FORE WARD

India is presently the fifth largest producer of Steel in the World. Indian Steel industry has ambitious growth plans for capacity expansions both green-field and brown-field. It is expected that India will be next to China only in next ten years if the growth plans as envisaged materialize.

The expansions of Indian Steel Industry will require large number of technical and trained personnel that will be needed for these ambitious growth plans. Technical inputs and trained manpower needs can never be over-emphasized. Shri S C Suri, a metallurgist and steel technologist of long standing, has taken the initiative to document and compile the glossary of Iron and Steel Making Terminology in language that are easily understandable. These technical terms are used by Iron and Steel makers having long working experience, but knowing little that a new entrant in the field requires guidance and provision of inputs that are easily understood and can help better to appreciate the real meaning of these terminologies. It is felt that this small booklet will serve the needs of young professionals to understand and appreciate the wonderful world of Iron and Steel technology.

I wish to compliment Shri S C Suri for undertaking this initiative and congratulate him for this compilation effort.

(Raj Tiwari)

Chairman, IIM-DC

PREFACE

There have been almost revolutionary changes in the global steel scene with fierce competitive pressures on performance, productivity, price reduction and customer satisfaction.

Steel industry is expanding in a big way in the South Asian region with their share encompassing almost two-third of the Global Steel production. South Asia has become the region of Steel Growth . India which has presently a capacity of around 65 Million Tonnes has development plans to produce over 200 Million Tonnes by 2020.

The requirement of trained and technical manpower to achieve this large expansion in steel capacity is a critical need and cannot be over emphasized.

In order to understand and appreciate the basic nuances of Iron and Steel technology, understanding and appreciating the Iron and Steel technology terms is a must.

After having worked for number of years in Indian steel industry, it is strongly felt that there exists a need for explaining to young professionals and students the implications of different technologies and terminologies which we so often use caring little for the needs of student and young professionals entering this wonderful arena.

I have received help from my several colleagues to prepare this small booklet. I wish to thankfully acknowledge the help of IIM-DC who have agreed to get this small document published free of cost.

This is a labour of love for the young metallurgical professionals and I trust this publication will meet their long felt need and requirement.

S C Suri

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Compiler Background

Shri S C Suri is a former Executive Director of SAIL and a Life Fellow of The Indian Institute of Metals. He has extensive experience in Iron and Steel operations, R&D Technology Management, Project Formulation and Design. He has authored several technical papers and reports, he has also authored a book titled “Indian Steel Perspective 2025”.

Shri S C Suri is a Chemistry (Hons) Graduate of Delhi University and a Post Graduate in Metallurgy from Indian Institute of Science, Bangalore.

GLOSSARY OF TERMS/ DEFINITIONS COMMONLY USED IN IRON & STEEL INDUSTRY

(i) Terms Related To 'IRON':

Iron

Iron is a base metal extracted from iron ore. Pure iron has melting point of 1530 Degree Centigrade and density of 7.86 gm/cc.

Iron Making

Iron making is the process of **Reduction of iron ore** using the relevant reducing agent (Reductant).

Hot Metal (Liquid Iron)

It is the hot, liquid, metallic iron product obtained upon reduction of iron ore (normally in **Blast Furnace** or in **Corex Furnace**).

It contains about 93-94% Iron (Fe) and other elements / impuritieslikeCarbon(4%),Silicon(~1%),Manganese(+1%)Sulphur, Phosphorus etc.

Hot metal is the primary input for production of steel in the Integrated Steel Plants.

Pig Iron

A product in solid (lumpy) form obtained upon solidification of Hot Metal in Pig Casting Machine.

It is called Pig or Pig Iron because of its typical humpy shape. It is produced in 2 broad categories/grades:

a) Foundry Grade Pig Iron

Pig iron used in the Foundries for production of **Cast Iron (CI) Castings** using Cupola Furnace. This is the major use of pig iron.

b) Basic/Steel Making Grade Pig Iron

Pig iron (including hot metal) used for production of Steel.

Sponge Iron/ Direct Reduced Iron(DRI)/ Hot Briquetted Iron(HBI)

• Direct Reduced Iron(DRI)

Solid metallic iron product obtained upon **Direct Reduction** of high grade iron ore in solid state itself without being converted into liquid form like that in Blast Furnace.

• Sponge Iron(SI)

DRI is also known as **Sponge Iron** because of its spongy micro structure.

• Hot Briquetted Iron(HBI)

At times the DRI/SI coming out from the furnace is converted into a bigger compact mass i.e. **Briquettes** for ease in transportation/ charging in steel making furnace, which are known as **Hot Briquetted Iron (HBI)**.

- SI/ DRI/HBI is produced by reducing high **quality iron ore lumps or iron ore pellets** with the help of **non-coking coal** in **Rotary Kiln (in Coal based Plants)** or with the help of **Natural Gas** in **Shaft Furnace** (known as **Gas based plants**).
- SI/ DRI/HBI is primarily used for production of steel (as a substitute of steel melting scrap), in the Electric Furnaces like the Electric Arc Furnace (EAF) or the Induction Furnace (EIF). However, TISCO is using it in their blast furnace as substitute for iron ore or/sinter

(ii) Terms Related To 'STEEL' and 'STEEL PRODUCTS'

Steel

Steel is an iron based alloy containing Carbon, Silicon, Manganese etc.

Steel making

Steel making is the process of **selective oxidation of impurities** present in the charge material (Hot metal/Scrap/DRI) in the presence of suitable fluxes in the **Steel Melting Shops (SMS)**.

Steel/Steel Products as per Form/shape/size

Liquid Steel

The immediate hot molten steel product from Steel Melting Shop (LD Converter/Electric Arc Furnace/Electric Induction Furnace/Energy Optimising Furnace). It is further cast into ingots/Semis. The by-product from SMS is called SMS **slag**.

Ingot Steel (ingots)

- The primary solid product obtained upon solidification of liquid steel in conventional, vertical, Cast Iron Molds which are intended for rolling into intermediate/semi-finished products after re-heating.
- Ingots are normally very large and heavy weighing several tonnes (up to 15-20 tonnes).

