PRAYAS 2018

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Dear Customer,

For over 150 years, the Tata Group has been led by visionaries who have stayed true to the vision of the Founder, Jamsetji Tata. A vision that placed the greater good of society a few steps ahead than the business growth. A vision which put into practice pioneering social initiatives that changed the way responsible businesses run and a vision that instilled into the Group a strong social conscience.

Tata Metaliks Limited (TML), as part of the Tata Group, has consistently adhered to the values and ideals articulated by the Founder for over 150 years. Tata Code of Conduct (TCOC), first crafted in 1998 under the visionary leadership of Mr.Ratan Tata, defines a value system which has endured since the Group was founded in 1868.

Today, the Code is the bedrock on which we base our individual, as well as leadership commitments to core Tata values. The Tata Code of Conduct outlines our commitment to each of our stakeholders, including the communities in which we operate, and is our guiding light when we are sometimes faced with business dilemmas that leave us at ethical crossroads. The Code is also dynamic and has been periodically refreshed in order to remain contemporary and contextual to the changes in laws and regulations. However, it remains unaltered at its core.

Our stellar reputation and success as a business entity has been defined by the powerful commitment and adherence to the core values and principles expressed in this Code, by all our employees, directors and partners. TML has a robust complaint/grievance mechanism for employees, suppliers, customers and stakeholders. TML also has in place `Whistle Blower Policy' governing actions of TML and its employees.

We, at TML, assure you that all our colleagues who interact with you during the course of any transaction, will conduct business in the most transparent, fair and ethical manner. However, if still there is any issue related to ethics, it may be placed by means of phone calls, letters, email and even meeting with the Ethics Counsellor wherein all identity will be kept confidential.

We look forward in nurturing an ethical partnership with a concerted business progress.

Our contact details are as follows :
Email: ethics.counsellor@tatametaliks.co.in
Phone No: 033-66134264 (P&T)
Toll Free No: 1800 103 2931
Access Code: 26791

Subhra Sengupta
CFO, Ethics Counsellor

CONTENTS

EDITORIAL

Dear Readers,

Greetings from Kolkata,

In the interest of time, change is the only constant. Even yesterday`s knowledge may not be helpful in solving the problems of today. It is this eclectic knowledge that leads to growth.

India has surpassed US to become the 2nd largest Casting producer nation in the world. The Indian Foundry Industry needs to increase productivity of foundries by implementing greener technology in various processes. Primary challenges, in front of the Indian Foundry Industry, are to be globally ready in terms of technology and quality of castings.

Rapid development in manufacturing technologies in Aerospace, Defence, Agriculture, Energy, Mining and Construction necessitate production of lightweight, thin- walled & critically engineered castings. In addition, increasing requirements for energy efficiency and stronger emission regulations will support migration towards greener technologies.

In this issue of **Prayas**, we are covering types of Cast Iron, its application & suitable Tata eFee grades. We hope that this issue of Prayas will assist you in terms of understanding various types of Cast Iron, their usage in different industry segments and selection of right Tata eFee grade for its production.

For further consultation & availing our services, we request you to kindly remain in touch with our Customer Service Centre.

Regards
Savvy Trivedi
& Roshni Khatri

CSR INITIATIVES
Foundries of our Customers

In line with our *"Tata Way" of giving back to the society it serves"*, TML has implemented a one-of-its-kind marketing led CSR initiative within TML's business environment to safeguard the health and safety of Foundry Workers in Howrah area. We are pleased to share with you that we have so far conducted health camps in 8 foundries, touching lives of 914 foundry worker till July'18 towards this one of its kind initiative.

The camps organized created positive advocacy among the Howrah foundry fraternity - the response from both the foundry workers and their owners was overwhelming and they have requested us to conduct similar camps on a regular basis. The health camp would not have been possible without the enthusiastic support and cooperation from the respective foundry owners apart from TML's CSR team, medical team, Narayana Multispecialty Hospital and a strong team of untiring TML volunteers from both the Kolkata HO and Kharagpur. In continuation, we plan to cover > 700 lives in 6 more foundries in Q2 FY19.

