Steel, Stainless Steel, High & Super Alloy-
Heat, Wear, Abrasion, Pressure & Corrosion Resistant
Castings, Spares, Replacement Parts, Custom-Made Components
Manufacturer-Supplier to OEM's, Plants, & Process Industry
Machined, Proof-Machined, CNC/VMC Precision Machined Components
Conversion to Castings from Fabrications, Forgings & Welded Assemblies
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5 Good Reasons to Choose Stainless Steel for Deep Well Hand Pumps

Why our cast stainless steel products are better than standard equivalents of wrought alloy AISI type 304 and type 316?

Stainless steels have superior corrosion resistance because they contain relatively large amounts of chromium. Other elements such as, copper, aluminium, silicon, nickel, and molybdenum enhance corrosion resistance in specific environments.

1 Upgraded 18-8 stainless steel imparts superior corrosion resistance to deep well hand pump/pump components as they encounter different forms of corrosion, in extraction of under-ground water application

Our cast stainless steels are slightly modified/upgraded gyrations from the standard alloy specifications to enable the components to withstand aggressive ground water chemistry and rigorous end use application of deep well hand pumps. Our upgraded stainless-steel castings in standard types/grades thus provide economical viable solutions for your application needs and eventually, more value for your money.

Broadly, corrosion can be classified into **eight** unique forms. These forms are:

1. Uniform or general attack
2. Galvanic, or two-metal corrosion
3. Crevice corrosion
4. Pitting
5. Inter-granular corrosion (IGA)
6. Selective leaching, or parting
7. Erosion corrosion
8. Stress corrosion (SCC)

Deep well hand pumps used for extracting underground drinking water across the world depending on the local ground water chemistry encounter one or more forms of corrosion mentioned as below:

General corrosion

- Atmospheric corrosion
- Galvanic corrosion
- General biological corrosion

Localized corrosion

- Crevice corrosion
- Pitting corrosion
- Localized biological corrosion

(Do note that localized biological corrosion often causes or accelerates pitting or crevice corrosion)

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Metallurgically influenced corrosion is mentioned due to the significant role metallurgy (chemical and mechanical metallurgy in particular) plays in these forms of attacks. It is well understood, that metallurgy is important in all forms of corrosion, but this classification here is meant to emphasize its role in the following specific form of attack

- Inter-granular corrosion IGA (carbide precipitation)

Mechanically assisted degradation groups those forms of corrosion that contain a mechanical component, such as velocity, abrasion, and hydrodynamics that has a significant effect on the corrosion behaviour. Corrosion fatigue is included in this category because of the dynamic stress state: however, it could be easily categorized as a form of environmentally induced cracking

- Erosion corrosion
- Fretting corrosion
- Cavitation
- Corrosion fatigue

Environmentally induced cracking

- Stress corrosion cracking (SCC)

Price does play a major role in the buying decisions of public domain deep well hand pumps, as funds and donations are often limited. The buying team often comprises of members having specific individual concerns, but the key dilemma persists whether to buy more for less (cast iron, gunmetal and mild-steel/PVC pump configuration) or to buy less for more (stainless steel pump configuration).

Funds required to pay for water pumps, spares, maintenance and replacement parts often exceeds far beyond supply in Africa, Asia and Latin America. Nevertheless, by using stainless steel the substantial reductions in maintenance, replacement, downtime, and lifecycle costs, which normally follow from specifying the most appropriate composition, microstructure, and quality, needs to be weighed against the extra cost of the higher quality obtained.

Low cost pumps have shorter operating life which after a certain period in service are generally short of replacement parts, lack of maintenance and at times even require a completely new installation or demand major replacement of pump components. This is what several pump performance assessment reports conducted by pump surveying consultants and committees indicate. A broken down handpump does not serve is prime purpose to provide clean and safe drinking water. With countless number of abandoned pumps across the world, it is worth questioning the initial investment that has been made to buy and install-a lower specification, low quality, shorter useful life product for community use. The donors, NGO's, banks like World Bank-Water, Sanitation, Asian Development Bank, African Project Bank etc. funding water projects, and Government; must understand that the cost-of-ownership of quality products and stainless steel is much lower in the long run that compared to pumps that break down fast, demand frequent replacement parts and require high maintenance in public domain or community level service.

2 Greater resistance to pitting corrosion than standard AISI 304 alloy

Our ACI-ASTM A 743 cast equivalent to the wrought alloy type stainless steel grade 304 (18/8), contains intentionally added 0.5 (maximum) molybdenum. Molybdenum imparts some resistance to pitting type of corrosion to the component, which is not present in the standard AISI 304 alloy that is generally available in the market or cast to exacting AISI 304 chemical composition. Although upgrading the alloy adds to the cost of component and difficulty encountered in the metallurgical processes of manufacturing it, yet we do not

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compromise on quality keeping in view its end application. Ground water does contain halogens, carbonates and bicarbonates along with other contaminants even though its pH value is less than 5.0.

