Why Ductile Iron?

NIBCO is the largest United States manufacturer of pressure rated Ductile Iron Valves. NIBCO Ductile Iron multi-turn valves are ideal for a wide variety of services: hydrocarbons, chemical, marine, fire protection services, pulp and paper applications where cast iron and/or cast steel valves could be installed.

Ductile Iron, also known as nodular iron, was developed in 1949 as a substitute for steel. Cast steel contains carbon of less than .3% by weight, while cast and ductile irons have at least 3% total carbon. This low carbon content in cast steel does not allow the carbon to form as free graphite resulting in a laminate type of structure. The natural form of carbon in cast iron is the free graphite flake form. In Ductile Iron, this graphite flake is modified by a specialized treatment process to form tiny spheres or nodules. These modified graphite nodules provide Ductile Iron with physical properties greater than cast iron and comparable to steel. It is this nodular microstructure of carbon in Ductile Iron which produces high ductility and shock resistance while the flake form of cast iron results in no malleability. Optimum ductility is obtained with a ferritic matrix, therefore, all NIBCO Ductile Iron pressure containing parts are treated with a ferritizing annealing cycle. In Ductile Iron spheroidal nodules also eliminate the crack effect of flake graphite which is exhibited in cast iron. In microscopic photos of Ductile Iron, cracks can be seen traveling to a graphite nodule and stopping. These graphite spheroids are know as "crack arresters" in the Ductile Iron industry because of their ability to stop cracks in their tracks.

In some circles, Ductile Iron is known as the metal that is the "best of both worlds" meaning that Ductile Iron combines the superior strength of cast steel with the excellent corrosion resistance of cast iron.

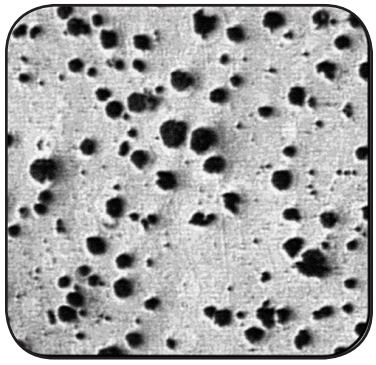
Ductile Iron vs. Cast (Gray) Iron

The strength of Ductile Iron when compared to cast iron is overwhelming. Ductile Iron tensile strength is 60k versus cast iron at 31k. Ductile Iron has a yield strength of 40k, whereas cast iron exhibits no yield, only ultimate fracture. Ductile Iron strength-to-cost ratio offers greater value for a marginal increase in cost over cast iron. (See page 89 for a complete comparison of mechanicals.) Ductile Iron offers excellent corrosion resistance that is equivalent to cast iron.

Ductile Iron vs. Cast Steel

The strengths of Ductile Iron and cast steel are comparable. Ductile Iron has a higher minimum yield strength at 40k versus cast steel at 36k. (See page 90 for a more complete comparison of mechanicals.) Ductile Iron has corrosion and oxidation resistance that surpasses cast steel in most general utility service applications. Because of Ductile Iron's spheroidal graphite microstructure, Ductile Iron is superior to steel in its ability to deaden vibration and therefore reduce stresses. An important factor in selecting Ductile Iron over cast steel is cost. The lower expense of Ductile Iron results from readily available materials, foundry operation efficiencies and reduced machining costs of Ductile Iron.

Cast (Gray) Iron
Flake Form



Ductile Iron
Spheroidal Graphite Nodules

Cast Steel Form

NOTE: For our metal comparison, NIBCO has chosen to use ASTM A395 Ductile Iron, ASTM A126 Cast Iron and ASTM A216 WCB Cast Steel. Wherever Cast Iron is listed, we are referring to Gray Iron.

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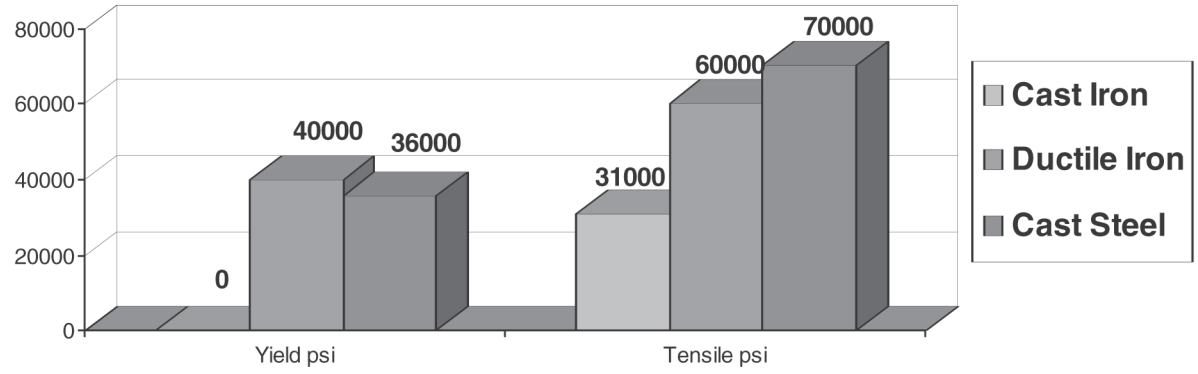
How Ductile Iron Compares to Cast Iron and Cast Steel

