API 652: *Lining of Aboveground Petroleum Storage Tank Bottoms* describes the procedures and practices for achieving corrosion control in aboveground storage tanks by application of tank bottom linings to both existing and new storage tanks. Tank bottom linings have proven to be an effective method of preventing internal corrosion of steel tank bottoms.

National Association of Corrosion Engineers (NACE)

NACE RPO193-93: *External Cathodic Protection of On-Grade Metallic Storage Tank Bottoms* provides guidelines for the design, installation and maintenance of cathodic protection systems for the exterior bottoms of on-grade metallic storage tanks. Design criteria are included for the upgrade of existing tanks and for newly constructed tanks.

Steel Tank Institute (STI)

STI R893: *Recommended Practice for Corrosion Protection of Shop Fabricated Aboveground Storage Tank Floors* details design and manufacture procedures for an external corrosion control system for vertical or horizontal ASTs that are shop fabricated to UL 142 within a secondary containment dike system. The corrosion control system is a practical and economic means of extending the life of ASTs for a minimum of 30 years in corrosive soil conditions to an indefinite term in less severe environments.

**Leak Detection**

American Petroleum Institute (API)

Publ 306: *An Engineering Assessment of Volumetric Methods of Leak Detection in Aboveground Storage Tanks* provides the results of a leak detection project in aboveground

storage tanks that utilized volumetric methods to detect leaks. The analytical and experimental results of the study suggest that volumetric leak detection methods can be used to detect small leaks in aboveground storage tanks.

Publ 307: *An Engineering Assessment of Acoustic Methods of Leak Detection In Aboveground Storage Tanks* provides the results of a leak detection project in aboveground storage tanks that utilized acoustic methods to detect leaks. The analytical and experimental results of the study suggest that passive-acoustic leak detection methods can be used to detect small leaks in aboveground storage tanks.

API 2350: *Overfill Protection for Petroleum Storage Tanks* suggests methods of preventing petroleum storage tanks from being overfilled and covers manual and automatic systems that provide protection against tank overfills, as well as safety, environmental protection, optimization of the workplace, maintenance, and installation and training information.

American Society for Testing and Materials (ASTM)

ASTM is in the process of developing new standards for leak detection systems.

**Inspection, Maintenance and Repair**

American Petroleum Institute

API 653: *Tank Inspection, Repair, Alteration and Reconstruction* provides guidance in the inspection, repair, alteration, and reconstruction of steel storage tanks used in the petroleum and chemical industries. The standard provides the minimum requirements for maintaining the integrity of welded or riveted, nonrefrigerated, atmospheric pressure, aboveground storage tanks after they have been placed in service.

Publ 2015: *Safe Entry and Cleaning of Petroleum Storage Tanks* describes precautions procedures to clean nonportable, nonrefrigerated atmospheric and pressurized petroleum storage tanks. It includes the use of suitable mechanical equipment and protective clothing, use of proper cleaning methods, elimination of potential ignition hazards and provision of a means of emergency exit.

## III. Equipment Suppliers and Availability

### A. Methodology

EPA obtained information on the cost and availability of tanks, containers, and buildings that could be used to store secondary materials from mineral processing, by identifying manufacturers of "appropriate" storage units and contacting them. Because EPA did not idenftify any state regulations or industry standards for containers or buildings, EPA determined that appropriate units would be units currently used to store similar materials, including: plastic and steel 55 gallon drums; metal roll-off containers; buildings used to store road chemicals; buildings used to store municipal solid waste prior to transhipment; and warehouse-type buildings. EPA identified several industry standards pertaining to tanks, most importantly API 650, which is a design standard for welded steel tanks for oil storage, and UL 142, which is a design standard for flammable and combustible liquids. Because these two

standards are the most commonly cited standards for large field erected tanks and smaller shop erected tanks, EPA identified manufacturers of these two types of tanks, in order to provide cost and availability information.

The methodology we employed included the following steps, which are described in more detail below:

- Identifying Relevant Trade Organizations,
- Identifying Building Manufacturers,
- Reviewing Trade Journals and Buyers Guides,
- Conducting Internet Searches,
- Requesting Catalogs, and
- Interviewing Tank, Container, and Building Manufacturers.

### 1. Identifying Relevant Trade Organizations

EPA performed a general search on the Internet for web sites dealing with tanks, containers, and buildings. In order to capture the largest number of potential manufacturers, our goal at this stage was to identify trade groups that represented numerous producers of these storage units. Later, after developing lists of manufacturers, EPA examined individual company's web sites for production and sales data.

Our search of the Internet yielded two lists of associations, one entitled the "Packaging Organizations Index," and the other the "Enviro$en$e Associations Listing." There was substantial overlap between the associations on the two lists. There was also a search of the CD-ROM version of the "Encyclopedia of Associations,"[3] for associations dealing with storage units. Our findings supplemented those of the Internet search, but largely produced the same list of organizations. The Enviro$en$e list provided a brief description of the companies the trade groups represent. Using this description and the names of the associations, we identified the several that appeared to be germane:

- The Air & Waste Management Association;
- The Hazardous Materials Advisory Council;
- The Steel Tank Institute;
- The Plastic Drum Institute;
- The Materials Handling Institute;
- The National Wooden Pallet and Container Association;
- The Steel Shipping Container Institute;
- National Solid Waste Management Association; and
- Waste Equipment Technologies Association.

EPA then searched for individual home pages for these organizations on the Internet. These organizations' home pages generally did not contain membership or sales data. These organizations were then called and we requested publicly available lists of their member companies as well as any aggregate sales or revenue data they might compile. Table 2 shows the results of our phone conversations with these groups.

[3] "Encyclopedia of Associations," Gale Research Inc., 1995.

As the table indicates, many of these trade groups either did not compile or could not release the requested information to non-members. The Steel Shipping Container Institute referred us to a Census Report MA34(K), which was issued on August 27, 1996, and contains detailed sales and cost information on steel pails and drums. In addition, a Mr. Garrison of the Plastic Drum Institute was able to estimate that 10-12 million plastic drums were produced in 1995, with a market value of approximately $200 million.

**Table 2**
**Trade Groups Contacted**

| Trade Group | Information Provided |
|---|---|
| The Air & Waste Management Association | Could not release information to non-members |
| The Hazardous Materials Advisory Council | Could not release information to non-members |
| The Steel Tank Institute | Faxed list of members. Does not compile sales information. |
| The Plastic Drum Institute | Faxed list of members. Does not compile such data. Contact provided rough estimate on the number of plastic drums produced in 1995. |
| The Materials Handling Institute | Sent a catalog of members. Does not compile sales information. |
| The National Wooden Pallet and Container Association | Sent a buyers guide, which revealed that the organization did not manufacture products relevant to this project. |
| The Steel Shipping Container Institute | Could not release information to non-members, but did refer us to a Census report on the Internet which does contain detailed cost data. |
| National Solid Waste Management Association | Could not release information to non-members |
| Waste Equipment Technologies Association. | Might release data, but we have not received a definitive word. |

### 2. Phone Calls to Identify Building Manufacturers

In order to obtain information on building manufacturers EPA contacted several state departments of transportation for names of vendors for road salt buildings. EPA decided to contact states across the country that were likely to maintain large stockpiles of road salts and chemicals. On the basis of geographic location and climate, we contacted Virginia, Michigan, Wisconsin, and Colorado. Two of these states identified two companies, Dome Corporation of America (formerly Envirotech Structures) in Saginaw, Michigan, (517) 777-2896 and Bulk Storage in Crete, Illinois, (708) 672-3113. EPA also contacted several state departments of solid waste, including California, Virginia, and Texas to determine who designed or constructed transfer stations (buildings used to store municipal

waste prior to transshipment). Most respondents from these state agencies indicated that we would have to speak directly with the transfer stations, as these operations tended to be owned and operated at the local or regional level.

### 3. Trade Journals and Buyers Guides

To develop a list of suppliers of tanks, containers, and buildings, we reviewed trade journals and buyers guides, including journals such as Waste Age, Solid Waste, and Pollution Engineering. EPA created a list of tank, container, and building manufacturers advertising in these journals and sent in reply cards requesting more information on these manufacturers. EPA added companies in the buyers guides that supplied storage equipment to our list.

### 4. Internet Searches

For the Internet searches, a list was compiled of manufacturers from the first three steps of the methodology. Ssearches for any available home pages providing information on these manufacturers were then conducted. From the information on the home page, EPA determined whether the manufacturer's products would likely be suitable for storing mineral processing secondary materials. EPA sent in Internet "reply cards" where available and appropriate to retrieve more information.

### 5. Phone Calls for Catalogs

When the list of possible suppliers of tanks, containers, and buildings was fully developed, all suppliers were contacted by phone that we did not contact by either trade journal or Internet reply cards. We asked the companies to send any information on products that would be suitable for storing mineral processing secondary material. During our calls we expressed our interest in their products but did not indicate that we intended to purchase them.

### 6. Detailed Phone Calls

Based on the available cost information in catalogs and promotional literature received, EPA had its contractor call one plastic drum manufacturer, three building manufacturers, two roll-off container manufacturers, one metal container manufacturer, and two tank manufacturers. EPA chose specific manufacturers in each category based on the nationwide availability of their products and the need for more detailed information from them. We selected manufacturers whose products were available nationwide or in number of locations over those with more limited distribution. The manufacturers contacted are listed in Table 3. EPA contractor (ICF) personnel questioned these manufacturers about the capital costs, shipping costs, warranty, and lifetime of their product. The detailed information gathered from these phone conversations, in addition to the information in the literature received from vendors, was used to determine the availability and cost and of the various types of storage units. Phone logs from these conversations are included as Appendix C.

## B. Availability and Cost by Storage Unit Type

In general, EPA was able to identify several manufacturers of each type of storage unit, as well as the capital costs associated with purchase of the storage units. Selected, representative vendor literature is included in Appendix D. Total cost to the facility operator will depend on a number of site specific variables. For instance, a facility operator could store 500 gallons of liquid in drums, movable tanks, or stationary tanks. To determine the most cost-efficient means of storage, the operator must

consider the initial capital and installation cost of each type of storage unit as well as operating and maintenance costs,

**Table 3. Manufacturers Contacted for Detailed Information**

| Type of Product | Manufacturer's Name |
|---|---|
| Plastic Drum | Florida Drum Company |
| Buildings | Bulk Storage |
| | Dome Corporation of America |
| | Sprung Instant Structures |
| Roll-Off Containers | Bucks Fabricating |
| | Modern Manufacturing |
| Metal Containers | General Container |
| Tanks | Bell Corporation |
| | Brown-Minneapolis Tank Company |

involving both maintenance cost of the unit, the expected lifetime of the unit, and the operating costs associated with material handling. The cost of the machinery to move drums or tanks may be higher or lower than the cost of pumping material across the facility, depending on the site layout, the point of generation, the point of reinsertion, and the quantity of material. While EPA was able to identify capital costs, and in some case maintenance costs, other operating costs are highly site-specific and we have not attempted to quantify them.

**1. Drums**

The manufacture of drums for storing hazardous wastes typically employs one of three materials: carbon steel, stainless steel, or fiberglass. While the most common size is the standard 55-gallon drum, manufacturers produce these items in sizes ranging from 8 to 110 gallons. Stackable polyethylene bins provide another option for waste storage, capable of containing anywhere from 190 to 300 gallons of waste. Some bins, such as those from Remcon Plastics, Inc., fit into a base that allows a valve on the bottom, enabling drainage of sludges and liquids. Polyethylene “Mini-Bulk” tanks (with a storage capacity of 175 gal.), such as those manufactured by Chem-Tainer, can be easily carried by forklifts while displaying the chemical resistance necessary for storing mineral processing wastes.

