



Why Make The Switch To Type 201 Stainless Steel?

By Cheryl Botti, Allegheny-Ludlum

With continued volatility of nickel prices, alternative stainless steels that contain less nickel, and therefore have lower and more stable costs, are becoming even more attractive. Allegheny Ludlum's lower-nickel, austenitic stainless steel, AL 201HP™ alloy, is gaining momentum in many markets where Type 304 or Type 301 stainless steels are often specified. AL 201HP™ (UNS S20100) alloy is a high performance austenitic stainless steel formulated to have a lower and more stable cost due to the substitution of manganese for a portion of the nickel found in the 300 series alloys. The resulting alloy has comparable properties and performance to the 300 series alloys and in many respects has the same look and feel of Type 304.

By definition, stainless steels are iron-based materials containing a minimum of 11% Chromium (Cr). The role of chromium in austenitic stainless steels is to combine with oxygen to form an invisible, adherent oxide or "passive" film which provides the corrosion resistance associated with this family of stainless steels. Nickel (Ni), the most commonly talked-about alloying element in stainless steels due to its impact on stainless steel price, stabilizes the austenitic phase as well as provides desirable mechanical properties which allow fabrication into many different shapes.

Type 304, the most common grade of stainless steel, contains a minimum 8% nickel. There are other alloying elements in austenitic stainless steels that can be used to partially replace nickel and yet not negatively impact the corrosion resistance. Chromium is the alloying element that gives stainless steels most of their corrosion resistance. These alloying elements include manganese (Mn) which is also an austenite stabilizer. It can partially replace nickel in a 2:1 ratio. Nitrogen (N) can also replace nickel as well as provide strengthening. Copper (Cu) also is an austenite stabilizer. In UNS and AISI specifications for Types 304, 301 and 201, copper is a residual element.

Other lower nickel austenitic alloys may be available from other producers, however, foreign producers may not manufacture to the UNS or AISI standards. Compositions containing lower chromium, lower nickel and higher copper have been noted. Such compositions are not the same and their resulting manufacturing and service performance are not the same as products produced to the UNS and AISI standards.

Not only do alloying elements provide specific roles to achieve desired corrosion resistance, formability, ability to fabricate, etc., but they also play a role in the overall product cost. Globally, mill producers generally use a mechanism known as a raw

AL 201HP™ (UNS S20100) alloy is a high performance austenitic stainless steel formulated to have a lower and more stable cost due to the substitution of manganese for a portion of the nickel found in the 300 series alloys.

material surcharge to pass along producers' cost of raw materials. A direct relationship exists between the price of nickel, the weight percentage of nickel in an alloy, and the raw material surcharge. The price of nickel has risen to levels not seen since the late 1980's. Generally, surcharges are applied on a monthly basis based on the prior two months' final average trading price. The end result is volatility in the raw material surcharge price and hence in the final price of the stainless steel.

In AL 201HP™ alloy, manganese is used primarily as the replacement for nickel in a 2:1 ratio. The typical chemistry of AL 201HP™ alloy has 4.5% nickel and 7.1% manganese, while the typical chemistry of Type 304 has 8.1% nickel and 1.0% manganese as seen below in Table 1. The difference in the nickel component of the raw material surcharge is \$0.20 per pound when the nickel price is at \$6.60 per pound. But a lower raw material surcharge associated with AL 201HP™ alloy is not the only benefit.

Alloy	Cr	Ni	Mn	N	C	N	Fe
AL 201HP™	16.3	4.5	7.1	0.07	0.08	0.07	Balance
Type 304	18.3	8.1	1.0	0.07	0.06	0.07	Balance

In addition to a lower and more stable cost, the composition of AL 201HP™ alloy provides some higher annealed mechanical properties than T304 which can result in an additional benefit of reduced weight. The AL 201HP™ alloy tensile strength is about 10 % higher than Type 304, which may allow the use of a thinner gauge and therefore less material. Initial adjustments may be needed on existing equipment to compensate for the

higher strength, but there should be no need for new equipment. Other manufacturing processes used to fabricate a part made of Type 304 are also suitable for AL 201HP™ alloy. The high uniform elongation permits similar performance to Types 304 and 301 in bending, forming, and drawing.

Alloy	Tensile Strength (ksi)	Yield Strength (ksi)	Elongation (% in 2')	Hardness (BB)
AL 201HP™	105	45	58	88
T304	95	45	53	85

Other fabrication processes used in the manufacturing of Type 304 can also be used with AL 201HP™ alloy. It can be welded using similar methods as T304. If filler

metal is required, there are commercially available weld wires suggested for use.

Because AL 201HP™ alloy falls in the same classification of austenitic alloy as Type 304, its appearance will be virtually the same as Type 304 from the as-shipped product from the mill producer to the final fabricated product. Parts manufactured from AL 201HP™ alloy will not appear any different than T304. This visual similarity enables them to be used side-by-side without noting any physical differences. All of the finishes and flat-rolled product forms that are commercially available in Type 304 are also available in AL 201HP™ alloy.

