

ATI 412™

Stainless Steel: Ferritic

(UNS S41003)

INTRODUCTION

ATI 412 alloy is a low carbon, nickel containing, dual phase 12% Cr stainless steel. It is intended to be a low cost stainless steel which can replace carbon steels in certain applications and provide improved performance. Because of its dual phase microstructure, which consists of alternating layers of ferrite and low carbon martensite, ATI 412 alloy has superior toughness when compared to fully ferritic stainless steel alloys. The high strength and corrosion resistance of ATI 412 alloy often allow a significant weight savings to be realized when it is used in place of carbon steel.

TYPICAL COMPOSITION

The following table lists the nominal composition of ATI 412 material, and the requirements of ASTM Standard A240-97A for a UNS S41003 stainless steel.

Element	Nominal Composition of ATI 412™ Alloy	ASTM A240 Specification for UNS S41003
C	0.020	0.30 max
Mn	0.90	1.50 max
Si	0.70	1.00 max
P	0.040 max	0.040 max
S	0.030	0.030 max
Cr	11.75	10.5 to 12.5 max
Ni	0.40	1.50 max
N	0.030 max	0.030 max
Fe	Balance	Balance

MECHANICAL PROPERTIES

Typical room temperature mechanical properties of ATI 412 material are shown in the table below, along with the requirements of ASTM Standard A240-97A for a UNS S41003 stainless steel.

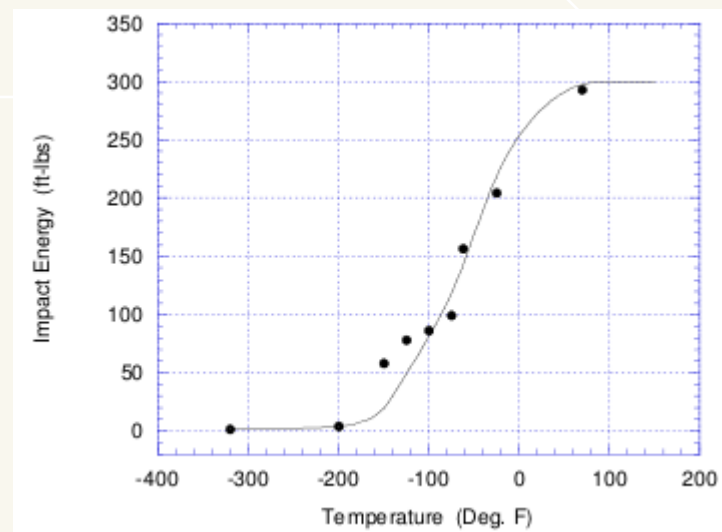


Technical Data Sheet

	Typical ATI 412 Alloy	ASTM A240 Specification for UNS S41003
0.2% Offset Yield Strength ksi (MPa)	60 (414)	40 min (276)
Ultimate Tensile Strength ksi (MPa)	82 (565)	66 min (455)
Elongation in 2 inches	24%	18% min
Rockwell Hardness	87RB	100RB (20 Rc) max

Charpy impact tests were performed on ATI 412 material in both the Longitudinal (L) and Transverse (T) directions. This data, which is displayed in the figures below, shows that the Ductile to Brittle Transition Temperature (DBTT) is below 0°F for this alloy.

