LaBour Taber

PUMPS THAT EXPERTS SELECT.

Materials of Construction
Ductile Iron (ASTM A436-84, (1997))

Because Ductile Iron has so many properties comparable to cast steel, its use in pumps in the chemical process, petro-chemical and petroleum refining fields has been well accepted.

LaBour Pump has highly specialized methods of production and quality control for ductile iron, which has proved to be an outstanding material for the Peerless Model 8196 as well as the LaBour Model LVA process pump.

The basic difference between steel and cast iron is the amount and nature of the contained carbon. Steels contain carbon in the range of 0.12% to 1.70%, and the carbon present may be in the free state as fine spheroidal graphite, mixed in layers consisting of iron and iron carbide (pearlite), or as free iron carbide (cementite). Generally cast iron contains carbon from 3.0% to 3.7% that is predominantly present as flakes of graphite. There also exists pearlite and some cementite. The presence of graphite flakes act to break up the continuity of the metal matrix, causing, in effect, a series of notches that act as stress concentrators, thereby causing brittleness and low strength. If these flakes of graphite could be made to occupy less space and conform to a definite pattern, the metal matrix would have good continuity and the iron would exhibit strength and toughness comparable to steel.

A cast iron which has a tensile strength of 25,000 PSI to 35,000 PSI can be converted to an iron of 60,000 PSI to 100,000 PSI tensile strength and have a good measure of toughness and ductility by proper treatment with magnesium and silicon alloys. These alloys convert the flake graphite to spheroidal graphite. Since a spheriodal shapte presents a minimum surface for a given volume, it produces the least area, and a far tougher and ductile material. This resulting structure is similar to steel and so are its physical properties. This iron is Ductile Iron and is also known as Nodular Iron, S G Iron and Graphitic Steel.
The chemistry of Ductile Iron and cast iron is similar. Precautions however are taken to minimize the impurities such as phosphorous and sulphur and to control the amount of magnesium and silicon present to get the desired physical properties.

Quality Control

Quality control of Ductile Iron is needed to assure the proper base chemistry. Our procedures list the raw feed material to be only pig iron, structural steel scrap, and ductile returns. The quality of Ductile Iron is checked by various means.
At least two standard keel block test blocks are cast from each pour. Castings and keel blocks are then heat treated and checked in the following manner:

1. A Spectrograph is utilized to confirm the chemical analysis.
2. Test bars are machined for physical tests. These bars are subjected to loads to determine the yield strength, and the tensile strength.
3. A test piece is cut for a microscopic analysis.
4. Spot tests, such as fracture test and oxy-acetylene torch cuts are performed on gates and risers of castings as an additional check that LaBour Ductile Iron meets specifications.
5. All castings poured in each heat are identified by cast-on heat numbers and the “DI” symbol. No castings are released from the foundry until the metal quality is confirmed.

Duplicate records are kept in the Metallurgical Office, identifying each casting pour by pattern number, heat number, order number, along with chemical, physical and photo-micrographic analysis. If the customer so desires, test pieces, which have been heat treated with his castings, will be sent to him with order number and heat number cast on.

Should the customer want a test piece, this has to be stated on the original order at the time of order placement. These items are not available after the casting is poured.

LaBour Types of Cast Iron

The LaBour standard type of Ductile Iron is ASTM A-395-98, “Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures”, 60-40-18, (60,000 PSI minimum tensile strength, 40,000 PSI minimum yield strength- 18% minimum elongation. The specification, ASTM 536-84 (re-approved 1993), “Standard Specification for Ductile Iron”, is the most commonly used standard and has five grades (60-40-18, 65-45-12, 80-55-06, 100-70-03, and 120-90-02)

LaBour will also make 60-45-10 and 80-60-03 if required. Type 80-60-03 has an essentially pearlite structure. The structure of 60-45-10 and 60-45-15, however, is mainly ferritic. Type 60-45-15 is fully annealed ferritic Ductile Iron having the greatest ductility of the three types. This makes it the best shock resistant type. Ferritic Ductile Iron can be heated up to temperatures above 1300 deg F and hosed down (quenched) with cold water without cracking.

Ductile Iron vs. Cast Steel

Navy explosion tests show Ductile Iron type 60-45-15 comparable in shock resistance to the ordinary grades of mild carbon steel. Because of its toughness, this type is permitted by the Navy for shipboard applications.
Broadly speaking types 60-45-10 and 80-60-03 have high temperature strength roughly comparable to that of ordinary cast steel up to 800 deg F. The yield strength of 60-45-15 is superior to cast low carbon steel at all temperatures up to 1200 deg F.

The fluidity of Ductile Iron makes it capable of being cast into small or large castings with light or heavy sections or intricate shapes that are difficult to cast in most steel. Castings of Ductile Iron varying from fractions of an ounce to over 50 tons and with sections from 1/8 inch to 50 inch in thickness have been cast successfully.

Corrosion Resistance

The following data was resultant with ductile iron that was inoculated using the International Nickel Company methods using a nickel based magnesium alloy, similar to a Ni-Resist material.

International Nickel Company, Inc., tested various types of iron in a 5% by weight air saturated sulphuric acid solution at 86 deg F for 24 hours. The results suggest that when there is a to be an exposure to acidic solution, Ductile Iron can be expected to perform better than gray cast iron and the greatest improvement will be achieved when the Ductile Iron is annealed to provide a ferritic matrix. Tests have also proven that Ductile Iron resists atmospheric corrosion better than most carbon steels.

The vast majority of ductile iron that is produced is inoculated using a ferro-silicon based magnesium alloy

Summary

Ductile Iron's high strength and toughness has allowed the engineer to design for economy as well as for performance. Ductile Iron should be considered in any application where cast steel has previously been required.

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