

Description

VCI (Vapor Corrosion Inhibitor) Preservation Methodology of Self-Propelled and Towed Howitzer Guns over Cycles of Two Years.

Background

The present invention relates to a VCI Preservation Methodology of self-propelled and towed Howitzer Guns.

In these days of downsizing of manpower and declining population, Armed Forces throughout the world are looking for a more efficient way to preserve the military equipment listed above.

Currently, in order to maintain its Howitzer Guns at operational readiness at all times, the Armed Forces utilizes manpower to manually maintain Howitzer Guns every three to four weeks. The repetition of this manual procedure every three to four weeks is both tedious and time-consuming. Moreover, to the Army's dismay, it does not effectively keep the Howitzer Guns in pristine condition. Over time, parts and joints begin to corrode, rubber and electrical components break down and require replacements. Manual maintenance becomes altogether too costly.

Humidity, moisture, and large temperature variations stemming from condensation take their toll on Gear Boxes left to stand both indoors and outdoors. Gearboxes, engines and even replacement parts are highly susceptible to changes in humidity. Weapon systems and electronic systems, in particular, are prone to breakdowns if left in an atmosphere of uncontrolled humidity. Oil and grease cause degeneration over time when exposed to high humidity. This leads to the break down of components and severely reduces the life span of the Howitzer Guns.

Aging is a collective term for changes in property of materials that occur on longer term storage without the action of chemicals and controlling the humidity of the environment. This leads to partial or complete degradation, which occur in the form of degradation processes and crack formation.

Rubber seals are especially prone to such aging effects if left unprotected. The unsaturated groups in rubber present sensitivity toward oxygen, ozone, UV irradiation, bacteria attack and other active substances. These reactions cause changes in the rubber seals and result in leakages of the hydraulic, fuel and lubrication system.



SUMMARY OF THE INVENTION

The current method is an old fashioned and tedious way which requires heavy dependence on physical manpower for maintaining the operational readiness of the abovementioned gun.

The intention of the present invention is to create a new method and the integration of its apparatus into a preservation system for above said gun without experiencing the drawbacks referred to above.

A special object of the invention is to develop an effective method using a range of Vapor Corrosion Inhibitor products to protect the said weapon from corrosion and at the same time reduces the need of manpower after the said guns are kept in storage.

Another object of the invention is reducing the time or manpower required to change the engine oil of every vehicle every three to six months, thereby enhancing operational readiness and better deployment of soldiers to combatant role.

A further object is to keep the said gun operational ready by providing a total preservation to the chassis, fuel system, lubrication system, cooling system, hydraulic system, electrical and electronic system, rubber parts, weaponry system, steering system, gear boxes, engines, optics, and exhaust system.

DETAILED DESCRIPTION OF THE INVENTION

In accordance with this discovery, it is an object of the invention to provide the novel process involved and the VCI products used for preservation of the afore-mentioned guns.

The novel process and the VCI products used are herein described.

The invention relates to a VCI preservation methodology over cycles of two years of Howitzer Guns using a range of VCI (Vapor Corrosion Inhibitor) products.

In an embodiment of the invention as shown in figure 1 the preservation method consists four methodological and detailed stages; first stage beginning with Zero Point Maintenance which involves a compulsory service task.

At the second stage, the Howitzer gun then undergoes the preparation stage of general cleaning, lubrication and treatment of inherent corrosion.

The third stage involves the application of VCI products in the engine, engine transmission, fuel system, hydraulic system, exhaust system, rubber components, electrical and electronic systems and connectors, weaponry system, suspension system, driver and crew compartment and moving parts such joints.

Once the VCI application is complete, the fourth stage involves sealing of the Howitzer gun and then it will be covered with VCI canvas and kept in storage for 2 years before it is mobilized for operational purposes.

Another embodiment of the said invention is the Zero Point Maintenance, involving the change of engine lubricant, oil filters, fuel, fuel filters, gear lubricant, hydraulics oils, and replacement of conventional grease with VCI grease and if required, repairs to the gun to ensure its operational efficiency.

