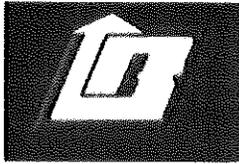
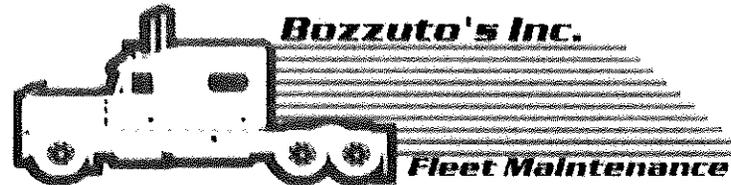


**Bob Hamilton**  
**Director of Fleet Maintenance**



**Bozzuto's Inc.**

HOMETOWN PROUD



- Robert Hamilton is a third generation trucking industry advocate. He has worked in numerous fleet maintenance sectors including private carrier, common carrier, leasing and OEM dealerships.
- In 2004, Bob joined Bozzuto's Inc. as Director of Fleet Maintenance. The fleet services grocery stores in 12 states, accumulating 16 million miles annually. Bob oversees the specifications and maintenance of 200 plus power units and over 500 dry van and refrigerated trailers.
- Additionally, Bob is on the Board of Directors for the Motor Transportation Association of Connecticut. He is an active member of the American Trucking Association and their Technology & Maintenance Council. Bob also holds a position on the editorial advisory board for Fleet Equipment magazine.
- During the last several years, corrosion has had a significant impact on component and equipment life cycles. Failure to be proactive with specifications and preventive maintenance programs can have devastating effects. Bob will discuss the challenges he faced and the critical changes he made in the battle against corrosion.

**The Battle Against**  
**CORROSION!**

# Today's Outline

- Problem Identification
  - Who or what is the source
  - What products are being utilized
  - Properties
  - Tips provided by the manufacturer
  - Why is it being utilized
  
- What is being affected
  - Electrical – alternators, starters, cables, etc.
  - Mechanical – brakes shoes, brake lines, landing legs, etc.
  - Structure – frames, cross members, radiators, etc.
  
- The Bozzuto game plan to achieve dependability & predictability
  - State of CT
    - Motor Transport Association of CT
    - Public hearing with proposed bill
  - Preventive Maintenance
    - Identifying specific area of concern
    - Data analysis plus open discussions with technicians
    - Focus on maintenance changes in key areas
      - Inspection
      - Lubrication
    - Specifications
      - Material changes
      - Product applications
      - OEM's

**Identifying the source?**



# Calcium vs. Magnesium Chloride

- Calcium chloride's eutectic point is  $-51^{\circ}\text{C}$  ( $-60^{\circ}\text{F}$ .) While  $\text{MgCl}_2$  has a eutectic temperature of  $-33^{\circ}\text{C}$  ( $-28^{\circ}\text{F}$ ), its melting rate drops to a low level well before it reaches this temperature.
- The effectiveness of  $\text{MgCl}_2$  is often limited by the presence of magnesium sulfate as an impurity. Magnesium sulfate crystallizes between  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ) and  $-20.5^{\circ}\text{C}$  ( $5^{\circ}\text{F}$ ) to cause sludge in tanks and clogging of spray nozzles and transfer pumps. By contrast, a 32%  $\text{CaCl}_2$  solution, the most commonly used concentration in winter, does not form crystals within its working range.
- **Calcium Chloride vs. Magnesium for Ice Melting, De-icing Capacity and Ice Penetration**
- **Calcium chloride melts more ice at low temperatures.** At  $-10^{\circ}\text{C}$  ( $14^{\circ}\text{F}$ ), 32%  $\text{CaCl}_2$  liquid melts 27% more ice than 30%  $\text{MgCl}_2$ . At  $-20^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$ ), 32%  $\text{CaCl}_2$  melts 94% more ice than 30%  $\text{MgCl}_2$ .
- The Midwest Research Institute study (based on FHWA, Strategic Highway Research Board test methods) evaluated ice penetration of calcium chloride vs. magnesium chloride. The study found that at  $-7^{\circ}\text{C}$  ( $20^{\circ}\text{F}$ ),  $\text{CaCl}_2$  has 22% more penetration after 10 minutes and 38% after 30 minutes than  $\text{MgCl}_2$ . At  $-15^{\circ}\text{C}$  ( $5^{\circ}\text{F}$ ),  $\text{CaCl}_2$  had penetrated 58% more ice after 30 minutes.
- **Application Rates Compared**
- Calcium chloride has a lower application rate compared to magnesium chloride because calcium chloride has higher ice melting capacity and faster ice penetration.
- Given their relative commercial strengths and active chemical purity, 50% to 100% more  $\text{MgCl}_2$  than  $\text{CaCl}_2$  is usually required to remove equal amounts of snow and ice.
- Liquid  $\text{CaCl}_2$  is applied at concentrations of 25% to 35%, while that for  $\text{MgCl}_2$  normally falls between 21% and 28%. Conceptually, this means that two parts of  $\text{CaCl}_2$  does more work in less time than three parts  $\text{MgCl}_2$ .

- **Calcium Chloride vs. Magnesium for Concrete and Corrosion Inhibiting**
- **Magnesium chloride is more detrimental to concrete. Testing was done by the Pittsburgh Testing Laboratory on air-entrained concrete over 500 freeze-thaw cycles. The data show that CaCl<sub>2</sub> has the least spalling of common deicers, including MgCl<sub>2</sub>. (Concrete Spalling is when concrete chips, fragments and/or breaks away, creating large holes or craters and dangerous trip points for anyone walking on the surface.) Spalling is measured on a scale of 0 to 5 (none to severe). A 4% solution of MgCl<sub>2</sub> showed moderate scaling and had a 3.1 rating. The same concentration of CaCl<sub>2</sub> had a 1.6 rating, or between very slight and slight to moderate scaling.**
- **The American Concrete Institute's guide to Durable Concrete says calcium chloride has a "negligible" effect on concrete while MgCl<sub>2</sub> causes a slow deterioration of concrete surfaces.**
- **In addition, a study of concrete deterioration by deicing salts, including MgCl<sub>2</sub> and CaCl<sub>2</sub>, at Iowa State University found that "magnesium chloride was the most destructive salt with severe deterioration produced under almost all of the experimental conditions". Deterioration was judged by the degree of crumbling, fracturing and brownish discoloration.**
- **The Corrosion Data Survey published by the National Association of Corrosion Engineers indicates that MgCl<sub>2</sub> is more than twice as corrosive to 304 stainless steel as CaCl<sub>2</sub>.**
- **The NACE survey also indicates that MgCl<sub>2</sub> can be 10 times more corrosive to mild steel than CaCl<sub>2</sub>.**
- **Tiger Calcium also offers corrosion inhibitors in our winter anti-icing and de-icing products.**
- **Although CaCl<sub>2</sub> and MgCl<sub>2</sub> are considered non-toxic, the Registry of Toxic Effects of Chemical Substances states that MgCl<sub>2</sub> has nearly three times the toxicity of CaCl<sub>2</sub> on a common measure of toxicity.**
- **The Environment – Magnesium and Calcium**
- **The Ministry of the Environment in British Columbia found that CaCl<sub>2</sub> has significantly less toxicity than MgCl<sub>2</sub> in bioassay tests on rainbow trout and the water flea daphnia. For instance, rainbow trout, which represent the high end of the food chain, were five times more sensitive to MgCl<sub>2</sub> than to 35% CaCl<sub>2</sub>.**
- **Both materials are used as micronutrient sources in animal feeds. CaCl<sub>2</sub> is also a common food ingredient and is "Generally Recognized as Safe" by the US Food and Drug Administration. If anything Magnesium Chloride is more harmful to vegetation.**
- **Tests with calcium chloride by Quebec's Ministry of Environment found "no definite areas of environmental problem...subject to the use of good application practices". In addition, CaCl<sub>2</sub> is a clear inorganic material that does not leave an oily or powdery residue after its use.**

