

## ACKNOWLEDGMENTS:

It takes a great deal of time and effort to put together a manual of this nature. The author would like to thank the many professionals who helped make this manual possible. for their generous contributions and support, special thanks are due to Messrs.:

Allan Hughes of Du Pont  
Robert Moore of United Engineers and Constructors  
Lee Boutelle of Gulf Corrosion Control Services  
Ernest Kletchka of Alyeska Pipeline Service Company

And to Ms. Tricia Cleary and Jeannie Suchy for their effort and patience.

---

## Manual Copyright

This manual is copyrighted and all rights are reserved for Cortec Corporation. This document may not, in whole or part, be copied, photocopied, reproduced, translated or reduced to any electronic medium or machine readable without prior consent in writing from the Cortec Corporation.

## Table of Contents

Chapter 1		
Introduction		Page 1
1. Purpose		Page 1
2. General: Corrosion Preventive Classes		Page 2
3. Safety		Page 2
4. Description of Corrosion Preventive Classes		Page 3
Chart #1: Corrosion Preventive Classes		Page 7A
Equipment Index (by equipment name)		Page 7B
Chapter 2		
Protective Storage of Processing Equipment		Page 8
Chapter 3		
Laying-up Power Equipment		Page 26
Chapter 4		
Protective Storage of New Equipment		Page 40
Chapter 5		
Protective field Storage of Pipelines and Drilling Equipment		Page 58
Chapter 6		
Diagrams: Equipment and Process Systems		Page 97A
Charts: Corrosion Preventive Selection		
#2: Ferrous Metals		
#3: Non-ferrous Metals		
#4: Ferrous and Non-Ferrous Metals		
Chapter 7		
Detailed Application and Removal Procedures for Corrosion Preventives		Page 99
Chapter 8		
Application Equipment and Product Sources		Page 110
Appendix 1		Page 111

## Chapter 1

### INTRODUCTION

#### 1. PURPOSE.

The purpose of this Corrosion Protection Manual is to save you time.

This manual provides systematic and documented procedures for temporary protection, lay-up and mothballing of equipment, systems and plants. You will find it organized for easy use and fast referencing by the classes of equipment you want to protect.

You can easily find the exact procedural steps to use for equipment that is brand new, in operation, ready for storage or ready to be put back into service.

In the past, temporary corrosion protection, lay-up or mothballing was seldom needed. Today, the opposite is true. Production capacity may be at 80% one day, at 50% six months later and then at 90% in two years. Although these capacity shifts can sometimes be anticipated, they are generally due to governmental or market events beyond a company's control. During these fluctuations, it generally makes good economic sense to place equipment in protective storage and then bring it back into service when it's needed. The equipment to be placed in protective storage is expensive, complex and requires several procedural steps to safeguard this capital investment. The task is multiplied for storing a system, production line or entire plant. To ensure the job is done properly involves a significant amount of research, because the protection must be effective, whether the length of storage is for 90 days or 5 years.

As a leader in the field of corrosion prevention for protective storage, CORTEC encountered this massive informational problem when helping companies store entire systems, production lines and plants. This manual helps you solve many of these difficulties. It provides systematic, documented procedures with detailed steps; procedures that are easily referenced and accessed by the name of each piece of equipment. These procedures have been used with major clients in each segment discussed in this manual.

CORTEC's system employs the most effective and latest technology in corrosion prevention for protective storage. In technical terms, the system is based on "temporary" corrosion inhibitors -- inhibitors that can easily be removed while providing extended protection for indoor or outdoor storage of both exterior and interior surfaces of equipment for predetermined time intervals.

Wherever practical, the system uses CORTEC's proprietary Vapor Corrosion Technology. These corrosion preventives have proven to be the most cost effective and reliable method of protection for interior surfaces. They allow very fast application, minimum maintenance during equipment storage, and very little work in removal -- a critical time and cost factor when returning equipment to service. Overall, they allow a significant reduction in costs compared to older, conventional methods.

Vapor Corrosion Inhibitors (VCI's) show significant differences in their mechanism of reaching the metal surface compared to direct contact inhibitors. Contact inhibitors only work by being directly applied to the surface. Vapor Corrosion Inhibitors do not need direct application to function; they protect by "vaporizing". During application, the VCI is dispersed or dispensed within the appropriate vicinity of the metal surface being protected. The VCI then vaporizes, migrating wherever corrosive agents or humidity can penetrate. The VCI then condenses and adsorbs on all metal surfaces, including recessed and hard-to-reach areas. VCI protection is effective as long as the space is enclosed in some fashion, as in electronic and electrical control housings or wrapped in plastic packages. Within reasonable limits, the VCI provides self-replenishing protection. Compared to the laborious process of spray coating the tank interior, VCI treatment is usually much faster and far more economical. To protect the interior of a large tank is now simple. Fog it with VCI; the VCI vaporizes and adsorbs on the interior surfaces; seal the tank -- It's protected. These same advantages apply to nearly all products and systems with interior spaces.

CORTEC VCIs can be applied as powder by fogging, in liquid systems by using water, solvent, or petroleum distillates as the carrier, as additives to boost corrosion inhibition of oils, a variety of plastic wraps for large and small products, or in breathable foam capsules for electronic applications. The wide array of CORTEC VCIs allows a systematic approach to corrosion prevention for the entire plant without sacrificing performance.

## 2. GENERAL: CORROSION PREVENTION CLASSES.

- 2.1 A CORTEC classification system has been established to specify and group corrosion preventives. Chart 1, Corrosion Prevention Classification System, lists ten general classes with their specific corresponding products which cover the majority of applications.
- 2.2 Instructions to apply these materials can be found by using the Table of Contents to reference the specific type of equipment by each application category: Protective Storage of Processing Equipment, Laying-Up Power Equipment, Protective Field Storage of New Equipment, Protective Storage of Pipelines and Drilling Equipment.

Brief application instructions for each class of corrosion preventive can be found in Chapter 8.

Detailed application instructions for each corrosion preventive can be found in Chapter 7: Methods of Application and Removal.

## 3. SAFETY.

- 3.1 Corrosion Preventives Class I through Class VIII must not be used on equipment which will be exposed to chlorine. Products must be hydrogen-free since chlorine, acting as an oxidizing agent, may react violently with hydrocarbon-based materials. In addition, a corrosive acid (HCl) may be formed. Class IX is the only corrosion preventive recommended for chlorine exposure (See Class IX: 4.9.1).

3.2 Corrosion Preventives Class VI - VCI Crystals and Powders, Class VII - VCI Wraps, and Class VIII - VCI Capsules can be obtained either as amine nitrite or amine carboxylate based material.

3.2.1 Nitrite based materials are combustible and sometimes explosive when heated in a confined space. Do not expose to flame or heat the outside of pipe or vessel containing the material. Before welding or heating equipment for any reason, thoroughly blow out VCI using dry air or wash out with water.

3.2.2 Nitrite based materials are also moderately toxic. Adequate workplace precautions to minimize exposure should be maintained. Aerosols should be tagged to warn personnel of these hazards.

3.2.3 The appropriate safety devices and methods should be used to protect personnel as specified in the Material Safety Data Sheet for each corrosion preventive product.

4. DESCRIPTIONS OF CORROSION PREVENTIVE CLASSES.

4.1 CLASS I - VCI THIN FILM.

4.1.1 DESCRIPTION. CLASS I is a vapor corrosion inhibitor that is supplied in solution using either solvent or water as the liquid carrier. After application the carrier evaporates, leaving a thin film. This film may or may not have to be removed prior to equipment use.

4.1.2 HOW APPLIED. Brush, dip or spray.

4.1.3 RECOMMENDED ENVIRONMENTAL LIMITATION. For indoor storage of machined metal parts.

4.1.4 PROTECTION PERIOD. Up to twelve months depending upon storage conditions (See Table 1).

4.2 CLASS II - GREASE.

4.2.1 DESCRIPTION. CLASS II material is a grease containing a corrosion inhibitor. It is intended for storage protection of antifriction bearings, pillowblocks or plain bearing assemblies. If the grease is waterfree and not discolored at the end of the storage period, the bearing may be put into service using the remaining grease for initial lubrication.

4.2.2 HOW APPLIED. Grease gun or by hand.

4.2.3 RECOMMENDED ENVIRONMENTAL LIMITATION. For indoor or sheltered outdoor storage.

4.2.4 PROTECTION PERIOD. Up to 24 months depending upon storage conditions (See Table 1).

4.3 CLASS III - VCI ANTI-CORROSION GREASE.

4.3.1 DESCRIPTION. CLASS III is a petroleum-based material containing vapor corrosion inhibitor. It provides outdoor protection while maintaining self-healing properties of the protective film. The coating will not crack or peel off due to thermal expansion/contraction of the metal. The coating can be removed easily even after prolonged exposure to field conditions.

4.3.2 HOW APPLIED. Brush, dip or spray.

4.3.3 RECOMMENDED ENVIRONMENTAL LIMITATION. For indoor, sheltered outdoor or unsheltered outdoor storage.

4.3.4 PROTECTION PERIOD. Up to 36 months depending upon storage conditions (See Table 1). In addition, the material can be used for intermediate protection, between the time a more permanent (Class IV) protective coating has just been removed and the time that the part is placed into operation.

4.4 CLASS IV - VCI DRY COATING.

4.4.1 PROTECTION PERIOD. Up to 48 months depending upon film thickness and storage conditions DESCRIPTION. CLASS IV is a combination of vapor and contact corrosion inhibitors that are supplied as a ready-to-use coating or in concentrate form that is then diluted with a solvent carrier. After application the carrier evaporates, leaving the residual film which is relatively hard and feels dry to the touch. Protection depends upon the thickness of the film and the integrity of the coating.

These materials are removed by steam cleaning, solvent wash or hot alkaline cleaners.

4.4.2. HOW APPLIED. Brush, dip or spray.

4.4.3 RECOMMENDED ENVIRONMENTAL LIMITATION. For indoor, sheltered outdoor and unsheltered outdoor storage. (See Table 1).

4.5 CLASS V - VCI FLUIDS.

4.5.1 DESCRIPTION. CLASS V - Vapor corrosion inhibitor fluids are petroleum distillates containing VCI compounds. The material produces a vapor that forms an adsorbed ionic layer on internal metallic surfaces. CLASS V materials can be used for internal surfaces of bearing housings, hydraulic systems, circulating oil systems, turbines, pumps, compressors, gear casings, housings, vessels and similar equipment.

- 4.5.2 HOW APPLIED. Fill equipment with VCI Fluid diluted with operating oil according to specific recommendations (usually 100%). Run equipment long enough to get full circulation. If practical, drain the VCI Fluid and seal all openings. Large vessels can be protected by fogging or coating the internal surfaces and then sealing all openings. For fogging, use the specific recommended rate depending upon volume of enclosed space.

In all situations, openings should be sealed to minimize breathing. Excessive vaporization and loss of protection will occur above 150°F (66°C).

- 4.5.3 RECOMMENDED ENVIRONMENTAL LIMITATION. Exposure limitations depend upon the integrity of sealing. With tight sealing, CLASS V materials are effective for indoor, sheltered outdoor and unsheltered outdoor storage.

- 4.5.4 PROTECTION PERIOD. Indefinite with tight sealing.

#### 4.6 CLASS VI - VCI POWDERS.

- 4.6.1. DESCRIPTION. CLASS VI - Vapor corrosion inhibitor powders are self-vaporizing chemical compounds. When the vapors condense, a protective layer of molecular thickness is deposited. The protective film is so thin that usually the stored items can be placed in use without cleaning. CLASS VI materials are used to protect interior surfaces of heat exchangers, vessels, valves, tanks and similar equipment.

#### 4.6.2 HOW APPLIED.

- A. Powder must be dispersed within the space to be protected, allowing VCI vapors direct access to surfaces to be protected. It is necessary to achieve good uniform or near uniform distribution of VCI material with the enclosed space.
- B. For dry lay-up applications, fog the equipment to be protected with a predetermined amount of VCI material. The material is generally applied at a rate of 1 ounce per 1 cubic foot of enclosed space. Conventional sandblasting apparatus or similar devices are suitable for fogging or spraying these materials. **All** openings should then be tightly sealed.
- C. For wet lay-up applications, flush the interior surface with a 2 - 5% solution of VCI in water, alcohol or mixtures thereof. For solubility data on specific compounds or other solvents, consult manufacturer's specifications. The equipment should be drained and then all openings tightly sealed.

- 4.6.3 RECOMMENDED ENVIRONMENTAL LIMITATIONS.  
Exposure limitations depend upon the integrity of sealing. with tight sealing, CLASS VI materials are effective for indoor, sheltered outdoor and unsheltered outdoor storage.
- 4.6.4 PROTECTION PERIOD. Depends upon integrity of sealing and amount of VCI material used.
- 4.7 CLASS VII - VCI PLASTIC WRAP.
  - 4.7.1 DESCRIPTION. CLASS VII - Vapor corrosion inhibitor material is polyethylene film treated with VCI compounds. Small parts can be wrapped, inserted in pouches or bagged. Large equipment can be shrouded.
  - 4.7.2 HOW APPLIED. Use heat sealing or other suitable closure methods to maintain protective vapor concentration within the package. Do not package oiled parts or components containing polycarbonate plastics in nitrite treated wraps. Large equipment should be completely wrapped or shrouded to prevent entry of moisture or air to maintain the protective vapor concentration.
  - 4.7.3 RECOMMENDED EXPOSURE LIMITATION. For indoor storage.
  - 4.7.4 PROTECTION PERIOD. Up to 36 months depending on the integrity of the seal and thickness of the film (See Table 1).
- 4.8 CLASS VIII - VCI CAPSULES.
  - 4.8.1 DESCRIPTION. CLASS VIII breathable capsules are filled with vapor corrosion inhibitor powder. They allow vapor transmission into the space to be protected.
  - 4.8.2 HOW APPLIED. Remove from original sealed package and attach to the enclosure wall by using adhesive backing. Allow free access of VCI vapors to the metal surfaces to be protected. Then close enclosure, cover or seal openings. Do not use forced ventilation in enclosure or leave enclosure doors open during protective period.
  - 4.8.3 RECOMMENDED ENVIRONMENTAL LIMITATIONS. For indoor use when enclosed in non-ventilated equipment housings, control boxes or other enclosures.
  - 4.8.4 PROTECTION PERIOD. Up to 24 months depending on integrity of sealing (See Table 1).



4.9 CLASS IX - CHLOROFLUOROCARBON WAX.

4.9.1 DESCRIPTION. CLASS IX is chlorofluorocarbon wax dissolved in Freon 113 as a carrier. After application, the Freon evaporates leaving a waxy film. This film is inert to most chemicals and is used to protect parts intended for chlorine service sometime in the future, see SAFETY 3.1.

CLASS IX material should be stored at temperatures below 110°F (43°C) to prevent the wax film from melting.

4.9.2 HOW APPLIED. Brush, dip or spray. If sprayed, use bottled nitrogen to avoid moisture. Parts to be treated should be clean and dry.

4.9.3 RECOMMENDED ENVIRONMENTAL LIMITATION. For indoor, sheltered outdoor and unsheltered outdoor storage.

4.9.4 PROTECTION PERIOD. Up to 24 months outdoor, indefinite indoors (See Table 1).

4.10 CLASS X- DESICCANTS.

4.10.1 DESCRIPTION. CLASS X Desiccants are moisture-absorbing materials. They are used for interior equipment surfaces that must be kept free of all moisture. Desiccants can be obtained in granular form, as silica gel or activated alumina. They can be obtained with color indicators to denote useful life.

Activated alumina should be used where the desiccant may contact stainless steel surfaces. Silica gel contains chlorides which could lead to stress-corrosion cracking.

4.10.2 HOW APPLIED. The desiccant should be spread in a thin layer on a tray and then placed in the vessel to be protected. All equipment openings must then be tightly sealed. Typically desiccants are used at a rate of 50 lb. per 1,000 cubic feet (23 kg/28.3m<sup>3</sup>) of enclosed space. After treatment, periodically check color indicator or condition of desiccant and replenish as needed.

4.10.3 RECOMMENDED ENVIRONMENTAL LIMITATION. Depends upon the integrity of the sealing and amount of granules used (See Table 1).

4.10.4 PROTECTION PERIOD. Up to 6 months depending upon the amount of initial moisture present and effectiveness of sealing.

Class	I Thin Film	II Grease	III VCI Anti- corrosion	IV Hard Coating	V VCI Fluid	VI VCI Crystal	VII VCI Wrap	VIII VCI Capsule	IX CF Wax	X Desiccant
Use	Displace Moisture	Anti-friction Bearings	Exterior Surfaces	External Surfaces	Oil Reservoirs Crankcase, Sealed Internal Surfaces	Sealed Internal Surfaces	Spare Parts	Electrical, Electronic Instruments Enclosures	Internal Surfaces	Sealed Internal Surfaces
Type	Solvent or Water Carrier	Number 2 Grease	Self-heating Grease	Solvent or Water Carrier	Oil-based Fluid MIL-P- 46002A	Nitrite or Arine carboxylate Powder MIL- I-22110B	Paper or Plastic Film, Bags or Tubing	Foam or Plastic Capsules	Solvent Cutback	Granular Absorbent
Protective period, months, unsheltered outdoors	Not recommended	Not recommended	Over 12	24-48	Depends upon integrity of sealing. (Indefinite with tight sealing)	Depends upon integrity of sealing and amount of crystals used	Not recommended	Depends upon integrity of sealing. # of units used	1-12	Depends upon integrity of sealing and amount of granules used
Protective period months, sheltered outdoors	1-3	6-12	Over 24	24-48	Depends upon integrity of sealing. (indefinite with tight sealing)	Depends upon integrity of sealing and amount of crystals used	12-36	24	12-24	Depends upon integrity of sealing and amount of granules used
Protective period, months, indoors	6-12	12-24	Over 36	Over 48	Depends upon integrity of sealing. (Indefinite with tight sealing)	Depends upon integrity of sealing and amount of crystals used	12-36	24	Indefinite	Depends upon integrity of sealing and amount of granules used
	VCI-337 water based  VCI-238 solvent based	Grease  VCI-369 Cor-Lube	VCI-369 oil based concentrate  VCI-389 water based	VCI-365, 373 375, 383, 386 387, 389, 393	VCI-329 oil based concentrate  VCI-326 oil based concentrate	VCI-309 VCI-609 water soluble (Carboxylate type)  VCI-560 (Nitrite type)	VCI-125 static dissipative VCI-126* VCI-128 static shielding *Film/Bags	VCI-101 Device VCI-111 Emitter VCI-105 Emitter	Chlorofluoro Carbon wax	Desiccant

Table 1

## Classes of Rust Preventative Compounds

# Equipment Index

<u>Item</u>	Chapter 2	Chapter 3	Chapter 4	Chapter 5
	<u>Processing Equipment</u>	<u>Power Equipment</u>	<u>New Equipment</u>	<u>Pipelines Drilling Equipment</u>
Accumulator				26
Agitators	4			
Air Ejectors		14		
Annular Preventer				7
Automotive Components	14			
Batteries	10			
Bearings	3			
Bins	2			
Blowers			9	
Blower and Motor for Rotary Drive				5
Blower Unit				10
Boilers				
Waterside		3 & 4		
Fireside		5 & 6		
Bolts	6			
BOP Handling Systems				4
Brake and Cooling System				3
Bushings	3			
Centrifuges	4			
Columns	2		4	
Compressors	11		10	
compressor, AC				11
Compressor, Air				43
Condensers				
General	2			
Turbine Connected		14		
Condensing Unit				9
Cooling Towers	16			
Couplings	3			
Cranes				28
Crown Block				14
Deaerators		13		
Degasser				20
Derrick Shale Shker				16
Desander				44
Diesel Engines	12			
Draw Works				19
Drill Pipe and Collars				21
Drives	3		10	
Electrical	10		7	
Engines, Main				32
Engines, Gasoline	13			
Extinguisher, Chemical				12

# Equipment Index

<u>Item</u>	<u>Chapter 2</u> <u>Processing</u> <u>Equipment</u>	<u>Chapter 3</u> <u>Power</u> <u>Equipment</u>	<u>Chapter 4</u> <u>New</u> <u>Equipment</u>	<u>Chapter 5</u> <u>Pipelines</u> <u>Drilling</u> <u>Equipment</u>
Fans		11	9	
Fittings			3	
Flanges	9			
Fuel Oil Systems	17			
Gears	3			
Gear Boxes			11	
Generators		10		
Heat Exchangers		14	5	
Hook Block				25
Hydraulic Systems	5			
Instruments	8		8	
Insulation	9			
Lightin' Mud Agitator				31
Living Quarters				42
Lubricating Oil Systems	5			
Machined Surfaces	3			
Mechanical Equipment			12	
Mechanical Seals	4			
Mechanisms	6			
Mixers	4			
Motors		10		
Mud Cleaner				45
Mud Pump & Mud System				35
Pipes			3	
Pipelines				56
Pipeline Contingency Equipment				57
Piping				
General	9			
Power		15		
Preload Diesel	17			
Pressure Vessels			4	
Process Vessels	2			
Pump, Bilge				18
Pump, Deepwell				15
Pump, Desander				34
Pump, Diesel Fuel				18
Pump, Dirty Lube				18
Pump, Drillwater				18
Pump, Mud Cleaner				34
Pump, Potable Water				48
Pump, Preload				38
Pump, Sanitary				48
Pumps		12	6	
Ram Preventer				8

# Equipment Index

<u>Item</u>	<u>Chapter 2</u> <u>Processing</u> <u>Equipment</u>	<u>Chapter 3</u> <u>Power</u> <u>Equipment</u>	<u>Chapter 4</u> <u>New</u> <u>Equipment</u>	<u>Chapter 5</u> <u>Pipelines</u> <u>Drilling</u> <u>Equipment</u>
Receivers	2			
Rectifiers	10			
Refrigeration Machines		16		
Refrigeration Systems	15			
Reservoirs - Oil	5			
Rotary Table				40
SCR				49
Screws	6			
Sewage Treatment Plant				47
Shafting	3			
Sheaves	3			
Skidder Unit				29
Slant and Elevating System				30
Speed Changers			11	
Spinner				50
Spinning Wrench				51
Spring Slips				52
Sprockets	3			
Stacks	7			
Super Choke				46
Survival Capsule & Winch				53
Switch Gear	10			
Swivel				36
Tanks	2		4	
Tanks, Bulk				6
Tanks, Drill Water				22
Tanks, Fuel Oil/Purifier				23
Tanks, Potable Water				37
Tanks, Preload				39
Transformers	10			
Transmission, Rotary				41
Tuggers				24
Turbines		9		
V-Belts	3			
Valves	9		3	
Vaporizers		7		
Vessels	2			
Washing Machine				33
Watermarker, RO				13
Winch, Anchor				27
Wire Line Archer				54

## Chapter 2

### PROTECTIVE STORAGE OF PROCESSING EQUIPMENT

#### 1. SCOPE.

- 1.1 This standard outlines procedures to prevent equipment that has been in service from deteriorating during storage or extended shutdown.
- 1.2 The specific kind of equipment, the type of installation, or climate conditions may require more thorough consideration, with this standard serving as a guide. For capital intensive equipment, consult manufacturer for additional precautions.
- 1.3 Other chapters contain information which is pertinent. Refer to Table of Contents, and Equipment Index.

#### 2. PROCESS VESSELS AND TANKS.

- 2.1 Stainless Steel and Non-Ferrous Metals. Clean with either VCI-416 or VCI-419, dry and seal. If plant is located in marine atmosphere, coat all joints, crevices, etc. with 3 - 4 mils (75-100 microns) Class IV VCI Dry Coating. This provides a barrier against penetration of chlorides and water which can cause crevice corrosion.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

- 2.2 Carbon Steel.

- 2.2.1 Clean equipment prior to storage with VCI-416 or VCI-419, spray Class VI VCI Powder into vessel's interior. Apply powder with a sandblasting gun or suitable device for spraying powders (See Figure 2). Apply in a manner that assures uniform distribution within the interior. Use 30 grams VCI Powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume. Seal all openings and vents using caps and covers. For added protection, VCI powder can be used with a nitrogen purge.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

- 2.2.2 Fill small vessel with 40% anti-freeze/60% water solution containing 2.5% Class VI VCI Powder and 0.25% of S-5 Wetting Agent.

VCI-309, S-5 & anti-freeze/water solution

or

1% VCI-649 and anti-freeze/water solution

- 2.2.3 Leave catalyst in reactors and purge with inert gas: seal all openings. Class VI VCI Powder can be sprayed in the reactors (refer to application method in 2.2.1). It must be assured that the selected VCI compound will not have harmful effects on catalyst.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

- 2.2.4 Coat bolting with Class III VCI Grease.

VCI-369 or VCI-389 1-2 mils (25-50 microns)

- 2.2.5 Clean with VCI-416 or VCI 419 and then coat open flange faces with 3-4 mils (75-100 microns) Class IV VCI Dry Coating. If 2 applications are needed to achieve recommended film thickness, allow 2 hours drying time between coats.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

- 2.2.6 Clean and then coat bare surfaces of open bins with Class IV VCI Dry Coating following recommendations discussed in 2.2.5.

VCI-368, VCI-369, VCI-388 or VCI-389

- 2.3 Cover open flanges, pipe ends and other openings with 6 mils (150 microns) Class VII VCI Plastic Wrap. Where practical, fasten a blank flange over the VCI Plastic Wrap.

VCI-126 6 mil (150 microns)

- 2.4 Fuel oil tanks used outdoors and above ground should be kept filled with oil or water containing 0.5% Class VI VCI Powder, or for economic considerations, other suitable water treatment compound that can be demonstrated effective, stable, non-polluting and economical. Keep tanks partially filled to prevent damage from high winds.

0.5% VCI-309  
or  
2500 ppm VCI-649

Spray tank exterior and base with 3-4 mils (75-100 microns) Class IV VCI Dry Coating. Periodically inspect to ensure good condition throughout lay-up period.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

- 2.5 Water storage tanks should be cared for in the same manner as considered satisfactory during normal operation. Periodically inspect coatings on interior and exterior surfaces; repair if necessary.

- 2.6 Storage tanks for other materials such as caustic, acid, propane, or Dowtherm require special consideration depending upon the nature of the material. Nitrogen blanketing may be sufficient for Dowtherm.

3. DRIVES.

3.1 Gear Cases.

- 3.1.1 Drain and fill to operating level with approved lubricant containing 10% (by volume) of Class V VCI Fluid.

10% VCI-329 or VCI-326

Run for a few minutes to ensure uniform distribution (See Figure 4). If not installed or operable, fog Class V VCI Fluid into the interior using 30cc concentrate per gallon (8cc/liter) of interior volume. Before re-starting equipment, replace this fluid with operational lubricant.

VCI-329 or VCI-326 30cc/gallon interior volume (8cc/liter)

- 3.1.2 Seal with oil-resistant tape to prevent leakage.

- 3.2 Coat open gears, sprockets, screws and chain drives with Class III VCI Grease.

VCI-369 or VCI-389 2-3 mils (50-75 microns)

- 3.3 V-belt Drives. Remove and store belts indoors. Coat sheaves with 2-3 mils (50-75 microns) Class III VCI Grease.

VCI-369 or VCI-389 2-3 mils (50-75 microns)

3.4 Bearings and Bushings.

- 3.4.1 Greased Bearings - pump full with Class III VCI Grease.

VCI-369 or VCI-389

- 3.4.2 Oil Bearings - fill with Class V VCI Fluid and seal with oil-resistant adhesive tape. Before re-starting the equipment, replace this fluid with the operating lubricant.

VCI-326 or VCI-329



3.5 Couplings.

- 3.5.1 Coat exterior with 3-4 mils (50-75 microns) Class Iv VCI Dry Coating. If 2 applications are needed to achieve recommended thickness, allow 2 hours drying time between coats.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

- 3.5.2 Oil lubricated - Fill with approved lubricant containing 10% Class V VCI Fluid. Before re-starting the equipment, replace this fluid with operating lubricant.

10% VCI-326 or VCI-329

- 3.5.3 Grease Lubricated - fill with Class III VCI Grease.

VCI-369 or VCI-389

- 3.6 Shafting and Machined Surfaces. Clean surface with VCI-416 or VCI-419 and coat with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388

4. AGITATORS, CENTRIFUGES, MIXERS.

- 4.1 Stainless Steel and Non-Ferrous Metals. Clean with VCI-416 or VCI-419, dry and seal. Coat joints and crevices with Class IV VCI Dry Coating applied to a film thickness of 2-3 mils (50-75 microns).

