Allegheny METAL

Approximating Precious Metals in Corrosion Resistance

Allegheny METAL CONTROLS CORROSION — THE SAFE METAL

BULLETIN A-1

Warehouse Stocks

JOSEPH T. RYERSON & SON, Inc.

BOSTON JERSEY CITY PHILADELPHIA BUFFALO CLEVELAND CINCINNATI DETROIT CHICAGO MILWAUKEE ST. LOUIS

Dunham, Carrigan & Hayden Company, San Francisco

Union Hardware & Metal Company, Los Angeles

ALLEGHENY STEEL COMPANY
General Offices and Works:
BRACKENRIDGE, PA.

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Allegheny

Sheets for Automobile Bodies - Metallic Furniture - Deep Draws - Allegheny Stainless Steels - Electrical Sheets - Steel Castings - Boiler Tubes - Pipe

Revised 1-1-34

ALLEGHENY METAL

	GRADE A	GRADE B	GRADE B SPECIAL	GRADE C
Carbon	Max. .08%	.08–.12%	Max. .08%	.08–.20%
Manganese	Max. .50%	Max. .50%	Max. .50%	Max. .50%
Phosphorous	Max. .025%	Max. .025%	Max. .025%	Max. .025%
Sulphur	Max. .025%	Max. .025%	Max. .025%	Max. .025%
Silicon	Max. .50%	Max. .50%	Max. .50%	Max. .50%
Chromium	16.00–20.00%	18.00–20.00%	18.00–20.00%	16.00–20.00%
Nickel	7.00–10.00%	8.00–10.00%	8.00–10.00%	7.00–10.00%

The Allegheny Metal grade B and grade B Special will contain combined chromium and nickel of not less than 28.00%

Where fabrication requires deep drawing, welding or severe cold work, Grade B will be found superior in most cases to Grade A because it has less tendency to work harden and requires much more cold work to make it magnetic. Its combined chromium and nickel of 28.00% insures greater stability than that of Grade A after short time heating such as in the welding operation. The higher carbon content also produces an alloy with higher true proportional limit and tensile strength giving greater resistance to reverse bending stresses thereby reducing the tendency for fatigue failure.

The Allegheny Steel Company, pioneered the production and sale of this alloy in 1925, and is in position, because of its technical and service experience, to assist you in selecting the most suitable and economical composition for your purpose.

For detailed information in connection with fabrication refer to bulletin, "Fabrication of Allegheny Stainless Steels".

INFLUENCE OF CARBON ON PHYSICAL PROPERTIES OF ANNEALED ALLEGHENY METAL

Carbon Content	Ultimate Strength Lb. per Sq. In.	Proportional Limit Lb. per Sq. In.	Elongation in 2 In.	Reduction of Area	Endurance Limit Lb. per Sq. In.
.065%	79,000	19,500	70%	72%	32,000
.11%	85,000	25,000	69%	76%	34,000
.15%	90,000	28,000	69%	73%	36,500
.17%	93,000	30,000	68%	75%	38,000

ALLEGHENY METAL

PHYSICAL PROPERTIES AT ELEVATED TEMPERATURES

NOTE: This table gives Physical Properties at Elevated Temperatures and should not be confused with Creep Values.

Temperature Degrees Centigrade	Degrees Fahrenheit	Proportional Limit Pounds Per Sq. In.	Ultimate Tensile Pounds Per Sq. In.	Elongation Per Cent 2 Inches	Red. of Areas Per Cent
25	75	28000	91100	62.0	75.1
100	212	28000	81710	57.0	75.8
200	392	27500	74690	51.0	74.0
300	572	26500	74300	48.0	69.5
400	752	25800	74290	49.0	69.9
500	932	25400	72730	47.0	69.5
600	1112	25000	67860	45.0	71.1
700	1292	21500	61120	39.0	60.5
800	1472	12000	43200	31.0	51.0
900	1652		24560	36.0	57.3

