# APPLICATION BULLETIN

## INTERNAL LINING AND REPAIR OF UNDERGROUND STORAGE TANKS WITH GLASS ARMOR™

## SPECIFICATIONS

## FOR

## GLASS ARMOR™ 27 SERIES (GA27) HIGH PERFORMANCE EPOXY LINING SYSTEM

EPOXY COATINGS AND LININGS

BRIDGEPORT CHEMICAL •1925 Whitfield Park Loop •Sarasota, FL 34243 •(800)676-8265 •Fax (941)753-2771

# Glass Armor™ 27 Application Bulletin

## FORWARD

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The process of lining underground storage tanks is inherently hazardous and requires adequate safeguards for personnel and property in conducting the operation. This specification serves only as a guideline for employers to warn and properly train and equip their employees concerning health and safety risks and precautions.

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# Glass Armor™ 27 Application Bulletin

## SECTION 1

### Part I INTRODUCTION

The use of internal linings to protect underground storage tanks against corrosion and leakage, is a technology that began in 1957. That was when Bridgeport Chemical first pioneered the process of repairing and lining leaking underground storage tanks (UST's). Since then, over 300,000 heating oil tanks and over 70,000 motor fuel tanks have been internally lined to prevent releases.

Today, underground storage tanks that are not protected against corrosion pose a serious health threat to our nations groundwater and drinking water supply. In 1988, the Federal Environmental Protection Agency (EPA) mandated rules and regulations governing the use and operation of underground storage tanks. These rules require existing bare steel tanks to be protected against corrosion by December 1998.

Although the EPA approved two (2) methods for upgrading existing UST's, they chose interior tank lining as the number one upgrade option. This alternative provides not only protection against internal corrosion, but also prevents leaks which may occur as a result of external corrosion. Typically, corrosion of steel tanks is concentrated to minute areas that result in the formation of pits and/or rust plugs. Since perforations or rust plugs are very small in size often not exceeding 1/8" diameter, they have little or no affect on the overall structural integrity of the tank. If a leak should develop, it is not an indication that the tank's structural integrity is poor.

A 125-mil lining provides additional structural strength to the tank walls by forming a composite tank. In addition, a 125 mil lining bridges perforations in the outer wall of the tank due to external corrosion. Thus, tank lining prevents releases due to both external and internal corrosion.

The EPA regulations on upgrading existing underground storage tanks can be found in the September 23, 1988 Federal Register, Part II, Volume 53, Number 185. Reference 40 CFR, Part 280.21.

Bridgeport Chemical high performance Glass Armor epoxy lining systems have been specifically formulated to provide excellent chemical and physical resistance in a wide variety of aggressive storage environments. In use for over 35 years, *Glass Armor* products have long been recognized by corrosion and maintenance engineers for their superior chemical resistant properties in today's toughest environments.

Our **G**lass **A**rmor 27 epoxy lining is specifically designed for high-build applications and may be sprayed to a thickness ranging from 80-150 mils. Structurally reinforced, GA 27 forms an impervious protective barrier that resists deterioration from abrasion, impact, corrosion and chemical attack.



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GA 27 meets both federal and industry requirements for coatings used to internally line underground storage tanks. It has been thoroughly tested using recognized industry standards for immersion compatibility and physical properties cited in Section 1.3 of American Petroleum Institute Standard, RP 1631, "Interior Lining of Underground Storage Tanks", Fifth Edition, June 2001.

Bridgeport Chemical has a network of authorized Glass Armor applicators providing tank lining services throughout the United States. If you would like information regarding the applicator in your area, please contact us at our toll-free telephone number **(800) 676-8265**.

## Part II SCOPE

**2.1** This technical information bulletin outlines Bridgeport Chemical specifications for the repair and internal lining of steel and fiberglass underground storage tanks using Glass Armor 27 epoxy lining products.

**2.2** Section II describes the requirements, procedures and operating conditions for lining and/or repairing steel underground storage tanks. This section also describes all applicable safety requirements, personnel training requirements, isolation of the tank and removal of hazardous vapors, vapor monitoring, and pre-entry precautions.

**2.3** Section III describes the requirements and procedures for the repair of fiberglass reinforced plastic (FRP) underground storage tanks.

**2.4** This specification is intended as a guideline for upgrading and repairing existing underground storage tanks in accordance with the Code of Federal Regulations, 40CFR, Parts 280.21 and 280.33.

**2.5** All work must be accomplished in accordance with applicable federal, state and local requirements as well as applicable safety standards.

## Part III REFERENCE PUBLICATIONS

**3.1** The editions of the following standards, codes and specifications that are in effect at the time of publication of this technical information bulletin are cited herein. The contractor/applicator and their employees shall be familiar and comply with the procedures established in the following publications:
**American Petroleum Institute (API)**
**1220 L. Street, Northwest, Washington, DC 20005**

RP 1631 - Interior Lining of Underground Storage Tanks

RP 2003 - Protection Against Ignition Arising Out of Static, Lightning, and Stray Currents

RP 2015 - Cleaning Petroleum Storage Tanks

RP 2027 - Ignition Hazards Involved in Abrasive Blasting of Tanks in Service

RP 2217 - Guidelines for Confined Space Work in the Petroleum Industry

**National Fire Prevention Association (NFPA)**
**Batterymarch Park, Quincy, MA 02269-9990**

327 - Cleaning Small Tanks and Containers

329 - Underground Leakage of Flammable and Combustible Liquids

77 - Static Electricity

**Steel Structure Painting Council (SSPC)**
**4400 Fifth Avenue, Pittsburgh, PA 15213-2683**

SP5 - White Metal Blast Cleaning

SP7 - Brush Off Blast Cleaning

**Fiberglass Petroleum Tank and Pipe Institute (FPTPI)**
**One SeaGate, Suite 1001, Toledo, Ohio 43604-1560**

T-90-01 - Remanufacturing of Fiberglass Reinforced Plastic (FRP) Underground Storage Tanks

**National Institute for Occupational Health and Safety (NIOSH)**
**United States Government Printing Office, Washington, DC 20402**

Publ. 80-106 -Working in Confined Spaces

**American National Standards Institute (ANSI)**
**1430 Broadway, New York, New York 10018**
Std. Z117.1 (1989) - Safety Requirements for Confined Spaces

**Occupational Safety and Health Association (OSHA)**
**United States Labor Department of Labor**
**2000 Constitution Avenue, N.W., Washington, DC 20210**



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The contractor shall be familiar with and comply with the rules and regulations of the Occupational Health Safety and Health Administration (OSHA) as published in 29 Code of Federal Regulations, Part 1910, and in particular:

Permit-Required Confined Space Entry for General Industry, Final Rule, 1993.

Subpart H - Hazardous Materials
par. 1910, 106 - Flammable and Combustible Liquid

Subpart I - Personnel Protective Equipment
par. 1910, 132 - general requirements
par. 1910, 134 - respiratory protection

Subpart J - General Environment Controls
par. 1910, 145 - specifications for accident prevention signs & tags

Subpart L - Fire Protection
par. 1910, 157 - portable fire extinguisher

Subpart Z- Toxic and Hazardous Substances

**3.2** Care should be taken to use procedures and equipment necessary to comply with all applicable safety rules and regulations.

