

CORROSION PROTECTION

Experiment Kit

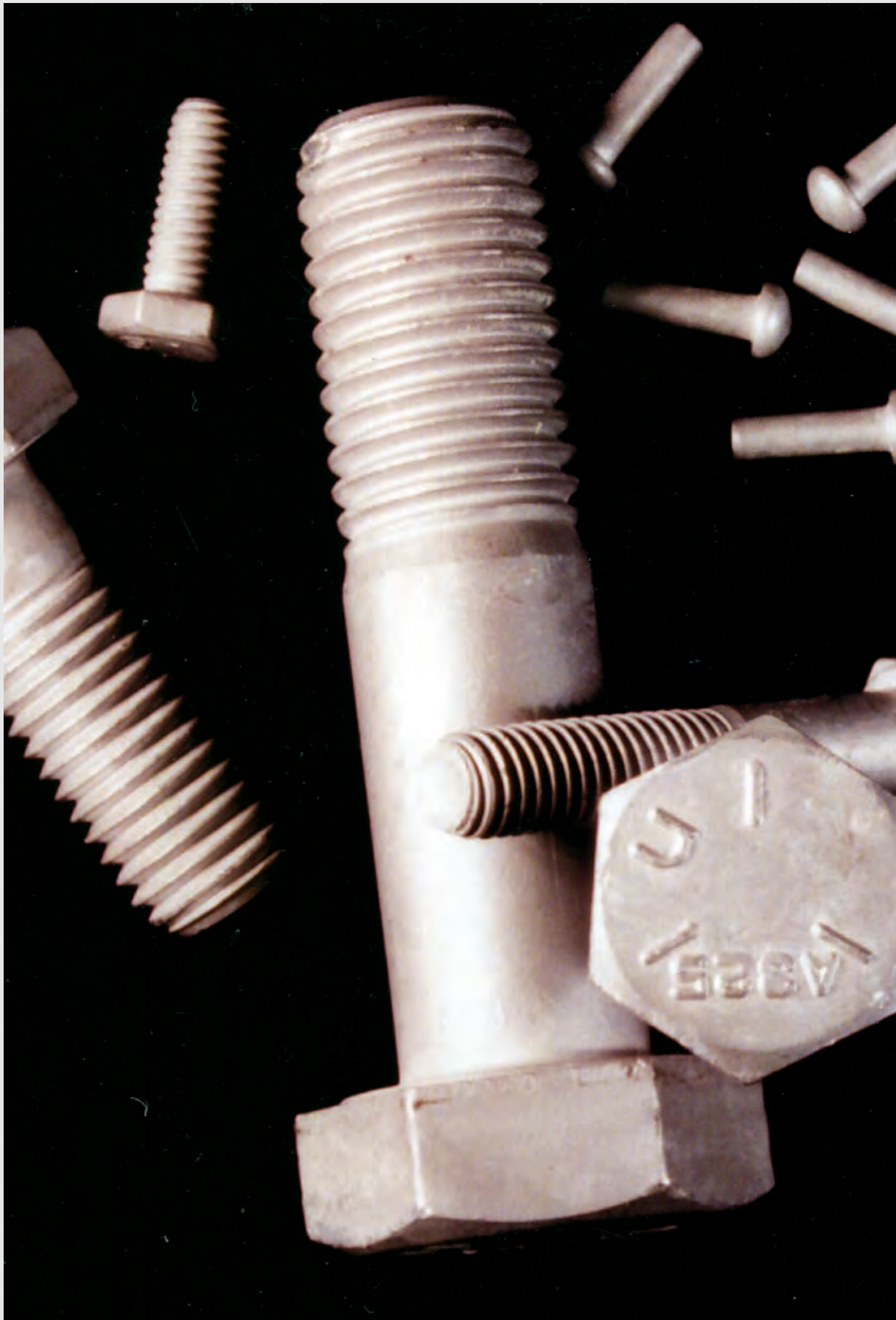




Corrosion

[kuh-roh-zhuhn] noun.

- 1) a process in which a solid, especially a metal, is eaten away and changed by a chemical action, as in the oxidation of iron in the presence of water by an electrolytic process
- 2) slow deterioration by being eaten or worn away



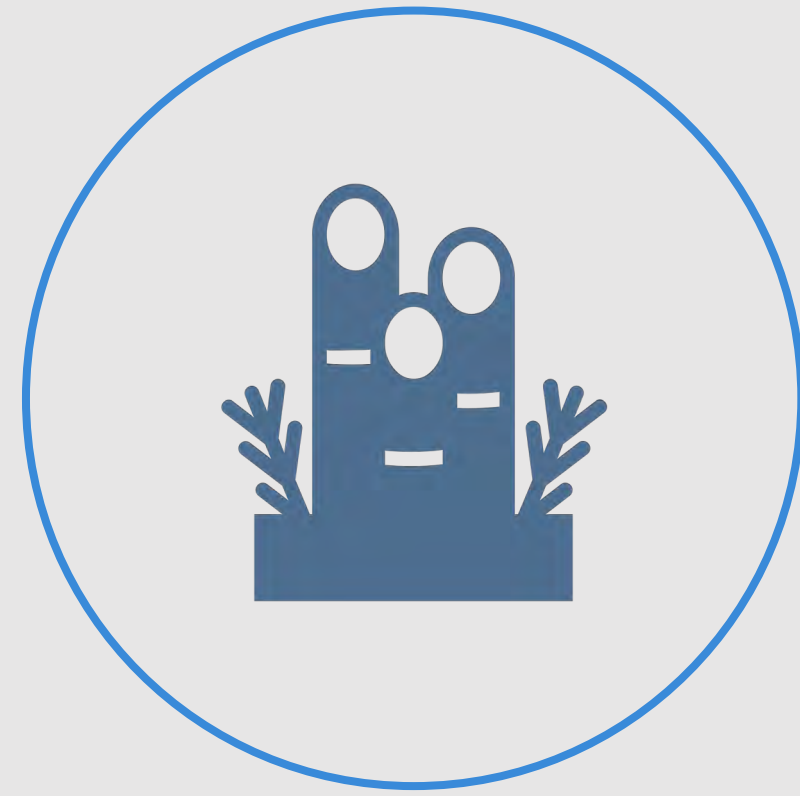
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Introduction

In this science experiment, you will observe the corrosion rate of fasteners (i.e. nails, screws, etc.) made of different materials and coatings when exposed to a variety of solutions. Using the scientific method, you will conduct research on corrosion & corrosion protection to hypothesize which fastener you think will perform best. You will then test your hypothesis through experimentation with different fasteners and solutions. Over the course of 2 to 3 weeks, you will record your observations with pictures and notes. At the end of the experiment, you will analyze the data collected to develop your conclusion.

Problem Statement



You are building a garden shed in your backyard. You have acquired most of the building materials except the metal fasteners that will hold the entire structure together. You want the shed to last a long time without maintenance, so you need to evaluate fasteners to determine what type will provide the longest lifespan. The following project uses the scientific method to evaluate material options in different environmental conditions.



Time Required: Approximately 2-3 Weeks



Materials & Equipment

To complete this experiment, you will need the following materials

Included

- ✓ 5 Bare Steel Fasteners
- ✓ 5 Painted Steel Fasteners
- ✓ 5 Hot-Dip Galvanized Steel Fasteners
- ✓ 5 Bronze or Brass Plated Steel Fasteners
- ✓ 20 Small Containers
- ✓ Tweezers
- ✓ Experiment Instructions & Data Collection Charts

Not Included

- ☐ Bottled Spring Water
- ☐ Iodized Salt
- ☐ Baking Soda
- ☐ Distilled White Vinegar
- ☐ Pen or Marker
- ☐ Old Towel
- ☐ Camera

Links & Sources

Now it's time to do your own research



AGA

Basic Corrosion



AMPP

What is Corrosion?



WIKIPEDIA

Corrosion Types



CORROSIONPEDIA

Corrosion Website

Click the logos/buttons above to learn more about corrosion from these great online resources to get you started

Research

Before beginning the experiment, research the following topics.

WHAT IS CORROSION?

Type Answers & Sources Here

WHAT CAUSES CORROSION?

Type Answers & Sources Here

WHAT IS OXIDATION?

Type Answers & Sources Here

**WHAT ENVIRONMENTAL CONDITIONS
ARE THE MOST & LEAST CORROSIVE**

Type Answers & Sources Here

Research

Before beginning the experiment, research the following topics.

WHAT DOES CORROSION LOOK LIKE?

Type Answers & Sources Here

HOW DOES PH LEVEL IMPACT CORROSION?

Type Answers & Sources Here

WHAT ARE THE PH LEVELS OF SPRING WATER, SALT WATER, BAKING SODA WATER SOLUTION & VINEGAR?

Type Answers & Sources Here

WHAT TYPE OF ENVIRONMENTS COULD THE SOLUTIONS LISTED ABOVE REPRESENT?

Type Answers & Sources Here

Hypothesis

WHICH FASTENER COATING WILL PERFORM BEST?

Type your hypothesis here.

Instructions

Setup

1. Gather all necessary materials to complete the experiment. Prepare an area to leave the experiment for a few weeks. We recommend placing an old towel under all the items in case spills occur.
2. Add the provided fasteners in the small containers. You will have 20 containers with fasteners once complete - 5 for each fastener type.
3. Label each container with the fastener type and solution to be added in the next step. Each fastener will have 4 different solutions, plus a control that won't have a solution added.
4. Prepare the solutions to be added to the containers. The solutions should cover the entire fastener.
 1. Bottled Spring Water: Pour directly in the correct containers
 2. Distilled White Vinegar: Pour directly in the correct containers
 3. Saltwater: Mix 1t salt with 8oz warm water. Stir until mixed, pour in correct containers
 4. Baking Soda: Mix 1t baking soda with 8oz warm water. Stir until mixed, pour in correct containers
 5. Control: No solution should be added to the control containers
5. Take pictures of all containers to capture your starting point.

Instructions

Check-in Process

1. Check-in to observe and photograph the fasteners per the schedule provided.
2. Complete the following steps for each check-in:
 1. Take a picture of the fastener in the solution first
 2. Use the tweezer to remove the fasteners from the solution one at a time to observe individually.
 3. Take a picture of the fastener before returning it to the correct solution using the tweezers.
 4. Record your observations in a notepad or the provided grid.
3. Take pictures of all containers to capture your starting point.
4. After your final observation, proceed to the analysis step on page 18