CAST IRON TYPES, APPLICATIONS AND SUITABLE TATA EFEE GRADES

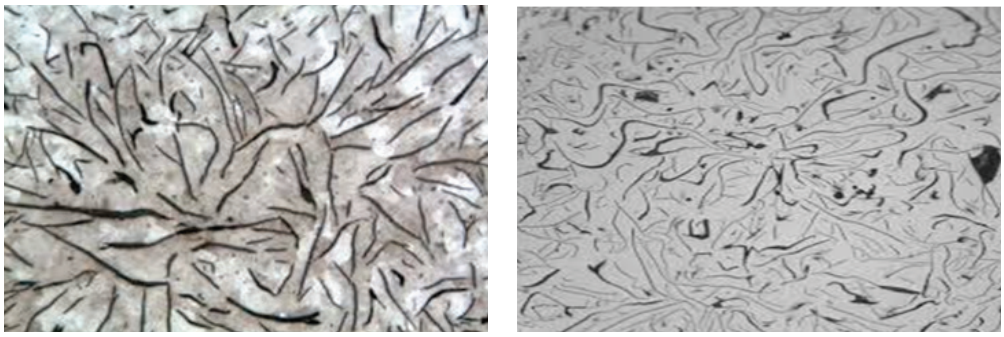
The best method of classifying cast iron is according to metallographic structure. There are four variables to be considered which lead to the different types of cast iron, namely the carbon content, the alloy content, the cooling rate during cooling and the heat treatment after casting. These variables control the condition of the carbon and also its physical form. The carbon may be combined as iron carbide in cementite or it may exist as free carbon in graphite. The shape and distribution of the free carbon particles will greatly influence the physical properties of the cast iron. The types of cast iron are as follows.

1. **Grey Cast Iron**
2. **White Cast Iron**
3. **Malleable Cast Iron**
4. **Chilled cast Iron**
5. **Nodular Cast Iron**
6. **Alloy Cast Iron**

GREY CAST IRON

This is one of the most widely used cast iron. In the manufacturing of grey cast iron, the tendency of cementite to separate into graphite and austenite or ferrite is favoured by controlling alloy composition and cooling rates.

Most grey cast iron contains 2.5 to 4.0% carbon. The graphitization process is aided by high carbon content, high temperature and proper amount of graphitizing elements notably silicon. The graphite appears as many irregular, generally elongated and curved plates which give grey cast iron its characteristic grayish fracture. The strength of grey cast iron depends almost entirely on the matrix in which the graphite is embedded. The constitution of the matrix may vary from pearlite, through mixtures of pearlite and ferrite in different proportions, down to pure ferrite. The graphite-ferrite mixture is the softest and weakest grey iron, the strength and hardness increases with the increase in combined carbon, reaching a maximum with the pearlitic grey iron.



Microstructure of Grey Cast Iron

APPLICATIONS:

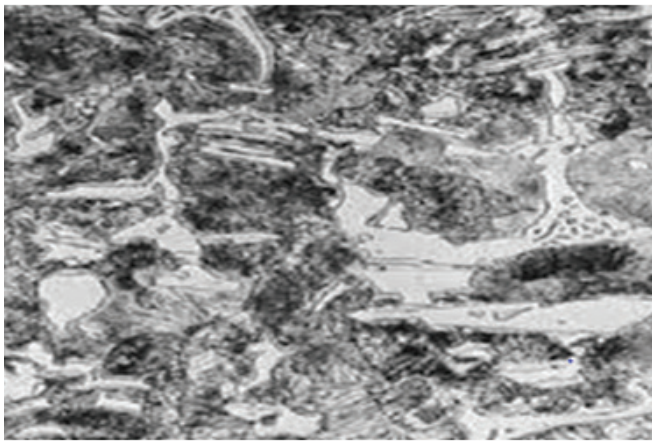
Because grey iron is the least expensive type of casting, it should always be considered first when a cast metal is being selected, for example- counter weights for elevators and industrial furnace doors, Automobile castings like fly wheels, cylinder blocks, gear housings, enclosures, pump housings, steam turbine housing, motor bodies, end covers, fire hydrants, sanitary castings etc.

