



15 REASONS

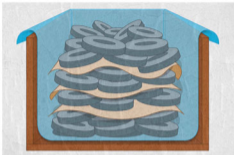
WHY METAL PARTS RUST DURING SHIPPING/STORAGE AND HOW TO AVOID THEM

Reason #15: Protection Radius

Improper positioning of VCI products within packaging

The corrosion protection radius depends on the vapor pressure of the VCI used in the master-batch formulation. Ingredients with higher vapor pressure can reach farther areas and are usually called Vapor Phase Protectors. Ingredients with lower VP only reach areas in close proximity and are usually called Contact Phase Protectors.

SOLUTION: VCI vapors can diffuse into the air up to 12 inches. Don't place metal parts beyond one foot away from the closest VCI source.



Reason #14: Water Variability

Chloride and Chlorine levels in water source can differ

Public water can contain high chlorine levels and other chemicals that can cause corrosion. The pH of public water can also vary greatly and pH plays an important role in preventing rust and corrosion on metal parts.

SOLUTION: Switch from public water to distilled or de-ionized water. For water-based rust inhibitors, consider a ready-to-use product like ARMOR's Dry Coat™ Rust Preventative. There is more information about Dry Coat™ available at www.armorvci.com.



Reason #13: Training

Improper or lack of VCI training and education

ARMOR cannot control variable conditions such as temperature, humidity, airflow, end-user production methods, surface area of metal to be protected, customer employee training and other factors beyond our control. However, ARMOR does guarantee the amount of VCI that is impregnated into the packaging for two to three years depending upon the product.

SOLUTION: Make sure to follow ARMOR usage guidelines and train all employees accordingly.

Use gloves when handling parts to minimize corrosion caused by fingerprints.

Package parts as soon as possible for optimum effectiveness.

Avoid reusing VCI packaging that is not at disposal.

Place ARMOR VCI product between metals and avoid packaging materials.

ARMOR WRAP VCI liners are impregnated with VCI on both sides.

Read help, advice and product compatibility for best protection.



Reason #12: Oil Treatment

Oil is not the best solution for preventing rust

R.P. oils are the traditional method of preventing rust and corrosion. However, R.P. oils are messy, labor intensive, and bad for the environment. Overall, R.P. oils are less effective than good VCI products when it comes to preventing rust.

SOLUTION: The obvious solution to this mistake is to switch from R.P. Oils to VCI packaging or a water-based RP such as Dry Coat™ rust inhibitor liquid. We have successfully helped hundreds of companies just like yours switch to VCI products from R.P. Oils and get great results, we would be happy to help you do the same!



Reason #11: Acidic Packaging

Metal contact with wood, paper or corrugated

All forestry-based products (wood, paper, corrugated) contain moisture, acids, and chlorides that cause corrosion.

Direct contact with these materials causes "contact corrosion" resulting in rust in the areas of direct contact with these products. Results can be sporadic, depending upon the moisture that they product absorb. Often some parts in a shipment may rust while others do not, due to the moisture that some forestry-based products absorbed.

SOLUTION: Line boxes, crates, etc. with a VCI poly bag or VCI paper. This creates an effective barrier between metal parts and the wood products that cause rust.



Reason #10: Improper Amount

Not using enough VCI packaging or products

The internal space needs to be saturated with VCI vapor before the VCI can condensate on the metal surface. If the amount of VCI is not sufficient, a protective concentration may never be reached.

More than 1000 types of VCI compounds are known, but only a fraction of them are efficient, cost effective and environmentally friendly.

SOLUTION: ARMOR products protect in both contact vapor phase and have proven through independent lab tests and real-world case studies. As a general rule, use 1 m² (10 sq. ft.) of VCI film for every 1-2.5 m³ (10-25 sq. ft) of metal surface. Use at least 1m². of VCI for every 0.25 cubic meter of void space.



Reason #9: Poor Quality

Use of ineffective or less quality VCI products

Not all VCI's are the same. Too high of a vapor pressure will cause the inhibitor to be released to such an extent that a protective concentration cannot be maintained. On the other hand, too low of a vapor pressure inhibitor is too slow to fill a space quick enough to protect parts that may experience flash rust.

SOLUTION: ARMOR products used a mixed inhibitor technology allowing for the metal to be protected quickly but also have a lasting effect. Always follow ARMOR usage guidelines when using ARMOR products. Consult with an expert to design a VCI system for your specific application and help you implement the usage of ARMOR products properly.

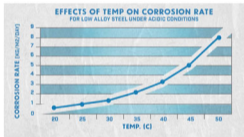


Reason #8: Temperature

Failure to maintain proper temperature for metal parts

For every 10^o Celsius increase in temperature, corrosion rates can double. Fluctuations in temperature cause metal pores to open and can also cause condensation to form on parts. Condensation becomes an electrolyte, enabling the corrosion cell to form, and allowing corrosion to propagate. Packaging parts in high humidity, allows that kind of atmosphere to be locked into the package. Metal parts stored close to manufacturing areas, specifically heat-treating processes, can become contaminated, which leads to corrosion.

SOLUTION: Maintain lower temperatures and lower humidity levels by installing climate controls, air conditioning and/or dehumidifiers. Package parts in areas away from dock doors or other parts of the plant that experience temperature swings or continual high temperatures, such as the heat treating area.