**Bozzuto's Inc. travels 16,500,000 miles annually in 12 states.**

**The 12 states combined, use over 343,500 gallons of calcium chloride plus sodium chloride annually to make our roads SAFE**

- **Calcium chloride (CaCl<sub>2</sub>), in the liquid form, is a highly soluble hygroscopic solution that is also exothermic. Its ability to draw in moisture from its surroundings, resist evaporation, and release heat in a chemical reaction makes it the perfect substance for road construction and maintenance, including ice and dust control.**
- **Rock salt (NaCl), a chemical compound that consists of crystals having equal numbers of sodium and chlorine atoms. Sodium chloride provides adequate economical performance temperatures at or just below 32° F. As temperatures drop below freezing, its ice-melting performance slows substantially. It is used as a deicer for highway application, often treated with liquid calcium chloride to improve low-temperature performance on highways.**

## PROPERTIES

- Calcium chloride releases heat to activate salts melting ability.
- Calcium chloride attracts moisture required for rock salt's melting action.
- Fast acting calcium chloride begins to dissolve immediately upon application to break the bond between pavement and ice.
- Powerful calcium chloride brine remains active for prolonged periods of time to prevent ice from bonding to the highway.
- Calcium chloride melts to a much lower temperature than salt.

## DEICING APPLICATION TIPS

When winter storms hit, correct application of pre-mixed or pre-wetted materials can make a difference in keeping roads in an easily plow able condition.

They save valuable time in treating roads by preventing precipitation from bonding with the road surface.

Application tips from road superintendents who use calcium chloride include:

Get out early and use adequate amounts of road materials throughout the storm.

Don't let ice build up under snow.

Keep snow slushy and plow it off.

Treat hills and intersections first.

## **BENEFITS**

- **Highway Safety:** studies show that in 85% of applications, calcium chloride/ salt mixtures achieve bare pavement faster than salt alone at temperatures near 30F (-1C), to ease traffic and reduce accidents.
- **Savings:** calcium chloride increases salts effectiveness, therefore reducing the number of applications necessary during storms - saving manpower, equipment and material costs. Plus, it freeze-proofs abrasives to help them embed in ice and snow, so less material is lost to spreader bounce and traffic scattering.
- **Summary:** Calcium chloride is an effective deicer, working at temperatures below most competing products. It is significantly more effective than sodium chloride because of its ability to extract moisture from its surroundings and to cause exothermic or heat generating reactions. Also, when mixed with traditional rock salt, calcium chloride greatly improves the effectiveness of the deicing material.

**Calcium chloride and sodium chloride are here to stay,  
until a better product is developed.**

**Safe, passable roads in winter are necessary for commerce and mobility. Public works agencies and private contractors maintain our roads. Levels of service (how often and how quickly roads are cleared) are driven by public expectations (as expressed through local and state governments) and by available technologies. Winter road maintenance is funded by taxpayers. Chloride salts are currently the most effective and economical material for maintaining safe, passable winter roads. Salts corrode vehicles, affect infrastructure and compromise water quality. These are the additional costs of winter mobility and safety. Level of service is a balance of the tradeoffs of safety, environmental impact and cost.**

**Corrosion includes the terms rust, tarnish, pitting, chalking and scaling. Technically, corrosion is decay resulting from a chemical or electromagnetic reaction between a metal and its environment. The process cannot be eliminated, but it can be minimized with proper equipment specifications and preventative maintenance practices.**

**The biggest issue with calcium chloride is that it can stay wet down to 15 percent humidity. The result is that the chlorides, in this brine state, continue to eat away at metals and remains active for prolonged periods.**

**Calcium chloride is basically liquid rust. It clings to everything, attracts water and will not wash off easily. The ATA's, Technology and Maintenance Council, TMC, has focused a great deal of attention on this topic, establishing a study group, aptly titled, the Corrosion Abatement Task Force. Their objective is to come up with solutions.**

**What are the long term implications to our Fleet Maintenance program**

**Sodium chloride mixed with calcium chloride, will damage fleet vehicles primarily because of the corrosive effects of chloride ions on metals. The chloride ions in salt disrupt natural protective films on metal surfaces and increase the conductivity of water. This creates an acceleration in electrochemical corrosion.**

**Long term implications to electrical, mechanical and structural components jeopardizes the safety of our fleets daily operations.**

**In a very big way, corrosion negatively impacts fleet expenses.**

**Life cycles are shortened, and with each component changed, labor costs increase.**

**Therefore, it is imperative that we focus on cost effective Fleet Maintenance solutions.**

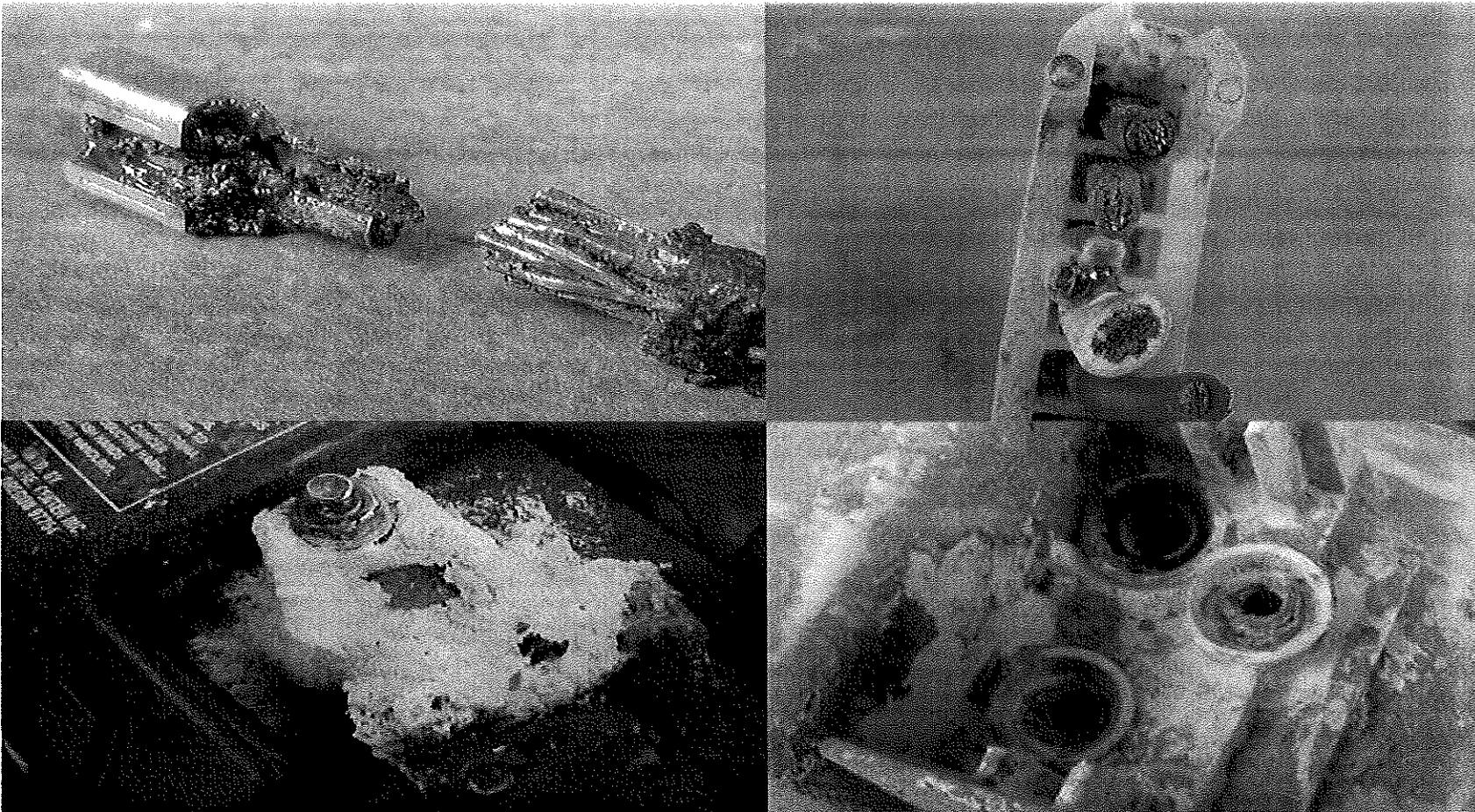
## **Impact of corrosion on Fleet Maintenance**