Check-In Pictures & Observations

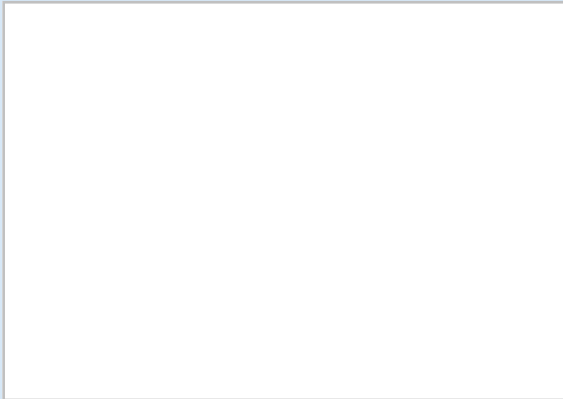
Spring
Water

Salt
Water

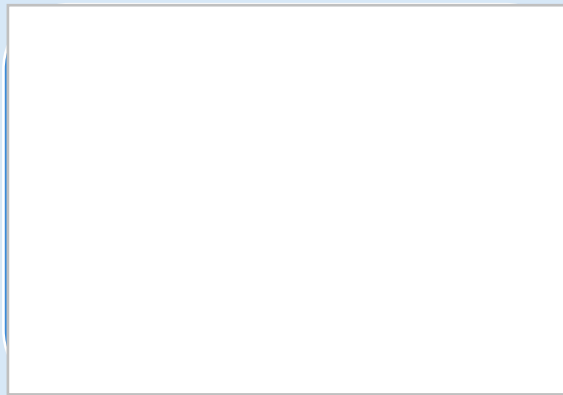
Baking
Soda

Vinegar

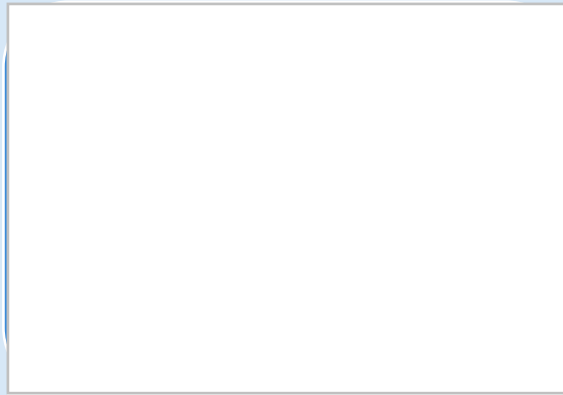
Bare



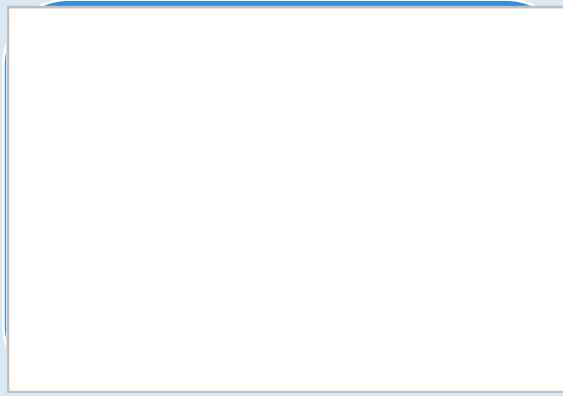
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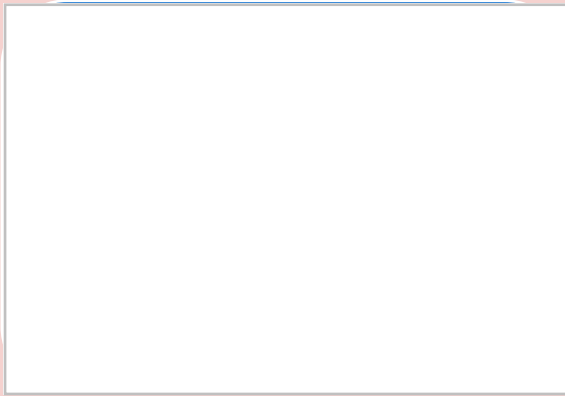


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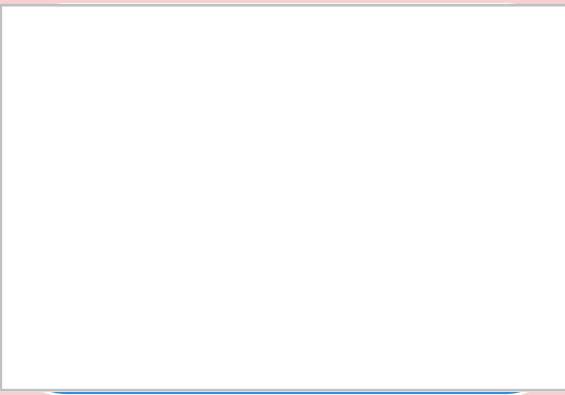


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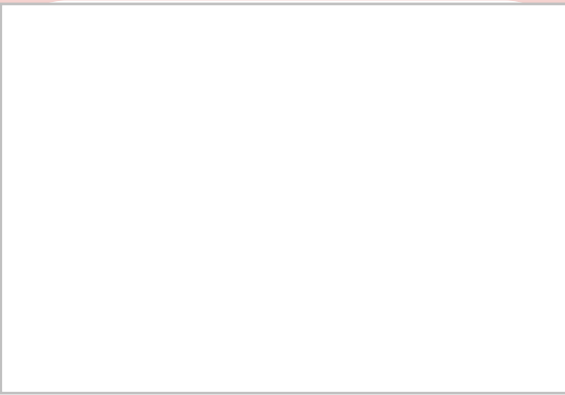
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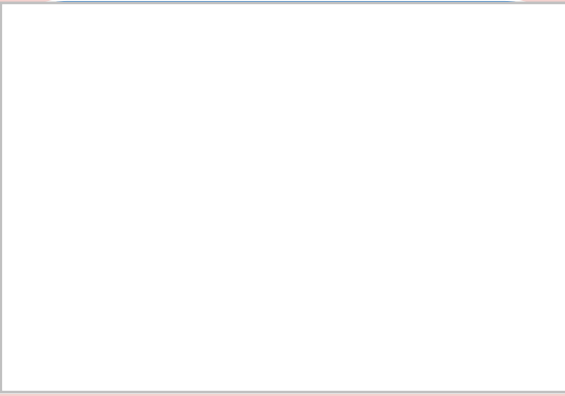
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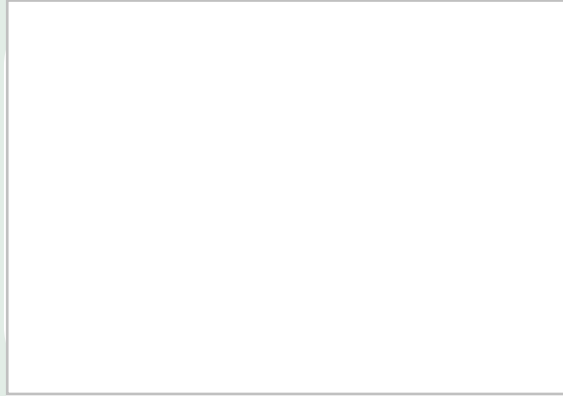


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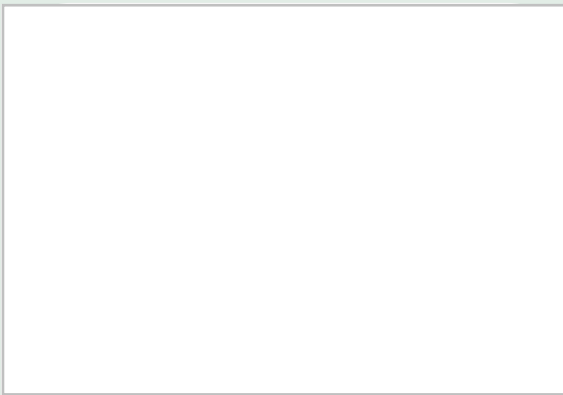


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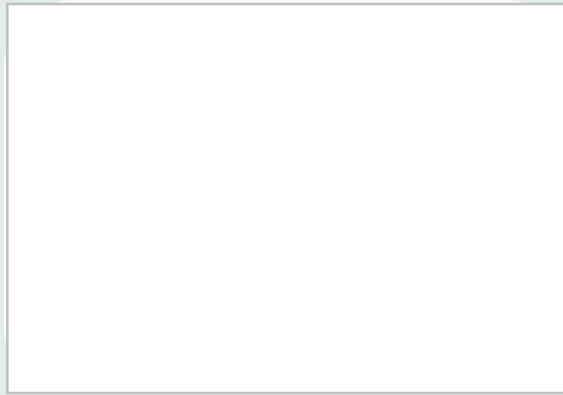
Galvanized (HDG)



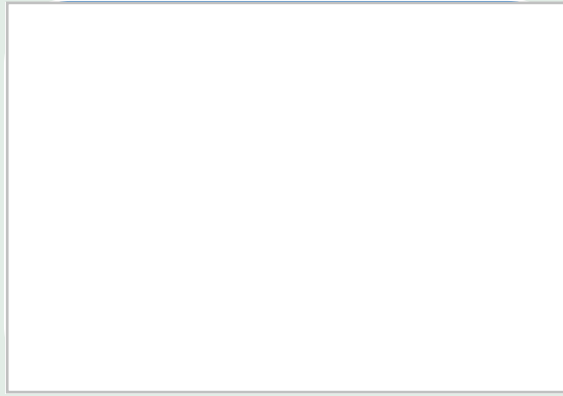
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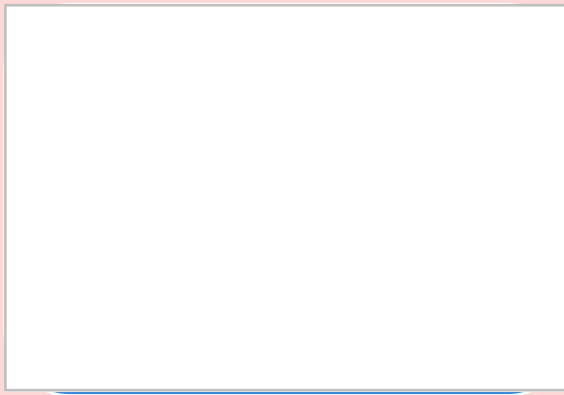


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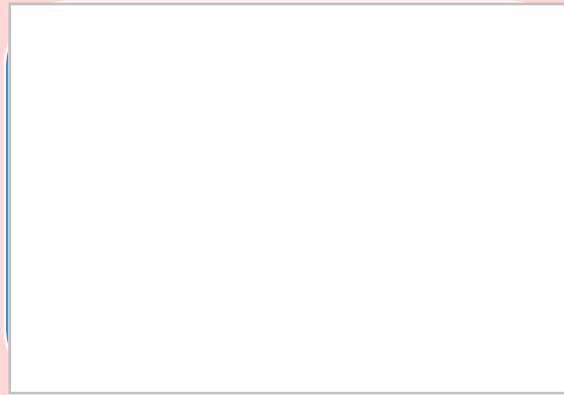
Bronze/Brass Plated



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Check-In Pictures & Observations

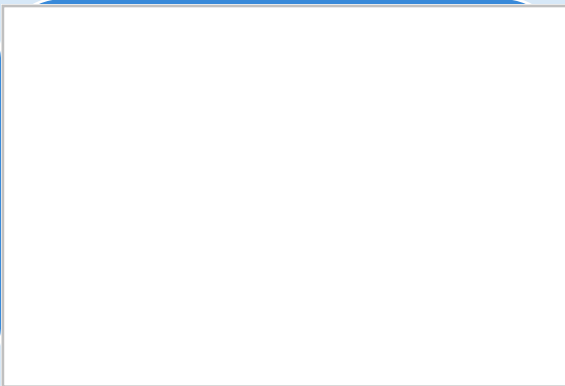
Spring
Water

Salt
Water

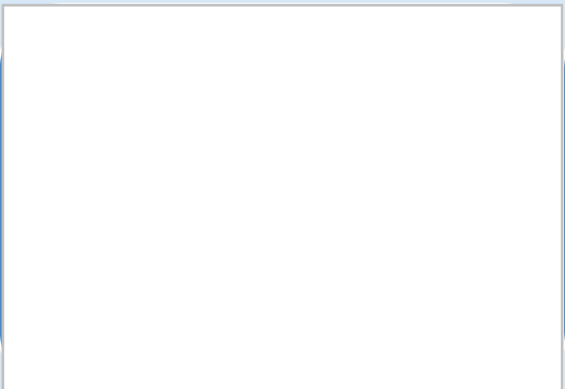
Baking
Soda

Vinegar

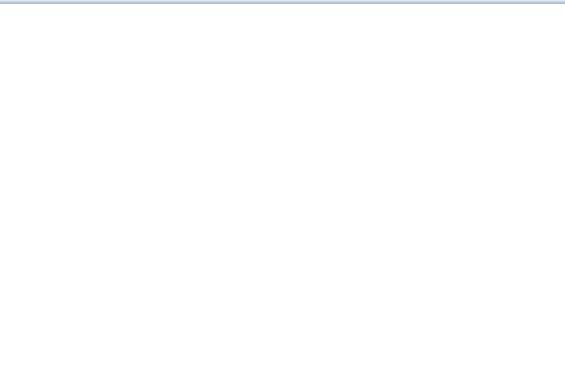
Bare



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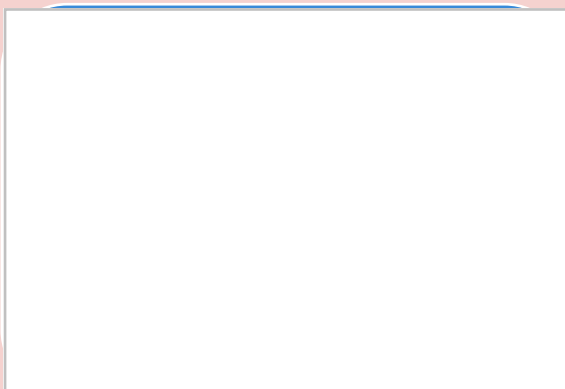