Minimum Mechanical Properties



Chemical Analysis

	Cast Iron ASTM A126 Class B*	Ductile Iron ASTM A395	Cast Steel ASTM A216 WCB
Iron and Residuals%	*94.0*	*94.5*	*98.1*
Carbon%	*3.3*	*3.0*	*0.3*
Silicon%	*2.0*	*2.5*	*0.6*
Manganese%	*0.7*		*1.0*

** Typical composition, ASTM Standard does not specify materials to this detail.*

Pressure/Temperature Ratings Comparing Cast Iron, Ductile Iron and Cast Steel

	ASTM A126 Cast Iron		ASTM A395 *Ductile Iron	ASTM A216 WCB Cast Steel
°F/°C Temperature	**Class 125**		**Class 150**	**Class 150**
	2"-12"	**14"-24"**	**2"-24"**	**2"-24"**
-20°F-100°F	200 psi	150 psi	**285 psi	285 psi
150°F/66°C	200 psi	150 psi	243 psi	
200°F/93°C	190 psi	135 psi	235 psi	260 psi
250°F/121°C	175 psi	125 psi	225 psi	
300°F/149°C	165 psi	110 psi	215 psi	230 psi
350°F/177°C	150 psi	100 psi	210 psi	
400°F/204°C	140 psi		200 psi	200 psi
450°F/232°C	125 psi		185 psi	
500°F/260°C			170 psi	170 psi
550°F/288°C			155 psi	
600°F/316°C			140 psi	140 psi
650°F/343°C			125 psi	125 psi

** These ratings apply when temperature exceeds 450°F and the valve has 316 SS trim. When ASTM B584 trim is used, maximum temperature limit is 450°F.*

*** ENGINEERING NOTE: NIBCO ductile iron valve wall thickness is designed to ASME B16.1 Class 125 standards, exceeding the wall thickness requirements of ASME B16.42 Class 150. NIBCO ductile iron valves are rated for susstained operation of 285 CWP when connected to Class 150 flanges.*

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Construction Features

Flanges	NIBCO® Ductile Iron Valves come standard ASME B16.42 Class 150 flanges and the same end-to-end dimensions as Class 125 iron or Class 150 steel valves. Thus Ductile Iron valves can easily replace cast iron or steel valves. NIBCO also offers PN10/16 flanges per BS 4504 and compliant to BS 5150 face-to-face dimensions.
Trim	Bronze ASTM B584, 316 Stainless Steel
Test Pressures	All NIBCO Ductile Iron Valves are tested to MSS requirements in our ISO 9002 quality certified manufacturing plant in Blytheville, Arkansas.
Color	NIBCO Ductile Iron valves are painted green in compliance with API 604.

Features and Benefits

Strength	Ductile Iron is a very strong material when compared to cast iron and comparable to cast steel. Ductile Iron has a higher yield strength than cast steel 40K vs. 30K. The strength of Ductile Iron when compared to cast iron is overwhelming. Ductile Iron tensile strength is 60K vs Cast Iron at 31K. Ductile Iron has yield strength of 40K and cast iron has none.
Corrosion Resistance	Ductile Iron has a corrosion and oxidation resistance in most cases that surpasses cast steel and is slightly better than cast iron. Oxide penetration can severely affect the strength and performance of valves.
Low Transition Temps	Ferrous metals are subject to brittle fractures with severe temperature changes. The chemical composition of NIBCO's Ductile Iron provides transition temperatures to -20°F. This property is important if physical shock loading is present in cold weather applications.
Cost Effective	These unique characteristics make Ductile Iron a cost-effective option for 150 psi steam service as well as hydrocarbon processing up to 650°F/343°C.

