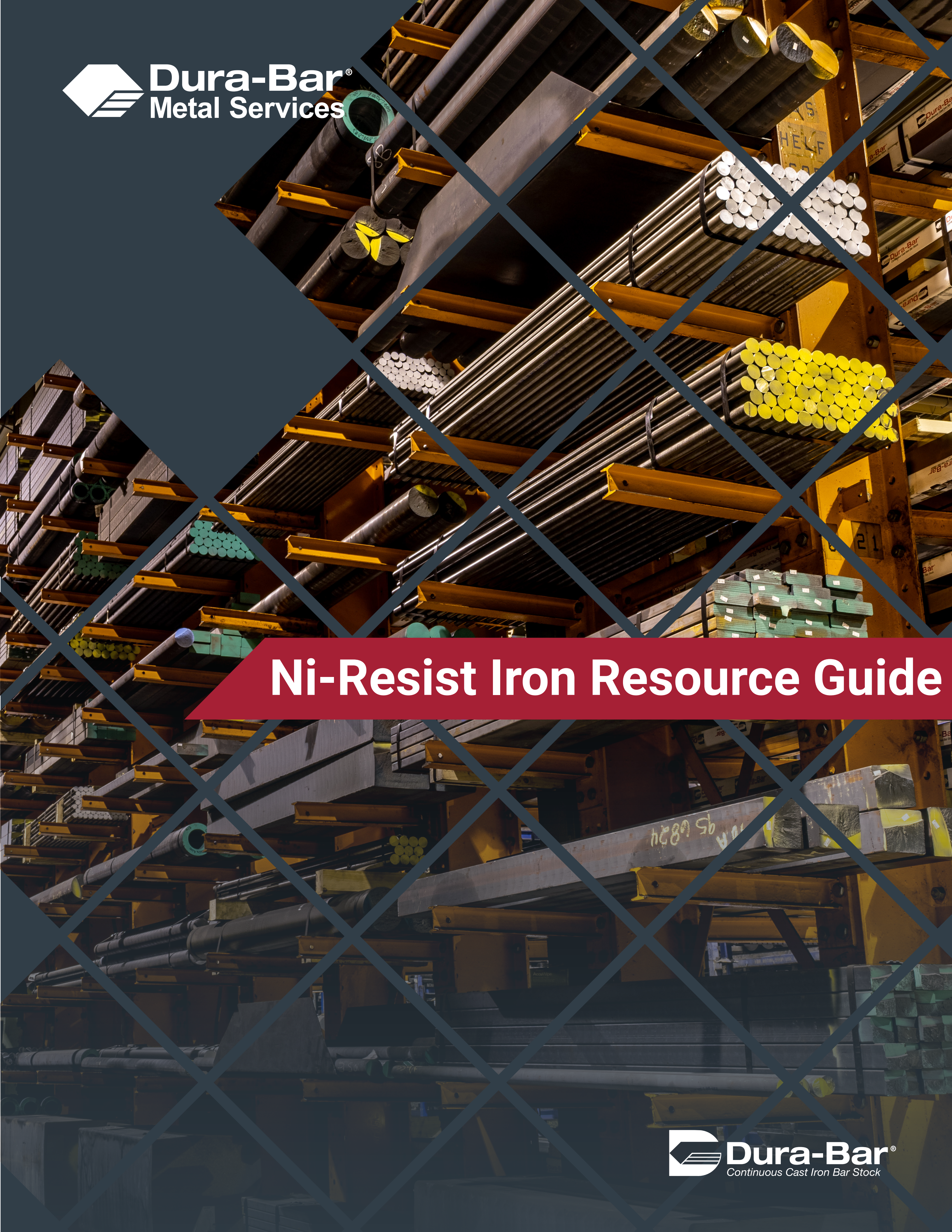
Dura-Bar® Metal Services



Ni-Resist Iron Resource Guide

Dura-Bar®
Continuous Cast Iron Bar Stock

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The scope of The Resource Guide is intended to be an informational reference to explain the typical characteristics of continuous cast iron bar stock. For more specific information, contact Dura-Bar Sales.

Ductile iron was developed in the 1940s and became widely recognized as an engineering material by 1960. The popularity of using ductile iron continues to increase especially with the concern over leaded steels being an Dura-

Ni-Resist Iron Description of Grades

Bar continuous cast Ni-Resist grades contain Type VII graphite, type A flakes, size 4-6, as defined in ASTM A247. The matrix is austenite with alloy carbide. The austenitic matrix provides excellent corrosion resistance and is non-magnetic. The carbide network provides resistance to wear but does not adversely affect machinability.

The austenitic structure is achieved by adding a specific combination of nickel and copper and will remain stable in temperatures to -300°F (-185°C). Ni-Resist parts maintain relatively high-impact properties even at low temperatures. The alloy carbide network remains stable at elevated temperatures providing good wear properties in moving parts that operate at temperatures up to 1300°F (705°C).