According to Chuck Garrison of the Florida Drum Co., the lifetime of this equipment varies, depending on the wastes stored and the environmental conditions present (i.e., temperature, humidity, and shock). However, the plastic, fiberglass, and stainless steel drums can be expected to have a life expectancy of 25-50 years. The lifetime of carbon steel drums is greatly dependent on the coating applied. Using the standard 55-gal. size as a base, drums cost anywhere from $30-$50 for carbon steel, $125 for polyethylene, and $500 for stainless steel. Trucks (containing 300-250 drums) transport from regional shipping centers located throughout the country, with freight adding another $1.50 - $2.00 per drum to the total price. Since drum orders are shipped by the truckload, there is little preference by distributors given to large orders (i.e., less than a 5% discount). In 1995, producers shipped 33 million steel drums (U.S. Census Report MA34K, Aug. 27, 1996) and 10-12 million plastic drums (Plastic Drum Institute). Table 4 provides a list of approximately 60 drum manufacturers, compiled using the methodology described above.

## 2. Tanks

Aboveground storage tanks are generally constructed of the same materials used for drums, such as plastic, stainless steel and carbon steel, depending on size (larger tanks are steel only). Table 5 compares

**Table 4. List of Manufacturers of Drums**

| Name | Location | Phone Number | Type | Sources |
|---|---|---|---|---|
| Ace Tank & Equipment | Dublin, CA<br>Portland, OR<br>Seattle, WA<br>Spokane, WA | 510/803-2003<br>503/284-5505<br>206/281-5000<br>509/244-4556 | Steel | B3 |
| Addison Co., Inc. | Chester, VA | 804/748-6453 | Steel | B3 |
| Alabama Tank, Inc. | Atmore, AL | 800/522-8265 | Steel | B3 |
| Anchorage Tank & Welding | Anchorage, AK | 907/272-3543 | Steel | B3 |
| Bakersfield Tank Co. | Bakersfield, CA | 805/589-9141 | Steel | B3 |
| Beta Tank & Welding Co., Inc. | Lebanon, PA | 717/270-2691 | Steel | B3 |
| Boss Petroleum Products | Baltimore, MD | 800/759-9988 | Steel | B3 |
| Bristol Tank & Welding Co., Inc. | Langhorne, PA | 215/752-9556 | Steel | B3 |
| Brothers Manufacturing | Hermansville, MI | 906/498-7771 | Steel | B3 |
| Brown Tank Company | Birmingham, AL<br>St. Paul, MN<br>Provo, UT | 205/841-0403<br>612/454-6750<br>801/373-8520 | Steel | B3 |
| Chicago Boiler Company | Lincolnshire, IL | 713/913-0100 | Steel | B3 |
| Derson Manufacturing, Inc. | Wanertown, MN | 612/955-2668 | Steel | B3 |
| Eastern Metal Products Co. | Colorado Springs, CO | 800/999-8085 | Steel | B3 |
| Eaton Metal Products Co. | Grand Junction, CO<br>Albuquerque, NM<br>Casper, WY<br>Salt Lake City, UT<br>Denver, CO | 303/245-0144<br>505/345-4577<br>307/234-0870<br>801/973-9055<br>303/296-4800 | Steel | B3 |
| Edison Steel Products | Albuquerque, NM | 800/748-2523 | Steel | B3 |
| Empire Steel Mfg. Co. Inc. | Billings, MT | 406/252-0101 | Steel | B3 |
| Fargo Tank Co. | Fargo, ND | 701/282-2345 | Steel | B3 |
| Fedco Omega | Sommersworth, NH | 603/692-2921 | Steel | B3 |
| Florida Drum Company | Pine Bluff, AZ<br>New City, NY<br>Charlotte, NC | 501/247-2800<br>914/638-6226<br>704/399-8633 | Plastic | B1 |
| General Industries, Inc. | Pasadena, MD<br>Goldsboro, NC | 410/437-3561<br>919/735-2882 | Steel | B3 |
| George I. Reitz and Sons, Inc. | Brookville, PA | 814/849-2308 | Steel | B3 |
| Glenwood Mfg. | Feasterville, PA | 215/322-1550 | Steel | B3 |
| Green Tank & Welding Inc. | Fairbanks, AK | No number available | Steel | B3 |

| Name | Location | Phone Number | Type | Sources |
|---|---|---|---|---|
| Greer Tank, Inc. | Anchorage, AK | 507/243-2455 | Steel | B3 |
| Hal Tank Company | North Little Rock, AR | 800/322-4255 | Steel | B3 |
| Hamilton Tanks | Columbus, OH | 614/445-8146 | Steel | B3 |
| Highland Tank | Watervliet, NY<br>Lebanon, PA<br>Manheim, PA<br>Stoystown, PA<br>Greensboro, NC | 518/273-0801<br>717/664-0600<br>717/665-68??<br>814/893-5701<br>910/218-0801 | Steel | B3 |
| Huron Clavert & Tank Co. | Huron, SD | 605/352-8643 | Steel | B3 |
| Imperial Tank Co. | San Antonio, TX | 210/561-2316 | Steel | B3 |
| International Production Specialists | Honey Creek, WI | 414/534-3130 | Steel | B3 |
| J.L. Houston Co. | Hopkins, MO | 816/778-3393 | Steel | B3 |
| Kennedy Tank & Mfg. Co., Inc. | Indianapolis, IN | 800/445-1344 | Steel | B3 |
| Kleepsie Tank & Ferro Equip., Inc. | Morris, MN | 612/539-2000 | Steel | B3 |
| Kohlhass Corporation | Albuquerque, NM<br>El Paso, TX | 503/243-3766<br>915/778-5357 | Steel | B3 |
| Labelmaster | Chicago, IL | 800/621-5808 | Steel | C |
| Lancaster Tanks & Steel Products, Inc. | Lancaster, NY | 716/683-2033 | Steel | B3 |
| Larmon Tank Corp. | Larmon, WI | 414/251-7890 | Steel | B3 |
| Metal Products Co. | Sewanee, GA | 404/545-8383 | Steel | B3 |
| Mid-South Steel Products, Inc. | Cape Giradeau, MO | 314/335-5529 | Steel | B3 |
| Modern Welding Co. | Burlington, IA<br>Newark, OH<br>Houston, TX<br>Fresno, CA<br>Orlando, FL<br>Augusta, GA<br>Owensboro | 319/754-6577<br>614/344-9425<br>713/675-4211<br>209/275-9353<br>407/843-1270<br>706/722-3411<br>502/583-5523 | Steel | B3 |
| Mohawk Metal Products, Inc. | Utica, NY | 315/793-3000 | Steel | B3 |
| Mosier Brothers | Woodlake, CA | 209/561-3304 | Steel | B3 |
| Newberry Tanks & Equip., Inc. | West Memphis, AR | 800/645-9395 | Steel | B3 |
| Nogales Hwy. Iron & Steel Inc. | Tucson, AZ | 520/294-1542 | Steel | B3 |

| Name | Location | Phone Number | Type | Sources |
|---|---|---|---|---|
| O'Day Equipment, Inc. | Billings, MT<br>Fargo, ND<br>Sioux Falls, SD<br>Minot, ND | 406/259-3484<br>701/282-9266<br>605/338-5030<br>701/852-3145 | Steel | B3 |
| Palmer Manufacturing and Tank | Garden City, KS | 800/835-9136 | Steel | B3 |
| Pee Dee Tank Co., Inc. | Florence, SC | 803/569-3381 | Steel | B3 |
| Pepco | Branchburg, NJ | 800-40-PEPCO | Plastic | C |
| Perkins Welding Works | Redding, CA | 916/383-5413 | Steel | B3 |
| Reliable Steel Fabricators, Inc. | Olympia, WA | ???/352-7575 | Steel | B3 |
| Remcon Plastics, Inc. | Reading, PA | 800/874-7793 | Plastic | D |
| Russell-Stanley Corporation | Red Bank, NJ | 908/741-6366 | Plastic | B1 |
| Service Welding & Machine Co. Inc. | Louisville, KY | 502/585-4295 | Steel | B3 |
| Skolink Industries, Inc. | Chicago, IL | 800/441-8780 | Carbon steel, stainless steel | D |
| Sonoco Plastic Drum | Lombard, IL<br>Marietta, GA | 708/620-3400<br>404/423-2512 | Plastic | B1 |
| Southern Tank & Mfg., Inc. | Owensboro, KY | 800/876-2324 | Steel | B3 |
| Specialty Tank & Equipment Co. | Jacksonville, FL | 904/353-0198 | Steel | B3 |
| Stacco, Inc. | Rhome, TX | 817/636-2215 | Steel | B3 |
| Stanwade Metal Products, Inc. | Hartford, OH | 216/772-2421 | Steel | B3 |
| Steel Tank & Fabricating Corp. | Columbia City, IN | 219/248-8971 | Steel | B3 |
| Trusso Tank, Inc. | San Luis Obispo, CA | 805/544-9155 | Steel | B3 |
| Userico, Inc. | Tomah, WI | 608/372-5911 | Steel | B3 |
| Waco Tanks, Inc. | Lavennia, TX | 210/779-2413 | Steel | B3 |
| We-Mac Manufacturing Co. | North Kansas City, MO<br>Altoona, IA<br>Carey, KS<br>Atchison, KS | 800/444-3218<br>800/937-2772<br>316/879-2187<br>913/367-3778 | Steel | B3 |

A = Journal Advertisement
B = Trade Organization List
B1 = Plastic Drum Institute
B2 = Material Handling Institute

B3 = Steel Drum Institute
C = Directory of Manufacturers/Buyers Guide
D = Internet

**Table 5. Characteristics of Various Types of Aboveground Storage Tanks**

| Tank Material | Pressure Service | Resistance to Corrosive Attack | Protective Coatings and Linings | Relative Costs | Additional Information |
|---|---|---|---|---|---|
| Carbon steel (bolted) | Atmospheric | Compatible with petroleum products and caustic soda, but not with mineral and oxidizing acids such as dilute sulfuric acid and concentrated hydrochloric or phosphoric acids | Coatings and linings may be applied for corrosion resistance to both the tank and its support foundation | Low | Tanks may be horizontal or vertical. Vertical tanks require concrete pads, and horizontal tanks are generally mounted on steel or concrete saddles. Note: because of environmental liability, bolted tanks should only be constructed as temporary, not permanent, tanks. |
| Carbon steel (welded) | Atmospheric and low-pressure | Same as above. | Same as above. | Low | Shop assembled tanks are generally welded, as are newer low-pressure tanks. |
| Stainless Steel | Atmospheric and low-pressure | Better corrosion resistance than carbon steel, depending on the grade. | Generally not used. | Medium to High (depending on grade of steel) | Stainless steel is used instead of a coating when the temperature of the liquid storage exceeds 200EF. Stainless steel is also used in storage situations where product purity is important (e.g., the food industry). |
| Fiberglass | Atmospheric; low-pressure tanks can be special ordered | Compatible with a wide range of organic and inorganic chemicals. | Not required. | Comparable to coated steel. | Fiberglass tanks have high corrosion resistance, but lack the structural strength, performance at elevated temperatures (above 200EF), or impact resistance of steel tanks. |
| Plastic | Atmospheric | Varies depending on the type of plastic. | Not applicable. | Low | Plastic materials include polyethylene, polypropylene, polyvinylchloride (PVC), and acrilonitrile butadiene styrene polymers (ABS). While these materials are used to manufacture portable and process tanks under 3,000 gal., they are generally not used for bulk storage because of their low structural strength |

*Source: *The Aboveground Storage Tank Guide*. Thompson Publishing Group, 1994.

the characteristics of the various materials used for aboveground storage tanks. API 650 and UL 142 tanks are usually made of welded carbon steel. Tank life spans, depending on the materials used and environmental conditions (e.g., heat and humidity), are 30 - 50 years. Prices for UL 142 tanks are listed in Table 6. Prices tend to increase with features such as double walls, dikes and other safety features. Smaller tanks can be prefabricated or field erected, while larger tanks (with a capacity greater than 20,000 gal.) must be field erected and require 7-10 weeks lead time. Modular tanks, constructed of mass-produced, preconstructed modular components, present an easy, inexpensive option in areas where time is critical and funds are limited. Various liners, such as polyethylene and Hypalon, allow these tanks to store a variety of wastes. As with drums, tanks can be coated with various substances to prevent corrosion and increase the tank's effectiveness. Analyses to determine the appropriate coatings and structural characteristics particular to the application may be required of the purchaser. Table 7 provides a list of tank manufacturers developed using the methodology outlined above.