Pencil Ingots: Small ingots in Kgs produced in mini-steel plants.

Semi-Finished Steel Products (Semis)

Intermediate solid steel products obtained by Hot rolling/Forging of ingots (in conventional process) or by Continuous casting of liquid steel are known as Semis. These are called so since they are intended for further rolling/forging to produce Finished steel products.

Various types of semis are as under:

• **Blooms**

A Semi-finished product, usually in square (at times in rectangular)

section of cross sectional size exceeding 5”x5” (125mm X 125mm). In some of the modern mills, the term bloom is used to cover such products of cross sectional size exceeding 8”x8”.

These are inputs for producing Heavy sections and Sheet piling section normally by hot rolling.

At times, like in VSP, blooms are used to produce billets by hot rolling in the Billet Mill.

- **Billets:** A semi-finished product which are similar to blooms but of smaller cross sectional size (usually less than or 5’’x5’’/ 7’’x7’’. These are used as input material for production of Finished Steel long products viz bars & rods, light sections etc.
- **Slabs:** A semi-finished Rectangular, wide, semi-finished steel product intended for production of finished Hot Rolled Flat products viz Plates, sheets, Strips etc. They are normally of width 150-250mm wherein width is at-least 3 or 4 times of thickness.
- **Thin Slabs:** In modern thin slab casting machine, liquid steel is continuously cast into much thinner slabs of 35-50mm directly which are used for production of Finished Hot Rolled Flat products upon heating on-line.

Finished Steel

Products obtained upon hot rolling/forging of Semi-finished steel (blooms/billets/slabs) .

These cover 2 broad categories of products, namely **Long Products** and **Flat Products:**

a) Long Products

Finished steel products produced normally by hot rolling/forging of Bloom/billets/pencil ingots into useable shape/sizes.

These are normally supplied in straight length/ cut length except Wire rods which are supplied in ir-regularly wound coils.

Different types of long products are :

- **Bars & Rods:** Long steel products obtained normally by hot rolling/forging of billets/blooms. They include **Rounds, Flats** (flat bars), **Squares, Hexagons, Octagons** etc. which find direct use in in a wide variety of products in Engg, & Agricultural,

House hold, Furniture sector etc. with/without further processing.

- **CTD (Cold-worked Twisted & Deformed)/ TMT (Thermo Mechanically Treated)Bar & Rods:** Hot rolled round bars/rods with indentations/ribs normally supplied in straight length or in folded bundles. Used directly in civil construction.

- **Wire Rod:** Hot rolled plain bar/rods (i.e without indentation) **in Coil Form,** normally used to produce **Steel Wires** and at times **Steel Bright Bars.**

- **Angles, Shapes & Section:** Hot rolled Structural Sections obtained by hot rolling of blooms/billets. They include Angles, Channels, Girders, Joist, I Beams, H Beams etc used in civil/ mechanical construction.

- **Rails:** Hot rolled Rail Sections obtained upon hot rolling of Blooms/Billets. Used in rail ways/tram ways, on which rail/tram moves.

- **Wires:** Wires are produced by cold drawing of wire rod through a die.

They are normally supplied in coils.

- **Bright Bars:** There are cold drawn/ ground/ Peeled plain bars produced from hot rolled plain bars/wire rods. **(Does not fall under the purview of MOS but under D/o IP&P).**

Flat Products (Flat Rolled Products)

Finished steel thin flat products, produced from slabs/thin slabs in rolling mills using flat rolls. These are supplied in **Hot Rolled (HR), Cold Rolled (CR)** or in **Coated** condition depending upon the requirement.

Different types of flat products are :

- **Plate:** Thick flat finished product of width: +500mm & Thickness: (+)5mm which are supplied in cut/straight length. Plates are normally produced/supplied in as hot rolled condition with or without specific heat treatments.

- **Sheet:** Thin flat finished steel products, Width: +500MM, Thickness: (-) 5mm, Supplied in cut/straight length. Sheets are produced/ supplied in hot rolled /cold rolled/coated condition and accordingly, known as **Hot Rolled (HR) Sheets or Cold Rolled (CR) Sheets** or **Coated Sheets.**
- **Strips:** Hot/cold/coated Flat rolled products, supplied in regularly wound coils of super imposed layers. Accordingly, known as **HR Strips** or **CR Strips** or **Coated Strips**. Depending upon width, strips are sub-classified as **wide strip** or **narrow strip** as under :

a) **Wide Strips:** Strips of widths 600mm & above. Also known as **Coils** in India and **Wide Coils** in Europe etc. Accordingly, the terms **HR Coils/Wide Coils or CR Coils/ Wide Coils etc.** are commonly used.

b) **Narrow Strips:** Strips of widths less than 600mm. **Hot Rolled (HR) flat products** are produced by re-rolling of slabs/thin slabs at high temperature (above 1000 Degree C) in **Plate Mills** (which produce plates) or in **Hot Strip Mills** (which produce strips). Hot Rolled Strips are cut into straight length to produce **HR Sheets** or **Thin Plates**. **Cold Rolled(CR) Strips** are produced by cold rolling of HR Strips in **Cold Rolling Mills** (normally at room temperature). CR Strips are cut to produce CR sheet. CR Strips/ sheets are characterised by lower thickness, better/bright finish, closer dimensional tolerance and specific mechanical/metallurgical properties. They are directly used in automobiles (cars/ scooters, motorcycles etc.), white goods, consumer durable etc. or for production of coated sheet products. Cold Rolled Sheets/ Strips are supplied in **as rolled** condition (**CRFH**- Cold Rolled Full Hard) or in **closed annealed (CRCA** –Cold Rolled Close Annealed) condition or in **closed annealed & skin passed/temper passed** condition, depending upon the requirement of the end users.