These grades are most commonly specified for use in corrosive atmospheres and will exhibit corrosion resistance properties somewhere between cast iron and austenitic stainless steel. In some cases, Ni-Resist will outperform austenitic stainless steel, depending on the environment to which the part is subjected.

A detailed study of the corrosion properties of Ni-Resist has been performed by the Nickel Development Institute, and data is available for specific applications. A selection of some of the environments in which Ni-Resist has been successfully used are:

Hydrogen sulfide and sour crude oil
Seawater
Sodium hydroxide
Sulfuric acid
Hydrochloric acid
Marine atmospheres

Ni-Resist alloys have thermal expansions similar to aluminum, thereby making them suitable for applications such as valve guides in aluminum cylinder heads.

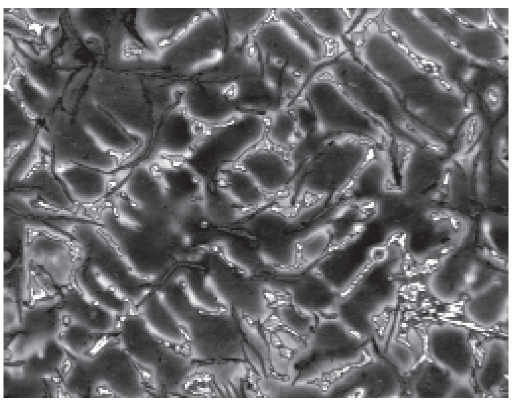

Fig. 1
Type A graphite in an austenitic matrix with chrome carbide (100x, etched in 5% Nitol)

201 (Type 1) Ni-Resist Iron

General Description

Ni-Resist irons contain an austenitic matrix with about 10% alloy carbides. The austenitic structure is suitable for corrosive environments in sour well oils, salts, salt water acids and alkalies. The iron is relatively soft and chrome is added to produce carbides that help improve wear resistance.

Ni-Resist is more dense than gray or ductile irons and will have a higher coefficient of thermal expansion. Dura-Bar 201 Ni-Resist is manufactured to produce a material conforming to ASTM A436, Type 1.

Microstructure

The microstructure consists of Type VII, type A, size 4-6, graphite as defined in ASTM A247. The matrix will be austenite with 5-10% alloy carbide. The rim will contain type D graphite, size 6-8. Chill carbides will be less than 5% in any field at 100x and will be well dispersed.

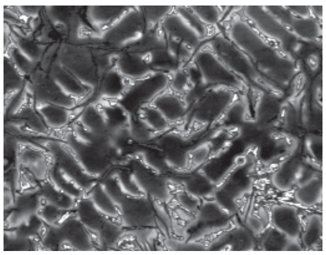

Fig. 2
Typical microstructure in the center area (100x, etched in 5% Nitol)

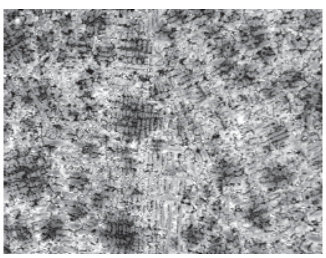

Fig. 3
Typical microstructure in the rim area (100x, etched in 5% Nitol)

Chemical Composition

The chemical composition for Dura-Bar 201 Ni-Resist is shown in Table 1 below. Specific targets will vary, depending on bar size, although the ranges listed are required.

Table 1 - Chemical composition of Type 1 Ni-Resist

Element	Percentage
Carbon	3.00% max.
Silicon	1.00 - 2.80%
Manganese	0.50 - 1.50%
Nickel	13.50 - 17.50%
Copper	5.50 - 7.50%
Chromium	1.50 - 2.50%
Sulfur	0.12% max.

Mechanical Properties

Brinell hardness values for nominal as-cast diameters are shown in Table 2 below. Hardness properties listed are minimum, maximum across the bar. Hardness values for rectangles and squares are a function of the height and width ratios and will be supplied upon request.

Table 2 - Hardness properties of Type 1 Ni-Resist

Bar Diameter		BHN	
Inches	mm	Min.	Max.
1.000 - 6.000	25 - 152	131	183

BHN in the center of bars 1.750" and smaller may be lower than the values shown because of thermal center microshrinkage.

The tensile strength will be approximately 25,000 psi for bars up to 3.000" diameter and 20,000 psi for bars larger than 3.000". Tensile strength tests in bars 1,750" and smaller may not be accurate because of thermal center microshrinkage.

Heat Treat Response

Austenitic alloys cannot be hardened by heat treatment. They may be softened and homogenized by heating to 1800 - 1900°F (980 - 1040°C) for 3-5 hours and air cooling. This breaks down some of the carbides and most of those remaining will be spheroidized. Annealing softens the material without detrimental effect on the strength properties. Dura-Bar 201 Ni-Resist should not be used in applications involving service above 1300°F (705°C).

Typical Applications

Typical applications for Dura-Bar 201 Ni-Resist are listed below. They are classified by industry.