Another embodiment of the said invention is the Preparation stage involves the cleaning the interior and exterior of the gun with VCI Cleaning Agent and the treatment of the inherent rust of the gun with VCI Rust Converter.

A further embodiment of the said invention involves the Application of VCI Products on all the essential systems and compartments of the vehicles spelled out below in the detailed preservation procedure of the guns.

By way of example and not limitation, the following are illustrative of various embodiments of the foregoing VCI preservation methodology for Howitzer Guns.

Example 1

The details of VCI Preservation Methodology of Howitzer Gun are herein described;

1.0. FIRST STAGE: ZERO POINT MAINTENANCE

- 1.1 Prior to putting the Gun into preservation, a full technical inspection, servicing and repair (if necessary) shall be carried out. The following tests shall be carried out:
 - a) A road test shall be carried out to assess the actual condition of the engine and transmission assembly.
 - b) An initial pulling back (at least thrice) shall be carried out to assess the actual condition of the Recoil Mechanism, the Breech Mechanism, Breech Opening Mechanism, Breech Closing Mechanism and Primer Feeding Mechanism.
 - c. The Auxiliary Power Unit (APU), Flick Rammer (less ramming of round) and its respective system shall be operated and exercised accordingly as indicated in the Operator's Manual and Maintenance Manual.
- 1.2. During the tests, perform the following task and inspections as indicated below in conjunction with the Preventive Maintenance Checks & Services:
 - a) Check for leakages in the following sub assemblies:
 - i. Engine fuel tank, cooling & lubricating systems;
 - ii. Breech Opening Mechanism;
 - iii. Breech Closing Mechanism;

- iv. Hand Pump;
- v. Primer Feeding Mechanism;
- vi. Flick Rammer;
- vii. Recoil Mechanism;
- viii. Firing Platform;
- ix. Trail Wheels Lifting / Lowering;
- xi. APU drive hydraulic systems; and
- xii. Equilibrators.

- b) Check for smooth operation and complete closure of the Breech Block.
- c) Check that the Primer Feeding Mechanism is aligned with the Spindle.
- d) Check for smooth operation in the Elevating and Traversing Mechanisms.
- e) Carry out external check for damages.
- f) Rectify any deficiency and incorrect observation accordingly.

1.3.

Zero Point maintenance also involve the changing of engine oil, oil filters, steering oil, engine transmission oil, hydraulic fluids, fuel, and fuel filter. Drain out all used fluids, and lubricants and replace with new ones and add 10% of VCI oil additives to said fluids and lubricants. The various systems shall be flushed when changing engine oil and hydraulic fluid. The corresponding hydraulic, oil, fuel filters shall also be replaced in the process of change.

2.0. SECOND STAGE: PREPARATION OF HOWITZER GUN BEFORE PRESERVATION

- 2.1. Clean the exterior and interior of Howitzer guns with VCI Water Based Cleaning and Degreasing agent.
- 2.2. Treat inherent corroded parts with VCI Rust Converter Primer.
- 2.3. Grease all hinges and all moving parts with VCI Grease.
- 2.4. Clean Barrel with VCI Cleaning Solvent

3.0. THIRD STAGE : APPLICATION OF VCI PRODUCTS ON ESSENTIAL COMPONENTS OF HOWITZER GUNS

3.1. TRANSVERSE MECHANISM

- 3.1.1 Coat Transverse Arc Gear with VCI Wax. Apply generously VCI Grease over the dried coat of VCI Wax.

