MANUFACTURING CLEANING ASSOCIATION

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Corrosion Prevention Procedures for Metal Parts

Paper Courtesy of KYZEN Corporation

Corrosion is the chemical or electrochemical reaction between a material, usually a metal, and its environment that produces a deterioration of the material and its properties. Usually, corrosion is the oxidation of metals in the presence of water or water vapor, and is known as rust (iron, steel), white rust (galvanized steel / aluminum), and other terms of corrosion failures such as tarnish, pitting and flaking.

- The corrosion reaction between metals and oxygen is immediate and continuous unless the corrosion cell perpetuating the reaction is stopped.
- Corrosion on metal is a result of oxidation – a molecular, destructive reaction between oxygen and a metal's surface.
- While oxidation does not weaken metal, its surface disintegrates, and a brittle film forms. Rust, however, does weaken metal and is a serious concern.

There are many different types of corrosion including atmospheric corrosion, corrosion in waters, corrosion in soils, corrosion in chemical environments, mechanically assisted corrosion, high-temperature corrosion, microbiologically influenced corrosion, etc. From an economic safety and aesthetic standpoint, atmospheric corrosion is one of the most important types of corrosion. Atmospheric corrosion is enabled by atmospheric humidity and stimulated by pollutants in the atmosphere such as acid gases [sulfur dioxide (SO_2), hydrogen sulfide (H_2S), and carbon dioxide (CO_2)], nitrogen oxides (NO and NO_2), ozone (O_3), and salts (chlorides and sulfides).

There are many different ways to prevent corrosion, including modifying the atmosphere by dehumidification, nitrogen purge, evacuation, etc., and creating a barrier on the metal surface to prevent the permeation of moisture. This barrier can be formed by organic (oil/wax) liquid coating, such as formulated wet films, aqueous dry film deposition, or via packaging products that contain VCI or Vapor (Volatile) Corrosion Inhibitors.

Vapor Corrosion Inhibitors work by diffusing corrosion inhibiting molecules from a source (packaging film or paper for example) to metal surfaces. These molecules settle on metal surfaces and form a protective corrosion inhibiting layer that inhibits the electro-chemical reactions that cause corrosion to form.

VCI film is packaging that generally consists of polyethylene film or an engineered paper that has been impregnated with chemical formulations that are unique to each

manufacturer. While the underlying formulations can vary significantly, the finished products all function similarity in that they release very low concentrations (typically in parts per ten-thousandth) of invisible corrosion inhibiting vapors into the surrounding air. The vapor molecules subsequently condense onto exposed metal surfaces and form a molecular corrosion shield that can protect against rust and other forms of corrosion for up to five (5) years, and even longer in some cases. When the VCI packaging is later removed, all vapor corrosion inhibiting molecules rapidly evaporate. This leaves the metal parts clean and ready for immediate use.

PREVENTION PROCEDURES:

1. Production, Inspection, and Packaging personnel should always wear gloves while handling metal parts because contaminants and acids present on human hands can cause and promote corrosion and rust.

2. Be sure that metal parts do not come in direct contact with wood pallets, corrugated boxes or untreated paper at any time during production, storage or shipment.

3. Chemical corrosion inhibitors, which impart liquid or dry film protection, should be used throughout the entire manufacturing process.

4. Parts must be clean, dry, and free of fingerprints before packaging. Tip: Place parts in a wire basket to dry. Vibratory action or forced air can dry parts more quickly. Do not stack parts on top of each other until completely dry. Parts can corrode when stacked one on top of the other or when contacting each other in tote bins. This is caused by the fluid acting as an electrolyte and forming a galvanic cell between the two parts.

5. Parts should be clean and oil / coolant free before application of liquid / dry film corrosion inhibitor. Applying corrosion inhibitor over oil and coolants is generally not effective. Oil and coolant films do not allow the corrosion inhibitors to make contact with the part surface, thereby, preventing effective protection.

6. For ocean transport or storage greater than 30 - days use a corrosion protection solution and a combination of VCI Paper and a VCI bag for complete corrosion and rust prevention.

7. Do not place hot parts in the shipping package. Let the parts cool to the ambient room temperature before packaging.

8. When your parts arrive at your customer's facility, instruct your customer to keep VCI bag closed until parts reach ambient air temperature.

9. Keep your cleaning solutions and metalworking fluids clean to reduce or eliminate small metal particles which are sometimes referred to as "dirt" or "swarf." Swarf deposited on the part and not properly washed away can form a galvanic corrosion cell and rust will occur underneath the swarf.

10. Be sure to maintain your solutions at the correct concentration. Refer to the Product Supplement for the appropriate control methods. Proportioned / Automated chemical additions are recommended.

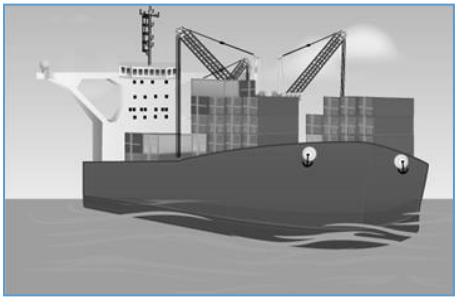
11. If you are using water in your cutting or cleaning fluids, DI (deionized) water is recommended.