D/DD/IF Steel:

Specific variety of Cold Rolled Sheets / Strips with specific chemical composition used in Tn Mills are known as **Tin Mill Black Plate (TMBP).**

- **Coated Products:** There are cold rolled products coated with metals or organic chemicals as under :

i) **Galvanised Plain/ Corrugated (GP/GC) Sheets:** These are Cold Rolled Sheets/Strips coated with zinc metal. Process is known as **Galvanising.** Used in roofing, paneling etc. GP sheets are normally produced by Hot Deep Galvanising of CR Sheets/ Strips in liquid zinc bath. GC sheets are obtained upon corrugating of GP sheets in corrugating machine. Although not practiced in India, GP sheets are also produced by electroplating of zinc on CR sheets/strips when the process is known as **Electro-Galvanising.**

Galvanised sheets are used mainly in roofing, paneling, automobile bodies, Trunks/Boxes etc.

ii) Tinplate: TMBP coated with **tin** metal. Used for manufacture of containers.

iii) Tin Free Steel: TMBP sheet/strips coated with **chromium metal and chromium oxide.**

iv) Colour coated products: Cold Rolled/ galvanised steel sheets/ strips coated with **PVC/ plastics or any other organic material.** Process known as **Colour Coating.** Used for mfr. of furniture, auto bodies, roofing, paneling etc.

v) Terni plate: Cold rolled steel sheets/strips coated with an alloy of tin and lead, used in manufacture of Petrol Tanks for automobiles. Not produced in India.

Galfan alloy coated sheets: These are CR Sheets/Strips coated with an Zinc- Aluminium alloy comprising of 95% zinc and 5% aluminium. Uses are similar to GP/GC sheets but it has better life and better corrosion properties.

Galvalume alloy coated sheets: These are CR Sheets/ Strips coated with an alloy comprising of approx. 55% aluminium and approx. 45% zinc with nominal amount of silicon. Uses are similar to that of GP/GC sheets but it has better life and much better high temperature performance.

Crude Steel:

The term is internationally used to mean the 1st solid steel product upon solidification of liquid steel. In other words, it includes Ingots (in conventional mills) and Semis (in modern mills with continuous casting facility).

According to International Iron & Steel Institute (IISI), for statistical purpose, crude steel also includes liquid steel which goes into production of steel castings.

Saleable Steel:

The term is used to designate various types of solid steel products, which are sold to outside customers for further processing or for direct use/consumption. Therefore, it includes ingots and/or semis and/or finished steel products. (Liquid steel is normally not traded).

Steel as per Composition:

1. Alloy Steel:

Steel which is produced with intended amount of one or more alloying elements in specified proportions to impart specific physical, mechanical, metallurgical and electrical properties. Common alloying elements are manganese, silicon, nickel, lead, copper, chromium, tungsten, molybdenum, niobium, vanadium etc. Some of the common examples of alloy steels are:

(a) Stainless Steel: which essentially contains chromium (normally more than 10.5% with/without nickel or other alloying elements. As the name implies, stainless Steel resist staining/corrosion and maintains strength at high temperatures. Used widely in Utensils, architectures and in Industrial applications viz automotive & food processing products as well as medical & health equipment.

Commonly used grades of stainless steels (SS) are:

- **Type 304:** Chrome –Nickel Austenitic S S accounting for more than half of SS produced in the world. 18:8 SS used for utensils are the most common example.

- **Type 316:** Chrome –Nickel (Austenitic) SS containing 2-3% Molybdenum, intended for specific industrial use.
- **Type 410:** Plain Chromium (Martensitic) S S with exeptional strength. It is a low cost, heat treatable grade suitable for non-corrosive applications.
- **Type 430:** Plain Chrome (Ferritic) S S, offering general purpose orrosion resistance, often in decorative applications.
- **Type 201/202 etc.:** Low Nickel Austenitic S S containing 2-5% Nickel . Used as cheaper substitute of Type 304 grade for production of utensils.

(b) **Silicon-Electrical steel:** which usually contains 0.6 – 6% silicon and exhibit certain magnetic properties, which make it suitable for use in transformers, power generators, and electric motors. They are normally supplied in 2 categories:

i) **CRGO:** Cold Rolled Grain Oriented Silicon-electrical steel sheets/strips, normally recommended for use in transformers and generators.

ii) **CRNO/CRNGO:** Cold Rolled Non-Grain Oriented Silicon-electrical steel sheets/strips, normally recommended for use in rotating machines such as electric motors.

(c) **High Speed Steel:** Alloy steel containing tungsten, vanadium, chromium, cobalt and other metals. Depending upon composition, they are classified as Cobalt Grade abd Non-Cobalt Grade. Used for manufacture of utting tools.

2. Non-alloy /Carbon Steel/Plain carbon /Un-alloyed Steel:

These steels by definition do not contain any alloying element in specified proportions (i.e beyond those normally present in commercially produced steel in industry).

Non- alloy steel is divided into 3 categories namely

(i) **Low carbon steel or Mild steel** (normally containing upto 0.3% carbon

(ii) **Medium carbon steel** (normally containing 0.3 – 0.6% carbon) and

(iii)**High carbon steel** (normally containing more than 0.6% carbon).

Non-alloy steel constitutes approx. 90% of total steel production, of which, mild steel takes the lion's share.

3. Special Steel:

Steel, in production of which special care has to be taken so as to attain the special/desired properties, such as, cleanliness, surface qualities and mechanical/ metallurgical properties.

In layman's language, all steel other than mild steel fall under the category of special steel. But metallurgically, even mild steel/low carbon steel i.e containing less than 0.25%/0.30% carbon, may still fall under the category of special steel if any special properties is specified in the steel. Examples are **DD / EDD** steel, **Forging Quality** steel, **Free Cutting** steel etc. **Classifications of Steel based on end use :** In terms of uses, steels are often classified as Structural steels, Construction steel, Deep Drawing Steel, Forging quality, Rail steel and the like.

iii) Terms Related To 'IRON ORE'

Iron Ore :

Definition: A naturally occurring mineral from which iron (Fe) metal is extracted in various forms viz Hot metal/ DRI etc.

