CORROSION PREVENTION
On
MOTOR and MACHINERY BRAKES
Installed On
HEAVY MOVABLE STRUCTURES
By

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ABSTRACT

Motor and Machinery brakes used on Heavy Movable Structures such as bascule bridges are subjected to a variety of challenges to their performance and survival. Corrosion is an ever-present challenge to brakes in general, but especially on bridges located over water where humidity, wind and dust are ever-present. How can the challenge of brake corrosion be addressed to prevent brake structural deterioration and provide long-lived, fully-serviceable brakes?

CORROSION

Corrosion can be defined as the deterioration of intrinsic properties in a material due to reactions with its environment. It is the oxidation of metals reacting with water or oxygen. More specifically: the weakening of iron due to oxidation of the iron atoms. This is commonly known as rust.[1] See photo #1 attached. Photo #2 shows corrosion on a bridge brake structure.

How can corrosion be prevented on bridge brakes?

NOTE: A thorough evaluation of all types of corrosion prevention is beyond the scope of this Paper. This discussion will be limited to the most common methods of preventing Corrosion on bridge brakes.

COMMON METHODS OF CORROSION PREVENTION ON BRIDGE BRAKES

1. Coating of brake structural members
2. Special brake components that resist corrosion
3. Nitriding
4. Coated Nitriding
5. Structural members of Stainless Steel
6. Brake Covers

1. Coating of Brake Structural Members

There are many different coating specifications for use on bridge brake structural members (levers, base, spring tube etc.) A typical brake coating procedure could be:

A. Preparation
- Cut Parts – remove all scale
- Machined Parts- degrease
- Sand or grit blasting of cut and machined parts to SA 2 1/2.

B. Priming
- Apply two component zinc phosphate primer to blasted surfaces to 40 micron thick

C. Finish Coat
- Apply two component polyurethane color coat to 40 micron thick

2. Special Brake Components That Resist Corrosion

The use of special corrosion-resistant brake components could include:

A. Maximum use of stainless steel parts, including:
- Spring Tube Cross Pieces
- Automatic Wear Compensator
- Eyebolts and Washers
- Unloaded Bolted Joints
- Grub Screws, Parallel Pins and Split Pins

B. Sea Water-Resistant Bushings

C. Delta Tone Coating of Bolt Spacers and Spacers

3. Nitriding

Nitriding is a process of nitrogen diffusion into the steel at elevated temperature from the part surroundings. The thickness of the nitride layer depends on the time and the process by which diffusion occurs. Addition of nitrogen changes the structure and chemistry of the outer layer to form nitrides of iron and other alloying elements such as Al, Zr, Ti etc. Nitriding can be done in three types of processes:[2]

Nitriding Processes

Process	**Description**	Advantages**/Disadvantages**
Liquid Nitriding	Use molten nitrates of different salts to provide nitrogen	Fast heat transfer Low cost **High Chemical Waste** **Inefficient**
Gas Nitriding	Use nitrogen and ammonia At 600 degrees Celsius	Low cost **Low level of control**
Ion Nitriding	Use partial pressure of Nitrogen and form plasma Around the parts to accelerate the nitrogen into the part	Good control of compound layers Uniform hardening Shorter cycle time **High cost**

Diagram # 1 attached is a schematic of a typical nitrided case structure. The "compound layers" referred to above are shown as the "Compound zone, dual phase" of the schematic. Early metallurgists concluded that the "white layer" or "compound zone" is composed of a nitride, either iron nitrides or a complex nitride layer, involving both iron and alloying elements. A further conclusion was that the white layer or compound zone was extremely hard but very brittle and that the layer should be avoided if possible.[3] Note that in the table above, good control of the compound layers is stated as an advantage of the Ion Nitriding process only.

4. Coated Nitriding

Salt spray testing of nitrided bridge brakes has shown that coating of a nitrided brake surface provides significant additional corrosion resistance. See photos #2, 3 and 4 attached. Photo #2 shows a gas-nitrided bridge brake after salt spray testing. Photo #3 shows a nitrided bridge brake with a coating applied over the nitriding. The coating used over the nitriding was as described in #1 above. Photo #4 shows the coated, nitrided brake with a circular hole in the coating.

5. Structural Brake Components of Stainless Steel

In Metallurgy, stainless steel is defined as a ferrous alloy with a minimum 10% chromium content. The name originates from the fact that stainless steel does not stain, corrode or rust as easily as ordinary steel. Stainless steels have higher resistance to oxidation (rust) and corrosion in many natural and man-made environments; however it is important to select the correct type and grade of stainless steel for the particular application.[4] Photo #5 attached shows a caliper disc brake made of stainless steel, which also includes the components listed in #2 above. This manufacturing approach provides superior corrosion resistance at added cost over the cost of a coated, nitrided or coated-nitrided brake.