**Table 6. Pricing of UL 142 Aboveground Storage Tanks**

| Tank Size | Vertical | | Horizontal | | |
|---|---|---|---|---|---|
| | **Single Wall** | **Double Wall** | **Single Wall** | **Double Wall** | **Diked** |
| **Tank Size** | | | | | |
| **1,000 gal** | $1,246 | $1,619 | $726 | $1444 | $2,545 |
| **2,000 gal** | $1,681 | $2,885 | $1,233 | $2,160 | $4,798 |
| **3,000 gal** | $2,150 | $4,095 | $1,650 | $2,830 | $6,436 |
| **4,000 gal** | $2,919 | $4,911 | $3,138 | $5,780 | $8,644 |
| **5,000 gal** | $3,466 | $6,164 | $3,637 | $6,690 | $9,934 |
| **6,000 gal** | $4,241 | $7,184 | $4,201 | $7,719 | $10,982 |
| **8,000 gal** | $4,593 | $8,086 | $4,361 | $8,481 | $13,530 |
| **10,000 gal** | $5,076 | $8,650 | $4,847 | $8.922 | $15,588 |
| **15,000 gal** | $6,876 | $12,200 | $7,084 | $12,896 | $19,402 |
| **25,000 gal** | $9,405 | $17,417 | $10,403 | $18,488 | $29,450 |

Source: Highland Tank and Manufacturing Co.
Note: The above prices do not include shipping costs. Horizontal tanks additionally require saddles; a 25,000 gallon tank may require 3-4 saddles costing $700 each. Saddle material will depend on the material used for tank design - fiberglass and polyethylene can use both steel and fiberglass saddles, while steel tanks require steel saddles.

While tanks greater than 12,000 gal are generally constructed of carbon steel, several manufacturers produce mid-sized (i.e., 10,000 - 12,000 gal) tanks from polyethylene, fiberglass and stainless steel. Prices for these tanks are comparable with equivalently sized double walled steel tanks. Manufacturers note fiberglass and polyethylene tanks as being resistant to highly corrosive products and impact, making them useful for process waste applications. Fiberglass tanks can also be used for field-erected modular tanks as large as 250,000 gal. Table 8 provides information on various fiberglass resins and manufacturers.

**Table 7. List of Manufacturers of Tanks**

| Name | Location | Phone Number | Type | Capacity Range | Sources |
|---|---|---|---|---|---|
| Aero Tec Laboratories Inc. | Ramsey, NJ | 800-526-5330 | Pre-fabricated (collapsible fabric storage bladders) | 50 - 100,000 gal | A |
| Atlantic Fabritech | McGaheysville, VA | 800-833-7655 | Steel Pre-Fabricated | 500 - 50,000 gal | D |
| Baker Tanks | Rancho Dominguex, CA<br>Offices Nationwide | (310) 763-5766 | Both | Don't know | C |
| Brothers Manufacturing, Inc. | Hermansville, MI | (906) 498-7771 | Field erected (custom-made) | 25 - 50,000 gal | B3 |
| Brown-Minneapolis Tank Company | St. Paul, MN<br>Birmingham, AL<br>Orem, UT<br>Houston, TX<br>Port Allen, LA | (612) 454-6750<br>(205) 841-0403<br>(801) 373-8520<br>(713) 783-1257<br>(504) 749-9545 | Field erected | Don't know | B3 |
| Chem-Tainer Industries, Inc. | West Babylon, NY<br>Offices Nationwide | (516) 661-8300 | Pre-fabricated | 45 - 12,000 gal | C |
| Eaton Metal Products | Denver, CO<br>Salt Lake City, UT<br>Grand Junction, CO<br>Casper, WY | (303) 296-4800<br>(801) 973-9055<br>(303) 245-0144<br>(307) 234-0870 | Pre-fabricated | 560 - 50,000 | C |
| Edison Steel Products, Inc. | Albuquerque, NM | (800)-748-2523 | Field erected | Up to 10 million gal | B3 |
| Empire Steel Mfg. Co. | Billings, MT | (406) 252-0101 | Pre-fabricated | 560 - 30,000 gal | B3 |
| General Industries Inc. | Goldsboro, NC | (800)-899-0132 | Field erected | 150 - 30,000 gal | B3 |
| George I. Reitz & Sons, Inc. | Brookville, PA | (814) 849-2308 | Distributor | Depends on the supplier | C |
| Highland Tank | Stoystown, PA<br>Manheim, PA<br>Watervliet, NY<br>Lebanon, PA<br>Fort Wayne, IN<br>Greensboro, NC | (814) 893-5701<br>(717) 664-0600<br>(518) 273-1365<br>(717) 664-0631<br>(219) 422-6191<br>(910) 218-1292 | Pre-fabricated | 185 - 50,000 gal | C |

| Name | Location | Phone Number | Type | Capacity Range | Sources |
|---|---|---|---|---|---|
| International Production Specialists | Honey Creek, WI | (414) 534-3130 | Pre-fabricated | 560 - 12,000 gal | A |
| Kennedy Tank and Manufacturing Co. | Indianapolis, IN | (317) 787-1311 | Field erected | Up to 60,000 gal | C |
| Lancaster Tanks | Lancaster, NY | (716) 683-2033 | Pre-fabricated | 190 - 12,000 gal | B3 |
| Lannon Tank Corp. | Lannon, WI | (414) 251-7890 | Pre-fabricated | Don't know | A |
| Liqua-Bin | Modena, PA | (800)-356-9167 | Pre-fabricated | Don't know | |
| Modern Welding Co. Inc. | Owensboro, KY | (502) 685-4400 | Pre-fabricated | 300 - 20,000 gal | B3 |
| ModuTank Inc. | Long Island City, NY | (800) 245-6964 | Field erected | 8,000 -1,000,000 gal | A |
| Mohawk Metal Products Co., Inc. | Utica, NY | (800)-765-3110 | Pre-fabricated | 500 - 20,000 gal | B3 |
| Nogales Hwy. Iron & Steel, Inc. | Tucson, AZ | (520) 294-1542 | Pre-fabricated | 200 - 12,000 gal | C |
| Palmer Tank Co. | Garden City, KS | (800) 835-9136 | Both | 500 - 250,000 | C |
| Peabody TecTank | Parsons, KS | (316) 421-9122 | Field erected | 4,000 - 1,371,100 gal | A |
| Pepco | Branchburg, NJ | (800)-40-PEPCO | Field erected | Don't know | C |
| Polystar, Inc. | Macedonia, OH | (216) 467-8300 | Both | 500 - 500,000 gal | C |
| REMCON Plastics, Inc | Reading, PA | (800) 874-7793 | Pre-fabricated | 25 - 500 gal | C |
| Schuff Steel Co. | Phoenix, AZ | (602) 252-7787 | Both | 500 - 5,000,000 gal | D |
| Trusco Tank, Inc. | Fresno, CA | (805) 544-9155 | Pre-fabricated | 250 - 20,000 gal | C |
| Service Welding & Machine Co. | Louisville, KY | 800-366-5413 | Pre-fabricated | 550 - 30,000 gal | B3 |
| Steel Tank Institute | Lake Zurich, IL | (847) 438-8265 | Pre-fabricated | 186 - 50,000 | A |
| Tackett Tank, Inc. | Eads, TN | 800-233-9704 | Steel | Don't Know | D |
| Tanks Direct | Burtonsville, MD | 800-865-5555 | Stainless Steel | 500 - 15,000 gal | D |
| USEMCO | Tomah, WI | (608)-372-5911 | Pre-fabricated | 300 - 10,000 | C |

A = Journal Advertisement
B1 = Plastic Drum Institute
B2 = Material Handling Institute
B3 = Steel Drum Institute

C = Directory of Manufacturers/Buyers Guide

D = Internet

**Table 8. Fiberglass Resins Used for Aboveground Storage Tanks**

| Dow | Reichold | Ashland |
|---|---|---|
| Derakane 411<br>470 Vinyl Ester<br>Derakane 510N | Dion 6631-T Isopthalic<br>Polyester<br>Dion 9100 Vinyl Ester<br>Atlac 382, 510<br>Koppers 6604-T<br>Dion 6693-FR, 6694-T, 9200 | Hetron 922 Vinyl Ester<br>Hetron 197 |

Source: Palmer Manufacturing and Tank, Inc. Garden City, KS, (800) 835-9136.

Again, it needs to be emphasized here that the constraints to properly handling mineral processing wastes are not technical issues. Construction of tanks and drums sufficient for storing mineral processing wastes is possible using a variety of materials and coatings. Nor does shipping present any major constraints, because even relatively large tanks (with a capacity up to 30,000 gal) can be trucked to the site.

### 3. Roll-Offs and Metal Containers

Containers can be thought of as a variety of products including tanks and drums. They can hold very small to very large amounts of material. This report is concerned with containers that hold intermediate amounts of material. Roll-off containers, stationary bulk containers, and sanitary containers are the three type of containers capable of holding intermediate amounts of material. Table 9 lists a number of manufacturers of containers. Because of their advantage over the other types of containers, roll-off container data and costs were collected.

Several types of roll-off containers can be used for the storage of intermediate quantities of solid mineral processing wastes/secondary materials. They include:

- open top containers - for solid waste scrap materials and demolition waste
- liquid-tight containers - for sewage and industrial waste sludges
- vacuum-load containers - for sewage and industrial waste sludges
- compactor waste receiving containers - for all standard stationary solid waste compactors
- special industrial material/waste and sludge containers

*Covers*

Open top containers are available with either liquid-tight or solid waste-style construction. Open top containers can be fit with a tarp to further contain the material. Prices for tarps are between $425 and $785. Closed top containers can be fitted with a variety of fill openings, including over and under rolling lids, two-split roll lids, hinged lids, manways, inspection hatches, and fill pipes.