VCI-368 or VCI-388 2-3 mils (50-75 microns)

4.2 Carbon Steel.

- 4.2.1 Clean equipment with VCI-416 prior to storage, spray VCI Powder into vessel's interior. Apply powder with a sandblasting gun or suitable device for spraying powder. Apply in a manner that assures uniform distribution within the interior. Use 30 grams of VCI Powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume. Seal all openings and vents, and if so desired, use nitrogen purge to ensure additional protection.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

- 4.2.2 Coat bolting with 2-3 mils (50-75 microns) Class III VCI Grease (See figure 7).

VCI-369 or VCI-389 2-3 mils (50-75 microns)

- 4.2.3 Coat flanges with 3-4 mils (75-100 microns) Class IV VCI Dry Coating after cleaning. If 2 applications are needed to achieve film thickness, allow 2 hours drying time between coats.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

4.3 Gear Cases.

- 4.3.1 Drain and fill to operating level with approved lubricant containing 10% (by volume) of Class V VCI Fluid.

10% VCI-326 or VCI-329

Run for a few minutes so that all surfaces are coated. If not installed or operable, fog Class V VCI Fluid concentrate into the interior using 30cc per gallon of interior volume. Before re-starting replace fluid with operating lubricant.

VCI-326 or VCI-329 30cc/gallon interior volume (8cc/liter)

- 4.3.2 Seal with oil-resistant tape to prevent leakage.

- 4.4 Coat gears, sprockets, screws and chain drives with 2-3 mils (50-75 microns) Class III VCI Grease.

VCI-369 or VCI-389 2-3 mils (50-75 microns)

- 4.5 V-belt Drives. Remove and store belts indoors. Coat sheaves with 2-3 mils (50-75 microns) Class III VCI Grease.

VCI-369 or VCI-389 2-3 mils (50-75 microns)

4.6 Bearings and Bushings.

- 4.6.1 Pump greased bearings full with Class III VCI Grease.

VCI-369 or VCI-389

- 4.6.2 Fill oiled bearings with approved lubricant containing 10% Class V VCI Fluid and seal with oil-resistant adhesive tape. Before re-starting the equipment, replace this fluid with operating lubricant.

10% VCI-326 or VCI-329

4.7 Couplings.

- 4.7.1 Coat exterior with 3-4 mils (75-100 microns) Class IV VCI Dry Coating. If 2 applications are needed to achieve recommended film thickness, allow 2 hours drying time between coats.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

- 4.7.2 Oil lubricated - Fill with approved lubricant containing 10% Class V VCI Fluid. Before re-starting equipment, replace this fluid with operating lubricant (See Figure 5).

VCI-326 or VCI-329

- 4.7.3 Grease lubricated. - Fill with Class III VCI Grease.

VCI-369 or VCI-389

- 4.8 Shafting and Machined Surfaces. Clean surface with VCI-416 or VCI-419 and coat with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

4.9 Mechanical Seals and Packing.

- 4.9.1 Remove used seals from equipment, then clean with VCI-416 or VCI-419 and package in Class VII 6 mil (150 microns) VCI Plastic Wrap (See figure 9). Attach seal to pump.

VCI-126 6 mil (150 microns)

- 4.9.2 On new equipment, clean with VCI-416 or VCI-419 prior to storage, protect the interior surfaces by dusting with Class VI VCI Powder through available openings. Apply powder with a sandblasting gun or suitable device for spraying powders. Use 10 grams per gallon of interior volume (2.642 kg/m<sup>3</sup>).

VCI-307 10g/gallon interior gallon (2.642 kg/m<sup>3</sup>)

Rotate several times before sealing. Spray all external machined surfaces with 2 mils (50 microns) Class III VCI Grease.

VCI-369 or VCI-389

- 4.9.3 Remove and discard used packing on packed equipment.

- 4.9.4 Clean the seal cavity in stuffing box with VCI-416. Coat with 2 mils (50 microns) Class III VCI Grease.

VCI-369 or VCI-389 2 mils (50 microns)

- 4.10 Cover open flanges, pipe caps and other openings with a waterproof barrier material, e.g. polyethylene sheet. Where practical, fasten a blank flange over the barrier.

5. HYDRAULIC SYSTEMS, LUBRICATING OIL SYSTEMS AND OIL RESERVOIRS

- 5.1 Drain and fill to operating level with approved lubricant containing 10% (by volume) Class V VCI Fluid.

10% (by volume) VCI-326 or VCI-329

Operate until the corrosion inhibitor has circulated throughout system. If not installed or operable, for Class V VCI Fluid concentrate into the interior using 30cc for each gallon (8cc/liter) of interior volume. Before re-starting equipment, replace this fluid with operating fluid with operating lubricant.

VCI-326 or VCI-329 30cc/gallon interior volume (8cc/liter interior volume)

- 5.2 Seal with oil-resistant adhesive tape to prevent leakage.

6. SCREWS, BOLTS, THREADS AND MECHANISMS.

Coat with 1 mil (25 microns) Class III VCI Grease by dipping or spraying.

VCI-369 or VCI-389 1 mil (25 microns)

7. STACKS.

Cover with metal or plastic caps. Spray Class VII VCI Powder into stack's interior. Apply with a sandblasting gun or suitable device for spraying powders. Apply in a manner that assures uniform distribution within interior. Use 30 grams VCI powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume.

VCI-307 30g/ft<sup>3</sup> (2.642 kg/m<sup>3</sup>)

8. INSTRUMENTS.

- 8.1 Pneumatic type equipment, control valves, pressure switches, solenoids, D/P cells, etc. are protected with Class VIII VCI Capsules (See Figure 8). Air conditioning, hermetic sealing or humidity control are not necessary.

2xVCI-105/5ft<sup>3</sup> (.14m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

- 8.2 Electronic amplifier type instruments are protected with Class VIII VCI Capsules.

2xVCI-105/5ft<sup>3</sup> (.14m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

- 8.3 Maintain control rooms at low humidity. If feasible, protect with Class VIII VCI Capsules (See Figure 8). If feasible, control temperatures in storage areas to avoid excess humidity condensation which would impair electrical conductivity on electronic components.

2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

- 8.4 Operate control valves once a week. Coat steel parts with 2-3 mils (50-75 microns) Class III VCI Grease.

VCI-369 or VCI-389 water based 2-3 mil (50-75 microns)

- 8.5 Leave analyzers energized and instrument air connected; or remove, tag and store per 8.2.

- 8.6 Drain Rotameters.

- 8.7 Remove dry cell batteries.

9. PIPING.

- 9.1 Stainless Steel and Non-Ferrous Metals.

- 9.1.1 If materials being handled cannot be left safely in the lines, clean and flush.

- 9.2 Carbon Steel.

- 9.2.1 If materials being handled cannot be left safely in the lines, flush and fill with 40% anti-freeze/60% water solution containing 2.5% Class VI VCI Powder and 0.25% Wetting Agent (See Figure 10), or 40% anti-freeze/60% water containing 1% solution of VCI-649.

VCI-309, S-5 & anti-freeze water(2.5%), VCI-649 water based (1%)

- 9.2.2 Dry Lay-up - Coat outside of unpainted pipe stored outdoors with 3-4 mils (75-100 microns) Class IV VCI Dry Coating. If 2 applications are needed to achieve recommended film thickness, allow 2 hours drying time between coats.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

Spray interior of pipes using Class VI VCI Powder. Apply powder with a sandblasting gun or suitable device for spraying powders. Apply in a manner that assures uniform distribution within interior. Use 30 grams VCI Powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume. Attention should be given that pipe ends (approx. 2 ft. from each end) have visible amounts of VCI Powder.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

- 9.3 Carbon Steel Valves. Coat unpainted Valves with 2-3 mils (50-75 microns) Class III VCI Grease.

VCI-369 or VCI-389 2-3 mils (50-75 microns)

- 9.4 Clean with VCI-416 or VCI-419, dry and coat open flange faces with 3-4 mils (75-100 microns) Class IV VCI Dry Coating (See Figure 3). If 2 applications are needed to achieve recommended film thickness, allow 2 hours drying time between coats.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

- 9.5 Insulation - Leave in place. Inspect to ensure that its covering is in good condition. If not, repair or remove insulation and coat bare pipe with 3-4 mils (75-100 microns) Class IV VCI Dry Coating. If 2 applications are needed to achieve recommended film thickness, allow 2 hours drying time between coats.

- 9.6 Tracing.

- 9.6.1 Steam Tracing - Flush and fill with 40% anti-freeze/60% water solution containing 2.5% Class VI VCI Powder and 0.25% S-5 Wetting Agent or 40% anti-freeze/60% water solution containing 1% VCI-649.

VCI-309, S-5 & anti-freeze/water  
or VCI-649

- 9.6.2 Electrical Tracing - Disconnect and leave in place.

## 10. ELECTRICAL EQUIPMENT.

- 10.1 General. Store all electrical equipment indoors; or if stored outside, protect from rain and high humidity. Use Class VIII VCI Capsules to protect interior of electrical enclosures (See figure 6).

2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

Air conditioned storage, hermetic sealing or humidity control are normally not necessary.

10.2 Motors.

10.2.1 Blow open motors with dry air or inert gas and seal with oil-resistant tape.

10.2.2 Install heaters in open motors not so equipped. Energize heater in all motors.

10.2.3 Where commutators or collector rings are accessible, remove brakes or lift brushes. Place a piece of wax-free, grease-proof insulating paper so that the brakes will rest on the paper. Brushes left in contact will cause etching. Coat collector rings with 2-3 mils (50-75 microns) Class III VCI Grease.

VCI-369 or VCI-388 2-3 mils (50-75 microns)

10.2.4 Clean exposed shafts and coat with 2-3 mils (50-75 microns) Class III VCI Grease.

10.2.5 Fill grease-lubricated bearing with grease.

10.2.6 Large Motors. Drain and fill lube oil system with approved lubricant containing 10% ( by volume) Class V VCI Fluid. Operate until the corrosion inhibitor has circulated throughout the system. Before re-starting the equipment, replace the fluid with operating lubricant. Install a strip heater near the windings and energize. If the period out of service is short, one winding can be energized at 5-10 percent of normal operating voltage as an alternative to use of a strip heater.

10% VCI-326 or VCI-329

10.3 Transformers. Maintain oil level and fog Class V VCI Fluid into air space above oil level. Use 30cc per 1 cubic foot (8cc/liter) of head space. Apply nitrogen pressure on oil-filled pressurized transformers to ensure additional protection.

VCI-326 or VCI-329 30cc/ft<sup>3</sup> (8cc/liter)

10.4 Switchgear.

10.4.1 Keep heat on in room or building where located.

10.4.2 Coat outdoor switches with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

Protect interiors with Class VIII VCI Capsules.

2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31m<sup>3</sup>)

10.4.3 Protect interior of motor controls, switchgear, power distribution panels with Class VIII VCI Capsules.

2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

10.4.4 Coat outdoor controls with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

Protect interiors with Class VIII VCI Capsules.

2x VCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

## 10.5 Batteries.

10.5.1 125 Volt switchgear station-type batteries left in service should be flat at 129 volt charge. Equalize once a month at 140 Volts. Make routine battery checks once a month.

10.5.2 Remove dry-cell batteries from emergency lighting systems. Disconnect wet-cell batteries from the power supply.

10.6 Rectifiers. Store indoors. Protect interiors with Class VIII VCI Capsules.

2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

## 11. COMPRESSORS.

11.1 General. Coat unprotected and machined parts with 2-3 mils (50-75 microns) Class IV VCI Dry Coating. Protect Bearing and gears per section 3.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

11.2 Reciprocating.

11.2.1 Drain and fill crankcase with approved lubricant containing 10% (by volume) of Class V VCI Fluid. Operate compressor for 10 minutes. Seal crankcase. Before re-starting the equipment, replace this fluid with the operating lubricant.

10% VCI-326 or VCI-329



- 11.2.2 Remove pistons and valves, coat steel pistons and valves with Class III VCI Grease. Wrap in Class VII 6 mil (150 microns) VCI Plastic Wrap and store.

VCI-126 6 mil (150 microns), VCI-369 1 mil (25 microns) or VCI-389

Apply Class VI VCI Powder into intake and exhaust manifolds. 20 grams per gallon (5.3g/liter) of interior volume. For fogging application, use a sandblasting gun or suitable device for fogging powders. Seal openings using oil-resistant tape.

VCI-307 20g/gallon interior volume (5.3g/liter)

- 11.2.3 For compressors in special services such as chlorine and oxygen, dry and fill with inert gas and desiccant.

- 11.2.4 Drain and fill cooling system with 40% anti-freeze/60% water mixture containing 2.5% addition of Class VI VCI Powder and 0.25% S-5 Wetting Agent or 1% addition of VCI-649.

VCI-309, S-5 & anti-freeze/water or  
VCI-649 & anti-freeze/water

- 11.2.5 Drain tanks and receivers. Spray Class VI VCI Powder into interior. Apply powder with a sandblasting gun or suitable device for spraying powders. Apply in manner that assures uniform distribution within the interior. Use 30 grams per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume. Seal the unit using oil-resistant adhesive tape.

VCI-307 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

### 11.3 Centrifugal and Rotary.

- 11.3.1 Fill casing with approved lubricant containing 10% Class V VCI Fluid and then drain completely.

10% VCI-326 or VCI-329

- 11.3.2 Treat exposed shafting and couplings per Section 3.

- 11.3.3 Protect bearings and oil system per Sections 3 & 5.

- 11.3.4 As an alternative method, centrifugal or rotary compressors can be preserved as follows: Spray or fog Class V VCI Fluid concentrate into the suction as the machine is turned over slowly. Use 30cc per gallon (8cc/liter) of interior volume.

VCI-326 or VCI-329 30cc/gallon (8cc/liter)

Spray the rotor and housing with 2-3 mils (50-75 microns) Class III VCI Grease. Rotate the shaft once a week leaving it in a new position each time.

VCI-369 or VCI-389 2-3 mils (50-75 microns)

11.4 Spare Compressor Rotors.

11.4.1 Clean spare rotors with VCI-416 or VCI-419. Do not leave fingerprints on polished surfaces. Use Class I VCI Thin Film containing fingerprint penetrating compound.

11.4.2 Coat surfaces as needed with 2 mils (50 microns) Class III VCI Grease.

VCI-369 or VCI-389 2 mils (50 microns)

11.4.3 Wrap the coated rotor in Class VII 6 mil (150 microns) VCI Plastic Wrap. Seal with oil-resistant adhesive tape.

VCI-126 6 mil (150 microns)

11.4.4 It is recommended to store spare rotors in a vertical position. They can warp if stored horizontally and supported at the ends. This result in imbalance.

12. DIESEL ENGINES.

12.1 Run the engine until it is at operating temperature.

12.2 Stop the engine and drain lubricating oil from the sump, lubricating oil tank, oil filter housing and fuel pump housings.

12.3 Fill engine crankcase and fuel pump housing with Class V VCI Fluid, 10% diluted with lubricating oil.

VCI-369 or VCI-389

12.4 Drain fuel from tank and fuel filter housings. Fill with kerosene containing 0.5% Class V VCI Fluid. Prime fuel system.

0.5% VCI-326, VCI-329

12.5 Drain and flush cooling system. Refill with 40% anti-freeze/water mixture containing 2% Class VI VCI Powder or 40% anti-freeze/60% water mixture containing 1% VCI-649.

VCI-309 & anti-freeze/water or  
VCI-649 & anit-freeze/water mixture

- 12.6 Run engine for 15 minutes at idling speed. A few times during this period, speed up engine to top speed.
- 12.7 Leave fuel lines filled with kerosene. Do not remove fuel injectors.
- 12.8 When engine has cooled, disconnect inlet and exhaust manifolds and spray Class V VCI Fluid into intake and exhaust outlets, turning engine over during the operation. Use 50cc per gallon (13.2cc/liter) of interior volume. Where possible, spray small quantities of oil through other suitable openings such as indicator holes, starting air valves, etc. with engine stationary. Do not rotate crankshaft after completing these procedures.

VCI-326 or VCI-329 50cc/gallon interior volume (13.2cc/liter)

- 12.9 For out of service engines when piping or fittings have been removed for shipment, spray with 2-3 mils (50-75 microns) Class IV VCI Dry Coating. Seal all the open flange joints, inlet and exhaust manifold, etc. with blind flanges and gaskets.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

- 12.10 Spray all machined and unpainted surfaces with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

- 12.11 Seal engine exhaust pipe, breathers and other vents; generator, starter motor, air filters, etc. with Class VII 6 mil (150 microns) VCI Plastic Wrap. Seal oil and fuel dipsticks and filler caps with oil-resistant adhesive tape.

VCI-126 6 mil (50-75 microns)

13. GASOLINE ENGINES.

- 13.1 Run engine until it reaches operating temperature. Stop engine and drain all lubricating oil from crankcase; replace oil filter.

- 13.2 Fill crankcase to operating level with approved lubricating oil containing 10% Class V VCI Fluid.

10% VCI-326 or VCI-329

- 13.3 Drain and flush cooling system. Refill with 40% anti-freeze/water solution containing 2% Class VI VCI Powder.

VCI-309 or VCI-645 & anti-freeze/water

- 13.4 Run engine for 10 minutes at about 1,000 rpm with a coolant temperature of 180°F (82°C). Slow engine to idling speed and stall by spraying Class V VCI Fluid into the carburetor air intake. Switch off ignition. Do not rotate crankshaft after completing these procedures.

VCI-326 or VCI-329

- 13.5 For bare engines when piping or fittings have been removed for shipment, seal all open flanged joints, inlet and exhaust manifolds, etc. with blank flanges and gaskets; coat surfaces with 3-4 mils (75-700 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

- 13.6 Drain fuel tank, fuel pump and float chamber of carburetor. Blow dry, compressed air through fuel lines. Spray Class V VCI Fluid into fuel tank using 30cc per gallon (8cc/liter) of interior volume.

VCI-326 or VCI-329 30cc/gallon (8cc/liter)

- 13.7 Coat all unpainted or machined parts with 3-4 mils (75-100 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

- 13.8 Seal engine exhaust pipe, breathers and other vents; generator, starter motor, air filters, etc. with Class VII VCI Plastic Wrap. Seal oil and fuel dipsticks and filler caps in place with oil-resistant adhesive tape.

VCI-126 6 mil (150 microns)

- 13.9 Spray Class VI VCI Powder into exhaust system prior to sealing up by using 30 grams per cubic foot (1.059 kg/m<sup>3</sup>).

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

#### 14. AUTOMOTIVE ASSEMBLIES AND COMPONENTS.

##### 14.1 Clutch and Brake Mechanisms.

- 14.1.1 If storing clutches in position on engines, treat all grease lubricated working parts with service grease and fog Class VI VCI Powder. Service grease and fog Class VI VCI Powder. Use 30 grams per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume; apply with a sandblasting gun or suitable device for fogging powders; assure uniform distribution; seal all openings.

VCI-307 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

- 14.1.2 If storing clutches as separate units, treat all grease lubricated working parts with service grease. Wrap units in Class VII 6 mil (150 microns) VCI Plastic Wrap; secure by heat sealing or oil-resistant tape.

VCI-126 6 mil (150 microns)

- 14.1.3 Coat all unpainted or machined surfaces with Class IV VCI Dry Coating to a wet film thickness of 3-4 mils (75-100 microns).

VCI-368 or VCI-388 3-4 mils (75-100 microns)

14.2 Gearboxes.

- 14.2.1 Gearboxes may be internally protected by the service lubricant. Fill box completely with the oil and seal breather with adhesive tape.

- 14.2.2 Coat exterior working and non-working surfaces on the gearboxes with 3-4 mils (75-100 microns) Class IV VCI Dry Coating. Before gearboxes are put into operation, remove protective coating from external working surfaces using a petroleum solvent. Remove sealing tape and drain oil in gearbox to operating level.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

- 14.2.3 As an alternative treatment, fill with approved lubricant containing 10% (by volume) Class V VCI Fluid (or per manufacturer's specifications). This procedure is recommended if sealing the gearbox is difficult or if the unit is exposed to severe conditions. Drain box and refill with normal service lubricant before putting it into operation.

10% VCI-326 or VCI-329

14.3. Axles and Differential Gears.

- 14.3.1 Units may be internally protected by the service lubricant. Units should be completely filled with the oil and then sealed. If there are no seals on the drive shafts, remove the brake units to avoid contaminating the linings with oil leaking from axles. It is recommended to rotate the driving flange monthly during storage. Coat all exterior surfaces with 3-4 mils (75-100 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

- 14.3.2 If sealing the units is difficult and storage conditions are severe, fill the units with approved lubricant containing 10% (by volume) Class V VCI Fluid. Replace this fluid with appropriate service lubricant before putting unit into service.

10% (by volume) VCI-326 or VCI-329

14.4 Automotive Transmissions. Fill to operating level with recommended transmission fluid and seal.

15. REFRIGERATION SYSTEMS.

15.1 Maintain positive pressure on refrigeration system with Freon fluorocarbon or nitrogen.

15.2 Compressor and Speed Increaser. Fill circulating lube system with approved lubricant containing 10% (by volume) Class V VCI Fluid. Operate system until the VCI Fluid has circulated throughout the system. Fill speed increaser with approved lubricant containing 10% (by volume) Class V VCI Fluid and seal shafts with oil-resistant adhesive tape.

10% (by volume) VCI-326 or VCI-329

16. COOLING TOWERS.

16.1 Spray exposed metal parts with 3-4 mils Class IV VCI Dry Coating. If 2 spray applications are needed to achieve recommended thickness, allow 2 hours drying time between coats.

VCI-368 or VCI-388 3-4 mils

16.2 Protect wood tower against fire. If wetted for fire protection, tower must be kept continuously wet to avoid wood deterioration.

16.3 Open flow control valves and apply 2-3 mils Class III VCI Grease on stems and threads.

VCI-369 or VCI-389 2-3 mils

16.4 Drain and fill gear reducers and oil-lubricated bearings with approved lubricant containing 10% (by volume) Class V VCI Fluid. Tape shafts with oil-resistant adhesive tape.

10% (by volume) VCI-326 or VCI-329

16.5 Fill grease lubricated bearings with Class III VCI Grease.

VCI-369 or VCI-389

16.6 Store V-belts Indoors. Coat sheaves with 2-3 mils Class III VCI Grease.

VCI-369 or VCI-389 2-3 mils

17. FUEL OIL SYSTEMS.

17.1 Drain all water from low points in system.

17.2 Spray Class VI VCI Powder into tank. Apply powder with a sandblasting gun or suitable device for spraying powders. Use 10 grams VCI Powder per 1 cubic foot of interior volume.

VCI-307 10g/ft<sup>3</sup> (360 g/m<sup>3</sup>)

17.3 Fill complete with fuel oil to exclude air.

17.4 Maintain system full of fuel oil.

## LAYING UP POWER EQUIPMENT

1. SCOPE.

1.1 This section outlines procedures for laying up power equipment to prevent damage resulting from corrosion or freeze up. The specific kind of equipment, the type of installation, or climate conditions of the area may require more thorough consideration with these procedures serving as a guide. Other chapters contain additional information which is pertinent. Refer to the Table of Contents and the Equipment index.

2. GENERAL.

2.1 Corrosion in a non-operating power plant can be controlled by proper lay-up. The procedures outlined here are based on one of the following approaches:

2.1.1 Thoroughly cleaning and coating with corrosion preventive.

2.1.2 Cleaning and protecting internal surfaces with VCI-Powder.

2.1.3 Preventing condensation by maintaining sufficiently high temperatures or by dehumidification.

2.1.4 Cleaning and blanketing with dry gas (nitrogen).

2.1.5 Cleaning and flooding with properly treated water.

2.2 Factors to be considered in selecting lay-up method include the following:

2.2.1 Lay-up Period. The following guidelines are used:

	SHORT-TERM LAY-UP	LONG-TERM LAY-UP
Provision I (Benign, inland Climate)	Up to 8 months	Up to 24 months
Provision II (Industrial Climate)	Up to 6 months	Up to 12 months
Provision III (Harsh environment)	Up to 3 months	Up to 12 months



- 2.2.2 Cost. In certain instances it may cost less to maintain for the equipment temperature at a safe level for corrosion protection than to clean and apply a protective coating.
  - 2.2.3 Equipment Design. Design of the equipment may make it impractical to clean and apply a protective coating.
  - 2.2.4 Availability for Service. When equipment is periodically placed in service or needed quickly in an emergency, the method of lay-up is different than for long-term storage.
- 2.3 Where the danger of freeze-up exists, one of the following conditions must be met:
- 2.3.1 Using dry storage methods.
  - 2.3.2 Maintaining adequate circulation to prevent freezing.
  - 2.3.3 Maintaining equipment temperature above freezing.

### 3. BOILERS, WATER SIDE - WET METHOD.

- 3.1 This method is recommended for short-term lay-up or where the boiler may have been put into service quickly. The method should not be used for extended sub-zero temperature periods.
- 3.2 The wet method requires precautions to prevent water freezing in the boiler and its apparatus.
- 3.3 The water used must be softened or demineralized. Add 1% by weight Class VI VCI Powder. Add powder before or following shutdown in a manner that ensures uniform concentrations.
- 3.4 Throughout the lay-up period, periodically check all hand-holes, manholes and tube rolls for leakage; make repairs as necessary. Check the water at least once a month to maintain at least 0.75% of Class VI VCI Powder in water. Maintain circulation as long as the boiler is idle.

0.75% VCI-309 or VCI-645

Test procedures and titration for determining concentrations of Class VI VCI Powder in aqueous solutions are found in chapter 8.

### 4. BOILERS, WATER SIDE - DRY METHOD.

- 4.1 This method used Class VI VCI Powder. It is recommended when wet Lay-up is not practical and freeze-up protection cannot be provided. This method is preferred for long-term lay-up.
  - 4.1.1 Dry nitrogen in the boiler drum can be used as an alternate method; For added protection, Class VI VCI Powder can be used with dry nitrogen purge.

- 4.2 If the boiler needs inspecting or acid cleaning, it should be done before starting lay-up procedures. If a boiler is chemically cleaned with an acid or solvent, its internal surfaces must be completely neutralized and passivated.
- 4.2.1 To neutralize, add three pounds of caustic soda and 1.5 pounds of anhydrous sodium sulfite to 1,000 gallons de mineralized or softened lay-up water. These quantities provide approximately 400 ppm of hydroxyl alkalinity (expressed as  $\text{CaCO}_3$ ). Add chemicals after acid or solvent cleaning in a manner that assures uniform concentration throughout the boiler. After filling the boiler to normal operating level, light-off unit and raise pressure to 25 p.s.i.g. our one half operating pressure, whichever is less. During the firing period the drum vent and outlet superheater drains should be open. Fire the unit in this manner until water sample for each circuit shows concentrations defined above. If specified levels are not met, add caustic soda or sodium sulfite as required.
- 4.3 After extinguishing fires, open the drain vent (also the superheater vent or boiler with drainable superheaters) until pressure drops to approximately one half operating pressure. Then blow down the following lines for about 30 seconds each: Water column, water gauge glass, continuous blowdown, lower drum blowdown, valves and all water wall header drain valves. This helps remove deposits from the lines.
- 4.4 Start draining the boiler slowly at all low points. To assure that water products are not left after draining, surfaces should be sufficiently dry before proceeding.
- 4.5 Spray Class VI VCI Powder into boiler interior. Apply powder with sandblasting gun or suitable device for spraying powders. Assure uniform distribution within interior. Use 30 grams VCI Powder per 1 cubic foot ( $1.059 \text{ kg/m}^3$ )of interior volume. Seal the drain and tag the boiler drums to indicate that VCI powder has been applied. Seal the unit at all points to best extent possible.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

5. BOILERS, FIRESIDE - COLD METHOD.

- 5.1 When boilers are laid-up for extended periods in a cold state, it is important that all exposed metal on the fireside is cleaned and protected from corrosion. This is particularly important where oil or coal containing sulfur has been used as fuel. If possible, fire the boiler on No.2 oil or natural gas for one week prior to shutdown to help clear the fireside or corrosive deposits.
- 5.2 Before taking the boiler off-line, operate all soot blowers several times to remove as much deposit and fly ash from tubes and setting as practical. The last operating sequence should start with the soot blower at the furnace and follow the flue gas path to the blower nearest the stack. An airlance is helpful in removing deposits.

- 5.3 After the unit is off-line and the temperature has dropped to 140°F or lower, the boiler, economizer and air heater should be washed down on the flue gas side to remove deposits and loose fly ash. A wash down with a 5% solution of soda ash will help neutralize the acidic solutions created by water and sulfur compounds in deposits.

Final washing should be done with a 2.5% solution of Class VI VCI Powder and should be completed while the unit is still warm so that the residual heat helps dry the unit.