Applications

Steam Service	Ductile Iron gate, globe and check valves are excellent choices for 150 psi steam service. Available with ASTM B584 bronze trim and CF8M SS trim.
Hydrocarbon Service	Ductile Iron is an acceptable substitute for cast steel in a wide range of processing services both on the production and refining side up to 650°F/343°C.
General Service	Ductile Iron can substitute for standard Class 125 cast iron where there may be concerns with potential stresses and a stronger material is desired, i.e. in situations of unusual pipe movement due to the system or external forces, such as cold weather, earthquakes, etc. Ductile Iron may be substituted for Class 250 cast iron for intermediate pressure services using steel Class 150 flanges up to 285 psi CWP. (Should save on valve and flange costs.) Ductile Iron is a good choice for general service, fire protection and Hi-rise applications. Has a higher application temperature than PTFE seated flanged ball valves.
Marine Service	For shipboard application and tanker piping, many marine agencies recommend the use of Ductile Iron Valves because of its resistance to shock, vibration and superior corrosion-resistant properties. Approved by DOT and Certificate of Approval from Lloyds Register of Shipping.

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Ductile Iron Valve Specifications

VALVES 2½" AND LARGER — 285 PSI CWP APPLICATION

Gate Valves

Valves to be Class 150 and 285 PSI CWP, tested in accordance with Manufacturers Standardization Society, flanged, bolted bonnet, OS&Y or Non-Rising, Ductile Iron body, bronze trimmed, with body and bonnet conforming to ASTM A395 Ductile Iron. Packing and gaskets to be non-asbestos.

ACCEPTABLE VALVES: NIBCO F-637-31 (OS&Y) or F-639-31 (Non-Rising).

Globe/Angle Valves

Valves to be Class 150 and 285 PSI CWP, tested in accordance with Manufacturers Standardization Society, flanged, bolted bonnet, OS&Y, Ductile Iron body, bronze trimmed, with body and bonnet conforming to ASTM A395 Ductile Iron. Packing and gaskets to be non-asbestos.

ACCEPTABLE VALVES: Straight Globe NIBCO F-738-31; Angle Globe NIBCO F-838-31.

Check Valves

Valves to be Class 150 and 285 PSI CWP, shall be swing-type tested in accordance with Manufacturers Standardization Society, flanged, bolted bonnet, Ductile Iron body, bronze trimmed, with body and bonnet conforming to ASTM A395 Ductile Iron, non-asbestos gasket.

ACCEPTABLE VALVES: Swing-type NIBCO F-938-31; Swing-type with outside lever and spring/weight NIBCO F-938-31-BL&S (BL&W).

VALVES 2½" AND LARGER — HIGH PRESSURE STEAM/HYDROCARBON

Gate Valves

Valves to be Class 150 and 285 PSI CWP, tested in accordance with Manufacturers Standardization Society, flanged, bolted bonnet, OS&Y, Ductile Iron body, 316 SS trimmed, with body and bonnet conforming to ASTM A395 Ductile Iron. Packing and gaskets to be non-asbestos.

ACCEPTABLE VALVES: NIBCO F-637-33.

Globe/Angle Valves

Valves to be Class 150 and 285 PSI CWP, tested in accordance with Manufacturers Standardization Society, flanged, bolted bonnet, OS&Y, Ductile Iron body, bronze trimmed, with body and bonnet conforming to ASTM A395 Ductile Iron. Packing and gaskets to be non-asbestos.

APPLICABLE VALVES: Straight Globe NIBCO F-738-31; Angle Globe NIBCO F-838-31 Bronze Trim for Steam Application ONLY.

Check Valves

Valves to be Class 150 and 285 PSI CWP, shall be swing-type tested in accordance with Manufacturers Standardization Society, flanged, bolted bonnet, Ductile Iron body, 316 SS trimmed, with body and bonnet conforming to ASTM A395 Ductile Iron, non-asbestos gasket.

ACCEPTABLE VALVES: Swing-type NIBCO F-938-33; Swing-type with outside lever and spring/weight NIBCO F-938-33-BL&S (BL&W).

GLOSSARY OF TERMS

Ductility: The ability of a material to become permanently deformed—stretched, drawn, or hammered without failure while maintaining an appreciable load.

Tensile Strength: Measures in force per unit area [i.e. pounds per square inch (PSI)] the ultimate stress that can be withstood by a material in tension prior to failure.

Yield Strength: Measures in force per unit area, the stress at which a material will undergo a permanent change in shape (plastic deformation) in response to an applied force.

Elongation: Measures by percentage, the amount of plastic deformation a material will exhibit in response to a force applied in tension.

Oxide Penetration: The depth of material deterioration or loss displayed along the surface of a metal that is exposed to highly corrosive (oxidizing) environment.

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