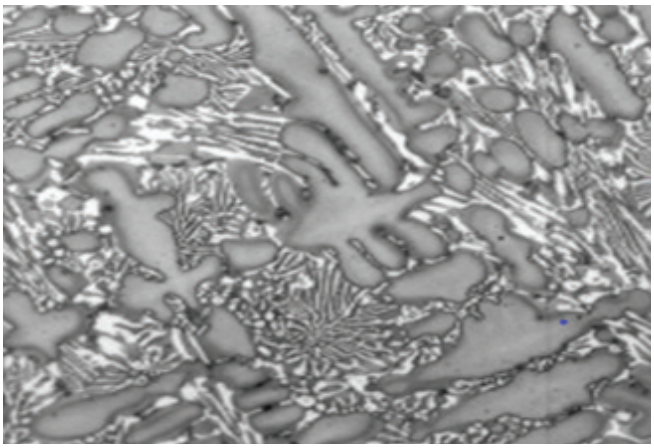
SUITABLE PIG IRON GRADES FOR GREY CAST IRON:

Grade	Matl. Code No.	Carbon (%)	Silicon (%)	Manganese (%)	Sulphur (%)	Phosphorus (%)
FG – I	Tata eFee® 101	3.5 Min.	2.00 - 2.25	0.50 - 0.90	0.06 Max.	0.20 Max.
FG - Low Phos	Tata eFee® 102	3.5 Min.	2.00 - 2.50	0.50 - 0.90	0.06 Max.	0.10 Max.
FG – II	Tata eFee® 103	3.5 Min.	2.25 - 2.50	0.50 - 0.90	0.06 Max.	0.20 Max.
FG -High Mn	Tata eFee® 104	3.5 Min.	2.00 - 2.50	0.90 -1.50	0.06 Max.	0.20 Max.

WHITE CAST IRON

White Cast Iron is the iron which has all the carbon is in the combined form as cementite. All white cast iron are hypoeutectic alloys. The typical microstructure of white cast iron, consisting of dendrites of transformed austenite in a white inter-dendritic network of cementite. As the cementite is hard, brittle interstitial compound and white cast iron contain a relatively large amount of cementite as a continuous inter- dendritic network, it makes the cast iron hard and wear resistant but extremely brittle and difficult to machine.





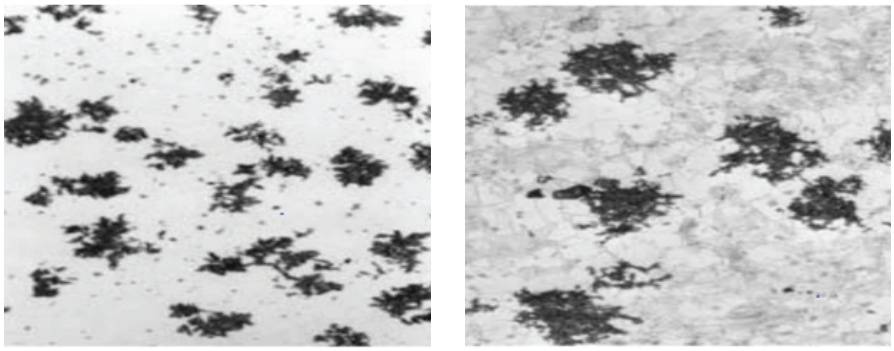
Micrtostructre of White Cast Iron

SUITABLE PIG IRON GRADES FOR WHITE CAST IRON:

Grade	Matl. Code No.	Carbon (%)	Silicon (%)	Manganese (%)	Sulphur (%)	Phosphorus (%)
FG – I	Tata eFee® 101	3.5 Min.	2.00 - 2.25	0.50 - 0.90	0.06 Max.	0.20 Max.
FG - Low Phos	Tata eFee® 102	3.5 Min.	2.00 - 2.50	0.50 - 0.90	0.06 Max.	0.10 Max.

MALLEABLE CAST IRON

The purpose of malleabilization is to convert all the combined carbon in white iron into irregular nodules of temper carbon and ferrite. The cementite is a metastable phase, there is a tendency for cementite to decompose into iron and carbon, but under normal conditions it tends to persist indefinitely in its original form and this tendency to form free carbon is the basis for the manufacture of malleable cast iron.



Microstructre of Malleable Cast Iron

The reaction Fe3C = 3Fe + C is favoured by elevated temperatures, higher carbon content and the existence of solid non-metallic impurities. The malleabilization process is carried out in two steps known as the first and second stages of anneal. In the form of compacted nodules, the temper carbon does not break up the continuity of the tough ferritic matrix, this results in higher strength and ductility than exhibited by grey cast iron. The graphite nodules also serve to lubricate cutting tools, which accounts for the very high machinability of malleable cast iron.

APPLICATIONS:

Axle, differential housings, cam shafts and crank shafts for automobiles, gears,chain links, sprockets, elevator brackets in conveyor equipment for rolls, pumps, nozzles, cams, rocker arms,gun mounts, tank parts and pistol parts in ordinance, tools such as wrenches,hammers, clamps and shears.