NOTE: Tests made on Annealed Bars

EFFECT OF ANNEALING TEMPERATURE ON PHYSICAL PROPERTIES

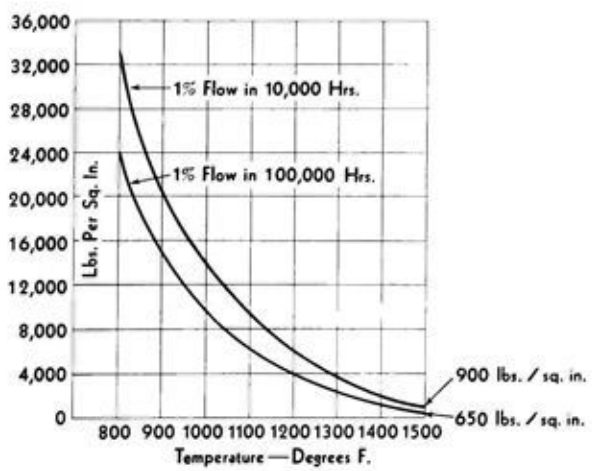
NOTE: Data Obtained on Hot Rolled Bars, 1 Hour at Annealing Temperature

	Tensile Strength	Proportional Limit	Elongation Per cent in 2"	Red. of Area %	Brinell Hardness	Izod Foot Pound
Hot Rolled.....	110900	73930	43.0	65.9	223	109
Annealed at 1700° F.....	107050	54440	48.0	56.0	217	112
Annealed at 1800° F.....	106800	54940	43.0	62.8	207	112
Annealed at 1900° F.....	93600	30580	58.5	67.6	165	112
Annealed at 2000° F.....	90400	28470	61.0	68.2	135	112

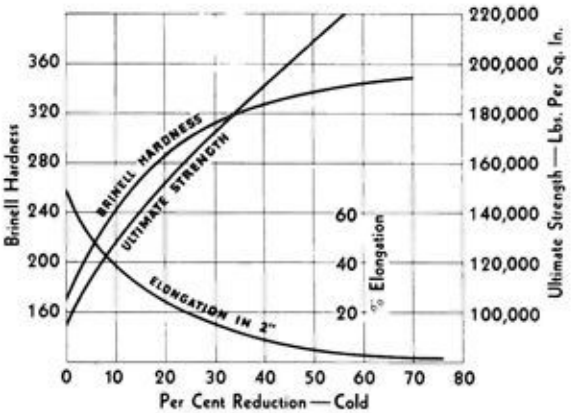
Sheets and plates supplied only in the annealed state. Rounds and flats can be supplied with higher physical properties than are given for annealed ALLEGHENY METAL and where higher physical properties are required for engineering purposes, inquiries should be submitted to the mill and proper information secured prior to ordering.

CREEP STRESS

The Creep Stress of a metal is that load per unit cross sectional area that will produce at a given temperature a definite stretch or flow in a definite time. Usually the time selected is either 10,000 or 100,000 hours and the amount of Stretch is 1%. Considerable variation exists in the Creep Stress values reported by various investigations. The values given below are conservative and representative of ALLEGHENY METAL.



INFLUENCE OF COLD WORK ON ALLEGHENY METAL



The curves given above were obtained on ALLEGHENY METAL containing:

Car.—0.11% Cr.—18.47% Ni.—8.20%

and are illustrative only of the rate of hardening by cold work. ALLEGHENY METAL of lower carbon content will work harden at a more rapid rate, and with slightly higher carbon, the rate of hardening will be less.