**Frame rails, cross members, suspension components, air tanks, fuel tanks, battery boxes, brackets, brake shoes, electrical systems, air conditioning condensers, radiators, metal coolant tubing, steel wheels, inside the floor of the cab - even refrigeration units aren't safe.**

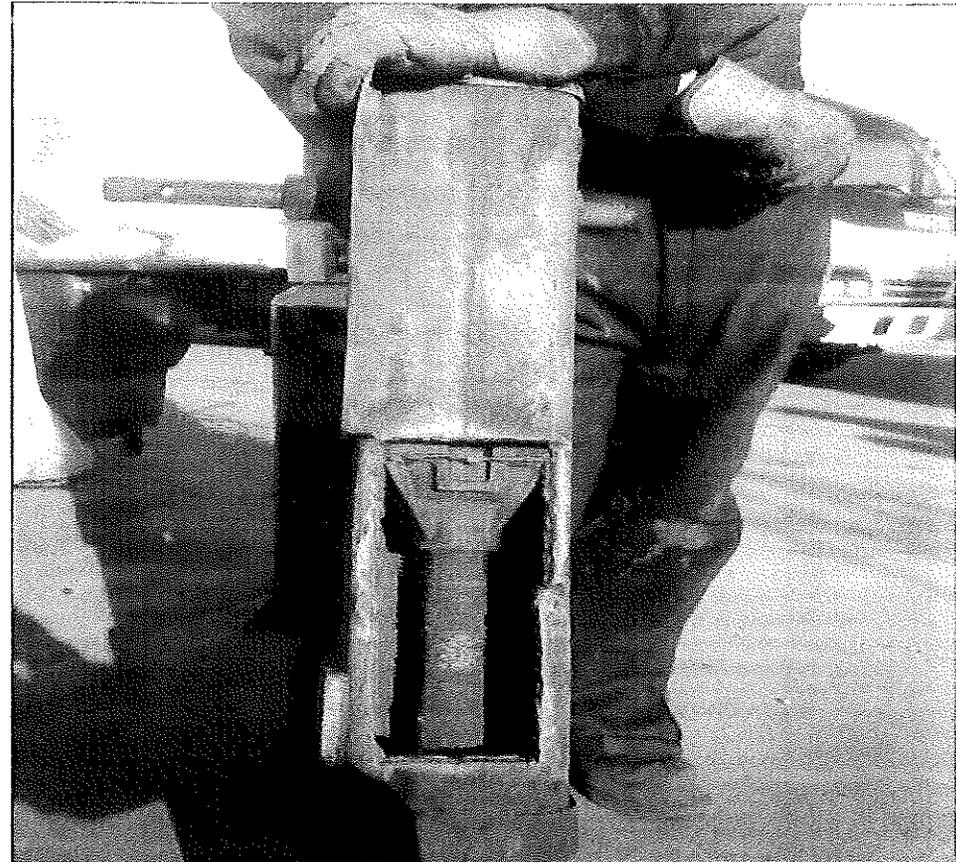
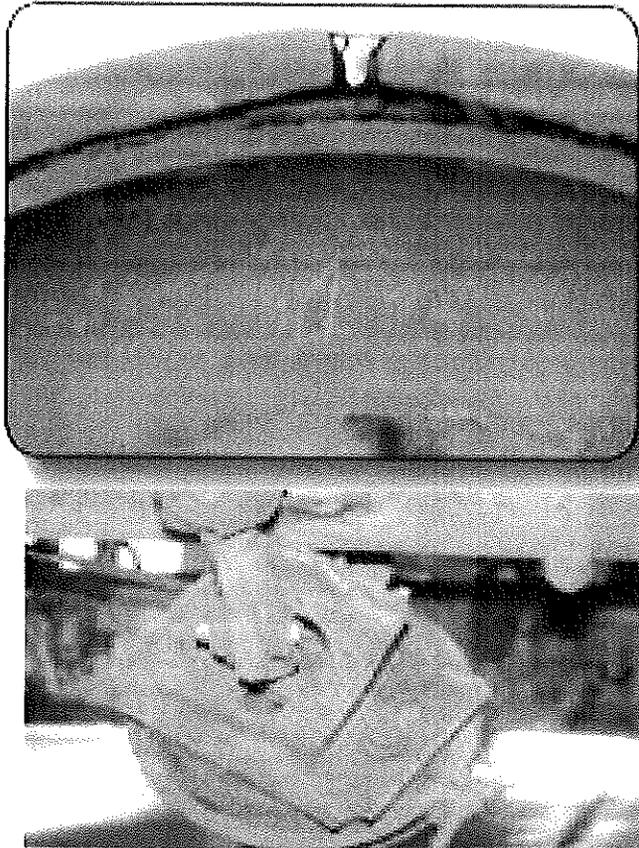
**Corrosion has really changed our thinking and how we approach treating all of these surfaces.**