It is learned from experience for now more than three decades in deep well hand pump business that our deep well pump parts and cylinder components with up to 0.5% molybdenum in 304 type alloy enhances resistance to pitting corrosion even though when 316 alloy is not used. SS316 is an even costlier alloy than SS304. Today SS304 deep well hand pumps are very few in number compared to the total number of deep well hand pumps installed world-wide.

Water should be free from contamination by corrosion of pump parts or pipe line but stainless steel still remains a costlier material option for developing third world countries but is an affordable option for the advanced and most advanced nations of the world. For saline and brackish waters that have pH value higher than 5.0, SS316 type alloy with higher nickel and chromium content along with 2%-3% molybdenum in it is recommended. For best corrosion resistance of the molybdenum containing grades of our stainless steel, we solution anneal components at temperatures high enough to reduce the molybdenum gradient of the cast structure. Contrarily, at present uPVC has gained prominence to combat corrosion resistant (for pump cylinder and riser main pipe), but it is far from providing long lasting pump life compared to stainless steel.

3 Intelligently heat-treating stainless steels to withstand stress corrosion cracking (SCC)

Our stainless-steel components are provided with necessary heat treatment based on its chemical composition and end use application, so that the final microstructure of the alloy improves the physical and mechanical properties of the part, that further results in maintenance free reliable operating life of the deep well hand pump, apart from providing good corrosion resistance.

We intelligently anneal stainless steel and do not perform full annealing. Since full stress relief of stainless steel requires heating to temperatures that can sensitize stainless steel castings making it susceptible to inter-granular corrosion (IGA). Therefore, stress relief treatments of stainless steel are avoided. If absolutely necessary to meet dimensional tolerances after machining or to meet residual stress targets in highly stressed rotating machinery (like impellers of a high-speed centrifugal pump or turbine blade), it is technically correct that stainless steel castings can be stress relieved. The actual temperature, time at holding temperature, and cooling rate that will give degree of stress relief required vary from alloy to alloy, with the size and complexity of the casting, and keeping in view the required machining to be done. Moreover, annealing is one way to correct a sensitised stainless steel. Hence, our components have higher capability to withstand stress corrosion cracking (SCC).

4 Combating carbide precipitation (sensitisation) and inter-granular corrosion

Sensitization, or carbide precipitation at grain boundaries, can occur when austenitic stainless steels are heated for a period of time in the range about 425°C to 870° C (800°F to 1600°F). Time at temperature will determine the amount of carbide precipitation. When the chromium carbides precipitate in grain boundaries, the area immediately adjacent is depleted in chromium. The carbide formed in conventional austenitic steels is $(Cr, Fe)_{23}C_6$, or $M_{23}C_6$ carbide. When the precipitation is relatively continuous, the depletion renders the stainless steel susceptible to inter-granular corrosion (IGA), which is the dissolution of the low-chromium layer or envelope surrounding each grain. Sensitization also lowers resistance to other forms corrosion such as pitting, crevice corrosion and stress-corrosion cracking (SCC).

Material science and metallurgy has made remarkable advancements over the last three decades that has helped mankind to tackle many tougher problems in engineering for the benefit of people. One significant method developed and used by metallurgists' worldwide today to avoid sensitisation of stainless steels is to stabilize the carbide structure. Stabilized stainless steels contain titanium and /or niobium/columbium and, if required, tantalum can be used to stabilize the carbide in the alloy microstructure.

Our corrosion resistant stainless steels SS304 and SS316 with titanium or niobium/ columbium stabilized microstructure enhances the components capability to not only combat but also to prevent grain segregation during welding of the parts in attempt to make the desired component assemblies. The standard alloy SS304 and SS316 is susceptible to failure due to grain segregation (sensitization) upon welding, as the precipitation of chromium takes place from the carbide structure that is present at the grain boundaries of the alloy microstructure. Niobium/Columbium, Titanium and tantalum have strong affinity for carbon and form carbides readily that are highly stable even at elevated temperatures. This allows the chromium to retain in solution, even for extremely long exposures to temperatures in the sensitising range during welding or even full annealing (if required).

5 Very good weld-ability due to stabilization of alloy microstructure with Titanium and Niobium

Our corrosion resistant stainless steels are stabilized by titanium and/or niobium/columbium to provide excellent weld ability and enable us to successfully manufacture the desired assembly with AISI type 304 and 316 alloy parts/pipes.

It is a common practice to repair weld defects in castings, following correct welding standards and procedures that comply with a particular alloy standard specification. But welding is often a subject of misunderstandings and problems. The myth that castings are not weld able or castings with welding are inferior is not true. It would be an inappropriate vacuous statement to make, without having in-depth understanding of welding as a manufacturing process. We employ excellent base alloy compatible filler materials, high purity argon and follow good welding practice based on correct-welding method, welding standard (AWS) and weld procedures. If required for weld corrections of our cast components, we use reputed make welding electrodes, TIG fillers and consumables. We use the same to fabricate our welded assembled parts/ components.