ALLEGHENY METAL

Manufactured pursuant to Licensé from the Chemical Foundation, Inc., under basic patents No. 1,316,817 and No. 1,339,378

RESISTANCE OF ALLEGHENY METAL TO VARIOUS MEDIA

ACIDS

Acetic 100%	unaffected
Acetic 33%	unaffected
Acetic 10%	unaffected
Acetic Anhydride	unaffected
Acetic vapor 100% sol.	slightly attacked
Acetic vapor 33% sol.	slightly attacked
Acetic Acid and Salt	attacked
Benzoic	unaffected
Boric	unaffected
Butyric	unaffected
Carbolic	attacked
Chloracetic	attacked
Chloro-sulphonic conc.	unaffected
Chloro-sulphonic 10%	slightly attacked
Citric	unaffected
Formic	affected
Gallic	unaffected
Hydrocyanic	unaffected
Hydrochloric	attacked
Hydrofluoric	attacked
Lactic	unaffected
Lactic Acid and Salt	attacked
Malic	unaffected
Nitric Acid, conc. plus 2% Hydrochloric Acid	unaffected
Nitric	unaffected
Nitrous	unaffected
Oleic	unaffected
Oxalic	slightly attacked
Phosphoric conc.	attacked
Phosphoric 10%	unaffected
Picric	unaffected
Pyrogallic	unaffected
Stearic	unaffected
Sulphuric conc.	practically unaffected
Sulphuric dilute	attacked
Sulphurous	unaffected
Tannic	unaffected
Tartaric	unaffected

SALTS

Alkalies,—Alum	unaffected
Aluminum Sulphate	unaffected
Ammonium Bromide	unaffected
Ammonium Carbonate	unaffected
Ammonium Alum, Saturated, slightly acid with Sulphuric acid, up to 200° F.	unaffected
Ammonium Chloride	unaffected
Ammonium Hydroxide	unaffected
Ammonium Nitrate	unaffected
Ammonium Sulphate	unaffected
Ammonium Sulphate plus 0.5% sulphuric acid	unaffected
Ammonium Sulphate plus 5.0% Sulphuric acid	attacked
Barium Hydrate	unaffected
Barium Carbonate	unaffected
Bleaching Powder	attacked
Calcium Carbonate	unaffected
Calcium Chloride	unaffected
Calcium Hypochlorite	attacked
Calcium Hypochlorite made slightly alkaline with Na-OH	unaffected
Calcium Hydroxide or Oxide	unaffected
Chlorine	attacked
Copper Carbonate	unaffected
Copper Chloride	attacked
Copper Nitrate	unaffected
Copper Sulphate plus 2% sulphuric acid	unaffected
Ferric Chloride	attacked
Ferric Nitrate	unaffected
Ferrous Sulphate	unaffected
Glauber's Salt	unaffected
Hydrogen Peroxide	unaffected
Hydrochloric Acid	attacked
Lead Acetate	unaffected
Lactic Acid	unaffected
Magnesium Carbonate	unaffected
Magnesium Chloride	unaffected
Magnesium Sulphate	unaffected
Mercurous Nitrate	unaffected
Mercuric Chloride	attacked
Mercuric Cyanide	unaffected
Naptha	unaffected
Nickel Nitrate	unaffected
Nitric Acid	unaffected
Nitrous Acid	unaffected
Potassium Bromide	unaffected
Potassium Chloride	unaffected
Potassium Cyanide	unaffected
Potassium Dichromate	unaffected
Potassium Ferricyanide	unaffected
Potassium Ferricyanide boiling	unaffected
Potassium Hypochlorite	affected
Potassium Iodide	unaffected
Potassium Nitrate	unaffected
Potassium Oxalate	unaffected
Potassium Permanganate	unaffected
Salt and Sea Water	unaffected
Silver Bromide	unaffected
Silver Nitrate	unaffected
Soaps	unaffected
Sodium Bisulphate	unaffected
Sodium Bromide	unaffected
Sodium Carbonate or Soda Ash	unaffected
Sodium Citrate	unaffected
Sodium Chlorate 10% solution	unaffected
Sodium Chlorate 25% solution	unaffected
Sodium Hydroxide	unaffected
Sodium Hypochlorite	affected
Sodium Hypochlorite, slightly alkaline with Na-OH	unaffected
Sodium Nitrate	unaffected
Sodium Peroxide at 212° F.	unaffected
Sodium Sulphate	unaffected
Sodium Sulphide	unaffected
Sodium Sulphite	unaffected
Sodium Thiosulphate plus 4% Potassium Bisulphate	unaffected
Sodium Thiosulphate 20% plus Acetic Acid 20%	unaffected
Soda Ash 10% up to 200° F.	unaffected
Soda Ash 50% up to 200° F.	unaffected
Spirits of Nitre	unaffected
Stannous Chloride	slight attack
Sulphuric Acid over 0.5% room temperature	attacked
Tartaric Acid	unaffected
Tannic Acid	unaffected