Valve guides
Insecticide pumps
Flood gates
Piston ring inserts
Sea water valves
Pump bodies

Availability of Sizes and Shapes

The stock listing for Dura-Bar 201 Ni-Resist follows this section. Sizes and shapes not listed are available by special order.

202 (Type 2) Ni-Resist Iron

General Description

Ni-Resist Type 2 will be similar to Type 1 having an austenitic matrix with approximately 5-10% alloy carbide. Type 2 will be suitable for most applications requiring Type 1 Ni-Resist, and the grades are often used interchangeably. The machinability of Ni-Resist will be similar to the pearlitic grades of gray iron, namely G2 and G2A. Type 2 is especially suitable for temperatures above 1300°F (704°C) and in steam handling applications. Copper levels are maximized at 0.50%, and this grade is suitable for food product applications.

Ni-Resist is more dense than gray or ductile irons and will have a higher coefficient of thermal expansion. Dura-Bar 202 Ni-Resist is manufactured to produce a material similar to ASTM A436, Type 2.

Microstructure

The microstructure consists of Type VII, type A, size 4-6, graphite as defined in ASTM A247. The matrix is austenite with 5-10% alloy carbide. The rim will contain type D graphite, size 6-8. Chill carbides will be less than 5% in any field at 100x and will be well dispersed.

Fig. 4
Typical microstructure in the center area (100x, etched in 5% Nitol)

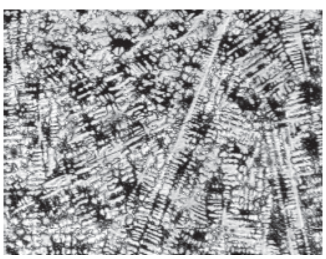

Fig. 5
Typical microstructure in the rim area (100x, etched in 5% Nitol

Chemical Composition

The chemical composition for Dura-Bar 202 Ni-Resist is shown in Table 3 below. Specific targets will vary, depending on bar size, although the ranges listed are required.

Table 3 - Chemical composition of Type 2 Ni-Resist

Element	Percentage
Carbon	3.00% max.
Silicon	1.00 - 2.80%
Manganese	0.50 - 1.50%
Nickel	18.00 - 22.00%
Copper	0.50% max.
Chromium	1.50 - 2.50%
Sulfur	0.12 max.

Mechanical Properties

Brinell hardness values for nominal as-cast diameters are shown in table 4 below. Hardness properties listed are minimum, maximum across the bar. Hardness values for rectangles and squares are a function of the height and width ratios and will be supplied upon request.

Table 4 - Hardness properties of Type 1 Ni-Resist

Bar Diameter		BHN	
Inches	mm	Min.	Max.
01.000 - 0.6000	25 - 152	118	174

BHN in the center of bars 1.750” and smaller may be lower than the values shown because of thermal center microshrinkage.

The tensile strength will be approximately 25,000 psi for bars up to 3.000” diameter and 20,000 psi for bars larger than 3.000”. Tensile strength tests in bars 1.750” and smaller may not be accurate because of thermal center microshrinkage.

Heat Treat Response

Austenitic alloys cannot be hardened by heat treatment. They may be softened and homogenized by heating to 1800 - 1900°F (980 - 1040°C) for 3-5 hours and air cooling. This breaks down some of the carbides and most of those remaining will be spheroidized. This anneal treatment softens without detrimental effect on the strength properties. Dura-Bar 202 Ni-Resist should not be used in applications involving service temperatures above 1300°F (705°C).

Typical Applications

Typical applications for Dura-Bar 202 Ni-Resist are listed below.

Valve guides
Insecticide pumps
Flood gates
Piston ring inserts
Sea water valve bodies
Pump bodies
Food service equipment

Availability of Sizes and Shapes

Dura-Bar Ni-Resist is a non-inventoried item. A wide variety of sizes and shapes are available by special order in minimum run quantities.

201 (Type 1) Ni-Resist Iron Rounds - Stock List/Weights

Dura-Bar Type 201 Ni-Resist			
Nominal Diameter (inches)	Stock Allowance (inches)	As-Cast Weight (lbs./ft.)	Cold Finished Weight (lbs./ft.)
1.000	0.088		2.5
1.250	0.088		3.9
1.500	0.095		5.6
1.625	0.095		6.6
1.750	0.095		7.6
2.000	0.095		10.0
2.125	0.118		11.3
2.250	0.118		12.6
2.500	0.118		15.6
2.750	0.118		18.9
3.000	0.118		22.5
3.250	0.136		26.4
3.500	0.136		30.6
3.750	0.136		35.1
4.500	0.154	54.1	
5.00	0.154	66.3	
5.500	0.172	80.3	
6.000	0.172	95.1	

Dura-Bar 201 Ni-Resist round bars not listed above, as well as tubes, rectangles, special shapes, and all Dura-Bar 202 sizes and shapes, are non-stock items and are produced to order in minimum run quantities.