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# CAST IRON – "IMPROVING THE WELDABLITY OF DIFFICULT TO WELD METALS / JOINTS"

**Cast iron definition**

Cast iron is the alloy of Iron and Carbon, in that carbon percentage will be in the range from two to four percent. It contains either inclusion of pure carbon or hard phases that contains high level of combined carbon. It can be classified as follows on the basis of graphite morphologies (or shapes of the graphite inclusion).

1. Gray Cast Iron - Carbon as graphite
2. White Iron - Carbides, often alloyed
3. Ductile Cast Iron - Nodular or Spheroidal graphite
4. Malleable Cast Iron - Irregular shape of nodular graphite

## Weldabilty ratings

Welding of cast iron is generally restricted to repair of castings in a foundry and welding of parts that are fractured or worn out in service. Fabrication of cast iron components is rare and mostly nodular cast iron is used.

## Product Update

### Thyroluxe 401 / 600

Better arc stability over a wider bandwidth of input supply fluctuations

Choice of heavy duty model to take care of both welding & gouging (for 600 model only)

### Champ 400


Inverter based digitally controlled

**Weldability of Cast Iron is therefore limited and depends on following factors:**

1. Type of Material
2. Thickness of the casting
3. Complexity of the casting
4. Machinability

**Considering the above factors, different types of cast iron have different weldability characteristics:**

1. White Cast Iron. This is generally not weldable; some small attachments can be welded
2. Gray Cast Iron .Weldability is better than for grey cast iron, but is still low and restricted to salvage and repair. Special care has to be taken while welding grey cast iron
3. Ductile and Malleable cast irons. Because of their higher ductility, these cast irons are easier to weld than grey cast iron (nodular cast iron has better weldabiltiy than malleable cast iron) however this weldabilty is Inferior to weldability of structural steel

**Typical composition of different cast irons is:**

| TYPES | STANDARD | CHEMISTRY (Typical) |
|---|---|---|
| **Gray Cast Iron** | GG DIN 1691 | C - 3.3 ; Si - 2.0 ; Mn - 0.6 ; S - <0.02 |
| **Malleable Cast Iron** | GTS DIN 1692 | C - 2.5 ; Si - 1.4 ; Mn - 0.4 ; S - <0.02 |
| **Ductile Cast Iron** | GGG DIN 1693 | C - 3.6 ; Si - 2.5 ; Mn - 0.4 ; S - 0.01 ; Mg - 0.04 |
| **Cast Steel** | DIN 1681 | C - 0.3 ; Si - 0.4 ; Mn - 1.0 ; S - 0.03 |

## Application fields

**Various Cast iron types are playing a vital role in following fields.**

| FIELD | CAST IRON MAIN PARTS |
|---|---|
| **Marine** | Cast Iron Welding Services repair cylinder heads, cylinder covers, turbocharger casings, liners, exhaust housings, valve cages, exhaust manifolds and gypsy chain wheels. |
| **Industrial Repairs** | Ranging from small cast iron brackets, flanges, Stator bodies and portable machines etc., to large capital plant; presses, gearboxes, pump housings, valve bodies, compressor heads, machine tools etc. |
| **Power Generation** | Pumps, gearboxes, pipes, valve housings, flanges, turbine housings, cylinder heads, turbocharger casings, blowers, crushers, liners, engine blocks, manifolds, bearing pedestals etc. |
| **Steam Locomotive and Traction engines** | Steam chests, chimney stacks, cylinder blocks, steam inlet and outlet ports, PTO units, flywheels, and pulleys etc |
| **Classic Motor vehicles** | Valve seats, manifold lugs and bearing locations etc. |

## Reasons for poor weldability

**The two main reasons for poor weldability of cast irons are:**

1. **Hardness inducing Microstructure formation** - Carbides and High carbon Martensite in HAZ. This leads to cracking in HAZ. This is applicable to all types of cast iron
2. **Poor ductility** -Not capable of local plastic deformation and accepting accompanying thermal stresses. Grey iron

is prone to cracking in this account, while malleable and nodular irons are less so because of their better ductility

## Improving weldability of cast iron

**To overcome the above two limitations, forthcoming two factors need to be observed during welding process:**

1. **HAZ Hardness reduction** - Resort to the combination of preheating and slow cooling after welding
2. **HAZ Cracking diminution -** Width of the hard and brittle zone next to the weld can be reduced by using low heat input during welding process

## Selection of welding electrodes for welding cast irons

For manual metal arc welding, the electrodes can be of mild steel, pure nickel, monel and ferro nickel.

The mild steel electrode is low hydrogen, basic coated electrode, E7016 type, that picks up carbon from the base metal and the weld deposit hardens because of the carbon pick up. The weld deposit is non machineable and has a tendency to crack under restraint. To avoid cracking of weld deposit, heat input is maintained low by using low currents and preheat of job being welded is advised.

In the case of nickel, monel and ferronickel electrodes designed for welding of cast irons, the weld metal picks up carbon well above the solubility limit and the excess carbon is rejected as graphite as the weld metal solidifies. This results in reduction of the residual stresses in the weld metal as well as HAZ, there by reducing the tendency of weld metal and HAZ to cracking. The deposit of monel and nickel electrodes is softer than that of ferronickel electrodes; the heat input is low because electrodes are used at lower currents than for mild steel electrodes and very often no or very little preheating is required. Hence these are commonly referred to as “cold welding electrodes”. The deposit of ferronickel electrodes is stronger, is more ductile and is more resistant to hot cracking. In cases where cast components are

fabricated, a ferronickel electrode is a preferred choice. Preheating is advisable in case of thick sections.

**AWL electrodes for welding cast irons**

| TYPES | AWS A/SFA 5.15 | CHEMISTRY (Typical) | COATING TYPE |
|---|---|---|---|
| **CASTEN** | E St | C - 0.08 ; Si - 0.1 ; Mn - 0.45 ; Fe - Rem. | Graphite basic |
| **CASTMONEL** | E NiCu-B | C - 0.8 ; Fe - 2.5 ; Ni - 68 ; Cu - Rem. | Graphite basic |
| **CAST NICKEL** | E Ni-CI | C - 0.8 ; Ni - 97 ; Cu - 2.0 ; Mn - 0.7 ;Fe - Rem. | Graphite basic |
| **FERRI CAST** | E NiFe-CI | C - 1.2 ; Ni - 50 ; Mn - 0.6 ; Fe - Rem. | Graphite basic |

Please click on the electrode name to know more about the special features of the respective electrode.

Please contact us at cmo@adorians.com for more details on this subject and for help in selecting the right consumables for these applications.

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