6. Use of Covers over Bridge Brakes

Covering bridge brakes will aid in corrosion prevention. Covers are typically available in galvanized and stainless steel executions, with the stainless steel covers providing superior corrosion resistance. Heaters can be provided in the covers to reduce condensation, and thereby also aid in corrosion prevention.

Watertight covers for submersible applications can also be furnished. Attached Diagram # 2 is a drawing of a submersible bridge brake cover.

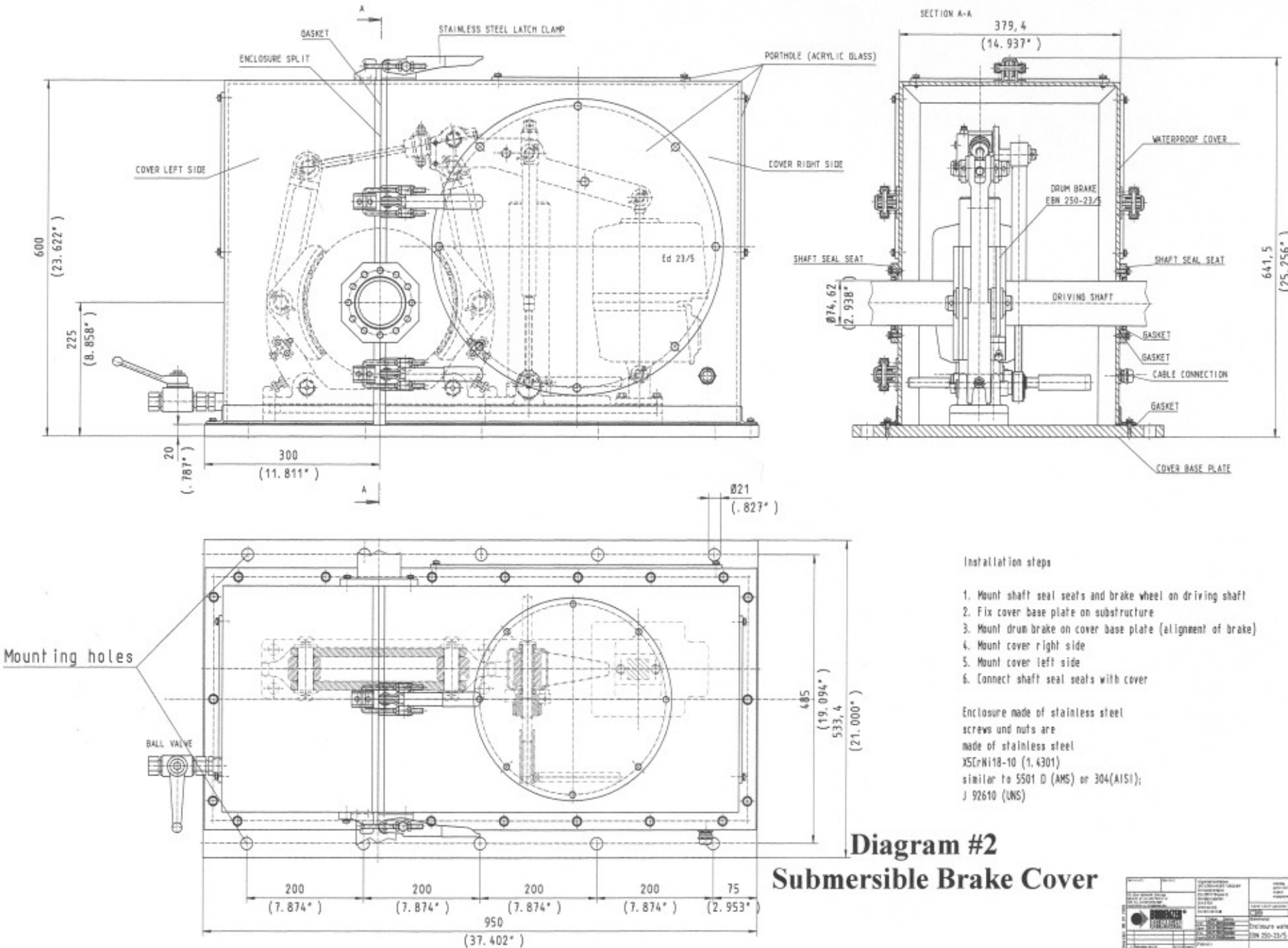
SUMMARY and RECOMMENDATIONS

A. Several different methods of bridge brake corrosion prevention are available on the market.

B. Choose the method best suited for your application based on the environment the bridge brakes will be exposed to, the proven performance and cost of the selected corrosion-prevention method.

