

Engineered CG Iron

A Solution for Less Leaks & Cracks from Doors & Jambs

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WHAT IS CG-IRON ?

**Comparison of mechanical & physical properties between gray iron,
compacted graphite iron and ductile/nodular iron
in ambient temperature**

PROPERTIES	GRAY IRON	CG IRON - Vermicular (COMPACTED GRAPHITE IRON)	DUCTILE IRON
Tensile Strength (psi)	15,000 ~ 30,000	30,000 ~ 90,000 (RAMM foundry 54,300)	60,000 ~ 100,000
Yield Strength (psi)	Low	15,000 ~ 55,000	40,000 ~ 70,000
Elongation	1 % max	1 ~ 5 % (RAMM frdy 1.5-2.0%)	3 ~ 20 %
Hardness HB	187-269	150-250	229-300
Fatigue Strength (psi)	18,000 max	20,000 ~ 35,000	35,000 min
Impact toughness (J/cm ²)	9-11	11-20	15-40
Transverse resisting fatigue strength (MPa)	140 max	170 min	190 min
Thermal Conductivity (cal/cm . s . °C)	0.12 ~ 0.14	0.10 ~ 0.115	0.08 ~ 0.095
Oxide Penetration	High	Intermediate	Low

What are the benefits

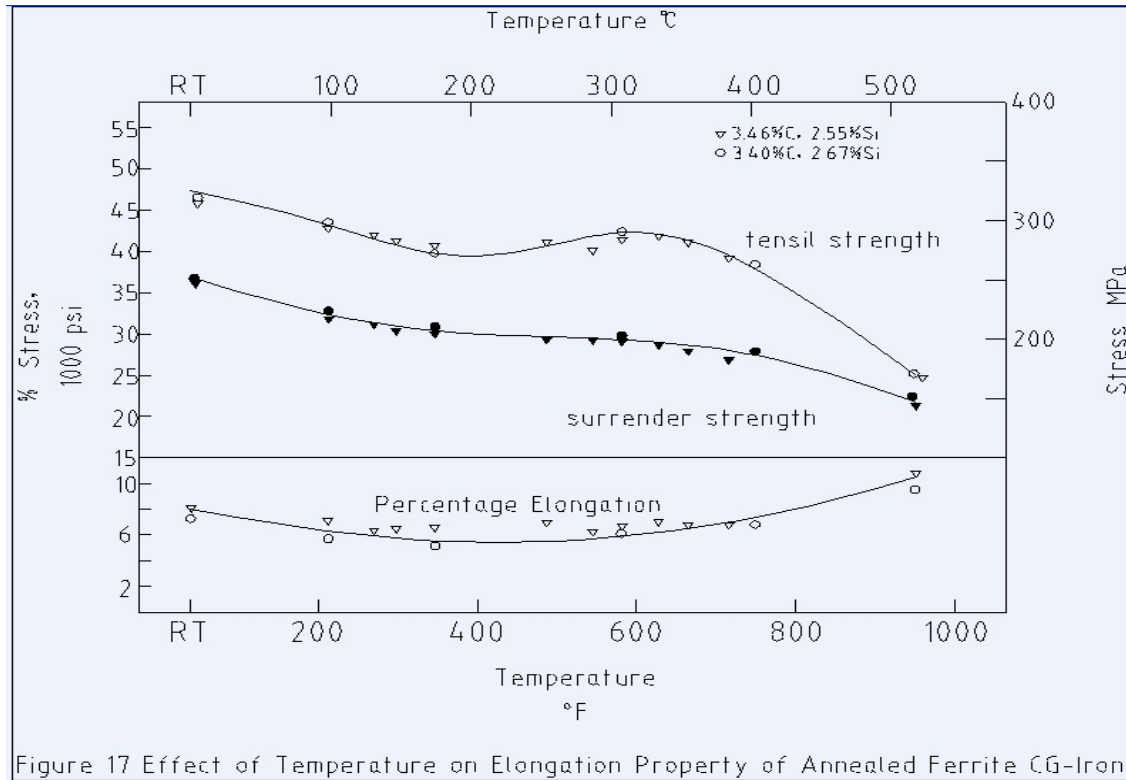
- **CG IRON VS. GRAY IRON**

- **Resists cracks-CG iron will not break under frequent “hot and cold” changing environment while the chrome heat-resisting gray iron trends to break under the same condition.**
- **The heat resistance fatigue performance is much higher for CG iron than gray iron.**
- **Resist wear-CG jambs resists wear from cleaning equipment**
- **The Strengths, Hardness and Impact toughness is much higher that gray irons. This gives CG Iron jambs much better resistance to wear from cleaning equipment.**

- **CG IRON VS. DUCTILE IRON**

- **No warpage (no deformation) due to stable elongation-resists deformation resulting from the heating/cooling cycle.**
- **CG jambs can be taken out of service for repairs on the battery and reused without warping.**
- **The CG iron doors and jambs made by our supplier perform with no leakage of gas for 15 years or more**

**Elongation and Mechanical Strength of
CG Iron vs. Temperature**



Tensile Strength of gray iron in temperatures over 500 °C: Less than 100 MPa
(It's the main reason of why gray iron parts crack earlier than CG-Iron parts)

Elongation of ductile/nodular iron in temperatures over 500 °C: More than 20%
(It's the main reason of why nodular iron parts deform earlier than CG-Iron parts)

How do you know when you have good CG iron?

- **The CG iron phase has been known throughout the world for many years but very few companies have the process control to mass produce CG iron castings. Our Chinese foundry is the only foundry that has achieved control of the mass production process for coke oven castings.**
- **One of the key process control variable for CG iron is the % worm shape achieved in the final Metallography. the RAMM foundry has perfected their worm analysis system.**
- **The RAMM foundry Standard is 70% \pm 5%. The world class performance that the RAMM foundry achieves is based on providing castings with 70% \pm 5% of the graphite worm shape.**
- **As an example of the worm shape control for Jambes purchased by Mittal-Warren. The average for the 15 jambes was 73.3% worm shape with the low of 65%.**
- **Mittal-Warren is very pleased with the castings to date and also has remarked about the quality of the as received castings being the best that they have seen.**
- **The other key process control innovations are:**
 - **The Heat Analyzer – a proprietary development that controls the temperature and weight of the liquid iron prior to pouring to give the final graphite worm shape of 70% \pm 5%.**
 - **The Special Heat Treatment Cycle- stabilizes the Ferritic portion of the metallic matrix. The stabilized matrix keeps the elongation low even in high temperatures in service avoiding deformation and leaks of gas.**

SUMMARY

- **The RAMM foundry produces the optimal CG iron for Coke Oven Castings. After many years of development, the 70%± 5 graphite worm shape is the best for coke oven castings.**
- **The RAMM foundry has developed the best process control system to provide stable CG Iron. Three (3) key components of the process control system are:**
 - **Worm Analysis System**
 - **Heat Analyzer**
 - **Special Heat Treatment**
- **The RAMM foundry standards- Control the**
 - **Percentage graphite worm shape and**
 - **Percentage Pearlite,**
 - **Percentage Ferrite,**
 - **Percentage Carbide of the matrix to make the best CG iron for coke oven castings.**
- **The RAMM foundry has been making coke oven castings for 4.3m batteries since the early 1990's and 6m batteries in high volumes for over 12 years. Currently they are producing parts for 7.63m batteries.**
- **The RAMM foundry has the technology to give coke oven castings long life with no warpage or cracking.**



Image Legend

1. Lev Doors & Frames
2. Frames
3. Charging Hole Frame
4. Ascension Pipe Elbow
5. 7.63M Doors & Frames