*Liners*

Roll-off containers are constructed of steel and can be lined with corrosive-resistant materials such as polyethylene. Polyethylene containers are used for the storage of liquids not compatible with steel containers. Liners are fabricated of flexible membrane material, including Polyvinyl chloride, Hypalon, XR-5, Polypropylene, and Urethanes. Liner panels are custom made by the geomembrane

manufacturers using a dielectric seaming technique, and the appropriate material is selected according the specific lining application.

**Table 9. List of Manufacturers of Containers**

| Name | Location | Phone Number | Type | Sources |
|---|---|---|---|---|
| Advent Electric, Inc. | Jessup, MD | 301/317-0700 | Metal | C |
| Basco, Inc. | Baltimore, MD | 410/235-1150 | Secondary containment | D |
| Benlee, Inc. | Romulus, MI | 800/521-4620 | Roll-off | C |
| Bucks Fabricating | Hadley, PA | 800/233-0867 | Roll-off | A |
| Budeke's Paints, Inc. | Baltimore, MD | 410/732-4354 | Metal | C |
| Chem-Tainer | Babylon, NY | 800/645-5607 | Secondary containment | D |
| CHUTE International | Waldorf, MD | 301/843-4700 | Metal | C |
| DeWald Northwest Co. | Albany, OR | 800/645-7106 | Roll-off | C |
| Environmental Liners | Cortez, CO | 800/821-0531 | Liners | A |
| Fabricators Steel, Inc. | Baltimore, MD | 410/342-6345 | Metal | C |
| Free State Storage & Distribution Systems | Largo, MD | 410/242-7780 | Metal | C |
| General Container Corp. | Somerset, NJ | 800/366-7044 | Steel, Stainless Steel, Polyethylene | C |
| Independent Can Co. | Belcamp, MD | 410/272-0090 | Metal | C |
| Industrial Dynamics Co. | Timonium, MD | 800/336-9273 | Metal | C |
| INTEREX | West Hartford, CT | 800/225-5910 | Metal | C |
| Modern Manufacturing | Beaumont, TX<br>LaPorte, TX<br>Silsbee, TX<br>Baton Rouge, LA<br>Sulphur, LA | 800/231-8198 | Roll-off | A |
| Morton International Inc. | Chicago, IL | 312/807-3106 | Secondary containment | D |
| MPC Containment Systems, LTD. | Chicago, IL | 800/621-0146 | Liners | A |
| National Seal Co. | Aurora, IL | 800/323-3820 | Liners | A |
| NIBCO, Inc. | Elkhart, IN | 219/295-3000 | Secondary containment | D |
| Packaging Research and Design Corp. | Madison, MS | 800/833-9364 | Liners | C |
| Perstorp Xytec, Inc. | Tacoma, WA | 800/423-3221 | Collapsible pallet containers | D |
| PHILCAN | Baltimore, MD | 800/787-2997 | Metal | C |
| Poly-Flex, Inc. | Grand Prairie, TX | 800/527-3322 | Liners | C |
| Progressive Technologies, Inc. | Chantilly, VA | 703/502-0700 | Secondary containment | D |

| Name | Location | Phone Number | Type | Sources |
|---|---|---|---|---|
| Remcon Plastics, Inc. | Reading, PA | 800/874-7793 | Bulk material handling | D |
| Raven Industries | Sioux Falls, SD | 800/635-3456 | Liners | A |
| Van Horn, Metz & Co. Inc. | Baltimore, MD | 800/282-8424 | Metal | A |
| Westec Barrier Technologies | St. Louis, MO | 800/793-7832 | Secondary containment | D |
| Williams Scotsman | Manassas, VA (various locations across U.S.) | 800/782-1500 | Metal | C |
| Wilmer Manufacturing Co. | Beltsville, MD | 301/937-6900 | Metal | C |

A = Journal Advertisement
B = Trade Organization List
B1 = Plastic Drum Institute
B2 = Material Handling Institute
B3 = Steel Drum Institute
C = Directory of Manufacturers/Buyers Guide
D = Internet

*Roll-Off Container Manufacturers*

From vendor literature, EPA collected information from three roll-off container manufacturers. EPA contacted two of the these vendors (Bucks Fabricating and Modern Manufacturing) for more detailed information. Prices vary according to size and type of container, however, the prices of the roll-off containers range from about $1,970 to $12,995. Roll-off container prices for Buck Fabricating are shown in Table 10, while those for Modern Manufacturing are shown in Table 11. The sizes range from 10 to 50 cubic yards, but both manufacturers will custom build containers to client specifications. The typical size of a roll-off container is usually 20 or 25 cubic yards. Both manufacturers indicated that the roll-off containers require minimal maintenance, however, they suggested that owners repaint the interior and replace the gasket every few years to extend the service life of these containers. The lifetime of the roll-off containers is typically 10 to 12 years if they are well-maintained.

The shipping costs of the containers depend on the final destination of the product, and are determined on a case-by-case basis, though an average cost for delivery of a roll-off container would be $1.30/mile to $1.60/mile. The salesperson for Bucks Fabricating estimated a fabricating capacity of 2-3 units per week with a delivery lead-time of 4 - 5 weeks.

**Table 10. Roll-Off Container Prices for Bucks Fabricating**
(Does not include taxes or delivery. Prices subject to change without notice.)

| Waste Capacity (cubic yards) | Steel open top container | Liquid-tight Poly-lined open top container |
|---|---|---|

| | | |
|---|---|---|
| 10 | $1,970 | $4,375 |
| 20 | $2,670 | $5,725 |
| 30 | $3,045 | $6,695 |
| 40 | $3,510 | $7,450 |

**Table 11. Roll-Off Container Prices for Modern Manufacturing**
(Does not include taxes or delivery. Prices subject to change without notice.)

| Type of Container | Waste Capacity (cubic yards) | | |
|---|---|---|---|
| | 20 | 25 | 30 |
| Steel open top | $2,763 | $2,991 | $3,297 |
| Steel open top (rubber sealed) | $3,112 | $3,343 | $3,652 |
| Steel closed top (rubber sealed) | $5,062 | $5,293 | $5,602 |
| Heavy duty, steel open top (rubber sealed) | $4,000 or $8.00/day* | $4,350 or $8.50/day* | $4,950 or $9.00/day* |
| Heavy duty steel closed top (rubber sealed) | $6,250 or $13.50/day* | $6,500 or $15.00/day* | $6,750 |
| Heavy duty vacuum-load | $9,995 or $30/day* | $10,995 or $35/day* | $12,995 or $40/day* |

*Rental Rate. Plus freight both ways, plus tax, must be returned clean & in like new condition.

A truck, driver (hauler), and a specialty trailer are required to haul roll-off containers. Modern Manufacturing and Benlee also manufacture roll-off trailers. Trucks would usually be obtained in the local area. The trailers and trucks can be bought, rented, or leased. Operational costs for the roll-off containers include maintenance of the roll-off container, trailer, and truck as well as the hauler's salary.

The wide variety of options available for roll-off containers make them a good candidate for short-term storage of mineral processing secondary wastes. Although they may not store as much as tanks, the advantages of roll-off containers can include the following:

- The potential to store larger amounts of mineral processing wastes/secondary materials than drums or small containers,
- The mobility to be shipped to different locations by trucks, and
- The flexibility of renting, leasing, or buying roll-off containers.

**4. Buildings**

Companies with large quantity bulk storage needs often use buildings and structures to house their solid materials. Table 12 lists the building manufacturers we identified using the methodology described above. Because buildings are used for many different waste types and quantities, these buildings may be classified by their shape, purpose, or their materials of construction. EPA groups these structures in terms of their shape to discuss their relevant features.

**Table 12. List of Manufacturers of Buildings**

| Name | Location | Phone Number | Type | Sources |
|---|---|---|---|---|
| Coronis Building Systems, Inc | Columbus, NJ | (609) 723-2600 | Storage | C |
| Diamond Engineered Space, Inc | Cleveland, OH | (800) 824-4769 | Storage | C |
| Clamshell Buildings, Inc | Ventura, CA | (805) 650-1700 | Storage | C |
| Cover-it-All Weather Shelters | New Haven, CT | (800) 932-9344 | Storage | C |
| Poly-Steel Shelters & Weather Block Shelters | Stuart, FL | (800) 330-9294 | Storage | C |
| Space Master Buildings | Atlanta, GA | (800) 394-0254 | Storage | C |
| Cathos Corp. | Princeton, NJ | (609) 921-8105 | Storage | C |
| Miracle Steel Structures, Inc | Minneapolis, MN | (800) 521-0386 | Storage | C |
| Universal Steel Buildings | McKees Rocks, PA | (412) 771-2944 | Storage | C |
| EASI-SET Industries | Midland, VA<br>Montgomery, NY<br>East Pembroke, NY<br>Monongahela, PA<br>Reidsville, NC<br>Gillsville, GA<br>Northport, AL<br>San Antonio, TX<br>West Bend, WI<br>Spokane, WA<br>St. Catherines, Ontario, Canada | (703) 439-8911<br>(914) 561-5700<br>(716) 894-2267<br>(412) 258-4450<br>(800) 742-4491<br>(404) 532-8269<br>(805) 333-8000<br>(800) 292-0007<br>(414) 338-6268<br>(509) 924-6300<br>(416) 684-8568 | Storage | C |
| IBEX International Incorporated | Virginia Beach, VA | (800) 959-0975 | Storage | C |
| Key Material Handling, Inc | Burbank, CA | (800) 223-5891 | Haz mat Storage | C |
| Unified Safety Corp | Beverly Hills, CA | (800) 394-5776 | Haz mat Storage | C |
| CID Associates | Leechburg, PA | (412) 842-2130 | Haz mat Storage | C |
| American Steel Span | Pittsburgh, PA | (800) 581-5843 | Storage | D |
| Safety Containment Company | Santa Monica, CA | (310) 828-8172 | Haz mat storage | C |
| Environmental Compliance Products | Westminster, CA | (800) 643-7065 | Haz mat storage | C |
| Environmental Protection Systems, Inc. | Buffalo Grove, IL | (800) 852-1880 | Storage | D |
| Bulk Storage, Inc | Crete, Illinois | (708) 672-3113 | Domes | A |
| Precision Quincy Corp. | Woodstock, IL | | Storage | A |
| Provincial Partitions Inc. | Ontario, Canada | (800) 387-7614 | Storage | D |
| Safety Storage, Inc. | Hollister, CA | (408) 637-5955 | Storage | A |

| Name | Location | Phone Number | Type | Sources |
|---|---|---|---|---|
| Sprung Instant Structures Ltd. | Allentown, PA<br>San Francisco, CA<br>Los Angeles, CA<br>Houston, TX<br>Atlanta, GA<br>Indianapolis, IN<br>Salt Lake City, UT<br>Denver, CO | (610) 391-9553<br>(800) 528-9899<br>(800) 528-9899<br>(800) 528-9899<br>(800) 528-9899<br>(800) 528-9899<br>(800) 528-9899<br>(800) 528-9899 | Domes, Barrel Domes | D |
| Pioneer Steel Building Systems | Mississauga, Ontario, Canada | (800) 813-1358 | Storage | A |
| Lester Building Systems | Lester Prairie, MN<br>Clear Brook, VA<br>Charleston, IL<br>Ottawa, KS | (320) 395-2531 | Warehouse | A |
| Warminster Fiberglass | Southampton, PA | (215) 953-1260 | Storage | A |
| Dome Corporation of America | Montclair, NJ<br>Saginaw, MI | (201) 744-0440<br>(517) 777-2050 | Domes, Barrel Domes | A |

A = Journal Advertisement
B = Trade Organization List
C = Thomas' Register
D = Internet

*Round Domes*

Domes may range in size from diameters of 25 feet to 150 feet with a range of capacity of 150 tons to almost 16,000 tons, respectively. Manufacturers indicated that domes are perfectly suited to house materials such as bulk ore, rock salt, potash, urea, phosphate, coal, and grain. Because these buildings are commonly used to house road chemicals, this use of dome buildings is discussed separately below. Generally, domes are constructed on top of 6-10 foot high concrete base walls which support prefabricated plywood or steel panels. An asphalt pad provides the foundation. Asphalt shingles, which often last up to 30 years, are used to waterproof the building.