- 3.1.2. Gear Housing Cover Sub-assembly Nipples.
Lubricate with VCI grease.
- 3.1.3. Gear Housing Grease Nipple
Lubricate with VCI grease.
- 4.0. Elevation Mechanism**
- 4.1. Tangential Screws and Locator.
Clean and Lubricate with VCI grease
- 4.2. Elevating Arc and Pinion Mechanism.
Clean and lubricate with VCI grease.
- 4.3. Elevating Arc and Pinion Mechanism.
Lubricate with VCI grease.
- 4.4. Worm Gearing Mechanism Assembly.
Check oil level and add 10% of VCI oil additives to the lubricant via the filler plug.
- 5.0. BRAKE, BATTERY AND ELECTRICAL CONNECTORS**
- 5.1 Add 5% of VCI Oil Additives into the brake fluid for self-propelled howitzer gun.
Open cover and treat spring with VCI Wax and fog powder.
- 5.2. Clutch (Applicable only for self-propelled howitzer)
- 5.2.1. If accessible, put a spacer in between the clutch and fog with VCI Powder.
Cover the High and Low Mechanism Assembly with VCI Film to keep it away from dirt.
- 5.3. Battery
Coat a layer of VCI wax on the terminals and cables of battery.
- 5.4. Slave receptacles and electrical connectors.
Spray said items with VCI electro-spray.
- 5.5. Power Distribution and Relay Boxes.
Spray all connectors with VCI electro-spray and install VCI foam emitters in the power distribution and Relay Boxes.
- 6.0. ENGINE, SPLITTER GEAR BOX AND FUEL SYSTEM
(APPLICABLE ONLY FOR SELF-PROPELLED HOWITZER).**
- 6.1. Engine
Change engine oil and add 10% by volume of VCI oil additives. Check for correct oil level
- 6.2. Splitter Gear Box
Change gear box oil and add 10% by volume of VCI oil additives. Check for correct oil level.

- Fuel Tank**
6.3. Add 1% VCI Fuel additives by volume into fuel tank, start engine and let it run for 10 minutes. Allow the fuel and VCI additives to remain in the fuel pipe lines.

- Exhaust System**
6.4. Spray VCI Oil additives into exhaust pipe, cover opening of the exhaust pipe with VCI bag and seal with aluminium foil tape.

7.0. BARREL AND BREECH MECHANISM

7.1. Barrel and Barrel Clamp

- 7.1.1. Pull through barrel with VCI Light Oil or VCI Solvent by means of Barrel Pull Through Kit and Brush or by means of an Automatic Barrel Winch.

- 7.1.2. Apply 2 Coats of VCI Wax in the bore of barrel.

- 7.1.3. Apply 2 coats of VCI wax on the Muzzle Brake and Seal barrel with VCI Bag and muzzle cover.

- 7.1.4. Apply 2 coats of VCI wax on barrel clamp

7.2. FIRING MECHANISM/ BRIDGE BLOCK

- 7.2.1. Spray Bridge Block with VCI Oil or VCI Solvent and apply VCI Grease on the mechanism of the Bridge Block.

7.3. PRIMER FEEDING MECHANISM

- 7.3.1. Lubricate with VCI Grease

7.4. BREECH CLOSING MECHANISM

- 7.4.1. Lubricate all moving parts with VCI Grease and add 10% of VCI oil additives to the breech mechanism lubricant.

7.5. BREECH OPENING MECHANISM

Lubricate all moving parts with VCI grease and add 10% of VCI oil additives to breech mechanism lubricant.

7.5.1. BREECH HAND PUMP

Lubricate all moving parts with VCI grease.

7.5.2. BREECH MECHANISM ASSEMBLY

Lubricate all moving parts with VCI grease.

7.5.3. REMOTE FIRING MECHANISM.

Lubricate all moving parts with VCI grease.

8.0. RECOIL MECHANISM

- 8.1. Recoil Buffer Grease Nipple.
Lubricate with VCI grease.
- 8.2. Replenisher Piston Indicator
Clean with VCI degreaser and check length of indicator. Add/Remove fluid, where necessary.
- 8.3. Recuperator
Clean with VCI degreaser and check correct amount of fluid and nitrogen.

9.0. TYRES, HOSES AND RUBBER PARTS

- 9.1. Tyres
 - 9.1.1. Apply VCI Silicon Fluid on the sides of the Tyres and increase the pressure of the tyres by 25%.
Note: Tyres are to be rotated a quarter turn every 6 monthly.

