

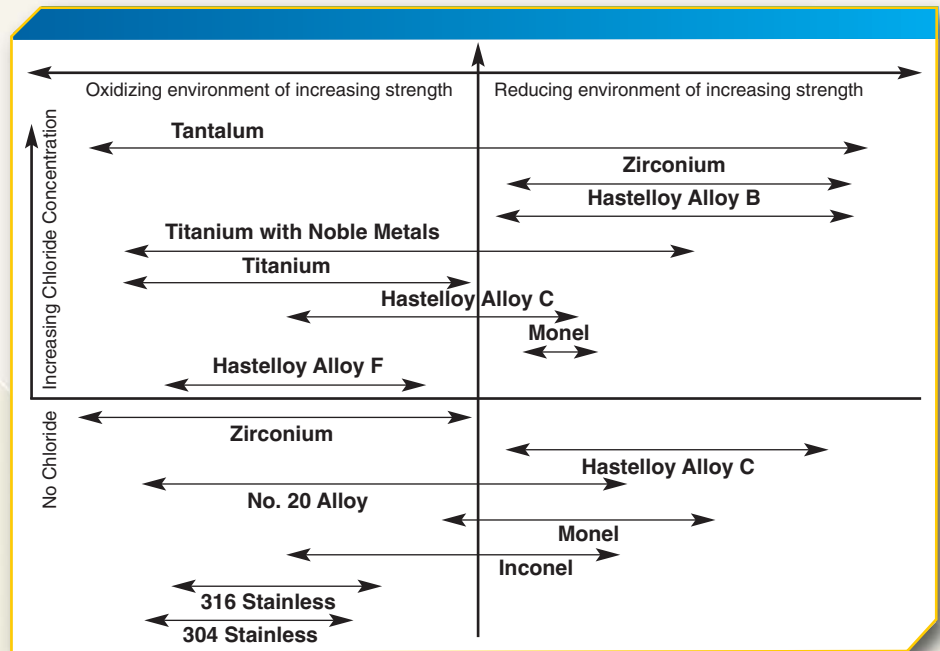


Titanium and Zirconium Rammed Graphite Castings for Defense

Allegheny Technologies (ATI), Albany, Oregon plant built the world's first titanium foundry in 1957. Today ATI is still the world leader in rammed-graphite titanium and zirconium castings.

CORROSION-RESISTANT

Both titanium and zirconium are unusually resistant to corrosive attack and virtually immune to many oxidizing and reducing environments. This is due primarily to a tenacious oxide film that is formed when titanium and zirconium are exposed to the atmospheres. By combining titanium with small amounts of palladium or molybdenum and nickel, its corrosion-resistant properties can be expanded.



SPECIFYING When to specify:

Titanium is ideally suited for the following environments:

- Desert/Sand
- Sea Water
- Fresh Water
- Wet Chlorine Gas
- Chlorine Rich Solutions
- Nitric Acid
- Calcium Chloride
- Hypochlorous Acid
- Hypochlorites

In these destructive environments, titanium will usually last many times longer than steel. Often, titanium also proves more economical than steel on a life cycle basis.

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Rammed Graphite Castings

Since some of the early titanium castings have yet to be replaced, there is no way to know just how long they may last. Zirconium performs especially well in the following environments:

- Hydrochloric acid
- Sulfuric acid
- Caustics
- Organics and Organic acids
- Nitric acid
- Acetic acid
- Formic acid

Since most corrosive environments are not covered by simple cases, testing is recommended. ATI Defense maintains a complete test laboratory to assist you in corrosion testing and material selection.

ATI Defense Castings Available:

Titanium, zirconium and their alloys are cast centrifugally or static depending upon shape and size.

TOLERANCES

Dimensional Tolerances:

Minimum section thickness: 3/16 inch; 1/8 inch if less than 1 inch in any 1 square inch.

Base Tolerances:

- Up to one linear inch $\pm 1/32$ inch
- 1 inch up to 10 inches $\pm 1/16$ inch
- 10 inches up to 20 inches $\pm 1/8$ inch
- 20 inches up to 60 inches $\pm 3/16$ inch

Added tolerance for dimensions across the parting line: $\pm 1/8$ inch

Added tolerance for dimensions across the parting line and parallel to the parting line (mismatch):

- $\pm 1/16$ inch less than 10 inch
- $\pm 1/8$ inch 10 inch and above

TYPICAL PRODUCT APPLICATIONS

- Defense Structural Components
- Marine Hardware
- Seaballs (for oceangoing submarine valves)
- Impellers
- Pump Sets
- Hydrofoil Components
- Final Machined Parts
- Near Net Shape Parts
- Anodes
- Agitators and Mixers
- Special Purpose Equipment

SPECIALIZED PRODUCT APPLICATIONS

U.S. Army P900 Perforated Cast Plate:

- Thickness ~ 0.625"
- Dimensions ~ 15"x17"
- Web Wall Thickness ~ 0.1875
- Cast From ATI 425®-MIL Titanium

Thickness, dimension and web wall thickness adhere to ARL P900 pattern specifications. Tolerances outside of the ARL specification will be evaluated on a per customer basis.