*Barrel Domes*

A different type of dome, the "Barrel Dome," is a dome that is "cut in half" and "stretched" by adding 20 foot long segments. Barrel Domes can be made as long as necessary for large capacity storage needs. These structures use laminated arches as supports so that there are no supports obstructing the interior storage area. When desirable, internal dividing bin walls allow for multi-product storage. While we were unable to find specific cost and capacity data for barrel domes, an example in the literature provided by the Dome Corporation of North America shows one structure that is 116 feet wide and 609 feet long and which can hold 60,000 tons of material. The cost of this type of structure will depend on the number of square feet it encompasses, although the average cost per square foot does not differ greatly from the costs of round domes.

*Materials of Construction*

In addition to the wood frame and concrete dome mentioned above, domes may be constructed of steel or stressed membrane. Pioneer Steel Buildings constructs pre-engineered trussless steel buildings that may be used for commercial, industrial, and agricultural uses. These steel structures have a 20 year limited warranty and are coated with a zinc aluminum alloy named Galvalume that is extremely corrosion resistant. Similar in appearance to barrel domes, these domes can be constructed with widths up to 100 feet. A typical building, measuring 50' x 120' was recently priced at $14,359 by the manufacturer.

Another type of dome built by Sprung Instant Structures, is a stressed membrane system, consisting of a series of aluminum arched ribs that are connected by a membrane of P.V.C. coated polyester trim under tension. The fabric must be "re-skinned" every 10 years or so, depending on site conditions. Re-skinning costs roughly one-fifth of the total cost of the structure. Sprung guarantees that 1,500 square feet can be constructed daily and that structures under 100 feet wide can be erected in 2-4 weeks. Depending on size, this type of dome costs between $12-14 dollars per square foot.[4]

*Road Chemical Storage Buildings*

Manufacturers of domes indicate that they are ideal for storing road salt. Because of the widespread use of domes to store road chemicals, EPA directed ICF personnel to visit a dome used to store road salt owned and operated by the Virginia Department of Transportation. The round structure consisted of a wood framed roof on top of a 6 ft concrete base. The base was built on a square foundation pad built using a layer of asphalt, a liner, and another layer of asphalt to protect the liner. The pad extended several feet outside the dome, and had a slight berming affect. Runoff from this pad was directed to a collection pond about 20 feet away. The run-off pond was built with the same asphalt-liner-asphalt base as the pad underlying the dome. The structure has a large open doorway through which a front-end loader pushes material. The salt in the dome was piled about 15 ft high, and some road sand was placed on the salt near the open doorway to protect the salt. When the salt is being loaded into the dome, the front end loader operator builds a “ramp” out of the salt, to get salt to the top of the pile. (Other facilities sometimes use a conveying system to get the salt to the top of the pile.) While the capacity of the dome was about 3,500 tons, not all of it was being used because of the height limitations when using a front end loader. A complete trip report describing our visit is included in Appendix E.

Several companies construct buildings that are designed specifically to house road salt and sand. One such company we contacted, Bulk Storage, Inc., provided literature describing the cost and capacities of the domes they produce. According to their representative, the domes generally cost between $35,500 and $155,000, but can cost as much as $270,000 if the materials must be shipped a great distance. Table 13 shows how much capacity (indicated in tons) is associated with domes of different diameter and base wall height.

Another manufacturer of domes used to house road salt and sand, Dome Corporation of America, provided a table showing the various sizes, capacities, and prices of its structures. It is important to note that these capacities represent the storage of road salt at a density of 80 pounds per cubic feet, at an angle of repose of 33 degrees from the horizontal. The capacity for other types of material may differ. This information is reproduced in Tables 14-16 for the various sizes of the concrete base wall.

[4] Discussion with representative from Sprung Instant Structures, Inc.

**Table 13. Capacity Chart for Bulk Storage, Inc.**
**(in tons unless specified)**

| Diameter (feet) | Base Area (Sq. Ft.) | 6' Base Wall | 8' Base Wall | 10' Base Wall |
|---|---|---|---|---|
| 25 | 367 | | 150 | 180 |
| 30 | 617 | | 269 | 318 |
| 35 | 776 | | 350 | 412 |
| 40 | 1,400 | 682 | 694 | 806 |
| 51 | 1,888 | 839 | 990 | 1,141 |
| 61 | 2,903 | 1,431 | 1,664 | 1,896 |
| 72 | 4,055 | 2,187 | 2,511 | 2,836 |
| 82 | 5,222 | 3,027 | 3,445 | 3,863 |
| 90 | 6,362 | 3,911 | 4,421 | 4,929 |
| 100 | 7,854 | 5,156 | 5,784 | 6,413 |

**Table 14**
**Dome Corporation Price/Capacity for Structures with 4 Foot Base Wall**

| Size (Diameter in feet) | Capacity (Tons) | 1996 Price |
|---|---|---|
| 40 | 431 | $49,000-$52,000 |
| 50 | 683 | $68,000-$72,000 |
| 100 | 4,397 | $117,000-$125,000 |
| 124 | 7,945 | $172,000-$184,000 |
| 150 | 13,148 | $329,000-$357,000 |

**Table 15**
**Dome Corporation Price/Capacity for Structures with 6 Foot Base Wall**

| Size (Diameter in feet) | Capacity (Tons) | 1996 Price |
|---|---|---|
| 40 | 535 | $54,000-$60,000 |
| 50 | 831 | $70,000-$74,000 |
| 100 | 5,003 | $122,000-$134,000 |
| 124 | 8,890 | $184,000-$196,000 |
| 150 | 14,506 | $349,000-$374,000 |

**Table 16**
**Dome Corporation Price/Capacity for Structures with 8 Foot Base Wall**

| Size (Diameter in feet) | Capacity (Tons) | 1996 Price |
|---|---|---|
| 40 | 640 | $60,000-$65,000 |
| 50 | 980 | $74,000-$78,000 |
| 100 | 5,610 | $128,000-$140,000 |
| 124 | 9,835 | $194,000-$211,000 |
| 150 | 15,864 | $367,000-$396,000 |

*Warehouse Structures*

Warehouse type structures are typically rectangular in shape and constructed of concrete or corrugated metal. These units are not generally sold by vendors or distributors, rather they are designed and built by local construction firms. Unless built with storage bin walls, they tend to use space less efficiently than dome type structures, requiring large amounts of overhead space for the movement of heavy equipment which cannot easily be used for the actual storage of material. However, these units have the advantage of being relatively easy to design and construct, using local firms and materials.

Lester Building Systems of Lester Prairie, Minnesota, with regional dealers in Virginia, Illinois, and Kansas advertises that its buildings can be built to "accommodate the various demands of the waste handling industry." Lester buildings are built from pre-engineered wood frames that appear to be capable of storing large amounts of waste.

*Transfer Stations*

Warehouse type buildings are commonly used as municipal solid waste (MSW) transfer stations (centralized facilities where waste is unloaded from several collection vehicles into larger transfer trailers, or where recyclable material is separated from waste). Many types of transfer stations are used throughout the country. Transfer stations handling the largest quantities of waste usually use a tipping floor configuration -- a large open floor area onto which waste is dumped -- prior to being pushed or loaded into a trailer for transport to a disposal facility. While waste is not usually stored for more than a few hours, these buildings can provide limited emergency storage. Further, these buildings are usually quite large, to accommodate trucks and other heavy equipment, and are built of concrete and steel by local construction firms. EPA directed ICF to visit a transfer station owned and operated by Fairfax County, Virginia. The 25,000 square foot facility processes between 1,600 and 2,000 tons per day, 7 days per week. Over 100 trucks drop off waste each day, which is loaded into larger trailers and shipped to the County's incinerator. A trip report is included in Appendix E.

EPA also reviewed *Waste Age*, a journal dealing with solid waste management issues. Each month they feature a "recycling facility of the month." The facilities they spotlight are typically material recovery facilities (MRFs). Similar to transfer stations, MRFs are large, industrial buildings used to sort

and store recyclable material prior to reuse. EPA identified 7 facilities, ranging in size from 10,000 to 325,000 square feet that were constructed by local firms.[5]

*Hazmat Sheds/Lockers*

Hazardous materials sheds and lockers are typically much smaller than the structures described above, and unlike other buildings discussed in this section, they are not suited for storage of bulk solids. They are typically used to store drums, or other containerized material. Sheds built by Environmental Service Systems are made of steel panels, and are generally fire-rated up to 2 hours and contain a maximum of 1,400 square feet. These sheds may also contain up to 350 55-gallon steel drums. Fiberglass reinforced plastic structures, another popular material for sheds, are light weight, corrosion resistant, and require no maintenance. The fiberglass panels are built to resist weather damage. Built upon concrete pads, these structures can be constructed to a maximum height of 16 feet and length of 60 feet. A smaller structure advertised by the manufacturer measuring 14'x 9'x 24' has a volume of 3,024 cubic feet.

*Advantages/Disadvantages*

Domes appear to be the most cost-effective type of building for bulk storage of loose materials, especially when large volumes are involved. The primary advantage of domes is that they maximize storage capacity for a given base area. For example, a dome advertised by Bulk Storage, Inc., stores 150 tons on only 367 square feet. Domes, usually with 15 foot doors, provide easy access for trucks and they generally can be constructed at lower cost than other types of structures for a given capacity. They tend to have long life spans if they are maintained correctly, and most domes can be erected in less than a month.

Hazmat sheds and lockers seem practical only when the amount of waste to be stored is small. They are not designed to accommodate large amounts of waste and they are difficult to fill given the small door frames available.

*Associated Capital Costs*

The prices provided by the building manufacturers may tend to understate the true cost of the buildings because there are some additional costs associated with their construction, operation, and maintenance. The number and type of these requirements depend on the manufacturer. Sprung Instant Structures, for example, requires the end-user to provide electricity to the site, as well as unskilled labor to actually construct the building. Other buildings do not come equipped with floors that may be necessary for certain waste storage or handling needs. Dome manufacturers mentioned that in order to make full use of their unit's storage capabilities, conveyor systems that load material from an opening in the dome's top are often used, especially in larger structures. They conceded, however, that these conveyor systems can be expensive, often starting at $25,000. Some dome companies sub-contract conveyor systems, while others only deal with the structures themselves, and not any loading mechanism. A cheaper alternative to conveyor systems is using a front end loader or dump truck to place the waste into the buildings, although the full height of the storage area may not be utilized. Depending on the size of a building's entrance, large dump trucks can fit inside to deliver or remove the waste pile.

