



# Which RO/DI Water Heater is Right For Your Application?

## Introduction

Deionized water, referred to as DI Water, has emerged as an indispensable component in process applications. From simple parts washing to pharmaceutical, medical, electronic, and food service applications, the use of deionized water has become imperative to many industries.

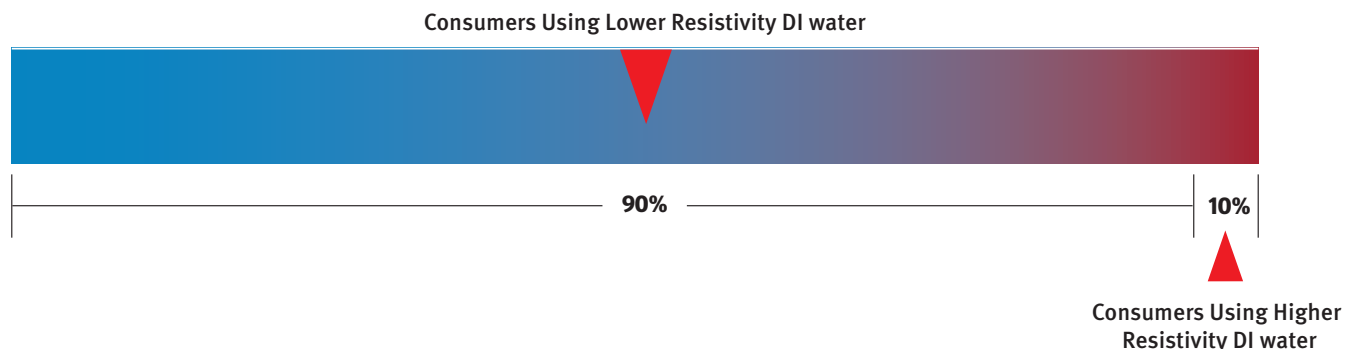
The DI process removes impurities found in our water supply, predominantly calcium, chlorides, iron, magnesium, sodium, hydrogen, copper, aluminum, and other minerals (ions). The deionization process removes these ions from water through ion exchange. Positively charged ions and negatively charged ions are exchanged for hydrogen and hydroxyl ions via a resin bed. The ion exchange process occurs on the binding sites of the resin beds, resulting in the water being diluted of ions and increasing in purity.

## Water Purity

Water can range in purity, from lower resistivity (.05-.8 megohms) to higher resistivity (10-18.2 megohms). The lower the purity of the water, the more easily it conducts electricity because it contains higher amounts of salts and minerals. As a result, the type of water used for a specific task can differ depending on the application. When cleaning medical devices (e.g., implants), or computer semi-conductors (e.g., microchips) the need for water of the highest purity is crucial. The high resistivity of this water means it doesn't leave behind any miniscule particles or debris. These intricate parts would be compromised or could prematurely fail if any residue is left behind.

Water that is ultrapure (highest resistivity) isn't necessary for more mainstream applications such as parts rinsing. Washing car parts and certain humidification systems with water that has a lower resistivity (but is still considered "high purity" compared to tap water) is acceptable because hot high purity water removes contaminants from surfaces better than low purity cold water, making deionized water advantageous for process applications. The parts involved in these applications do not need to be completely devoid of particles, so high purity water with a low-medium resistivity (around 6.7 megohms) is standard for most applications involving parts washing with deionized water.

### DI Water Comparison



## Materials of Construction

### What are Your Options?

Many consumers looking for an RO/DI (Reverse osmosis/deionized) water heater assume they need expensive construction materials such as titanium or Teflon coating, but there are other options that yield the same results. Let's break it down further...



#### Titanium

Titanium is a strong, exotic metal with a low density (light in weight/low concentration) making it a material that is used for a variety of highly specialized applications. When deionized water is heated, it becomes very aggressive and corrosive, but titanium is able to resist any degradation that could occur from coming in contact with this water. This makes it a great solution for applications involving deionized water. But, its lack of abundance and accessibility means it's not readily available to use for mainstream applications. It is a very costly material and it isn't necessary for applications involving low-mid resistivity water. Titanium is a great option for pharmaceutical and microchip applications, but would be an excessive use of technology if used for tasks like parts rinsing and wash downs that don't require high resistivity water.