SUITABLE PIG IRON FOR MALLEABLE CAST IRON:

Grade	Matl. Code No.	Carbon (%)	Silicon (%)	Manganese (%)	Sulphur (%)	Phosphorus (%)
FG – I	Tata eFee® 101	3.5 Min.	2.00 - 2.25	0.50 - 0.90	0.06 Max.	0.20 Max.
FG - Low Phos	Tata eFee® 102	3.5 Min.	2.00 - 2.50	0.50 - 0.90	0.06 Max.	0.10 Max.

CHILLED CAST IRON

Chilled Iron Castings are made by casting the molten metal against a metal chiller, resulting in a surface of white cast iron. This hard, abrasion resistant white iron surface or case is backed up by a softer grey iron core. This case-core structure is obtained by careful control of the overall alloy composition and adjustment of the cooling rate. The cooling rate is most rapid where the molten metal is in contact with the mould walls and the cooling rate decreases as the centre of the casting is approached. If only selected areas are to be white iron, it is a common practice to use metal liners (chills) to accelerate the cooling rate of the selected areas. The depth of the white iron layer is controlled by thickness of the chills.

APPLICATIONS:

Chilled Cast Iron castings are used in railway car wheels, crushing rolls, stamp shoes and dies, sprockets and heavy duty machinery parts.

SUITABLE PIG IRON GRADES FOR CHILLED CAST IRON:

Grade	Matl. Code No.	Carbon (%)	Silicon (%)	Manganese (%)	Sulphur (%)	Phosphorus (%)
FG – I	Tata eFee® 101	3.5 Min.	2.00 - 2.25	0.50 - 0.90	0.06 Max.	0.20 Max.
FG - Low Phos	Tata eFee® 102	3.5 Min.	2.00 - 2.50	0.50 - 0.90	0.06 Max.	0.10 Max.

NODULAR CAST IRON

Nodular Cast Iron also known as Ductile Iron, Spheroidal Graphite Iron and Spherulitic Iron, is cast iron in which the graphite is present as tiny balls or spheroids. The compacted spheroids interrupt continuity of the matrix much less than graphite flakes, this results in higher strength and toughness compared to a similar structure of grey iron. Nodular Cast Iron differs from malleable iron in that it is usually obtained as a result of solidification and does not require heat treatment. These spheroids are more rounded than the irregular aggregates of temper carbon found in malleable iron.

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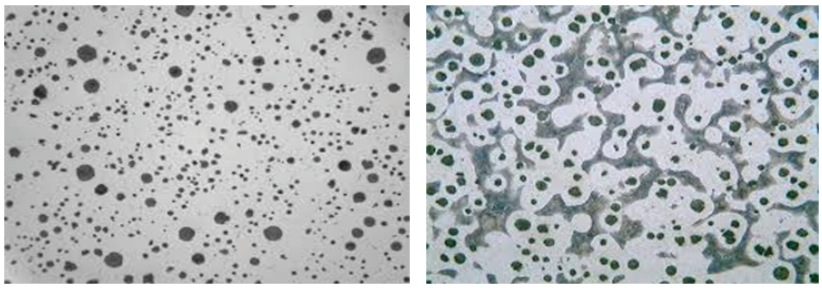


Microstructure of Nodular Cast Iron

Spheroidal graphite particles form during solidification because of the addition of a small amount of magnesium or cerium to the ladle just before casting. Since these elements have a strong affinity for sulphur, the base metal sulphur must be below 0.02 % for the treatment to be effective.

The amount of ferrite in the cast matrix depends on composition and rate of cooling. Nodular iron with a matrix having a maximum of 10% pearlite are known as Ferritic Iron. This structure gives maximum ductility, toughness and machinability. A matrix structure which is largely pearlite can be produced as cast. These are stronger but less ductile than ferritic irons.

APPLICATIONS:

Typical applications of nodular iron are agricultural, tractor parts, automotive and diesel-crank shafts, pistons and cylinder heads, electrical fittings, switch boxes, motor frames, circuit breaker parts, mining-hoist drums, drive pulleys,, fly wheels and elevator buckets. Pipes and pipe fittings for potable water and sewerage, dies for shaping steel, aluminium, brass, bronze and titanium.