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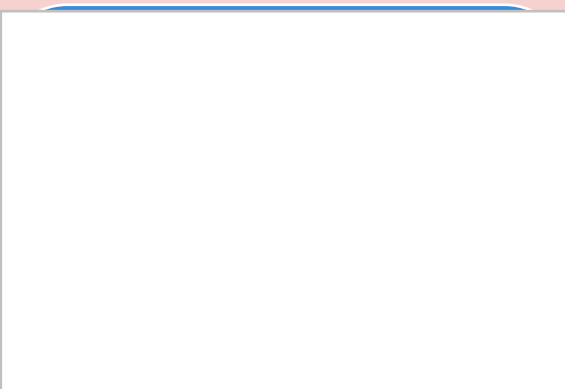
Painted



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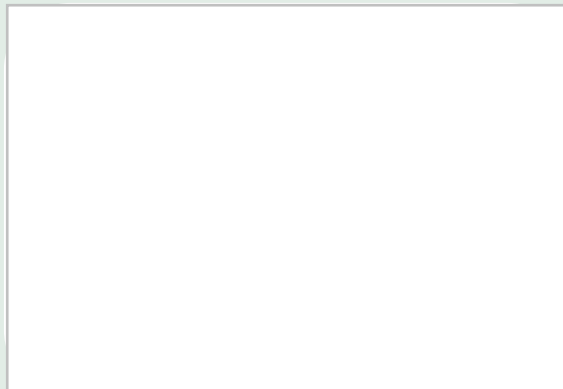


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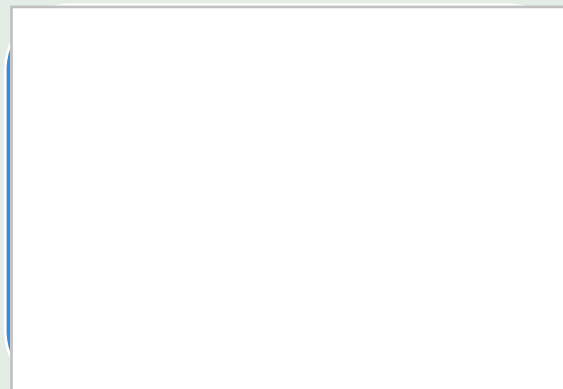
Galvanized (HDG)



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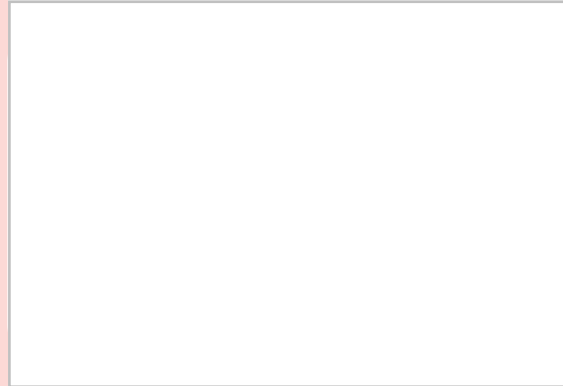


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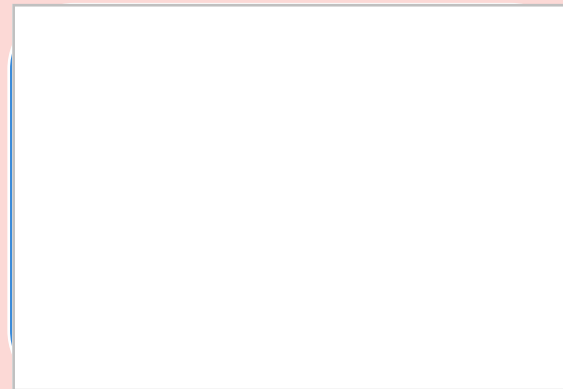


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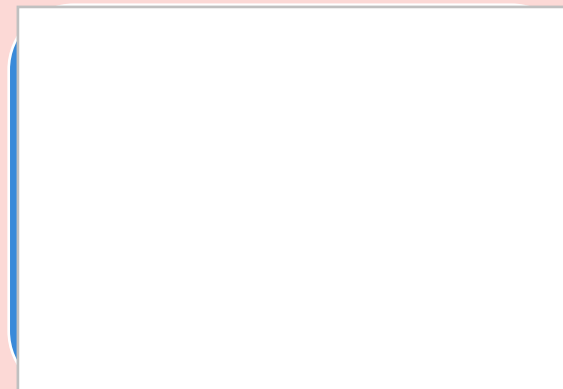
Bronze/Brass Plated



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Check-In Pictures & Observations

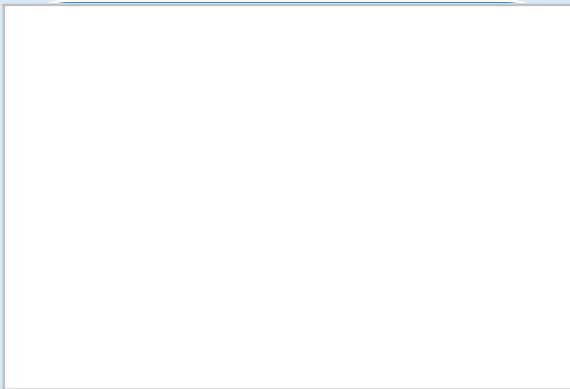
Spring
Water

Salt
Water

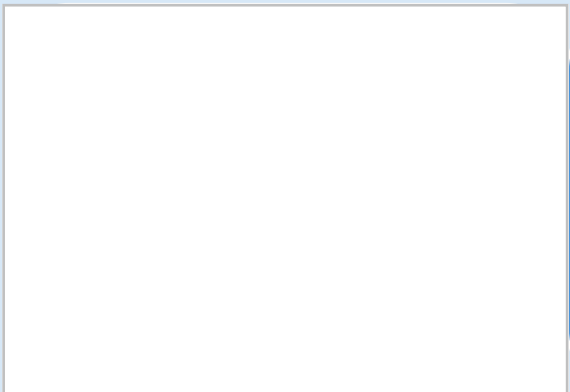
Baking
Soda

Vinegar

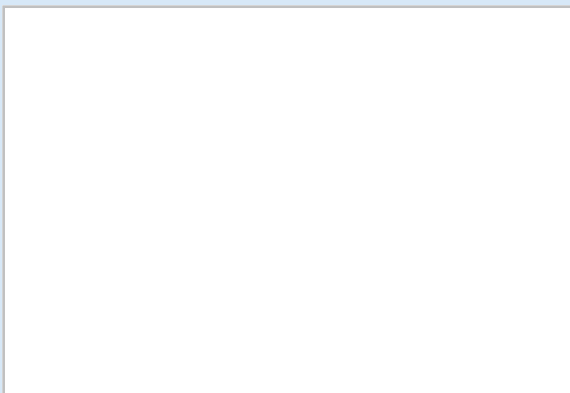
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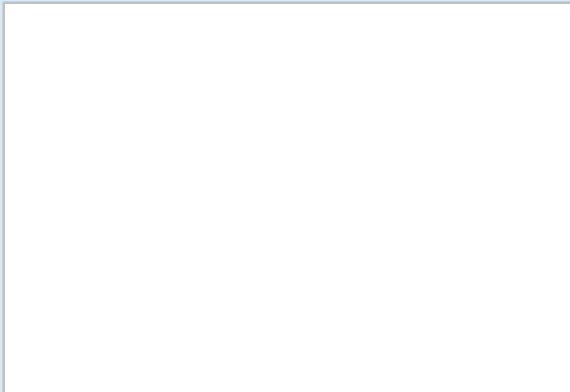
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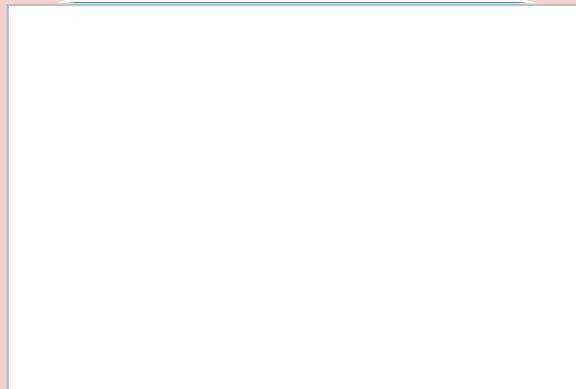


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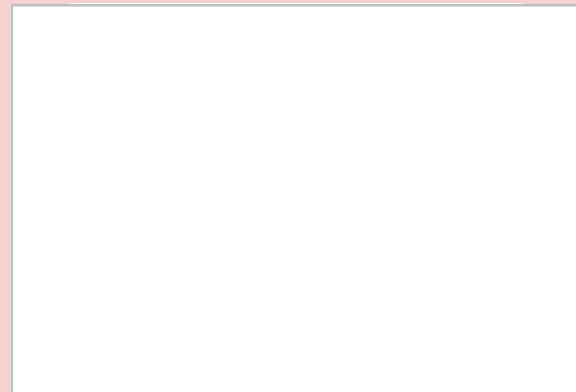


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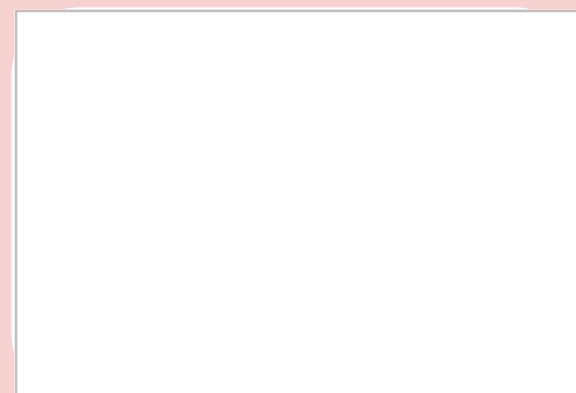
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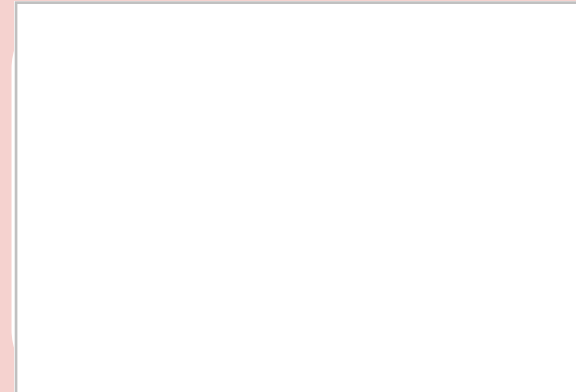
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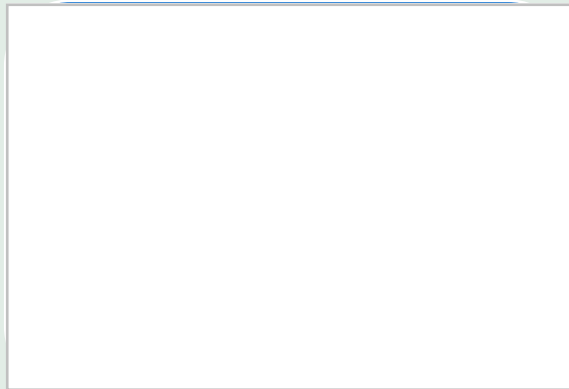