Types of Ore: Two major varieties used for iron making are **Haematite Ore(Containing Ferric Oxide - Fe2O3)** and **Magnetite Ore (containing Ferro-Ferric Oxide – Fe3O4)**. When chemically pure, Haematite contains apprx 70% and Magnetite 72.4% iron . But usually iron content of ores ranges between 50-65/67% (rich ores) and 30-35% (lean ores); the remains being impurities known as **Gangue (such as Alumina, silica etc.)** and Moisture.

Grades of Ore: Iron ore is typically classified as **High grade** (+65% Fe), Medium grade (+62 – 65% Fe) and **Low grade** (-62% Fe). Typically, the Integrated Steel Plants(ISPs) use medium/High grade Iron Ore whereas the Sponge Iron plants require only High Grade iron ore, preferably, with +67% Fe.

Lumpy/Fine Ore: Iron Ore is traded in **lumps** (i.e. **sized ore**) or in **fines**. roduction/availability of lumps is limited by virtue of the natural occurrence and also because of generation of lot of fines during crushing of large lumps present in the run-of -mines.

Natural pellet: It is a term coined by producers like NMDC to designate sized iron ore used directly in Sponge Iron production.

Blue Dust: Blue Dust is the name given to naturally occurring, extremely friable, high grade Haematite Iron Ore powder.

Beneficiation of Ore: Very low grade Iron ore cannot be used in metallurgical plants and needs to be upgraded to increase the iron content and reduce the Gauge content. Processes adopted to upgrade ore is called Beneficiation.

Indian ores are: Indian ore is generally rich in iron (Fe) content but the Alumina content is very high which call for special adjustments/ techniques for production of iron/steel at the cost of productivity and quality and hence money.

Beneficiation at KIOCL: KIOCL has set up a Beneficiation plant to beneficiate Magnetite ore with approximately 35% Fe to high grade **Iron Ore Concentrates,** part of which is also used for production of **pellets** inhouse, and part is exported.

Agglomeration of Iron Ore: Iron Ore Fines/blue dust cannot be charged in the blast furnace directly since they block the passage for ascending gas inside the fee. So, they are **agglomerated** (by igniting at lower temperature causing only interfacial fusion) into larger lumpy pieces with/without addition of additives like limestone, dolomite etc.

Two types of agglomerated products are commonly produced/used in the industry namely **Sinter** and **Pellet**. Accordingly the processes are known as **Sintering** and **Pelletising** respectively:

(a) **Sinter:** Sinter is a clinker like aggregate which is normally produced from relatively coarser fine iron ore (normally –3mm) mixed with coke breeze (-3mm), limestone dolomite fines (-3mm) and other metallurgical return wastes from the plant.

Sinter is a much preferred input/raw material in blast furnaces. It improves BF operation and productivity and reduces coke consumption in blast furnace. Presently, more than 70% hot metal in the world (in India 50%) is produced through the sinter.

(b) **Pellet:** Pellets are normally produced in the form of Globules from very fine iron ore (normally –100 mesh) and mostly used for production of Sponge Iron in gas based plants, though they are also used in blast furnaces in some countries in place of sized iron ore.

(iv) Terms Related To 'COAL/COKE':

Coal:

Definition: Coal is a naturally occurring combustible rock containing 70% (by Vol) carbonaceous material including moisture.

Classification based on level of Maturity: Depending upon the level of maturity/metamorphism, coal is classified under 3 main categories namely, **Lignite/Brown Coal, Bituminous Coal, Anthracite Coal**.

Grouping based on Property: Coals are grouped according to particular properties as defined by their Rank (which is a measure of degree of maturity/metamorphism), Type (Vitrinite, Liptinite and Inertinite which are the 3 main groups of materials that constitute coal) and Grade ((depending on Impurities and Calorific Value).

Use of Coal: Natural coal in general is too dense and/or fragile and has limited use as a fuel/reductant in metallurgical plants like Blast Furnace. However, some specific varieties of natural coal (crushed and screened in specified size ranges) find direct application in other metallurgical operations (such as Corex Plant, Coal Dust Injection/ Pulverised Coal Injection in Blast Furnace etc.).

Coking/Non-coiking Coal: Based on coking property, coals are broadly classified into two categories namely, **Coking Coal** and **Non-coking Coal**. **Steam coal** used for steam/power generation falls under the broad group of Non-coking coal.

Coking Coal:

Definition: Coking coals are those varieties of coal which on heating in the absence of air (process known as **Carbonisation**) undergo transformation into plastic state, swell and then re-solidify to give a Cake. On quenching the cake results in a strong and porous mass called coke.

Primary/Medium/Semi/Week Coking Coal: Coking coal is divided into 3 sub-categories namely, **Primary Coking Coal** (Low ash , low Volatile, High Coking property) **Medium Coking Coal** (low ash, medium volatile, low caking index) and S**emi/Weak Coking Coal** (low ash, high volatile, very low caking index).

Characteristics of Coking coal for BF Coke: Coking coal for production of BF Coke (which is the right type of fuel/reductant needed for a BF) is characterised by certain specific properties in terms of appropriate composition (viz low Ash (10% max), Volatile Matter (20-26%), and very low sulphur and phosphorous content, appropriate Rank of coal (1—1.3), good rheological properties, wide range of fluidity , low inert content etc.

Indian Coking Coal: Indian Coking Coal found in Gondwana belt (Bihar &West Bengal region) has very high ash (17% or more) and poor rank and other properties, which results in lower productivity and higher coke consumption in blast furnace. **Assam coking coals** though, are low in ash have very high sulphur which limits their use in iron making in blast furnace.

Washing of Coal: Since ash content in Indian coal is very high, washing is esorted to to lower the ash content to some extent. However, Indian coals are otorious with respect to its Washability because the ash /inerts are fairly and finely distributed in the coal matrix thereby rendering washing difficult.

Blending of coal: Because of limited availability of good quality coking coal, the Indian Steel plants use a optimal **Blend** of the 3 or more varieties of coking coal to compensate for the lack of individual coals with the necessary properties. Another important consideration in selecting a coal blend is that it should not exert a high coke oven wall pressure and should contract sufficiently to allow the cake/coke to be pushed out from the oven.