## Part IV PERMITS AND LOCAL APPROVAL

**4.1** Where necessary, approval from local authorities shall be obtained prior to the beginning of any work. Any permits required for activities relating to the alteration or repair of tanks or equipment in connection with the storage, handling or use regulated flammable or combustible liquids shall be obtained.

## Part V PERSONNEL TRAINING REQUIREMENTS

**5.1** Employees performing the repair or lining work shall be properly trained in the following:

a) The handling and disposal of tank bottom sludge and residues including tetraethyl lead and it's by-products.
b) The use of equipment and procedures for testing and vapor-freeing tanks

c) All applicable safety rules & regulations



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d) The application & handling of the tank lining material

e) OSHA permit required confined space entry requirements and procedures. All personnel involved in the tank lining process shall be thoroughly trained in all aspects of confined space entry shall have completed an OSHA approved training course for personnel involved in confined space entries and procedures.

**5.2** Contractor shall certify to the owner that the employees and subcontractors responsible for the tank lining have been trained per the requirements given in Section 1, Part 5.1 of this document, and that they are aware of the reference publications given in Section 1, Part 3.1 of this document.

## SECTION 2 INTERNAL LINING AND REPAIR OF STEEL UNDERGROUND STORAGE TANKS

### PART I GENERAL SAFETY REQUIREMENTS

**1.1** Prior to beginning excavation of the tank access area, sources of ignition must be removed from the area surrounding the tank(s) and vapor vents. All open flame and spark producing equipment or machinery must be shut down until it has been determined that the area is vapor free. A combustible gas indicator shall be used to check and monitor for hazardous vapors. Barricades and warning signs reading "Flammable - No Smoking" shall be erected and posted around the affected area.

**1.2** A minimum of two portable fire extinguishers (A:B:C type) each having a rating not less than 80B:C shall be available on the job site at all times.

**1.3** Electrical equipment used in the area must be explosion proof (Class 1, Division 1, Group D) as specified in NFPA 70.

**1.4** Adequate precautions shall be taken to prevent the accumulation and discharge of static electricity (See API, RP-2003 or NFPA 77).

**1.5** Work shall not commence if current wind conditions might cause vapors to be carried to an area where they could cause ignition or could be inhaled.

**1.6** The employer shall develop a confined space entry training program and make the employees aware of the hazards associated while entering, exiting and working in confined spaces at normal atmospheric pressure. Documentation of employee training including written records, safety drills, inspections and tests should be available for review by the State implementing agency. A confined space entry checklist and permit

shall be reviewed and completed prior to entry for all tank entrants and attendants.

### 1.7 Isolation of the Tank and Related Piping

a) The tank must be completely isolated before any work begins. Any manifolded lines such as vents, fills, or suction shall be "blocked off" from other existing tanks and lines that are to remain in service during the tank lining process. Product and vapor recovery lines shall be drained of product and purged or disconnected and blanked. A separate temporary vent may be required for the tank being lined.

b) Where possible, fill (drop) tubes should be removed to allow for maximum removal of liquid and to provide additional ventilation.

c) All electrical switches supplying current to submerged pumps and/or other equipment connected to the tank shall be "locked out" (See 29 CFR, Part 1910.147).

### 1.8 Removal of Liquid Product

a) Explosion-proof or air-driven transfer pumps shall be used to remove as much product, water and sediment as possible from the tank. Pump motors and suction hoses must be properly grounded to prevent electrostatic ignition hazards (See API, RP 2003).

b) A small quantity of water can be pumped into the tank to float any remaining product from a low spot to a level where it can be removed from the tank.

### 1.9 Removal of Flammable Vapors (Vapor - Freeing)

a) The tank shall be thoroughly purged with air to remove flammable vapors. During this process the concentration of flammable vapors may go thorough the flammable range before a safe atmosphere can be obtained. Precautions shall be taken to prevent the discharge of static electricity or other sources of ignition during the vapor-freeing process, (See API, RP 2003 and NFPA 77).

b) **Purging vapors and ventilating the tank can be accomplished by one of the methods described below (See figures 1 and 2).**

1) An eductor-type air mover (See figure 1), typically driven by compressed air can be used. The air mover shall be properly grounded to prevent the generation and discharge of station electricity. The fill (drop) tube shall remain in place to ensure ventilation of the tank bottom. Air pressure in the tank must not exceed five (5) psig. An extension should be used to discharge vapors a minimum of twelve (12) feet above grade.



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2) A diffused air blower may be used to ventilate the tank (See figure 2). When using this method it is imperative that the air diffusing pipe is resting on the bottom of the tank and properly grounded to prevent the possibility of static electricity generation and discharge. The fill (drop) tube must be removed to allow proper diffusion of the air. The air supply from the compressor shall be checked to insure a clean air supply free of volatile vapors. Air pressure in the tank must not exceed five (5) psig.

## 1.10 Testing Flammable Vapor Concentrations

a) Testing for flammability is the most important phase of the operation. Test for flammable vapor concentrations in the excavated area before testing the tank. Tests for flammable vapor concentrations are to be made with a combustible gas indicator that has been properly calibrated on hexane-in-air and thoroughly checked and maintained in accordance with the manufacturer instructions. Personnel responsible for performing the tests must be familiar with the instrument and the interpretation of its measurements. The instrument should be purged with fresh air after each reading.

b) When using an eductor-type air mover, vapor concentration tests shall be performed through a probe hole located in the side of the eductor (See figure 1A) with the air mover on. The drop tube shall not be removed when using the probe hole for vapor testing to ensure that vapors are drawn off the bottom of the tank.

**A reading of (10) percent or less of the lower flammable limit (LFL) must be obtained prior to opening the tank.**

c) When using a diffused air blower, tests shall be performed by placing the combustible gas indicator probe into the fill opening with the fill (drop) tube removed. Vapor readings shall be taken at the bottom, middle and upper portions of the tank with the blower off. Do not allow any liquid product to enter the tube. Vapor concentrate should also be tested at the vent riser while the air blower is in operation. Once vapor readings of ten (10) percent or less of the lower flammability limit (LFL) in the tank and at the vent riser are obtained, the tank may then be safely opened.

## 1.11 Opening the Tank

a) After it has been determined that a safe atmosphere has been established, the tank may be opened. Continual monitoring of the vapor concentrations shall be maintained during the opening of the tank. If no manway exists, an access opening

can be cut in the top of tank using air-driven or explosion-proof tools. The access opening should have minimum dimensions of 18" x 18". The tank section to be removed should be outlined with chalk. A hole should be drilled with an explosion-proof drill at one corner of the section. Lubricating oil should be used to reduce friction and prevent sparking. Test for vapor concentration by inserting the combustible gas indicator probe into the hole to verify that the vapor concentration does not exceed 10 percent of the LFL.

b) Using an explosion-proof saw or sniper, cut out the access opening. Lubricating oil shall be used to reduce friction, heat and possible sparking. Prior to the final cut, the entry section must be supported to prevent it from falling into the tank.

c) **Pre-Entry Requirements and Precautions**

1) Before entering the tank, the procedures described in API publications 2217 and 2015, ANSI Z117.1, NIOSH 80-106, NFPA 77, and all applicable sections of 29 CFR, Part 1910, shall be followed to ensure the safety of personnel.