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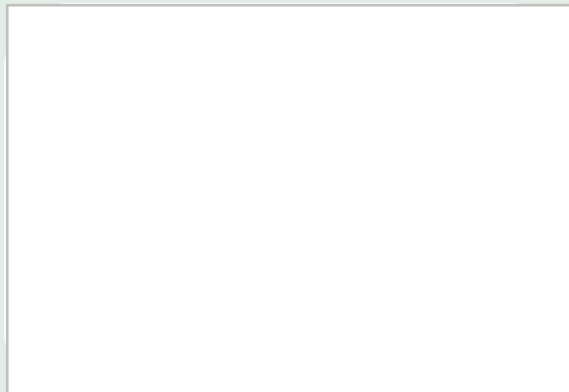


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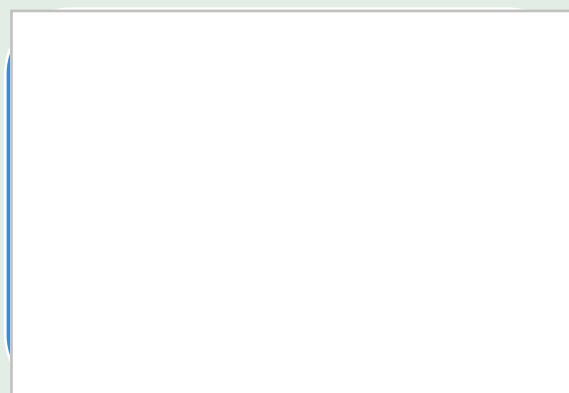
Galvanized (HDG)



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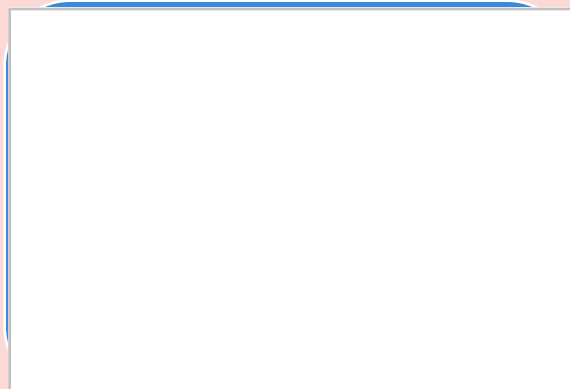


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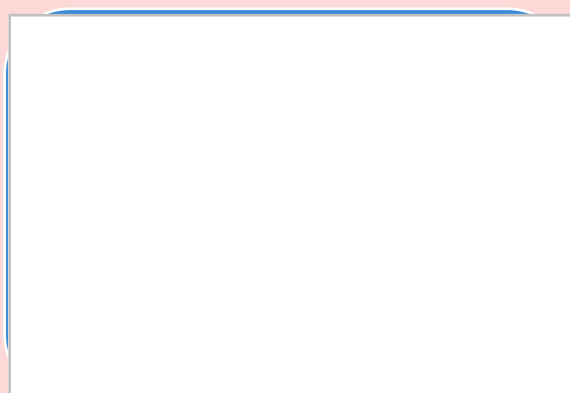
Bronze/Brass Plated



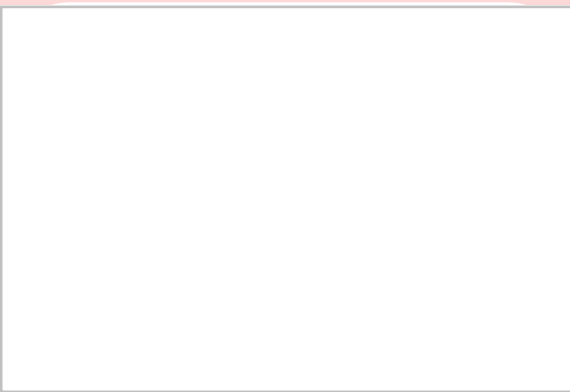
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Check-In Pictures & Observations

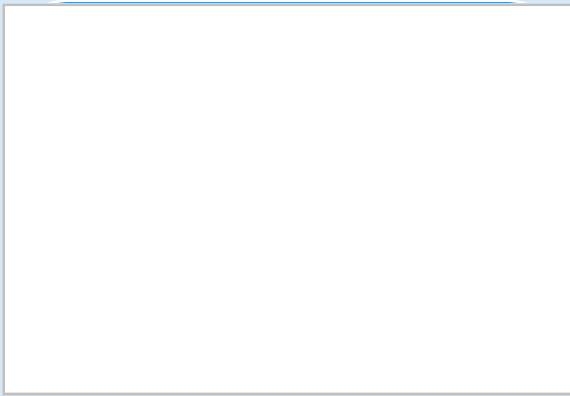
Spring
Water

Salt
Water

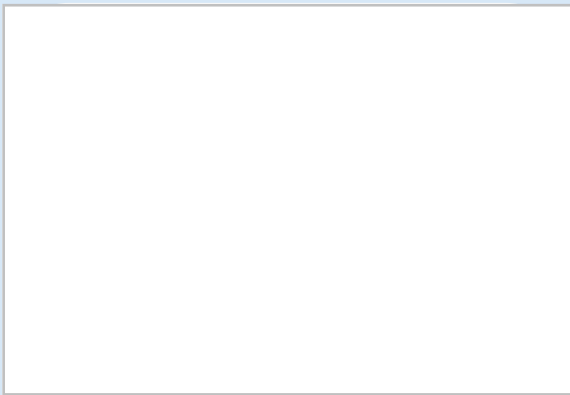
Baking
Soda

Vinegar

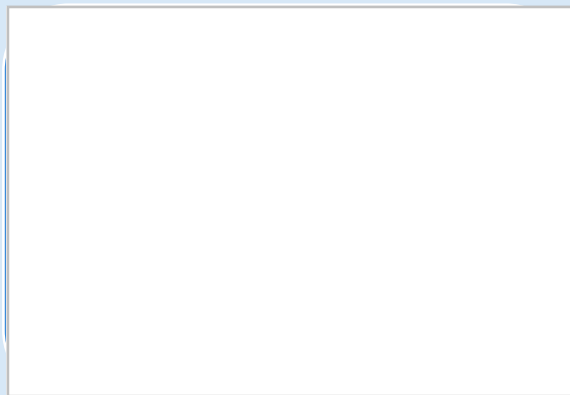
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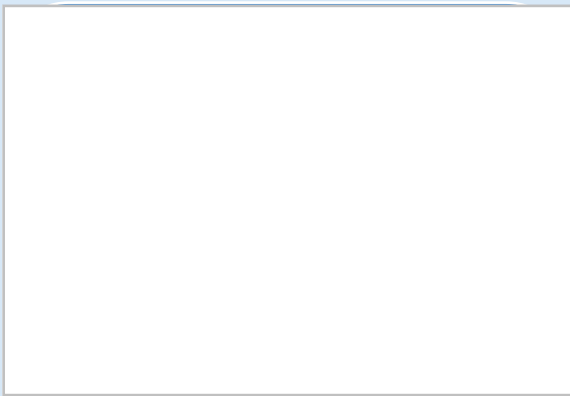
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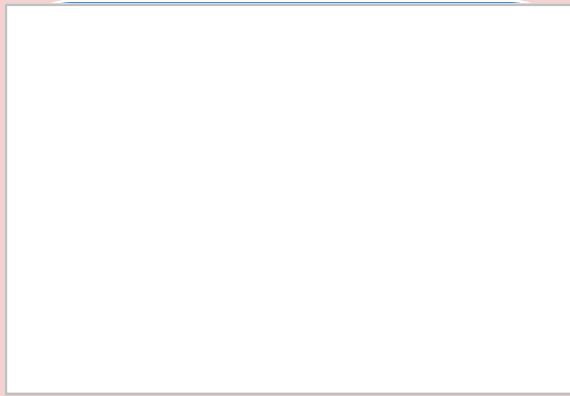


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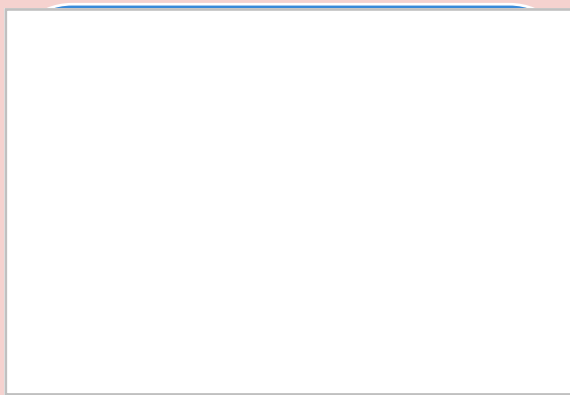


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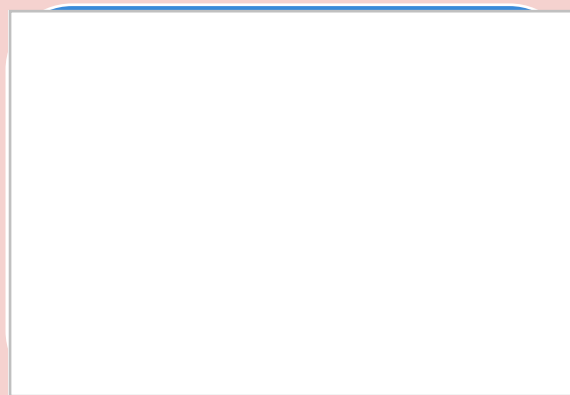
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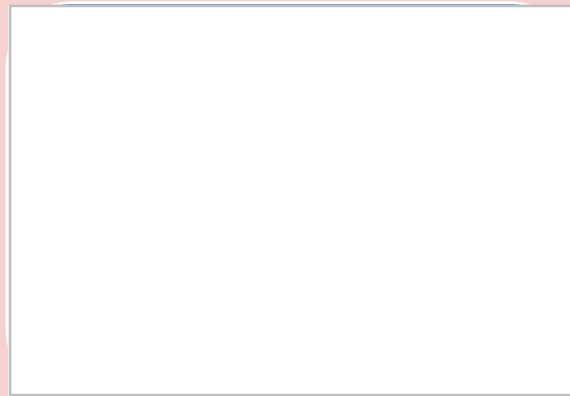
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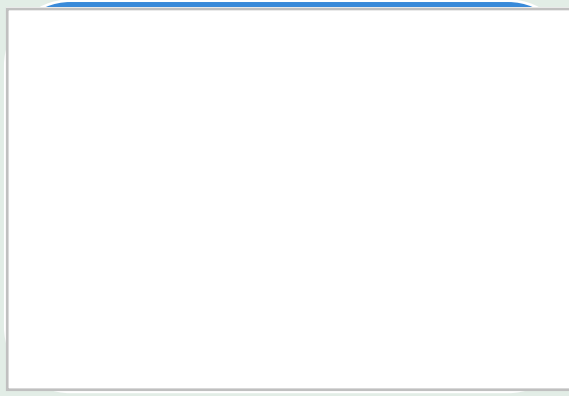