2.5% (by weight) VCI-309 or VCI-645

- 5.4 After all metal surfaces are cleaned, apply 3-4 (75-100 microns) mils Class IV VCI Dry Coating. If 2 applications are needed to achieve recommended film thickness, allow 2 hours drying time between coats.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

After dry coat application, spray Class VI VCI Powder to protect inaccessible surfaces. Use 30 grams VCI Powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume. Seal all openings and vents.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

- 5.4.1 When applying VCI Dry Coating, exercise care to guard against fire or explosion. No flame or spark of any kind should be permitted in the vicinity.
- A. Maintain adequate ventilated work space.
  - B. Apply thorough coating of protective cream to parts of body exposed to solvent emission.
  - C. Wear protective gloves while exposed to chemicals.
  - D. Wear suitable respirator and eye protection while spraying corrosion inhibitor.
  - E. Certain elastomers and non-metallics may become attacked by solvents used in Class IV VCI Dry Coating.

- 5.5 Provisions should be made to prevent rain from entering the boiler through the stack or other points.

- 5.6 The boiler and exterior duct work should be cleaned with VCI-416 or VCI-419 and sprayed with Class IV VCI Dry Coating to a film thickness of 3-4 (75-100 microns) mils.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

- 5.7 Clean and store oil guns and flame scanners; install blanks in gun ports. See Section 15 for protection of piping.
- 5.8 Boilers laid-up longer than six months should be given a "dry out" before returning to service to prevent damage to refractory materials. To "dry-out", fire the unit at a rate requiring approximately six hours to reach half operating pressure or 100 p.s.i.g., whichever is less. Fire the unit at a rate to hold at that pressure for about 4 hours, then proceed with normal firing practice to bring the unit on line.

6. BOILERS, FIRESIDE - HOT METHOD.

- 6.1 Some boilers designed to burn residual oils cannot be cleaned and coated with corrosion inhibitor on the gas side without extensive dismantling. In such cases hot lay-up may be more practical, particularly when lay-up does not exceed 6 months.
- 6.2 To prevent hygroscopic action of deposits on flue gas side, the temperature of the boiler surfaces must be maintained at or above 170°F.
- 6.3 When the unit is removed from service, place a blank in the flue gas duct before the temperature falls below 170°F. If the flue gas duct cannot be blanked, place a blank in the air supply duct.
- 6.4 Circulate blow-down water through the unit at a rate that maintains temperature of the metal surfaces at a minimum of 170°F.
- 6.5 As an alternative method, the unit temperature can be maintained at a safe level by controlled light firing or sulfur-free fuel. Using continuous burning pilots has proven effective and economical in some instances. Where this method is used, blanks are not placed in ducts. Continuous monitoring of pilot flames, minimum air flow, and other safety precautions must be met.

7. VAPORIZERS, DOWTHERM SIDE - DRY METHOD.

- 7.1 This procedure protects a vaporizer that will be out of service for one or more months. The dry method allows an expedient return to service. It can be done with available heated Dowtherm for filling the vaporizer. With the wet storage method the Dowtherm could be frozen, requiring time for a slow melt program. The wet method also keeps the Dowtherm dosage out of usable inventory.
- 7.2 If the vaporizer is on the line, reduce its load gradually and allow the other vaporizers to pick up the plant load.
- 7.3 When the unit pressure starts to drop and the non-return valve closes, shut down the combustion air fan and close all manual isolation valves. Let the unit cool for 8 hours (over night) or until its pressure matches the atmosphere.

- 7.4 Drain Dowtherm from the vaporizer through the charge, and drain the system pump to a storage tank having adequate space to hold Dowtherm.
- 7.5 Pull vacuum on the vaporizer through the upper drum vents to clear residual Dowtherm from the unit. Check the valves, manholes, etc. for leakage. By using century tube suction principle, place Class VI VCI Powder in the funnel connected with intake pipe of the vaporizer (on the opposite side of vacuum pump). Use 30 grams per cubic foot (1.059 kg/m<sup>3</sup>) Class VI VCI Powder appears in the exhaust side of vacuum pump. Close the vent valves and seal all the openings.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

8. VAPORIZERS - FIRESIDE.

Refer to Section 5 for procedures applicable to vaporizer fireside protection.

9. TURBINES.

- 9.1 When Laying-up multi-stage turbines, consult the manufacturer for special precautions to prevent damage to the equipment like shaft deflection and bearing damage.
- 9.2 Turbine lay-up must be done with care so that steam vapors from any source of not leak into the turbine, or if it is a condensing unit, into the condenser.
- 9.3 Where applicable, remove water soluble deposits prior to shut-down using local plant procedures.
- 9.4 Short-Term Lay-Up.
  - 9.4.1 Steam lines connected to the turbine should be valved off in a manner that prevents any steam leakage to the turbine. Spray turbine steam lines and spaces with Class VI VCI Powder. Use 30 grams VCI Powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) interior volume. Apply with sandblasting gun or suitable device for spraying powders. Distribute the powder as evenly as possible by turning the rotor as the powder is blown in. Seal the turbine casing and close all apertures leading into the steam spaces. For condensers, see 14.1. Follow similar procedures for both single and multi-staged machines.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

- 9.4.2 When Class VI VCI Powder is used, removing the inhibitor from boiler feed water is normally not necessary, which simplifies restarting.

9.4.3 Charged Systems.

9.4.3.1 Drain and clean oil reservoir. Test the oil to be sure it is free of water and is suitable for continued use. Filter or centrifuge the oil as needed. Change if necessary.

9.4.3.2 Refill the reservoir with approved lubricant containing 10% Class V VCI Fluid. Operate the auxiliary pump system to circulate oil while operating the mechanisms of the governor, serv-o-motor, pressure regulator and other oil-operated apparatus'. Repeat the procedure monthly.

10% VCI-326 or VCI-329

9.4.4 Uncharged Systems.

9.4.4.1 If a new unit does not contain oil, protect bearings with approved lubricant containing 10% Class V VCI Fluid. Turn the turbine rotor to ensure the protective oil is distributed adequately. Where practical, first seal the oil connections to the bearings.

10% VCI-326 or VCI-329

9.4.4.2 Spray reduction gears. all gear surfaces and interior of gear case with Class V VCI Fluid.

VCI-326 or VCI-329

9.4.4.3 When putting a new turbine in operation after using the above procedure, flush oil system thoroughly with the same type of oil to be used in service.

9.4.5 Heat Exchangers.

9.4.5.1 Disconnect water lines and dry water surfaces.

9.4.5.2 If necessary, install space heaters to help drying. Spray Class VI VCI Powder at 30 grams per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume. Inject powder in all openings including drain valves, relief valves and instrument connections to achieve an even distribution throughout the heat exchanger. Open mainways if possible to inject VCI Powder into tubes. Immediately after spraying, close all openings and seal the unit.

VCI-307 or VCI-645 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

9.5 Long-Term Lay-up.

9.5.1 All steam lines connected to the turbine should be blanked off so no steam leaks into the turbine.

9.5.2 After ensuring that oil is clean and free of water, add 10% by volume Class V VCI fluid. Circulate the lubricant while operating the mechanism of the governor, serv-o-motor, pressure regulator, and other oil-operated apparatus'. Drain lubricant and provide for its safe, clean storage.

10% (by volume) VCI-326 or VCI-329

9.5.3 Completely dismantle and clean all turbine parts including the turbine spindle, labyrinth packing, diaphragms, steam valves and consoles, oil system and auxiliary oil pump. Clean any corrosion on steam seating/sealing surfaces with 400 grit wet/dry paper. Wipe surfaces clean with mineral spirits. Brush Class V VCI Fluid to minimum thickness of 1 mil, on the exposed machined surfaces, including horizontal joint face.

9.5.4 Reassemble Turbine.

9.5.5 If the turbine is equipped with carbon ring seals, the seals should both be re-installed but stored during extended lay-away periods. Spray sealed chambers with 2-3 mils (50-75 microns) Class III VCI Grease.

VCI-326 or VCI-369 2-3 mils (50-75 microns)

9.5.6 Before reassembly, spray the inside of the turbine cases with Class VI VCI Powder. Use 30 grams per 1 cubic foot (1.059 kg/m<sup>3</sup>) interior Volume. Close the turbine case and seal. Close all turbine drain valves to isolate turbine case.

VCI-307 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

Remove turbine journal and thrust bearings. Wash out bearing pedestals with mineral spirits and lint-free rags. Brush or spray bearing basket (inside) and parts with Class V VCI Fluid to a minimum film thickness of 1 mil (25 microns) . Re-assemble turbine bearing baskets, installing the temporary shaft closure seal plates. Disassemble the control valve operating mechanism; clean, reassemble and lubricate. Brush all parts with Class V VCI Fluid.

VCI-326 or VCI-329 1 mil (25 micorns)

10. GENERATORS, ETC.

- 10.1 When laying-up power generators, consult the manufacturer for special precautions to prevent damage.
- 10.2 Insulation on electrical equipment like generators, absorbs moisture when out of service for long periods. Keep equipment warm using space heaters if possible. The relative humidity inside the generator should not exceed 30%. In some instances, using incandescent light bulbs may be adequate. The heat supplied should maintain the temperature of the equipment above the dew point. The heat source must not create localized hot spots because temperatures above 190°F may damage insulation.
- 10.3 Lift slip/commutator brushes and coat rings with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

- 10.4 Coat bearing journals with 3-4 (75-100 microns) mils Class III VCI Grease.

VCI-369 or VCI-389 3-4 mils (75-100 microns)

11. FANS.

- 11.1 Thoroughly clean fan blades with VCI-416 or VCI-419. Clean internal and external casing surfaces. Apply 2-3 mils (50-75 microns) Class IV VCI Dry Coating. Close inlet and outlet dampers.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

- 11.2 Greased bearings should be pumped full with Class III VCI Grease.

VCI-369 or VCI-389

- 11.3 Fill oiled bearings with approved lubricant containing 10% (by volume) Class V VCI Fluid.

10% (by volume) VCI-326 or VCI-329

Sealed with oil-resistant tape. Water-cooled bearings should have water jackets drained, flushed and blown out until dry. Water lines should be shut off near the header, disconnected and drained to prevent freeze-up. Protect the internal surfaced by dusting with Class VI VCI Powder. Use 10 grams per gallon (3 g/liter) of cooling system volume. Apply powder with sandblasting gun or suitable device for spraying powders. Plastic or metal covers on flanged connections should be held in place by at least two bolts.

VCI-309 10g/gallon interior volume (1.059 kg/m<sup>3</sup>)



- 11.4 After cleaning with VCI-416 or VCI-419, coat shafts with Class IV VCI Dry Coating to a film thickness of 2-3 mils (50-75 microns).

VCI-368 or VCI-388 2-3 mils (50-75 microns)

- 11.5 Induced draft fans should have all fly ash removed from the casing and duct work. Blank the duct at the stack to prevent leakage of rain or back flow of gases to the duct or fan.

- 11.6 Gear boxes and the related oil system should be drained, cleaned and filled to operating level with vendor recommended lubricant. Add a 10% concentration of Class V VCI Fluid to the gearbox.

10% VCI-326 or VCI-329

Couplings should be cleaned and greased with class III VCI Grease or oiled with approved lubricant containing 10% Class V VCI Fluid.

10% VCI-326, VCI-329 VCI-369 or VCI-389

## 12. PUMPS.

- 12.1 When laying-up large heavy equipment, consult the manufacturer for special precautions.

- 12.2 Stainless Steel and Non-Ferrous Metals. - Clean, dry and seal.

- 12.3 Carbon Steel.

12.3.1 Close all lines connected to the pump including suction, discharge and re-circulating lines. If necessary to prevent leakage, blank line. Open bents and drains and blow out all water with compressed air.

12.3.2 Remove all packing from the pump and replace with Class III VCI Grease.

VCI-369 or VCI-389

12.3.3 Remove mechanical seals, clean and package in Class VII 6 mil VCI Plastic Wrap.

VCI-126 6 mil (150 microns)

12.3.4 Greased bearings should be pumped full with Class III VCI Grease.

12.3.5 Drain oiled bearings and flush with Class V VCI Fluid or fill bearings with approved lubricant containing 10% (by volume) Class V VCI Fluid and seal with oil-resistant tape. Before re-starting the equipment, replace the fluid with the operating lubricant.

10% (by volume) VCI-326 or VCI-329

12.3.6 Remove and drain pressure gages and their "pigtailed". Store to prevent damage by freezing.

12.3.7 Coat all exterior unpainted metal parts and surfaces with 3-4 mils (75-100 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

12.3.8 Clean interior with VCI-416 prior to storage. Protect the interior by dusting with Class VI VCI Powder through available ports and openings. Use 10 grams per gallon (3 g/liter) of interior volume. Apply powder with a sandblasting gun or suitable device for spraying powders. Rotate several times before sealing.

VCI-307 10g/gallon interior volume (1.059 kg/m<sup>3</sup>)

### 13. DEAERATORS.

13.1 Close inlet and outlet waterlines and steam supply line to the deaerator. Completely isolate the unit. If necessary, blank lines to prevent leakage. Open drains and remove all moisture. Drain vent condenser.

13.2 Clean with VCI-416 and remove all rust and foreign materials with VCI-422 or VCI-425 and remove all rust and foreign material from internal surfaces.

13.3 When clean and dry, spray Class VI VCI Powder. Apply in a manner that assures uniform distribution within the interior. Use 30 grams VCI Powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume.

VCI-307 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

13.3.1 Check bi-monthly to assure unit is tightly sealed.

### 14. CONDENSERS, HEAT EXCHANGERS AND AIR EJECTORS.

14.1 A condenser directly connect to a turbine should be treated as an integral part of the turbine. The steam side should be thoroughly isolated including condensate pump, to prevent moisture from leaking into the unit. Use Class VI VCI Powder for long-term lay-up periods. (See 13.3 for procedures and 2.2 for definition of long-term lay-up).

- 14.2 Close valves in supply and return lines to water side of condenser. If necessary, blank lines to prevent leakage. Clean cooling water side of tubes and blow air through them until dry. Clean sludge and foreign material from water boxes if needed with VCI-416. Coat exterior with Class IV VCI Dry Coating to a film thickness of 2-3 mils (50-75 microns).

VCI-368 or VCI-488 2-3 mils (50-75 microns)

- 14.3 Protect heat exchangers in the same manner as condenser.
- 14.4 Air ejectors should be isolated from steam supply, process connection and discharge point. On multi-stage units with inter-stage condensers, completely drain condensers. Protect inter-stage condensers following the procedure described in 13.3 and 14.1. To protect ejectors, spray with 2-3 mils (50-75 microns) Class IV VCI Dry Coating, or remove and seal in Class VII 6 mil VCI Plastic Wrap.

VCI-127 6 mils (150 microns) or VCI-368 2-3 mils (50-75 microns) 1 mil\*

VCI-126 or VCI-388

\*1 mil is for the VCI-126 film

15. PIPING.

- 15.1 When laying up equipment, all associated piping that is not needed should be removed from service and drained. Vent the lines at their highest point in the system to ensure drainage. All products should be drained.
- 15.2 When isolation and drainage are complete, dry the lines by circulating warm, dry air. After drying, spray Class VI VCI Powder using a sandblasting gun or suitable device for spraying powders. Using 30 grams VCI Powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) interior volume. Inject the powder in all possible openings, including through drain valves, relief valves, etc. to achieve an even distribution throughout piping.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

- 15.3 Protect any lines left filled with liquid using ethylene glycol containing 2% Class VI VCI Powder.

2% VCI-309

- 15.4 Maintain insulation on outdoor lines in watertight condition.
- 15.5 To protect Dowtherm lines which are drained and evacuated, follow procedures in 15.2.

16. REFRIGERATION.

16.1 Consult manufacturer for detailed procedures to prevent damage. This section covers the lay-up of centrifugal type refrigeration machines only.

16.2 Close cooler shut-off valves and blank the refrigerator cooler inlet and outlet chilled water lines.

16.3 Drain cooler and condenser waterbox heads.

16.4 Remove cooler waterbox heads and condenser waterbox heads. Sandblast heads and then apply 3-4 mils (75-100 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

16.5 Close condenser shut-off valves and blank refrigeration condenser inlet and outlet water lines.

16.6 Drain condenser waterbox heads.

16.7 Remove condenser waterbox heads. Sandblast heads and apply 3-4 mils (75-100 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

16.8 Pressurize refrigerant side with 3-4 p.s.i.g. dry air or nitrogen to remove refrigerant from system.

16.9 Shut off water to the internal compressor oil cooler; drain lines and install a blank in the inlet line.

16.10 After refrigerant has been removed, remove oil charge from the compressor sump and replace with new oil containing 10% Class V VCI Fluid (or per manufacturers specifications).

10% VCI-326 or VCI-329

16.11 Disconnect any electrical oil sump heaters at compressor. Because system has been drained of refrigerant, compressor sump oil heaters are not required.

16.12 While maintaining refrigerant side under 3-4 p.s.i.g. dry air or nitrogen pressure, test for leaks. Plug all leaks so that refrigeration machine remains under positive pressure at all times. This is very important to prevent corrosive attack.

16.13 Purge Unit.

A. Drain condenser lines and purge pot.

B. Close the refrigerant line from condenser.

- C. Close the purge compressor suction and discharge valves.
- D. Remove any refrigerant and replace condenser oil with new dosage containing 10% Class V VCI Fluid (or per manufacturers specifications).

10% VCI-326 or VCI-329

- E. Open both valves from top of main condenser and exit line to refrigeration system, to maintain slight pressure on purge unit.

- 16.14 Clean cooler and condenser tubes on water side with nylon brushes. Replace cooler and condenser waterbox gaskets. Dust with Class VI VCI Powder through available openings. Use 30 grams per gallon (8 g/liter) interior volume. Seal all openings and vents.

VCI-307 30g/gallon interior volume (1.059 kg/m<sup>3</sup>)

- 16.15 Record air or nitrogen pressure daily, maintaining at 3-4 p.s.i.g (on refrigerant side).

PROTECTIVE STORAGE OF NEW EQUIPMENT

1. SCOPE.

- 1.1 Material or equipment from vendors often must be stored before it is put in use. This standard outlines procedures for protecting new and reconditioned material and equipment from corrosion, mechanical damage, dirt and insects during storage period.
- 1.2 Consideration should also be given to atmospheric conditions and the length of storage time.
- 1.3 Other chapters contain information which is pertinent. Refer to the Table of Contents and Equipment Index.

2. GENERAL.

- 2.1 Effective delivery scheduling of new equipment can reduce or eliminate the need for storage protection. When equipment is stored over long periods, regular inspections must be scheduled to assure protection has not deteriorated.
- 2.2 Some protective measures may be provided by the vendor before shipment. It may be advisable to specify protection required in the purchase order. Cost and available facilities usually determine where protection should be applied. If protection must be removed for receiving inspection, final protection must be provided at the plant site.
- 2.3 Acceptable oil-resistant, water-resistant and pressure sensitive tapes are listed in Chapter 7. These tapes have less than 250 ppm chloride content.

3. PROTECTION OF PIPES, VALVES AND FITTINGS. (see Table 2)

- 3.1 Clean and drain. The method used depends on the cleanliness required, which is determined by the end use. Usually, specifications for the job will name the contaminant materials to be removed and their acceptable residual levels. Water flushing is frequently the only cleaning required for cast iron pipe. When necessary to eliminate corrosion caused by standing water after cleaning, add 1% (by weight) Class VI VCI Powder (Increase dosage if water has high chloride level)

- 3.2 Fog interior with Class VI VCI Powder. Apply 30 grams per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

- 3.3 Apply Volatile Corrosion Inhibitors (VCI's). This method requires certain levels of containment and it works best with sealed equipment. Sealing does not have to be 100% airtight, and some air exchanges due to convection are acceptable for VCI Fluids, VCI Powders, and VCI Capsules (See Chapter 1 and Corrosion Preventive Classes Chart).

- 3.4 Seal the openings immediately after cleaning and protecting the interior (several methods are listed in Table 3, below). Where special cleanliness of the flange face is required, do not apply adhesive tape directly to the face. Instead, the flange face can be protected from the adhesive by inserting Class VII 6 mil (150 microns) VCI Plastic Wrap between the adhesive and the gasket seat.

VCI-126 6 mil (150 microns)

TABLE 3

Sealing openings

TYPE OF CLOSURE	FLANGED ENDS	UNFLANGED ENDS
Wood plug and water-proof, cloth-backed, pressure sensitive tape* or equivalent		X
Plastic caps or plugs and tape.*	X	X
Plastic envelopes and tapes.*	X	X
Plastic or metal flange covers**and tape.*	X	

\*Tape is required when an airtight seal is needed.

\*\* Full-face blind gasket is sometimes desirable for added flange face protection.

- 3.5 Protect flanges by securing metal or plastic covers with at least two bolts. For pipe or fittings that need airtight seals, use both full-face blind gasket and metal covers.
- 3.6 Corrosion Inhibitor Applied by Dipping. The corrosion inhibitor must provide the protection capabilities needed. Keep coating thickness within manufacturer's specifications to assure adequate protection.

4. TANKS, PRESSURE VESSELS, COLUMNS.

- 4.1 Clean equipment prior to storage with VCI-416 and spray Class VI VCI Powder into vessels interior. Apply VCI powder with a sandblasting gun or suitable device for spraying powders. Suggested dosage is 30 grams VCI Powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) interior volume. Apply the powder in a manner that assures uniform distribution within the interior.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

- 4.2 Clean, dry and coat flange surfaces with Class IV VCI Dry Coating to a film thickness of 3-4 mils (75-100 microns). If 2 applications are needed to achieve film thickness, allow 2 hours drying time between coats.

VCI-368 or VCI-388 3-4 mils (50-75 microns)

- 4.3 Cover vessel flange and other openings with Class VII 6 mil (150 microns) VCI Plastic Wrap and secure with waterproof tape. For best results, seal flanged openings by taping with cloth-backed adhesive tape.

VCI-126 6 mil (150 microns)

- 4.4 Seal other openings and vents using caps, covers or with Class VII 6 mil (150 microns) VCI Plastic Wrap. Use waterproof adhesive tape to secure. For added protection, Class VI VCI Powder can be used with a nitrogen purge.

VCI-126 6 mil (150 microns)  
VCI-309 at 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)



- 4.5 If a lubricating tape protection is preferred, coat with 1-2 mils (25-50 microns) Class III VCI Grease.

VCI-369 or VCI-389 1-2 mil (25-50 microns)

- 4.6 Other internal parts susceptible to corrosion which are handled separately before installation, like column trays, should also receive treatment. The corrosion inhibitor selected should provide protection capabilities required as discussed in Chapter 1 and the Corrosion Prevention Classes Chart.

- 4.7 Protect exposed machined or moving parts with 1-2 mil (25-50 microns) Class III VCI Grease.

VCI-369 or VCI-389 1-2 mil (25-50 microns)

- 4.8 Painting the vessel, when necessary, should be done following sandblast cleaning. Prime with 1 mil Class IV VCI Dry Coating. The vessels' exterior carbon steel parts should be treated in the same way.

VCI-388 1-2 mil (25-50 microns)

- 4.9 When stored outside, place equipment on skids to avoid contact with ground water.

- 4.10 Inspect the equipment to assure the protective measures are effective. Frequency of inspection will vary from 6 to 12 months according to atmospheric conditions.

## 5. HEAT EXCHANGERS AND SPARE HEAT EXCHANGER TUBE BUNDLES.

- 5.1 Spray interior surfaces with Class VI VCI Powder using a sandblasting gun or suitable device for spraying powders. Use 30 grams VCI Powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) interior volume. Apply in a manner that assures uniform distribution within the interior.

VCI-307 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

- 5.2 Seal all openings using steel blind flanges for nozzles or Teflon tape wrapped pipe plugs. Coat flanges, blanks, or coupling threads with 1-2 mils (25-50 microns) Class III VCI Grease. Bolt steel blank flanges with neoprene or soft rubber gaskets. Coat bolts and nuts with 1-2 mils Class III VCI Grease.

VCI-369 or VCI-389 1-2 mil (25-50 microns)

- 5.3 If a dry coating is preferred, clean, dry and coat surfaces with 3-4 mils (75-100 microns) Class IV VCI Dry Coating. If 2 spray applications are needed to achieve recommended thickness, allow 2 hours drying time between coats. For added protection, Class VI VCI Powder can be used with nitrogen purge, at a dosage of 20 grams per cubic foot (706 g/m<sup>3</sup>).

VCI-368, VCI-388 3-4 mils (75-100 microns) and VCI-307 20g/ft<sup>3</sup> (706 g/m<sup>3</sup>)

- 5.4 Protect exchanger packing closures and floating head machined surfaces with Class III VCI Grease applied to a wet film thickness of 2 mils (50 microns). Protect floating heads from mechanical damage and dirt.

VCI-369 or VCI-389 2 mils (50 microns)

- 5.5 Protect exteriors of carbon steel surfaces with Class IV VCI Dry Coating applied to a thickness of 3-4 mils (75-100 microns). To achieve recommended film thickness, allow 2 hours drying time between coats.

VCI-368 or VCI-388 3-4 mil (75-100 microns)

- 5.6 Spare heat exchanger tube bundles must have adequate support for tubes and baffles to prevent sagging, warping and damage (for skid storage).
- 5.7 Inspect storage conditions every 3-6 months. Record date of storage, inspection and conditions for each heat exchanger or heat exchanger bundle.

## 6. PUMPS.

Reciprocating, axial flow with propeller, centrifugal, positive displacement, hydraulic and portable.

- 6.1 Clean with VCI-416 or 419, dry and coat all exterior, unpainted metal parts and surfaces with 3-4 mils (75-100 microns) Class IV VCI Dry Coating. If 2 spray applications are needed to achieve film thickness, allow 2 hours drying time between coats.

VCI-368 or VCI-389 3-4 mils (75-100 microns)

- 6.2 Remove carbon and graphite packing from all stuffing boxes. Fill stuffing boxes and gland follower (pulled up) with Class III VCI Grease.

VCI-369 or VCI-389

- 6.3 Spray the interior with Class VI VCI Powder through available ports and openings. Use 10 grams per gallon (3 g/liter) of interior volume. Apply powder with a sandblasting gun or suitable device for spraying powders. Rotate several times before sealing. Seal pumps airtight if internal rust is objectionable for the process they serve.

VCI-307 10g/gallon interior volume (3 g/liter)

- 6.4 Cover flanges, pipe tops and other openings with Class VII 6 mil (150 microns) VCI Plastic Wrap. Where practical, a blank flange should be bolted in place or a plug installed over VCI Plastic Wrap.
- 6.5 After cleaning and protecting in accordance with 6.1, exposed surfaces (including shaft ends or couplings, if any) should be wrapped with Class VII 6 mil (150 microns) VCI Plastic Wrap. Waterproof adhesive tape may be used to hold the wrapper in place.

VCI-126 6 mil (150 microns)

- 6.6 Fill all grease-type bearings full with Class III VCI Grease.

VCI-Cor-Lube or VCI-389

Fill oil-type bearing reservoirs and the breather to the proper level with approved lubricant containing 10% (by volume) Class V VCI Fluid. Seal against entry of dirt or other abrasive materials. These corrosion inhibitors need not be removed, and can be used for start-up lubrication.

10% VCI-326 or VCI-329

- 6.7 When stored outside, place equipment on skids to avoid contact with mud or ground water. To prevent direct contact between metal surface and wooden skid, place Class VII 6 mil (150 microns) VCI Plastic Wrap between the two surfaces.

VCI-126 6 mil (150 microns)

- 6.8 Turbine Drive (see 10.7).
- 6.9 Gasoline Or Direct Drive (see 10.8).
- 6.10 Motor Drive (see Section 7).

7. ELECTRICAL EQUIPMENT

7.1 Electrical Motors - Definition of equipment status storage environment.

- A. Waiting installation at the site.
- B. Installed, but operation is delayed until completion of plant construction.
- C. Long idle periods between operating cycles.
- D. The motor is a spare intended for emergency use.

The first step in determining proper care is to define the storage environment. The motor will need protection from weather, moisture condensation, dust, damaging fumes, chemicals that might be spilled accidentally, salt air, fungus and small animals. See Table 4.

7.1.2 General and Short-Term Storage

7.1.2.1 Windings. In all cases, (a,ab,c, &d), as defined in 7.1, (except recently received or reconditioned motors and windings), blow clean to remove any dust accumulation. Remove excess grease and grime from bearing housings and shaft.

7.1.2.2 Bearings. Grease lubricated bearings in new motors generally require no special preparation because they are shipped properly lubricated by the manufacturer. Oil-lubricated bearing motors are generally shipped by the manufacturer with only a thin film of oil. To protect these bearings, fill oil reservoir to the proper level with an approved lubricant containing 10% (by volume) Class V VCI Fluid before the motor is stored.

10% (by volume) VCI-326 or VCI-329

If the motor is being removed from service and placed in storage, check for proper lubrication. Also check the oil reservoir for proper oil level. Top off, if required, with Class V VCI Fluid.