Longitudinal Charpy Impact Test Results



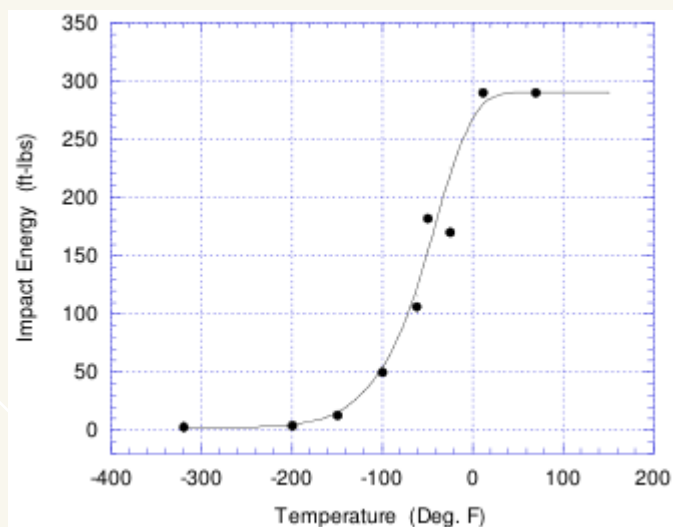
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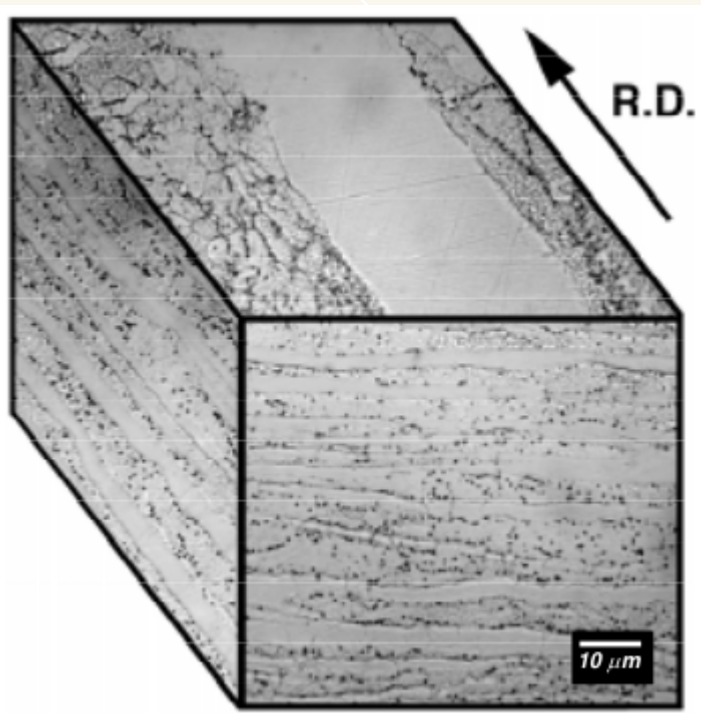
Transverse Charpy Impact Test Results



ATI 412 alloy has a relatively low work hardening rate and is readily cold formable.

MICROSTRUCTURE

Following a sub-critical anneal, the microstructure consists of layers of ferrite and tempered martensite. This is illustrated in the figure below, which is a composite of three micrographs taken of ATI 412 material (R.D. indicates the rolling direction).



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WELDABILITY

ATI 412 material may be welded to carbon steel or other stainless steels. It is recommended that low carbon austenitic stainless steels, such as types 309L, 309 Mo, 316 L and 310 S, be used as filler material. The Schaeffler diagram can be used to determine the suitability of joint preparation / consumable type. The weld metal should be primarily austenitic.

CORROSION RESISTANCE

The presence of 12 percent chromium in the ATI 412 alloy makes it a more corrosion resistant alternative for many applications in which carbon steels, low alloy steels, or coated steels are not adequate. However, if ATI 412 alloy is placed in contact with carbon steel, it may cause the carbon steel to become susceptible to accelerated corrosion due to galvanic effects, especially when the ratio of ATI 412 material to carbon steel is high. For this reason, stainless steel fasteners (bolts, rivets, etc.) should be used for mechanical connections involving ATI 412 material.

Because of its ability to resist corrosion, ATI 412 alloy also exhibits improved wear resistance. It is well known that the presence of corrosion products can greatly accelerate the rate at which a steel will be lost by abrasion. In many mildly corrosive environments, ATI 412 alloy will exhibit a wear rate many times lower than a non-corrosion resistant alloy. In a similar vein, ATI 412 alloy will provide improved sliding characteristics for gravity feeding or dumping of bulk material from a rail car or through a hopper.

POTENTIAL APPLICATIONS

Some current and potential applications of ATI 412 alloy are: rail cars, coal handling equipment, sugar processing equipment, mining equipment, storage bins and hoppers, and bus frames.

SUMMARY

ATI 412 alloy is a corrosion resistant, dual-phase, 12% Cr stainless steel which offers a good combination of strength, ductility, toughness, wear resistance, and weldability. ATI 412 alloy offers potential cost savings compared to less corrosion and wear resistant materials based on its longer service life and the possibility of using thinner, lighter sections for a given application.