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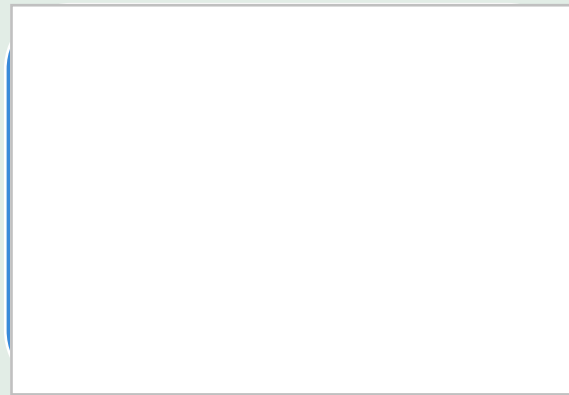


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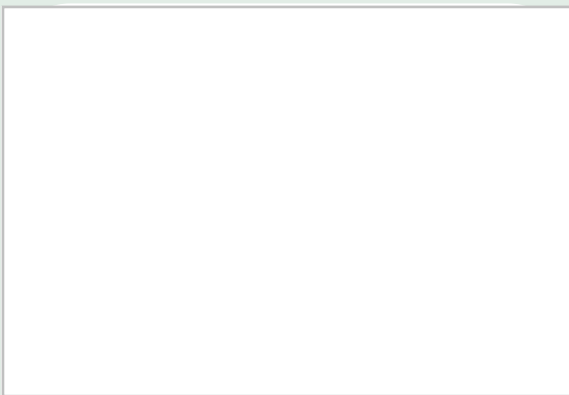
Galvanized (HDG)



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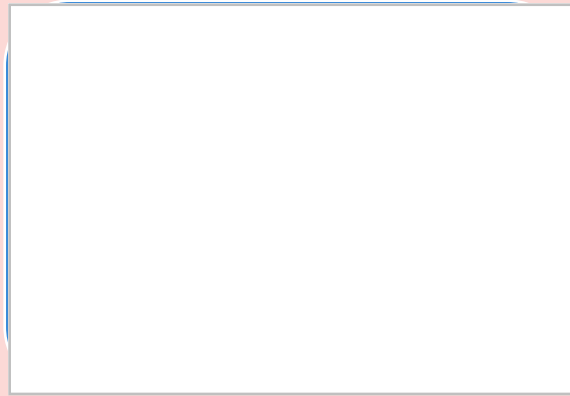


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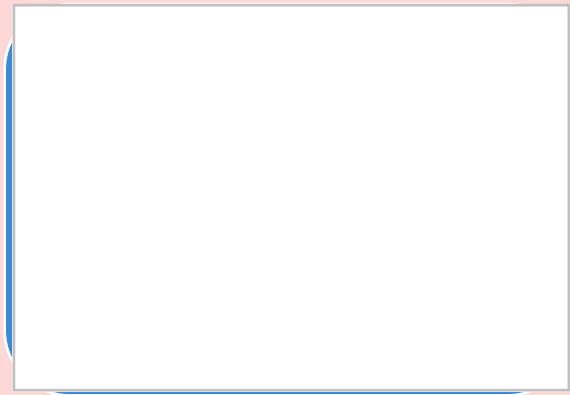


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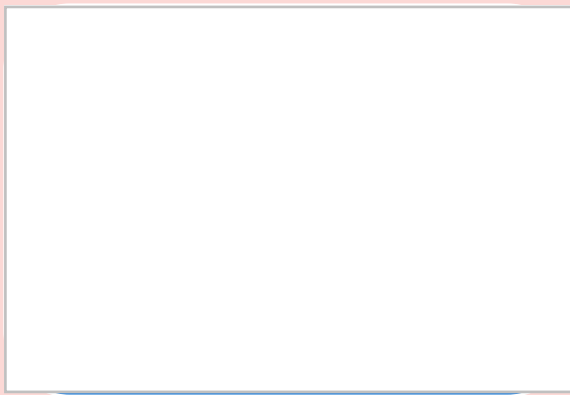
Bronze/Brass Plated



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Check-In Pictures & Observations

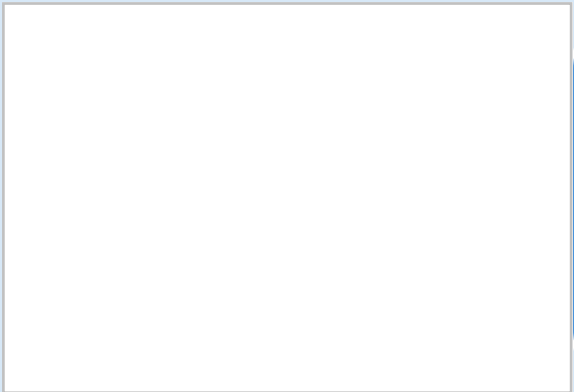
Spring
Water

Salt
Water

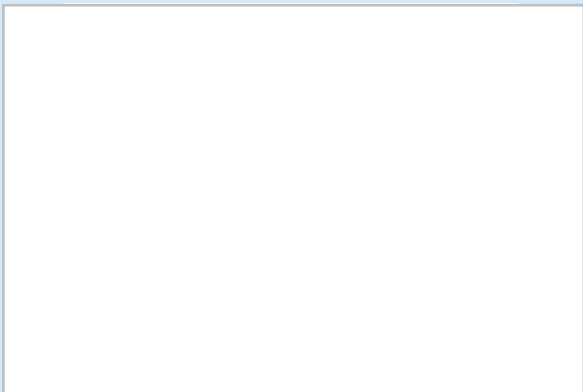
Baking
Soda

Vinegar

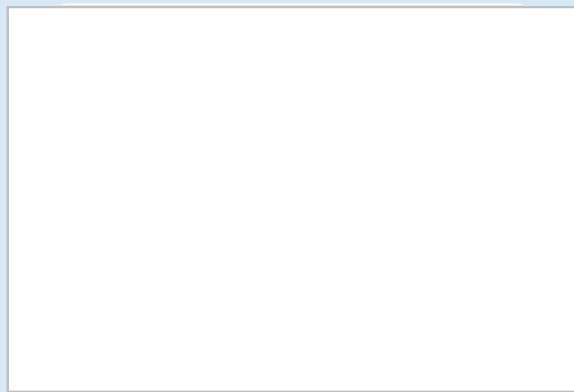
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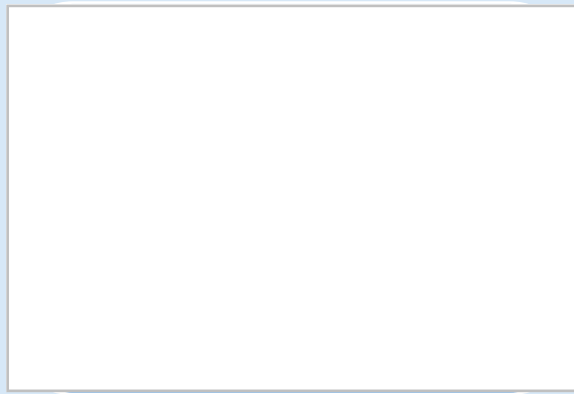
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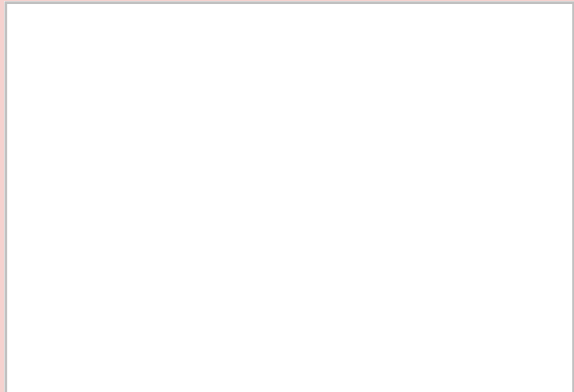
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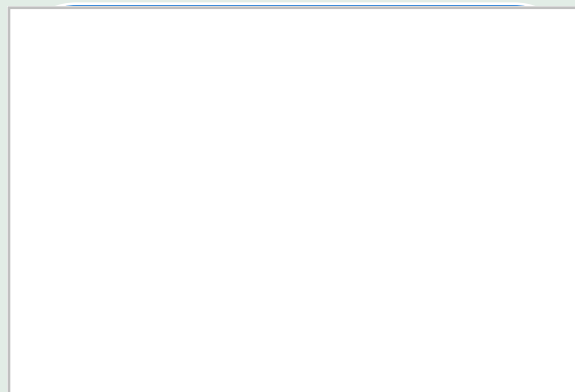


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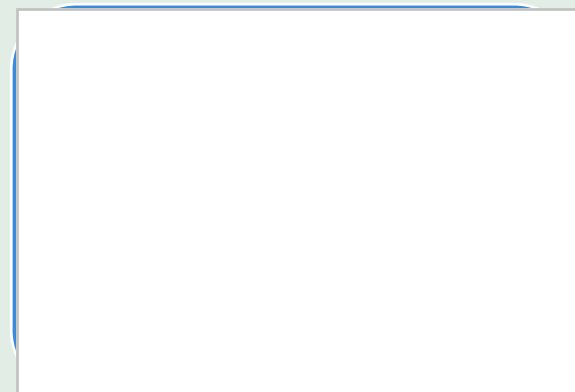


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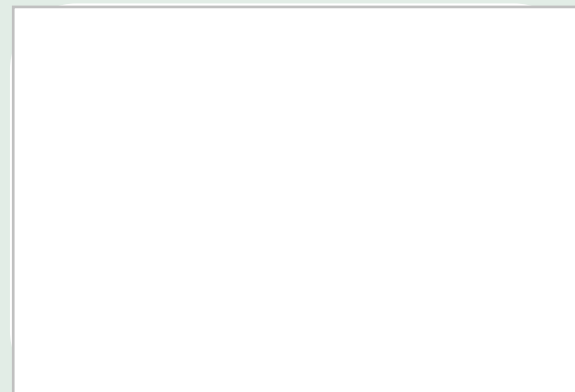
Galvanized (HDG)



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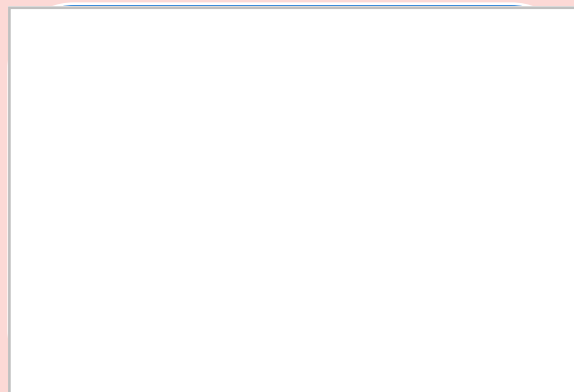


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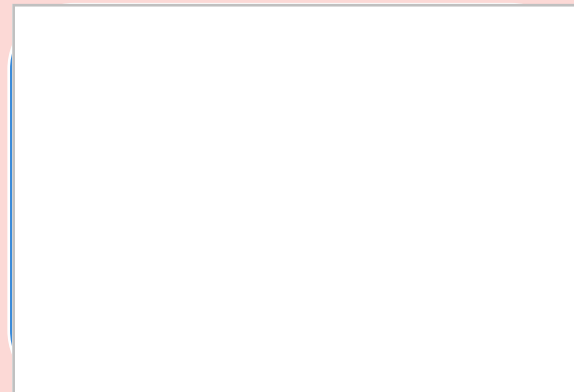


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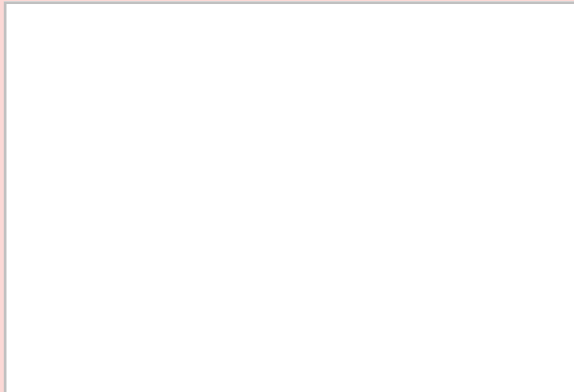
Bronze/Brass Plated