ORGANIC SUBSTANCES

Acetone	unaffected
Benzol	unaffected
Camphor	unaffected
Carbon Tetrachloride	affected
Carbon Tetrachloride vapors refluxed	affected
Coffee	unaffected
Copal Varnish	unaffected
Ethyl Alcohol	unaffected
Ethyl Ether	unaffected
Food Pastes	unaffected
Formaldehyde	unaffected
Fruit Juices	unaffected
Gasoline	unaffected
Glue	unaffected
Inks	unaffected
Lemon Juice	unaffected
Lysol	unaffected
Methyl Alcohol	unaffected
Milk—fresh or sour	unaffected
Mustard	unaffected
Oils—mineral or vegetable	unaffected
Paraffin	unaffected
Paregoric Compound	unaffected
Quinine Bisulphate	slight attack
Quinine Sulphate	unaffected
Sodium Salicylate	unaffected
Soft Soap	unaffected
Trichlorethylene 100%	attacked
Vinegar	unaffected

MISCELLANEOUS

Atmosphere of Steam, Carbon Dioxide and Air	unaffected
Atmosphere of Steam, Sulphur Dioxide, Carbon Dioxide and Air	unaffected
Sulphur Dioxide	unaffected
Baking Oven Gases	unaffected
Calcium Chloride—neutral or slightly alkaline	unaffected
Sodium Chloride—neutral or slightly alkaline	unaffected
Sauer Kraut Brine	attacked
Bromine	attacked
Bromine Water	attacked
Chlorine Gas—wet or dry	attacked
Mine Water	unaffected
Steam and Air, Refluxed	unaffected
Water	unaffected
Zinc, molten	attacked

Chemicals containing free chlorine are frequently used, in the dairy and food industries, for sterilizing purposes. Allegheny Metal is unaffected by most of these reagents over the short period of exposure required for sterilizing processes, but it is not suggested for storage containers or applications involving a continued exposure to the reagents.

NOTE: The above table is based on laboratory tests made at room temperature (70° F.) unless otherwise stated. Tests should be made under service conditions wherever possible before installations are made or additional information should be obtained.

It should not be assumed that where Allegheny Metal is not attacked by two substances used alone that the combination will have no effect. Additional information on the corrosion resistance of Allegheny Metal will be supplied by the Allegheny Steel Co. on request.

ALLEGHENY METAL should be used for all applications where exceptional resistance to most forms of corrosion must be coupled with very high tensile properties.

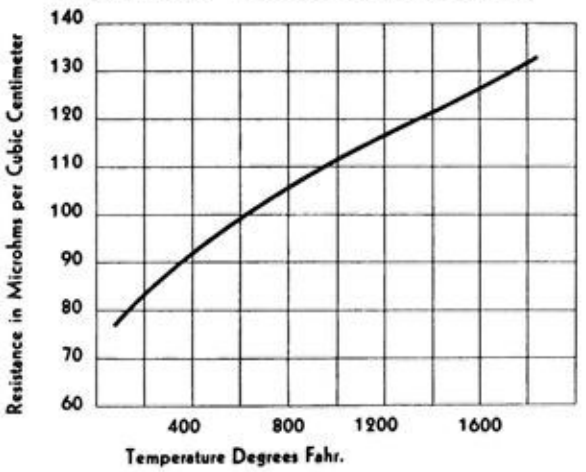
ALLEGHENY METAL

The modulus of elasticity of annealed ALLEGHENY METAL is 28,600,000. Where high tensile strength is obtained by cold working, the modulus of elasticity may fall as low as 22,000,000. The modulus of shear is 11,900,000.