2) Maintain controlled ventilation to ensure a safe atmosphere of 10% LFL prior to tank entry and while personnel are working within the tank. Monitoring vapor concentration shall be performed periodically during the entire tank lining process. The vent line must remain unobstructed to allow continuous ventilation. All other lines and openings should be plugged or capped off during the cleaning and lining.

3) Oxygen contents and flammable vapor concentration must be at safe levels prior to any work commencing in the tank. Tank entry restrictions are based on measured oxygen and/or explosion limits:

**NO ENTRY** is allowed if the oxygen levels are below 16% and/or explosion levels are above 20% LEL (lower explosion level).

**RESTRICTED ENTRY** is allowed if the oxygen levels in the tank are between 16.1% and 19.4%, and explosion levels are less than 10% LEL. Personnel may only enter the tank with proper breathing and safety equipment.

**GENERAL ENTRY** is allowed in the tank if the oxygen levels are between 19.5% and 21.4% and explosion levels are below 3% LEL. Breathing apparatus is not required, however a safety harness and line shall be worn by all personnel entering the tank and continuous venting shall be maintained to insure safe oxygen and explosion levels.

4) The following equipment shall be available for rescue operations or other emergencies: a positive pressure air-supplied respirator with full face enclosure, a safety harness which is connected to a safety line, a self contained breathing



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apparatus and fire extinguisher. No personnel should be inside the tank without a safety attendant immediately outside the tank opening, (See 29 CFR, Part 1910.134).

5) Positive pressure air-supply sources shall be continually monitored for carbon monoxide.

6) During the cleaning process, personnel entering the tank shall wear a positive pressure air-supplied respirator with full-face enclosure and safety harness connected to a safety line. Oil-and water-resistant rubber or neoprene boots shall be worn. Protective clothing that is resistant to the types of products stored in the tank shall be worn to protect the arms, legs, torso and head of employees entering the tank. Grounding devices and static control apparel should be worn throughout the cleaning and lining process.

7) Prior to entry, petroleum absorbent should be spread under the entry hole and as far as possible within the tank to absorb liquids on the bottom.

## Part II PREPARATION OF THE TANK INTERIOR

### 2.1 Tank Cleaning

a) Upon initial entry into the tank, any accumulated liquid sludge or residue must be removed from the tank. An absorbent material capable of absorbing the liquid residues shall be spread throughout the tank bottom to solidify any remaining liquids. If the spent absorbent has become over saturated, add new absorbent to suppress vapors and dry the area. Continue to monitor vapor readings throughout the entire cleaning process. If any lighting is required during the initial cleaning operation, a Class 1, Division 1, Group D explosion proof light shall be used.

b) Using a non-ferrous or sparkproof shovel, remove any solid sludge or saturated absorbent material from the tank bottom and place in tightly sealed containers or drums. Disposal of the containers and contents shall be in accordance with all local, state and federal regulations.

c) Tank sludge and residue are potentially hazardous since they may contain lead compounds and/or benzene vapors. Personnel involved in the removal of these wastes must wear proper equipment and protective clothing. More information on those substances can be found in OSHA, 29 Code of Federal Regulations, Part 1910, Subpart Z- “Toxic and Hazardous Substances”.

d) Clothing that has become saturated with the stored product shall be removed immediately.



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## 2.2 Tank Surface Preparation

a) All personnel involved in abrasive blasting shall be familiar with API publication 2027.

b) Monitor vapor readings to ensure that no flammable vapors have accumulated. Continue ventilation procedures to ensure a safe working environment.

c) If product is entering the tank through a perforation in the tank shell, then repairs will be performed prior to abrasive blast operations.

d) Abrasive blast operators shall wear approved protective clothing and helmets connected to sources of clean air. The blasting nozzle shall be bonded to the work surface or otherwise grounded to provide protection from static electricity generation and discharge.

e) The entire interior surface of the tank shall be abrasive blasted until completely free of scale, rust and other foreign matter. Blast the surface to achieve an SSPC SP-5-63 (S.S.S. a3, White Metal Blast) with a minimum of 2.5 mil anchor profile. It may be preferable to conduct a preliminary blast of the internal surface for inspection purposes.

f) If the relative air humidity in the tank is greater than 85%, abrasive blasting should not be performed. Also, grit blasting operations must not be conducted when the surface is less than 5°F above the dew point.

g) Maintain a minimum of 90 psig air pressure during abrasive blasting operations. A minimum of 18 mesh-grit or 12/40 blasting media shall be used to obtain the proper anchor profile. Use separators and traps to remove oil and water from the compressed air utilized to operate the blasting equipment.

h) Following completion of the abrasive blasting operation, the entire interior surface shall be vacuumed and/or cleaned with a fine brush or broom and blown with compressed air.

i) The surface shall be lined within eight (8) hours after blasting and before any visible rusting occurs.

# Part III TANK INSPECTION AND STRUCTURAL ASSESSMENT

**3.1** Visual inspection of the tanks interior surface shall be conducted to determine if the tank is suitable for lining. Throughout the inspection procedure, monitor vapor readings to ensure a safe working environment.



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**3.2** During the inspection, the extent of any internal and/or external corrosion should be determined. Suspected areas of severe corrosion and other randomly selected areas within the tank should be tested to determine the structural integrity of the steel shell. Uniform corrosion may be difficult to detect and may require the use of ultrasonic techniques in addition to the ballpeen hammer technique to ensure metal thickness of at least 1/8".

**3.3** Ultrasonic thickness gauging may be required to determine the structural integrity of an underground steel tank. Personnel performing this procedure shall be trained and certified in Non-Destructive Testing, Level I, as specified by the American Society for Non-Destructive Testing, Recommended Practice SNT-TC-1A.

**3.4** A brass ballpeen hammer can be used to tap the tank shell and sound for thin areas. If a thin area is detected, the metal should be holed with the hammer or a drill to determine metal thickness. Remove the thin metal areas until a minimum metal thickness at the edge of the hole of 1/8" is obtained. This method has commonly been used for the inspection of underground tanks since corrosion typically results in pitting rather than deterioration over the surface area.

**3.5** Criteria used to determine if the tank qualifies for internal lining requires an assessment of the structural soundness of the tank. This can be accomplished by visually inspecting the tank for the number and size of any perforations in the tank walls.