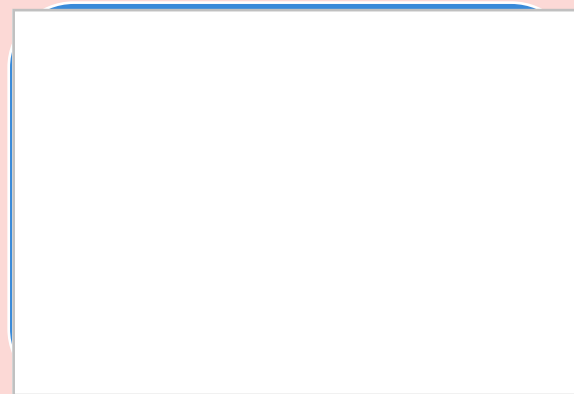
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Check-In Pictures & Observations

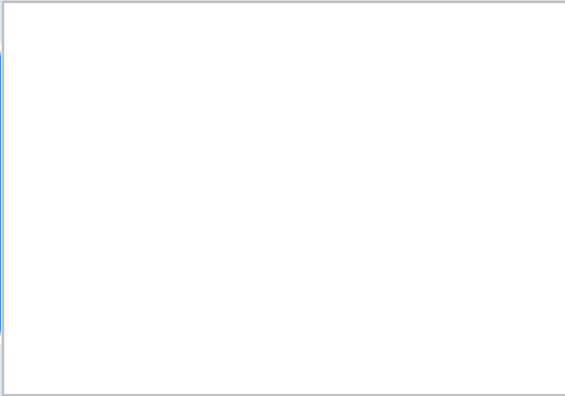
Spring
Water

Salt
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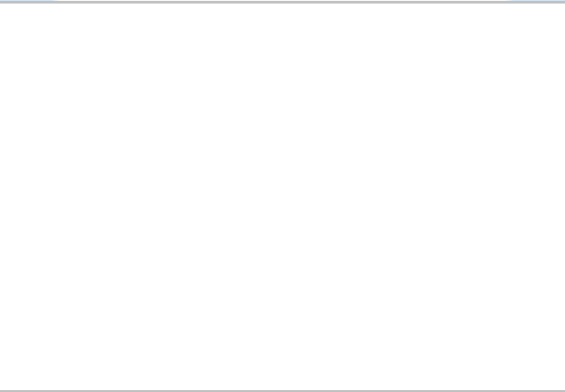
Baking
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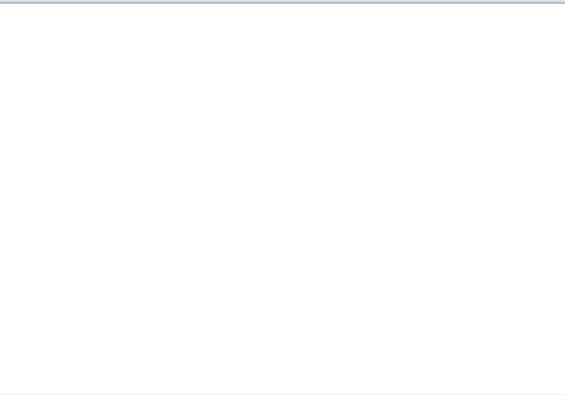
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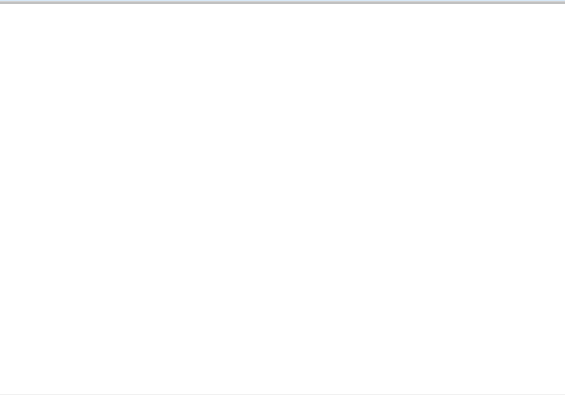
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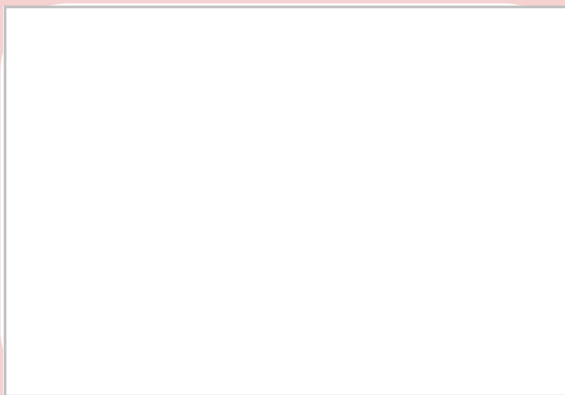
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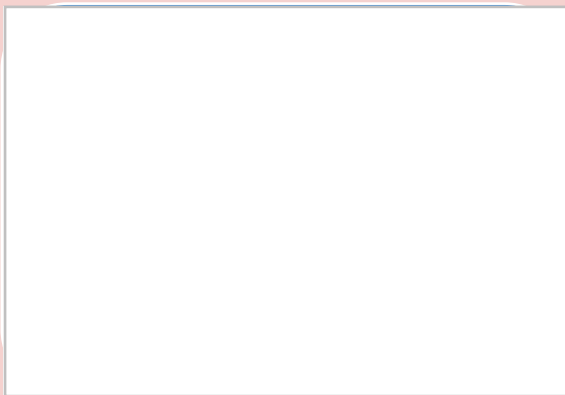
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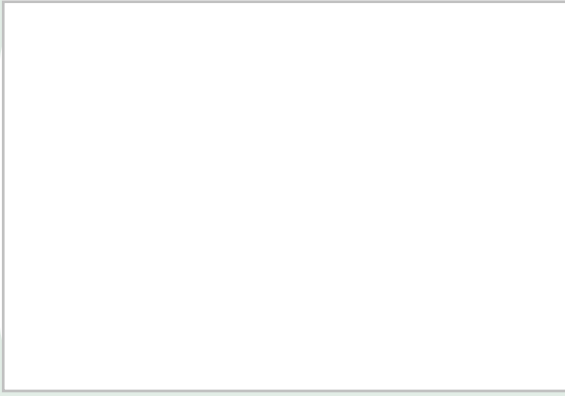


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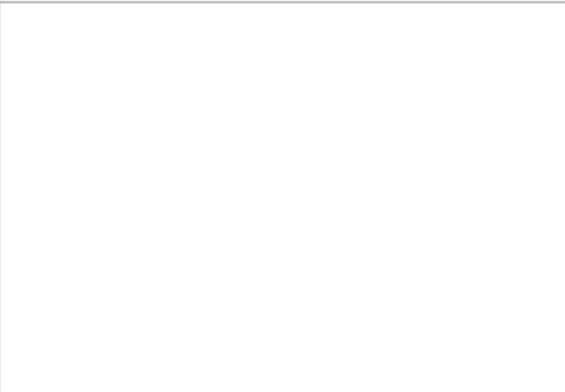


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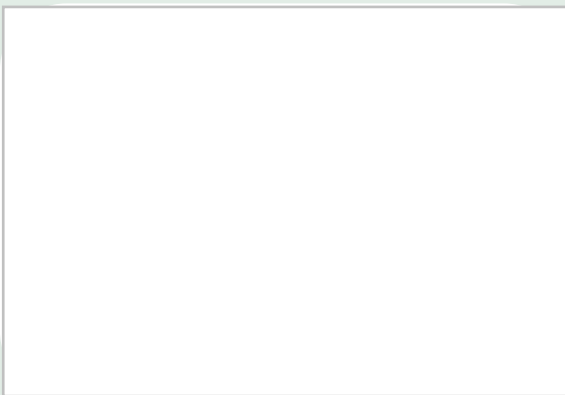
Galvanized (HDG)



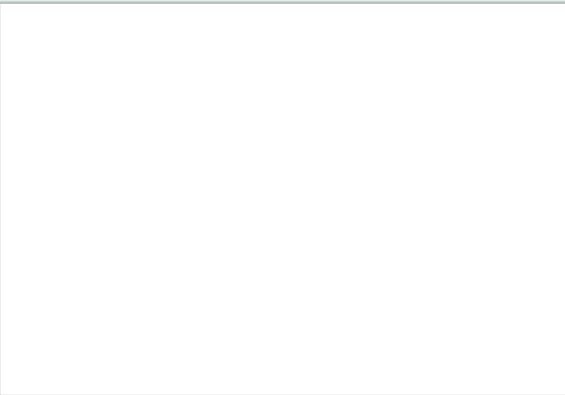
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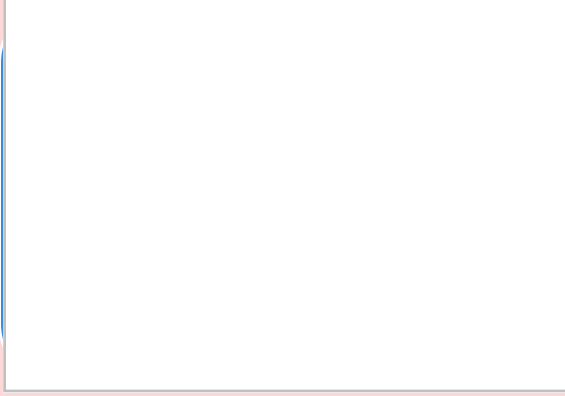


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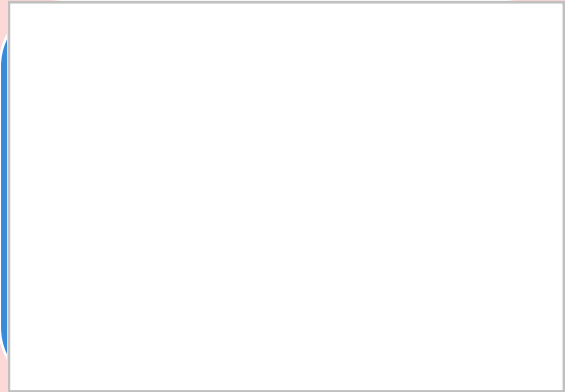


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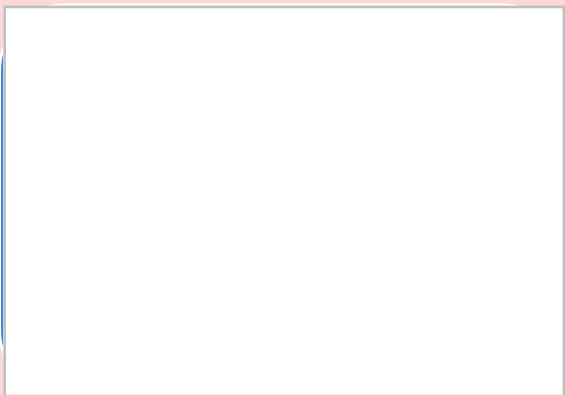
Bronze/Brass Plated