## What is corrosion affecting?

**Electrical components:  
alternators, starters, cables and lights,  
ultimately affect safe operation.**



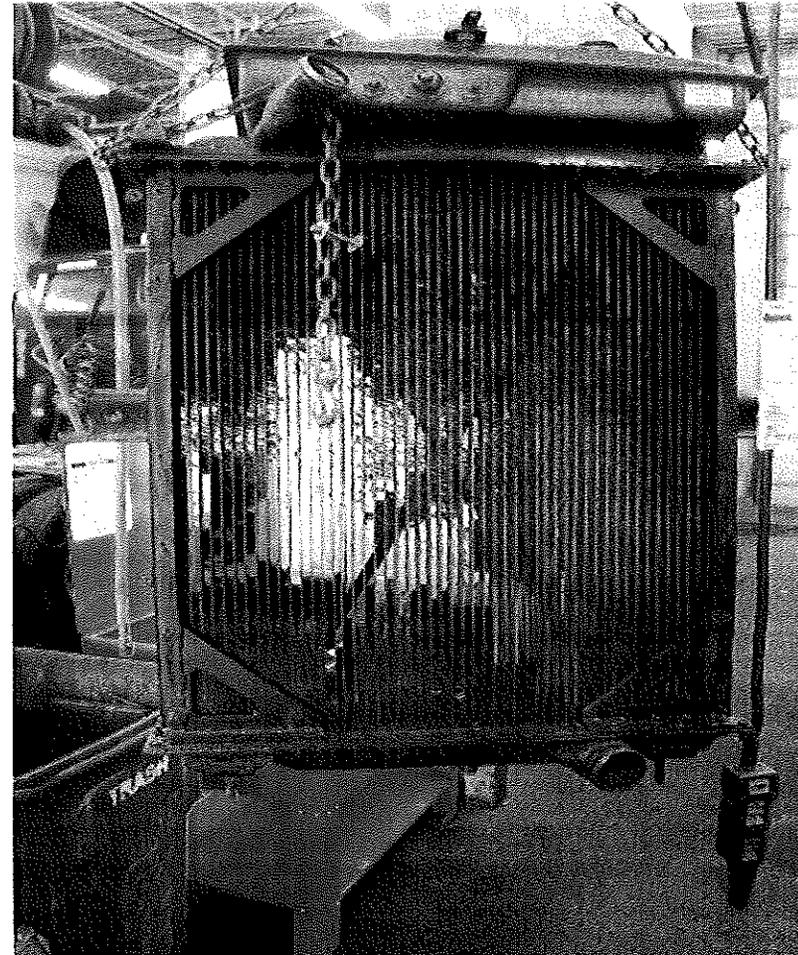
**Mechanical components:  
brake shoes, chambers and landing legs  
ultimately effecting safe operation**



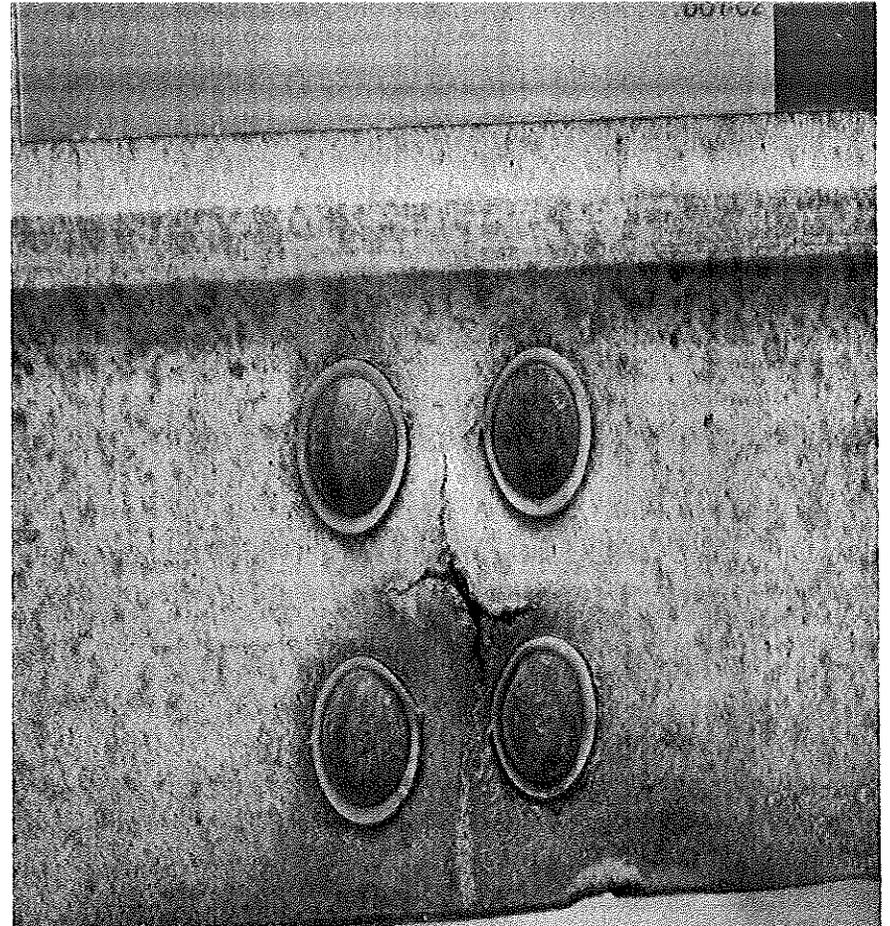
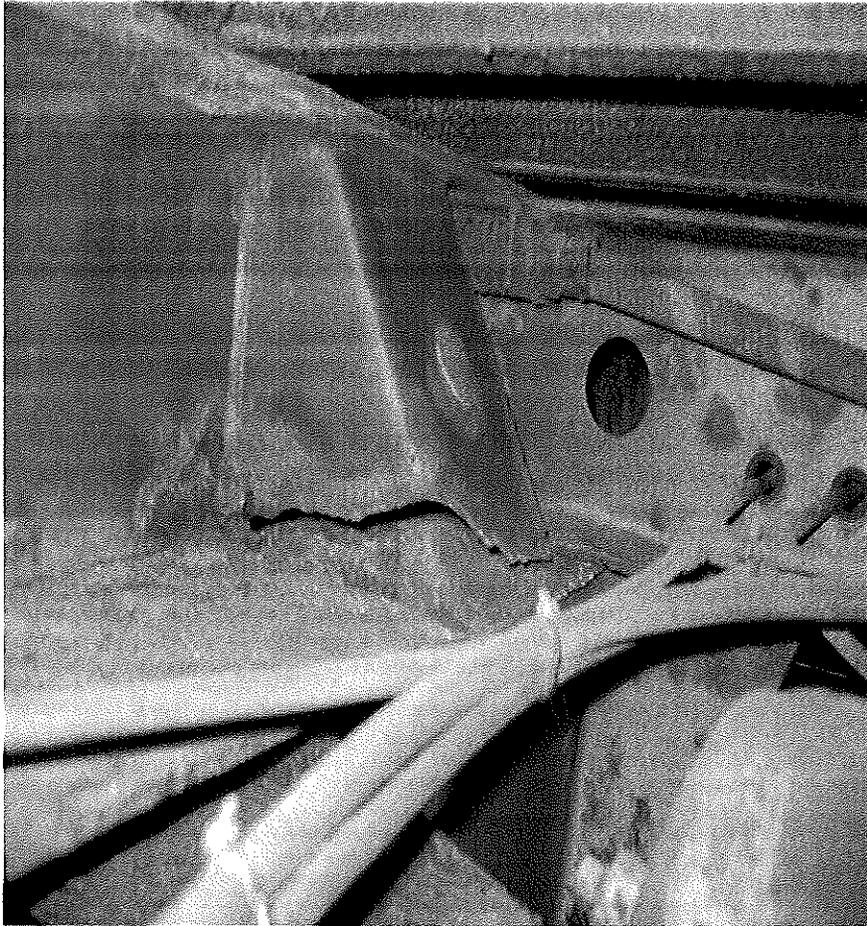
## The result of a landing leg failure.