Coke:

Coke is the residual solid product obtained upon carbonisation of coking coal. Depending upon property, coke is known as Hard Coke, Soft Coke and Metallurgical Coke.

Metallurgical Coke: Not all coke can be used in metallurgical operations for which good quality coke made from specific blend of coking coal is essential. Such coke is classified as Met. Coke.

Blast Furnace (BF) Coke: The term is used to refer to such Met Coke which are used for iron making in BF. BF coke fulfills 3 main functions in the blast furnace operation:

i) It acts as a **fuel** providing heat for all reactions

ii) It acts as a **reductant** provicing Carbon dioxide gas anc carbon for readuction of iron ore, and

iii) It provides the required **permeability** for movement of gases through the bed of iron ore, coke and limestone inside the blast furnace. BF Coke is characterised by the following parameters:

- i) Specified Size Range (25/40-80mm),
- ii) High Fixed Carbon (80-85%),
- iii) Low Ash (10- 15% ash),
- iv) Low Volatile Matter (2% Max),
- v) Low Alkalies,
- vi) Low Sulpher(0.7%Max),
- vii) Low Phosphorous(0.3% max),
- viii) High Strength/Abrasion Resistance(measured in terms of Micum Index(namely M10 value 10% Max and M40 value 75/80% Min),
- ix) Reasonable Coke Strength after Reaction (CSR : 55-60), and
- x) Appropriate Reactivity (CRI: below 25).

These characteristics depends not only on the coal properties but also on the coking technology/parameters as well as pre-carbonisation & postcarbonisation techniques adopted thereof.

Adverse effects of Ash: Ash has highly adverse effect on the productivity of BF and on consumption of coke in the BF. An increase in ash content by 1% over a critical limit results in increase in coke consumption by about 4-5% and decrease in BF productivity about 3-6%.

Indian Integrated Steel Plants **normally** use high ash coke produced inhouse, at the cost of productivity, energy consumption etc. The Mini Blast Furnace units however use mainly imported low ash Met coke from China and other sources.

Non-Coking Coal (NCC)

These are coal of poor coking properties i.e. does not soften and form cake like coking coal during carbonization in the coke oven. Such coals with relatively lower ash and higher fixed carbon are used in metallurgical applications viz. COREX technology based iron (pig iron) plants, Coal based DRI Plant etc, while those with higher ash are normally used in thermal Power Plants as steam coal. NCCs are classified into A,B,C,D,E and F grades depending upon its heat value which is a fraction of carbon and volatile matter and ash content in the coal.

Coke Ovens/Coke Oven Battery: Coking Coal is converted into Coke in coke ovens which are silica refractory lined ovens/ chambers. Coke Oven battery comprises of a large number of ovens, 50-70 in tandem. Such batteries are normally attached with By-product plant where in valuable constituents are recovered from the volatile /gaseous content of coal driven out during carbonisation. Accordingly, such coke ovens are known as By-product coke oven battery vis-a-vis Non-recovery type coke ovens, also known as Bee-hive type coke ovens.

Coking time: Coking time is defined as the time required for conversion of coal to coke in the coke oven which varies in the range of 15-20 hrs.

Yield of different varieties of coke: Typical yield from one tonne of dry coal charge to coke is 75%. Depending upon size ranges, coke is classified into the following categories:-

Category	Yield	Use
BF Coke (25/40-80mm)	85%	Blast Furnace
Nut Coke (15-25mm)	5%	Sinter Plant /Ferro Alloy/Pig Iron Industry
Coke breeze (0-15mm)	10%	Sinter Plant /Cement Industry

Coal Dust Injection(CDI)/ Pulverised Coal Injection(PCI): These are technologies wherein pulverised/ granulated/ dust coal is injected into the blast furnace through the tuyers along with the Blast to replace part of the coke requirement.

(v). **Terms Related TO 'TECHNO-ECONOMIC PARAMETERS' :**

These are parameters which are normally used to judge the operational efficiency/effectiveness of iron & steel making processes in the steel plants.

Most commonly used parameters are :

i) **BF Productivity:** which is measured in terms of tonnes of hot metal produced, per cubic meter of blast furnace volume, per day (T/cubic met/day).

ii) **Coke Rate:** This is measured in Kgs. of BF Coke consumed per tonne of Hot Metal produced in the Blast Furnace(Kg/THM). By convention, this excludes coke (nut/pearl coke) mixed with sinter etc.

iii) **Energy Consumption:** This is measured in Giga Calorie (i.e. 1000 million calorie) per tonne of Crude Steel produced(Gcal/TCS).

iv) **Power Consumption:** This is measured in terms of Number of units of electrical power consumed in KWH per tonne of crude steel produced (KWH/TCS).

v) **Refractory Consumption:** This is measured in terms of total refractory consumed per tonne of crude steel(Kg/TC.

(vi) MISCELLANEOUS TERMS:

Fluxes : Limestone, Dolomite, etc. used in Iron/ Steel making which react with the undesirable gangue material/ impurities and removed ash **slag.**

Ferro Alloys: Master alloys used for de-gassing/ de-oxidising/alloying in steel making. Common varieties are ferro silicon, ferro manganese, silico manganese, ferro chrome, ferro nickel etc.

Refractories: Heat resistant bricks/ shapes/ monolithic mass used for construction/ lining of reaction vessels/ furnaces. Common varieties are Silica, Magnesite, Dolomite, Alumina, Fire-clay, Mag-carbon, Mag-chrome etc.

Steel Melting Scrap: Steel waste/scrap not usable as such in its existing form which are further re-melted to produce liquid steel to produce various products. Depending on their form/type, they are classified as Heavy Melting Scrap, Light Melting Scrap, Turnings/ borings etc.

Re-rollable Scrap: Seconds & defective products, Cuttings/end cuttings, Used steel products like used rails etc which could be directly used for rerolling (without resorting to re-melting) into finished products for specified applications. These are substitutes of steel billets /pencil ingots. Ship breaking generates substantial quantity of re-rollable steel scrap.