*Availability*

[5] The seven facilities were found in the following editions of *Waste Age*: November, 1993; August, 1994; October, 1994; March, 1995; July, 1995; November, 1995; and December 1996.

The building manufacturers with which we spoke insisted that their products are readily available in all parts of the country, oftentimes the world. Buildings are routinely shipped cross country or overseas in less than a week. Below are descriptions of availability based on our discussions with the building manufacturers.

- Provincial Partitions, headquartered in Toronto, Canada builds fiberglass structures most often used to store hazardous waste. These structures can be sent to their destination in less than a week (irrespective of size) and in a worst case scenario will be erected in less than a month. Provincial Partitions routinely builds structures all over the world, and recently erected a 3,000 square foot building in Guam less than 3 weeks after the order was placed. Using commercial haulers, any location within the United States is easily accessible within 3 days, though the cost of shipping is passed on to the end-user.

- The Dome Corporation of America, with offices in Michigan and New Jersey erected 150 buildings last year and reported that inventory in their warehouse would accommodate any "reasonable" surge in demand. They will ship to any address in the United States in 2-3 days, generally at a cost of less than $1,000. Once the materials are delivered, the concrete retaining wall takes 1-2 weeks to erect, then the building requires another 2-3 weeks to complete.

- Last year Sprung Instant Structures built 200-300 buildings. A representative reported that with 1-2 million square feet of building material in inventory, they could meet almost any surge in demand. Sprung ships all over the world and reported that materials will be delivered to any site in the lower 48 states in 2-3 days. Within the United States, shipping usually does not exceed $6,000 unless structures are extremely large. Sprung also requires the end-user to supply unskilled labor to construct the building.

- Bulk Storage, Inc. builds structures that are specifically designed to hold road salt. Consequently, Bulk Storage has traditionally built domes only in states with significant amounts of snowfall, (e.g., the upper midwest, and New England). Nonetheless, the company will ship to all locations, and is equipped to erect roughly one building per week. Last year, they built 45 structures. Unlike the other companies, however, Bulk Storage reported that it takes 6-8 weeks to ship and complete a building.

## IV. Conclusions

EPA was not able to identify any federal or state standards that apply directly to storage of mineral processing secondary materials. There are a large number of industry standards which pertain to aboveground storage tanks either directly or by reference in another standard. However, these standards were typically designed for storage of petroleum products or flammable material, and may or may not be appropriate for storage of mineral processing secondary materials. There do not appear to be industry standards related to storage of materials in tanks and drums.

There are numerous combinations of drums, containers, tanks, and even buildings available from many regional and national manufacturers. The type of unit most appropriate for any particular waste will depend largely on the quantity and physical characteristics of the material. These factors also will affect the cost of such a unit. With sufficient lead time, tanks, drums, or other storage vessels

can be manufactured to fit virtually any order, within a reasonable transportation range for most locations in the country.

**Appendix A**
**Federal Regulations**

## Appendix A. Federal Programs and Regulations

There are several different sections of Code Federal Regulations (CFR) which address storage of hazardous materials and/or hazardous wastes. These include implementing regulations for the Oil Pollution Act of 1990 (40 CFR 112), which regulates storage of oil products, the Occupational Safety and Health Act (29 CFR 1900), which covers the handling and storage of hazardous materials, and the Resource Conservation and Recovery Act (RCRA); regulations found at 40 CFR 264 that address storage of hazardous waste. Each of these programs is described below.

### 1. 40 CFR 112 - Oil Products

A principle federal program regulating ASTs is the Oil Pollution Act of 1990 (40 CFR 112), which applies to all non-transportation related facilities that have oil storage capacities greater than 660 gal. for a single tank or an aggregate storage capacity of 1,320 gal. For the purposes of this regulation, oil is defined as including both petroleum and non-petroleum (e.g., vegetable oil based materials).

Under 40 CFR 112, oil storage facilities must meet a variety of safety criteria. Tanks must be designed and constructed in accordance with standard industry practices, such as those of UL 142 and API 620. Additionally, tanks are required to have adequate secondary containment, spill and overflow prevention devices, and undergo periodic inspections, including tightness testing.

### 2. OSHA Requirements - Hazardous Chemicals

OSHA requirements regarding hazardous chemicals concern the handling and labeling of any drums or other containers holding these materials. These requirements include inspection of containers, safe practices for opening drums, communications requirements, and procedures for moving drums. Additionally, training programs are required for workers handling these materials. OSHA also requires first aid stations and hygiene facilities, depending on the number of personnel at a particular site. There are no specific requirements relating to waste compatibility other than that the tanks and drums have a sufficient capacity for holding the particular material in question.

### 3. RCRA Requirements - Hazardous Waste

This section describes federal regulations which apply to tank systems, containers, and containment buildings used to store hazardous waste. These regulations are found in 40 CFR Part 264, Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.

**Containers**

Requirements for the use and management of containers are found in Subpart I. These requirements apply to all owners and operators of hazardous waste facilities that store containers of hazardous wastes. Storage areas maintaining containers holding only wastes that do not contain free liquids (except for FO20, FO21, FO22, FO23, FO26, and FO27) are not required to have a containment system if the storage area is able to drain and remove precipitation or if the containers are elevated or protected to prevent contact with accumulated liquid (§264.176). The requirements are outlined below.

**Container Requirements (§264.172, §264.173, and §264.177)**

- The container must be made of or lined with a material that is compatible with the waste.
- The container must remain closed except when transferring waste.
- Incompatible wastes may not be placed in the same container.
- Waste may not be placed in an unwashed container that previously held an incompatible waste.

**Storage Area Requirements (§264.174 through §264.177)**

- The storage area must have a containment system.
- The storage area must be inspected at least weekly for leaking containers and deterioration of the containment system.
- Containers holding ignitable or reactive waste must be at least 15 meters from the facility's property line and separated from sources of ignition or reaction.
- A storage container holding a waste that is incompatible with other wastes stored nearby must be separated from the other wastes.

**Spill and Leak Detection Requirements (§264.175)**

- Containers must either be underlain by a sloped impervious base or the containment system must be able to remove liquid from leaks, spills, or precipitation, unless the containers are elevated or protected from contact with accumulated liquids.
- The containment system must be able to contain 10 percent of the volume of the containers or the entire volume of the largest container, whichever is greater, if the containers are used to store free liquids.
- Run-on into the system must be prevented if the containment system does not have sufficient capacity to contain run-on that might enter the system in addition to the capacity required above.
- Spills, leaks, or precipitation must be removed from the sump or containment system to prevent overflow of the collection system.

**Air Emissions Requirements (§264.1086)**

For containers having a capacity greater than 0.1 $m^3$:

- Waste must be placed in a container with a cover that operates with no detectable organic emissions, a covered container with a capacity of no more than 0.46 $m^3$ that complies with all DOT regulations regarding packaging hazardous wastes for transport, or a container attached to or forming part of a truck, trailer, or railcar and is organic vapor tight.
- If the container must be open during treatment, it must be in an enclosure that is vented through a closed-vent system to a control device.

- The enclosure must have sufficient airflow to capture the organic vapors emitted and may have openings to allow worker access, passage of containers, entry of equipment, or airflow.
- The pressure in the enclosure must be less than atmospheric pressure.
- When transferring waste into a container with a capacity greater than 0.46 $m^3$, the waste must be pumped using a conveyance system that uses a tube to add the waste into the container.
- During pumping, the cover and all openings must remain closed except for the openings through which the tube enters.
- The tube outlet must stay below the waste surface and no more than 15.25 centimeters or two inside diameters, whichever is greater, above the bottom.
- During a transfer by a means other than pumping, the cover and all openings must stay closed except for the opening through which the waste enters.
- The container must remain closed at all times except when transferring or sampling the material in the container, inspecting or repairing equipment inside the container, or venting gases or vapor to a closed vent system connected to a control device.

**Tank Systems**

Requirements for the use and management of tank systems are found in Subpart J. Tank systems used to store wastes that contain no free liquids and are located in a building with an impermeable floor are exempt from these requirements. Tanks used as part of a secondary containment system or in conjunction with drip pads are also exempt from these requirements (§264.190). The requirements are outlined below.

**Tank Requirements (§264.191 and §264.199)**

- Tank systems must have sufficient structural integrity and be acceptable for the storing and treating of hazardous waste.
- The foundation, structural support, seams, connections, and pressure controls must be adequately designed and the tank system must have sufficient structural strength, be compatible with the waste, be able to withstand frost heave, and have corrosion protection to prevent collapse, rupture, or failure.
- Tank foundations must be able to maintain the load of a full tank and the tank must be anchored to prevent flotation or dislodgment when the tank is located in a saturated zone or seismic fault zone.
- Ignitable and reactive wastes may not be placed in tank systems unless the waste is treated, rendered, or mixed so that it is no longer ignitable or reactive; or the waste is stored or treated so that it is protected from any conditions that may cause it to ignite or react; or the tank system is used only for emergencies.
- Incompatible wastes must not be placed in the same tank system or placed in a tank system that has not been decontaminated and previously held an incompatible waste unless the waste is protected from any material or conditions that may cause the waste to react in a manner that endangers human health or the environment.

**Tank Area Requirements (§264.191 and §264.195)**

- Tank systems placed underground or backfilled must be backfilled with material that is noncorrosive, porous, homogenous, and compacted to ensure uniform support.
- The owner or operator must conduct daily inspections of aboveground portions of the tank system for corrosion or releases, data gathered from the monitoring and leak detection system, construction materials and the area immediately surrounding the tank, including the secondary containment system, for erosion or releases.
- Overfill controls and cathodic protection systems must be inspected according to a determined schedule.

**Spill and Leak Detection Requirements (§264.193 and §264.194)**

- Tank systems must have secondary containment systems which prevent migration out of the system and are capable of detecting and collecting releases and accumulated liquids.
- The secondary containment must be constructed of or lined with materials that are compatible with the waste; be strong and thick enough to withstand pressure gradients, physical contact with the waste, climatic conditions, and the stresses of daily operation; placed on a foundation or base capable of supporting the secondary system and withstanding pressure gradients, settlement, compression, or uplift; equipped with a leak detection system that will detect the failure of the secondary containment system or the presence of any release or accumulated liquid within 24 hours; and sloped or designed and operated to drain and remove liquids from leaks, spills, and precipitation within 24 hours.
- Secondary containment systems must include a liner, vault, double-walled tank, and/or equivalent device.
    - Liners must be free of cracks, be able contain 100 percent of the capacity of the largest tank, prevent run-on or infiltration, and surround the tank and cover the surrounding earth.
    - Vaults must be able to contain 100 percent of the capacity of the largest tank, prevent run-on or infiltration (unless the collection system has capacity to contain precipitation from a 25-year, 24-hour rainfall event), be constructed with chemical-resistant water stops at all joints, have an impermeable interior coating or lining compatible with the waste, prevent the formation and ignition of vapors in the vault if the waste is ignitable or reactive, and either have an exterior moisture barrier or prevent migration if it is subject to hydraulic pressure.
    - Double-walled tanks must be designed so that any release from the inner tank is completely contained by the outer shell, be protected from corrosion, and have a continuous leak detection system.

- Owners and operators of tank systems must prevent spills and overflows by using controls and maintaining freeboard (in uncovered tanks).