9.2. RUBBER PARTS

- 9.2.1. Treat all rubber parts with VCI Silicon Fluid.

10.0. CHASSIS

- 10.1. Grease all moving parts and fill all greasing points with VCI Grease.
- 10.2. Ensure the chassis coating is intact; apply all exposed parts with VCI Wax.
- 10.3. TRAIL LEGS
 - a. Tow Eye and Drawbar Catch
Clean with VCI degreaser and lubricate with VCI grease.
 - b. Trail Wheels
Inflate tyres with compressed air to 5 bars and coat it with silicon fluid.
 - c. Wheel Stud and Nut
Check for correct torque (260 Nm).
 - d. Hub and Axle
Check for damage or missing wheel stud and nut .Add 10% of VCI oil additives into the Axle.
 - e. Tie Rod Fasteners
Clean VCI degreaser and lubricate with VCI grease.

f. Plunger of Trail Wheel
Clean with VCI degreaser and lubricate it with VCI grease.

g. Spade and Stopper
Clean, Inspect and Lubricate with VCI grease.

h. Barrel Clamp
Clean, Inspect and Lubricate VCI grease

i. Trail Spreading Cylinder
Clean and Lubricate with VCI grease.

10.4. LAYER'S SEAT AND PLATFORM

a. Layer's Seat
Check for damages and apply a layer of VCI silicon fluid on the layer's seat.

b. Seat Fore and Aft Mechanism
Clean and Lubricate with VCI grease.

c. Back Stoppers
Clean and ensure that they are not deficient.

10.5. FIRING PLATFORM

a) Right and Left Link
Lubricate with VCI grease
b) Travelling Lock Assembly.
Lubricate with VCI grease.
c) Bracket, Bipod Leg
Lubricate with VCI grease.
d) Base Plate Assembly
Lubricate with VCI grease through grease nipple.
Mechanical Linkages
Clean, Inspect and Lubricate with VCI grease.

10.6. Suspension System
VCI grease is applied on the suspension system of the Howitzer such as tensioners, the idler wheels, support rollers via the grease nipples.

10.7. Driver & Crew Compartment
VCI Foam emitter and VCI pouch will be installed into the driver and crew compartment of the vehicle.

11.0. EQUILIBRATOR

11.1. Ensure there is sufficient of nitrogen in the Chamber Of Balancing Mechanism Unit. The pressure should read 1510 PSI at 70°F under normal conditions. The range perimeters are +97 or -56 of the said pressure.

11.2. Ensure that all rubber seals are intact and protect it with VCI Silicon Fluid.

- 11.3. Treat rubber seals with VCI Silicon Fluid.
- 11.4. Ensure gate valve assembly is free from dirt and grime by covering it with VCI Polyethylene Film.
- 11.5. Charging Valves and Test Couplings Caps.
Clean with VCI degreaser and lubricate moving parts with VCI grease.
Tighten, if necessary.
- 11.6. Equilibrator Piston Rod.
Clean, Inspect and Lubricate with VCI grease.
- 11.7. Indicator at Pressure Tank
Add 10 % by volume of VCI oil additives and check that oil level is maintained between "REFILL" and "FULL". Indicator rod shall not slide towards the left.
- 12.0. **FOURTH STAGE: SEALING OF 155 MM, 240 MM, 105 MM AND 8 INCH HOWITZER GUNS**
- 12.1. Seal all opening with Aluminium Foil Tape and place security seal at all openings.
- 12.2. If equipment is store in unsheltered area, cover equipment with VCI Canvas Cover.
- 13.0. **ROUTINE INSPECTION DURING STORAGE EVERY 6 MONTHS POINT**
- 13.1. External Chassis
 - 13.1.1. Inspect the conditions of enclosure. Carry out sealing on the enclosure if required. Inspect all hinges and lubricate if necessary.
 - 13.1.2. Inspect equipment for signs of deterioration, and carry out necessary maintenance works if required.
- 13.2. **RUBBER SEAL**
 - 13.2.1. Inspect all rubber seals and treat them with VCI Silicon Fluid if necessary.
- 13.3. **TYRES**
 - 13.3.1. Check tyres' pressure and increase the pressure if necessary. Check the integrity of VCI Silicon Fluid Coating; treat tyres with VCI Silicon Fluid if required.
- 13.4. **EQUILIBRATOR**
 - 13.4.1. Inspect the seals of the equilibrator and treat with VCI Silicon Fluid if required.