Integrated Steel Plants: Steel plants using iron ore as the basic raw material for production of crude steel which is further rolled into finished shapes in-house. Conventionally, these plants have captive coke ovens also and the sensible heat of the outgoing gases from iron/coke making are utilised as fuel for various applications.

It therefore, includes units with in-house coke making (optional), iron making followed by production of liquid steel & crude steel and finished steel. So all ISPs adopting BF- BOF route and Major producers adopting Corex-BOF or DRI-EAFor MBF-EOF technology would technically, fall under this category.

Mini Steel Plants: Conventionally, EAF/IF based steel plants with/ without captive rolling mills were covered under this category. How-

ever, now all steel plants (based on any technology) of capacity upto 5 lakh tpa are covered under this category.

Primary Steel Producers: Steel (crude and/or finished steel) producers using iron ore as the basic raw material/input. It therefore, includes in-house iron making followed by production of liquid steel & crude steel with/without in-house rolling. So all ISPs adopting BF- BOF route and Major producers adopting Corex - BOF or DRI-EAF or MBF-EOF technology would fall under this category.

Hot Rolling : Rolling of Steel at above the recrystallisation temperature of steel (normally above 1000 C) to produce Hot Rolled Long products/Flat Products from semis. Ingots are also hot rolled to get semis. At times blloms are also hot rolled to produce Billets. Rolling Mills used for hot rolling are known as **Hot Rolling Mills**.

Cold Rolling: Rolling of steel (normally flat products) below the recrystallisation temperature of steel (normally at Room Temperature) to produce cold rolled sheets /strips /coils. Mills used for the purpose are called Cold Rolling Mills.

2Hi/4 Hi/6 Hi/20 Hi Mills: Rolling Mills are classified as 2-High / 2 Hi, 4 Hi and so on depending on Number of Rolls used in the arrangement/configuration of rolls in single stand. For example, a 2 Hi mill consist of 2 rolls one above the other known as Upper roll and the Lower roll. In a 4 Hi mill, there are 4 rolls in a stand—2 upper rolls one above the other and 2 lower rolls one above the other. A typical configuration of 4 Hi mill is shown below:

STEEL INDUSTRY GLOSSARY OF TERMS

Technical Glossary – Jargon made simple

Glossary Term	Glossary Explanation
Anneal	Refers in metallurgy to heat treatment which is used to impart changes in mechanical properties such as strength and hardness. Typically, the annealing process is used to induce softness and to relieve stress, allowing the steel to be further worked
AOD	Argon oxygen decarburisation: a process often applied to special steels whereby argon and oxygen are blown into

	the converter to reduce the carbon content of the steel
API	American Petroleum Institute - the trade association that represents the US oil and gas industry. The API also has an important role in the development of industry standards which have broad international acceptance and which include steel grades (for example) for use in oil and gas transmission pipelines
Apparent consumption	The mathematical sum of production plus imports minus exports. The difference between 'apparent' consumption and 'real' consumption is that the latter definition also recognises changes in stock levels
Bar-in-coil	Steel bar that is in coiled form, rather than in lengths. Bar products 10mm in diameter and below are typically coiled
Base metals	The glossary term typically refers to the set of easily corroding [non-ferrous] metals that includes copper, aluminium, lead, nickel, tin and zinc
BAT	Best available technique. Typically used in the context of environmental performance, BATs have supporting technical reference documents known as BREFs, which are reference benchmarks
Beneficiation	Reference in the mining industry to the process of separating ore by crushing and other means into mineral and waste products
Billet	A semi-finished steel product, typically cast to a square cross section of ~120 x 120 mm to ~180 x 180 mm and usually used for rolling into bar and / or small sections
Black plate	Glossary phrase refers to uncoated cold rolled steel, typically thin gauge material between 0.14-0.5 mm thick. The most common application of black plate is production of tinplate for the packaging industry
Bloom	A semi finished steel product, larger than billet and typically cast to a square cross section of ~200 x 200 mm to ~360 x 360 mm (or as a round of ~300 mm diameter)
Body-in-white	Glossary item refers to car body shell after the welding stage but prior to painting of the steel
BOF	Basic oxygen furnace, which converts hot metal (pig iron from the blast furnace) into liquid steel by blowing oxygen into the furnace to remove carbon as carbon monoxide gas
BREF	Stands for best reference and refers to best available technique documentation which is often used as a benchmark environmental performance measure

BRIC	Reference to Brazil, Russia, India and China. In iron and steel, these BRIC countries are notable because of their high expected economic growth rates in the coming 20-30 years and the consequent implication for growth in future steel demand. Compared to the industrialised world, the BRIC countries also have relatively low labour costs and / or access to low cost energy or steelmaking raw materials making them strategically attractive locations for the manufacture of steel
Campaign	Period of continuous blast furnace operation: 20-25 years represents a fairly typical campaign
Capacity creep	Trend for slow increase in capacity over a period of years, arising because of learning, incremental investment, modernisation of maintenance practices etc. In the steel sector, capacity creep results in steel plant capacity increasing on average by perhaps 0.5% to 1% per annum
CAPL	Continuous annealing and processing line, used for the production of cold rolled steel. The continuous anneal process is to be distinguished from batch annealing. Whilst the former is better suited to high volume production (e.g. on automotive-dedicated production lines) the latter is best suited to small job lots and / or specialty grades
Carburisation	Process of introduction of carbon into steel - typically involving heat treatment - to improve surface hardness
Cast iron	A ferrous alloy with more than 2.1% carbon content and typically also with significant amounts of silicon, normally in the 1 - 3% range
Cobble	An incident when bar that is being hot rolled either jams in the mill guides, resulting in delays to reset the guides and rolls, or comes out of its normal rolling trajectory, frequently landing (often at high speed) in the area adjacent to the rolling mill stands
Coke	A solid carbon based product derived from baking bituminous coal at high temperature to remove volatile constituents. Metallurgical coke [‘met coke’] is used as the main fuel in the smelting of iron ore in a blast furnace
Cold finishing	Processing of steel either with surface removal (polishing, grinding, peeling) or without surface removal (e.g. through wire drawing), primarily for further machining into shapes such as gears, shafts, hydraulic fittings etc
Cold heading	Also known as cold upsetting, or fastener production. Glossary term refers to the production of nuts and bolts