VCI-326 or VCI-329

- 7.1.2.3 Shaft, Flange Surfaces and Mounting Feet. New motors are shipped with the shafts coated with a rust preventive compound. Check the shaft to see if the coating is intact. If the coating has been damaged, re-coat with 2-3 mils (50-75 microns) Class IV VCI Dry Coating. Also apply to the shaft, mounting flanges and feet of motors being removed from service. Do not apply Dry Coating on the bearings.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

- 7.1.2.4 Protection against Rodents and other Animals. Fasten covers over all vent openings to prevent entry by "mud daubers", rodents, birds and other animals or insects. In addition to nesting, rodents eat some types of insulation.

7.1.3 Long-Term Storage.

- 7.1.3.1 Protection of Motor Surfaces. Disassemble the motor and thoroughly clean all main components. Apply a solvent cutback type, hard clear resin film to machined surfaces of the rotor, between the rotor core and bearing fit shoulder of open motors (other than those having air-gap surfaces already protected by epoxy resin or equivalent material). If applied properly, to a wet film thickness of not more than 2 mils (50 microns), the resin film will not require subsequent removal. Re-paint painted surfaces; painted interior surfaces should also be repainted before reassembly.

For Cases B and C, added protection is needed against fungi. Before reassembly, all internal painted surfaces, except machined surfaces protected with Class IV VCI Dry Coating, should be treated with an anti-fungus varnish (such as P.D. George No. 11137 Insulation Manufacturer's Co-op).

- 7.1.3.2 Protection against condensation. If the motor has condensation drain plugs, remove and place in Class VII 6 mil VCI Plastic Wrap. Then attach drain plug package to the motor at drain openings so they will not be lost or over looked when the motor is placed into service. Wrap entire motor in Class VII 6 mil (150 microns) VCI Plastic Wrap and enclose small packs of desiccants. Tape to provide total enclosure. For Case B and C, electric space heaters are suggested for preventing condensation from forming in the motor.

VCI-126 6 mil (150 microns)

- 7.1.3.3 Overall Protective Coverings. Cover the motor to exclude dirt, moisture and other contaminants. Enclose the motor in Class VII 6 mil (150 microns) VCI Plastic Wrap. Attach a moisture indicator to the side of the motor where it will be visible through the opaque plastic. Place several bags of desiccant in the bag and seal.

VCI-126 6 mil (150 microns)

In Cases B and C, place Class VIII VCI Capsules inside the VCI Plastic Wrap.

2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>), VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>), VCI-126 6 mil (150 microns)

For very large motors stored outdoors in a temporary shelter, energized space heaters, Class VII 6 mil (150 microns) VCI Plastic Wrap and Class VIII VCI Capsules are recommended to protect from the elements.

VCI-126 6 mil (150 microns)- 2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>), VCI-111/11t<sup>2</sup> (.31 m<sup>3</sup>)

#### 7.1.4 Maintenance During Short or Long-Term Storage.

7.1.4.1 Bearings. For Case A and B, rotate the motor shaft by hand, a minimum of 10 complete revolutions monthly; for Case A, rotate a minimum of 10 complete revolutions every 3 months. In all cases, lubricate the bearings every 2 years. Additional attention to bearings might be required, as indicated in the motor manufacturer's instruction manual.

7.1.4.2 Shafts and Flanges. Check the condition of corrosion inhibitor periodically. Touch-up surfaces with Class IV VCI Dry Coating as required. For Case A, a minimum coating thickness of 2-3 mils is required to achieve 2 years protection. For Case B and C, a minimum coating thickness of 3-4 mils is required for 2 years protection.

VCI-368 or VCI-389

7.1.4.3 Moisture Check. Periodically check the moisture indicator and the condition of desiccant, if used. For case a and B, check at least once a month. In Case C, for instances with extreme deviations in temperature, it might be necessary to check for moisture weekly. Replace desiccant when the indicator color changes. If space heaters are used, check periodically; it is very important that they function properly.

7.1.5 Additional storage precautions for direct-current and wound - rotor alternating - current motors. For motors containing commutator and slip rings, brushes should be raised in, or removed from contacting the commutator or slip ring while the motor is in storage. Slip rings and commutators should also be sealed with Class VII 6 mil (150 microns) VCI Plastic Wrap.

VCI-126 6 mil (150 microns)

#### 7.1.6 Preparation For Service.

General. Thoroughly clean the motor to remove any oil, dust or dirt that has accumulated despite precautions taken in preparing the motor for storage. The exterior should be wiped clean with VCI-416 and the interior blown clean with low

pressure air. Use an appropriate solvent (petroleum distillate) to remove the corrosion inhibitor from shaft, flanges and mounting feet. No attention need be given to the resin film compound applied to the rotor, and between the rotor core and bearing fit shoulder, if the compound was applied to a thickness of not more than 2 mils (50 microns).

There is also no need to remove the anti-fungus compound. All temporary heaters and desiccant bags must be removed, condensation drain plugs re-installed and temporary cover removed. Remove temporary covers from all air inlets and outlets.

7.1.6.1 Bearings. Check bearings and lubrication walls to ensure they are free of dirt, dust and that drain plugs are tight. Any scratches, bruises or rust on shaft journals should be removed carefully. For motors stored 2-3 years, replace the lubricant after two years. For motors stored beyond three (3) years, replace the bearings.

7.1.6.2 Insulation Resistance Test. Test motor windings with a megaohm meter in accordance with the motor manufacturer's instruction manual.

## 7.2 Indoor Storage - Controlled Environment.

Store the following equipment in buildings heated and ventilated, as required, to control humidity. When the possibility of overhead leakage is present, wrap the equipment in Class VII 6 mil (150 microns) VCI Plastic Wrap and seal with adhesive tape. Place equipment on skids to avoid water damage. Place Class VII 6 mil (150 microns) VCI Plastic Wrap between the two surfaces to prevent direct contact.

VCI-126 6 mil (150 microns)

### 7.2.1 Air Cooled Transformers and Indoor Substation.

Where this equipment is fitted with electric heaters, connect temporary service to supplement heat in the inside storage area. This assures that the equipment remains dry and dielectric materials do not absorb moisture. Care must be taken to prevent energizing the substation through backfeed from the temporary heater power supply.

### 7.2.2 Panelboards and Switchgear.

Indoor equipment such as control and relay panel boards, motor control centers, switchgear, electric drive cabinets, heating control cabinets, panels and fire alarm consoles should be protected from mechanical damage with 1/2 inch plywood sheets or similar material. Place Class VII 6 mil VCI Plastic Wrap between plywood and metal surfaces.

VCI-126 6 mil (150 microns)

See 7.2.1 for heaters in such equipment. Protect interiors of switchgear and panelboards with Class VIII VCI Capsules.

2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>), VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

7.2.3 All Generators (whenever possible), see 7.1

7.2.4 Miscellaneous Equipment (including relays, choke, solenoid valves, meters, instruments, etc.). Wrap individual items in Class VII 6 mil (150 microns) VCI Plastic Wrap and secure with adhesive backed tape.

7.3 Indoor Storage - Partially Controlled Environment.

Incandescent type lighting and fluorescent fixtures may be stored in enclosed buildings without temperature and humidity control, but should be protected from possible flooding and roof leakage. To prevent electrical contact surfaces against oxidation, place VCI Capsules inside the storage containers; seal containers with adhesive backed tape.

2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>), VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

If not stored in containers or boxes, wrap with Class VII 6 mil (150 microns) VCI Plastic Wrap and protect from possible floor flooding or roof leakage.

VCI-126 6 mil (150 microns)

7.4 Outdoor Storage. The following equipment may be stored outdoors.

7.4.1 Outdoor Substation Equipment. May be stored exposed or under temporary shelter if the strip heaters furnished with the equipment are kept energized at the rated voltage and openings in partially assembled gear have temporary closures. Care must be taken to prevent energizing the substation through backfeed from the temporary heater power supply. For additional protection place Class VIII VCI Capsules in the interior.

2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>), VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

7.4.2 Oil Filled Transformers. Check periodically for oil level and pressure. Consistent zero pressure indicates a leak. Protect the bushings against mechanical damage. Fog Class V VCI- Fluid into air space above oil level. Use 30cc concentrate per 1 cubic foot (8cc/liter) of head space.

VCI-326 or VCI-329 30cc/ft<sup>3</sup> (8cc/liter)

7.4.3 Outdoor Switches. Coat 2-3 mils (50-75 microns) Class IV VCI Dry Coating.



- 7.4.4 Large Generators. Store in at least a temporary shelter equipped with energized heaters. Use Class VII 6 mil VCI Plastic Wrap and Class VIII VCI Capsules to protect from the elements. Periodically check for moisture. For Cases A and B, check at least once a month. In Case C for instances with extreme deviations in temperature, it might be necessary to check for moisture weekly. Check space heater operation at the same time.
- 7.4.5 Insulated Wire and Cable Impervious to Moisture. In general, wire and cable stored on reels or coils should be protected from the sunlight if the out layer is clear or any color other than black. Wires with clear nylon skin, such as THWN single conductor ( SE 33.4B) are designed for continuous service in full sunlight. This type of cable can be stored without sunlight protection. Cable ratings above 600 volts should have the ends sealed.
- 7.4.6 Batteries. Should be stored upright and be protected from mechanical damage by    inch plywood sheets or comparable material. Check the specific gravity of electrolyte. If it is low, fully charge the battery before storage. If storage will be longer than two months, use trickle chargers and periodically check the electrolyte. (If space is available, it is preferable to store indoors.)

## 8. INSTRUMENTS.

### 8.1 Shipping Containers.

It is highly recommended that the (purchase) order for new equipment state the conditions the shipping containers must meet to give adequate protection during storage. All instruments, particularly instrument panels and control valves, can be rapidly damaged or rendered inoperative if adequate measures are not taken to protect them from the following hazards:

- Mechanical damage.
- Unprotected exposure to aggressive atmospheres.
- Unskilled or repeated handling.
- Excessive moisture

Depending upon the type of instrument, protection from the above hazards can be accomplished and is recommended regardless of storage duration.

- 8.2 Electric and electronic instruments which include all instruments with electrical connections, chart drives, solenoid valves, pressure switches, relays, etc. NOTE: THESE INSTRUMENTS ARE PARTICULARLY SENSITIVE TO MOISTURE AND FREEZING. The standard cells may freeze and the circuit components may become affected with condensed moisture and render them useless. Generally, new equipment is not resistant to those conditions, and preventive steps must be taken prior to putting the instruments into storage.

- 8.2.1 Place all equipment into suitable bins (not piled) by trained personnel. To prevent corrosion and mechanical damage, wrap individual instruments in Class VII 6 mil (150 microns) VCI Plastic Wrap and secure with adhesive tape.

VCI-126 or VCI-128 6 mil (150 microns)

Protect interiors with Class VIII VCI Capsules.

2xVCI-105/5ft<sup>3</sup>, VCI-111/11ft<sup>3</sup>

New equipment should be sealed in their original crates after inserting Class VIII VCI Capsules. NOTE: THE CARE THAT MUST BE EXERCISED IN HANDLING INSTRUMENTS EXCEEDS ANY OTHER TYPE OF EQUIPMENT. Instruments are delicate and frequently have delicate tolerances and fine machining essential to their operation.

- 8.2.2 Store equipment above ground in a heated shed, or in control rooms which may already have been built and are air conditioned.

8.3 Field-Mounted Instruments Not Equipped With Electrical Connectors.

- 8.3.1 With a large volume of instruments stored outside, (shop fabricated pipe stands, racks, cubes, etc.) and awaiting field installation, it is difficult to justify the expense of inside storage. Outside supports must hold the stands and racks in an upright position until installation. To prevent corrosion and mechanical damage, wrap instruments enclosures with Class VII 6 mil (150 microns) VCI Plastic Wrap and seal with water-resistant adhesive tape. Protect interiors with Class VIII VCI Capsules.

VCI-126 or VCI-128 6 mil (150 microns), 2xVCI-105, VCI-111

NOTE: PERIODIC INSPECTION FOR WATER ACCUMULATION SHOULD BE PERFORMED. Corrective measures must be taken to prevent water accumulation.

8.4 Control Valves, Orifice Flanges, Level Chambers, Venturi Tubes, Back-Pressure Regulators, Pressure Reducing Valves, etc.

- 8.4.1 If outside storage is required, place above ground on skids and wrap in Class VII 6 mil VCI Plastic Wrap. make certain that the VCI Plastic Wrap is placed between wooden and metal surfaces to avoid direct contact. Secure VCI Plastic Wrap using water-resistant adhesive tape.

VCI-126 6 mil (150 microns)

- 8.4.2 This equipment must be adequately closed and preserved in accordance with Section 3.
- 8.4.3 Instrument air connections of control valves must be plugged, otherwise the diaphragm chambers will fill with condensed moisture or rain water.

- 8.4.4 Whenever possible, control valves should not be stored outdoors unless they are to be used within a few days. Even for temporary storage follow 8.3.1 and 8.4.1 as required.

8.5 Instrument Panels.

- 8.5.1 Seal new equipment in its original crate after inserting Class VIII VCI Capsules to protect the interior. To prevent corrosion and mechanical damage, wrap individual uncrated panels in Class VII 6 mil (150 microns) VCI Plastic Wrap and secure with adhesive tape.

2xVCI-105, VCI-111and VCI-126

- 8.6.1 Store panels in a heated/air conditioned building to protect them form mechanical and atmospheric damage. Panel finish is easily damaged and contains delicate instruments requiring the same precautions described in 8.3 and 8.4.

- 8.6.2 Heated and air conditioned trailers would be a suitable alternate facility for critical instruments.

The site's instrument supervision should normally incur the responsibility to define and coordinate storage of all instruments to ensure compliance with above recommendations.

9. FANS AND BLOWERS.

- 9.1 Inspect fans and blowers immediately upon receipt to determine if painting is adequate for the length of storage and any mechanical damage. If conditions warrant, prime with 1 mil Class IV VCI- Dry Coating. If fan or blower is a high speed type, spray primer on uniformly to preserve the dynamic balance of the impeller.

VCI-388 1 mil (25 microns)

- 9.2 Block units up when stored. Place on skids to keep them out of mud and dirt. To prevent direct contact between wood and metal surface, place Class VII 6 mil (150 microns) VCI Plastic Wrap between the two surfaces. If stored outside, set the units so that water does not collect in the housings. Provided that this will not damage the bearings, the units could be positioned horizontally or at an angle to allow better drainage.

VCI-126 6 mil (150 microns)

- 9.3 Coat shafts with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mil (50-75 microns)

- 9.4 Seal bearings with a weatherproof tape to keep out water or abrasive materials. Fill oil type bearing reservoirs to the proper level with vendor recommended lubricant. Add 10% Class V VCI Fluid to the reservoir.

Grease type anti-friction bearings should be coated with Class III VCI Grease. Neither the fluid or the grease need to be removed when the unit is put into operation.

- 9.5 If the units have vane control mechanisms, coat with 3-4 mils (75-100 microns) Class III VCI Grease. If two spray applications are needed to achieve film thickness, allow two hours drying time between coats.

- 9.6 Heating and cooling coils should have screwed connections sealed with caps and plugs. Protect the internal surfaces by dusting with Class VI VCI Powder. Use 10 grams per gallon (3 g/liter) of cooling system volume. Apply with a sandblasting gun or suitable device for spraying powders.

VCI-309 10g/gallon interior volume (3 g/liter)

- 9.7 Cover units with Class VII 6 mil (150 microns) VCI Plastic Wrap. Secure with waterproof adhesive tape.

VCI-126 6 mil (150 microns)

## 10. AIR COMPRESSORS.

- 10.1 Air compressors lubricated from the crankcase should have the crankcase filled to operating level with vendor recommended lubricant. Add 10% Class V VCI Fluid to the crankcase.

10% VCI-326 or VCI-329

- 10.2 With the air cleaner removed, spray or fog Class V VCI Fluid into the section opening. Use 30cc concentrate for each gallon (8cc/liter) of interior volume.

VCI-326 or VCI-329 30cc/gallon interior volume (8cc/liter)

- 10.3 All cylinder drains should be left open to prevent collection of moisture. Open water jackets and drain to prevent accumulation of moisture and possible freezing.

- 10.4 Coat exposed shafts and machined surfaces with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-373, VCI-375, VCI-376 or VCI-VCI-386 2-3 mils (50-75 microns)

Fill packing glands with Class III VCI Grease.

VCI-369 or VCI-389

- 10.5 If stored outside, clog up and cover units with Class VII 6 mil (150 microns) VCI Plastic wrap. Secure with waterproof adhesive tape.

VCI-126 6 mil (150 microns)

- 10.6 Interior of air tanks and ferrous air lines should be fogged with VCI Powder using conventional sandblasting gun or similar device suitable for fogging or spraying powder. Use 30 grams per 1 cubic foot (1.059 kg/m<sup>3</sup>) of tanks' volume. Seal the units using oil resistant adhesive tape.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

10.7 Turbine Drive.

- 10.7.1 Flush turbine bearings with Class V VCI Fluid.

VCI-326 or VCI-329

- 10.7.2 Coat the governor mechanism with 2 mils (50 microns) Class V VCI Fluid.

VCI-326 or VCI-329 2 mils (50 microns)

- 10.7.3 Brush carbon packing glands with 3 mils (75 microns) Class III VCI Grease.

VCI-369 or VCI-389 3 mils (75 microns)

- 10.7.4 Brush all exterior unpainted metal surfaces with 2 mils Class III VCI Grease.

VCI-369 or VCI-389

10.8 Gasoline or Diesel Engine Drive.

- 10.8.1 Lubricating oil systems should be thoroughly drained and filled to operating level, with vendor recommended lubricant. Add a 10% concentration of Class V VCI Fluid to the crankcase. Turn engine slowly to achieve uniform distribution.

- 10.8.2 Remove spark plugs in gasoline engines and spray Class B VCI fluid in cylinders and replace plugs. Use 30cc concentrate per gallon (8cc/liter) of interior volume. In diesel engines, spray Class V VCI Fluid into air intake while turning over engine manually using same dosage as for gasoline engines.

VCI-326 or VCI-329 30cc/gallon interior volume (8cc/liter)

- 10.8.3 The cooling system should be drained and dusted with Class VI VCI Powder. Use 10 grams per gallon (3 g/liter) of interior volume. Apply with a sandblasting gun or suitable device for spraying powders. Seal all openings with waterproof adhesive tape.

VCI-309 10g/gallon interior volume (3 g/liter)

- 10.8.4 Remove inspection covers for access to valve mechanisms, gears, cams, etc. Spray machined surfaces with 1-2 mils (25-50 microns) Class III VCI Grease.

VCI-369 or VCI-389 1-2 mil (25-50 microns)

- 10.8.5 On the exterior of the engine, unpainted metal surfaces should be brushed or sprayed with 2 mils (50 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2 mils (50 microns)

- 10.8.6 Tag unit with notice of treatment and date.

## 11. GEAR BOXES AND SPEED CHANGERS.

- 11.1 Gear boxes and speed changers including oil type bearings should be filled to operating level with vendor recommended lubricant. Add 10% concentration of Class V VCI Fluid.

10% VCI-326 or VCI-329

Grease type anti-friction bearings should be protected with Class III VCI Grease. Manually or power operate the unit for a few minutes to ensure that VCI is uniformly distributed within the interior.

VCI-326 or VCI-326

If not installed or inoperable, spray interior with VCI Fluid concentrate and fill with approved lubricant containing 10% Class V VCI Fluid.

VCI-326 or VCI-329

- 11.2 Coat exposed metal with 2-3 (50-75 microns) mils Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mil (50-75 microns)

- 11.3 Seal bearings, casing flanges and vents with oil resistant, weatherproof adhesive tape to keep out water and prevent leakage.

- 11.4 Inspect painted surfaces and where paint is in poor condition, prime with 1 mil (25 microns) Class IV VCI Dry Coating.

VCI-373, VCI-375, VCI-376 or VCI-386 1 mil (25 microns)

12. MECHANICAL EQUIPMENT.

12.1 General. If size permits, store all mechanical equipment indoors or protect from rain and elements.

12.2 Stainless Steel. Clean interior then dry with clean, dry compressed air and seal. Coat joints and crevices with Class IV VCI Dry Coating.

VCI-373 1 mil (25 microns)

12.3 Carbon Steel.

12.3.1 Clean interior of equipment; spray Class VI VCI Powder into vessel's interior. Apply with a sandblasting gun or suitable device for spraying powders. Use 30 grams of VCI Powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume. Apply powder in a manner to assure uniform distribution within the interior. Seal all openings and vents using caps and covers. For additional protection, VCI Powder can be used in conjunction with a nitrogen purge.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

12.3.2 Coat bolting with 2 mils (50 microns) Class III VCI Grease.

VCI-369 or VCI-389 2 mils (50 microns)

12.3.3 Coat open flanges with 3-4 mils (75-100 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

12.4 Coat exposed shafting with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

12.5 Fill oil type bearing reservoirs to operating level with vendor recommended lubricant. Add a 10% concentration of Class V VCI Fluid to the reservoir. Grease type anti-friction bearings should be protected with Class III VCI Grease.

10% VCI-326 or VCI-329

12.6 Seal bearings, flanges and vents with oil resistant, waterproof adhesive tape.

12.7 Inspect painted surfaces, and where paint is in poor condition, touch-up with Class V VCI Dry Coating.

VCI-386 2 mils (50 microns)

TABLE 4

Electric Motor Storage, Environmental Classification

- CASE A INDOOR AND SHELTERED OUTDOOR - Includes indoor, controlled environment; indoor partially controlled environment.
- CASE B OUTDOOR - Includes outdoor dry, inland; outdoor humid inland environments. Dust, rain, snow and organic (fungus) growth, sheltered outdoor without direct exposure to sun and elements.
- CASE C OUTDOOR, HARSH ENVIRONMENT - Includes outdoor salty and industrial environment. Air laden with salt, corrosive chemical agents, coal dust or fly ash, in addition to dust and sand, rain, snow, sun, heat, and fungus growth. A "worst case" environment.



## Chapter 5

### PROTECTIVE FIELD STORAGE OF DRILLING EQUIPMENT AND PIPELINES

#### 1. SCOPE.

- 1.1 This standard outlines the procedures for protecting oil field and pipeline equipment and systems. Only the most cost effective methods are referenced, although in some instances deviations are acceptable due to practical limitations.
- 1.2 In mothballing a complex system like a drilling rig and platform, some logical order must be established for accomplishing these tasks. Certain equipment will be required to accomplish these procedures and must be left operating until near completion. Many tasks can be done concurrently.
- 1.3 The specific kind of equipment, the type of installation or climate conditions of the area may require more thorough consideration. These procedures and recommendations serve as a guide only. For capital intensive equipment, consult manufacturer for additional precautions.
- 1.4 Other chapters contain information which may be pertinent. Refer to Table of Contents and Equipment Index.

#### 2. GENERAL.

- 2.1 Lubricating Films. In many instances lubricating oil and grease films will rupture as a result of prolonged exposure to elements or due to emulsification. A vented case will allow repeated condensation cycles and water will accumulate at the bottom of the sumps. Pitting of anti-friction and journal bearings may occur.
- 2.2 Touch-Up. Do a thorough touch-up coating before storing. First, wire brush loose paint and rust, then clean surface with a suitable solvent or cleaner. Apply Class IV VCI Dry Coating to a film thickness of sharp corners and edges, (e.g. top scabs, laps trim, ragged torch cuts or broken tack welds), scrape or wire brush away weld slag and spatter, mill scale or rust. As above, make sure that the surface is clean and dry. Touch-up protection can be done conveniently with a brush or spray gun.
- 2.3 Shroud with Class VII 6 mil (150 microns) VCI Plastic Wrap over the control cabinets and similar structures.

VCI-126 6 mil (150 microns)

If necessary, cut openings around handles or similar protrusions which are difficult to seal. Before shrouding, work Class V VCI Fluid into the pivots and rollers to prevent corrosion in crevices and similar areas.

VCI-326 or VCI-329

Protect the pivot points of the heavy mechanical control linkages located below the floor by working Class III VCI Grease into the fits.

VCI-369 or VCI-389

- 2.4 Covering with Tarpaulin. If a tarpaulin is used to cover the equipment it should not be less than 6 mils (150 microns) in thickness. High wind locations will require a much greater mil thickness. Black normally endures prolonged sunlight exposures better than clear inhibitors. Before applying the tarpaulin, all points, ridges or other abrupt contour changes with which the covering will touch should be rounded and padded with cardboard that is tied and taped in place. Large openings, such as those above the cable and sand line drums and at guard junctures, should be boarded up sufficiently to give support to the tarpaulin. The wood should be wired or otherwise held securely in place so that it will not move from position when it shrinks with drying. It is desirable to hold the tarpaulin with wood framing. A strip of wood may be placed over the tarpaulin and nails driven into the framing, or the tarpaulin may be reinforced with waterproof tape and roofing nails or staples driven into the wood. The tarpaulin should be carefully draped so that there will be no folds or depressions which will catch water, especially if freezing may occur, as such points of weight would destroy a tarpaulin in the wind. Light rope or cord should be used to keep the tarpaulin draped as desired, provide support and prevent billowing and fluttering.

2.6 Index of Drilling Equipment Categories.

1. AC Blower Units (Carrier 40 RR)
2. AC Compressor (Carrier 5F40)
3. Accumulator Unit (Koomey)
4. Air Compressor (Quincy ASI 490)
5. Airtemp AC Condensing Unit (Carrier 38AE)
6. Anchor Winch (Le Tourneau)
7. Annular Preventer (Cameron Type D)
8. Auxiliary Brake & Cooling System (Baylor 7838)
9. BOP Handling System (Beebe)
10. Blower and Motor for Rotary Drive
11. Bulk Tanks
12. Chemical Extinguishing Unit
13. Cranes (Le Tourneau PCM-120)
14. Crown Blocks
15. Deepwell Pumps
16. Degasser (Drilco)
17. Derrick Shale Shaker

18. Desander (Swaco)
19. Dirty Lube Pump, Bilge Pump, Drillwater Pump, Diesel Fuel Pump
20. Drawworks (National 1320-UE)
21. Drill Pipe and Collars
22. Drill Water Tanks
23. Fuel Oil Tanks/Purifier
24. Hook Block
25. Kelly Spinner
26. Main Engines
27. Mud Agitator (Lighthin')
28. Mud Cleaner (Swaco)
29. Mud Cleaner Pump and Desander Pump
30. Mud Pump & Mud System (National)
31. Potable Water Tanks
32. Preload Diesel
33. Preload Tank
34. Preload Pump
35. Quarters
36. Ram Preventer (Cameron Type U)
37. Rotary Table
38. Rotary Transmission
39. SCR
40. Sanitary Pump, Potable Pump
41. Sewage Treatment Plant
42. Skidder Unit (Le Tourneau)
43. Slant and Elevating System (Le Tourneau)
44. Spinning Wrench (Varco SSW-10)
45. Spring Slips (Varco)
46. Super Choke (Swaco)
47. Survival Capsule & Winch (Whittaker CA 5400)
48. Swivel (National P-500)
49. Tuggers (Ingersoll Rand K 4UL)
50. Washing Machine (Milnor)
51. Watermaker (Chemtreat RO)
52. Wire Line Anchor

## 2.7 Suggested Order for Tasks.

Some order must be established for accomplishing these tasks. Certain equipment will be required to accomplish these procedures and must be left operating until near completion. The following is a suggested order for the performance of these procedures. Many can be done concurrently.

1. Drill Pipe and Collars
2. Survival Capsule & Winch
3. Annular Preventer
4. Ram Preventer
5. Spring Slips
6. Kelly Spinner

7. Spinning Wrench
8. Swivel
9. Rotary Transmission
10. Rotary Table
11. Hood Block
12. Crown Block
13. Drawworks
14. Wire Line Anchor
15. Auxiliary Brake and Cooling System
16. Mud Pumps
17. Degasser
18. Mud Cleaner Pumps and Desander Pump
19. Mud Cleaner
20. Desander
21. Shale Shaker
22. Super Choke
23. Blower & Motors for Rotary Drive, Drawworks & Mud Pumps
24. Watermaker
25. Drill Water Tanks
26. Preload Tanks
27. Preload Tanks
28. Sewage Treatment Plant
29. Sanitary Pump, Potable Pump
30. Potable Water Tanks
31. Skidder Unit
32. Accumulator Unit
33. Slant and Elevating Systems
34. Bulk Tanks
35. Tuggers
36. BOP Handling System
37. Washing Machine
38. Preload Diesel
39. Lightening Mud Agitators
40. Anchor Winch
41. Living Quarters
42. AC Condensing Unit
43. AC Compressor
44. AC Blower Units
45. Air Compressor
46. Fuel Oil Tanks/Purifier
47. Cranes
48. Chemical Extinguishing Unit
49. Dirty Lube Pump, Bilge Pump, Drillwater Pump and Diesel Fuel Pump
50. SCR
51. Deepwell Pumps
52. Main Engines
53. Emergency Generator
54. Diverter
55. Cement Unit
56. Logging Unit
57. Sec. 35
58. Anchor System
59. Fuel Purifier

3. AC BLOWER UNITS.

- 3.1 Clean interior of unit with VCI-416 or VCI-419
- 3.2 Remove v-belt from motor and coat with silicone grease.
- 3.3 Wrap motor in Class VII 6 mil (150 microns)VCI Plastic Wrap.