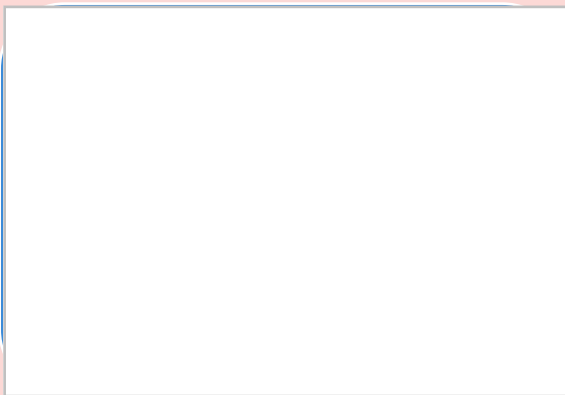
Type Observations Here



Type Observations Here



Type Observations Here



Type Observations Here

Check-In Pictures & Observations

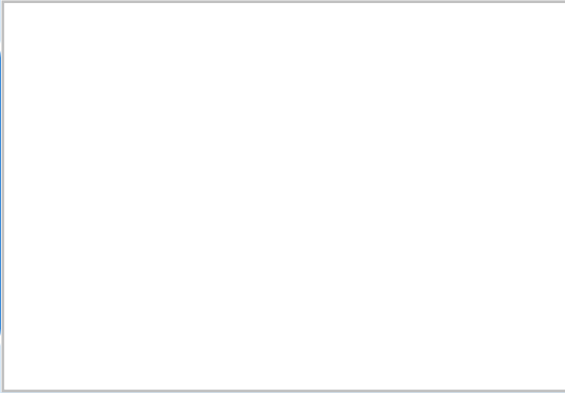
Spring
Water

Salt
Water

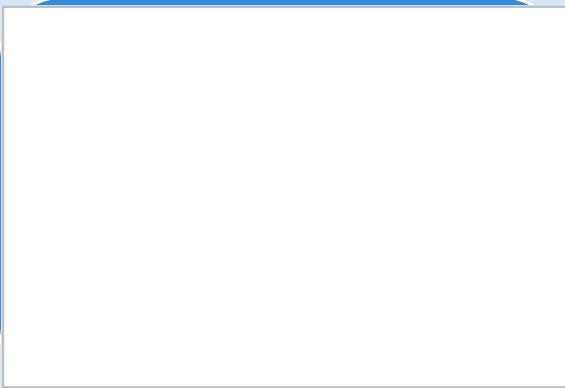
Baking
Soda

Vinegar

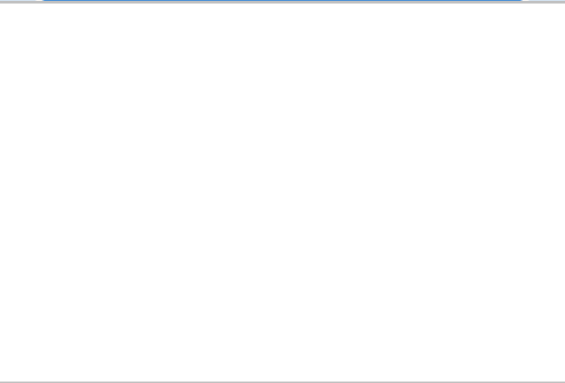
Bare



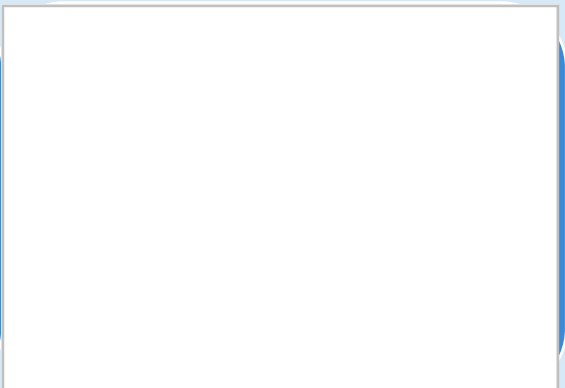
Type Observations Here



Type Observations Here



Type Observations Here

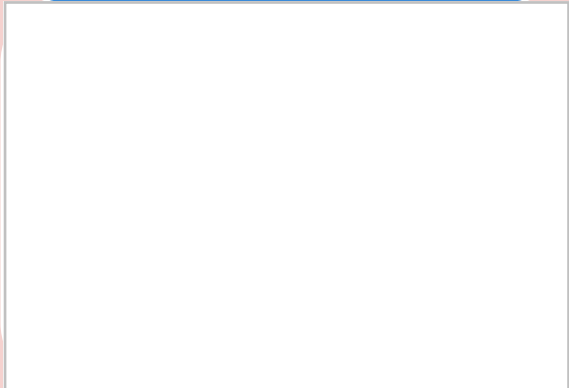


Type Observations Here

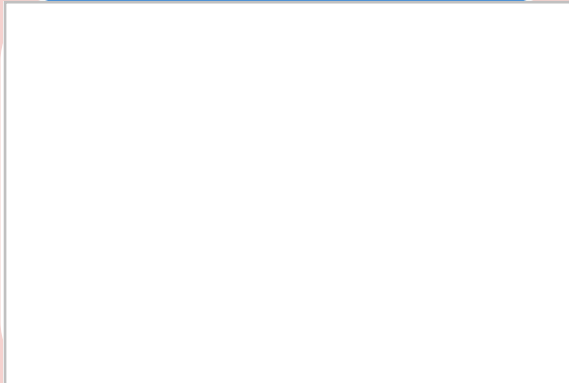
Painted



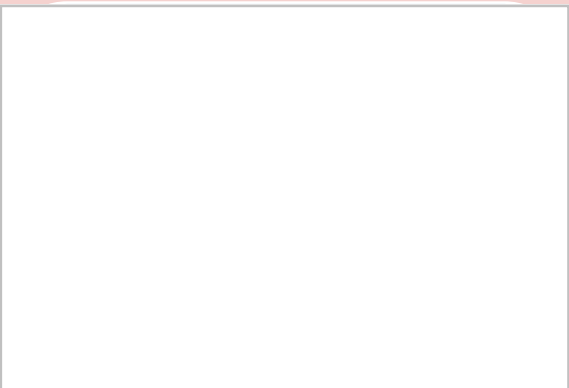
Type Observations Here



Type Observations Here

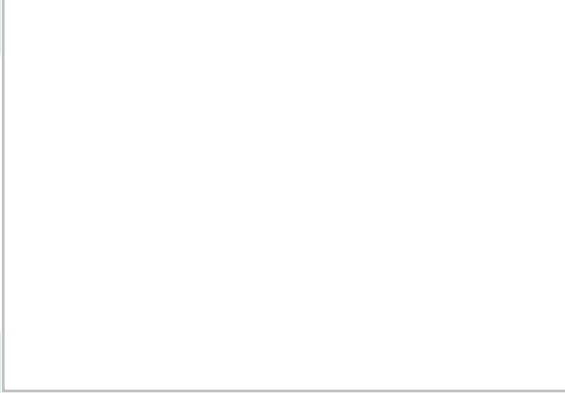


Type Observations Here



Type Observations Here

Galvanized (HDG)



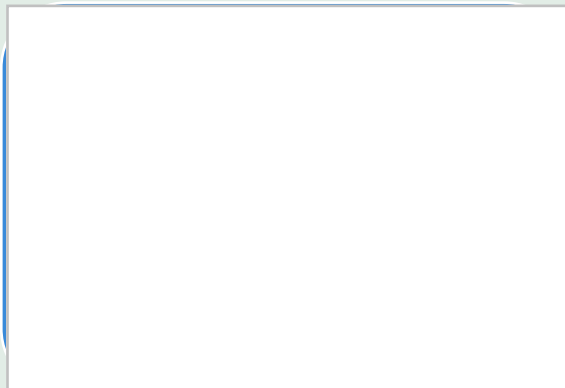
Type Observations Here



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Type Observations Here

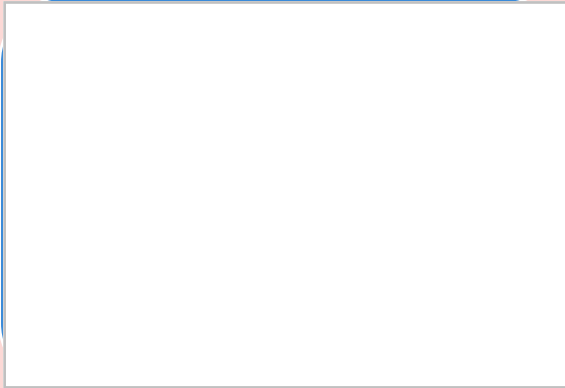


Type Observations Here

Bronze/Brass Plated



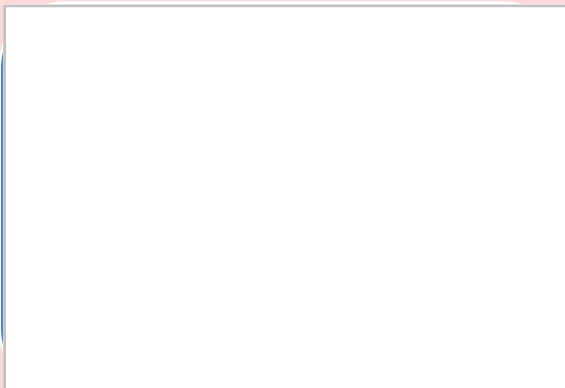
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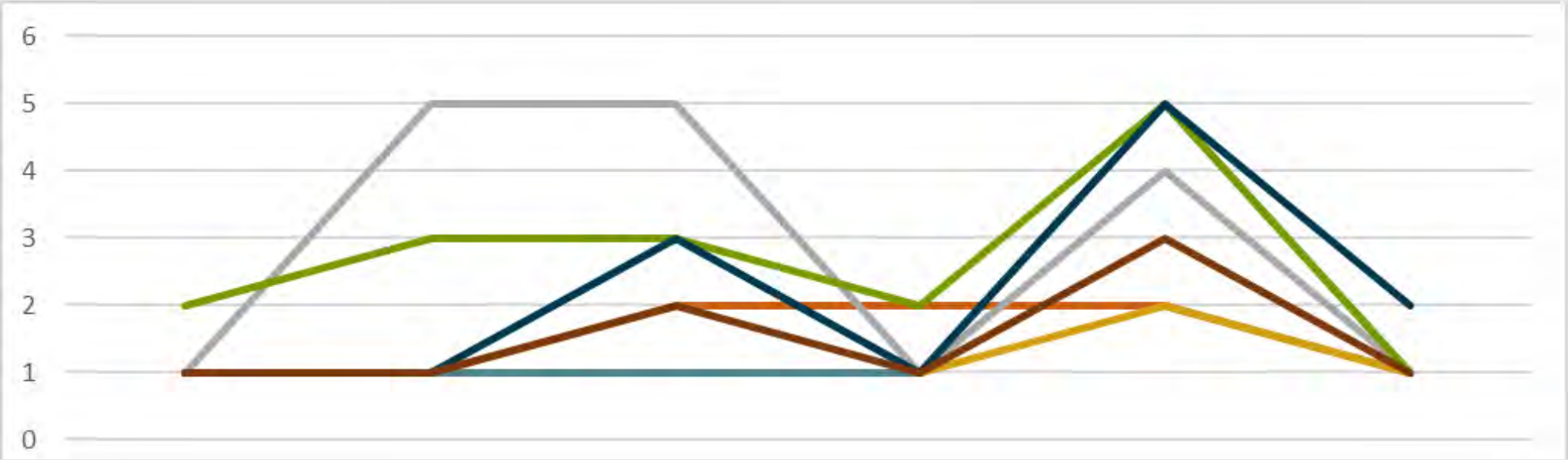
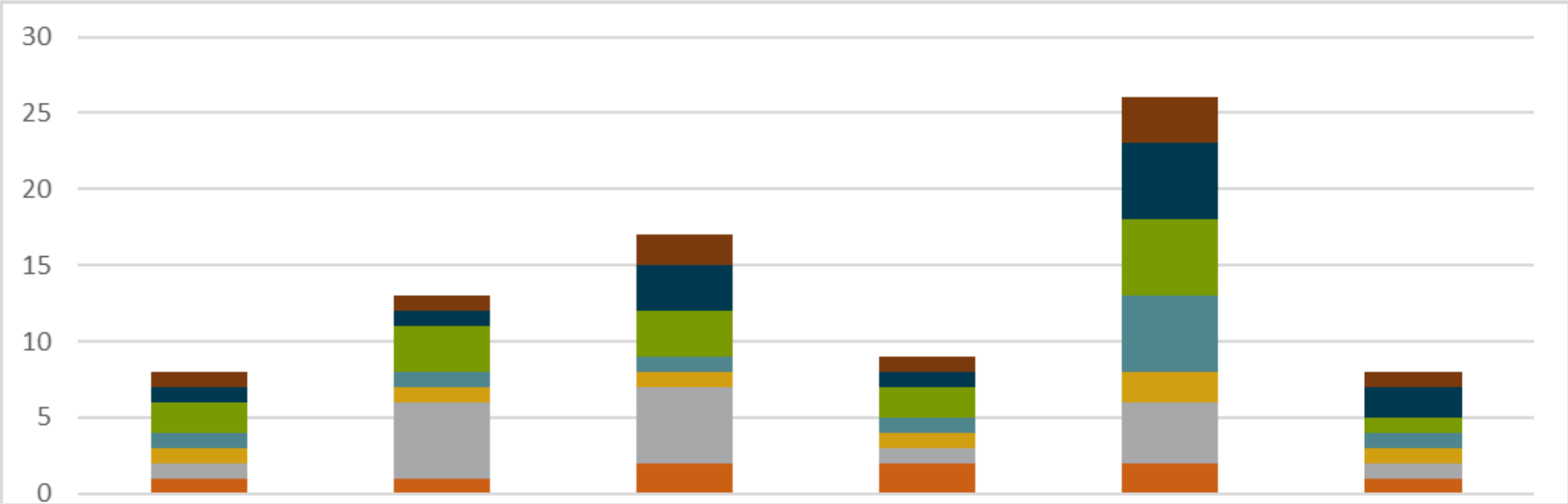
Type Observations Here

