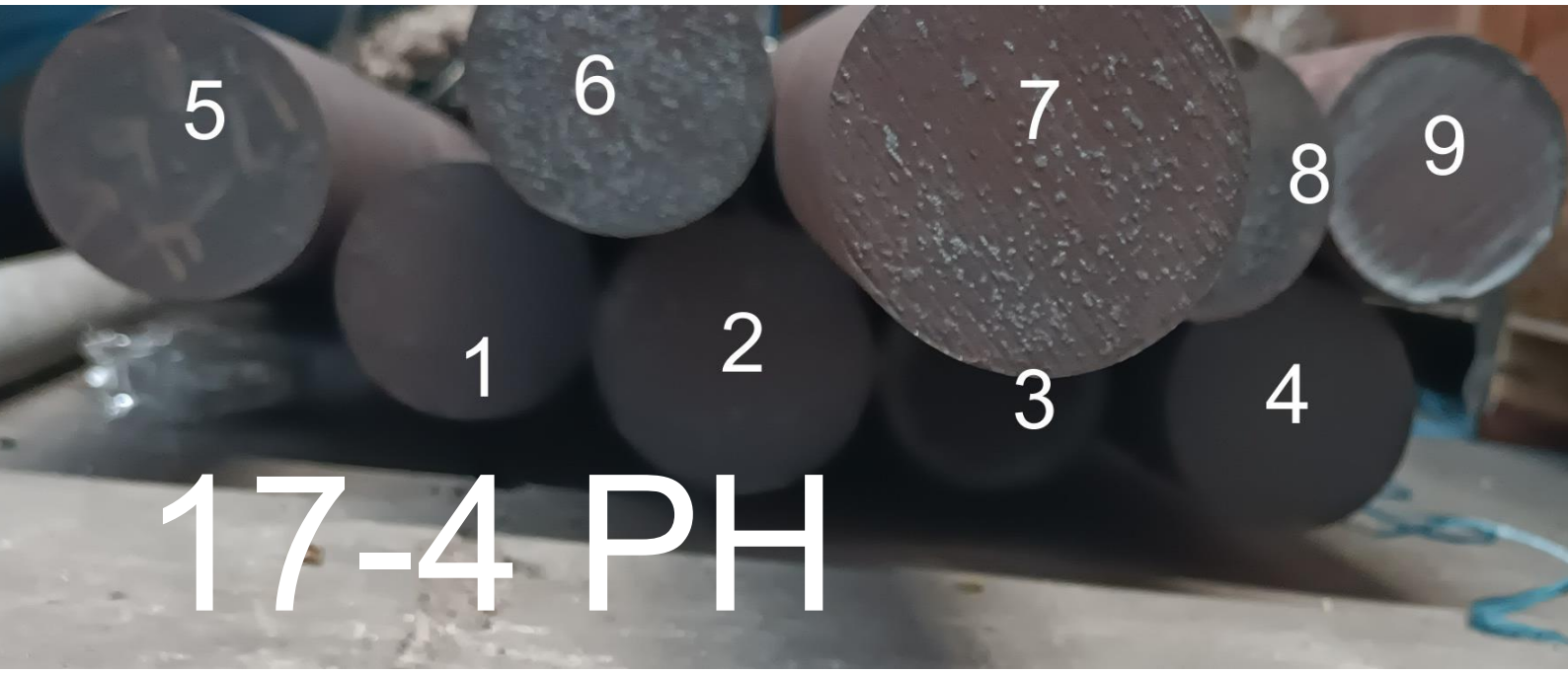
List of Core values

Professional, Reliable, Efficient



17-4PH is a precipitation hardened (PH) martensitic stainless steel consisted of copper and niobium/tantalum. This grade features high strength, hardness and corrosion resistance. Its mechanical properties can be optimized by heat treatment with the compression strength achieving up to 1100-1300mpa (160-190ksi). Due to low carbon content, it features better workability, corrosion resistance and weldability than Martensitic Stainless Steels such as Cr13 and 9Cr18 and 1Cr17Ni2.

