KIRSH FOUNDRY INCORPORATED

GRAY, DUCTILE AND MALLEABLE IRON CASTINGS

July 2016

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WELCOME

We are pleased to bring you the July edition of our newsletter. In this issue we focus on cast irons. Described in detail are the varieties of cast irons, each of which has different properties, different manufacturing methods and different costs.

When you finish this article, I hope you have a better understanding of the benefits of each cast iron and which will work for your particular manufacturing process. I look forward to receiving your questions and comments.

- James T Kirsh

CAST IRONS 101

With the economy forcing many companies to change or add to the responsibilities of their personnel we think this is a good time to put forth a primer on how a foundry works. We hope these explanations will assist casting buyers, new to their position, with a basic understanding of our industry.

Cast Irons

The two most common cast irons are gray iron and ductile iron. A third, less common cast iron is malleable iron. Each has different properties, different manufacturing methods and different costs of production. All cast irons are made with the same basic ingredients. They are an alloy of iron, carbon and silicon with smaller amounts of other elements. By varying the amounts of the elements the different properties of each cast iron are produced. Cast irons are melted primarily in electric furnaces, either in a batch or continuous method. The major melt material is steel scrap. Adding alloying elements as needed produces the desired chemistry. The material is tested using a spectrograph to get the chemical analysis and by pouring test bars which are used to record the strength of the iron.

Gray Iron

Gray iron is the most common of all the cast irons in terms of tonnage produced. Gray iron is produced “as-cast.” This means that the iron, after solidification into a part in the mold, has its final properties. The primary difference between gray iron and the other cast irons is that it has no ductility. To illustrate: if you put a piece of gray iron in a vice and hit it with a hammer it would break without bending. It is a brittle material. So gray iron cannot be used anywhere the casting will see an “impact” load. It will break when subjected to this kind of force.

The advantages of gray iron are twofold. First, it is the least expensive cast iron. This makes it ideal for castings such as table bases, counter-weights, covers, and other applications where the properties of the iron are not a primary concern. Second, it has good vibration damping ability. Here such things as gear or transmission housings, bearing housings, and other uses where the casting is holding moving parts are good applications.

Gray iron is defined by its tensile strength. For example, Class 25 or G2500 gray iron has a minimum tensile

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strength of 25,000 psi. Class 30 or G3000 will have a tensile strength of 30,000 psi and so on.

Ductile Iron

Ductile iron is the second most commonly produced cast iron. It differs from gray iron in that it has, as its name implies, ductility. To illustrate: if you put a piece of ductile iron in a vice and hit it with a hammer it will bend over before breaking. Ductile iron starts in the furnace with the same basic chemistry as gray iron. However, the base iron is then mixed with magnesium to produce the ductility. Like gray iron, ductile iron is an "as-cast" material.

The advantage of ductile iron is its ductility. Castings made from ductile iron can take an impact loading without breaking. They have the ability to flex when hit with the impact force.

A common application for ductile iron is gears. The gear teeth can take the sudden impact of starting and stopping. However this ductility comes with an added cost. The magnesium inoculation adds cost to the manufacturing process and adds to the price of ductile iron when compared to gray iron.

Grades of ductile iron are also defined by their properties. However in addition to the tensile strength, the yield strength and elongation percentage are added. Yield strength is the point at which the iron, when bent, will not return to its original shape. The elongation percent measures the amount of ductility. So, ductile iron is defined by three numbers: tensile strength, yield strength, and elongation. Grade 60-40-18 ductile iron has a 60,000 psi tensile, 40,000 psi yield and 18% elongation. Other common grades are 65-45-12, 80-55-06, and 100-70-03.

Malleable Iron

Malleable iron is the third common type of cast iron. It is not used much any more and has, for the most part, been replaced by ductile iron. However, in certain applications, malleable iron has advantages that make it the preferred material. Malleable iron is very similar to ductile iron in that it has malleability or ductility. It also has a similar cost of production so pricing with ductile is very comparable. The difference between the two is in the method of manufacture. Malleable iron starts with a different chemistry and is made with a heat treatment after the iron has solidified. As such it is not an "as-cast" material and the castings, as they come from the mold, are not ready to be used. The heat treatment must be completed first.

The heat treatment though, is the advantage of malleable iron. This homogenizes the iron in the casting making it a more consistent material than ductile iron.

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In applications where the casting has a wide variation in section sizes or has only very thin section sizes malleable iron is the better material. Applications include conduit rings, clamps, or brackets.

The most common grade of malleable iron is 32510. This grade has a 50,000 tensile strength, 32.500 yield strength and 10% elongation. Other grades include 50005, 60004, 70003, and 80002.

KIRSH PRODUCES ALL GRADES

At Kirsh Foundry we produce all the major cast irons. Using our three electric furnaces we pour:

- Gray Iron – Class 30, Class 35, Class 40
- Ductile Iron – 60-40-18, 65-45-12, 80-55-06, 100-70-03
- Malleable Iron – 32510 ferritic and most grades of pearlitic

Specification sheets for each material are available upon request. If you would like more information we invite you to tour our foundry for a more complete overview of how your castings are made. Contact Jim Kirsh at (920) 887-0395 to arrange a visit.

Questions or Comments?

We'd love to hear from you! Please contact:

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