Types 430 and 434

GENERAL PROPERTIES

Allegheny Stainless Types 430 and 434 are low carbon ferritic stainless steels which, in mildly corrosive environments or atmospheric exposures, have corrosion resistance approaching that of some nickel stainless steels. These alloys are oxidation resistant at elevated temperatures. Types 430 and 434 are ductile, do not work harden readily, and can be formed using a variety of roll forming or mild stretch bending operations as well as the more common drawing and bending processes.

Structures

At temperatures below about 1650F,these alloys have a ferritic structure with randomly dispersed spherical carbides. When heated above 1650F, smally amounts of austenite form in the grain boundaries and within the grains. Depending on the cooling rate, this austenite transforms to martensite or ferrite and carbides. Martensite may be found in weld zones and in base metal heat affected zones. Martensite is transformed to ferrite and carbides by annealing.

Forms and conditions

Types 430 and 434 are available as plates, sheets, strip, bars, wire, extrusions, seamless tubing and pipe, forging billets and ingots. In strip and sheet forms, these alloys are produced in a variety of finishes ranging from a nondirectional pickled finish through several highly directional polished finishes to a mirror like bright annealed product.

APPLICATIONS

These alloys are used in a variety of interior and exterior trim applications where corrosion resistance is more important than high strength. Typical applications are sinks and sink rims, appliance trim and counter tops. Type434 is used mainly for automotive trim and other more severe exterior environments.

For supplementary information on product forms, applications, conditions, sizes, finishes, coatings and pattern finishes see the Allegheny Ludlum Stainless Steel Brochure Series SS91.98. Information on specifications is contained in pamphlet SS90.

TYPICAL ANALYSIS

Element	Percent	
	430	434
Carbon	0.12max	0.12max
Manganese	1.00max	1.00max
Phosphorus	0.04max	0.04max
Sulphur	0.03max	0.03max
Silicon	1.00max	1.00max
Chromium	16.00-18.00	16.00-18.00
Molybdenum	--	.75-1.25

RESISTANCE TO CORROSION

These alloys are resistant to attack in a wide variety of corrosive media. Type 434 with molybdenum is used mainly for automotive trim applications where it shows no rusting except in sea coast areas. These alloys are most corrosion resistant when polished or rolled to a mirror like finish.

RESISTANCE TO OXIDATION

Allegheny Ludlum Stainless Steels Types 430 and 434 resist oxidation at temperatures up to 1600F for intermittent service, and from 1450-1500F for continuous service. The scale formed is tightly adherent and not easily shed during sudden temperature changes. Since the rate of oxidation is greatly affected by the atmosphere involved, by the heating and cooling cycles, and by the structural design, no actual data can be presented which would apply to all service conditions. Personnel of our Corporate Research Center will be glad to discuss specific applications and environments.

PHYSICAL PROPERTIES

The general values listed here will apply to Types 430 and 434.

Melting Range	2600F-2750F
Density	0.276 lbs/in^3
Specific Gravity	7.65

Linear Coefficient of Expansion

Temperature Range		Coefficients*	
℃	℉	℃	℉
20-100	68-212-	10.3×10^{-6}	5.7×10^{-6}
20-500	68-932	11.2×10^{-6}	6.2×10^{-6}
20-787	68-1450	11.9×10^{-6}	6.6×10^{-6}

*Expressed as cm/cm or in/in

Thermal Conductivity

Temperature Range		$\frac{Ca1\cdot cm}{℃\cdot sec\cdot cm^2}$	$\frac{BTU\cdot ft}{℉\cdot hr\cdot ft^2}$
℃	℉		
20-100	68-212-	.057	13.8
20-500	68-932	.062	15.0

At 100C (212F) Type 430 stainless has about 40 percent of the thermal conductivity of wrought iron and at 500c (932F), about 65 percent.

Specific Heat

℃	℉	Cal/gm · ℃	BTU/lb · ℉
0-100	32-212	.11	.11

Electrical Resistivity

Temperature Range		Microhm-cm	Microhm-in
℃	℉		
20	68	60.0	23.6
100	212	67.5	26.6
200	392	77.0	30.3
400	752	92.5	36.4
600	1112	105.0	41.3
800	1472	115.0	45.3

MECHANICAL PROPERTIES

The following data concerns Types 430 and 434

Typical Room Temp. Properties of Sheet and Strip

Property	430	434
Yield strength(ksi).2% offset*	Strip 45-55 Sheet 50-60	Strip 50-60 Sheet 55-65
Ultimate Tensile* Strength(ksi)	65-80 sheet & strip	74-84 sheet and strip
Elongation in 2 inches, %**	Strip 25-32 Sheet 20-28	Strip 24-31 Sheet 22-28
Hardness ***	.012-.0175 15-t 85-87.5 .018-.039 30-t 67-72 .040 RB 75-83	.012-.0175 15-t 86-88.5 .018-.039 30-T 69-74 .040 RB 78-96
Fatigue Strength	35-45% of Tensile Strength	

*These are typical mechanical properties for cold rolled and annealed sheet and strip. The mechanical properties for certain pattern finishes requiring and additional rolling operation will be slightly higher.