Corrosion performance as ranked by a number of standard ASTM tests demonstrate very similar performance of AL 201HP™ alloy compared with Type 304 in salt spray tests, crevice corrosion, and pitting corrosion tests. The similar chromium levels of AL 201HP™ alloy and Type 304 are responsible for this similar level of performance in service. Austenitic stainless steels obtain most of their corrosion resistance from the alloying element chromium. The 16.3% typical level of chromium in AL 201HP™ alloy compared to the 18.3% in Type 304 is more than enough to protect the steel from corrosion in most environments. In most cases AL 201HP™ alloy will display comparable corrosion resistance to Type 304. The comparative results in the ASTM G48A and G48B pitting and corrosion tests shown below demonstrate similar performance.(3) Another way to rank alloys with respect to their pitting and crevice corrosion resistance is a calculation known as the PREN value. AL 201HP™ alloy PREN value is 18.4 compared to Type 304 PREN value of 20.4. ASTM B117 salt spray tests exposed for 100 hours yielded similar results for both AL 201HP™ alloy and Type 304 with neither alloy exhibiting any rust. (4, 5)

		AL 201HP™	T304
ASTM G48A Pitting Test	Weight Loss	0.0228g/cm ²	0.0280g/cm ²
	Max Pit Depth	0.001"	0.001"
ASTM G48B Crevice Test	Weight Loss	0.0211g/cm ²	0.0259g/cm ²
	PREN= $Cr+16.3.PbMo+16.6.N$	18.4	20.4

AL 201HP™ alloy is suitable for use in food contact areas and food service, the same as T304. The alloy is approved for use by ANSI/NSF International Standard for Food Equipment 51. (7)



AL 201HP™ can be used to provide appliances with long-lasting stainless beauty – like this refrigerator

AL 201HP™ alloy has been used in a variety of applications in commercial and residential food service. Hot food wells, garbage disposal flanges, toasters, ice and water dispensers are just a few of the many areas where AL 201HP™ alloy has been specified. AL 201HP™ alloy has been successfully used in the manufacture of beverage dispensers and ice makers. Its clean appearance and resistance to corrosion have made AL 201HP™ alloy a popular alloy in this industry.

AL 201HP™ alloy has been used to make cookware lids, and has also been used in the manufacture of pots and pans. Its combination of good formability and corrosion resistance make AL 201HP™ alloy an excellent choice for many food and beverage storage and preparation applications (see Figure 3). The protective chromium oxide film which forms naturally on the surface of AL 201HP™ alloy enhances the resistance of cookware and other food service applications to corrosion by foodstuffs and cleaning products, and prevents contamination of its contents. (1)

The alloy has also been used in other diverse applications like industrial and commercial washing machines, specialty hose clamps, and structural components of truck trailers and railcars. In fact the alloy has been commercially available for over 50 years.

In summary, AL 201HP™ alloy offers a viable alternative to Types 304 or 301 for the foodservice industry when these alloys are working satisfactorily in service. AL 201HP™ alloy offers lower and more stable costs such as raw material surcharge, but also the possibility of reducing the thickness of product required to take advantage of the increased strength level without having to change equipment. Many of the material and aesthetic properties that are currently associated with Type 304 are similar or in some cases improved with AL 201HP™ alloy. Corrosion resistance, formability, weldability, and clean appearance of stainless steel are important in foodservice applications. AL 201HP™ alloy offers these properties while helping to stabilize costs. Equipment made of AL 201HP™ will not look physically different when placed side-by-side with equipment made from Types 304 or 301.

Material availability and lead-times for AL 201HP™ alloy are comparable to those

A cookware lid made from AL 201HP™ alloy.
Photo courtesy of Regal Ware, Inc.



for Types 304 and 301 because of the nearly identical processing steps used in the production of these materials. All of the flat-rolled product forms and finishes available in Types 304 and 301 are available in AL 201HP™ alloy.

With a similar appearance and performance to Type 304 and Type 301, why not consider “The Switch Is On™” to AL 201HP™ alloy?

For additional information contact Cheryl Botti, Manager, Market and Product Development at ATI Allegheny Ludlum, cbotti@alleghenyludlum.com, phone 724 226 6557, fax 724 226 6565 or go online at www.alleghenyludlum.com.

References:

1. David S. Bergstrom, Cheryl A. Botti, “AL 201HP™ (UNS S20100) Alloy: A High-Performance, Lower-Nickel Alternative to 300 Series Alloys”, presented at the Stainless Steel World Conference in Maastricht, The Netherlands, November 9, 2005. Reprinted with the permission of KCI Publishing bv.
2. ATI Allegheny Ludlum Website, “Stainless Steel Alloy Selection Guide”, ATI Allegheny Ludlum, Pittsburgh, PA, 2005.
3. ASTM Standard G48-03, Standard Test Methods for Pitting and Crevice Corrosion Resistance of Stainless Steels and Related Alloys by Use of Ferric Chloride Solution, ASTM International, West Conshohocken, PA, 2003.
4. ASTM Standard B117-03, Standard Practice for Operating Salt Spray (Fog) Apparatus, ASTM International, West Conshohocken, PA, 2003.
5. B. Ozturk, Salt Spray Testing of Type 201, 201LN, 301, 304, 430 and 439HP Samples, Internal ATI Allegheny Ludlum Report, June 27, 2005.
6. ATI Allegheny Ludlum, Unpublished Research.
7. ANSI/NSF International Standard 51, Food Equipment Materials, NSF International, Ann Arbor, MI, 1997.

AL 201HP™ alloy has been used in a variety of applications in commercial and residential food service. Its clean appearance and resistance to corrosion have made AL 201HP™ alloy a popular alloy in this industry.