VCI-126 6 mil (150 microns)

- 3.4 Place Class VIII VCI Capsules in top side of unit. Seal unit tightly.

4. AC COMPRESSOR

- 4.1 Shut suction valve closest to compressor. Run compressor until it shuts off. Close pressure valve closest to compressor. Slowly bleed off remaining pressure.
- 4.2 Fill crank case with approved oil (Mobile Arctic 155 or equivalent) containing 20% class V VCI Fluid.

20% VCI-326 or VCI-329

- 4.3 Run unit for 30 minutes.
- 4.4 Coat shaft and all exposed metal surfaces with 1-2 mils (25-50 microns) Class III VCI Grease.

VCI-369 or VCI-389 1-2 mil (25-50 microns)

- 4.5 Cover electric motor with Class VII 6 mil (150 microns) VCI Plastic Wrap and seal.

VCI-126 6 mil (150 microns)

5. ACCUMULATOR UNIT.

- 5.1 Check fluid in reservoir for water contamination (fluid should be black, water soluble oil).
- 5.2 If fluid is contaminated, drain and refill system.
- 5.3 Fill the reservoir with approved oil (Mobil 5 or equivalent) containing 20% V VCI Fluid.

20% VCI-326 or VCI-329

- 5.4 Fill triplex pump with approved oil (Mobile Delvac 1220 or equivalent) containing 20% Class V VCI Fluid.  
20% VCI-326 or VCI-329
- 5.5 Drain chain guard and refill with Class V VCI Fluid.  
VCI-326 or VCI-329
- 5.6 Fill air lubricator with Class V VCI Fluid.  
VCI-326 or VCI-329
- 5.7 Circulate reservoir fluid using the air pumps and the triplex pump for 10 minutes. Close manifold bleeder valve and allow system to pressure up to 3,000 psi.
- 5.8 Alternately open and close all the 4-way control valves using the control manifold and the control panel.
- 5.9 Adjust both regulators on the control manifold through their full operating range 2-3 times.
- 5.10 Shut down unit and vent all fluid pressure in the system.
- 5.11 Check accumulator precharge, maintain a charge of 1000 psi and add nitrogen if necessary. Accumulator bank isolator valves should be in the open position.
- 5.12 Coat exposed shafts on air pumps with 2-3 mils (50-75 microns) Class III VCI Grease.  
VCI-369 or VCI-389 2-3 mils (50-75 microns)
- 5.13 Place Class VIII VCI Capsules in the motor starter.  
2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)
- 5.14 Place Class VIII VCI Capsules inside the motor and cover with 6 mil (150 microns) tarpaulin.  
2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

- 5.15 Coat the exposed pump and electric motor shafts and plunger rods with 2-3 mils (50-75 microns) Class III VCI Grease.
- VCI-369 or VCI-389 2-3 mils (50-75 microns)
- 5.16 Place all lever operated control valves in the open position. Use 2-3 mils (50-75 microns) Class III VCI Grease on the exposed cylinder shafts. Open manifold bleeder valve. Ensure nitrogen precharge on surge dampener is at 400 psi.
- VCI-369 or VCI-389 2-3 mils (50-75 microns)
- 5.17 Close shutoff valves of each nitrogen bottle. Open nitrogen backup isolator valve.
- 5.18 Spray entire unit with 2-3 mils (50-75 microns) Class IV VCI Dry Coating. If 2 applications are need to achieve recommended film thickness, allow 2 hours drying time between coats.
- VCI-368 or VCI-388 2-3 mils (50-75 microns)
- 5.19 Fill air lubricator of remote panel with Class V VCI Fluid, operate unit.
- VCI-326 or VCI-329
- 5.20 Spray remote panel with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.
- VCI-368 or VCI-388 2-3 mils (50-75 microns)

6. AIR COMPRESSOR.

- 6.1 Fill oil sump with approved oil (Mobile Delvac 1220, or equivalent) containing 20% Class V VCI Fluid.
- 20% VCI-326 or VCI-329
- 6.2 Run compressor for 15 minutes.
- 6.3 Blow Class VI VCI Powder into air intake housing with a sandblasting gun or suitable device for fogging powders. Apply in a manner that assures uniform distribution within the interior. Use 20 grams Class VI VCI Powder per 1 cubic foot (706 g/m<sup>3</sup>)of interior volume. Seal all openings.
- VCI-309 30g/ft<sup>3</sup> (706 g/m<sup>3</sup>)
- 6.4 Place Class VIII VCI Capsules in top of electrical control box. Seal box with tape.
- 2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>)or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

- 6.5 Place Class VIII VCI Capsules inside the electric motor and seal.  
 2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)
- 6.6 Place Class VIII VCI Capsules in top section of each air dryer and seal unit.  
 2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)
- 6.7 Drain condensate trap on air dryer. Add a mixture of fresh water with 2.5% by weight of Class VI VCI Powder and 0.25% by weight of S-5 Wetting Agent.

VCI-309 & S-5 Wetting Agent

7. AIRTEMP AC CONDENSING UNIT.

- 7.1 Use fin cleaner to clean fins and inside of unit.
- 7.2 Spray fins with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.  
 VCI-368 or VCI-388 2-3 mils (50-75 microns)
- 7.3 Place Class VIII VCI Capsules inside top of unit. Cover unit with tarpaulin.  
 2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

8. ANCHOR WINCH.

- 8.1 Fill gear sump with approved oil (Mobile Gear 636 or equivalent) containing 20% Class V VCI Fluid.  
 20% VCI-326 or VCI-329
- 8.2 Operate unit for 15 minutes.
- 8.3 Place Class VIII VCI Capsules inside motor case and seal.  
 2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)
- 8.4 Spray entire unit, cable and fairleader with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.  
 VCI-368 or VCI-388 2-3 mils (50-75 microns)

9. ANNULAR PREVENTER.

- 9.1 Make sure the BOP is fully open.
- 9.2 Remove and bleed all operating pressure.



9.3 Remove the plugs from the unused opening and closing ports on the BOP to vent the operating system.

9.4 Grease the actuator screws with 1 mil (25 microns) Class III VCI Grease.

VCI-369 or VCI-389 1 mil (25 microns)

9.5 Clean the quick-release top. Make sure the lower surface of the quick-release top, the lock rings, and the actuator ring are clean.

9.6 Remove, clean and inspect the top trash seal.

9.7 Grease the top trash seal with 2-3 mils (50-75 microns) Class II Grease and re-install.

Grease 2-3 mils (50-75 microns)

9.8 Remove, clean, and send the packer and doughnut to another rig or place in storage off-site.

9.9 Remove the support plate.

9.10 Clean out the inside of the BOP body.

9.11 Clean out the vent ports with a welding rod.

9.12 Check tightness of pusher plate screws.

9.13 Make certain the outer cylinder is fully seated.

9.14 Spray the inside of the BOP body and all components with Class V VCI Fluid.

VCI-326 or VCI-329

9.15 Install the support plate.

9.16 Spray the inside of the quick release top with Class V VCI Fluid.

VCI-326 or VCI-329

Grease the actuator screws and cavity around the screws with 2-3 mils (50-75 microns) Class III VCI Grease.

VCI-369 or VCI-389 2-3 mils (50-75 microns)

9.17 Spray unit externally with 3-4 mils (75-100 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

9.18 Secure unit from movement.

10. AUXILIARY BRAKE AND COOLING SYSTEM.

- 10.1 Drain system of all coolant.
- 10.2 Circulate clean water through system for one hour.
- 10.3 Drain water from system.
- 10.4 Remove all dirt, mud, and other contaminants from the brake, heat exchangers, pumps, etc.
- 10.5 Clean inside of brake cooling tank.
- 10.6 Add 2.5% Class VI VCI Powder and 0.25% S-5 Wetting Agent in brake cooling tank and circulate in system for 30 minutes.

VCI-609 & S-5 Wetting Agent

- 10.7 Upon completion of step 10.6 and after slugging pit has been thoroughly cleaned out, transfer solution of Class VI VCI Powder & S-5 Wetting Agent to slugging pit.

VCI-609 Solution

- 10.8 Spray the inside of the brake cooling tank with above solution.

VCI-609 Solution

- 10.9 Pump both bearing cavities on brake full of Class III VCI Grease.

VCI-369 or VCI-389

- 10.10 Using Cortec VCI-609/water solution, spray the interior of the brake by inseting an air nozzle into each of the four 1" NPT inspection holes. These holes are equally spaced in each of the end rings at the rotor diameter. CAUTION: Do Not spray coil breather or cavity drains.

VCI-609 Solution

- 10.11 Remove motors from brake cooling pumps and wrap in Class VII 6 mil (150 microns) VCI Plastic Wrap. Place into storage.

VCI-126 6 mil (150 microns)

- 10.12 Spray all exposed metal surfaces on system with 3-4 mils (75-100 microns) Class IV VCI Dry Coating. Allow 2 hours drying time between coats.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

- 10.13 Cover brake with tarpaulin.

11. BOP HANDLING SYSTEM.

- 11.1 Drain oil from all the following and refill with Class V VCI Fluid.

Air Lubricator  
1st Stage Reducer  
2nd Stage Reducer  
Trolley Gear Box  
Trolley Air Motor  
Hoist Air Motor

VCI-326 or VCI-329

- 11.2 Use Class III VCI Grease on the following: trolley wheels, sheaves, hook bearings and suspension yoke (13 fittings).

VCI-369 or VCI-389 2-3 mils (50-75 microns)

- 11.3 Run unit for 15 minutes.

- 11.4 Spray entire unit and chain with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

12. BLOWER AND MOTORS FOR ROTARY DRIVE, DRAWWORKS AND MUD PUMPS.

- 12.1 Remove all dirt, mud and other contaminants from blowers and motors.

- 12.2 Coat shafts with 3 mils (75 microns) Class III VCI Grease.

VCI-369 or VCI-389 3 mils (75 microns)

- 12.3 Coat any exposed metal with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

- 12.4 Remove, tag and wrap motors with Class VII 6 mil (150 microns) VCI Plastic Wrap.

VCI-126 6 mil (150 microns)

- 12.5 Cover blowers with black 6 mil (150 microns) tarpaulin.

- 12.6 Check every 3 months.

13. BULK TANKS.

- 13.1 Blow tanks and lines clean with dry compressed air.

- 13.2 Sweep tanks clean.

- 13.3 Spray interior of tank with Class VI VCI Powder. Apply powder with a sandblasting gun or suitable device for spraying powders. Apply in manner that assures uniform distribution with interior. Use 30 grams VCI Powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume. Seal all openings.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

- 13.4 Apply Class VI VCI Powder inside all cement lines using method described in 6.3.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

- 13.5 Remove hydraulic load cell from each tank. Wrap cell in Class VII Plastic Wrap and place into storage.

VCI-126 6 mil (150 microns)

- 13.6 Remove cell read-out dial. Wrap in class VII 6 mil (150 microns) VCI Plastic Wrap and place into storage.

VCI-126 6 mil (150 microns)

14. CHEMICAL EXTINGUISHING UNIT.

- 14.1 Wash down unit.

- 14.2 Coat hoses with silicone grease.

- 14.3 Wrap all pressure gauges in Class VII 6 mil (150 microns) VCI Plastic Wrap.

VCI-126 6 mil (150 microns)

- 14.4 Cover unit with VCI-126 Reinforced Film.

15. CRANES.

- 15.1 Grease all fittings including motors in accordance with normal preventive maintenance.
- 15.2 Add Class V VCI Fluid to the hook, swing and boom gear boxes at 20% VCI Fluid with approved oil (Mobil Gear 636 or equivalent).
- 20% VCI-326 or VCI-329
- 15.3 Place Class VIII Capsules inside cabin at various locations. Seal cabin air tight.
- 2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)
- 15.4 Operate crane for 15 minutes.
- 15.5 Coat wire rope with penetrating oil then spool up on drum. Once spooled, spray with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.
- VCI-368 or VCI-388 2-3 mils (50-75 microns)
- 15.6 Coat all exposed gears with 2-3 mils (50-75 microns) Class III VCI Grease.
- VCI-369 or VCI-389 2-3 mils (50-75 microns)
- 15.7 Spray boom with 2-3 mils (50-75 microns) Class IV VCI Dry Coating. If 2 spray applications are needed to achieve recommended film thickness, allow 2 hours drying time between coats.
- VCI-368 or VCI-388 2-3 mils (50-75 microns)

16. CROWN BLOCK.

- 16.1 Inspect external surfaces of traveling block and crown block for signs of rust. If large areas of rust are found on traveling blocks, the sheave guards should be opened up for further inspection.
- 16.2 Any rusted areas should be wire brushed clean and painted with a zinc rich primer.
- 16.3 Grease all fittings with 2-3 mils (50-75 microns) Class III VCI Grease. Rotate sheaves to move bearing contact points and distribute grease. Repeat every three months.
- VCI-369 or VCI-389 2-3 mils (50-75 microns)
- 16.4 Spray all exposed metal parts with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.
- VCI-368 or VCI-388 2-3 mils (50-75 microns)
- 16.5 Cover blocks with 6 mil (50-75 microns) tarpaulin (See 2.4).

17. DEEPWELL PUMPS.
- 17.1 Pull pump up on deck.
- 17.2 Remove all marine growth from pump body, pump screens, piping and wiring. Drain any water from pump.
- 17.3 Coat interior and exterior of pump with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.  
VCI-368 or VCI-388 2-3 mils (50-75 microns)
- 17.4 Disconnect electric cable and store with pump.
18. DEGASSER.
- 18.1 Operate unit for 30 minutes with fresh water to clean out mud.
- 18.2 Remove electric motor and wrap in Class VII 6 mil (150 microns) VCI Plastic Wrap and place into storage.  
VCI-126 6 mil (150 microns)
- 18.3 Place Class VIII VCI Capsules in electrical box..  
2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)
- 18.4 Spray unit externally with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.  
VCI-368 or VCI-388 2-3 mil (50-75 microns)
- 18.5 Spray interior with Class VI VCI Powder: Use 30 grams of powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior foot of interior volume.  
VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)
19. DERRICK SHALE SHAKER.
- 19.1 Remove and store screens.
- 19.2 Clean unit. Prime and paint where needed.

19.3 Fill oil sump with approved oil (Mobil SHC 619 or equivalent) containing 20% Class V VCI Fluid.

20% VCI-329

19.4 Run unit for 30 minutes.

19.5 Remove and cover vibrator motors with Class VII 6 mil (150 microns) VCI Plastic Wrap and place into storage.

VCI-126 6 mil (150 microns)

19.6 Place Class VIII VCI Capsules inside top of lubricator housing and seal up.

One VCI-110/10ft<sup>3</sup> (1.28 m<sup>3</sup>), 2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

19.7 Spray entire unit with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

19.8 Cover unit with tarpaulin.

20. DESANDER.

20.1 Thoroughly wash inside and outside of units with fresh water.

20.2 Prime and paint where needed with approved coating.

20.3 Spray entire unit (inside and outside) with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

21. DIRTY LUBE PUMP, BILGE PUMP, DRILLWATER PUMP, DIESEL FUEL PUMP.

21.1 Drain pump of all fluid.

21.2 Spray pump internally with 1 mil (25 microns) Class V VCI Fluid.

VCI-326 or VCI-329 1 mil (25 microns)

21.3 Cover pump and motor with Class VII 6 mil (150 microns) VCI Plastic Wrap.

VCI-126

22. DRAWWORKS.

22.1 Remove drill line from drum after setting traveling block on drill floor.

22.2 Clean exterior of all mud, dirt and other foreign material.

- 22.3 Clean and repaint all rust spots with zinc rich primer if required.
- 22.4 Drain and clean sumps in transmission and chain cases.
- 22.5 Remove all guards and covers. Coat all shafts, bearings, and any bare metal with 2-3 mils (50-75 microns) Class IV VCI Dry Coating. Rotate shafts to ensure complete coverage.
- VCI-368 or VCI-388 2-3 mil (50-75 microns)
- 22.6 Pump SAE 30 weight non-detergent oil (Mobil DTE heavy or original oil may be used) containing 20% Class V VCI Fluid into the transmission oil system until the entire system is flushed of untreated oil. Rotate shafts so that chains are completely covered with oil.
- 20% VCI-326 or VCI-329
- 22.7 Brush Class II Grease into spline tooth clutches and reverse gear set.
- Brush with grease
- 22.8 Thoroughly grease all fittings with 2-3 mils (50-75 microns) Class III VCI Grease. Use enough material to force old grease out of the cavities. Rotate linkage and shafts while applying grease to ensure full distribution. DO NOT over grease catheads, use only 3-4 strokes.
- VCI-369 or VCI-389 2-3 mils (50-75 microns)
- 22.9 Remove constricting-type clutch elements including motor inertia brake, rotary brake, coring reel clutch etc. and store in rig store room. Coat clutch drums with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.
- VCI-368 or VCI-388 2-3 mils (50-75 microns)
- 22.10 Remove break bands and store in rig store room. Be careful not to kink or otherwise deform bands. Coat brake rims, brake band devices, eye bolts, and pins with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.
- VCI-368 or VCI-388 2-3 mils (50-75 microns)
- 22.11 Drain brake rim cooling system and flush with a 5% solution of Class VI VCI Powder.
- 5% VCI-309
- 22.12 Lubricate all shift and control levers on drillers console with 2-3 mils (50-75 microns) Class III VCI Grease.
- VCI-369 or VCI-389 2-3 mils (50-75 microns)



Coat inside and outside of control cabinet with 2-3 mils (50-75 microns) Class IV VCI Dry Coating. Be sure to grease the emergency low clutch pedal and linkage. Leave pedal in up position.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

22.13 Drain condensation from air lines, air receiver tank and water trap after air system has been treated. (See Air Compressor/Air System).

22.14 Spray Class VI VCI Powder through lines and into the receiver tank. Use 30 grams of powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

22.15 Remove sump drain plug from drawworks transmission. Fill with 10% Class V VCI Fluid. Replace all guards and seal all openings in the drawworks to prevent entry of moisture or dust. cover sump plug hole with cloth or screen.

10% VCI-326 or VCI-329

22.16 Plug exposed ends of water, air, and oil lines.

22.17 Place Class VIII VCI Capsules in control cabinets.

2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

22.18 Check to be sure all bare metal and moving parts are coated with 2-3 mils (50-75 microns) Class VI VCI Dry Coating. Tightly seal all openings and covers. Use silicone or waterproof tape to seal openings.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

22.19 For coring reel brake unit, repeat procedures described in step 20.10. Spray Class I VCI Thin film onto brake linkages and lever.

VCI-337

22.20 Grease drawworks alignment and mounting hardware.

22.21 Activate strip heaters on motors (752).

22.22 Pull brushes from holders on motors (752) and store brushes.

22.23 Apply 2-3 mils (50-75 microns) Class III VCI Grease to all exposed shafts on motors.

VCI-369 or VCI-389 2-3 mils (50-75 microns)

22.24 Install class VIII VCI Capsules in the top of each motor.

2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

22.25 Seal all openings in motors.

22.26 Cover drawworks with tarpaulin (See 2.4).

22.27 Check at three month intervals. Rotate unit and motors every three months.

23. DRILL PIPE AND COLLARS.

23.1 As possible, remove loose scale and foreign matter with a brush. Wash interior and exterior with water. If needed to prevent flash rusting, wash with 1% Class VI VCI Powder.

1% VCI-609

Thoroughly clean threads and inspect for damage. When pipe is washed and dry, fog with Class VI VCI Powder. Apply powder with a sandblasting gun or suitable device for fogging powders. Apply in manner that assures uniform distribution within interior. Use 30 grams powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

Protect threads with 2-3 mils (50-75 microns) Class III VCI Grease.

VCI-369 or VCI-389 2-3 mils (50-75 microns)

Seal drill pipe end using standard thread protectors and plastic end caps.

23.2 After washing down and installing thread protectors, spray thread protectors and pipe (both ends) with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

23.3 Off-load all drill pipes and collars.

23.4 Coat all external surfaces with 3-4 mils (75-100 microns) Class IV VCI Dry Coating (See figure 21).

VCI-368 or VCI-388 3-4 mils (75-100 microns)

Protect threads with 2-3 (50-75 microns) mils class III VCI Grease.

VCI-369 or VCI-389 2-3 mils (50-75 microns)

Seal drill pipe ends using standard thread protectors and plastic end caps.

- 23.5 If drill pipe is to be stored on board, wash interior and exterior with Class VI VCI Powder.

VCI-309 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

Apply powder with a sandblasting gun or suitable device for fogging or spraying powder. Apply in a manner that assures uniform distribution within interior. Use 30 grams powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume.

Thoroughly wash drill collars and threads. Grease with Class III VCI Grease. Install thread protectors.

VCI-326 or VCI-329

24. DRILL WATER TANKS.

- 24.1 After all piping systems have been flushed and treated, and no more drill water is required, empty all water until suction is lost.
- 24.2 Gas free tanks and have them certified safe for entry by a marine chemist.
- 24.3 Spray tops of tanks with Class VI VCI Powder/water solution that was used for treating brake cooling systems, mud systems, etc.

5% VCI-309

- 24.4 Spray interior of tank with Class VI VCI Powder. Apply powder with a sandblasting gun or suitable device for spraying powders. Apply in a manner that assures uniform coverage within the interior. Use 30 grams powder per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume.

VCI-307 30g/ft<sup>3</sup> (1.059 kg/m<sup>3</sup>)

25. FUEL OIL TANKS.

- 25.1 Transfer fuel to trucks until suction is lost.
- 25.2 Using a vacuum truck, remove remaining fuel from tanks. Have tanks certified safe for entry by a marine chemist.
- 25.3 Clean tanks of all foreign matter.
- 25.4 Spray interior of tanks with Class V VCI Fluid.

VCI-326 or VCI-329

- 25.5 Seal tanks.

26. HOOK BLOCK.

- 26.1 Drain approximately one gallon of oil. Then lay hook block horizontally on timbers and add one gallon of Class V VCI Fluid. Fill with Mobil DTE Heavy oil or equivalent.

VCI-326 or VCI-329

- 26.2 The hook portion should be attached to the block portion and the assembly stored vertically suspended from the eye in the top cap if possible.
- 26.3 Remove all dirt, mud and/or other contaminants from assembly.
- 26.4 Clean and prime any rust spots using a zinc rich primer.
- 26.5 Unlatch and swing open tongue. Pump class III VCI Grease into grease fittings on tongue latch and tongue pin. Work tongue latch and tongue back and forth to distribute grease before closing tongue.

VCI-369 or VCI-388

- 26.6 Unlock positioner lock and rotate hood body two revolutions to move bearing contact points.
- 26.7 On hook blocks, all sheaves should be rotated by hand to move the contact points of bearing rollers. At the same time fresh grease should be applied to grease nipples.
- 26.8 Coat all exposed metal with 2-3 mils (50-75 microns) Class IV VCI Dry Coating. If 2 spray applications are needed to achieve recommended film thickness, allow 2 hours drying time between coats.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

- 26.9 Repeat steps 25.5 - 25.8 every 3 months.

27. KELLY SPINNER.

- 27.1 Clean air filter with diesel fuel.
- 27.2 Pump Class III VCI Grease into top bearing while turning the assembly body back and forth.

VCI-369 or VCI-389

- 27.3 To grease lower bearing, unscrew 4 bolts holding lower seal retainer. Pump Class III VCI Grease into fittings while turning the assembly body back and forth until grease escapes through lower bearing rollers.

VCI-369 or VCI-388

- 27.4 Repack the lower seal retainer with Class III VCI Grease and bolt back to the body.

VCI-369 or VCI-389

- 27.5 Check to see that clutch ring did not engage during greasing or it will burn all seals during operation.

- 27.6 Disconnect air hoses from unit and pour 1 pint of diesel fuel into the open end of each line. Re-connect the hoses and operate the unit in free spin for 1 minute, reversing direction every 5 seconds.

VCI-326 or VCI-329

- 27.7 Remove hoses and store. Plug hose connections on unit.

- 27.8 Spray unit with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

## 28. MAIN ENGINES.

- 28.1 Drain the engine cooling system. Flush system with fresh water. Refill system with fresh water; 2.5% by weight Class VI VCI Powder and .25% by weight S-5 Wetting Agent.

VCI-309 & S-5 Wetting Agent

- 28.2 Fill oil sump with approved oil containing 20% Class V VCI Fluid.

20% VCI-326 or VCI-329

- 28.3 Start engine, run for 15 minutes.

- 28.4 Drain the engine cooling system.

- 28.5 Remove air box covers. Spray each cylinder liner bore with class V VCI Fluid as the parts of each liner are uncovered by barring the engine over. Spray all other parts accessible through air box. Apply with a sandblasting gun or suitable device for spraying liquids. Apply in manner that assures uniform distribution within interior. Use 30cc VCI Fluid per 1 cubic foot (1.059 kg/m<sup>3</sup>) of interior volume.

VCI-326 or VCI-329

- 28.6 Make sure all cylinder test valves are closed.
- 28.7 Remove oil pan covers and spray lower end of cylinder liners with Class V VCI Fluid.

VCI-326 or VCI-329

- 28.8 Spray all parts under the engine top deck covers with Class V VCI Fluid.

VCI-326 or VCI-329

- 28.9 Cover entire air intake filter unit with Class VII 6 mil (150 microns) VCI Plastic Wrap.

VCI-126 6 mil (150 microns)

- 28.10 Add 10% Class V VCI Fluid to the governor oil.

10% VCI-326 or VCI-329

Place a Class VIII VCI Capsule on the governor.

One VCI-110/10ft<sup>3</sup> (.28 m<sup>3</sup>) or VCI-126

Cover entire governor with Class VII 6 mil (150 microns) VCI Plastic Wrap.

VCI-126 6 mil (150 microns)

- 28.11 Coat all external unpainted machined surfaces (such as couplings, cylinder test valves, and injector control shaft linkage bearings) with 2 mils (50 microns) Class III VCI Grease.

VCI-369 or VCI-389 2 mil (50 microns)

- 28.12 Drain the fuel tank and piping.

- 28.13 Purge fuel system with Class V VCI Fluid diluted 5% in original fuel. When VCI Fluid flows from the fuel return line at the engine mounted fuel filters, bar the engine over one complete revolution.

5% VCI-326 or VCI-329

- 28.14 Allow fuel lines to drain.

- 28.15 Remove filter elements. Drain and clean filter housings. Spray filter housing with Class V VCI Fluid and replace elements, filter housing and covers.  
5% VCI-326 or VCI-329
- 28.16 Coat air starter Bendix pinion gear with 2 mils (50 microns) Class III VCI Grease.  
VCI-369 or VCI-389 2 mils (50 microns)
- 28.17 Wrap shaft between generator and coupling with Class VII 6 mil (150 microns) VCI Plastic Wrap.  
VCI-126 6 mil (150 microns)
- 28.18 Seal all air ducts and place Class VIII VCI Capsules inside generator near the top of the housing.  
2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)
- 28.19 Coat all external, unpainted steel surfaces with 2 mils (50 microns) Class III VCI Grease.  
VCI-369 or VCI-389 2-3 mils (50 microns)
- 28.20 Place Class VIII VCI Capsules in junction box on generator.  
2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)
- 28.21 Place Class VIII VCI Capsules in top of electrical cabinet.  
2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)  
Cover cabinet with Class VII 6 mil (150 microns) VCI Plastic Wrap.  
VCI-126 6 mil (150 microns)
- 28.22 Cover air starter exhaust opening with Class VII 6 mil (150 microns) VCI Plastic Wrap.  
VCI-126 6 mil (150 microns)
- 28.23 Cover exhaust outlet.
- 28.24 Clean radiators with fin cleaner VCI-416.
- 28.25 Spray radiators with 2-3 mils (50-75 microns) Class IV VCI Dry Coating. If 2 spray applications needed to achieve film thickness, allow 2 hours drying time between coats.  
VCI-386 2-3 mils (50-75 microns)

29. MUD AGITATORS.

29.1 Completely clean all mud from unit.

29.2 Prime and paint where needed.

29.3 Fill oil sump with approved oil (Mobil DTE oil Extra Heavy or equivalent) containing 20% Class V VCI Fluid.

20% VCI-326 or VCI-329

29.4 Grease the upper and lower low speed shaft bearings with Class III VCI Grease.

VCI-369 or VCI-389

29.5 Run unit for 30 minutes.

29.6 Grease flexible couplings with Class III VCI Grease. Coat couplings and motor shaft with 1-2 mils (25-50 microns) Class III VCI Grease.