13.5. RECOIL MECHANISM UNIT

- 13.5.1. Components of the Recoil Mechanism Unit need to be activated 6 monthly in accordance to Manufacturer's Technical Manual.
- 13.5.2. After equipment has been inspected and re-preservation completed, ensure all openings are properly sealed with security label.

14.0. REPRESERVATION OF 105 MM, 155 MM, 120 MM, 240 MM, and 8 inch ARTILLERY GUN

14.1. General

Replace V.C.I. at every 2nd annual inspection, - alternatively after 24 months if Howitzer gun has not been opened for interior inspection.

- 14.1.1. Equipment should be cleaned and dried, followed by inspection before re-applying of VCI products. Water trapped in the equipment should be removed.

14.2. Static Mobilization

- 14.2.1. If it is just only static mobilization i.e. only to start the engine for less than half an hour, then re-application of new VCI products is not necessary. You may recycle the existing used VCI Products. However, it is of paramount importance to seal all opened openings with new sealing tapes and security label seal.

14.3. Moving / Open Mobilization

- 14.3.1. If the Howitzer gun is mobilized for few days, please repeat the said preservation.

14.4. Estimated Time for Re-preservation

- 14.4.1. Estimated time for re-preservation is approximately 6 hours for open mobilization and ½ hour for static mobilization.

The foregoing embodiments are susceptible to considerable variation in its practice. Accordingly, the embodiments are not intended to be limited to the specific exemplifications set forth hereinabove. Rather, the foregoing embodiments are not within the spirit and scope of the appended claims, including the equivalents thereof available as matter of law.

The patentees do not intend to dedicate any disclosed embodiments to the public, and to the extent any disclosed modifications or alterations may not literally fall within the scope of the claims, they are considered to be part hereof under the doctrine of equivalents.

Claims:**What is claimed:**

1. A VCI Preservation Methodology of Self-Propelled and Towed Howitzer Guns with caliber of 105 mm, 120mm, 155mm and 240mm, using VCI (vapor corrosion inhibitor) over cycles of two years.
2. The VCI Preservation Methodology of claim 1 wherein the preservation methodology involves the use of VCI products to maintain the operational readiness of the said guns by eliminating corrosion, preventing the deterioration of the electrical system, brake system, battery system, engine and transmission system, lubrication system, clutch system, hydraulic system, weaponry system, and rubber parts.
3. The VCI Preservation Methodology of claim 1 wherein the preservation methodology involves four methodological stages, routine six month inspection and mobilization, re-preservation at two year point. It starts with Zero Point Maintenance, Preparation of Howitzer Gun, Application of VCI Products on the essential systems of Howitzer gun and sealing of Howitzer gun.
4. The VCI Preservation Methodology of claim 3 wherein the Zero Point Maintenance involves a full Technical Inspection, servicing and repair (if necessary) shall be carried out. A road test shall be carried out to assess the actual condition of the engine and transmission assembly. An initial pulling back (at least thrice) will be carried out to assess the actual condition of the Recoil Mechanism, the Breech Mechanism, Breech Opening Mechanism, Breech Closing Mechanism and Primer Feeding Mechanism. The Auxiliary Power Unit (APU), Flick Rammer (less ramming of round) and its respective system shall be operated and exercised accordingly.
5. The VCI Preservation Methodology of claim 3 wherein Zero Point Maintenance also involve the changing of engine oil, oil filters, engine transmission oil, hydraulic fluids, fuel, and fuel filter.
6. The VCI Preservation Methodology of claim 5 wherein 10% of VCI oil additives is added to all new lubricants and hydraulic fluids.
7. The VCI Preservation Methodology of claim 3 wherein the Preparation of Howitzer gun involves the cleaning of the interior and exterior of the said gun with VCI water based cleaning and degreasing agent.
8. The VCI Preservation Methodology of claim 3 wherein the Preparation of the howitzer gun involves the treatment of any inherent rust of the vehicle with VCI rust converter.
9. The VCI Preservation Methodology of claim 8 wherein the inherent rust of Howitzer gun will be converted by the VCI rust converter from ferric hydroxide $\text{Fe}(\text{OH})_3$ to ferrosferric oxide (Fe_3O_4) a stable compound which does not readily change as exposure conditions change.