DESCRIPTION

Radium Dimensions:

Patterns constructed by ATI Defense will typically have:

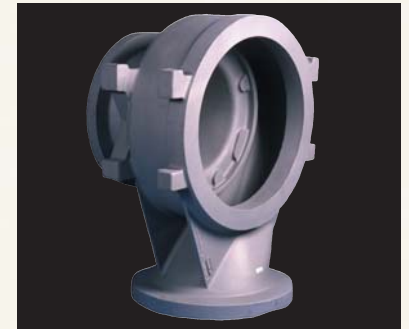
- Sharp to 1/8 inch radius + 1/32 inch
- 1/2 inch fillet radius + 1/32 inch

Finish Stock:

3/16-1/4 inch on all machined surfaces



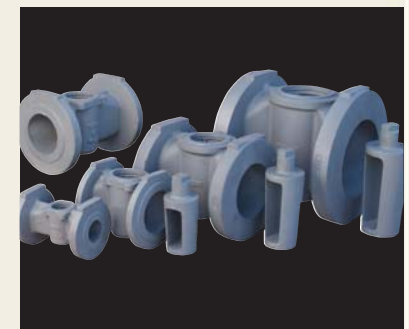
Titanium and Zirconium Cast Impellers



Titanium Cast Pump Casing



Zirconium Cast Pump Casings



Titanium or Zirconium Cast Valves

Rammed Graphite Castings

Maximum Weights:

ATI Defense castings are produced over a weight range of 1 lb. to 1,300 lbs. in titanium. Zirconium castings can be produced in any size up to 1,800 lbs. Larger castings can be produced by fabricating several castings into a single component.

*In certain configurations casting weights in excess of this figure are possible but must be evaluated on a case-by-case basis.

Pattern Equipment:

Standard loose or match-plate patterns, either wood or metal. Standard core boxes except those designed for core blowing only. Most patterns for ferrous and nickel based alloy conform dimensionally. Pattern modifications or new construction can be accommodated through a state-of-the-art pattern shop. Generally, pattern equipment designed for sand casting processes can be utilized with modifications to gating and riser systems.

Properties of ATI Defense Castings						
	Commercially Pure Titanium ASTM B367-93 OMC 105 GR C3	Palladium Stabilized Titanium ASTM B367-93 OMC 105 GR TiPd8A	ATI 64-MIL™ Titanium ASTM B367-93 OMC 105 GR C5	Commercially Pure Zirconium ASTM B752-97 ASTM B752-97	Ti-12 Grade 12	Zirconium ASTM B752-97 OMC 302 GR 705C
Carbon (max.)	0.10	0.10	0.10	0.10	0.10	0.1
Hydrogen (max.)	0.0150	0.0150	0.0150	0.005	0.015	0.005
Nitrogen (max.)	0.05	0.05	0.05	0.03	0.05	0.03
Oxygen (max.)	0.40	0.40	0.40	0.25	0.40	0.3
Iron (max.)	0.25	0.25	0.25	0.30	0.30	0.3
Aluminum (max.)	–	–	5.5-6.75	–	–	–
Vanadium (max.)	–	–	3.5-4.5	–	–	–
Palladium (min.)	–	0.12	–	–	–	–
Others (max.)	0.40	0.40	0.40	0.40	0.40	0.40
Tensile Strength (min.)	65 ksi	65 ksi	130 ksi	55 ksi	80 ksi	70 ksi
Yield Strength (min.)	55 ksi	55 ksi	120 ksi	40 ksi	50 ksi	50 ksi
Elongation (min.)	12%	12%	6%	12%	10%	12%
Brinell Hardness	235	235	365	210	235	235

Other common grades: C-2 and C-7B

PROPERTIES OF ATI DEFENSE CASTINGS AND CASTING DIMENSIONS

Class I: Casting dimensions are a product of the customer supplied pattern. No dimensional inspection of the pattern or the casting is performed.

Class II: Dimensional inspection of the customer supplied pattern is performed. Recommended pattern modifications are quoted as necessary to ensure the casting produced by the pattern will result in a dimensionally acceptable casting based on customer supplied drawing requirements.

Class III: ATI Defense will quote and provide the pattern equipment and inspect to ensure the castings produced by the pattern will be dimensionally acceptable based on customer supplied drawing requirements. A first article casting layout will be performed on the initial casting from this pattern.

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