VCI-369 or VCI-389 1-2 mils (25-50 microns)

29.7 Spray unit, including shaft, with 2-3 mils (50-75 microns) Class IV VCI Dry Coating. If 2 spray applications are needed to achieve recommended film thickness, allow 2 hours drying time between coats.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

29.8 Cover electric motor with Class VII 6 mil (150 microns) VCI Plastic Wrap.

VCI-126 6 mil (150 microns)

30. MUD CLEANERS.

30.1 Remove and store screens.

30.2 Clean unit. Prime and paint where needed.

30.3 Remove and cover vibrator motor with Class VII 6 mil (150 microns) VCI Plastic Wrap and place into storage.

VCI-126 6 mil (150 microns)

30.4 Spray entire unit with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

30.5 Cover unit with tarpaulin (See 2.4).



31. MUD CLEANER PUMP AND DESANDER PUMP.
- 31.1 Flush and thoroughly clean the impeller and pump interior surface. Then spray with 2-3 mils (50-75 microns) Class IV VCI Dry coating.
- VCI-368 or VCI-388 2-3 mils (50-75 microns)
- 31.2 Pump a mixture of fresh water, 2.5% by weight Class VI VCI Powder and 25% by weight S-5 Wetting Agent through the pumps and lines.
- VCI-609 & S-5 Wetting Agent
- 31.3 Spray exterior of pumps with 2-3 mils (50-75 microns) Class IV VCI Dry Coating if 2 applications are needed to achieve recommended film thickness, allow 2 hours drying time between coats.
- VCI-368 or VCI-388 2-3 mils (50-75 microns)
- 31.4 Remove motors.
- 31.5 Place Class VIII VCI Capsules inside motor and seal.
- 2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)
- Cover motor with Class VII 6 mil (150 microns) VCI Plastic Wrap.
- VCI-126 6 mil (150 microns)
- 31.6 Coat motor shaft with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.
- VCI-326 or VCI-329 2-3 mils (50-75 microns)
- 31.7 Store motors in store room.
- 31.8 Spray shaker pits with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.
- VCI-368 or VCI-388 2-3 mils (50-75 microns)

32. MUD PUMPS & MUD SYSTEM.

- 32.1 Fill the gear oil sump- with approved oil (Mobile Gear 634 or equivalent) containing 20% Class V VCI Fluid.

20% VCI-326 or VCI-329

- 32.2 Fill the chain sump with approved oil (Mobil DTE Heavy Oil or equivalent) containing 20% Class V VCI Fluid.

20% VCI-326 or VCI-329

- 32.3 Connect standpipe manifold to choke manifold. Clean out sandtraps. Put potable water in one clean mud pit. Circulate water through mud pumps, mud mixing pumps, and charge pumps and system. Circulate until system is clean.

- 32.4 Transfer the 2.5% solution of Class VI VCI Powder from drawworks brake cooling system to clean slugging pit. Pump this mixture through the mud pumps, mud mixing pumps, mud charge pumps and system. Drain and seal the piping mixing and charge pumps.

2.5% VCI-609 & S-5 Wetting Agent

- 32.5 Drain and clean liner spray coolant tank. Remove plug from end of coolant header opposite the liner spray pump and flush hoses and header with clean water. Replace plug and pump Class V VCI Fluid through the entire liner spray system and allow to remain in system.

VCI-329 or VCI-389

- 32.6 Grease intermediate rod wiper seals with Class III VCI Grease.

VCI-369 or VCI-389

- 32.7 Fluid End - Remove valves, piston rods, and liners. Leave in valve seats. Clean inside of fluid cylinder, liner busing and rod chamber. Coat rod ends, rod clamps, liner clamps, liner busing, wedge-loc assembly and valve cover threads with 3-4 mils (75-100 microns) Class III VCI Grease.

VCI-369 or VCI-389 3-4 mils (75-100 microns)

Coat pistons and inside of liners with Class III VCI Grease and store in an upright standing position or transfer to a working rig.

VCI-369 or VCI-389

- 32.8 Power-End - Remove main cover and inspection covers. Clean settling chamber. Spray bearings, exposed surfaces and all of the inside of the power end with Class V VCI Fluid. Seal unit, including breather.

VCI-326 or VCI-329

- 32.9 Clean exterior of all mud and dirt. Clean and repaint all rust spots with zinc rich primer.
- 32.10 Spray 2-3 mils (50-75 microns) Class IV VCI Dry Coating on the mud mixing pumps and charge pumps. The impellers and other pump interior surfaces must be flushed and cleaned thoroughly before spraying VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

- 32.11 Place Class VIII VCI Capsules in each electric motor of the mixing and charge pumps (See figure 20.2). Seal up the fan end of each motor.

2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

Coat the shaft with 2-3 mils (50-75 microns) Class III VCI Grease.

VCI-369 or VCI-389 2-3 mils (50-75 microns)

- 32.12 Activate strip heaters on motors (752).
- 32.13 Pull brushes from holders on motors and store brushes in store room.
- 32.14 Apply 1-2 mils (25-50 microns) Class III VCI Grease to all exposed shafts on motors.

VCI-369 or VCI-389 1-2 mils (50-75 microns)

- 32.15 Install Class VIII VCI Capsules in top of each motor. Seal all openings.

2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

- 32.16 Rotate motors every 3 months.

33. POTABLE WATER TANKS.

- 33.1 Empty the potable water tanks.
- 33.2 Suction all gas from tanks. Have them certified safe for entry by a marine chemist.
- 33.3 Clean and dry out tanks.

- 33.4 Check tanks for signs of corrosion. Clean and repaint all rust spots with approved coating.
- 33.5 Make expanded metal covers for manholes that have small vent holes for air circulation. Place covers on manholes.
- 33.6 Check every six months for corrosion.

34. COLD START DIESEL.

- 34.1 Clean the engine on the outside with kerosene or detergent.
- 34.2 Fill the sump with approved oil (15/40 w oil) containing 20% Class V VCI Fluid.  
20% VCI-326 or VCI-329
- 34.3 Pour the oil from the air cleaner bowl; clean bowl and fill with Class V VCI Fluid.  
VCI-326 or VCI-329
- 34.4 Run the engine for 30 minutes.
- 34.5 Detach the rocker chamber covers and spray chambers with Class V VCI Fluid.  
VCI-326 or VCI-329
- 34.6 Drain fuel from tank. Purge fuel system with Class V VCI Fluid diluted to 5% with operating fuel by barring engine.  
5% diluted VCI-326 or VCI-329
- 34.7 Remove v-belts and coat with silicone grease. Spray v-belt pulleys with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.  
VCI-368 or VCI-388 2-3 mils (50-75 microns)
- 34.8 Close intake opening of air cleaner and exhaust opening.

35. PRELOAD TANKS.

- 35.1 Dump any water that remains in preload tanks.
- 35.2 Suction all gas from tanks. Have tanks certified safe for entry by marine chemist.
- 35.3 Using submersible pumps, pump tanks out as much as possible.
- 35.4 Spray interior of tanks with 2.5% Class VI VCI Powder/0.25% S-5 Wetting Agent/water solution.  
VCI-609 & S-5 Wetting Agent

36. PRELOAD PUMPS.

36.1 Remove pipe plugs from pump and allow water to drain.

36.2 Spray inside of pump with Class V VCI Fluid and re-install pipe plugs.

VCI-326 or VCI-329

36.3 Spray exterior of pump with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

37. QUARTERS.

37.1 Clean living quarters internally.

37.2 Remove all food and supplies and transfer to another rig or off-site storage.

37.3 Clean out walk-in coolers and refrigerators, sanitize. Leave doors open to ensure adequate ventilation.

37.4 Drain all water from toilets and piping.

37.5 Close all windows, portholes and hatches.

37.6 Seal all openings with tarpaulin and water-resistant tape so no external air can enter quarters.

37.7 Install, hook up and activate dehumidifier.

38. RAM PREVENTER.

38.1 Remove ram assembly. Remove ram packing and send to another rig or place in storage off-site. Spray assembly with 3-4 mils (75-100 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

38.2 Spray ram charge pistons, operating piston and their cylinders with Class V VCI Fluid.

VCI-326 or VCI-329

38.3 Spray bonnet and ram body cavity with Class V VCI Fluid and seal unit.

VCI-326 or VCI-329

38.4 Clean bonnet bolt threads and lightly grease with 1 mil (25 microns) Class III VCI Grease.

VCI-369 or VCI-389 1 mil (25 microns)

38.5 Run locking screws in and out. Coat with 1 mil (25 microns) Class III VCI Grease.

VCI-369 or VCI-389 1 mil (25 microns)

38.6 Spray unit externally with 3-4 mils (75-100 microns) Class IV VCI Dry Coating. If 2 spray applications are needed to achieve recommended film thickness, allow 2 hours drying time between coats.

VCI-368 or VCI-388 3-4 mils (75-100 microns)

39. ROTARY TABLE.

39.1 Remove all bushings from rotary bowl and coat with 2-3 mils (50-75 microns) Class IV VCI Dry Coating. Store in rig's store room.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

39.2 Remove all dirt, mud and contaminants from unit.

39.3 Clean and prime rust spots with a zinc rich primer.

39.4 Drain oil from rotary using both drain plugs. If mud or water is present in oil, remove gear table and clean pinion cartridge, table housing and main bearings.

39.5 Spray Class V VCI Fluid on all internal parts and casings. Apply with a sandblasting gun or suitable device for spraying liquids. Apply in a manner that assures uniform distribution within interior. Use 30cc Class V Fluid per 1 cubic foot (1,059 cc/m<sup>3</sup>) interior volume. Fill with Mobil Gear 630 oil or equivalent.

VCI-326 or VCI-329

39.6 Grease lock pawl fittings and components with 2-3 mils (50-75 microns) Class III VCI Grease.

VCI-369 or VCI-389 2-3 mils (50-75 microns)

39.7 Coat pinion shaft and any other exposed metal surfaces with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

39.8 Rotate pinion shaft every three months.

40. ROTARY TRANSMISSION.

- 40.1 Remove independent drive cover.
- 40.2 Remove all dirt, mud and contaminants from unit.
- 40.3 Drain oil from transmission.
- 40.4 Spray all internal parts with Class V VCI Fluid. After all parts are sprayed, fill transmission with 10% Class V VCI Fluid and Mobil 630 Gear Oil, or equivalent.

VCI-326 or VCI-329

- 40.5 Rotate shafts several times.
- 40.6 Grease all fittings and couplings with 2-3 mils (50-75 microns) Class III VCI Grease.

VCI-369 or VCI-389 2-3 mils (50-75 microns)

- 40.7 Coat all exposed metal surfaces with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

- 40.8 Activate heater strips on motor.
- 40.9 Pull brushes from holders on motor.
- 40.10 Apply Class III VCI Grease to all exposed shafts.

VCI-369 or VCI-389

- 40.11 Install Class VIII VCI Capsules in top of motor housing.

2xVCI-105 or VCI-111

- 40.12 Seal all openings in motor using silicone gel or waterproof adhesive tape.
- 40.13 Place 2 desiccant bags on motor and wrap in 6 mil (150 microns) black Grifalon T75, or equivalent.
- 40.14 Replace independent drive cover.
- 40.15 Rotate shafts and motor every 3 months.
- 40.16 Rotate GE 752 motors every 3 months.

41. SCR.

- 41.1 Place Class VIII VCI Capsules in all components of the SCR system. One Capsule will protect 11 cubic feet (.31 m<sup>3</sup>) of interior volume. Approximately 120 Capsules will be required. Once the capsules are in place, seal the units.

2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

42. SANITARY PUMP, POTABLE PUMP.

- 42.1 Drain pump of all fluid.

- 42.2 Cover pump and motor with 6 mil (150 microns) VCI Plastic Wrap.

VCI-126 6 mil (150 microns)

- 42.3 Fill cavity of sanitary pump with fresh water and 2.5% by weight Class VI VCI Powder and .25% S-5 Wetting Agent. Seal the equipment.

2.5% (by weight) VCI-609 & S-5 Wetting Agent

43. SEWAGE TREATMENT PLANT.

- 43.1 Open the 2 primary tank drain valves and allow tank to drain.

- 43.2 Flush sewage lift station with fresh water while pumping to main tank. Shut down.

- 43.3 After main tank has drained, remove aeration tank access hatch cover on top of unit and flush out tank with clean water.

- 43.4 Remove the two biological filter access hatches.

- 43.5 Use a hose to flush clean water over the top of the spherical biological filter elements. This can be done by moving the hose around through the top aeration access hatch and over the spheres.

- 43.6 When clean, close the 2 drain valves.

- 43.7 Using clean water, refill the tank. Allow flushing water to overflow into the chlorine contact chamber. Remove chamber drain valve and continue to run water until both the filter and chlorine chamber have been flushed clear.

- 43.8 Drain unit, empty chlorine tank, replace drain plugs, shut off air supply.



- 43.9 Pump a mixture of fresh water and 2.5% (by weight) Class VI VCI Powder and .25% (by weight) S-5 Wetting Agent, from the lift station to the main tank. When main tank is full, drain entire system and seal up.

2.5% VCI-609 & .25% S-5 Wetting Agent

- 43.10 Coat 2 mils (50 microns) Class III VCI Grease on exposed metal surfaces of lift station pump.

VCI-369 or VCI-389 2 mils (50 microns)

- 43.11 Cover lift station motors with Class VII 6 mil (150 microns) VCI Plastic Wrap.

VCI-126 6 mils (150 microns)

44. SKIDDER UNIT.

- 44.1 Add 20% Class V Fluid to the gear sump.

20% VCI-126 or VCI-329

- 44.2 Spray interior with 1 mil (25 microns) Class V VCI Fluid.

VCI-126 or VCI-329 1 mil (150 microns)

- 44.3 Place Class VIII VCI Capsules inside motor case and seal.

2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

- 44.4 Coat exposed gear with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mil (50-75 microns)

45. SLANT AND ELEVATING SYSTEMS.

- 45.1 Drain and fill the gear sump with approved oil

20% VCI-326 or VCI-329

- 45.2 Fog interior with Class V VCI Fluid. Apply liquid with a sandblasting gun or suitable device for fogging liquids. Apply in manner that assures uniform distribution within the interior. Use 30cc VCI Fluid per 1 cubic foot of interior volume.

- 45.3 Place Class VIII VCI Capsules inside motor case and seal up.

2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)

- 45.4 Coat exposed gear with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

46. SPINNING WRENCH.
- 46.1 Grease all fittings with Class III VCI Grease.  
VCI-369 or VCI-389
- 46.2 Fill gear case with Class V VCI Fluid.  
VCI-326 or VCI-329
- 46.3 Fill air lubricator with Class V VCI Fluid.  
VCI-326 or VCI-329
- 46.4 Run unit for 15 minutes.
- 46.5 Spray unit with 2-3 mils (50-75 microns) class IV VCI Dry Coating and place in storage.
47. SPRING SLIPS.
- 47.1 Use Class III VCI Grease on all fittings.  
VCI-369 or VCI-389
- 47.2 Spray unit with Class IV VCI Dry Coating.  
VCI-368 or VCI-388 2-3 mils (50-75 microns)
48. SUPER CHOKE.
- 48.1 Replace battery in digital rate meter.
- 48.2 Drain and fill oil sump with approved oil containing 20% Class V VCI Fluid.  
Seal breather cap.  
20% VCI-326 or VCI-329
- 48.3 Operate choke for 15 minutes.
- 48.4 Place Class VIII VCI Capsules in control panels and close lid.  
One VCI-110/10ft<sup>3</sup> (.28 m<sup>3</sup>)  
2xVCI-105/5ft<sup>3</sup> (.14 m<sup>3</sup>) or VCI-111/11ft<sup>3</sup> (.31 m<sup>3</sup>)
- 48.5 Cover entire unit with tarpaulin (See 2.4).

49. SURVIVAL CAPSULE AND WINCH.
- 49.1 Drain the engine cooling system. Flush system with fresh water. Refill system with fresh water, 2.5% (by weight) Class VI VCI Powder and .25% (by weight) S-5 Wetting Agent.  
2.5% VCI-609 & .25% S-5 Wetting Agent
- 49.2 Fill oil sump with approved oil containing 20% Class V VCI Fluid.  
20% VCI-326 or VCI-329
- 49.3 Add 10% Class V VCI Fluid to hydraulic start system with approved oil.  
10% VCI-326 or VCI-329
- 49.4 Add 10% Class V VCI Fluid to transmission with approved oil.  
10% VCI-326 or VCI-329
- 49.5 Start engine, run for 5 minutes.
- 49.6 Drain the cooling system.
- 49.7 Drain the fuel system. Purge the system with Class V VCI Fluid diluted 5% in original fuel by barring the engine over.  
Purge VCI-329 diluted 5%, VCI-326 water based
- 49.8 Remove the air intake hose from the engine air intake manifold and seal the manifold opening with tape.
- 49.9 Remove the exhaust hose from the heat exchanger and seal the exhaust/heat exchanger with tape.
- 49.10 Seal the outside exhaust opening with tape.
- 49.11 Remove engine drive belts and retain.
- 49.12 Seal the fuel tank vent with oil-resistant tape.
- 49.13 Turn the grease cup fittings 2 full turns on both the sea water cooling pump and the sprinkler pump. Open both pump's drains.
- 49.14 Open the exhaust hose elbow drain.
- 49.15 Remove batteries from dome lights, flashlight, and match can in the day compartment.

- 49.16 Close all air cylinder valves. Open the main air valve to dump pressure from the manifold. Close the main air valve.
- 49.17 Seal the check valve flapper (above and behind the helmsman's seat) with tape.
- 49.18 Coat all parts of disengaging apparatus with 2-3 mils (50-75 microns) Class III VCI Grease.

VCI-369 or VCI-389 2-3 mils (50-75 microns)

- 49.19 Place Class VIII VCI Capsules inside the capsule at the following locations:  
Top of conning tower above helmsman's seat, top of unit by hook, top of unit by forward dome light, inside top aft engine shroud, above fuel tank, under laminate cover, and over air bottle valves.
- 49.20 Cover capsule with tarpaulin (See 2.4)
- 49.21 Coat all rubber seals with silicone grease.
- 49.22 Fill winch speed reducer with approved oil containing 20% Class V VCI Fluid.

20% VCI-326 or VCI-329

- 49.23 Coat winch cable with wire rope lube while lowering capsule.
- 49.24 Spray winch with 2-3 mils (50-75 microns) Class IV VCI Dry Coating. Cover with tarpaulin.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

## 50. SWIVEL.

- 50.1 With the swivel in an upright position, drain oil from swivel body.
- 50.2 Add 20% Class V VCI Fluid with approved oil into swivel. Original oil may be used.

20% VCI-326 or VCI-329

- 50.3 Rotate swivel for 5 minutes.
- 50.4 Grease fittings on gooseneck support and on bail pins using Class III VCI Grease. Support swivel body and rock bail so that grease can flow around pins.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

- 50.5 Remove washpipe packing assembly. Disassemble and remove "o" rings and packing rings. Clean and coat washpipe assembly with 2-3 mils (50-75 microns) Class IV VCI Dry Coating and store inside rig.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

- 50.6 Clean exterior of swivel and prime any rust spots with zinc rich primer.
- 50.7 Grease and install thread protectors on sub and gooseneck hose connections.
- 50.8 Swivel should be stored in an upright position. If this is not possible, store swivel on a rack or pallet so all parts of the swivel are off the ground. Lay swivel on bail bumper with the sub end down.
- 50.9 Spray all exposed metal parts with 2-3 mils (50-75 microns) Class IV Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

- 50.10 Cover with black tarpaulin (See 2.4).
- 50.11 Rotate swivel sleeve several times and rock bail every three months.

51. TUGGERS.

- 51.1 Fill gear case with Class III VCI Grease.

VCI-369 or VCI-389

- 51.2 Fill motor case with approved oil containing 20% Class V VCI Fluid.

20% VCI-326 or VCI-329

- 51.3 Run out cable and coat with 2 mils (50 microns) Class V VCI Fluid.

VCI-326 or VCI-329 2 mils (50 microns)

Spool up cable on drum and spray entire unit with 2-3 mils (50-75 microns) Class IV VCI Dry Coating.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

- 51.4 Cover unit with tarpaulin (See 2.4).

52. WASHING MACHINE.

- 52.1 Fill the main bearing sump with approved oil containing 20% Class V VCI Fluid.
- 52.2 Run unit for 30 minutes.

- 52.3 Remove v-belt and coat it with silicone grease.
- 52.4 Wrap motor in Class VII 6 mil (150 microns) VCI Plastic Wrap.

VCI-126 6 mil (150 microns)

- 52.5 Place Class VIII VCI Capsules inside closed compartment and seal up.

One VCI-110/10 ft<sup>3</sup> (.28 m<sup>3</sup>) 2xVCI-105, VCI-111

53. WATERMAKER.

- 53.1 Pickle the permeators and watermaker per manufacturer's specifications.
- 53.2 Flush the rest of the watermaker system with the solution described above the follow with fresh water flush. The system is then drained and stored dry.
- 53.3 Flush the high pressure pump with Class V VCI Powder. Drain Pump.

VCI-609

- 53.4 Cover all gauges, small pumps and motors with Class VII 6 mil (150 mils) VCI Plastic Wrap.

VCI-126 6 mil (150 mils)

- 53.5 Place Class VIII VCI Capsules in the high pressure pump motor at fan end. Seal openings of fan.

2xVCI-105 or VCI-111

- 53.6 Place VCI Capsules in top of electrical control panel.

2xVCI-105 or VCI-111

54. WIRE LINE ANCHOR.

- 54.1 Remove all dirt, mud and other contaminants from unit.
- 54.2 Wire brush any rust spots and coat with zinc rich primer.
- 54.3 Grease unit using Class III VCI Grease, anchor drum should be rocked back and forth after greasing to distribute.

VCI-369 or VCI-389

- 54.4 Spray any exposed metal with 2-3 mils (50-75 microns) Class IV VCI Dry Coating. If two applications are needed to achieve film thickness, allow 2 hours drying time between coats.

VCI-368 or VCI-388 2-3 mils (50-75 microns)

- 54.5 Cover with tarpaulin (See 2.4).

- 54.6 Check every 3 months.

55. PIPELINES.

- 55.1 During normal pipeline operation, corrosion will occur if proper prevention methods are not employed. Because the prevention methods are not employed. Because the protective requirements for pipelines can vary so greatly, please contact us directly to discuss your situation for suggested treatments.

Crude oil with small amounts of chlorides and water is pumped through the pipeline. These small amounts of water can accumulate in areas of low flow such as bypass piping and future pump connections. This can cause expensive and potentially disruptive repairs to operate the equipment.

The pipe buried in moist soil can corrode externally if not properly protected. Below ground sections of pipelines are normally protected with coatings and cathodic protection, and must be protected internally with Class VI VCI Powder.

Contingency equipment is typically stored in unheated warehouses or outdoors. Since storage intervals are indefinite (until such time that equipment or pipe is needed in case of emergency or rupture), the protection must be carefully maintained to allow quick turn around time.

- 55.2 Low Flow Bypass Piping or Dead Legs.

Because of high chlorine and water concentration in these areas, corrosion damage could occur if not properly controlled. To prevent corrosion in these areas, a solution of Class VI VCI Powder in water is injected (See Figure 24). Periodic testing of the inhibitor concentration is recommended to maintain the appropriate protective levels.

55.3 Road Crossings and Casings (See Figure 25).

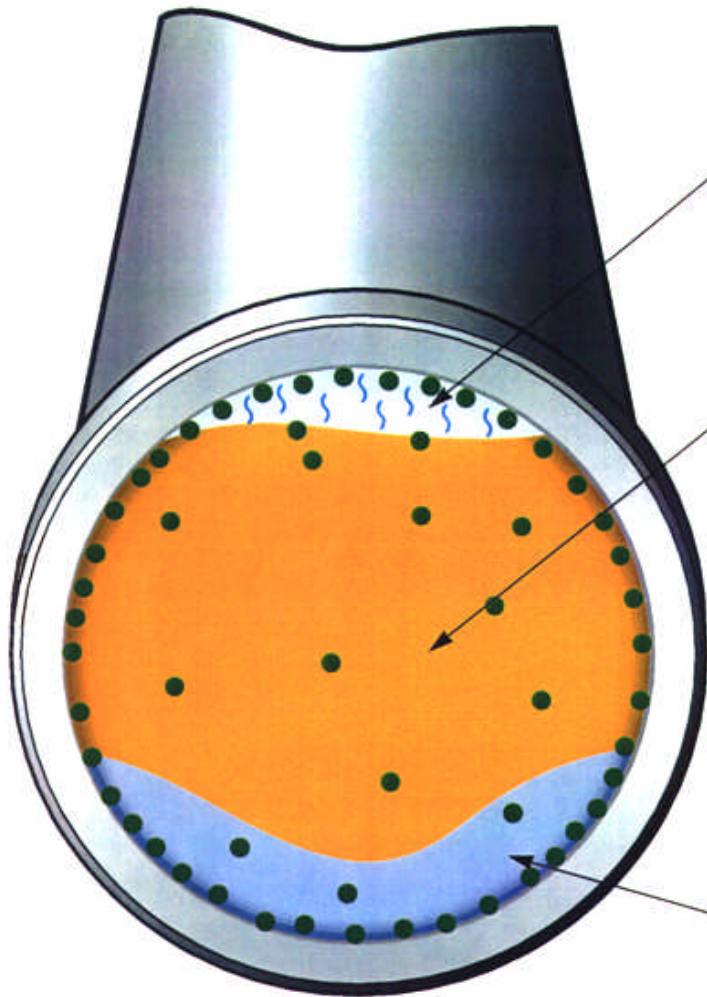
To prevent the pipeline from mechanical damage, road casings are installed at all major road crossings. These casings are typically separated from the main pipe with insulators and the pipe ends sealed with "Lirk" seals. The purpose of this design is to prevent water penetration inside casings and to provide electrical insulation between pipeline and casing. As the system grows older, if these seals are not maintained, they tend to leak water causing damage to the encased main pipe.

55.4 Contingency Equipment.

For further information on various classes of contingency equipment stored in environments with different degrees of corrosivity, please consult Chapters 2 and 3.