12. Keep metal parts away from industrial air contaminants such as exhaust from lift trucks, manufacturing, and heat treat areas, because they are corrosive to metal.

13. Keep temperature in manufacturing and shipping areas constant. Every 10° C increase in temperature can double the corrosion rate.

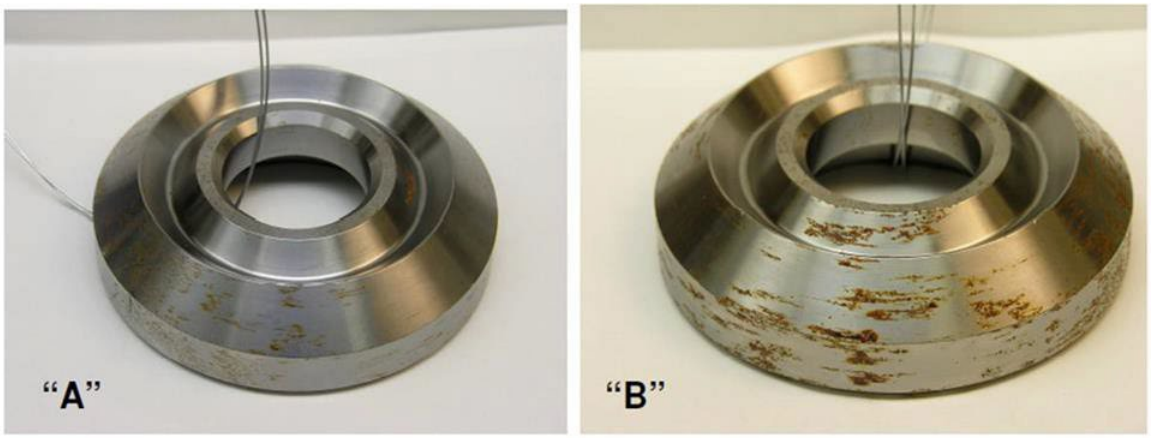
14. Keep relative humidity in manufacturing and shipping areas constant and as low as possible. Fluctuations in humidity and temperature can cause condensation which will cause, promote, and accelerate rust and corrosion.

15. Ship parts via the most direct method. Temperature cycling often occurs during transport through different climates. This can cause condensation on parts, and subsequent corrosion.

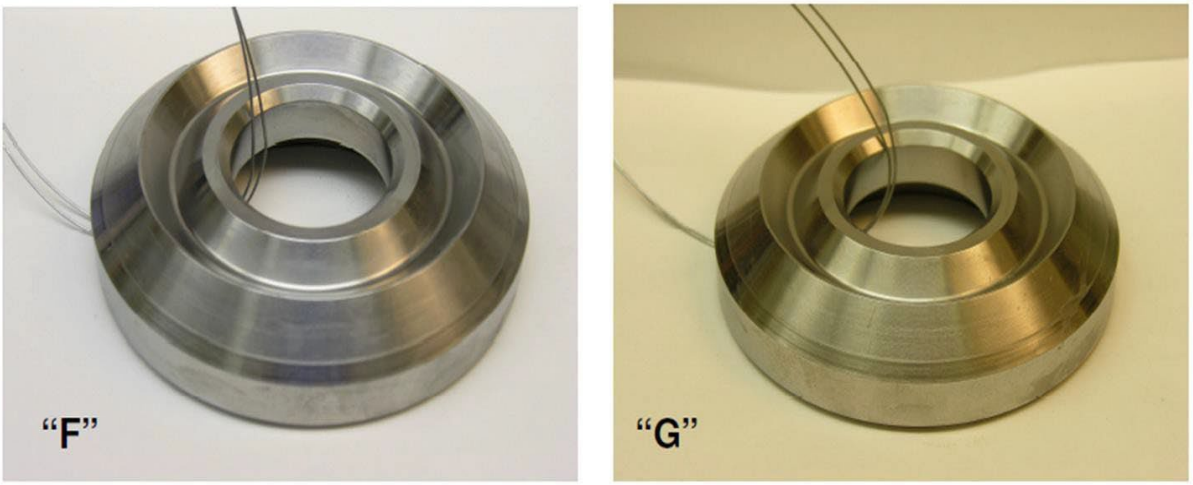




The parts were placed in a humidity cabinet maintaining 85% – 90% humidity at ambient lab temperature. The parts were photographed after 24 hours and 15 days.

RESULTS: Below are the photographs of each part taken after 24 hours and 15 days in the humidity cabinet.



Part #1, coated with Blaser coolant and tested as received, after 24 hours ("A") and 15 days ("B").



Corrosion: is a constant, indiscriminate and costly enemy of metal parts, especially when packaged for storage and distribution. Stay up-to-date on the best practices to keep your metal parts safe from corrosion by following MCA.