CO-EFFICIENT OF LINEAR EXPANSION

Temperature Range	Mean Co-efficient of Linear Expansion
20° to 100° C.	0.0000173 per degree C.
20° to 300° C.	0.0000179 per degree C.
20° to 600° C.	0.0000187 per degree C.
20° to 800° C.	0.0000194 per degree C.
20° to 1000° C.	0.0000202 per degree C.

ELECTRICAL RESISTANCE OF ANNEALED ALLEGHENY METAL



The electric resistance of copper at 68° F. is 1.72 microhms per Cm^3.
The electric resistance of iron at 68° F. is 12 microhms per Cm^3.

NOTE: To obtain the resistance in Ohms per circular mil foot multiply microhms per Cm^3 by 6.017.
Cold work considerably increases the electrical resistance.

PERMEABILITY

ALLEGHENY METAL is non-magnetic when fully annealed and has a permeability of less than 1.02. Cold working increases this value. Severely cold worked metal may have a permeability as high as 12.

THERMAL CONDUCTIVITY

The thermal conductivity of ALLEGHENY METAL is 48% of that of iron. Taking the absolute value for the conductivity of iron as .143, the thermal conductivity of ALLEGHENY METAL is .069 calories per centimeter per second per degree centigrade over the range from 20 degrees Centigrade to 100 degrees Centigrade.

OXIDATION

ALLEGHENY METAL is highly resistant to oxidation and is suggested for use in many applications for temperatures up to 1700°F.

MELTING POINT

The melting point of ALLEGHENY METAL is 2606 to 2679 degrees Fahrenheit or 1430 to 1470 degrees Centigrade.

SPECIFIC GRAVITY

ALLEGHENY METAL, heavily cold rolled, annealed, 7.97—8.07. Average weight .2895 lbs. per cubic inch.

ALLEGHENY METAL, hot rolled, annealed, 7.86—7.94. Average weight .285 lbs. per cubic inch.

HIGH TEMPERATURE SERVICE

ALLEGHENY METAL is highly resistant to oxidation up to 1700°F. in non-corrosive atmosphere. It is recommended for use up to this temperature. It is not recommended for use in corrosive atmosphere between 800 and 1550° F.

FABRICATION

Instructions covering the fabrication of ALLEGHENY METAL will be furnished upon request. Definite information should be given us concerning the specific operation to be performed, form of product and finish to be applied to finished article.

COMPARATIVE WEIGHTS

Metal or Alloy	Weight in Pounds Per Cubic Inch	Percentage Difference in Weight in Favor of ALLEGHENY METAL
ALLEGHENY METAL	.285	
ALLEGHENY 33	.279	
Steel	.283	
Monel Metal (Sheets)	.317 to .325	12.00% to 15.00%
Cyclops	.288	1.70%
Tobin Bronze	.303	7.00%
18% Nickel Silver	.315	11.00%
High Brass	.305	8.00%
Low Brass	.313	10.00%
Nickel	.319	12.00%
Copper (Sheet)	.325	15.00%

ALLEGHENY STAINLESS STEELS

ALLEGHENY METAL . . .

Controls Corrosion

Send for Technical Bulletin A

EXTENSIVELY USED IN many applications demanding maximum resistance to corrosion and permanent beauty of surface, such as hotel, restaurant and clinical equipment; food manufacturing and processing equipment for dairy, creamery, cereal plants, fruit and vegetable canneries; meat packing plants, laundry machinery, building trim, refrigerator linings and trim, automobile radiator shells, chemical plant equipment, ice-cream cabinets, freezers and cans, soda fountains and counters.

ALLEGHENY 22 . . . . .

Special Corrosion Resisting

Send for Technical Bulletin 22

EXTENSIVELY USED IN many applications demanding maximum resistance to chemical corrosion coupled with facility of fabrication such as digesters, blow-pit bottoms, pipe, tanks, agitators, auto-claves, strainers, drying pans, fittings.