Features

17-4PH alloy features excellent corrosion resistance, superior to any other harden able stainless steel. In most cases, it has as good corrosion resistance as type 304. Despite this, stress corrosion can happen under a high-strength state; if there is a risk of stress corrosion cracking, it will be necessary to adjust the stabilization temperature. The alloy 17-4PH is susceptible to corrosion or crack corrosion in static seawater. However, in the petrochemical, food processing and paper industries, its corrosion resistance matches grade 304L.

17-4PH embodies the advantages of austenitic steel after solution treatment and is easy to work with. It can obtain high strength through intermediate pressure treatment and aging treatment, so it is widely used in pressure vessels, aircraft and steam turbine blades. It is mainly used for these parts because they are either in contact with the medium or highly stressed. For example, if the impeller is in direct contact with the medium, it poses high requirements on the corrosion resistance of the material used. Since the shaft must drive the rotor components such as the impeller to rotate together, it is subject to large force, requiring very good strength and toughness to operate. The mechanical properties required for its materials, hence, must be very good. That’s how 17-4PH comes into play as its corrosion resistance and mechanical properties meet these two requirements.

Applications

17-4PH is a widely-used martensitic precipitation-hardening stainless steel with a high concentration of chromium and nickel. It has many favorable properties, including excellent strength, good corrosion resistance, and excellent mechanical properties up to 600 °F (316 °C).

- Aerospace — structural and parts
- Biomedical — hand tools
- Chemical Processing
- Food Process Equipment
- Gate Valves

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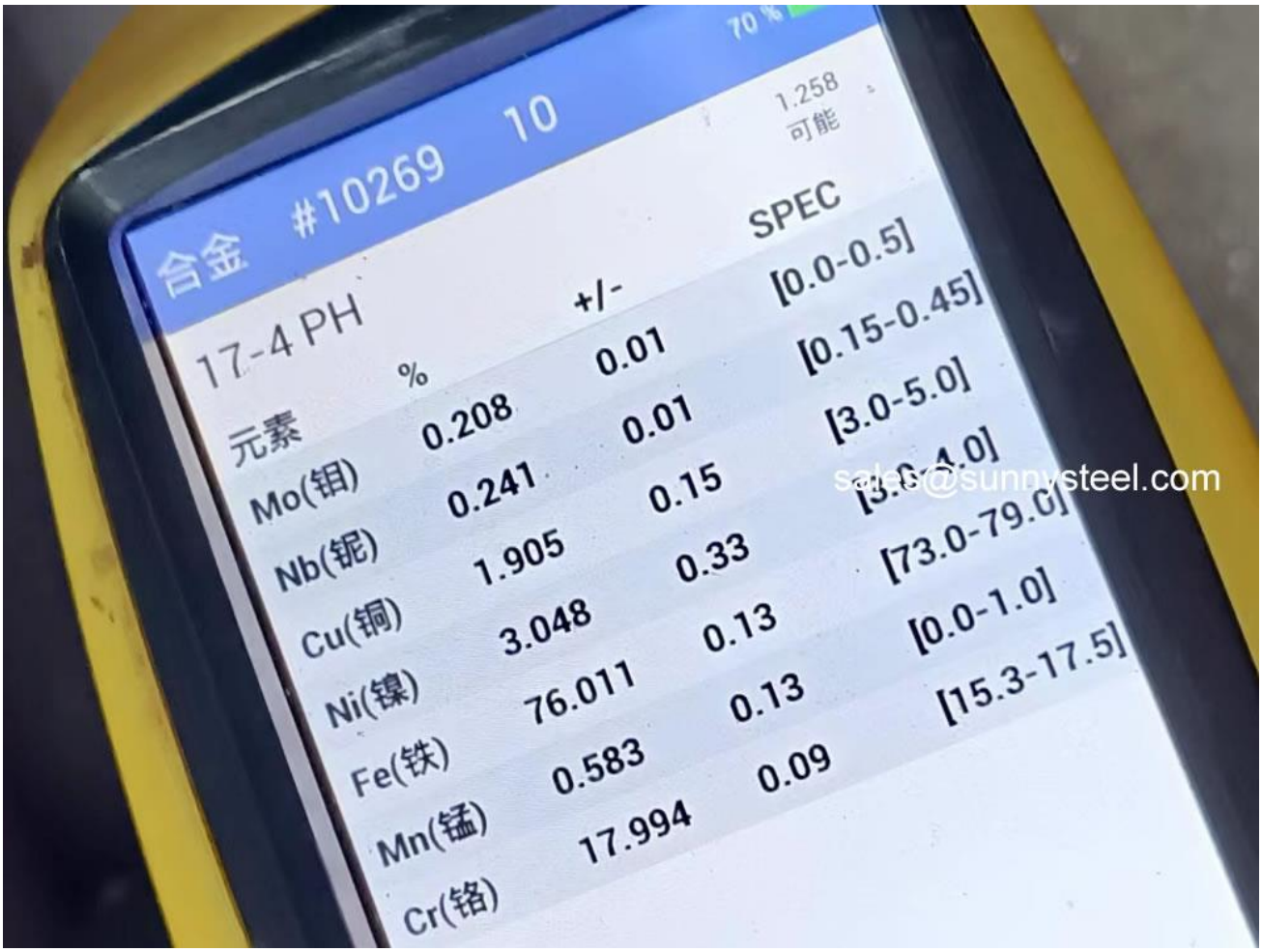
- Mechanical Components
- Nuclear Waste Processing and Storage
- Oil and Gas Production — foils, helicopter deck platforms, etc.
- Pulp and Paper — paper mill equipment