10. The VCI Preservation Methodology of claim 3 wherein stage 3 of the preservation methodology involves the application of VCI Products on the main operating systems of the Howitzer gun, i.e. engine, engine, transmission & transverse mechanism, fuel system, hydraulic system, exhaust system, rubber hoses, seals, rubber components, tyres, electrical and electronic systems and connectors, weaponry system, suspension system, brake system, clutch system, driver and crew compartment and moving parts such joints.

11. The VCI Preservation Methodology of claim 3 wherein all openings, crevices and entrances of the Howitzer gun will be covered by VCI Polyethylene film and hermetically sealed by foil tape and security label to prevent tempering and before a VCI Canvas Cover is place over the said gun and kept for storage for two years.

12. The VCI Preservation Methodology of claim 10 wherein 10% by volume of VCI oil additives is added into the engine.

13. The VCI Preservation Methodology of claim 10 wherein 10% by volume of VCI oil additives is added into engine transmission.

14. The VCI Preservation Methodology of claim 10 wherein 1% by volume of VCI fuel additives is added into the fuel tank.

15. The VCI Preservation Methodology of claim 10 wherein 5% by volume of VCI hydraulic oil additives is added into the all the hydraulic system of the vehicle.

16. The VCI Preservation Methodology of claim 10 wherein VCI oil is sprayed into the exhaust system via the exhaust pipe before they are covered with VCI plastic film and then hermetically sealed with foil tape.

17. The VCI Preservation Methodology of claim 10 wherein VCI silicon fluid is applied on all the rubber components, hoses, seals, and tires of the howitzer guns to preserve them from deterioration due to the presence of ozone and ultra violet rays.

18. The VCI Preservation Methodology of claim 10 wherein VCI electro-spray will be applied on all electrical contact points, battery terminal connectors, sockets, master switch panel, instrumental switch panel, slave receptacle, printed circuit boards (PCBs) and the installation of VCI Foam Emitters in the electrical and electronic enclosures.

19. The VCI Preservation Methodology of claim 10 wherein VCI light oil or VCI Cleaning solvent is used to clean and preserve the weaponry system such as gun barrel.

20. The VCI Preservation Methodology of claim 10 wherein VCI grease is applied on the suspension system of the vehicle such as tensioners, the idler wheels, support rollers via the grease nipples.

21. The VCI Preservation Methodology of claim 10 wherein VCI Foam emitter and VCI pouch will be installed into the driver and crew compartment of the vehicle.

22. The VCI Preservation Methodology of claim 10 wherein the VCI grease is applied on all joints of the Howitzer gun.

23. The VCI Preservation Methodology of claim 3 wherein a routine inspection and exercising of recoil mechanism of the Howitzer gun will be carried out every six months to ensure 100% operational readiness condition of the preserved Howitzer gun.

24. The VCI Preservation Methodology of claim 11 wherein all the openings, entrances and crevices of the Howitzer gun will be sealed by VCI foil tape and security labels after the application of VCI products; and then covered by VCI Canvas Cover and will be placed in storage for two years.

25. The VCI Preservation Methodology of claim 2 wherein VCI Silicon Fluid is applied on to all rubber parts to protect them against degeneration due to the presence of Ultra Violet Rays or Ozone gas.

26. The VCI Preservation Methodology of Claim 1 wherein the VCI Products will be replaced at the end of two years preservation cycle.