**3.6** The following guidelines shall be used to determine if a tank may be lined:

a) A tank having a perforation no larger than 1-1/2 inches in diameter, except under gauge opening where the perforation may be no larger than 2½ inches in diameter.

b) A tank with less than five (5) perforations (none larger than 1-1/2 inches in diameter) in any one square foot area.

c) A tank with less than twenty (20) perforations (none larger than 1/2 inch in diameter) in a 500 square foot area.

**3.7** Perforations to be repaired shall be reamed until the metal thickness at the edges of the hole is a minimum of 1/8 inch thick.

**3.8** Tanks that exceed any of the above criteria shall not be internally lined unless approved by an authority having jurisdiction.

## Part IV TANK REPAIRS

**4.1** Perforations and split seams can be permanently repaired by either welding and/or by sealing the perforated area with a reinforced epoxy laminate patch.

**4.2 Weld Repairs**

a) Plates may be welded to the interior tank shell walls over perforated areas in order to maintain compliance with the perforation criteria specified in Section II, Part 3.5. Welding may also be used to repair breaks or splits in the seams.

b) Welding operations must be performed after the tank has been abrasive blasted to white metal. If welding is necessary on a lined tank, the lining should be removed at least six (6) inches in all directions from the area to be welded.

c) Testing of flammable vapor and oxygen concentrations shall continue throughout the entire welding operation. Vapor monitoring shall be within three (3) feet of where the welding is being performed.

d) Respiratory protection shall be worn by all personnel in the tank. An exhaust hood shall be used to control fumes generated during welding. Hoods shall be within twelve (12) inches of the area being welded and shall maintain a minimum velocity of 200 cubic feet per minute to remove all smoke, vapors, and flammable substances generated during the welding operation. In addition, an eductor shall be used to provide continuous ventilation in accordance with Section II, Part 1.8b.

e) Weld repairs of perforations shall be by continuous welding of the steel plate(s) edges to the existing tank wall. The plates shall overlap the perforation(s) by at least one (1) inch. Steel plates used for weld repairs shall be equal or greater than the original tank metal thickness and match the contour of the tank wall.

f) Seams or joint repairs shall be continuously welded.

**4.3 Plug Repairs**

a) Perforated areas to be sealed with boiler plugs and/or hydraulic cement shall be abrasive blasted to white metal around repair area at least twelve (12) inches in all directions. Hydraulic cement shall not overlap the perforation(s) by more than two (2) inches or protrude from the tanks interior surface by more than two (2) inches.

b) Boiler plug(s) and/or hydraulic cement shall be covered with a Glass Armor lining repair resin and silane treated fiberglass cloth with a minimum weight of four (4) ounces per foot. The fiberglass cloth and lining resin shall overlap all edges of the boiler plug(s) by a minimum of five (5) inches in all directions.

c) For perforations exceeding 3/4 inches but less than 1½ inches, it is recommended that a 6" x 6" steel plate be installed over the plug and bonded to the tank wall with

Glass Armor epoxy compounds. A laminate of epoxy and fiberglass cloth shall cover the plate by a minimum of five (5) inches in all directions. Work the lining resin into the fiberglass cloth until the cloth is free of any entrapped air.

### 4.4 Re-coatability and Re-lining

a) To re-line a tank that has been previously lined with Glass Armor products, or to re-line an area of the tank that does not meet minimum thickness requirements or has pinholes or voids, it will be necessary to brush blast or grind the affected area to obtain a suitable anchor profile or pattern. Depending upon the size of the affected area, either spray apply or trowel the lining material or patching compound to obtain the proper thickness or to cover any discontinuities. Consult Bridgeport Chemical for additional information.

## Part V GA 27 PRODUCT INFORMATION

**MATERIAL**: 100% solids, epoxy resin with proprietary curing agents
Two component system: Resin and Activator

**RECOMMENDED THICKNESS**: 100 mils minimum, 125 mils nominal

**MIXING PROCEDURE**: Mix 2 parts (by weight) of Glass Armor 27 Resin with 1 part (by weight) Glass Armor 27 Activator.

**VISCOSITY**: Thixotropic

**POT LIFE**: 8 - 10 minutes at 95°F

**COLOR**: Light Blue

**COVERAGE** (actual): @ 100 mils - 55 square feet per unit
@ 125 mils - 42 square feet per unit

**DRYING TIME**: To Touch - 4 hours at 77°F
To Handle - 6 hours at 77°F

**CURING**: Ten to twelve (10-12) hours 77°F and/or until a minimum Barcol Hardness of 65 is obtained. Cure time may be accelerated by force curing with heated air using an approved indirect fired heater with a minimum rating of 300,000 BTU's per hour.

**EQUIPMENT REQUIREMENTS**: Plural Component Proportioning System similar to a Graco Hydra-Cat. Consult Bridgeport Chemical for equipment recommendations. OPTIONAL: Heavy duty



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industrial airless spray system similar to a Graco 45:1 King or Bulldog pump.

**5.2 Chemical Properties** (films cured for seven (7) days at 77°F are unaffected by the following products after one (1) year immersion at 77°F):

| REAGENT | VISIBLE EFFECTS |
|---|---|
| Alcohol, Ethyl (Ethanol)* | No Effect |
| Alcohol, Isopropyl* | No Effect |
| Alcohol, Methyl (Methanol)* | No Effect |
| Alcohol, Propyl | No Effect |
| ASTM Reference Fuels A & C | No Effect |
| Benzene | No Effect |
| Diesel Fuel | No Effect |
| Ethanol/Gasoline Blends* | No Effect |
| Ethyl Tertiary Butyl Ether (ETBE) | No Effect |
| Gasohol (15% EToH or MEoH) | No Effect |
| Gasoline, Aviation | No Effect |
| Gasoline, Leaded | No Effect |
| Gasoline, Unleaded | No Effect |
| Gasoline, Oxygenated (15% MTBE or TBA) | No Effect |
| Jet Fuel (Jet A, JP4 and JP5) | No Effect |
| Kerosene | No Effect |
| Methanol/Gasoline Blends* | No Effect |
| Methyl Tertiary Butyl Ether (MTBE) | No Effect |
| Mineral Spirits | No Effect |
| Oil, Fuel | No Effect |
| Oil, Heating | No Effect |
| Oil, Lubricating | No Effect |
| Sodium Chloride (5%) | No Effect |
| Sodium Hydroxide (20%) | No Effect |
| Sulfuric Acid (10%) | No Effect |
| Tertiary Butyl Alcohol (TBA) | No Effect |
| Toluene | No Effect |
| Water, Distilled | No Effect |
| Xylene | No Effect |

* GA27P only

For a more comprehensive listing or to select a lining system for specific corrosion problems or immersion conditions, consult our Product Resistance Data Guide or call for technical assistance.

## Part VI APPLICATION OF GLASS ARMOR EPOXY LININGS



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**6.1** Prior to the application of the lining material, inspect the surface to ensure that a SSPC SP-5 "white metal" finish has been obtained. Check for a gray white uniform color with a minimum 2.5-3.0 mil anchor profile. The surface shall be free of any visible dust, dirt, oil, grease, rust, scale, or other foreign matter.