#### Teflon

Teflon coating is made of a chemical called Polytetrafluoroethylene, a synthetic material that comes in powder and liquid form and coats the internal surface of the tank. It is mainly used to resist rust and corrosion, making it a suitable solution for applications involving deionized water. It seals the internal tank surface by adhering directly to it, stopping the corrosive waters from washing up and into the tank, which can cause debris and particles. But its traits are similar to titanium in that it isn't economical, can be hard to work with, and isn't the best option for mainstream applications. Water heaters used for tasks such as parts rinsing don't need a Teflon coating in order to achieve the purity level that is necessary. Opting for a material such as stainless steel will guarantee top performance without unnecessary expenditures.



#### Cement

The corrosive properties of high resistivity deionized water make cement-lined water heaters an unfavorable option for most deionized water applications. Cement lined tanks contain minerals that will leach out of the cement and into the deionized water, contaminating it while breaking down the lining. When deionized water comes in contact with cement, it easily picks up ions, thus affecting the water's ionic state, decreasing its purity and resistivity.

While these are reasons why you should NOT use a cement-lined vessel for deionized water applications, there are certain situations where a cement-lined water heater can be the ideal option. Deionized water is widely used for flushing contaminants off of parts and in some instances the level of resistivity may not be as critical. When using low resistivity water, a cement-lined tank may be a viable alternative when the cost benefit of a large stainless steel vessel is prohibitive. There are certain formulations of cement that withstand the effects of low resistivity deionized water, making cement an economical and easily obtainable budget alternative.

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### Glass

Glass lined water heaters are one of the most unfavorable options for an RO/DI water heater because of their porous qualities. Glass degrades at a faster rate, leading to unevenness. When this deterioration takes place, it's easier for cracks and nicks to form, resulting in a corrosive environment. But it isn't just the glass that poses a problem. As soon as you opt for a glass lined water heater, you opt for an anode rod as well; the combination is necessary because of the imperfections that naturally occur with glass. Anode rods are used to keep the water in the tank from corroding the carbon steel pressure vessel of the heater. The rod introduces magnesium, zinc and possibly aluminum into the process water. The anode is comprised of a layer of sacrificial metal, so it draws the corrosion towards it, preserving the inside of the tank. Because of this, the rod needs to be monitored for depletion. "Glass goes fast" when utilized for applications involving low resistivity water, and it goes even faster with high resistivity deionized water that has ultra corrosive properties.

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### Stainless Steel

Stainless steel resists corrosion longer than most other metals, making it an excellent material for an RO/DI water heater. The elements that make up stainless steel (chromium, nickel, iron, carbon, aluminum) react with the oxygen from water to form a thin, stable film that consists of metal oxides and hydroxides. The presence of this film prevents additional corrosion by acting as a barrier that limits oxygen and water access to the underlying metal surface. The film forms quickly and tightly, reducing the rate of corrosion to very low levels.

A study performed by NASA on the corrosive effects of metals in deionized water revealed that 300 series stainless steel showed no signs of deterioration after 10+ days of being immersed in deionized water, while other metals like copper and cadmium showed substantial dissolution. This means stainless steel was able to resist the harsh, aggressive qualities of deionized water without breaking down at all because of the chromium oxide barrier that rests on top of the steel. Other common metals and materials can't compete with stainless steel because their elemental composition doesn't react the same way with oxygen and water. These unique traits of stainless steel are what make it one of the best options when choosing an RO/DI water heater for low-medium resistivity water.

While the elemental properties of stainless steel make it a great choice for RO/DI applications, it is also ideal because it is economical and easily accessible. Stainless steel is commonly used in a multitude of everyday applications such as cooking, food production, storage, and architecture. The frequent utilization of stainless steel throughout the world validates its abundance, as well as its cost-effectiveness as a solution to water heating for various applications. Choosing stainless steel continues to be an optimal route for consumers looking for a strong, high quality material that is also very affordable.

## Conclusion

When it comes to the selection of an RO/DI water heater, there are a few materials to consider as well as the application that the water heater will be utilized for. A large percentage (around 90%) of applications utilize lower resistivity water that doesn't need high-grade materials such as titanium and Teflon. What they really need is a simple, efficient and effective water heater that does the job. Most end users fall prey to situations where over-engineering occurs, but proper understanding of the application and minimum requirements will provide end users with significant savings. Stainless steel is one of the best choices in instances such as these because it is an affordable, readily available material that is durable and long lasting.