**Air Emissions Requirements (§264.1084)**

- Waste must be placed in a tank with a cover and vented through a closed-vent system to a control device, a tank with a fixed roof and internal floating roof, a tank with an external floating roof, or a pressure tank that operates with no detectable organic emissions.
- Under certain circumstances, waste may be placed in another sort of covered tank. The waste must not be mixed, stirred, agitated, or circulated so as to result in splashing, frothing, or visible turbulent flow; heated (except to prevent freezing or provide adequate waste flow); or treated using a process that produces an exothermic reaction.
- The cover must stay closed and operate with no detectable organic emissions.
- The tank must have a closed system to transfer wastes.
- The container must remain closed at all times except when transferring or sampling the material in the container, inspecting or repairing equipment inside the container, or venting gases or vapor to a closed vent system connected to a control device.

**Containment Buildings**

Requirements for the use and management of containment buildings are found in Subpart DD. The owner or operator of a containment building is not subject to these requirements if the unit is completely enclosed, self-supporting, and constructed of durable manmade materials; has a durable primary barrier; has controls to prevent fugitive dust emissions; and is designed and operated to ensure containment and prevent tracking of materials from the unit. The containment building must be constructed of materials that can support themselves, the waste, and any personnel and equipment operating within the unit and be able to withstand pressure gradients, settlement, compression or uplift, contact with the wastes, and climatic conditions. Also, if the unit is used to manage liquids, it must have a primary barrier, liquid collection system, secondary containment system, and leak detection system to be exempt from these requirements (§264.1100). The requirements are outlined below.

**Building Requirements (§264.1101)**

- Containment buildings must be completely enclosed, constructed of durable materials, prevent collapse or other failure, not contain incompatible wastes or reagents, and have a primary barrier. The primary barrier must be able to withstand the movement of personnel, waste, and equipment and be appropriate for the characteristics of the waste. The containment building must be constructed of materials that are able to support themselves, the waste, and any personnel and equipment operating within the unit and be able to withstand pressure gradients, settlement, compression or uplift, contact with the wastes, and climatic conditions. Any surfaces in contact with the waste must be compatible with it.
- Light-weight doors and windows may be allowed if they provide an effective barrier against fugitive dust emissions and if the waste will not come in contact with the openings.
- If treatment is to be conducted in the building, the unit must have an area in which the treatment can be conducted that prevents releases to other portions of the building.

**Spill and Leak Detection Requirements (§264.1101)**

- Containment buildings used to manage hazardous wastes containing or treated with free liquids must have a sloped primary barrier to prevent migration and drain liquids to the containment system, a liquid collection and removal system, a secondary containment system and barrier that is chemically resistant to the waste and strong enough to withstand the pressure exerted by overlaying materials and equipment used in the building, and a leak detection system that has a bottom slope of at least 1 percent and is either constructed of a granular drainage material with a hydraulic conductivity of at least $1x10^{-2}$ cm/sec and a thickness of at least 12 inches, or synthetic or geonet drainage materials with a transmissivity of at least $3x10^{-5}$ $m^2$/sec.
- A containment building can serve as a secondary containment system for a tank stored in the building or as an external liner for a tank if the containment building prevents migration to the environment; is capable of detecting and collecting releases; is constructed of or lined with durable materials that are compatible with the waste; and is placed on a foundation or base capable of providing support to the secondary containment system and withstanding pressure gradients, settlement, compression, and uplift.
- Owners and operators of containment buildings must obtain certification by a professional engineer that the unit meets the design criteria described above, repair conditions that could lead to a release, inspect and record at least once every seven days data from the monitoring equipment, leak detection equipment, and the containment building and surrounding area.
- Owners and operators of containment buildings must ensure containment of waste within the unit by constructing a primary barrier, maintaining the level of stored waste so that the height of any containment wall is not exceeded, preventing tracking of waste out of the unit by personnel or equipment, designating an area to decontaminate equipment and properly collecting and disposing of associated rinsate, and preventing fugitive dust emissions during routine operating and maintenance conditions (including when equipment and personnel are entering and exiting the unit), and ensuring that associated particulate collection devices are operated and maintained with sound air pollution control practices.
- Containment buildings that have areas with and without secondary containment must be operated in accordance with the requirements described above, prevent releases to areas without secondary containment, and maintain the integrity of the areas without secondary containment.

**Appendix B**
**State Regulations**

**Appendix C**
**Selected Phone Logs**

**Phone Log**

Date: November 26, 1996
Time: 10:00 am
Contact: Bulk Storage
Subject: Information on buildings
ICF Staff: Annie Ho

Information:

I contacted Bulk Storage Incorporated in Crete, Illinois, (708) 672-3113 to obtain information about their buildings. The salesperson indicated that their buildings generally had a lifetime of 30 years and that the manufacturer guaranteed the shingles for 25 years. She indicated that their buildings required relatively little maintenance. Maintenance consisted of repainting the building every 4 to 7 years. The interior of their buildings can be covered with a chemical that can make water penetration impossible. The average cost of a building ranges from $35,500 to $155,000.

**Phone Log**

Date: November 26, 1996
Time: 11:00 am
Contact: General Container Corporation
Subject: Information on storage containers
ICF Staff: Annie Ho

Information:

I spoke with Martin Kapp (800/336-7044) about storage containers. He indicated that they sold a variety of containers including drums made of steel, stainless steel, and polyethylene. The sizes range from 1 to 55 gallons, and the prices range from $35 to $75 depending on the size and material needed.

**Phone Log**

Date: November 26, 1996
Time: 10:30 am
Contact: Modern Manufacturing (800/383-2859)
Subject: Information on roll-off containers
ICF Staff: Annie Ho

Information:

The salesperson indicated that they sold a variety of roll-off containers, including open top and closed top containers. The closed top containers can be installed with different covers such metal rolling lids. The typical size of a roll-off container is usually 20 or 25 cubic yards. The salesperson also mentioned that Modern Manufacturing rented out these containers. He said he would send me more detailed information in the mail.

**Phone Log**

Date: October 31, 1996
Time: 9:30 am
Contact: Virginia Department of Transportation
Subject: Information on road chemical container and building vendors

Information:

Contacted Bill Lindsey, VDOT, (804) 786-2721. For the most part, VDOT uses two types of buildings to house road salts, pole barns and domes. Pole barns are rectangular block buildings and domes are wooden or concrete structures. In a few instances, the road salt is on a lined concrete pad covered with a PVC liner. He did not know the contractors but transferred me to Donna Lao, VDOT, (804) 786-3247. I was then transferred to Tim Brown, VDOT.

According to Mr. Brown, a local Richmond company builds most of the pole barns, Brooks and Company, (804) 266-6088. The domes are built by two companies, Envirotech Structures in Saginaw, Michigan, (517) 777-2896 and Bulk Storage in Crete, Illinois, (708) 672-3113.

**Phone Log**

Date: October 31, 1996
Time: 11:30 am
Contact: EI Digest
Subject: Information on state hazardous waste regulations

Information:

Jeff Smith, EI Digest, (800) 593-6271 was referred to me as a tank expert. EI Digest has not done anything on state regulations involving standards for containers, buildings, or above ground storage tanks. However, there is a trade organization, the Petroleum Equipment Institute, comprised of manufacturers and dealers of tanks for the petroleum industry. While its members are probably mostly involved with underground storage tanks, some may also deal with above ground storage tanks. A contact person in this trade group is Bob Renkes, (918) 414-9616. In addition, in early 1993, the Moran-Robb bill was introduced. This bill addressed the need for above ground storage tank regulations.

**Phone Log**

Date: October 31, 1996
Time: 11:00 am
Contact: Virginia Department of Environmental Quality, Solid Waste Division
Subject: Information on who constructs transfer facilities

Information:

This is not the sort of information DEQ maintains. In order to obtain this information, it would be necessary to contact the operator (county or private company) of the transfer station.

**Phone Log**

Date: October 31, 1996
Time: 12:00 pm
Contact: California Environmental Protection Agency
Subject: Information on who constructs transfer facilities

Information:

This is not the sort of information they maintain. In order to obtain this information, it would be necessary to contact the operator (county or private company) of the transfer station.

**Phone Log**

Date: October 31, 1996
Time: 12:00 pm
Contact: Texas Environmental Protection Agency
Subject: Information on who constructs transfer facilities

Information:

Left message and did not receive a return call.

**Phone Log**

Date: November 14, 1996
Time: 1:00 pm
Contact: Michigan Department of Transportation, (515) 322-3330
Subject: Information on who constructs road salt buildings

Information:

Left message and did not receive a return call.

**Phone Log**

Date: November 14, 1996
Time: 1:00 pm
Contact: Colorado Department of Transportation, (303) 757-9514
Subject: Information on who constructs road salt buildings

Information:

A company called Strataspan in Boulder, CO constructed their last building about 4 years ago. I am unable to find a phone number for this company.

**Phone Log**

Date: November 15, 1996
Time: 3:00 pm
Contact: Wisconsin Department of Transportation, (608) 266-9490
Subject: Information on who constructs road salt buildings

Information:

According to Jay Wells, there are three types of buildings -- domes, high-arch barns, and crypt-style buildings. Two companies construct domes, Dome Corporation of America in Saginaw, Michigan, (517) 777-2050, and Bulk Storage Incorporated in Crete, Illinois, (708) 672-3113. Advanced Storage Technologies (AST) in Minnetonka, Minnesota constructs the high-arch barns. I am unable to find a phone number for AST. The Wheeler Consolidated Incorporated in Steven Point, Wisconsin constructs the crypt-style buildings. I am unable to find a phone number for Wheeler.

**Phone Log**

Date: November 18, 1996
Time: 3:00 pm
Contact: New York State Department of Environmental Conservation,
Dick Cowhan (518) 457-4351
Subject: Information on state regulations for above ground storage tanks

Information:

The State of New York regulates two categories of petroleum bulk storage above ground storage tanks (ASTs): (1) ASTs with a combined storage capacity of 1,100 gallons and (2) ASTs with a combined storage capacity greater than 400,000 gallons. Regulations for "Major facilities," facilities with ASTs having a combined storage capacity greater than 400,000 gallons, are found in 6 NYCRR Parts 610 and 611 and 12 NYS Navigation Law. Regulations for facilities with ASTs having a capacity of 1,100 to 400,000 gallons are found in 6 NYCRR Parts 612 and 614. Mr. Cowhan is mailing copies of these regulations to me.

The State of New York regulates chemical bulk storage also. They regulate over 1,000 hazardous and acutely hazardous materials. Both the petroleum bulk storage and the chemical bulk storage regulations may be more stringent than Federal Regulations. For example, the New York State chemical bulk storage regulations regulate more chemicals, have a smaller reportable quantity than RCRA, regulate ASTs with a capacity greater than 185 gallons, regulate all USTs, require spill prevention reports, and have performance standards. Mr. Cowhan is sending me a copy of the chemical bulk storage regulations also.

**Phone Log**

Date: November 22, 1996
Time: 3:00 pm
Contact: Florida State Department of Environmental Protection, (904) 488-3935
Subject: Information on state regulations for above ground storage tanks

Information:

According to John Speck in the Tank Division, Florida has no regulations (beyond a registration requirement for tanks greater than 110 gallons) for above ground storage tanks containing hazardous wastes or materials. The only above ground storage tank regulations they have are for petroleum, ammonia pesticides, and their derivatives. These regulations were developed in 1984 and can be found on the internet at http://www.dep.state.fl.us/waste/programs/tanks/tnkswbpg.htm.