	through cold deformation
Cold roll formed sections	The term usually refers to hot rolled steel (although it can be cold rolled steel) that is roll formed [or 'bent'] cold into angles, channels or shaped / corrugated sheet. The word 'cold' refers to the forming process, not to the type of steel that is used
Continuous casting	A process in which molten steel is poured into a water-cooled copper mould for gradual solidification as it is drawn down the caster, turning into a solid steel billet, bloom, or slab. Compared to ingot casting, continuous casting has evolved as the preferred method for making semi-finished steel because of much better yield, productivity and cost performance
Corex ®	Reduction process for production of hot metal from iron ore using coal. Key advantages over traditional integrated steelmaking include the ability to use non-coking coal [eliminating the need for coke batteries] and the ability to iron ore pellets [eliminating the need for sinter plant]
Cost price squeeze	Refers to the long term trend in the steel sector for new technology to lead to cost improvements - for example through introduction of continuous casting replacing ingot casting - meaning reductions over time of overall price and cost levels. The trend is sometimes quantified as an erosion of nominal revenue of ~1% per annum or more
CSP	Compact strip production - see glossary under 'thin slab casting'
DNV	Det Norske Veritas - independent foundation based in Norway with objective of safeguarding life, property, and the environment - with an important role in product certification
DRI	Direct reduced iron - a residual-free scrap substitute
EAF	Electric arc furnace - a furnace that melts (and thus recycles) steel scrap for the production of liquid steel using electrical power
ECSC	European Coal and Steel Community - the original version of what is now known as the European Community. Founded by the Treaty of Paris in 1952, the ECSC was based on the principle of member nations sharing their coal and steel resources
ECX	European Climate Exchange - marketplace for trading carbon dioxide emissions

EGL	Electrogalvanised - typically used to describe electrolytically zinc coated sheet steel
EIA	Environmental impact assessment - an appraisal of the environmental impact of a project during both construction and operation phases, and of future compliance with relevant regulatory requirements
ERW	Electrical resistance welding: welding by the process of passing of an electric current through two metals. Resistance to the current creates heat, melting the metal (often under some force) and thus forming the weld
ESTEP	Acronym for European Steel Technology Platform - a body focused on strategic research undertaken for various European and National Research Ministries
ETS	Emissions trading scheme - a system for reducing carbon dioxide emissions, based on pricing of CO2 output
Ferroalloy	Alloy of iron with high proportion of an element such as nickel, chromium, molybdenum, vanadium, manganese etc that used in the production of steel
Finex ®	Smelting reduction process based on reduction and melting of non-agglomerated iron ore fines using thermal coal [i.e. non-coking coal] as the main energy source
Fior	Direct reduction process based on the use of iron ore fines to make iron units. FIOR is an acronym for Fluidized Iron Ore Reduction
Flux	A substance such as limestone which is added to a furnace and which reacts with impurities to form a slag
Full hard	Refers to cold rolled sheet steel that has not been softened by annealing
Galvanneal	Refers to a sheet steel product that is annealed after hot dip galvanizing with zinc. The additional annealing step produces an external zinc-iron alloy coating which gives the coated steel product exceptional corrosion resistance
Gauge	Another term for the thickness of sheet steel
Greenhouse gas	Name collectively refers to a group of gases which trap radiation leaving the Earth. The main GHGs responsible for the resulting climate change are carbon dioxide CO2, methane CH4 and nitrous oxide N2O. The full GHG list also includes water vapour H2O, ozone O3, sulphur hexafluoride SF6 and several other halogen-containing hydrocarbons
Grey iron	Basic form of cast iron that is relatively easy and

	inexpensive to produce. Grey iron [‘gray iron’] is suitable for making a wide range of castings including valve, pump, rail and auto applications
HBI	Compacted DRI, formed into briquettes for easier handling
HDG	Hot dip galvanised - describes a zinc coating obtained by dipping steel sheet into a bath of molten zinc
Hismelt	Direct ironmaking process, based on use of iron ore fines and non-coking coal for the production of hot metal
HMS1, HMS2	HMS1 and HMS2 are the preferred forms of scrap for the production of steel. Both are defined as obsolete scrap - which is generated when a steel product comes to the end of its working life. HMS denotes ‘heavy metal scrap’ [sometimes ‘heavy melting steel’]. HMS1 comprises clean iron and steel with a minimum thickness of 1/4” and a defined maximum size [e.g. 60”x24” wide]. HMS2 is similarly defined but has a minimum thickness of 1/8”
Hot metal	Another term for pig iron (see glossary entry below) - the product made in a blast furnace
Hot band	North American term for hot rolled coil
HRC	Common abbreviation for hot rolled coil
HSLA	High strength low alloys: group of higher strength steels formed by the addition of small quantities of alloying elements such as titanium
IISI	International Iron & Steel Institute - one of the leading world steel industry associations
Inclusion	Steel impurity - most often an oxide or a sulphide - which can have a detrimental impact on mechanical properties
Induction furnace	Furnace is which steel is heated by a process of induction, whereby electromagnetic coils that surround the furnace heat the steel by generation of eddy currents within the metal. Relatively speaking, the process is both very clean with respect to emissions and fairly enegy efficient
Ingot	Mass of metal obtained from casting liquid steel into a mould. The resulting ingot - a semi-finished product - is typically then hot rolled or forged
Interstitial-free	Interstitial-free (IF) steels have few solute interstitial elements, such as carbon and nitrogen. These interstices can be sources of strain and may result in brittleness