ALLEGHENY 33 . . . . .

(formerly Ascoloy 33)

Corrosion Resisting . . . Responds to Heat Treatment

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EXTENSIVELY USED IN many applications where resistance to progressive corrosion is necessary and where surface discoloration is not objectionable. This alloy resists atmospheric corrosion. It is 50% stronger than soft steel and offers greater resistance to abrasion. This alloy resists temperatures up to and including 1500 degrees F. and is used in automotive parts, internal combustion engine parts, steam engine parts, chemical plant equipment, roofing and siding, tanks and containers, fans and blowers, furnace parts, condensers and evaporators.

ALLEGHENY 44 . . . . .

(formerly Ascoloy 44)

High Heat Resisting with High Strength

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EXTENSIVELY USED IN many applications demanding maximum heat resistance coupled with facility of fabrication. This alloy resists scaling at temperatures up to 2000 degrees F. and even at this high temperature the metal retains an appreciable percentage of its remarkable physical properties.

ALLEGHENY 44 combines with its high resistance to oxidation the one other essential requirement, viz., ease of fabrication. It is the most readily workable high temperature resisting alloy offered in commercial forms and warehouse quantities, at prices warranting its extended use.

ALLEGHENY 44 is malleable and ductile. It may be welded and machined. Welds of ALLEGHENY 44 are soft. It is being used for furnace parts, boiler baffles, fire-box sheets, pump parts, industrial oven linings, recuperators, kiln linings, still tube supports, furnace and stack dampers.

ALLEGHENY 46 . . . . .

High Heat Resisting

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EXTENSIVELY USED IN many applications demanding strength at temperature with resistance to corrosion coupled with facility of fabrication. Bubble caps and tractionating trays. Furnace, exchanger, condenser and air preheater tubes and parts. Tube sheets, still bottoms, dampers, pumps and valves, tanks, pipes, tie-rods, bolts and studs, indicate the wide range of uses in the oil industry.

ALLEGHENY 55 . . . . .

(formerly Ascoloy 55)

High Heat Resisting

Send for Technical Bulletin 55

EXTENSIVELY USED IN many applications demanding maximum temperature resistance but where no difficult fabrication is involved. ALLEGHENY 55 is resistant to oxidation at temperatures that scale most other materials. It may be used under both oxidizing and reducing conditions.

ALLEGHENY 55 will not withstand temperatures in excess of 2150 degrees F.

ALLEGHENY 55 is machinable in the softened condition. In addition to the high heat resisting qualities of ALLEGHENY 55 is the remarkable resistance of this metal to many corrosive influences, one of which is acid mine waters. It is being used for the following applications: Furnace parts, boiler baffles, recuperator parts, kiln linings, glass molds, furnace and stack dampers, pyrometer protection tubes, oil still tube supports, rabble arms on roasting furnaces.

ALLEGHENY 66 . . . . .

(formerly Ascoloy 66)

Corrosion Resisting and Mildly Responsive to Heat Treatment

Send for Technical Bulletin 66

EXTENSIVELY USED IN many applications demanding resistance to chemical and atmospheric corrosion coupled with facility of fabrication. This alloy resists all temperatures up to, and including, 1600 degrees F. Nitric acid equipment, steam engine parts, low temperature furnace parts, fans and blowers, condensers and evaporators, chemical plant equipment, roofing and siding, indicate the broad uses of this metal.

For specific applications of these stainless steels consult the

ALLEGHENY STEEL COMPANY

Sheets for Automobile Bodies Metallic Furniture Deep Draws Allegheny Stainless Steels Electrical Sheets Steel Castings Boiler Tubes Pipe

General Offices and Works BRACKENRIDGE, PA.

New York Buffalo Cleveland Detroit Chicago Milwaukee St. Louis Los Angeles San Francisco Washington, D.C. Louisville

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