**6.2** All personnel involved in the handling, mixing and application of Glass Armor products shall be knowledgeable of Bridgeport Chemical procedures for the safe use of epoxy resin compounds. Material Safety Data Sheets (MSDS) shall be available on site for all Glass Armor products used during the tank lining process. MSDS's shall also be available for solvents and other potentially hazardous products used during the operation.

**6.3** Plural component spray, Graco 56:1 Xtreme Mix or equivalent, is generally the preferred method of application. However, equipment recommendation may vary from job to job. Contact Bridgeport Chemical or their authorized distributor for specific equipment recommendations. Non-plural airless spray systems may be used, however, due to the short pot life and thixotropic nature of the lining material Bridgeport Chemical or their authorized Distributor should be contacted for specific application instructions.

**6.4** Use heated product tanks with Resin heated to 125ºF and Activator heated to 135ºF with constant agitation.

**6.5** Once heated and ready use approximately 3000 PSI to spray using 50 FT. 1/2 inch diameter hoses to mixer and 10 to 15 FT 3/8 inch whip hose spray using .035 tip size.

**6.6** One unit of product will cover approximately 36 square feet at 125 mils. It may be necessary to mark off quadrants in 36 sq. ft. sections to obtain the proper coverage at the desired thickness.

**6.7 Installation of Steel Reinforcing Plate**

a) A ¼" steel reinforcing plate, rolled to the contour of the tank, and with minimum dimensions of 8" x 8" shall be installed under the fill (drop) pipe and gauging tube.

b) The plate shall be attached in place during the initial spray application of the lining material. Spray apply a minimum of 60 mils of Glass Armor 27G in the designated area underneath the fill pipe. Set the plate in place and apply Glass Armor 27G to a minimum thickness of 100 mils to completely cover the plate and to extend a minimum of six (6) inches beyond the perimeter of the plate.

## Part VII CURING GLASS ARMOR LININGS

**7.1** Allow six hours curing time at 77°F and/or until a minimum Barcol Hardness of 65 is



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obtained. For tank temperatures less than 77°F, the time necessary to ensure a complete cure may exceed 24 hours and/or until a minimum Barcol hardness of 65 is obtained.

**7.2** To compensate for cold weather temperatures, it is recommended that the lining be force cured using an indirect-fired portable air heater. Heat the ambient air in the tank to 180-220°F with a minimum 300,000 BTU air heater. This can be accomplished by placing a flexible hose from the heater into the tank and directing the heated air to both ends of the tank. Force cure for a minimum of three (3) hours until a Barcol hardness reading of 65-70 is obtained.

**7.3** If a heater is used to accelerate the curing process eliminate any sources of flammable vapors in the work area.

## Part VIII TESTING THE LINING

**8.1** Once the lining material has been applied and properly cured, the following tests shall be performed:

a) Thickness - An Elcometer Thickness Gauge, Model III, Scale, range 8E (25-250 mils) shall be used to determine the lining thickness. Measurements should be taken at designated areas on the tank heads and walls. A minimum thickness of 100 mils and a nominal thickness of 125 mils is required.

b) Hardness - A Barcol Hardness Tester, Model GYZJ 935 shall be used to determine that the lining has cured to the proper hardness. Hardness readings should be a minimum of 65 gauge.

c) Holiday's - A Holiday Detector with Silicone Brush Electrode or a T-Tip Electrode (voltage range 10,000-12,500) shall be used to inspect the tank for air pockets, pinholes, and/or holidays.

**8.2** Pinholes and holidays shall be repaired with Bridgeport Chemical Glass Armor 56P epoxy patching compound. Any other test failures require correction in accordance with Bridgeport Chemical recommended procedures (See Section 2, Part 4.4 for procedures to repair or re-line a tank that has been previously lined with Glass Armor products).

## Part IX INSPECTION AND COMPLIANCE

**9.1** The tank owner or a designated employee of the tank owner should be available to witness the tank condition, sandblasted surface, lining, and tank tightness test. It is recommended that the tank owner or the owners designated employee or agent attest that all work has been performed in accordance with recognized industry standards

such as API-1631 (See Section 1, Part III).

**9.2** It is the responsibility of the tank owner to determine that the lined tank(s) meets all Federal and/or State requirements for a valid upgrade.

**9.3** The tank lining installer shall complete a tank lining compliance report to certify that the tank meets the criteria for structural integrity, proper surface preparation and lining application (See Appendix B).

## Part X CLOSING AND SEALING THE TANK MANWAY

**10.1** If an opening has been cut into the tank, a steel cover plate rolled to the contour of the tank shall be used to seal the tank. The cover plate shall be made to overlap the access opening at least two (2) inches on each side. The cover plate shall have a minimum thickness of 1/4 inch steel.

**10.2** The steel cover plate shall be constructed with 3/4 inch diameter holes along the perimeter. The holes shall be located a minimum of 1 inch from perimeter and should be spaced no more than five (5) inches apart around the perimeter (See figure 3).

**10.3** Using the cover plate as a template, drill holes through the tank a minimum of one (1) inch from the perimeter tank access opening.

**10.4** Abrasive blast the cover plate on both sides. The tank shell exterior shall also be abrasive blasted in the area that will be under the cover plate and a minimum of six (6) inches from the perimeter of the cover plate.

**10.5** Seal the cover plate to the exterior tank shell using Bridgeport Chemical Glass Armor 56P epoxy patching compound. Before the patching compound cures, fasten the cover plate to the tank with 1/2 inch diameter by 1-1/2 inch long bolts. Place the bolt shafts through the holes from the inside of the tank and hold in place by spring clips placed between the cover, plate and the tank shell (See figure 4). An optional method for sealing the cover plate using self-tapping bolts may also be used (See figure 5).

**10.6** Bolt the cover plate to the tank. Using Glass Armor 56P epoxy patching compound, seal the area around the cover plate a minimum of four (4) inches in all directions from the perimeter of the cover plate.

**10.7** Before the tank excavation area is backfilled, the cover plate and seal shall be tightness tested using a soap solution and air pressure. Apply the soap solution over the entire cover plate area and pressurize the tank with a maximum five (5) psig of air. Inspect the cover plate area and seals for bubbles.



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## SECTION 3 INTERNAL LINING AND REPAIR OF FIBERGLASS UNDERGROUND STORAGE TANKS

### PART I GENERAL SAFETY REQUIREMENTS

**1.1** The safety requirements for the repair and internal lining of fiberglass underground storage tanks are the same as the safety requirements for lining steel underground storage tanks.

**1.2** All applicable permits, personnel training requirements, equipment requirements, tank isolation and vapor-freeing procedures, and tank entry precautions discussed in Sections 1 and 2 of this specification must be adhered to when lining fiberglass tanks.

### PART II CUTTING AN ENTRY INTO A FIBERGLASS STORAGE TANK

**2.1** Entry into fiberglass tanks not equipped with a manway shall be through the head of the tank.

**2.2** Prior to cutting into the tank, the head of the tank must be exposed and the excavation area properly shored. A working area of 5 square feet must be available.