**Driveline components as well as radiators are affected.**



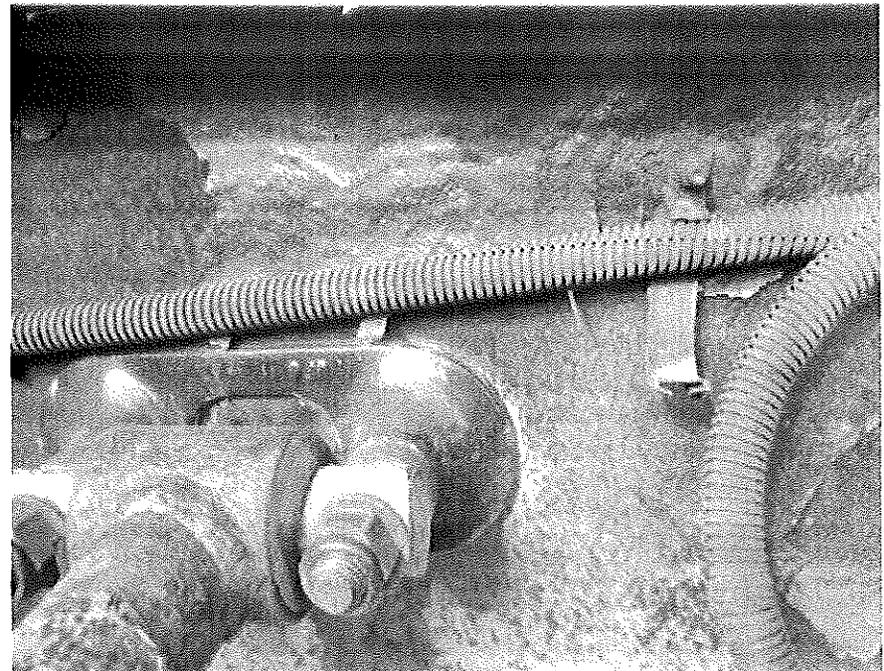
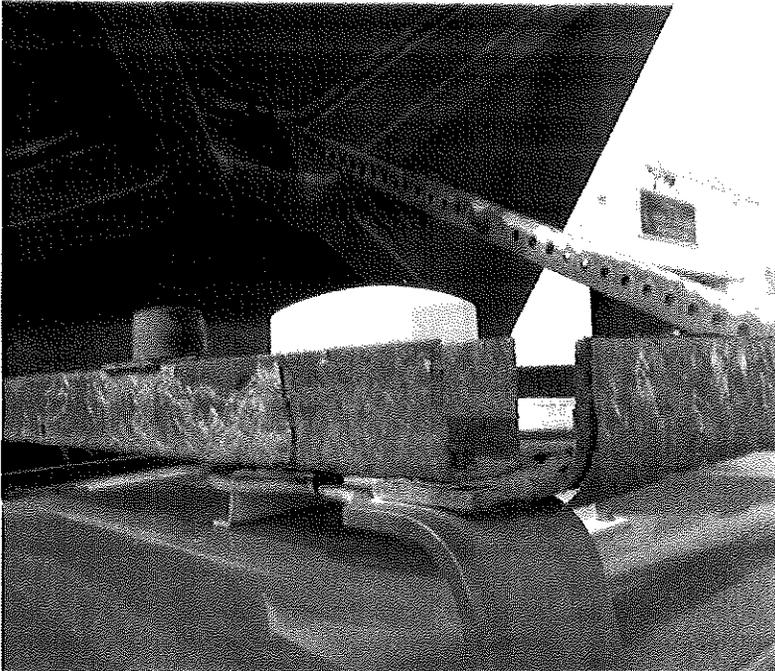
**Structural components ultimately affecting safe operation.**



**Housings – can you imagine a heavy axle housing having this huge of an issue with corrosion?**



**Cab components are not exempt from corrosion.**



# **Bozzuto's Game Plan in The Battle Against CORROSION!**

**We took a three pronged approach.**

- 1. State of Connecticut**
  - **Motor Transport Association of Connecticut**
    - MTAC board meeting discussions
    - Proposed bill presented to a Connecticut Public Hearing
- 2. Preventive Maintenance**
  - **Identifying specific areas of concern**
    - Data analysis
    - Team meetings with Supervisors and Technicians
  - **Focus on required maintenance changes**
    - Inspection
    - Lubrication
    - Forms
- 3. Specifications**
  - **Material changes**
    - Aluminum vs. steel
    - Galvanizing
    - Special paints
  - **Product applications**
    - Researching under coatings
    - Neutralizers
  - **OEM involvement**

## **State of Connecticut**

### **Motor Transport Association of Connecticut**

1. It was during board meetings with the MTAC that a plan was developed to propose a bill asking the State DOT to perform a study on the impact of calcium chloride and sodium chloride on our states infrastructure and it's vehicles to include commercial and personal vehicles.
2. We were successful in having the hearing.
3. We were not successful in having the bill accepted.
4. We did, however, learn. We learned why we were very successful in navigating our streets and highways during the worst January (2011) weather in years. For that, we are grateful to our State's DOT.

**This process motivated me to focus on what we could control.**  
**We took a proactive approach to our maintenance.**

## **Identifying specific areas of concern**

- 1. Data collection and analysis**
  - **Maintenance software**
    - **Component life cycles**
    - **Labor costs**
  - **Component failure analysis**
  
- 2. Team meetings**
  - **Team members to include drivers, office staff, parts and service**
  - **Focusing on**
    - **Solutions to increase component life cycles**
    - **Solutions to prevent premature failure**
  
- 3. Vendor participate**
  - **Support in data collection**
  - **Component analysis**
  - **Problem solving**

## **Maintenance Changes**

- 1. Inspection**
  - **Focusing on key target areas**
  - **Component analysis**
- 2. Lubrication**
  - **Product research on industry development**
  - **Lubricants were changed**
  - **Intervals were increased in various areas**
- 3. Forms**
  - **Schedules**
  - **Line items**
  - **Technician comments**

## **Specifications**

- 1. Material Changes**
  - **Aluminum vs. steel**
  - **Galvanizing**
  - **Special Paints**
- 2. Product applications**
  - **Researching under coatings**
  - **Neutralizers**
- 3. OEM involvement**

**Every OEM is asked:  
“What are you doing in the battle against corrosion”?**

**They have provided various material options:**

- 1. Trailer manufacturers are providing galvanized steel components.**
- 2. Lift gate manufacturers are building gates out of galvanized steel or aluminum platforms.**
- 3. We are considering under coatings for both tractor and trailers.**

## Some of our findings

### Corrosion prevention tips for electrical components

- Install heavy-duty, adhesive-lined heat shrink tubing on all electrical connections.
- Protect battery posts and terminal with anti-corrosive spray.
- Grounding to the chassis or engine will lead to corrosion, poor contacts and faulty electrical operations. Always make sure ground leads directly to the negative battery post.
- Do not pierce wire jacketing. Punctures in the wire jacketing causes wicking, which will create a leak path for contaminants to seep in. This will cause the wire to corrode from the inside out.
- Frequently wash equipment during cold weather to reduce calcium chloride build up. Do not power wash because water can be forced into areas and cannot escape.
- Re-apply dielectric grease on plug and socket pins after every cleaning.

**Treat the electrical system as you would the chassis.**

Lubricate electrical sockets, pigtails, battery terminals and connections with a non-conductive anti-corrosion compound.

The purpose, to totally encapsulate and protect against corrosion.