SUITABLE PIG IRON GRADES FOR NODULAR IRON:

Grade	Matl. Code No.	Carbon (%)	Silicon (%)	Manganese (%)	Sulphur (%)	Phosphorus (%)
SG	Tata eFee® 201	3.5 Min	1.60 - 2.50	0.30 Max.	0.05 Max.	0.08 Max.
SSG	Tata eFee® 202	3.5 Min.	1.60 - 2.25	0.20 Max.	0.025 Max.	0.08 Max.
SSG Ultra Low S	Tata eFee® 203	3.5 Min.	1.60 - 2.25	0.20 Max.	0.015 Max.	0.08 Max.

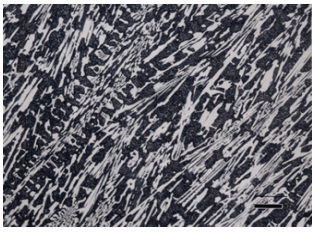
ALLOY CAST IRON

An Alloy Cast Iron is one which contains a specially added element or elements in sufficient amount to produce a measurable modification in the physical or mechanical properties. Elements normally obtained from raw materials such as silicon, manganese, sulphur and phosphorous are not considered alloy additions.

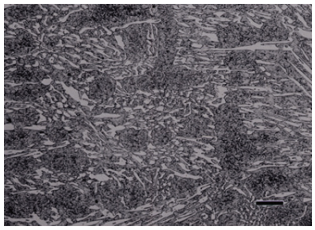
Alloying elements are added to cast iron for special properties such as resistance to corrosion, heat or wear and to improve mechanical properties. Most alloying elements in cast iron will accelerate or retard graphitisation and is one of the important reasons for alloying. The most common alloying elements are chromium, copper, molybdenum, nickle and vanadium.

APPLICATIONS:

Thermal power plant castings, Nuclear reactor castings, exhaust manifolds for automobile engines, cooling tower castings for power plants, ash handling plant castings steam turbine castings, boiler parts, castings for mining industry and pipe lines for chemical and pharmaceutical industries.



Microstructure of an alloy cast iron
(Fe – 3.1% C – 0.8% Mn -1%
Si – 18.6% Cr – 2% Mo)



Microstructure of an alloy cast iron
(Fe – 2.8% C – 0.7% Mn – 0.5% Si -25.9%
Cr – 0.2% Ni – 0.1% Mo)

SUITABLE PIG IRON GRADES FOR ALLOY CAST IRON:

Grade	Matl. Code No.	Carbon (%)	Silicon (%)	Manganese (%)	Sulphur (%)	Phosphorus (%)
FG – I	Tata eFee® 101	3.5 Min.	2.00 - 2.25	0.50 - 0.90	0.06 Max.	0.20 Max.
FG - Low Phos	Tata eFee® 102	3.5 Min.	2.00 - 2.50	0.50 - 0.90	0.06 Max.	0.10 Max.
FG – II	Tata eFee® 103	3.5 Min.	2.25 - 2.50	0.50 - 0.90	0.06 Max.	0.20 Max.
FG -High Mn	Tata eFee® 104	3.5 Min.	2.00 - 2.50	0.90 -1.50	0.06 Max.	0.20 Max.

CUSTOMER SPEAKS

" We have been associated with Tata Metaliks Ltd Kharagpur for almost the past two decades. Apart from the all round support that TML provides in quality and service and support, we are also appreciative of the CSR activities carried out by them. They have carried out a very successful health camp at our factory premises for our staff and labour in the form of free health check up and medicines which is extremely commendable. Furthermore, we have attended their ethics month programme in July which proves they believe in ethical business practices and promote the same. We are proud of being associated with TML and look forward to continuation of this fruitful relationship."

Mohit Beriwal
Director:Vinayak Founders Pvt Ltd.

Our relationship with Tata Metaliks Ltd. dates back to 2004. The first pig iron used by us at the inauguration of our foundry was TML and since then there was no looking back. TML provides us all grades of pig iron with consistent quality. TML delivers what it promises. The dealings are very fair and transparent. The officers are very professional, helpful and customer oriented. TML does not just sell pig iron, it provides customer satisfaction – it provides technical support both for cupola operations and moulding, it also provides medical care for labourers of foundry industry as part of CSR. TML treats its customers as part of an extended family – invites us for their customer meets, conducts plant visit and seminars on ethics etc. TML has a holistic approach towards foundry.

Yashwant Ruia
Keith Cermaics India Pvt. Ltd

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