**2.3** The first cut shall be made at least 5 inches and no more than 12 inches from the rib. The opening must be a minimum of 18 inches square.

**2.4** Bevel cut the entryway to prevent the cut-out section from falling into the tank. Use an air-driven saber saw or other non-sparking tools to eliminate potential ignition sources.

### PART III INTERNAL INSPECTION AND EVALUATION

**3.1** Fiberglass tanks can be repaired and internally lined using procedures similar to those used for steel tanks. The tank shall be checked for damage, signs of structural failure, chemical attack of the gel coat, cracks, holes, wall buckling, bottom flattening, and leakage around the seams where the walls are joined.

**3.2** To monitor the structural and operational life of a fiberglass tank, the tank must be inspected and tested.

**3.3** Inspection testing of a fiberglass tank for structural soundness may include a vacuum test established from the Underwriters Laboratories Standard 1316, and measurement of the interior tank wall diameter to determine the structural deflection limits.

**3.4** The visual internal inspection of fiberglass tank walls shall determine any signs of

damage or structural failure, the existence and extent of chemical attack to the tank walls, cracks, holes, delamination, leakage around the seams, and wall buckling or flattening:

a) To visually inspect a fiberglass tank for chemical attack, holes and cracks, the entire interior surface shall thoroughly cleaned with soap and water and then completely dried.

b) The interior surface shall be vigorously rubbed with a rag containing graphite powder.

c) The graphite will adhere to cracks, stressed areas and holes that are not visibly noticeable. Any holes or cracks shall be repaired.

**3.5** Chemical attack can occur on the interior surfaces of fiberglass tanks when the product stored is not compatible with the resin used in the manufacturing of the tank. When this occurs, the tank walls develop excessive hairline cracks and the gel coat begins to soften.

## PART IV SURFACE PREPARATION OF FIBERGLASS TANKS

**4.1** The procedure for abrasive blasting of fiberglass tanks is similar to the method outlined for steel tanks.

**4.2** Fiberglass tanks shall be abrasive blasted to obtain a minimum 1.5 to 2.0 mil anchor profile pattern or ground until fibrous material is fully exposed.

**4.3** Upon completion of the abrasive blasting or grinding operation, the entire surface area shall be brushed, blown with compressed air, and vacuumed.

**4.4** A steel reinforcing plate shall be installed under the fill pipe in the same manner employed when lining or repairing steel tanks.

## PART V REPAIR OF FIBERGLASS TANKS

**5.1** Repairs to seams, cracks and holes, but not including buckling or flattening, shall include a minimum thickness of glass cloth and resin equal to the tank wall thickness.

**5.2** Fiberglass cloth and resin repair material shall include layers of 5 or 6 ounce fiberglass cloth or 24 ounce woven roving.

**5.3** Fiberglass repairs must be rolled out to remove air bubbles and shall not have any

exposed glass ends or unbonded edges.

**5.4** The fiberglass repair material shall overlap all sides of the perforation by a minimum of 6 inches.

**5.5** When a seam leak is suspected, all of the interior seams shall be abrasive blasted or ground until fibrous material is fully exposed, troweled smooth, and repaired as described above.

**5.6** All repairs must be completed prior to the lining of the tank.

**5.7** When a fiberglass tank is more than 1% but less than 2% out round, the tank must be structurally reinforced with a lining material that has a minimum of 30% fiberglass reinforcement with one or more of the following: reinforcing mats, continuous strand (used with a fiberglass chopper), fabric ply construction woven roving or any combination thereof. The material property of the fiberglass and resin shall have a minimum flexural strength of 27,000 psi.

## PART VI INTERNAL LINING OF FIBERGLASS TANKS

**6.1** The manufacturers instructions and safety precautions shall be followed during the handling and mixing of lining compounds, and shall be applied to the entire interior surface of the tank following the specified method of application.

**6.2** Internal linings shall be a minimum of 100 mils thick and a nominal thickness of 125 mils or greater.

**6.3** The lining shall be cured thoroughly according to the manufacturer specifications and tested to determine hardness and thickness.

## PART VII CLOSING THE ENTRY ON FIBERGLASS TANKS

**7.1** After the interior work is completed, the cut out section of the tank dome and a minimum 6 inches of the adjoining tank wall surface shall be abrasive blasted or ground until all fibrous material is fully exposed.

**7.2** All cut edges on the tank and the cut out section shall be sealed with the tank lining material prior to replacement of the section in the tank.

**7.3** The entry area shall be closed by replacing the cut out section that was previously removed.



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**7.4** The seams of the entry area and cut out section shall be reinforced by application of five layers of 1.5 ounce matting saturated with lining material followed by the application of 34 ounce fiberglass woven roving and lining material. The reinforcing cloth shall be tested with silane to insure compatibility with the lining material.

**7.5** After each application of fiberglass matting the area should rolled to remove any entrapped air bubbles.

## PART VIII FINAL TEST

**8.1** After all work has been completed, the tank must be tested to ensure that it is leak-free.

**8.2** Pressurize the tank with 5 PSIG (Use 3 PSIG for tanks over ten feet in diameter).

**8.3** The test pressure shall hold, without fluctuation, for a period of 1 hour.

## SPECIAL NOTES

The information and recommendations contained in this specification is to the best of our knowledge and belief accurate. However, since the conditions of handling and use are beyond our control, Bridgeport Chemical makes no guarantee of results, and assumes no liability for damages incurred by the use of this product. The applicator assumes all responsibility for the selection of Glass Armor products for coating the interior of tanks, for the safety in the application of any such products, for the fitness of such products for any such application including the durability and safety of any such product, and the Applicator shall indemnify and hold Bridgeport Chemical harmless from any claim, action, damage or liability asserted by any third party against Bridgeport Chemical because of any Bridgeport Chemical product used by the Applicator. The Applicator shall maintain sufficient insurance coverage to hold Bridgeport Chemical harmless under this indemnity.