17-4PH finds use in various industries. Typical parts include mechanical seals, oil patch, and pump shafts.



Sunny Steel offers Stainless Steel 17-4PH in two sub-type specifications and

multiple shapes/forms:

- AMS 5604 (Plate, Sheet, and Strip)
- AMS 5643 (Bar, Forging, Ring, Tubing, and Wire)

Furthermore, the alloy also finds use in the aerospace industry, petroleum industry, and chemical industry, food processing equipment, paper and pulp industry, nuclear waste processing and storage, and general metalworking.

Chemical composition of 17-4PH

Element	Min (%)	Max (%)
Carbon, C	–	0.07
Manganese, Mn	–	1
Silicon, Si	–	1
Sulfur, S	–	0.03
Phosphorus, P	–	0.04
Chromium, Cr	15	17.5
Niobium + Tantalum, Nb + Ta	0.15	0.45
Nickel, Ni	3	5
Copper, Cu	3	5
Iron, Fe	–	*Balance

*Not exclusively to the element mentioned, but that one predominates other elements that are used in smaller quantities.

Fabrication and working instructions

Stainless Steel 17-4PH reacts best to hot forming at 1742 to 2192 °F (950 to 1200 °C), with annealing at 76 °F (25 °C) and aging. The alloy can also be cold-formed in limited form, primarily to plates in the annealed condition. However, stress corrosion resistance can be improved with re-aging.

Furthermore, 17-4PH can be cut using mechanical operations, such as abrasive waterjets, machining, bandsaw, and shearing. However, plasma cutting isn’t recommended on this alloy.

17-4PH has the best welding characteristics of competing stainless steel alloys. Moreover, it can be welded using all standard techniques, including gas tungsten arc, gas metal arc, shielded metal arc, and plasma arc. To achieve desired mechanical properties, pre-weld and post-weld heat treatments are recommended. For the best results, we recommend the AMS 5643 wire.