# CORTEC VCIs IN OIL PIPELINES



GAS

*VCI inhibitors protect against corrosion caused by hydrogen sulfide, carbon sulfide and condensed moisture in the gas phase through unique vapor action.*

OIL

*In the oil (liquid) phase, VCIs provide protection by forming a physically adsorbed molecular layer on internal walls of the pipeline. Due to the strong ionic nature of VCI molecules, the adsorption layer provides protection under dynamic conditions of flow, elevated temperatures and pressures. The ambiodic nature of VCI affords protection to both cathodic and anodic areas. Thus, effectively controlling stress corrosion cracking and hydrogen embrittlement.*

BRINE

*CORTEC VCIs protect the lower areas of pipelines in the water phase by forming a tenacious adsorption layer on the walls of the pipe contacted by water.*

Figure 3

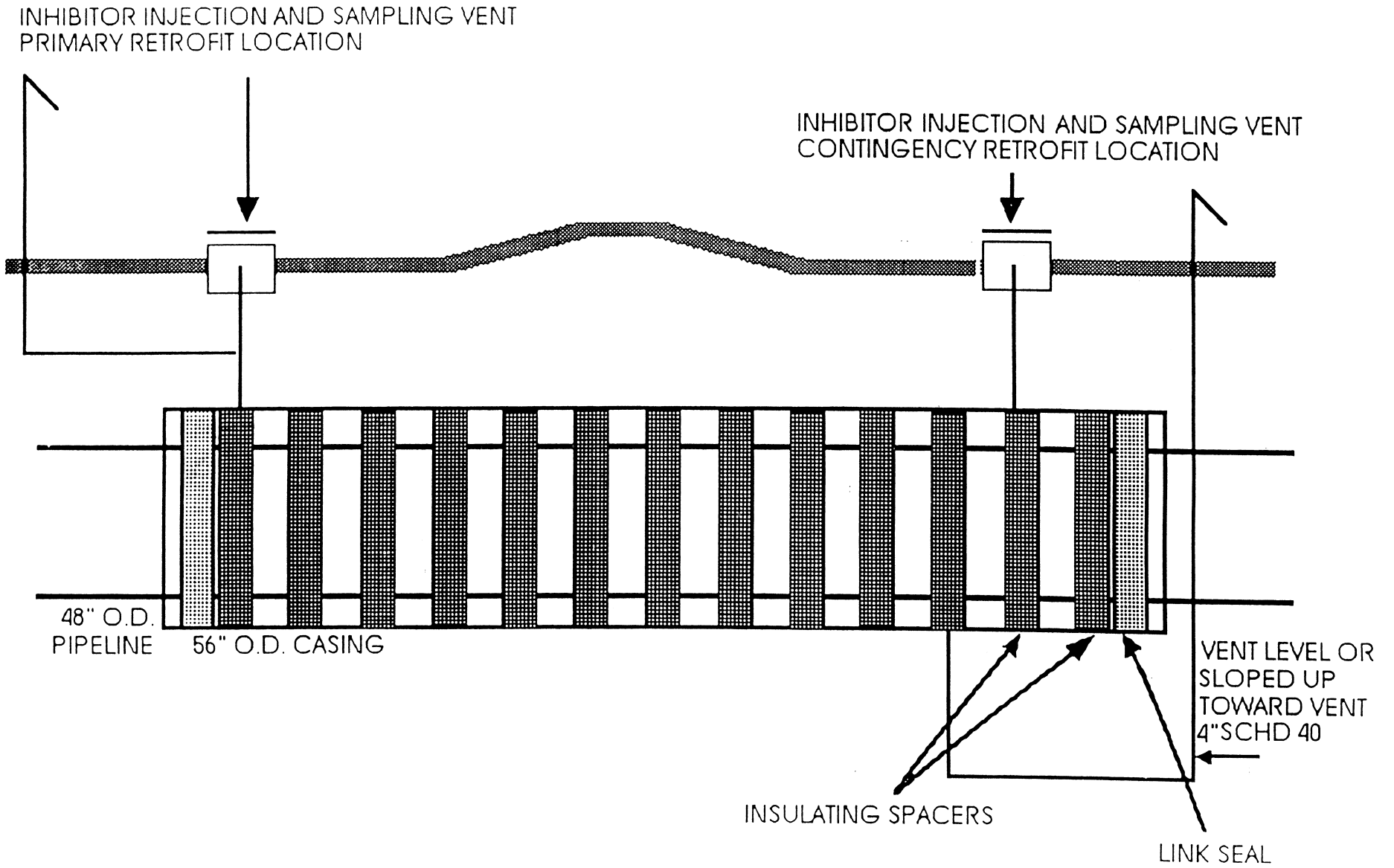


Figure 4

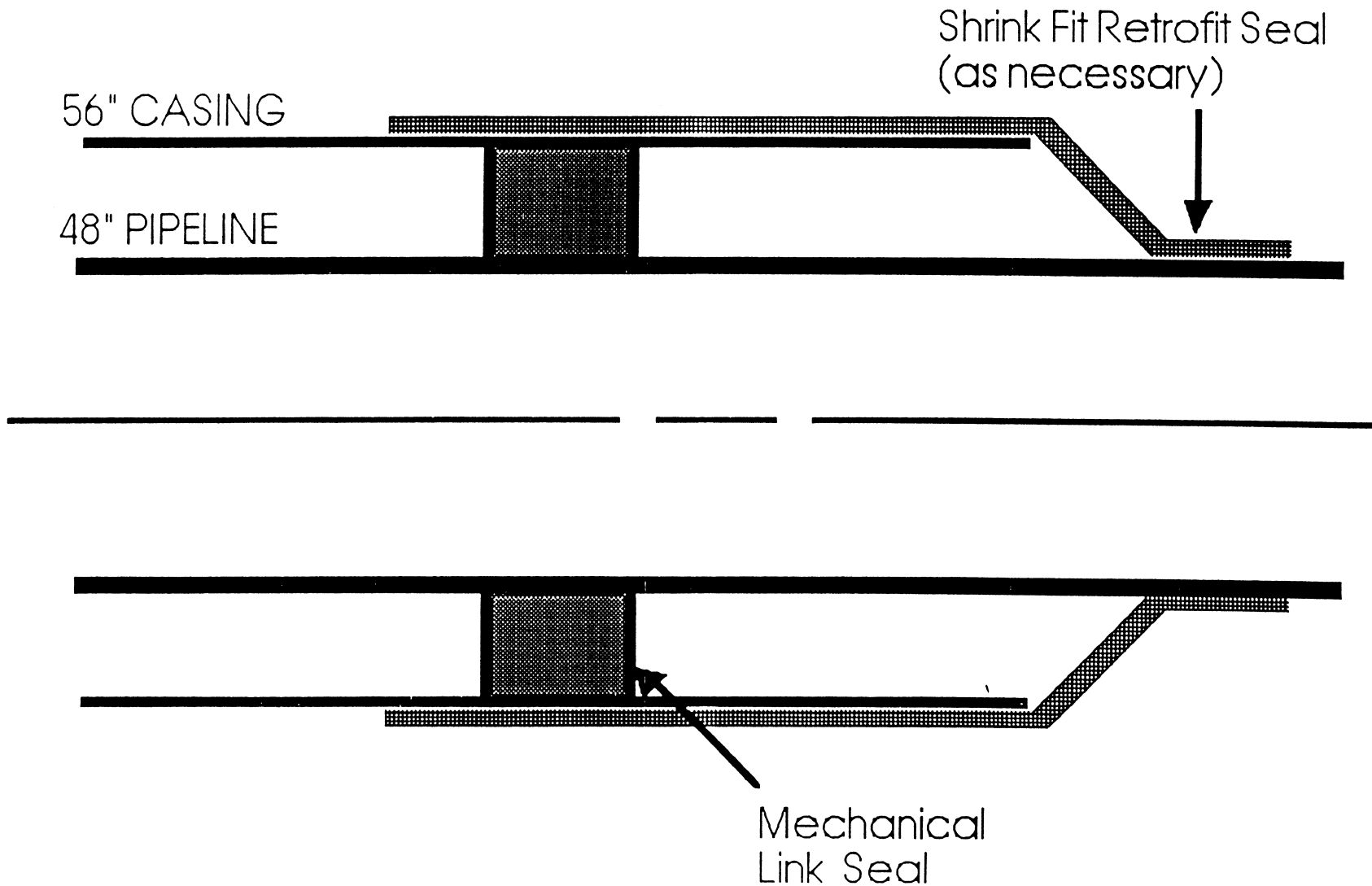


Figure 4 End Closure For Road Crossing Casings

Figure 4B

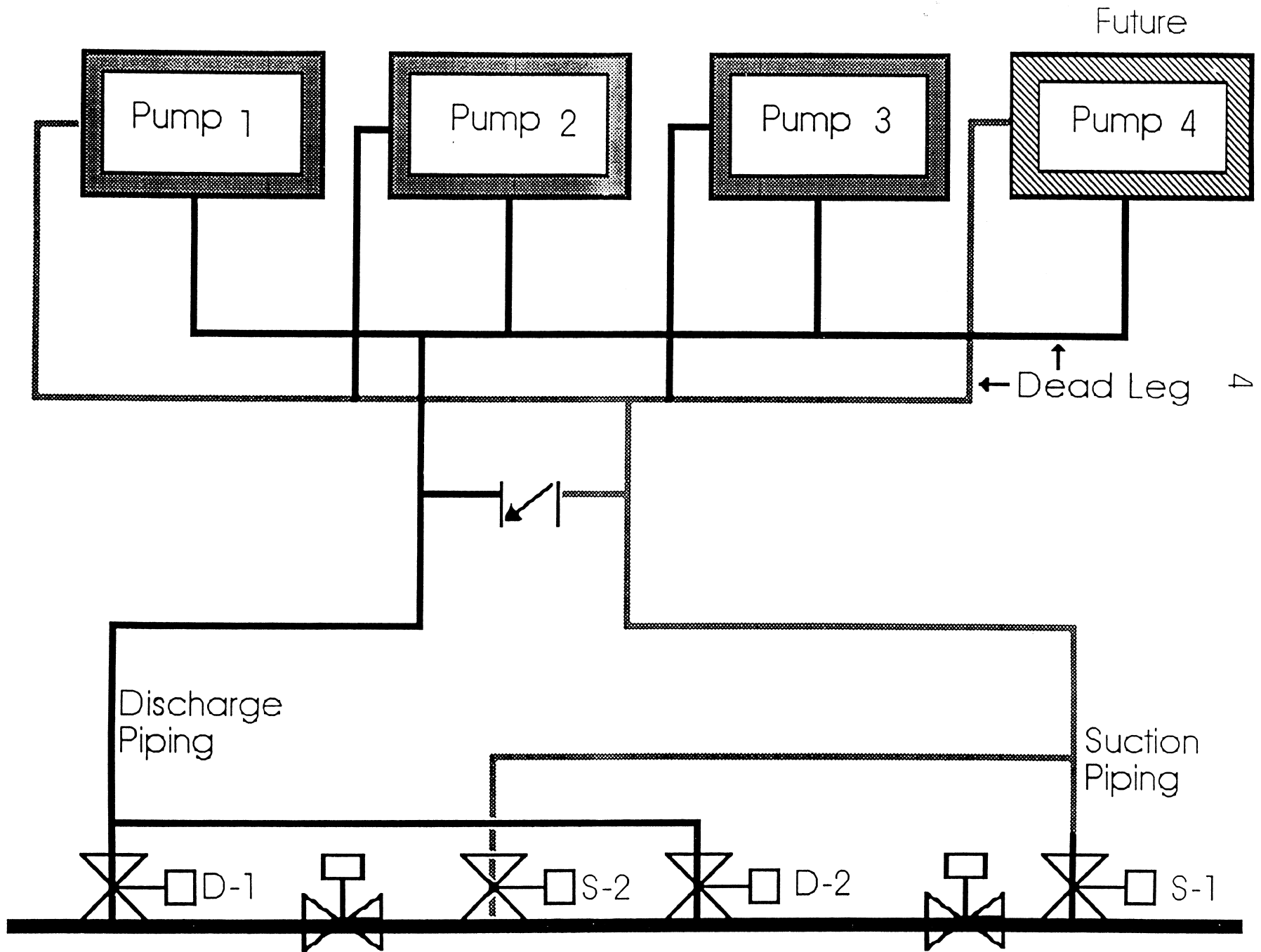


Figure 10

# SPRAY OPERATION

Heat Exchange Bundle

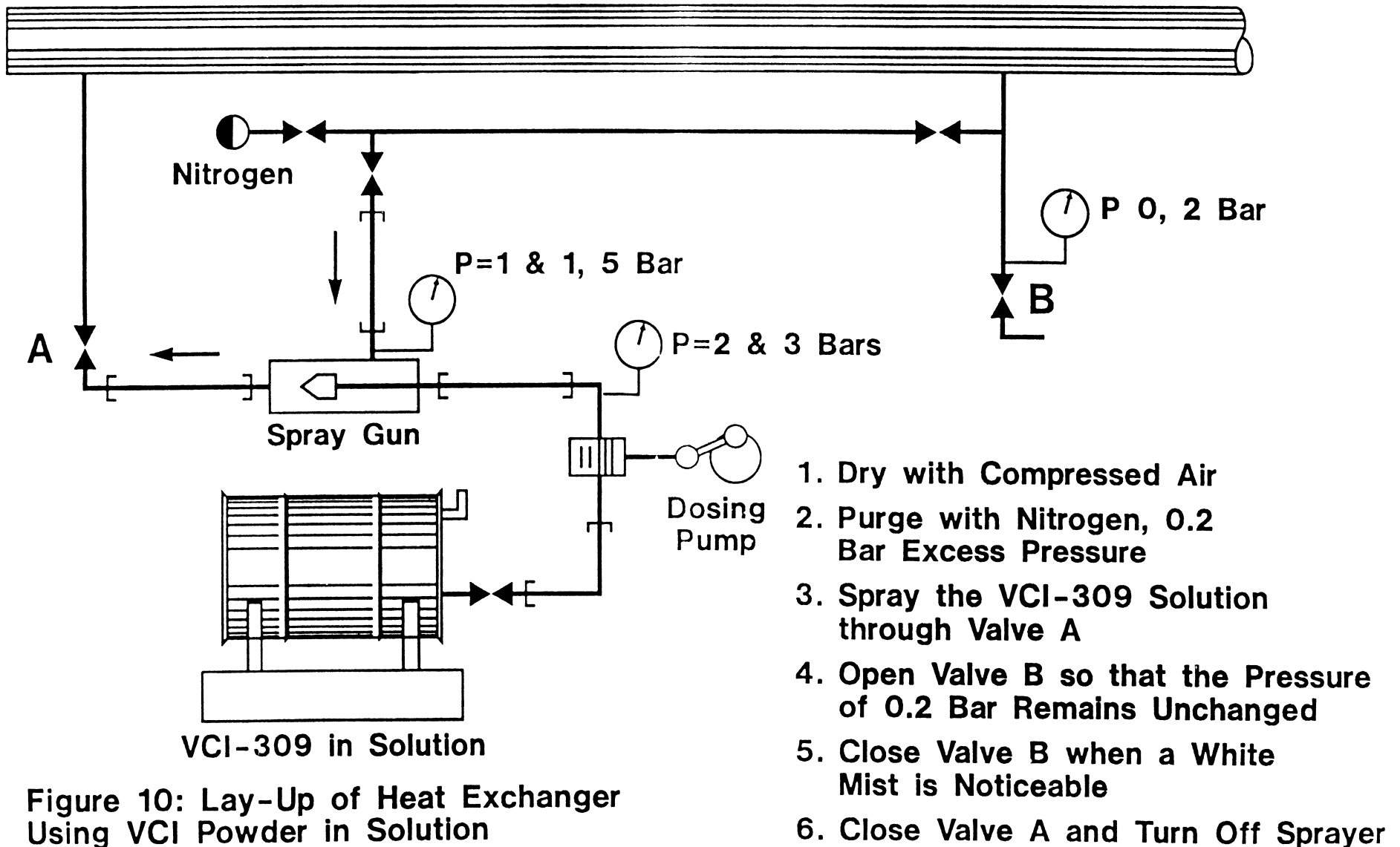


Figure 10: Lay-Up of Heat Exchanger Using VCI Powder in Solution

Figure 15

# DRY POWDER APPLICATION USING VACUUM SUCTION

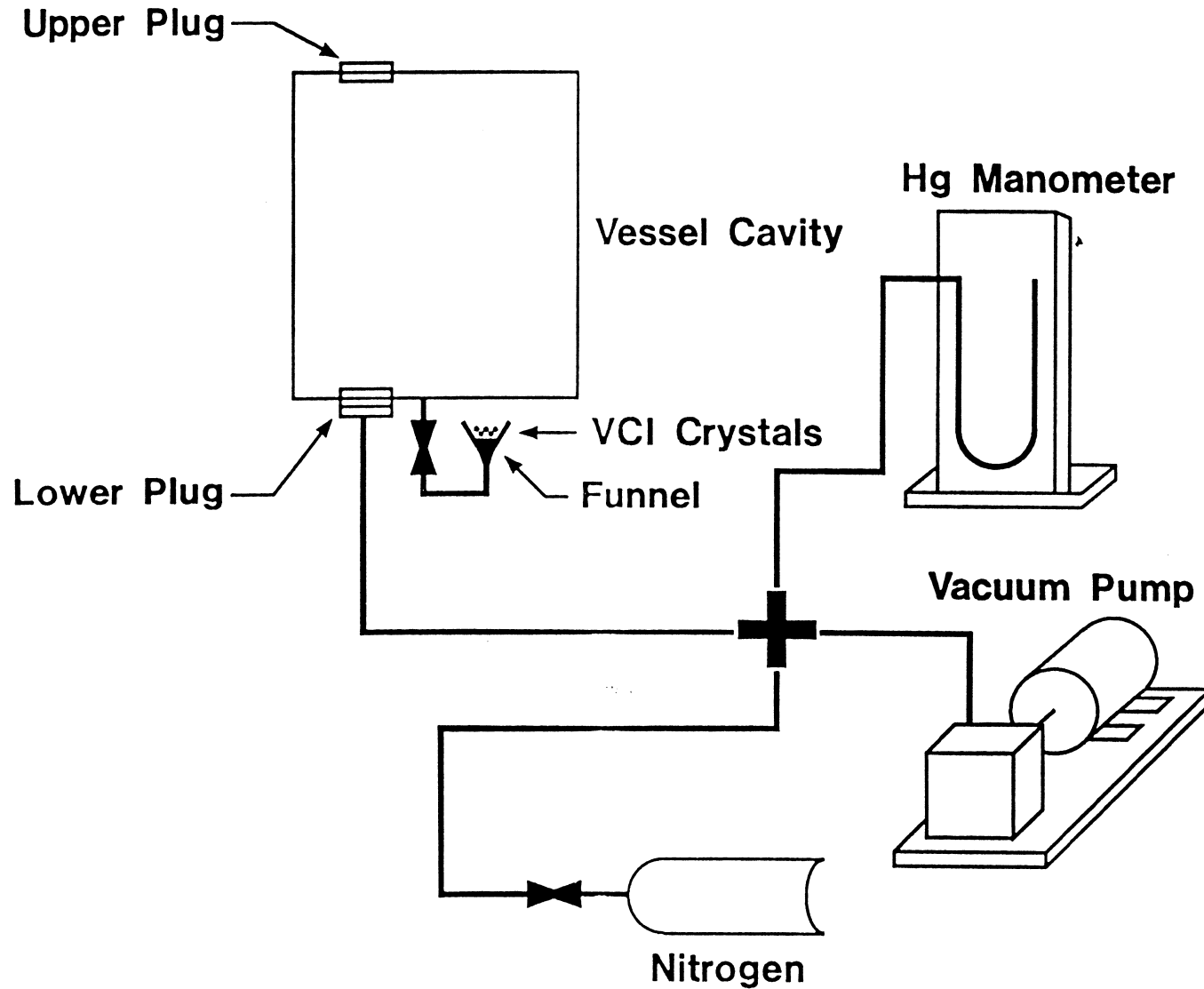


Figure 16: Schematic Diagram of Power Plant Steam System

# STEAM SYSTEM

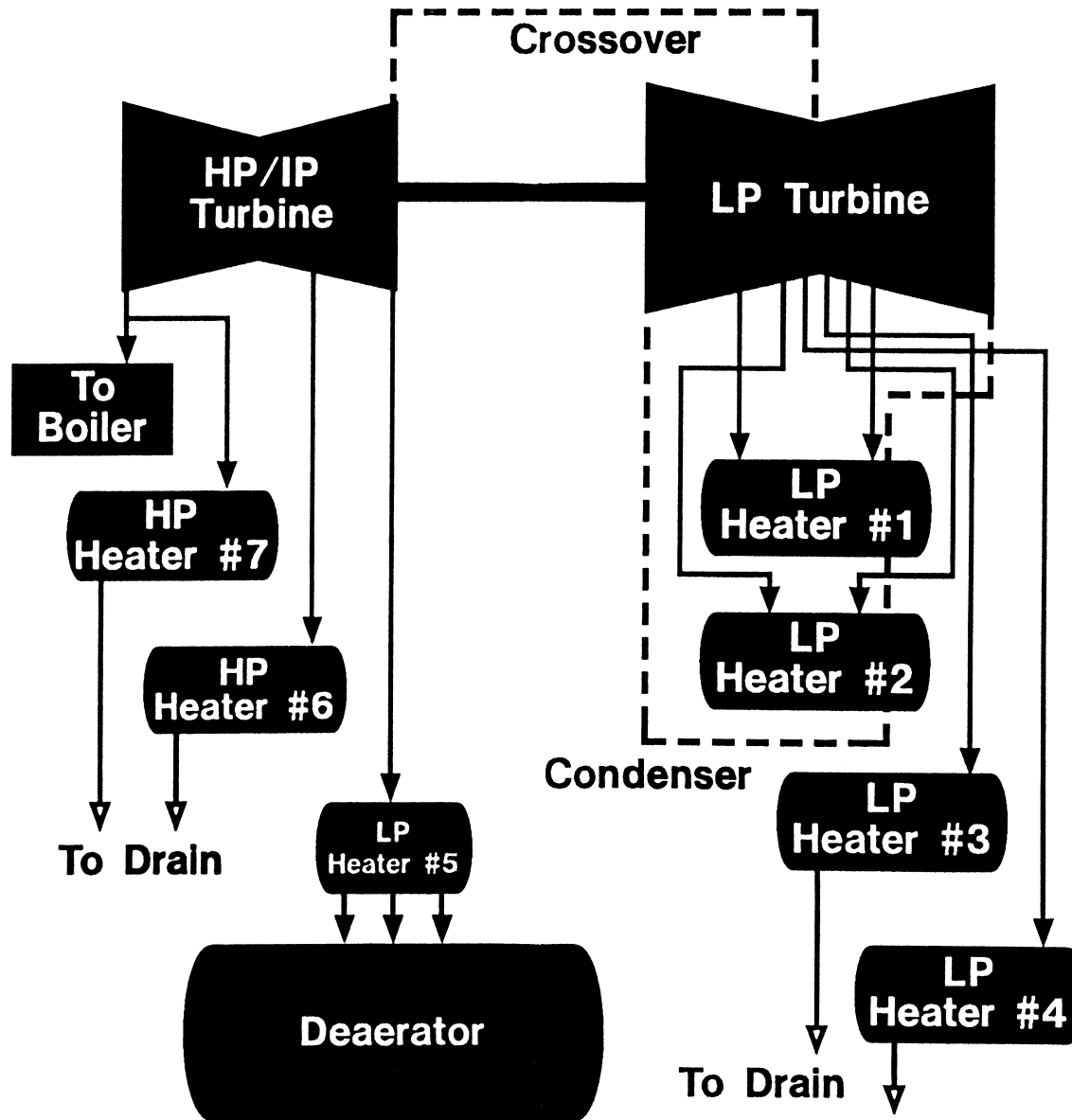
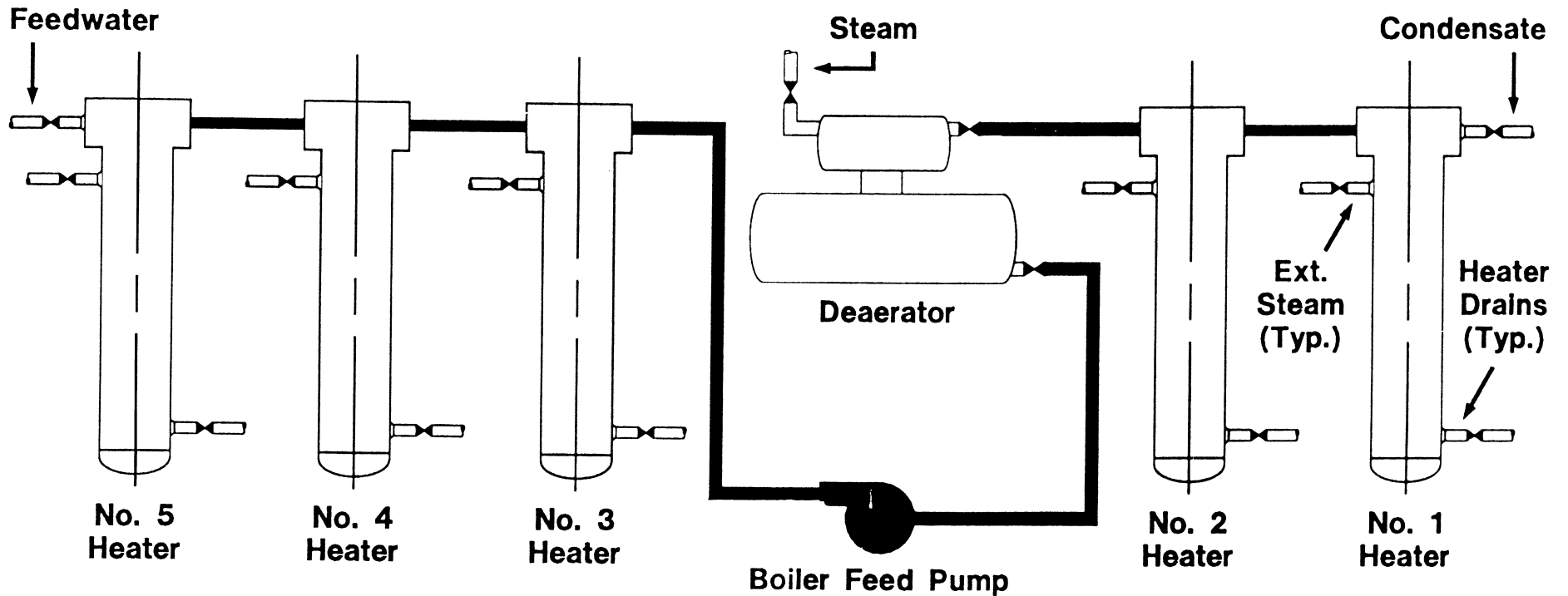


Figure 17



113

## CONDENSATE & FEEDWATER HEATING TRAIN

### Heater Shell Side

Vents and Drains Piping are Sealed with Blind Flanges

Inlet and Outlet Piping are Dried and Sealed by Closing the Valves

### Heater Tube Side

Inlet and Outlet Piping are Dried and Sealed by Closing the Valves



Access Points for VCI Injection



Figure 18

# TYPICAL OF DEAERATING FEEDWATER HEATER

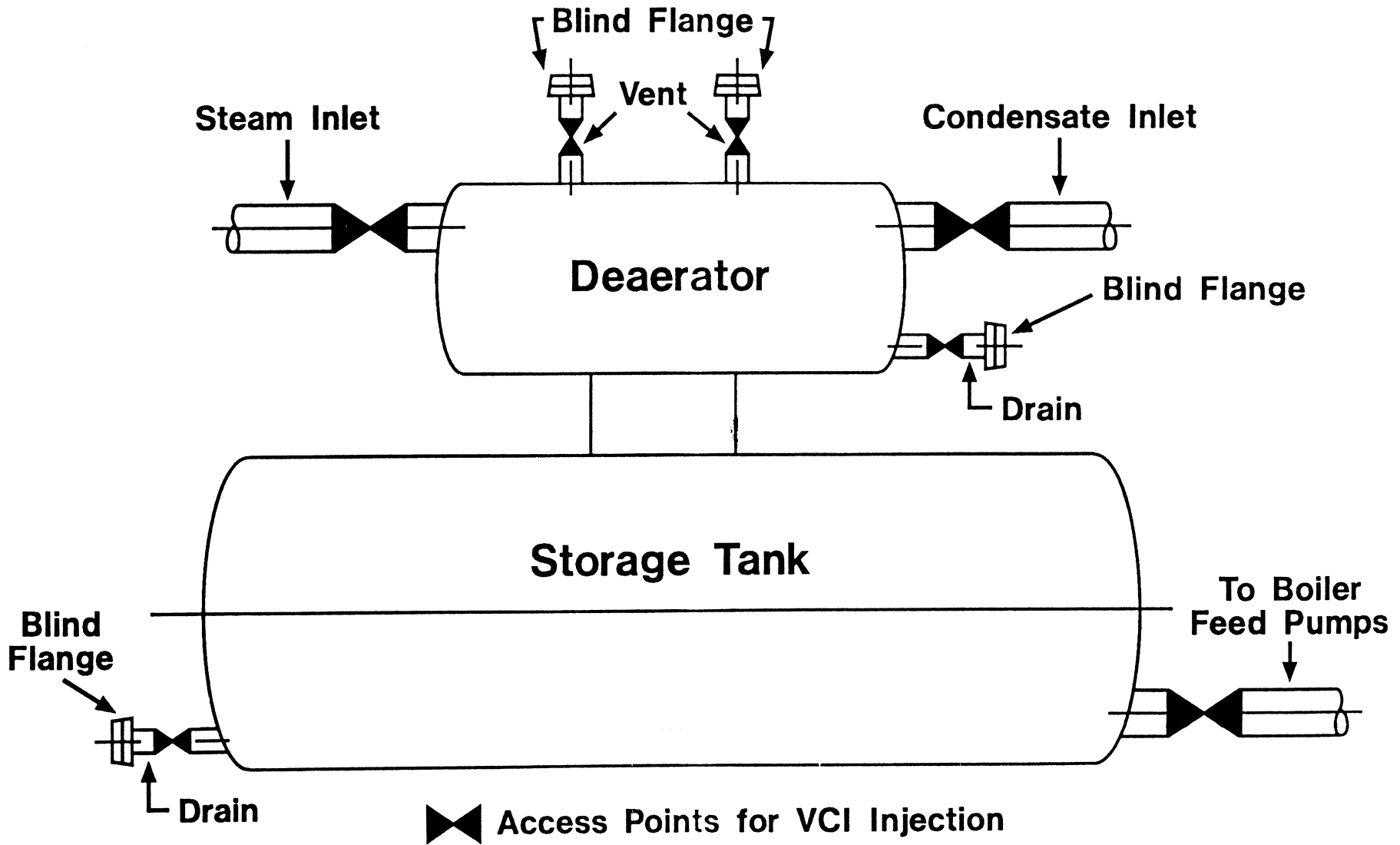
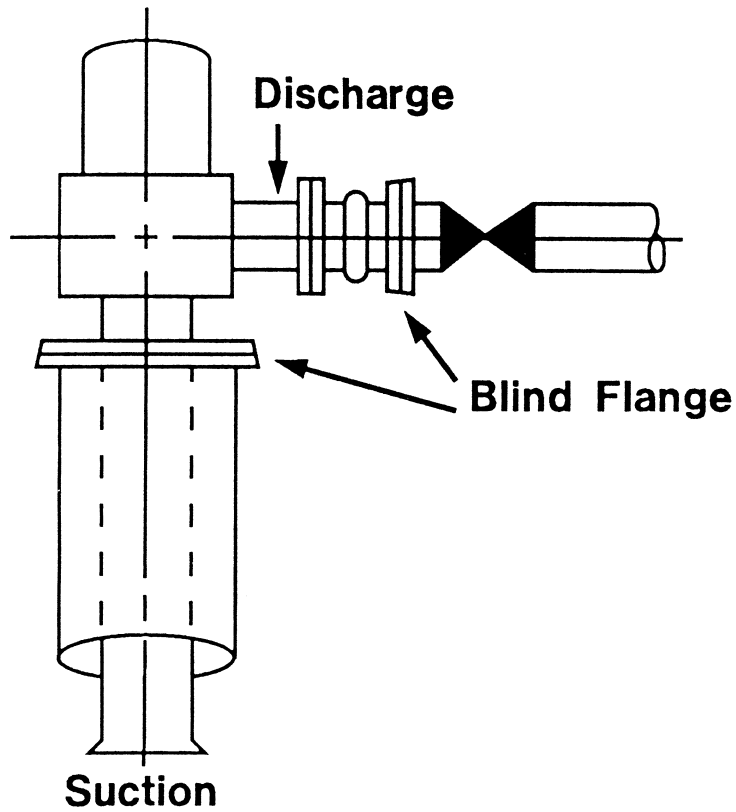
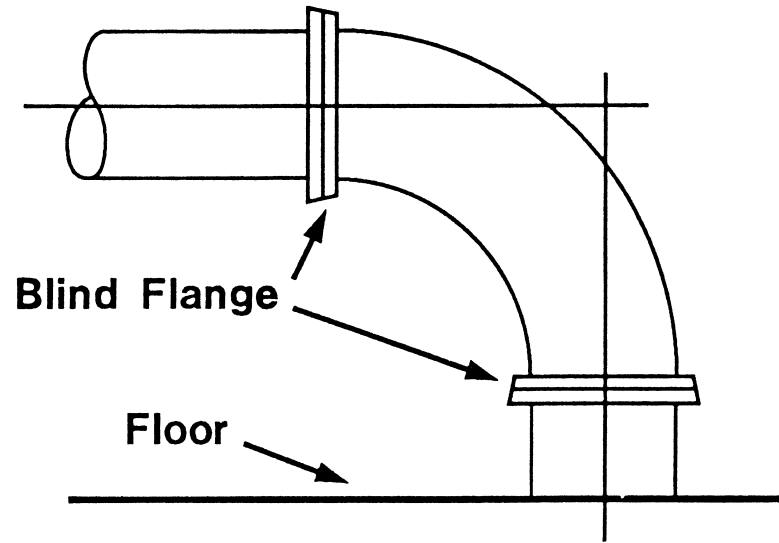