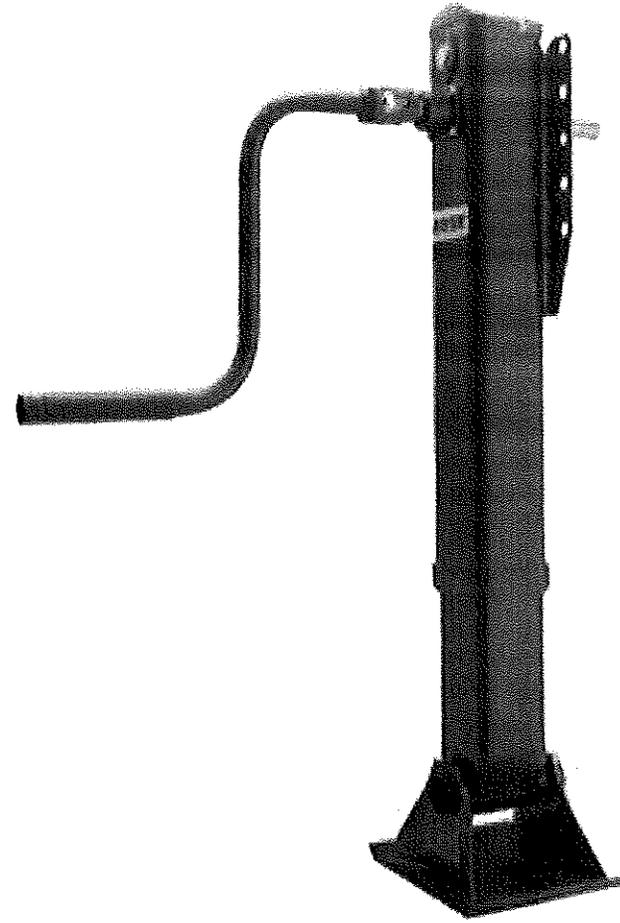
The best product we have used for removing corrosio is a wire brush and some PB Blaster®. We have been using PB Blaster® for removing rusted bolts. One day, a mechanic showed me that it was also great on electrical components. He showed me a severely corroded ABS cord. Then he sprayed PB Blaster® right into the connector. You could see it work right before your eyes. He waited about 30 seconds and took a wire brush to the connectors, put some dielectric grease on both ends and put the cable back together.

Important note:

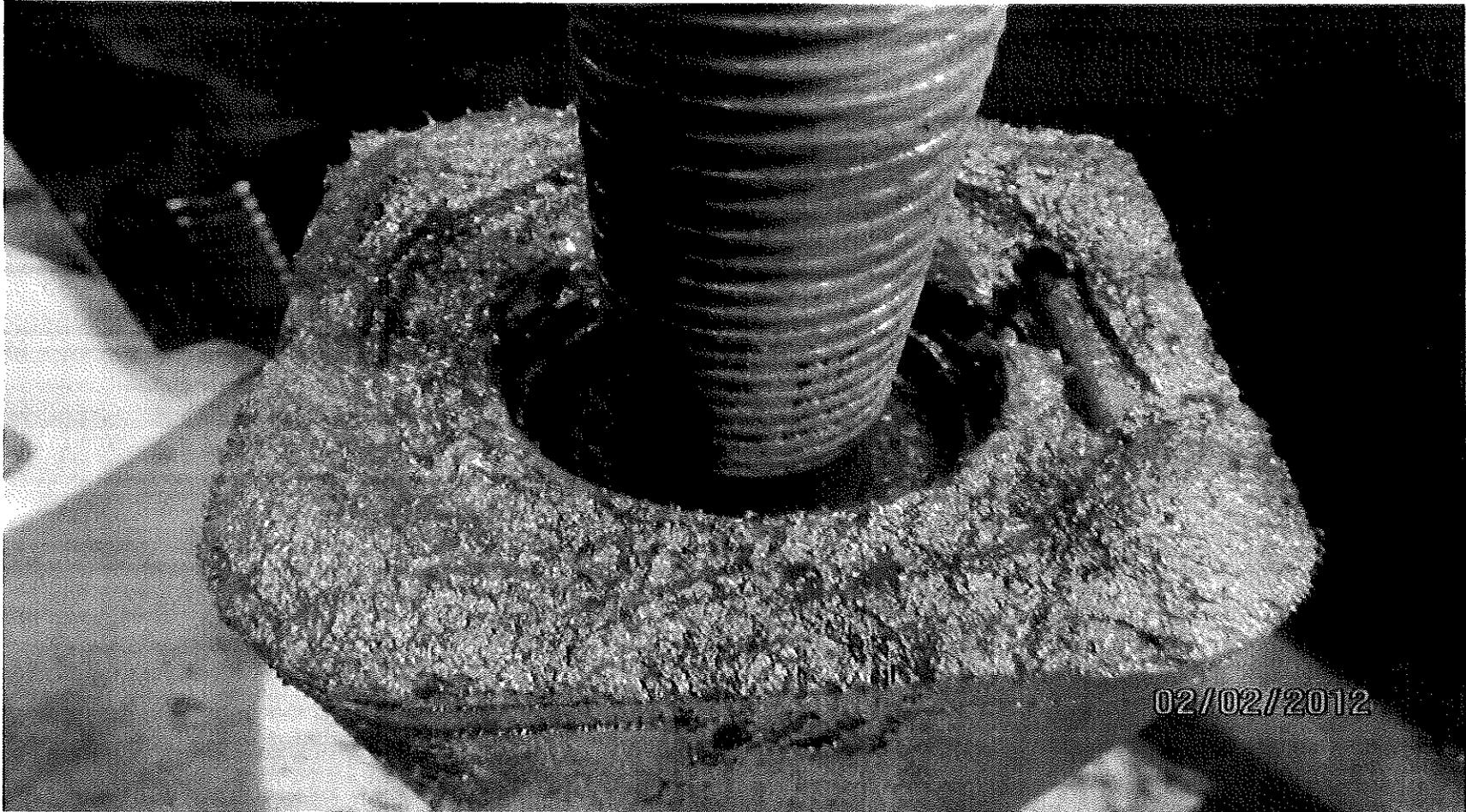
Corrosion will void your manufacturer's warranty.

