FAQ's for Designing with ADI

What are the most logical applications for ADI?

- Suspension components, brackets
- Hitches, clevises, tow hooks
- Tillage parts, ground engaging components, wear components
- Sprockets, Drive train components
- Undercarriage parts, idlers, rollers
- Hubs, planetary housings,
- Gears

What are the practical limits to section size on an ADI casting?

Because metal casting is a near-net-shape process, it can allow for some highly variable section sizes - sometimes in the same part! The minimum section that can be cast is approximately 0.060" (1.5 mm); although any added thickness to this minimum will aid castability and may reduce cost. Heavier sections (up to several inches) can also be austempered to produce ADI. However, as the section thickness of a component increases, more alloy content (Cu, Ni, Mo) is needed to through-harden or produce an ADI structure throughout the cross-section of the component, ultimately increasing the cost of the base ductile iron. The designer should take every advantage of the casting design process' inherent flexibility to remove section size to avoid this cost penalty for added alloy.

What are maximum section thicknesses that can be through hardened without adding additional alloy for various grades of ductile iron?

The chemistry requirement for each part is unique, but as a rule of thumb, the following suggestions typically work when austempering is completed using a Universal-Batch-Quench-Austemper (UBQA) furnace:

Grade of Ductile Iron (per ASTM A536)	Maximum Section Thickness (inches)
65-45-12	0.75
80-55-06	1.00
100-70-03	1.25

These numbers indicate that most foundries' 80-55-06 iron will produce good ADI in sections up to 1" thick. Keep in mind that all foundries produce these grades of ductile in different fashions, and should confirm with AP whether or not their iron chemistry will be sufficient for the ADI process for a given section modulus.

What is the maximum operating temperature of ADI and what is the maximum high temperature exposure (time) it can handle?

Elevated temperatures should never be applied to ADI as the ausferrite microstructure can rapidly degrade within several minutes when exposed to a high temperature. The maximum temperature limit is dependent on the grade of ADI to be used. In general, the following maximum temperature guidelines will not degrade ADI properties with an exposure of up to 1000 hours.

Grade of ADI (English Units / SI Units)	Maximum Temperature Exposure (Results to 1000 hours)
GR 130-90-09 / GR 900-650-09	550°F / 288°C
GR 150-110-07 / GR 1050-750-07	500°F / 260°C
GR 175-125-04 / GR 1200-850-04	450°F / 232°C
GR 200-155-02 / GR 1400-1100-02	400°F / 204°C
GR 230-185-01 / GR 1600-1300-01	350°F / 177°C

Can you weld ADI?

The short answer is “no”. Welding of any cast iron is generally NOT considered a desirable practice; although some people will tell you that it can be done with sufficient preheat, selection of the correct welding rod and the use of proper welding procedures. Keep in mind that when you weld an ADI component, you are applying another high temperature heat treatment on top of something that has already been heat treated. If welding must be done, then it should be completed before austempering.

Can you hardface ADI?

ADI has been successfully hardfaced with excellent performance results. The key is to austemper AFTER hardfacing. This results in a key benefit, which is that the austempering heat treatment erases the heat affected zone, which means better adherence of the overlay.

What are the size changes associated with ADI?

When the ausferrite microstructure of ADI forms, it happens over time at one temperature. As a result, a uniform transformation occurs i.e. the component grows, but will not quench crack. The growth that occurs is dependent upon the starting microstructure (Pearlite/Ferrite ratio) and the grade of ADI to be produced. Contact AP for more information on this.

Can austempering be used to salvage a heat of substandard ductile iron?

No and maybe!! The effects of substandard microstructures in ductile iron are magnified in ADI. Austempering can make good iron great but it cannot make bad iron good. Occasionally a new casting will be designed in as-cast ductile iron (like 80-55-06) and will go into service. The OEM might discover that the 80-55-06 material is not sufficient for the job but it is too late to redesign the part. Parts like these are often re-specified in ADI to avoid the time and expense of redesigning the as-cast component.

What do I need to know about environmental embrittlement?

Environmental Embrittlement is NOT an exclusive “ADI phenomenon” as all higher strength grades of ductile iron have been shown to exhibit some susceptibility to environmental embrittlement. Only those grades that are dominated by a ferritic microstructure (60-40-18 and 65-45-12) exhibit no sensitivity. AP has a separate document that provides more detailed information titled, “Observations on Environmental Embrittlement of Ductile Iron and ADI”. Please contact AP for a copy.