Example Analysis

After your final observation, you will need to analyze the results to develop your final conclusion.

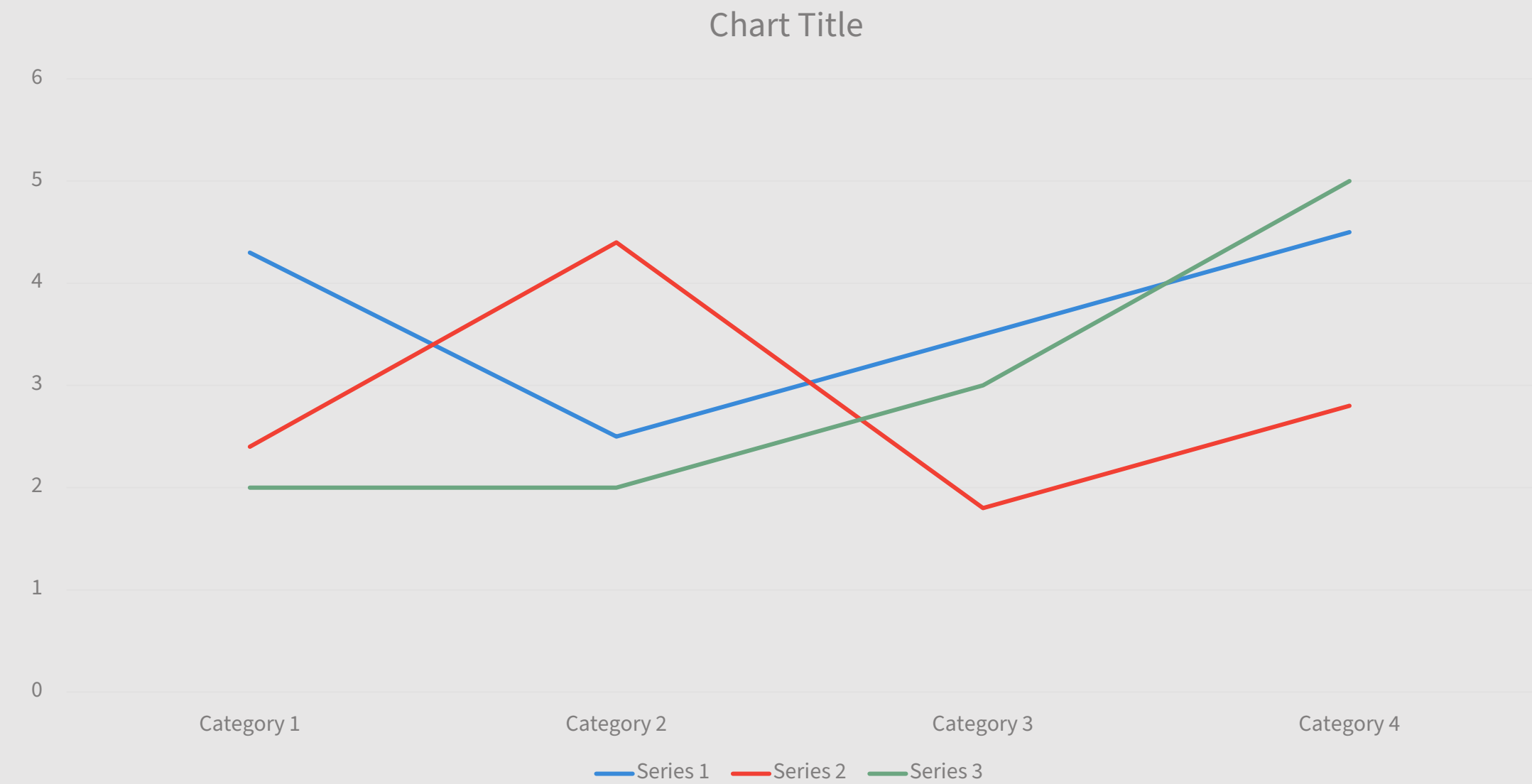
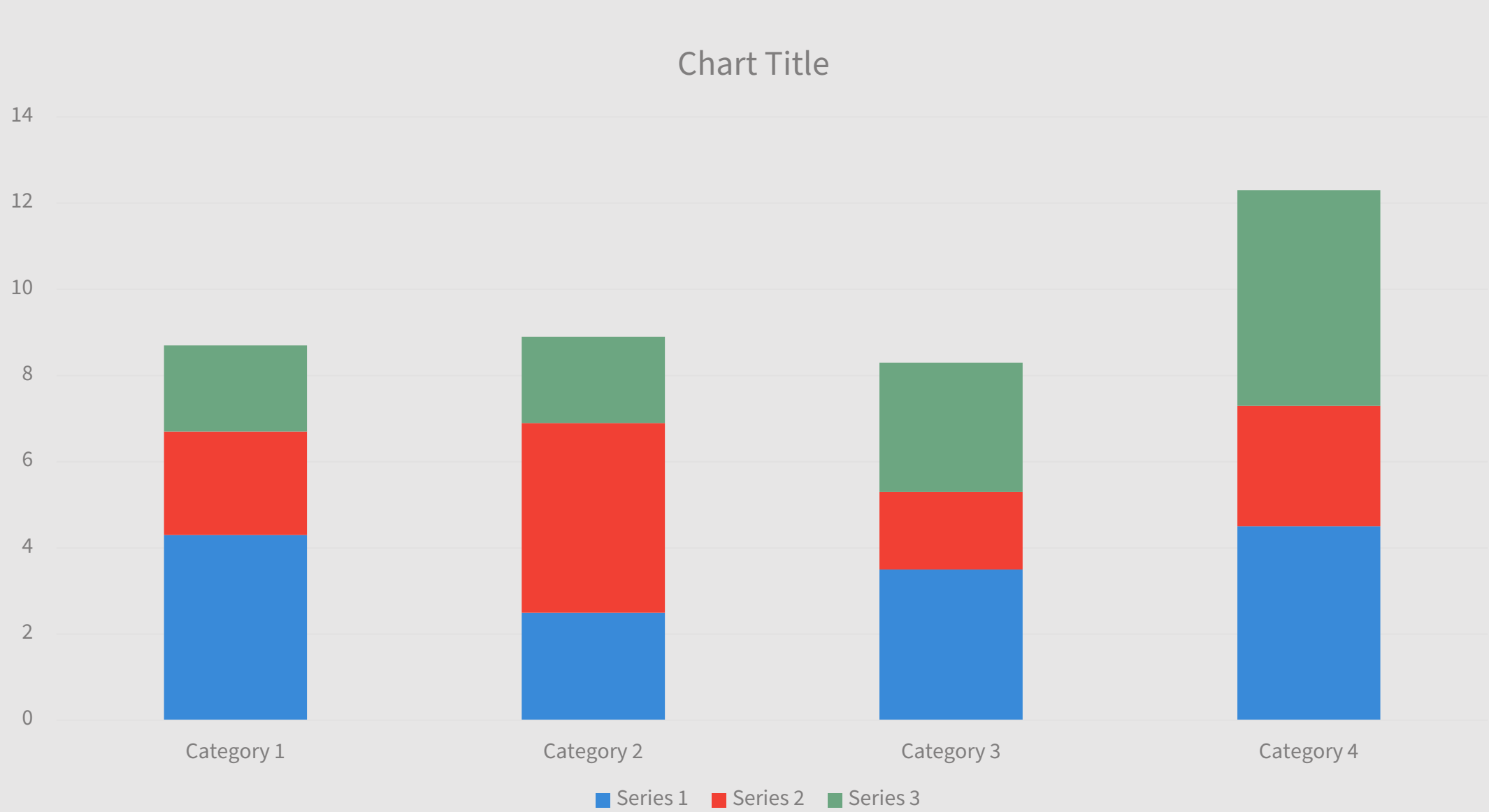
- 1. Develop a rating scale to rank the final conditions of the fasteners against each other. Describe what each value means for your analysis. For example, in a 1 to 5 scale, a 1 would indicate no changes occurred to the fastener or the solution while a 5 would indicate significant rust.
- 2. Use your rating scale to generate charts and graphs depicting your results on the next page (examples below).
- 3. Once complete, answer the questions on page 20 and complete any additional necessary research to fully understand the results.

	Fastener 1	Fastener 2	Fastener 3	Fastener 4	Average
Solution 1	1	2	2	2	1.75
Solution 2	5	5	1	4	3.75
Solution 3	1	1	1	2	1.25
Solution 4	1	3	1	5	2.50
Average	2.00	2.75	2.50	3.25	2.31



Analysis Ranking Charts & Graphs

	Bare	Painted	Galvanized	Bronze/Brass Plated	Average
Spring Water					
Salt Water					
Baking Soda					
Vinegar					
Average					



Analysis Questions

Which combination of fastener and solution showed the greatest amount of oxidation? Why?

a) Type your observations here

Which combination of fastener and solution showed the least amount of oxidation? Why?

a) Type your observations here

Outside of rust/oxidation, what other changes did you observe?

a) Type your observations here

Were there any solutions that caused significantly more or less oxidation? Why or Why Not? What environments could those solutions represent?

a) Type your observations here

Outside of corrosion, what are the benefits and drawbacks of each fastener type?

a) Type your observations here

Optional Questions

What are the key variations between the solutions that fasteners react differently depending on the solution its submerged in?

a) Type your observations here

What are the key variations between fasteners that caused them to react differently in the same solutions?

a) Type your observations here

What was the most surprising reaction? Can you tell why that reaction occurred?

a) Type your observations here

What can happen when a corrosion susceptible metal is used in construction?

a) Type your observations here

Why is it important to consider when it comes to the impact of corrosion in construction?

a) Type your observations here

How would other variations impact your results? Temperatures, Wet/Dry Cycles, Other Metal Substrates, Dissimilar Metals in Contact

a) Type your observations here

Conclusion

WHICH FASTENER COATING PERFORMS BEST?

Type your conclusion here.

Share Your Results

Post a video, picture or description of your results on Social Media for a chance to win an AGA prize!



OFFICE



6881 S Holly Cir, Ste. 108

Centennial, CO 80112

(720) 554-0900

aga@galvanizeit.org

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