**These are typical elongations for cold rolled and annealed materials. The elongation for certain pattern finishes requiring an additional rolling operation will be slightly less.

***hardness values are reported in the proper scale for

respective gages, in part as outlined in ASTM specification #E-18.

Typical Room Temp. Properties for Bars and wire

	1/8-3/4in. rd Cold Drawn and Annealed	Over 3/4 in. rd Annealed
Yield Strength, .2% offset, psi	45000-65000	40000-55000
Ultimate tensile strength, psi	75000-95000	70000-85000
Elongation in 2 inches, %	20-30	20-35
Reduction of Area, %	55-65	50-65
Izod impact strength, ft-lb	--	4-85
Hardness, Brinell Rockwell B	-- 85-95	130-170 72-87

Effect of Cold Reduction

The following graphs show the effect of cold reduction on the mechanical properties of Types 430 and 434.

Elevated Temperature Properties

The following data was obtained on annealed .20" Type 430 with .07% Carbon, 17.15% chromium and .30% Nickel using ASTM procedures. Similar temperature mechanical properties and creep strengths can be anticipated for Type 434.

Testing Temperature °F	Ultimate Tensile Strength psi	Yield Strength .2% offset psi	Elong in 2in percent
Room	74000	49000	26.0
200	70100	47600	23.5
400	68100	42200	18.5
600	65500	38100	18.5
800	62100	34400	17.5
1000	45700	25300	26.0
1200	18000	13300	69.5
1400	6700	4900	87.5
1600	4000	2800	79.0

Impact Strength

The range of lzod impact values for these alloys is 3-85 foot pounds depending on the final size of the processed material and the heat treament. Higher impact values can be expected from smaller hot rolled sizes. Annealed 13/4" rounds may have impact values as low as 4 foot pounds; a 20-85 foot pound range can be expected for rounds 1"and smaller.

Annealing* hot-rolled material at 1450Fresults in the best impact proeperties while higher annealing temperatures yield much lower impact properties. Impact properties of these alloys are greatly reduced when they are head in the 800Fto 1000F range for several days. Annealing, however, will restore the original impact properties.

*For specific annealing in formation see heat treating section.

FABRICATING PROPERTIES

Forging Temperatures, °F

Initial	2000-2100
Final	1300-1400

Deep Drawing

These alloys have excellent deep drawing properties and are used to produce many products such as stainless steel sinks. In general, a blank 2.1-2.3 times the final cup diameter can be drawn compeletely into a cup without fracturing. This is referred to as a limiting drawing ratio. Since ferritic steels are normally anisotropic, some earing of deep drawn parts should be anticipated.

Machining

Types 430 and 434 should be machined at speeds about 60% of those used for a similar operation on reference type B1112. Your Allegheny Ludlum representative will furnish information on free-machining modifications of these alloys.

Welding

Allegheny Types 430 and 434 can be welded by all commercial processes normally used to weld stainless steels. For best results the stainless steel parts to bejoined must be

completely free of grease, oil or other surface contamination. Satisfactory joints can be made with austenitic weld deposits of base metal. If the welded structure is to be subjected to thermal cycling, filler wire of the base metal composition should be used to avoid differences in thermal expansion which can cause bucking.

Welding these alloys will cause a decrease in ductility of the weld and heat affected zones due to the formation of martensite during cooling. The weld heat affected zone will also suffer a marked loss of corrosion resistance in some environments, Both ductility and corrosion resistance can be restored by annealing.
Both welding and subsequent annealing will form a scale or heat tint of these alloys. These discolorations must be completely removed to realize maximum corrosion resistance.

Heat Treating
Types 430 and 434 should be annealed at 1450-1550F and furnace cooled at a rate of 50F per hour at 1100F and air cooled. If the annealing temperature does not exceed 1450F, an air cool may be substituted for the furnace cool when annealing thin sections. Annealing these alloys as outlined produces no phase transformations and is used only to impart full softness and maximum ductility. Annealing will produce a heat tint on these materials which must be removed to obtain maximum corrosion resistance.

Response to High Temperature Exposures
These alloys become susceptible to intergranular corrosion in certain environments when they are air cooled from temperatures above 1500F. This sensitivity to intergranular attack may be accompanied by a decrease in ductility. Normal corrosion resistance and ductility are restored by annealing.

Resistance to Roping
In certain forming operations requiring a large amount of stretching in the rolling direction these alloys may develop a surface condition known as rope. This condition manifests itself as striations parallel to the rolling direction. In some instances, these striations are sever enough to be felt by running ones thumb nail across the specimens. In most cases, however, the condition is merely an optical effect which sometimes requires additional finishing to correct.
For some applications, modifications in processing or chemical compostion may be required to minimize this problem. Mill Technical Services Personnel have had customer contact on the characteristics of roping requirements.

Cleaning
These alloys should be cleaned following accepted procedures for stainless steels. For specific information in regard to heat tint, or welding scale, etc, see ASM metals handbook volume #2 or contact Allegheny Ludlum Corporate Research Center.