Physical properties of 17-4PH

Property	Imperial	Metric
Melting Range	2560-2625 °F	1404-1440 °C
Specific Heat	0.11 Btu/lb.-°F	460 Joules/gg-K
Specific Density	0.282 lb/in3	7.8 g/cm3
Electrical Resistivity	38.6 μΩ in	98 μΩ cm
Linear Coefficient of Thermal Expansion (70 °F to 200 °F) (21 °C to 93 °C)	6 [in/in/°F·106]	10.8 [μm/m·°C]
Linear Coefficient of Thermal Expansion (70 °F to 400 °F) (21 °C to 204 °C)	6 [in/in/°F·106]	10.8 [μm/m·°C]
Linear Coefficient of Thermal Expansion (70 °F to 600 °F) (27 °C to 316 °C)	6.2 [in/in/°F·106]	11.2 [μm/m·°C]
Linear Coefficient of Thermal Expansion (70 °F to 800 °F) (21 °C to 427 °C)	6.3 [in/in/°F·106]	11.2 [μm/m·°C]
Thermal Conductivity (@ 300 °F) (@ 149 °C)	124 Btu/(hr/ft^2/in/°F)	17.9 [W/m-K]
Thermal Conductivity (@ 500 °F) (@ 260 °C)	135 Btu/(hr/ft^2/in/°F)	19.5 [W/m-K]
Thermal Conductivity (@ 860 °F) (@ 460 °C)	156 Btu/(hr/ft^2/in/°F)	22.5 [W/m-K]
Thermal Conductivity (@ 900 °F) (@ 482 °C)	157 Btu/(hr/ft^2/in/°F)	22.6 [W/m-K]
Poisson's Ratio (H900 Condition)	0.272	0.272
Modulus of Elasticity (H900 Condition)	28 x 106ksi	197 x 103 MPa
Modulus of Rigidity in Torsion	9.68 x 103ksi	67 x 103 MPa

Condition	Temperature [± 15 °F (± 8.4 °C)]	Cooling Method and Duration
H 900	900 °F (482 °C)	Air cooling for 1 hour
H 925	925 °F (496 °C)	Air cooling for 4 hours
H 1025	1025 °F (551 °C)	Air cooling for 4 hours
H 1075	1075 °F (580 °C)	Air cooling for 4 hours
H 1100	1100 °F (593 °C)	Air cooling for 4 hours
H 1150	1150 °F (621 °C)	Air cooling for 4 hours
H 1150 + 1150	1150 °F (621 °C)	Air cooling for 4 hours
	followed by	followed by
	1150 °F (621 °C)	Air cooling for 4 hours
H 1150-M	1400 °F (760 °C)	Air cooling for 2 hours
	followed by	followed by
	1150 °F (621 °C)	Air cooling for 4 hours

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Fabrication data

Alloy 17-4PH can be easily welded and processed by standard shop fabrication practices. It is magnetic. Alloy 17-4PH is provided in the solution-annealed condition (Condition A). Mechanical properties may be altered by subsequent age hardening treatments. These aging treatments are referred to as Conditions H900, H1025, H1075, H1150, H1150M and H1150D. The processes are outlined in Table 2 below. The resultant mechanical properties appear above in Table 1.

Cold Forming

Alloy 17-4PH has limited cold forming properties. Cold forming can only be undertaken on plates in the fully annealed condition. Stress corrosion resistance is enhanced by re-aging at the precipitation hardening temperature after cold working.

Hot Forming

Heat uniformly at 1742 – 2192°F (950 – 1200°C). A full solution anneal, cooling lower than 76°F (25°C) and aging at the required temperature must occur after hot forming. The post forming heat treatment should be a function of the desired mechanical properties.

Machining

Alloy 17-4PH can be machined in both the solution treated and precipitation hardened conditions. Machining characteristics may vary according to the hardness of the metal. High speed tools are acceptable, but carbide tools are preferred. Standard lubrication should be used. Dimensional changes as a result heat treatment should be taken into account if very stringent tolerances are required.

Cutting

Thermal cutting operations such as plasma cutting should be avoided.

Mechanical cutting operations such as bandsaw, abrasive waterjet, shearing and machining are preferred.

Welding

Alloy 17-4PH can be readily welded by most standard processes including SMAW, GTAW, PAW and GMAW.

