THERM-TECH OF WAUKESHA, INC.
HEAT TREATING SPECIALISTS

AUSTEMPERING DUCTILE IRON

We want to present several of the ideas important to the successful austempering of ductile iron to help you decide if this is a market where you can participate. The ideas presented are generalizations - over simplifications - and we would welcome every opportunity to plan specific jobs with you.

APPLICATIONS: Austempered Ductile Iron (ADI) has been successfully applied to a variety of parts. Of great importance to the foundry industry is that much of it has replaced forgings. Specifics follow.

In-ground applications: Farm and construction equipment.
Material handling equipment: Conveyor components, wheels, links.
Gears: Automotive drive trains.
Cam and Crank Shafts.
Heavy duty suspension components: Spring hangers, equalizers.

ECONOMICS: ADI derives its value in any combination of these three areas:
Superior performance in service.
Casting cost advantage over other fabrication methods.
Machining cost advantage of ductile iron over other materials.

TECHNOLOGY: ADI is produced in a range of strengths from 80,000 psi yield to 185,000 psi yield. As the strength increases through this range, the typical elongation drops from 13% to 2%. The following are important considerations:

The machinability of lower strength grades of ADI is reasonable -roughly comparable to steels of the same hardness. When hardness exceeds 321 BHN, parts are best ground. In most cases, it is best to machine parts prior to Austempering.

Dimensional stability is good since the ADI process is "Isothermal." Accordingly, cracking and warpage are rarely issues. Parts, however, do grow about 0.0008 in/in and very predictably, so machining dimensions are easily adjusted to compensate.

Metal chemistry needs to meet only a few criterion. Most important is for the chemistry to be consistent from lot to lot. Second in importance is manganese content which is best kept below 0.35%. Please note that this becomes increasingly important with increasing wall sections. Third is alloying and wall section considerations. To get a good ADI structure through walls greater that 0.75 inches, we usually need a little copper; or occasionally, nickel or molybdenum.

The Austenitizing time and temperature is determined by the metal chemistry.

The ADI strength is controlled by the Austemper time and temperature, and it is not significantly affected by metal chemistry. This means that we can obtain all grades of ADI with one chemistry of iron.

ASTM 897-90 FOR AUSTEMPERED DUCTILE IRON

GRADE	BHN RANGE	U.T.S. (PSI)	YIELD (PSI)	ELONG %	IMPACT FT/LBS	APPLICATIONS
1	269-321	125	80	10	75	Trunions, Hubs, Gears, Levers, Brackets
2	302-363	150	100	7	60	Chain links, Sprockets Crane Wheels
3	341-444	175	125	4	45	Wear plates, Mill liners Plow shoes, Axe heads, Mixer shoes
4	388-477	200	155	1	25	Rock crusher rolls, Chute liners, Rack and pinions, Guides
5	444-555	230	185	N/A	N/A	Break shoes and other high wear applications

Characteristics

Grades 1 through 3 have superior strength without the attending loss of ductility typical of ductile cast iron. Tensile and yield strengths are, in fact, comparable to low alloy steels.

Grades 4 and 5, with higher hardnesses, provide superior wear resistance and can provide cost effective substitutes for many carburized and quenched and tempered steel components.

It is possible, especially in the higher grades, to attain an ADI microstructure which contains some retained austenite. This phase will transform in service just at the working surface which further improves wear resistance.

The modulus of elasticity of ADI is 20% less than that of steel. This results in 40% faster dampening in ADI than in steel. When steel gears are replaced by ADI gears, noise reduction is typically five (5) decibels.

Ductile cast iron is about 10% lighter (less dense) than steel. Replacement of steel components with ADI will reduce weight.