## Landing legs

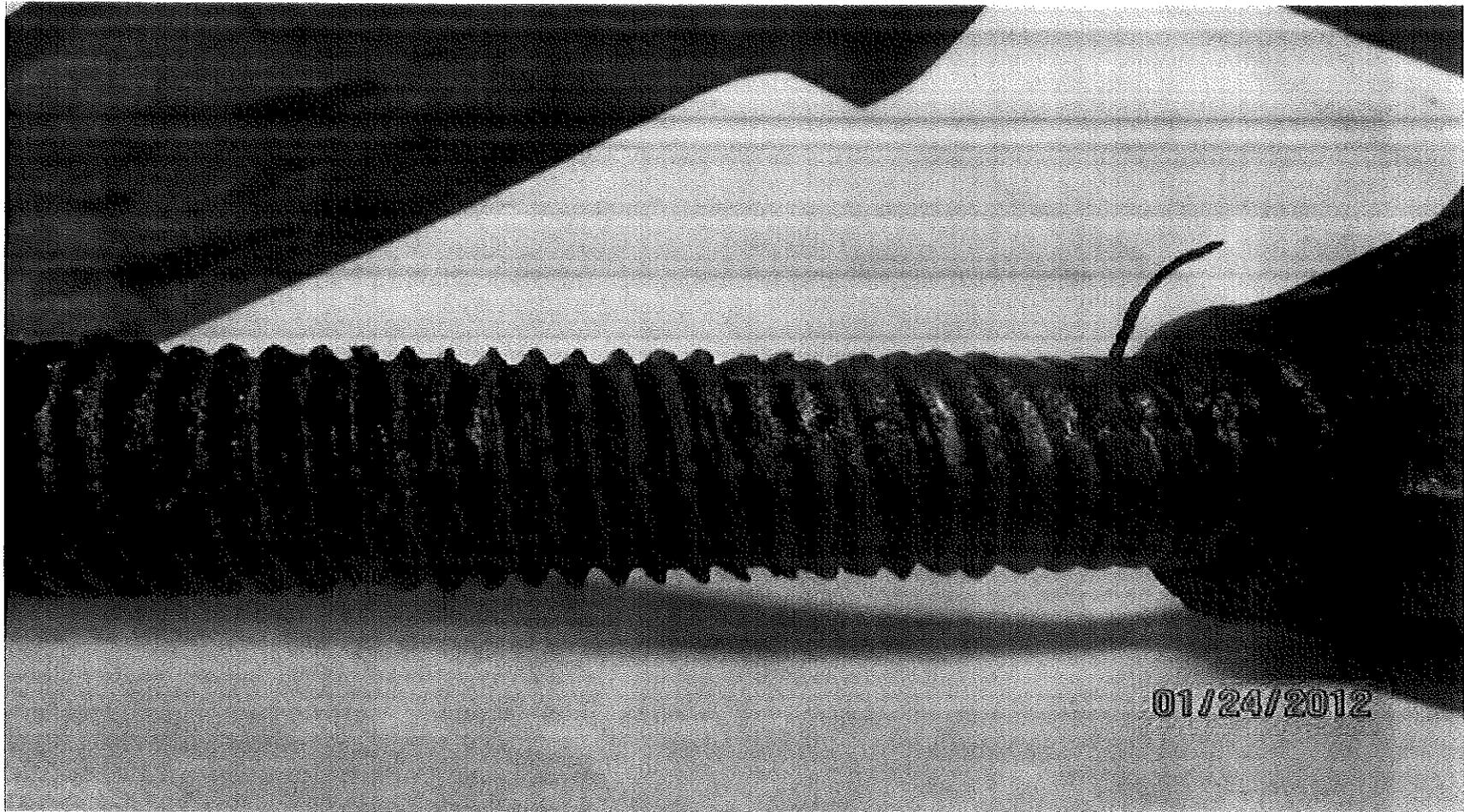
Screw located inside the leg housing.



**The negative impact of calcium chloride and sodium chloride on our landing leg grease and the screw.**



**This is what happened to the screw when the landing leg failed.**



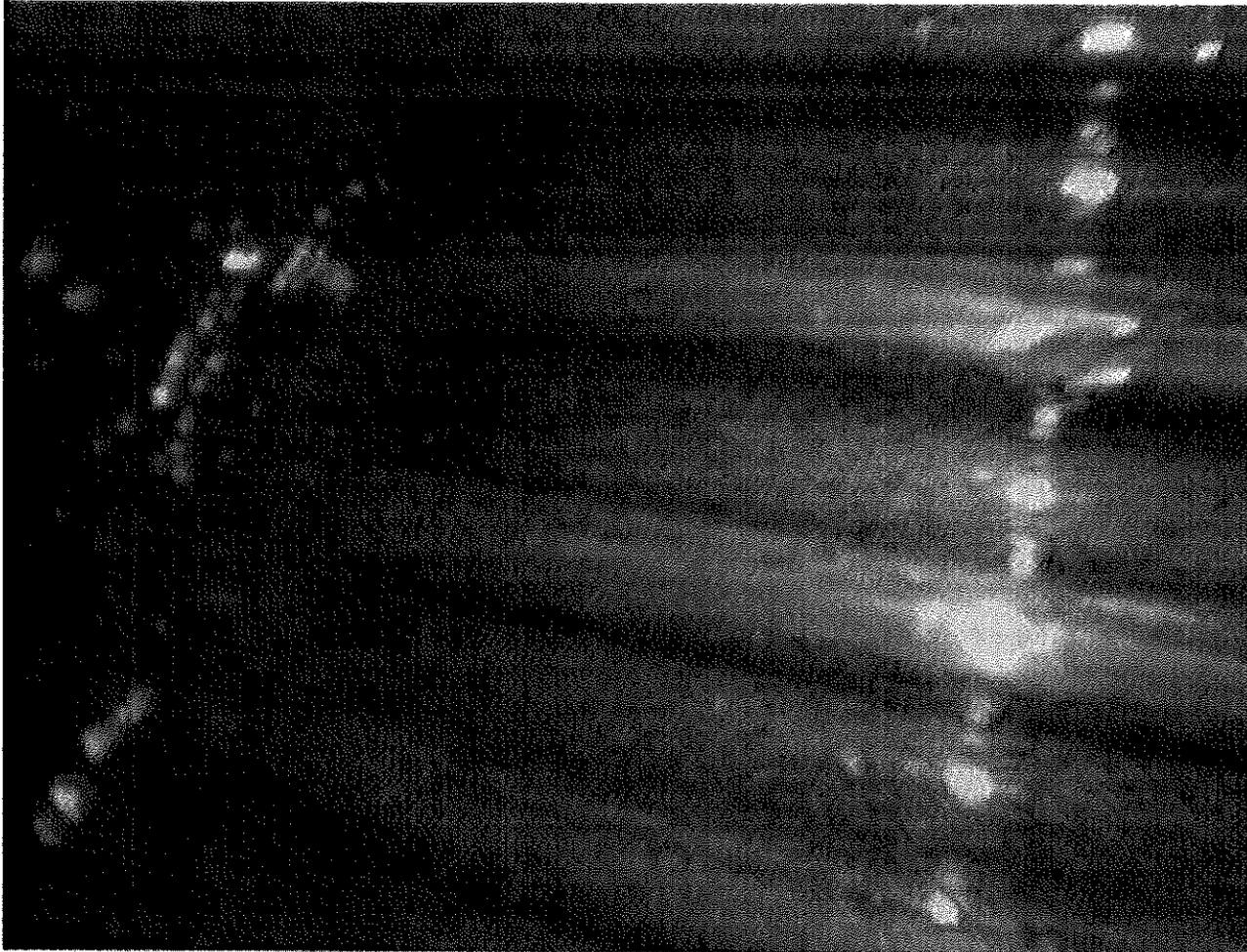
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## Our approach

1. **Inspection campaign on every leg - 1000+**
2. **Spreadsheets to evaluate data**
3. **Manufacturer was contacted**
4. **Routine Inspections were modified**
5. **Team members received training**
6. **Lubrication procedure changed**
7. **Lube was improved**

**Finally our best solution**

**A bore scope provides an excellent visual inspection.**



## **Washing and Neutralization**

**Washing should help. We utilize high-volume, low-pressure washing. High pressure is likely to drive bits of chloride deep into crevices where they will keep eating steel.**

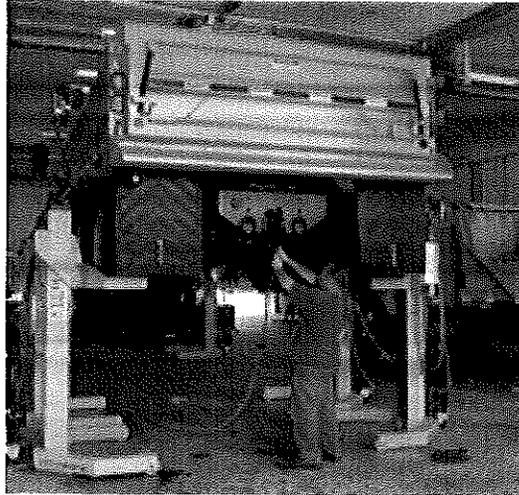
**We want to flush it out.**

**We are also looking into how to neutralize calcium chloride.**

**We are currently working with DuPont and other vendors to identify a reasonable product that can neutralize calcium chloride and sodium chloride.**

## ARMOUR-SEAL Chassis, Frame & Component Coating

Finally an undercarriage coating that your personnel can safely apply in your shop with virtually no downtime!