**Phone Log**

Date: November 18, 1996
Time: 4:00 pm
Contact: New Jersey State Department of Environmental Protection,
(609) 633-0610
Subject: Information on state regulations for above ground storage tanks

Information:

According to Morari Sanchez in the Bureau of Discharge Prevention, New Jersey does have regulations for tanks containing hazardous waste, hazardous substances, and petroleum. The regulations differ depending on what is in the tank and the volume. The tanks are regulated by 5 departments:

Hazardous Waste Division, (609) 292-9880,
Right to Know Program, (609) 984-3219,
Bureau of Discharge Prevention, (609) 292-1690,
Air Program, (609) 292-5194, and
TCPA, (609) 633-7289.

When I called the Hazardous Waste Division, I was informed that no one there could tell me about the state regulations and that I would have to call the library, (609) 392-7188, to try to get a copy of them for myself. I spoke to Christopher Stewart in the library and was informed that the regulations are in several different places and someone would have to get back to me. He called me back and suggested that I call the New Jersey state library, (609) 292-6220. The regulations are in Title 7 Chapter 14B of the New Jersey Administrative Code. Someone there will mail them to me if there is no charge (since we are an EPA contractor); if there is a charge ($31) she will leave me a message and I will get back to her on Monday.

Alan Bookman from the Right to Know Program returned my call, (609) 984-5338. They only require that facilities annually report what is stored in tanks.

Ms. Sanchez is mailing me a copy of the AST regulations for the Bureau of Discharge Prevention.

When I called the Air Program, I was told they have nothing to do with ASTs.

TCPA regulates “extra hazardous substances.” TCPA has no regulations for ASTs, manufacturers just have to report having a chemical storage tank.

**Phone Log**

Date: December 12, 1996
Time: 1:30 p.m.
Contact: John Lewis, Provincial Partitions, Inc.
Subject: Availability of Structures

Information:

Provincial Partitions, headquartered in Toronto, Canada builds fiberglass structures most often used to store hazardous waste. These structures can be sent to their destination in less than a week (irrespective of size) and in a worst case scenario will be erected in less than a month. Provincial Partitions routinely builds structures all over the world, they recently erected a 3000 square foot building in Guam less than 3 weeks after the order was placed. Using commercial haulers, any location within the United States is easily accessible with 3 days, though the cost of shipping is passed on to the end-user.

**Phone Log**

Date: December 12, 1996
Time: 2:00 p.m.
Contact: Hugh Dickie, Dome Corporation of America
Subject: Availability of Structures

Information:

The Dome Corporation of America, with offices in Michigan and New Jersey erected 150 buildings last year and reported that inventory in their warehouse would accommodate any "reasonable" surge in demand. They will ship to any address in the United States in 2-3 days, generally at a cost of less than $1,000. Once the materials are delivered, the concrete retaining wall takes 1-2 weeks to erect, then the building requires another 2-3 weeks to complete.

**Phone Log**

Date: December 12, 1996
Time: 2:15 p.m.
Contact: Dominic Stella, Sprung Instant Structures
Subject: Availability of Structures

Information:

Last year Sprung Instant Structures built 200-300 buildings. A representative reported that with 1-2 million square feet of building material in inventory, they could meet almost any surge in demand. Sprung ships all over the world and reported that materials will be delivered to any site in the lower 48 states in 2-3 days. Within the United States, shipping usually does not exceed $6,000 unless structures are extremely large. Sprung also requires end-user to supply unskilled labor to construct the building.

**Phone Log**

Date: December 12, 1996
Time: 4:00 p.m.
Contact: Building Engineer
Subject: Availability of Structures

Information:

Bulk Storage, Inc. builds structures that are specifically designed to hold road salt. Consequently, Bulk Storage has traditionally built domes only in States with significant amounts of snowfall, (e.g., the upper midwest, and New England). The company will ship to all locations, and is equipped to erect roughly one building per week. Last year, they built 45. Unlike other companies, however, Bulk Storage reported that it takes 6-8 weeks to ship and complete a building.

**Phone Log**

Date: 11/22/96
Time: 1:00 p.m.
Contact: Bud Greenert, Superintendent, Bucks Fabricating
Subject: General Information

Although they make many varieties of metal containers ranging in size from 10 to 40 yards, Bucks Fabricating specializes in roll-off containers. They are located in Hadley, Pennsylvania and supply roll-off containers throughout the Northeast. They will deliver equipment as far south as Tennessee and as far west as Indiana. Delivery costs for their containers are $1.60/mile. Mr. Greenert estimated a fabricating capacity of 2-3 units per week with a delivery lead-time of 4-5 weeks. Mr. Greenert estimated the lifetime of the metal roll-off to be 5-10 years. Bucks Fabricating makes a specialty "Poly Box" roll-off that is corrosion resistant and suitable for hauling sludges and other corrosive material. A "Poly Box" roll-off can last up to two times as long as a steel container. Mr. Greenert stated that maintenance of roll-off containers is very low and consists of repainting the container as often as needed and replacing the gasket every 2-5 years. Mr. Greenert priced a 30 yard steel roll-off container at $6,695 + delivery charges. Bucks Fabricating does not lease, rent, or sell trucks used to haul the roll-off bins. Mr. Greenert indicated that haulers would need to be hired in the local area to move the roll-off containers.

**Phone Log**

Date: November 24, 1996
Time: 1:30 p.m.
Contact: Representative, Highland Tank
Subject: Steel Aboveground Tanks

Information:

Highland Tank Co. manufactures a variety of steel aboveground storage tanks, including diked and double-walled tanks. Prices for tanks vary anywhere from $15,000 - $35,000 for 30,000 gal tanks. More expensive tanks have double walls and other safety features. Because these tanks are primarily designed for petroleum storage, they all satisfy the requirements found at 40 CFR 112. Highland Tank Co. considers mineral processing wastes as chemical wastes, and therefore would require a customer to perform any analyses necessary to determine the tanks' design specifications.

**Phone Log**

Date: November 24, 1996
Time: 4:30 p.m.
Contact: Representative, Bellcorp
Subject: Steel, Fiberglass and Stainless Steel Tanks and Drums

Information:

Bellcorp is a distributor for manufacturers of steel, stainless steel and fiberglass tanks and drums. The representative explained that providing general information is difficult since the prices vary between products and design specifications particular to the use, but noted that their products should be able to handle mineral processing wastes for 30 years or more. Shipping, done by truck, allows easy transport to any area of the country. Delivery times range from 4-6 weeks, depending on the size of the tank and the distance shipped.

**Appendix D**
**Selected Vendor Literature**

**Vendor Literature from**

# Sprung Instant Structures

**Vendor Literature from**

# Dome Corporation of North America

**Vendor Literature from**

# Highland Tank

**Vendor Literature from**

# Chem-Tainer Industries, Inc

**Vendor Literature from**

# Palmer MFG. & Tank Inc.

**Vendor Literature from**

# Ace Tank & Equipment Co.

**Vendor Literature from**

# Morse Construction Group, Inc

**Vendor Literature from**

# Modern Manufacturing

**Vendor Literature from**

# Benlee

**Vendor Literature from**

# Bucks Fabricating

**Appendix E**
**Trip Reports**

**Trip Report**
**I-66 Transfer Station, Fairfax County Virginia**

The County of Fairfax Virginia owns and operates a transfer station located at 4618 West Ox Road. Built on top of a closed landfill, the 25,000 sq ft facility is used to transfer municipal solid waste (MSW) from private haulers trucks to larger county-owned trucks, prior to shipment to the County's waste incinerator, located in another part of the County. The facility processes between 1,600 and 2,000 tons per day of MSW, and operates 7 days per week from 4:30 a.m. to about 9 p.m.. On December 13, 1996, Jennifer Mayer of ICF met with Amarjit Riat, a project manager with the Environmental Projects Branch of the Division of Solid Waste Disposal and Resource Recovery, to gather information about the facility's operations and tour the facility.

The facility is a large concrete bi-level building. Trucks back through large truck doors, and dump MSW onto the tipping floor, which is the upper floor of the building. The tipping floor has three areas cut out for dumping into trailers parked on the lower level. The trucks then drive out and a front end loader pushes MSW through one of the cut-out areas, into the trailers parked below. Each cut-out area has a crane to even out the material within the trailers. When the trailers below are full, they drive out, and other trailers drive below the cut-out areas.

The transfer station is being expanded. A second facility is being added alongside the first to increase the capacity of the station. The new facility, which will be identical to the existing facility, is being designed and constructed by local contractors that were selected by a bidding process. The new facility is being constructed using a combination of poured concrete, and precast panels. The poured concrete is used for floors and supports, while the precast panels are joined and sealed to create the walls. A membrane roof was being constructed with skylights to increase lighting in the facility.

Both facilities have 10 garage door type openings for the trucks to back into. These openings are about 18 feet wide and 20 feet high. The cut-out sections in the floor that the MSW falls through are slightly smaller than the trailers the waste falls into, so no waste will "miss" the trailer. The buildings have an internal drainage system, to collect any wastewater, or "leachate" from the MSW. Additionally, the floors have a slight rise at the truck door ways to prevent water from coming in or out of the facility. The floor of the new building is concrete covered with asphalt, to protect both the floor and the equipment used inside the building. The facility expected to upgrade the asphalt annually.

At the end of each day, facility personnel hose down the tipping floor. Run-off is collected in the internal leachate collection system. The facility has a separate storm water collection system. Mr. Riat indicated that the facility did not experience other environmental problems, although they occasionally had some paper blow out of the facility's truck doors on windy days. He stated that the facility had to meet local building codes, as well as MSW regulations. He pointed out that the MSW regulations did not require a specific permit.

**Trip Report**
**Virginia Department of Transportation Salt Storage Building**

The Virginia Department of Transportation owns and operates a number of dome-shaped buildings that are used to store road salt. On December 16, 1996 Jennifer Mayer of ICF visited VDOT's salt dome located on Lee Highway in Merrifield, Virginia. Mr. Alan Wood of VDOT also was present.

Mr. Wood was unsure about the exact dimensions or age of the dome, but he estimated that the dome is approximately 4 years old. The dome appeared to be at least 35 feet high and about 50 or 60 feet in diameter, with a 20 foot high open doorway through which material is added and removed. The round structure consists of a wood framed roof on top of a 6 ft concrete base. The base was built on a square foundation pad built using a layer of asphalt, a liner, and another layer of asphalt to protect the liner. The concrete base also is lined with the same material. Mr. Wood did not know what type of liner was used, but it was exposed in several places and appeared to be a geomembrane liner. The base pad extended several feet from the dome, and had a slight berming affect. Runoff from this pad was directed to a collection pond about 20 feet away. The run-off pond was built with the same asphalt-liner-asphalt base as the pad underlying the dome.

The structure has a large open doorway through which a front-end loader pushes material. The salt in the dome was piled about 15 ft high, and some road sand was placed on the salt near the open doorway to protect the salt. When the salt is being loaded into the dome, the front end loader operator builds a "ramp" out of the salt, to get salt to the top of the pile. (Other facilities sometimes use a convey system to get the salt to the top of the pile.) While the capacity of the dome was about 3,500 tons, not all of it was being used because of the height limitations when using a front end loader. Mr. Wood also indicated that Mr. Tommy Atkins of VDOT's Buildings and Grounds might have the design specifications and cost.