Figure 19



**Condensate  
Cooling Pump**



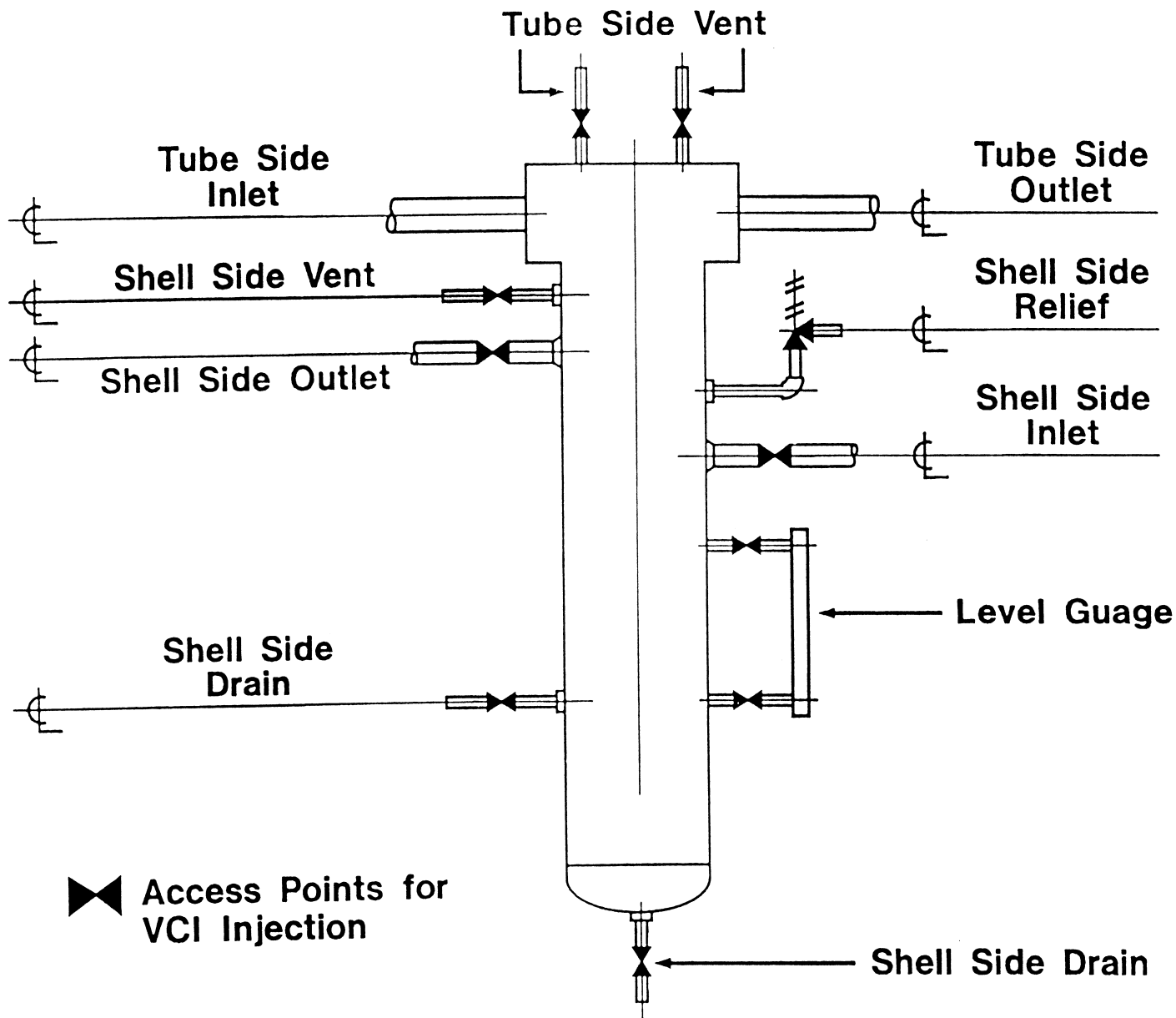
**Circulating Water  
Discharge Elbow**

**Will be Pulled, Dried and Placed in Wooden Cradles and Covered for Storage. The System Piping is Sealed with Blind Flanges at the Discharge and Pump Support Connections. Expansion Joint to be Stored Separately.**

 **Access Points for VCI Injection**

Figure 20

# TYPICAL VERTICAL FEED HEATER



## Chapter 7

### Detailed Application and Removal Procedures For Corrosion Preventives

#### Class I - VCI Thin Film Cortec VCI-238 ElectriCor™ Spray Inhibitor / Cleaner / Antistat CFC Free

#### METHOD OF APPLICATION.

Apply VCI-238 to interior space, directly to the surface to be protected or enclosure wall, by spraying. Small applications can be handled with aerosol spray. For large applications, use conventional paint sprayer or similar apparatus for applying liquids. Apply VCI-238 in a manner that assures uniform distribution within interior space.

After application, cover, close or seal all openings to the interior of the product or container. Although an airtight seal is not necessary, VCI-238 protected surfaces should be contained in a way that prevents direct exposure to rain, water spray, etc. Occasional opening of enclosure or package for brief periods will not adversely affect protection.

Record date when products were treated with VCI-238 and attached dated marker to protected product, box or container. Depending on storage conditions and integrity of sealing, check condition of product at intervals of every 3 to 12 months. Re-apply as conditions warrant.

#### SUGGESTED DOSAGE.

Use 30 cc of VCI-238 Concentrate per cubic foot (1,059 cc/m<sup>3</sup>) of interior space to be protected. Coat product to a film thickness of 0.25 to 0.5 mils (6.25-12.5 microns).

#### PRECAUTIONS.

While applying product, observe the accepted good practices for working with chemical liquids. Maintain adequate ventilation in work area, wear suitable respirator, hand and eye protection. Do not use on equipment which will be exposed to chlorine. For additional safety and material information, refer to Material Safety Data Sheet.

#### EXPOSURE LIMITATIONS.

Cortec VCI-238 should be used only in interior cavities and voids that are covered, closed or sealed after application. Product can be stored in indoor or outdoor conditions. Length of protection depends on integrity of sealing.

#### METHOD OF REMOVAL.

Unless stated in the procedural steps, VCI-238 typically does not require removal prior to product use. If removal is desired, remove with Freon or similar solvent suitable for electronics.

### Class I - VCI Thin Film Cortec VCI-337

#### METHOD OF APPLICATION.

VCI-337 is used in concentrate form and can be applied by dip, fog or spray. For spray or fog, use conventional apparatus for fogging or spraying liquids.

Check condition of product at intervals of every 1 to 3 months. Re-apply as conditions warrant.

#### SUGGESTED DOSAGE.

Coat products to be protected with 0.25 to 0.5 mil (6.25-12.5 microns) dry thickness.

#### PRECAUTIONS.

While applying product, particularly in spray application, observe the accepted good practices for working with chemical liquids. Maintain adequate ventilation in work area, wear suitable respirator, hand and eye protection. Do not use on equipment which will be exposed to chlorine. For further safety and material information, refer to Material Safety Data Sheet.

#### EXPOSURE LIMITATIONS.

VCI-337 can be used as a surface treatment in uncovered, inside storage of wrapped or sealed surfaces, closed interior cavities or voids, and for use in closed packages.

#### METHOD OF REMOVAL.

VCI-337 can be removed with mineral spirits, alkaline cleaners, aliphatic solvents or vapor degreasing solvents.

## Class II - Grease

### METHOD OF APPLICATION.

Grease can be applied by grease gun or by hand. Check condition of grease at intervals of every 3 to 12 months. If grease is contaminated by water or discolored, remove and re-apply fresh material.

### SUGGESTED DOSAGE.

Use as supplied.

### PRECAUTIONS.

Typically, no special handling or application precautions are required. However, while applying product, observe the accepted good practices for working with chemicals. Do not use on equipment which will be exposed to chlorine. For further safety and material information, refer to manufacturer's Material Safety Data Sheet.

### EXPOSURE LIMITATIONS.

Grease can be used for uncovered outdoor storage, sheltered outdoor, indoor and enclosed storage.

### METHOD OF REMOVAL.

Typically grease can be removed manually, with residual grease removed with mineral spirits, aliphatic solvents or vapor degreasing solvents.

## Class III - VCI Anti-Corrosion Grease Cortec VCI-369 and VCI-389

### METHOD OF APPLICATION.

VCI-369 and VCI-389 can be applied by brush, dip or spray. For spray, use conventional spray apparatus; the product can be diluted with lubricating oil, mineral spirits or other suitable solvents to facilitate application.

Check condition of product at intervals of every 3 to 12 months. Re-apply as conditions warrant.

#### SUGGESTED DOSAGE.

External Surfaces: Coat product to be protected with 3-4 mil (75-100 microns) wet thickness.

Bearings: Pump full with VCI-369 and VCI-389 using a grease gun.

#### PRECAUTIONS.

While applying product, particularly in spray application, observe the accepted good practices for working with chemical liquids. Maintain adequate ventilation in work space, wear suitable respirator, hand and eye protection. do not use on equipment which will be exposed to chlorine. For further safety and material information, refer to the Material Safety Data Sheet.

#### EXPOSURE LIMITATIONS.

VCI-369 and VCI-389 can be used as a surface treatment in uncovered outdoor storage for up to 24 months, and longer periods for sheltered outdoor, inside and enclosed storage.

#### METHOD OF REMOVAL.

VCI-369 and VCI-389 can be removed with mineral spirits, alkaline cleaners, aliphatic solvents, or vapor degreasing solvents.

### Class IV - VCI Dry Coating Cortec VCI-368 and VCI-388

#### METHOD OF APPLICATION.

VCI-368 and VCI-388 can be applied by brush, dip or spray. For spray, use conventional spray apparatus; the product can be diluted with mineral spirits or other suitable solvents to facilitate application.

Check condition of product at intervals of every 3 to 12 months. Re-apply as conditions warrant.

#### SUGGESTED DOSAGE.

Coat product to be protected with a 3-4 mil (75-100 microns) wet thickness.

#### PRECAUTIONS.

While applying product, particularly in spray application, observe the accepted good practices for working with chemical liquids. Maintain adequate ventilation in work space, wear suitable respirator, hand and eye protection. Do not use on equipment which will be exposed to chlorine. For further safety and material information, refer to the Material Safety Data Sheet.

#### EXPOSURE LIMITATIONS.

VCI-368 and VCI-388 can be used as a surface treatment in uncovered outdoor storage for up to 24 months, and longer periods for sheltered outdoor, indoor and enclosed storage.

#### METHOD OF REMOVAL.

VCI-368 and VCI-388 can be removed with mineral spirits, alkaline cleaners, aliphatic solvents or vapor degreasing solvents.

### Class IV - VCI Dry Coating Cortec VCI-373, VCI-375, VCI-376 and VCI-386 Water Based

#### METHOD OF APPLICATION.

VCI-373, VCI-375, VCI-376 and VCI-386 is applied preferably by spray. If more than one application is needed to achieve film thickness, allow 2 hours drying time between applications.

Check condition of product at intervals of every 3 to 12 months. Re-apply as conditions warrant.

#### SUGGESTED DOSAGE.

Coat product to be protected with a 3-4 mil (75-100 microns) dry thickness.

#### PRECAUTIONS.

While applying product, particularly in spray application, observe the accepted good practices for working with chemical liquids. maintain adequate ventilation in work space, wear suitable respirator, hand and eye protection. Do not use on equipment which will be exposed to chlorine. For further safety and material information, refer to the Material Safety Data Sheet.

#### EXPOSURE LIMITATIONS.

VCI-373, VCI-375, VCI-376 and VCI-386 can be used as a surface treatment and primer for surfaces to be painted in uncovered outdoor storage and for inside storage.

#### METHOD OF REMOVAL.

VCI-373, VCI-375, VCI-376 and VCI-386 can be removed with hot alkaline cleaners, steam cleaners or paint stripper.



## Class V - VCI Fluid Cortec VCI-326 and VCI-329

### METHOD OF APPLICATION.

Oil Additive - Typically, drain system of existing oil or lubricant. Replace with fresh material containing 10% VCI-326 or VCI-329. Run equipment long enough to get full circulation. If practical, drain fluid and seal all openings.

Fog Interior Voids - Fog interior space of product or container using conventional paint spray apparatus. After application cover, close or seal all openings.

Surface Treatment - Spray, dip or brush product to be protected with VCI-326 or VCI-329 to a wet film thickness of 2 mils (50 microns). Up to 12 months protection, apply diluted VCI-329 one part concentrate to four parts light oil to a wet film of 0.75 - 1 mil (18.75 - 25 microns).

### SUGGESTED DOSAGE.

Oil Additive - Use 10% by volume VCI-326 or VCI-329 with fresh oil/lubricant.

Interior Space - Use 30 cc of VCI-326 or VCI-329 per cubic foot (1,059 cc/m<sup>3</sup>) of interior space to be protected (1 pint [0.47 liters] VCI-326 or VCI-329 per 15 to 20 cubic feet [0.6 m<sup>3</sup>] of interior space to be protected).

Surface Treatment - Up to 24 months protection, apply concentrate to a wet film thickness of 2 mils (50 microns). Up to 12 months protection, apply diluted VCI-326 or VCI-329 one part concentrate to four parts light oil to a wet film thickness of 0.75 - 1 mils (18.75-25 microns).

### PRECAUTIONS.

While applying product, particularly in fog or spray application, observe the accepted good practices for working with chemical liquids. Maintain adequate ventilation in work area, wear suitable respirator, hand and eye protection. Do not use on equipment which will be exposed to chlorine. For further safety and material information refer to the Material Safety Data Sheet.

### EXPOSURE LIMITATIONS.

Cortec VCI-326 or VCI-329 can be used as a surface treatment in sheltered storage and uncovered inside storage. It can be used as a fogging treatment in interior cavities and voids that are covered, closed or sealed after application, and for use as an additive in enclosed lubrication or hydraulic systems.

In all cases, excessive vaporization and loss of protection will occur above 150° F (66°C).

## METHOD OF REMOVAL.

VCI-326 or VCOI-329 can be removed with mineral spirits, alkaline cleaners, aliphatic solvents or vapor degreasing solvents. When used as an oil additive, removal is simply draining system of oil and replacing with fresh material. Generally no further removal steps are required.

## Class VI - VCI Powder Cortec VCI-307

## METHOD OF APPLICATION.

Apply powder to interior space of product or container by dusting, fogging or sprinkling. After application, cover, close or seal all openings to the interior of the product or container.

Fogging is achieved by using a low pressure air hose and sandblast cup. large, conventional sandblasting systems can also be used. Other similar devices that are suitable for dusting, spraying or fogging may also be employed. Apply powder in a manner that assures uniform distribution within the interior space.

Record date when products were treated with VCI-307, attach dated sticker on protected product, box or container. Depending on storage conditions and integrity of sealing, check condition of product at intervals of every 6 to 12 months. Re-apply as conditions warrant.

## SUGGESTED DOSAGE.

Interior space of equipment (dry lay-up). Use 10-30 grams (1/3 - 1 ounce) of VCI-307 per cubic foot (.028 m<sup>3</sup>) of interior space to be protected.

## PRECAUTIONS.

While applying VCI-307, particularly in fog or spray application, observe the accepted good practices for working with chemical powders. maintain adequate ventilation in work area, wear suitable respirator for powders and nuisance dusts, wear hand and eye protection. Do not use on equipment which will be exposed to chlorine. For additional safety and material information, refer to the Material Safety Data Sheet.

VCI-307 should be removed from pipe interiors before welding, exposure to flame, or any other heated treatment or processing.

### EXPOSURE LIMITATIONS.

Cortec VCI-307 should be used only in interior cavities and voids that are covered, closed, or sealed after application. product can be stored in or outdoors. Length of protection depends on integrity of sealing.

### METHOD OF REMOVAL.

unless stated in the procedural steps, VCI-307 typically does not require removal prior to product use. If removal is desired, VCI-307 can be removed in powder form using a low pressure gun. Further more, a simple water flush will usually suffice to remove VCI-307.

## Class VI - VCI Powder Cortec VCI-309

### METHOD OF APPLICATION.

Apply VCI-309 Powder to interior space of product or container by dusting, fogging or sprinkling. After application, cover, close or seal all openings to the interior of the product or container.

Fogging is achieved by using a low pressure air hose and sandblast cup. large, conventional sandblasting systems can also be used. Other similar devices that are suitable for dusting, spraying or fogging may also be employed. Apply powder in a manner that assures uniform distribution within the interior space.

For wet lay-up, circulate a solution of water with 2.5% by weight VCI-309 and 0.25% (by weight) S-5 Wetting Agent through equipment to assure uniform concentration. For situations where it is necessary to protect equipment from freezing, add ethylene glycol according to the manufacturer's specifications for anticipated temperature ranges.

Record date when products were treated with VCI-309 on sticker and attach to protected equipment. Depending on storage conditions and integrity of sealing, check condition of product at intervals of every 6 to 12 months. Re-apply as conditions warrant.

### SUGGESTED DOSAGE.

Interior space of equipment (dry lay-up). Use 30 grams (1 ounce) of VCI-309 per cubic foot (.028 m<sup>3</sup>) of interior space to be protected.

Interior space of equipment (wet lay-up). use 2.5% (by weight) VCI-309 and 0.25% (by weight) S-5 Wetting Agent with mixture of 40% anti-freeze/60% water.

## PRECAUTIONS.

While applying product, particularly in fog or spray application, observe the accepted good practices for working with chemical powders. maintain adequate ventilation in work area, wear suitable respirator for powders and nuisance dusts, wear hand and eye protection. Do not use on equipment which will be exposed to chlorine. For additional safety and material information, refer to Material Safety Data Sheet.

VCI-307 should be removed from pipe interiors before welding, exposing to flame, or any other heated treatment or processing.

## EXPOSURE LIMITATIONS.

Cortec VCI-309 should be used only in interior cavities and voids that are covered, closed or sealed after application. Equipment can be stored in indoor or outdoor conditions. Length of protection depends on integrity of sealing.

## METHOD OF REMOVAL.

Unless stated in the procedural steps, VCI-309 typically does not require removal prior to equipment use. If removal is desired, VCI-309 can be removed in powder form using a low pressure gun. In addition, a simple water flush will usually suffice to remove VCI-309.

## Class VI - VCI Powder Cortec VCI-609

## METHOD OF APPLICATION.

Apply VCI-609 Powder to interior space of product or container by dusting, fogging, or sprinkling. After application cover, close, or seal all openings to the interior of the equipment or container.

Fogging is achieved by using a low pressure air hose and sand blast cup. large, conventional sand blasting systems can also be used. Other similar devices that are suitable for dusting or fogging may also be employed. Apply powder in a manner that assures uniform distribution with the interior space.

For aqueous application, spray or circulate a solution of water, VCI-609 and S-5 Wetting Agent in such a manner that assures uniform distribution within equipment. After application, cover, close, or seal all openings to the interior of the equipment or container.

record date when product (s) were treated with VCI-609 on sticker, and attach to protected equipment. Depending on storage conditions and integrity of sealing, check condition of product at intervals of every 3 to 6 months. Re-apply as condition warrant.

### SUGGESTED DOSAGE.

Interior space of equipment (dry lay-up)

Use 10 grams (0.4 ounce) of VCI-609 per cubic foot of interior space to be protected.

Interior space of equipment (wet lay-up)

Use 2.5% by weight VCI-609 and 0.25 by weight S-5 Wetting Agent with water.

### PRECAUTIONS.

While applying product, particularly in fog or spray application, observe the accepted good practices for working with chemical powders. Maintain adequate ventilation in work space, wear suitable respirator for powders and nuisance dusts, wear hand and eye protection. Do not use on equipment which will be exposed to chlorine. For additional safety and handling information, refer to Material Safety Data Sheet.

VCI-609 should be removed from product before welding, exposure to flame, or any other heat treatment.

### EXPOSURE LIMITATIONS.

Cortec VCI-609 should be used only in interior cavities and voids that are covered, closed, or sealed after application. Equipment can be stored in indoor or outdoor conditions. Length of protection depends on integrity of sealing.

### METHOD OF REMOVAL.

Unless stated in the procedural steps, VCI-609 typically does not require removal prior to equipment use. If removal is desired, VCI-609 can be removed in powder form using a low pressure gun. In addition, a simple water flush will usually suffice to remove VCI-609.

Class VI - VCI Concentrate\*  
Cortec VCI-645 and VCI-649

### METHOD OF APPLICATION.

VCI-645 and VCI-649 can be applied by spray, pump injection, flooding, circulation, and can be added to standing water. Apply powder in a manner that assures uniform distribution within the interior space. After application cover, close, or seal all openings to the interior of the system or equipment.

Record date of treatment on sticker and attach to protected system or equipment. Depending on storage conditions and integrity of sealing, check level of protection at intervals of every 3 to 12 months. Re-apply as conditions warrant.

### SUGGESTED DOSAGE.

Normal condition

Use 0.5% by volume VCI-645 or VCI-649 with water (chloride level less than 150 ppm).

Severe Condition

9

Use 1.0% by volume VCI-645 or VCI-649 with water (chloride level between 150-200 ppm).

### PRECAUTIONS.

While applying product, particularly in spray application, observe the accepted good practices for working with chemical liquids. Maintain adequate ventilation in work space, wear suitable respirator, gloves and eye protection. Do not use on equipment which will be exposed to chlorine. For additional safety and material information, refer to Material Safety Data Sheet.

VCI-645 or VCI-649 should be removed from product before welding, exposure to flame, or any other heated treatment or processing.

\*Liquid version of VCI-609

### EXPOSURE LIMITATIONS.

VCI-645 or VCI-649 should be used only in interior cavities and voids that are covered, closed, or sealed after application. product can be stored in indoor or outdoor conditions. Length of protection depends on integrity of sealing.

### METHOD OF REMOVAL.

VCI-649 can be removed with water or conventional cleaning techniques. the product contains ethylene glycol. Consult local authorities for proper disposal.

## Class VIII - VCI Plastic Wrap VCI-126 or VCI-128

### METHOD OF APPLICATION.

Bags, gusseted bags (liners), pouches, tubing:

Insert product in bag or tube and close securely to prevent entry of moisture or air. Depending on degree of seal integrity desired, closing can be accomplished with wire closures, twist closures, stapling or heat sealing.

Sheeting:

Completely wrap or shroud product to prevent entry of moisture or air.

Record date when product (s) packaged or wrapped in VCI Plastic. Depending on storage conditions and integrity of sealing, check level of protection at intervals of every 3 to 12 months. Simple visual check by looking through transparent plastic wrap is usually sufficient. Repackage or re-wrap product as conditions warrant.

PRECAUTIONS.

No special application or handling precautions are required for normal use. However, if persons' hands are especially sensitive to chemical exposure, it may be desirable to wear gloves. Do not use on equipment which will be exposed to chlorine. For additional safety and material information, refer to Material Safety Data Sheet.

EXPOSURE LIMITATIONS.

Cortec VCI-126 and VCI-128 must enclose product to prevent entry of moisture and air. Plastic wrap can be used to protect products stored indoors, or outdoors in sheltered condition. Length of protection depends on integrity of sealing.

## Chapter 8

### Application Equipment, Product Sources, and Publications

#### SAND BLASTING EQUIPMENT

Model 2Z631	Speedair
Model 4Z677	Dayton Electric Manufacturing Company 5959 Howard Street Chicago, IL 60648

#### AIRLESS SPRAYING EQUIPMENT

Model GH433	Graco, Inc. P.O. Box 1441 Minneapolis, MN 55440
-------------	---

#### PRESSURE SENSITIVE TAPES

3M Tape	3M Corporation Paul Nelson (Manufacturer's Rep) Jesco Industries 4700 Quebec Avenue North Minneapolis, Minnesota 55428
---------	--

## Appendix 1

February 17, 1984

### CORTEC QUANTITATIVE CONCENTRATION ANALYSIS OF VCI-309 POWDER IN SOLUTIONS

1. MATERIALS:
  - 1.1 Ferric Chloride ( $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ ) reagent grade
  - 1.2 Distilled water
  - 1.3 Hydrochloric acid
  - 1.4 Titration apparatus
  - 1.5 Eye dropper
  - 1.6 Test tube



2. PREPARE 1.0 N HCl SOLUTION:
  - 2.1 Mix 92.0 ml distilled water with 8.0 ml HCl.
  - 2.2 Place the solution of section 2.1 in titration apparatus.
  
3. PREPARE FERRIC CHLORIDE TEST SOLUTION:
  - 3.1 Dissolve 9 grams of Ferric chloride in water to make 100 ml of finished solution.
  
4. PROCEDURE:
  - 4.1 Place 1 ml of sample solution to be tested into test tube.
  - 4.2 To the test tube of section 4.1, add 5 ml distilled water.
  - 4.3 Lastly, to the test tube of section 4.1, add 10 drops (0.3 ml) of the Ferric Chloride solution prepared in section 3.0.
    - 4.3.1 Reference 'drop': 33 drops=1ml.
  - 4.4 Shake well to mix contents of test tube:
    - 4.4.1 This resultant solution should be turbid.  
If not, the VCI-309 Powder concentration is less than 2%.
  - 4.5 Titate the solution in the test tube with 1.0 N HCl bvery slowly until solution is clear.
    - 4.5.1 Do this by adding one to two drops at a time and mixing well for several seconds, then titrate further.
  - 4.6 Record the number of ml of HCl used and determine VCI-309 Powder concentration from graph.

January 20, 1993

**To:** ALL SALES REPRESENTATIVES

**From:** Boris Miksic  
President/CEO Cortec Corporation

For your perusal we have enclosed the article, "Evaluation of Corrosion Prevention Methods for Above ground Storage Tank Bottom", by S.R. Rials and J.H. Kiefer in the January 1993 edition of Materials Performance. The report articulates the successful use of Cortec VCI-307 for vapor phase corrosion inhibition.