January 10, 2006



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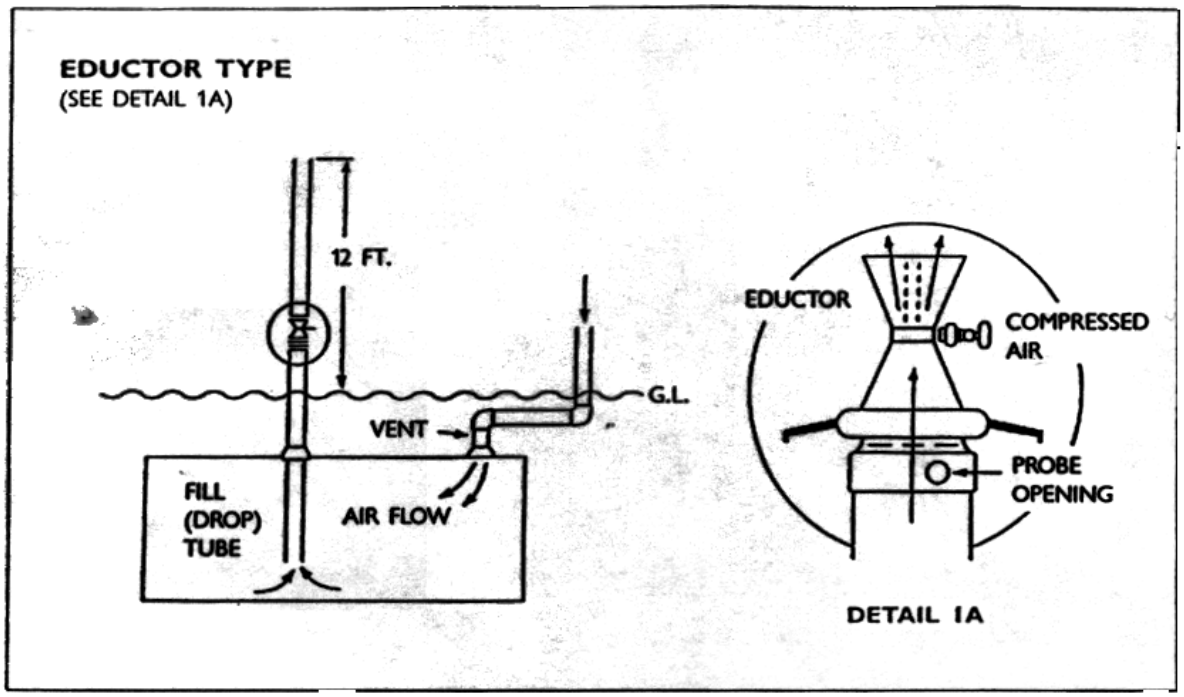