**NEUTRO-WASH** gives your equipment a fighting chance against rust & corrosion!

Use it today and enjoy the following benefits:

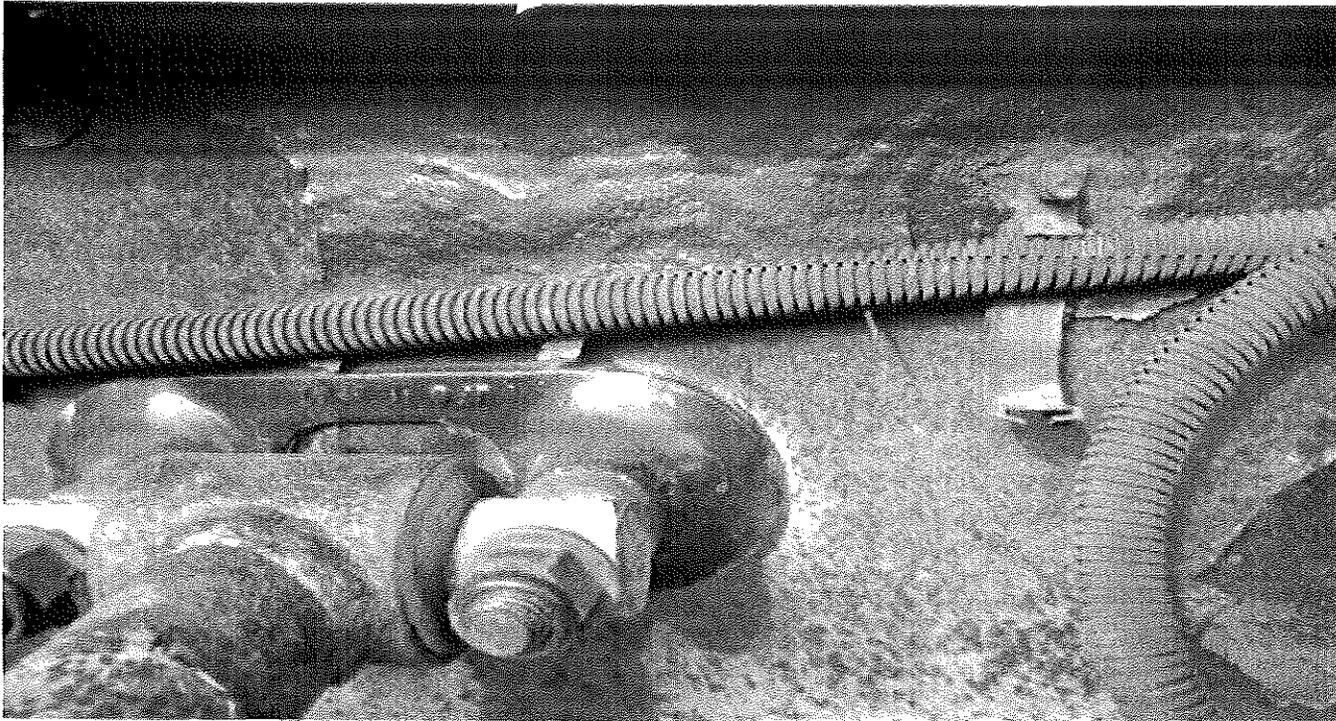
**Extends the operational life of your fleet and equipment** – by removing the corrosive **white salt residue**  
**Easy and economical to use** – dilutes 1 to 8 with cold water and is applied through your pressure washer

***DAUBERT***  
***CHEMICAL COMPANY, INC.***

**TECTYL 518**

TECTYL 518 is a solvent borne, thixotropic, corrosion preventive compound designed for rustproofing transportation equipment. The dry film is translucent and semi-firm. TECTYL 518 is approved under Military Specification MIL-C-62218, Type I, QPL Reference Number AR-18-85. TECTYL 518 possesses dielectric strength of 800 volts per dry mil of coating. TECTYL 518 provides galvanic corrosion protection and can be applied on battery terminals for insulating purposes.

**Halfway through the chassis life cycle, we are taking frame rail down to bare metal and re-painting to achieve the life cycles that we have experienced in the past. Undercoating will undoubtedly be added to this process once the correct product has been identified.**



# Technology & Maintenance Council



**NEW** from ATA's Technology & Maintenance Council (TMC), this manual is intended to serve as a comprehensive resource that addresses various aspects of vehicle corrosion.

This document provides users a practical guide for better understanding proper procedures and guidelines for selecting, servicing, and maintaining commercial vehicles so as to minimize premature corrosion during the useful service life of the vehicle.

Manual is based on material compiled from various TMC recommended practices, position papers and technical presentations

Appendix includes a *Corrosion Solutions Provider Directory* of TMC member companies who report offering various solutions to address component and vehicle corrosion.

**A new area where fleets are reporting corrosion, according to the TMC, is the air system - the control ports of air brake valves are developing corrosion.**

**The corrosive material can get inside the lines and tanks. The inside of a valve fitting, per current manufacturing standards do not require an anticorrosion coating. That means it's more critical than ever to maintain the air driers and keep water drained from the system.**

**Specifying glad-hand seals with dust flaps will keep contaminants out of the air system when the trailer is un-tethered. Otherwise it's very easy for rainwater to become contaminated with the chlorides on the trailer surfaces and creep into the air system**

**Industry catch phrases are hitting our industry  
chemical and impact resistant ABS plastics  
anodized aluminum glad-hands  
Dura-Bright wheels  
Platinum Shield  
moisture-barrier lighting systems  
Black Armour  
CorroGuard**

**Obviously, this list is just a sample of some of the more recent industrial efforts to battle road chemical induced corrosion. It's probably accurate to say that nearly all vehicular-related manufacturers are refining their products in some way to deal with the issue. In doing so, we must balance the cost and benefit of each improvement. There is a limit to the amount of money available for spending on trucks, trailers and parts, no matter how well they're made.**

**Durability, cost and image are three main factors in fleet decisions about tractor and trailer specifications that are directly affected by our common enemy – corrosion.**

**From the roofline to structural members, suspensions, axles, landing gear and upper-couplers, constant bombardment makes specifying tractors and trailers for corrosion protection of utmost concern.**

**OEM's are equally aware of the challenges and are addressing the problems caused by corrosion with new technologies and processes.**

**However, it is vital that you voice your concerns.**

**Ask every OEM “What are you doing to help fight**

# **The Battle Against CORROSION!**

**I would like to conclude my presentation with one final thought.**

**On slides 14, 16, 17 and 20 I mentioned safety.**

**Corrosion will dramatically impact the safe operation of your fleet.**

**It is critical that you are proactive in**

**The Battle Against CORROSION!**