C. Choose a Brake Manufacturer:
- Thoroughly familiar with corrosion prevention on bridge brakes
- That does continuous, rigorous testing and R&D of corrosion-prevention systems
- That works to improve corrosion prevention on Bridge Brakes based upon testing and feedback from the field.
- That offers a variety of corrosion-prevention systems to fit your application and budget.

1. Corrosion, Wikipedia.org/wiki/Corrosion
2. www.surfacesolution.com/nitriding.html
3. An Introduction to Nitriding, Chapter 1, ASM International
4. Stainless Steel, Wikipedia.org/wiki/Stainless_steel

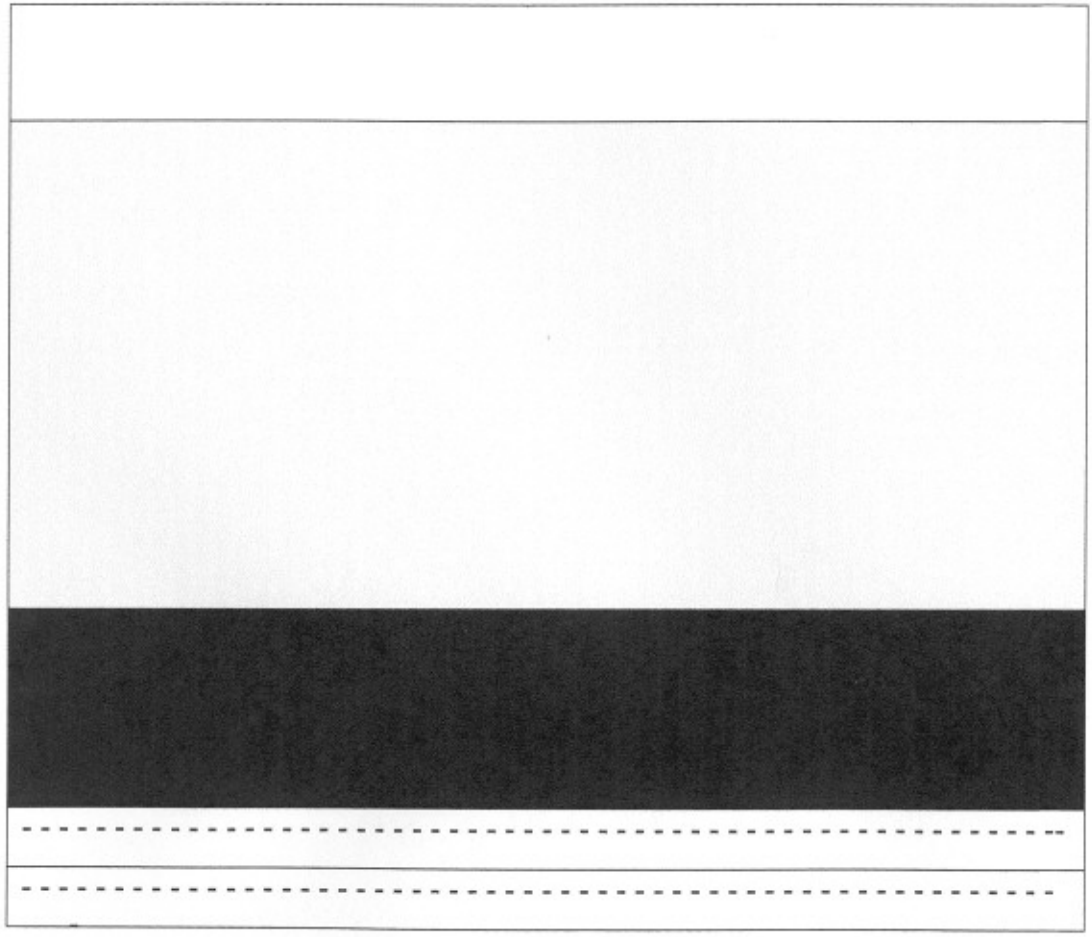


Installation steps

1. Mount shaft seal seats and brake wheel on driving shaft
2. Fix cover base plate on substructure
3. Mount drum brake on cover base plate (alignment of brake)
4. Mount cover right side
5. Mount cover left side
6. Connect shaft seal seats with cover

Enclosure made of stainless steel
screws und nuts are
made of stainless steel
X5CrNi18-10 (1.4301)
similar to 5501 D (AMS) or 304(AISI);
J 92610 (UNS)

Diagram #2
Submersible Brake Cover



Schematic of a typical nitrided case structure

Diagram #1