Heat Treatment

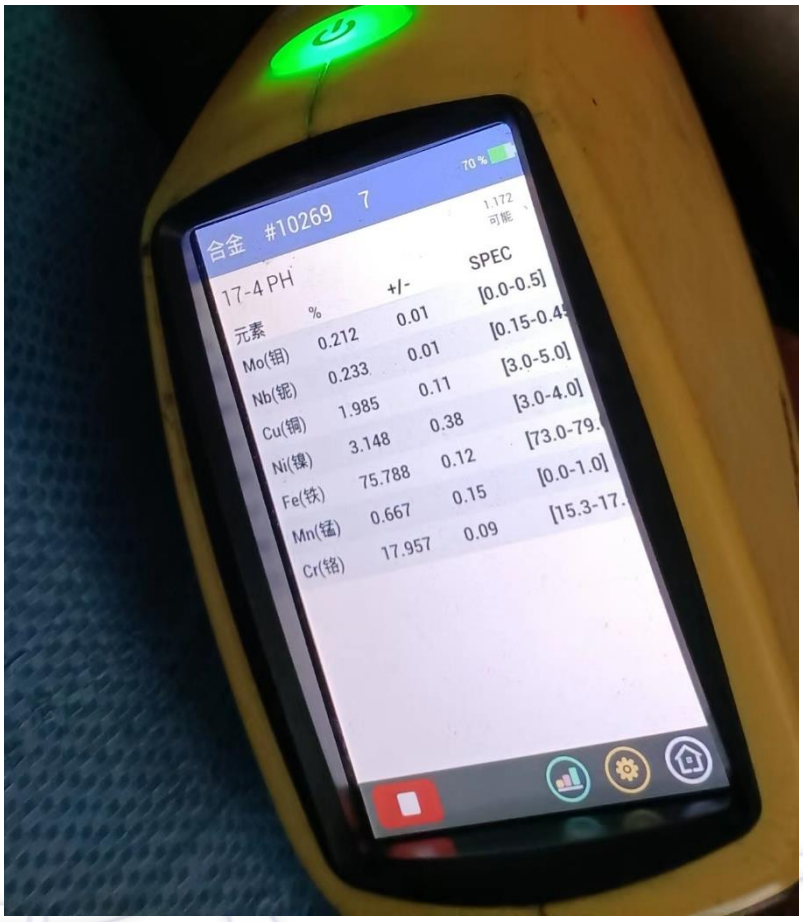
Stainless Steel 17-4PH is available in the solution annealed condition at 1900 °F (1038 °C) and then air-cooled to 90 °F (32 °C). However, additional heat treatments can produce various hardness and toughness levels. The most common treatments are listed in the table below.

Condition	Temperature [± 15 °F (± 8.4 °C)]	Cooling Method and Duration
H 900	900 °F (482 °C)	Air cooling for 1 hour
H 925	925 °F (496 °C)	Air cooling for 4 hours
H 1025	1025 °F (551 °C)	Air cooling for 4 hours
H 1075	1075 °F (580 °C)	Air cooling for 4 hours
H 1100	1100 °F (593 °C)	Air cooling for 4 hours
H 1150	1150 °F (621 °C)	Air cooling for 4 hours
H 1150 + 1150	1150 °F (621 °C)	Air cooling for 4 hours
	followed by	followed by
	1150 °F (621 °C)	Air cooling for 4 hours
H 1150-M	1400 °F (760 °C)	Air cooling for 2 hours
	followed by	followed by
	1150 °F (621 °C)	Air cooling for 4 hours

Select AMS number of 17-4 PH

AMS Number	Alloy	Type	UNS	Cross Ref. Spec	Misc./Shape
AMS 5604	17-4PH	Stainless Steel	S17400		
AMS 5604 Plate	17-4PH	Stainless Steel	S17400	-	Plate
AMS 5604 Sheet	17-4PH	Stainless Steel	S17400	-	Sheet
AMS 5604 Strip	17-4PH	Stainless Steel	S17400	-	Strip
AMS 5643	17-4PH	Stainless Steel	S17400		
AMS 5643 Bar	17-4PH	Stainless Steel	S17400	-	Bar
AMS 5643 Forging	17-4PH	Stainless Steel	S17400	-	Forging
AMS 5643 Ring	17-4PH	Stainless Steel	S17400	-	Ring
AMS 5643 Tubing	17-4PH	Stainless Steel	S17400	-	Tubing
AMS 5643 Wire	17-4PH	Stainless Steel	S17400	-	Wire

7 Things You Should Know About 17-4 PH Stainless Steel



The discovery of metals has resulted in the production of many products that are part and parcel of our daily lives. Metals are used in manufacturing items such as an ordinary saucepan to space-going vessels. Individual metals tend to have certain characteristics and properties. Certain components need elements with particular properties. When a metal is unable to be suited to a particular application, it is combined with one or more elements resulting in an alloy.