Figure 1 – Eductor-Type Air Mover

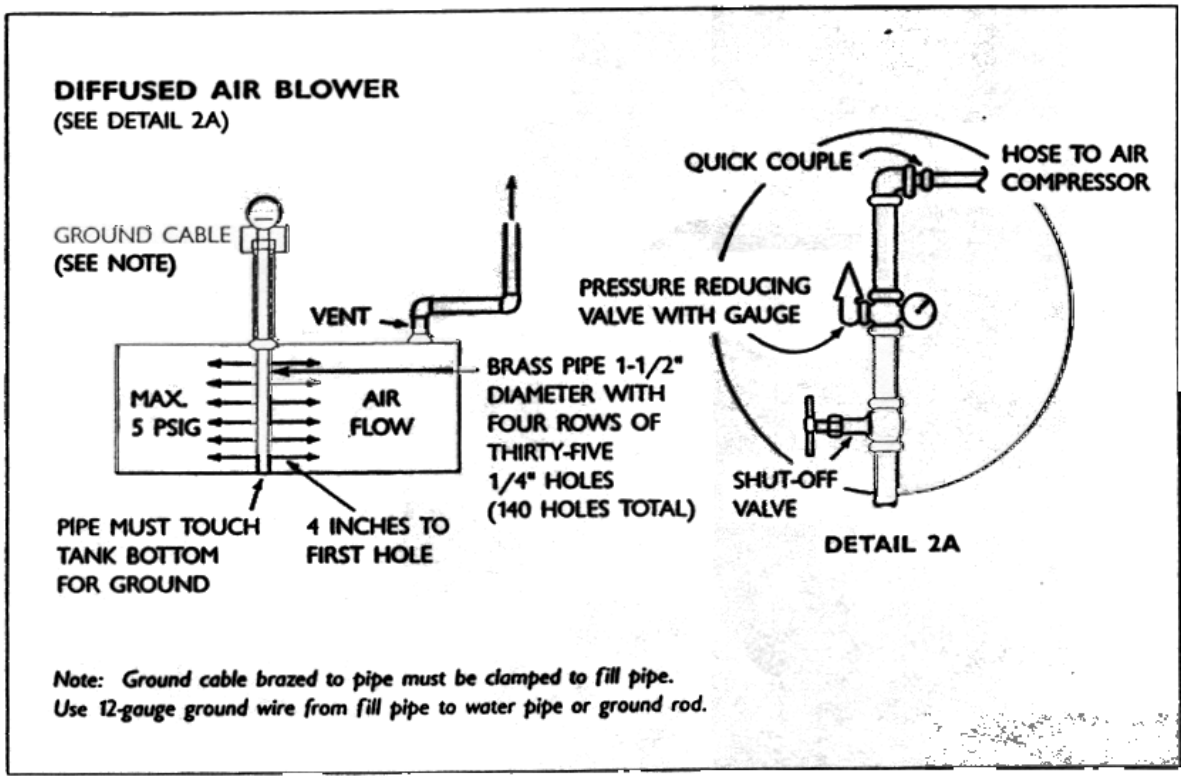


Figure 2 – Diffused Air Blower

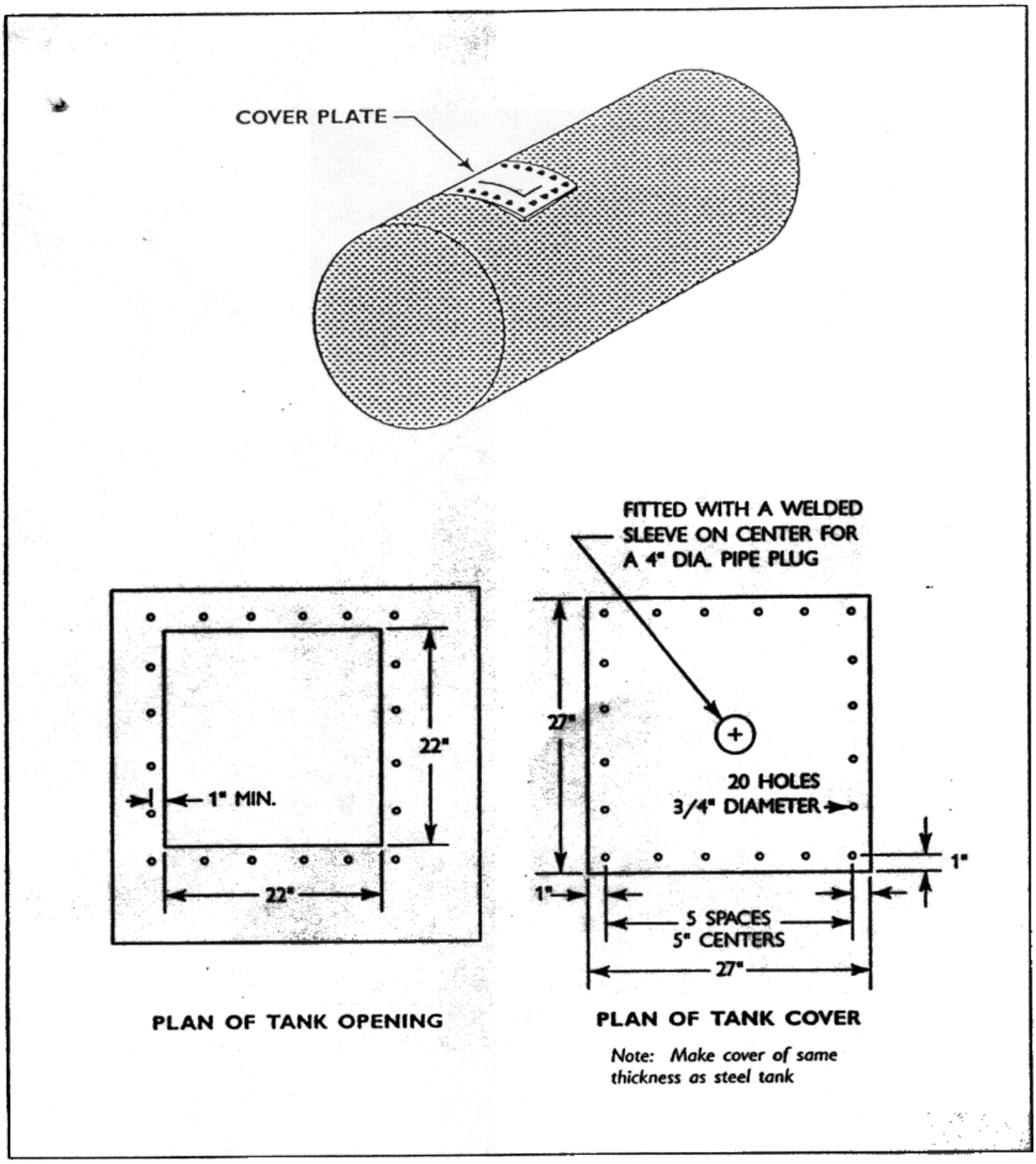


**Figure 3 – Method for Installation of Tank Cover Plate**

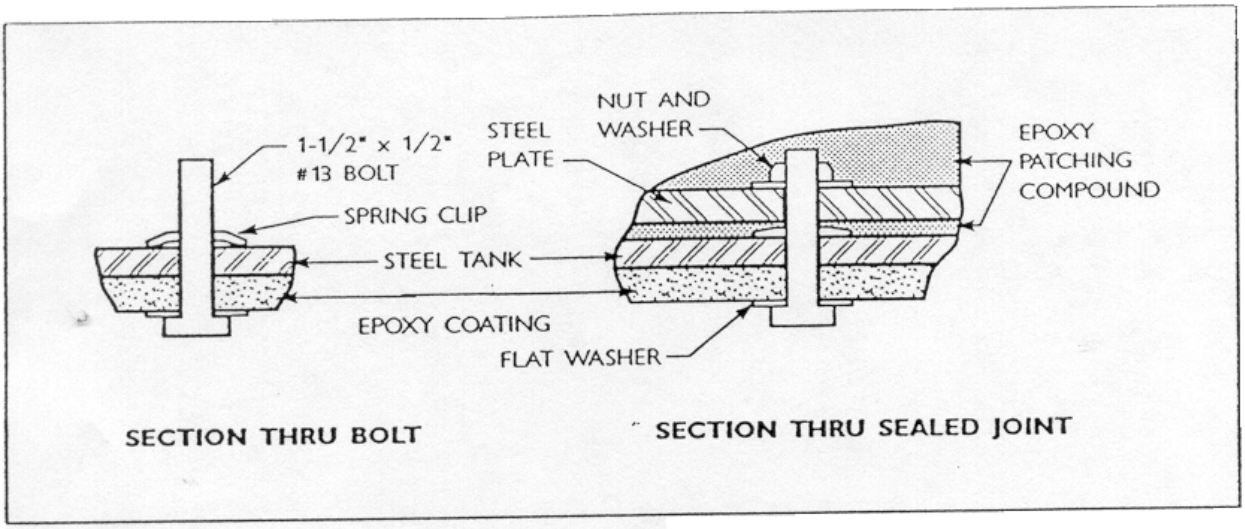


Figure 4 – Cover Plate Installation Detail

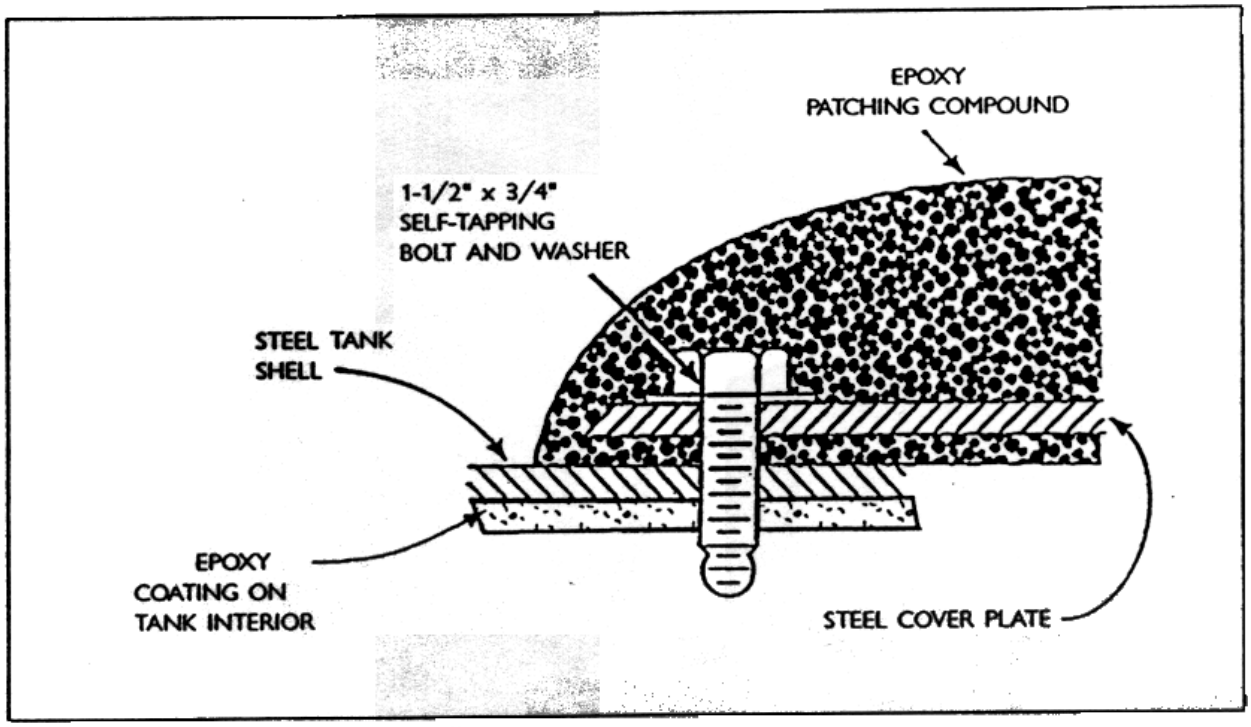


**Figure 5 – Alternate Cover Plate Installation Detail**