Reason #7: Contamination

Leaving metal parts uncovered and unprotected

Leaving parts uncovered while sitting in the plant, waiting for secondary operations, while in queue for additional machining, drilling, tapping, waiting to be packaged, etc. makes parts susceptible to rust and corrosion. Parts left uncovered in the plant are susceptible to forklift exhaust and other processes (chlorides, sulfides, and oxides).

SOLUTION: Cover all metal parts with VCI paper or VCI poly bags, protecting them from oxygen and contaminants that are in the plant atmosphere.

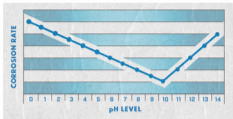


Reason #6: pH Levels

Improper titrations of baths and pH levels

Proper pH levels depend on the type of the metal parts. For ferrous parts, a pH level of at least 9.0 should be maintained. For non-ferrous metal parts such as copper and alloys like brass and bronze, a pH level of 7.0 – 7.5 should be maintained. Be sure to check with your in-process fluids supplier(s) for proper usage.

SOLUTION: Regularly check and correct pH levels of all cleaning solutions. Adjust pH levels according to manufacturer's instructions.



Reason #5: Improper Usage

Incorrect application of VCI packaging or products

Using VCI products incorrectly can result in them being ineffective. Placing VCI bags on the outside of interior dunnage or around corrugated will not work. VCI materials should be as close to the metal surface as possible. If vapors of the VCI are not able to attach themselves to the metal surface due to other packaging materials being in the way, they will never reach a point of true protection. Likewise, using VCI products intended for shipping and storage as outside packaging or covering will result in rust over time as these materials are not designed for those environments.

SOLUTION: Always follow manufacturer's instructions when using VCI products. ARMOR has a Usage Guide poster that can be displayed to assist those employees packaging products. Consult with a VCI expert to design a VCI system for your specific application and help you implement the usage of VCI products properly.

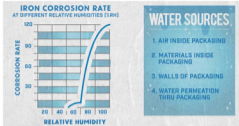
Reason #4: Condensation!

Moisture collection on metal parts inside packaging

Moisture accelerates corrosion. Moisture can cause normal temperature variations to be accentuated inside of a package making air move upwards; like in a chimney. As air either heats or cools, it flows up and down inside the package causing temperature variations and repeated evaporation and condensation.

Condensation and evaporation cycles will repeatedly bring contaminants in contact with the metal surface as well as provide thermal conductivity promoting temperature gradients and electrical potential differences on the metal surface.

SOLUTION: Stuff VCI Paper into the packaging to prevent the chimney effect and block any air flow. Another good solution is the use of ARMOR desiccants to adsorb moisture inside of the package.



Reason #3: Handling

Touching metal parts with bare hands

Acids, oils, and contaminants on human hands can cause and accelerate corrosion. Due to natural body chemistry, women's hands cause more corrosion than do men's hands.

SOLUTION: All employees who handle metal parts including production workers, inspectors, and packaging personnel should wear gloves when handling parts. It's simple: wear gloves, every time!

Reason #2: Rinse and Dry

Packaging of metal parts while damp or wet

Stacking or packing metal parts into boxes after being taken directly out of cleaning solution without thoroughly drying them will result in rust. When washing or cleaning parts, do not stack or package them until completely dry. Wet parts rust when stacked on top of each other because the fluid acts as an electrolyte and forms a galvanic cell between the two parts.

SOLUTION: Make sure metal parts are thoroughly dried before stacking them or packing them into boxes. Placing metal parts in a wire basket allows them to air dry quickly. Vibratory action, forced air, and heat can also dry parts more quickly. Soon after the metal parts are dry, package them into VCI paper or VCI bags to prevent corrosion from occurring.

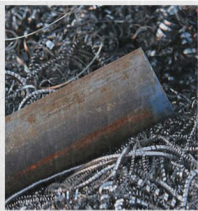


Reason #1: Dirty Conditions

Unclean works spaces, swarf or cleaning solutions

Dirty or contaminated cleaning solutions (processing fluids including cutting fluids, coolants and RPs that are recycled) result in a tremendous amount of corrosion within manufacturing settings. Small metal particles, also called swarf, in the metalworking or cleaning solution can end up on metal parts and if not properly washed away, these particles can form a galvanic corrosion cell, and corrosion will occur underneath the swarf.

SOLUTION: Keep your metalworking fluids and cleaning solutions clean and free of dirt and swarf. Fluids and solutions should be checked on a regular basis and kept free of contaminants that can cause corrosion.



Summary

As you can see from the 15 reasons above, most of the causes of rust during shipping and storage are attributed to things that happen during the manufacturing process, before it ever leaves the building. Let's face it, there are a lot of variables each and every day that take place within a manufacturing setting. Things like temperature and humidity changes, changes in personnel, unintended process changes, fluids within a system that become dirty and contaminated- to name only a few. When proper planning has been done and you combine quality packaging materials and rust preventative products with proper attention to these 15 factors you will experience a rust-free Zen-like state!

Thank you for your interest in knowing why metals rust during shipping and storage. We hope it was informative enough for you. If it wasn't as deep as you like to go, we have people in our lab that have been waiting for a call from someone like you their entire career. Call, talk shop and make their day!

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