Stainless steel is an example of a common alloy used in the fabrication of many products. To further strengthen the stainless steel, they are subjected to heat treatments which result in the precipitation hardening stainless steel material. One of the most used types of PH stainless steel is 17-4 PH stainless steel.

There are many things that you probably did not know about the alloy? Take heart, though. You will be amazed by how much you did not know about the most commonly used types of stainless steel. The following are seven things that you probably did not know about type 17-4 PH stainless steel:

Most Common Type of Precipitated Hardening Stainless Steel

PH stainless steels are a group of alloys that are resistant to the effects of corrosion. To increase their yield strength, these alloys are subjected to heat treatment during precipitation hardening (PH) or age hardening.

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You must be wondering what all these terminologies mean. Usually, PH alloys are kept at elevated temperatures for an extended time frame. This allows precipitation to take place.

Hopefully, you remember your elementary science classes at this point. This aging or time-delayed technique tends to significantly increase the alloys yield strength.

During PH-treating, certain “impure” particles are added to the stainless steel. Such particles include elements such as molybdenum, copper, titanium or aluminum, either in combination or singly.

There are three main types of PH stainless steel, namely:

1. Low Carbon Martensitic
2. Semi-Austenitic
3. Austenitic

Type 17-4 PH stainless steel is the most common type of martensitic PH stainless steel. At low temperatures of 250 degrees Centigrade, the martensitic alloy transforms to martensite. Martensite is basically a steel crystalline structure that is hard.

The stainless steel alloy can harden further by aging at temperatures ranging between 480-620 degrees Centigrade. The combination of the alloy’s superior properties allows it to increase product reliability while making fabrication simple and cost effective. Type 17-4 PH stainless steel has applications in industries like

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paper, petrochemical, aerospace and food processing. It is widely used in various general metalwork applications.

Use in Marine Vessels: Great Resistance to Effects of Corrosion

The alloy has superior resistance to corrosion and has high mechanical strength. This enables it to be used in marine applications. The fact that it is resistant to corrosion enables it to survive exposure to salty sea water.

You should know that one of the elements that confer the alloy with high resistance is chromium. Type 17-4 PH stainless steel contains between 15-17.5% of chromium in its composition. In this regard, a seagoing vessel's pump and valve parts are made of type 17-4 PH stainless steel.

Most of the parts of that ship that you went on that annual cruise are made from type 17-4 PH stainless steel. Most of the process piping, seawater piping, and heat exchangers are made of the alloy.

Use of Type 17-4 PH Stainless Steel in Nuclear Industries

Did you know that the alloy has been used in the nuclear power generation industry? Well, what usually happens during nuclear power generation is there is the use of fuel during the process. The used fuel should be given some time to cool and be stored. Used or spent fuel from nuclear power generation is stored in a dry cask.

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The dry cask is usually fabricated using type 17-4 PH stainless steel. The spent fuel in the cask has an inert gas surrounding layer. The steel cylinder cask is usually butted or welded closed. The great welding characteristics of the alloy allow this to be possible.

This design of the dry cask using type 17-4 PH stainless steel ensures that the radioactive spent fuel is in a safe storage design that is 100% leak proof. To ensure that there is adequate radiation shielding for you, in case you work in such a plant, reinforcement is achieved using extra steel, concrete or other material.

Use in Pulp and Paper Industries

To increase its strength during PH treatment, some elements are added to the stainless steel. The composition of type 17-4 PH stainless steel is as follows:

1. Carbon-0.07%
2. Manganese-1.00%
3. Sulphur-0.03%
4. Tantalum and Colombium-0.15-0.45%
5. Chromium-15-17.50%
6. Silicon-1.00%
7. Nickel-3.00-5.00%
8. Copper-3.00-5.00%

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As a result of its composition and depending on the temperature, the alloys are able to develop various properties.The versatility of the alloy makes it quite popular in industries like the pulp and paper. In the past, you may have noticed that paper mills were made of materials such as carbon steel, bronze, and granite. Well, not anymore.

In the manufacture of paper, batch digesters are important pieces of equipment. What batch digesters do is they manufacture solid pulp products. The paper that you use every day to write on is then made from these pulp products. In the past, bulk digesters in the pulp and paper industry required plants to shut down at least every 18 months for routine maintenance. Currently, such bulk digesters are made of stainless steel.

You will find that stainless steel bulk digesters are much thinner than their carbon steel counterparts. This is because type 17-4 PH stainless steel has a higher yield pressure than carbon steel.

Corrosion of carbon steel digesters has been a perennial design problem. The use of type 17-4 PH stainless steel, which has a high resistance to corrosion, has been of great significant value in the paper industry. As you can see, this also reduces costs because the equipment will not succumb to the effects of corrosion and breakdown.

Turbine Blade Design

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The next time you see a gas or windmill turbine at work, try and remember that it works because of the use of type 17-4 PH stainless steel in its construction.

In case you are familiar with the design of a turbine, then you are familiar with a combustor. If not, a combustor produces gas at a high pressure and temperature. It is the turbine blades that extract the energy that you need from these gasses.

As you can see, the turbine blade material should be able to withstand the harsh conditions of high heat and pressure. In the past, one of the common causes of failure in turbine blades was a stress material failure and fatigue.

Current turbine blade design makes use of super-alloys like type 17-4 PH stainless steel. The fact that the alloy has a high resistance and is able to keep its strength under adverse conditions like high temperatures makes it an ideal choice in turbine blade design.

Most plane engine manufacturers like Pratt and Whitney or Rolls Royce make use of the alloy when designing the turbine blades for their massive engine.

Food Processing Equipment

In case you work in the food and beverage industry, then you should know that most of the equipment that you use is made from stainless steel. The type 17-4 PH stainless steel is used in equipment for the processing and manufacture of foods and beverages.

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The fact that the alloy has a good surface condition and great finish makes it an ideal choice. The alloy's smooth surface and high chromium content make it less prone to corrosion and makes it easy to clean as hygiene is an integral element of food and beverage manufacture.

Type 17-4 PH Stainless Steel in the Oil and Gas Industry

Did you know that the alloy is a significant part of the oil and gas industry? There are two main reasons why the alloy is used:

First, Oil is usually obtained at great depths, below sea level. Such depths are associated with high pressure. The high strength of type 17-4 PH stainless steel makes it a great construction material for piping at such depths.

Second, Type 17-4 PH alloy is resistant to corrosion both on and offshore. Its resistance to corrosive media like hydrogen sulfide gas, carbon dioxide and low pH levels in oil prospecting conditions makes it the material of choice for oil rigs and pipes.

Conclusion

It is quite evident that type 17-4 PH stainless steel is the most used type of PH stainless steel. It has an ideal combination of corrosion resistance, good mechanical properties at high temperatures and high yield strength. This combination makes it a suitable alloy for many applications. Its superior

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properties and cost effectiveness makes it the best, most used type of stainless steel.

17-4 PH Stainless Steel

17-4 PH Stainless Steel is a precipitation hardening martensitic stainless steel. Typical usage is seen in applications requiring high strength and a modest level of corrosion resistance. Strength and toughness desired can be manipulated by temperate range in the heat treatment process.

What is 17-4 PH

17-4PH is a martensitic precipitationhardenable Cr-Ni-Cu-steel possessing high strength and toughness. It provides an outstanding combination of good corrosion resistance and good mechanical properties at temperatures up to 320 °C. This versatile material is widely used in the aerospace, chemical, petrochemical, and general metalworking industries. The good mechanical characteristic values of stainless steel make it suitable for heavy-strain applications, thanks to its high wear resistance.

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