IPPC	Integrated Pollution Prevention and Control. To obtain an IPPC permit a business must prove that its applied technologies are equivalent or better than 'best available', as defined by the European Council Directive
Killed steel	Steel that has its oxygen content reduced - typically through addition of aluminium. Hence the term aluminium killed
Ladle metallurgy	A process step typically applied in a ladle furnace for alloying, deoxidation, desulphurisation as well as for temperature adjustment prior to casting of quality steels
Large diameter pipe	Definition in size terms varies but trade and other statistics frequently define large diameter pipe as over 16 inches (or 406.4mm) in diameter. Large pipe of this size is invariably welded rather than seamless, and can be produced by longitudinal or spiral welding for applications that often include gas and oil transport
LME	London Metal Exchange - leading non-ferrous metals market in the UK
Long ton	Measure of weight used in the UK prior to metrication. The long ton is equivalent to 2240 pounds or approximately 1016 kg. See also under glossary term short ton and tonne below
Merchant bar	A category of light long products comprising steel bars shaped as rounds, squares, hexagonals, rectangles, flats etc used mainly as support structures for building, construction, machinery. Merchant bar is to be distinguished from reinforcing bar (which is used to reinforce concrete) and from engineering steel (which often ends up moving rather than being stationery)
MHPT	Man hours per tonne - a common measure of labour force or process productivity
Micum index	The percentages of coke remaining in a given size-band after rotating a coke sample within a drum for a given time. The index is a measure of the strength of coke against both impact and abrasion
Midrex ®	Direct reduction process for converting iron ore into direct reduced iron (DRI) for iron and steelmaking
Mild steel	Low carbon steel - often also referred to as soft steel. Carbon content generally under 0.25%
Mini mill	The term 'minimill' normally refers to a scrap-based EAF route steelmaking operation of relatively small scale (usually less than 500 kt capacity / year; thus much smaller

	than a typical BOF plant making several million t/yr) producing long products - although the concept is increasingly finding application in flat product mills. The word 'mini' is applied both because of the relatively small scale in volume terms and because of the relatively low capital cost per tonne involved in construction [broadly ~$250/t for a minimill versus ~$1000/t for an integrated plant]
National Allocation Plans, NAPs	Facility lists prepared by EU Member States that specify [by country] key installations and their CO2 emission limits
NACE	End-use industry classification system used in the European Union
NDT	Non-destructive testing - refers to electronic or other methods of inspection that do not permanently affect the properties of the material
Nickel pigs	Iron units made from low grade pig iron produced from laterite ore (0.9% to 1.9% nickel). When the cost of refined nickel rose steeply in 2006, these 'pigs' came into popularity (especially in China) in attempts to offset high stainless steel production costs
Normalising	Heat treatment for relief of internal stress, based on heating and subsequent air cooling
OCS	Organic coated sheet
OCTG	Oil country tubular goods - refers to the group of steel tube products (both seamless and welded) used in vertical oil well applications such as casing, drill pipe, and well tubing
OHF	Open hearth [Siemens-Martin] steelmaking furnace, use of which has now been largely superseded by higher productivity / more efficient BOF and EAF steelmaking processes. Using a hearth with a low roof, molten pig iron and scrap in the hearth are heated by overhead gas burners using preheated air to produce steel
OHS	Occupational health and safety
Old environmental burdens	Refer to liabilities for past environmental damage, often caused during periods of previous State-ownership. In the main, the damage concerns that caused to the soil and to groundwater
Organic coated	Organic coating refers to paint or varnish which is added

	as an extra corrosion protection layer to products typically made from zinc-coated sheet
Passivation	Changing of a chemically reactive metal surface to a less reactive state, typically through chemical treatment
PCI	Pulverised coal injection - a process increasingly used in
	blast furnaces, typically offering substantial economic benefits through greater use of coal and proportionately less use of metallurgical coke
Pickling	Removal of mill scale by mechanical and chemical means
Pig iron	A key intermediate material in the integrated (converter-based) steelmaking process, pig iron is the product of smelting iron ore, coke and limestone in a blast furnace. Merchant pig iron is sometimes used as as substitute for scrap in EAF steelmaking, when there is a need to control residuals
Price cycle	Refers to the well-established phenomenon of cyclicality in international steel price movements. Although no cycle is ever identical, this cyclicality has in recent years been characterised by price swings from peak to trough of 25% or more, and by a periodicity (from peak to peak, or trough to trough) of approx. two years
Quenching	Rapid cooling - typically undertaken to obtained a specific property such as increased hardness of steel
REACH	Acronym for 'Registration, Evaluation and Authorisation of Chemicals', an initiative introduced by the European Commission to improve the protection of the environment from chemical hazards
Reduction	Chemical removal of oxygen. Thus direct reduced iron (DRI) is formed through the reduction of iron oxide
Reduction ratio	Typically refers to extent of area compression in the production of hot rolled bar. Reduction ratios of 15:1 used to be the norm for quality applications (e.g. engineering steels) some 10-20 years ago, but even this expectation has fallen with the advent of modern continuous casting practices. Reduction ratios as low as 8:1 are currently acceptable for many high quality long product applications
Residuals	Refer to so-called tramp elements such as copper and tin, which are typically introduced into the steelmaking process in the form of unsorted or contaminated scrap and which can impair the physical and mechanical properties of steel

Refractory	Adjective refers to an ability to retain strength at high temperature. Noun describes the material. In the steel industry, refractory materials are used for furnace linings
SAW	Submerged arc welding - a welding process that uses the heat of an electric arc to melt an electrode held adjacent to a workpiece under a blanket of granular flux [hence 'submerged']
SBQ	Special bar quality - an American term for engineering steel
Scale	Oxide layer which forms on a steel surface at high temperatures
Scarfing	Glossary term describing method for removal of surface blemishes from slab, billet or bloom
Semi	Colloquialism used in reference to semi-finished steel, i.e. ingot, bloom, billet or slab
Sequence casting	Process of casting two or more heats of the same grade of steel in succession through a continuous caster in order to reduce yield losses
Sheet piling	Piling based on use of thin interlocking sheets of steel to obtain a continuous barrier in earth or sand
Short ton	Unit of weight commonly used in the USA and which refers to 2000 pounds. A short ton is equivalent to ~0.907 metric tonnes. See also glossary entry for tonne
Silicon steel	Another term for electrical steel - steel with particular electrical and magnetic properties that makes it especially suited to use in cores of electrical transformers, electrical motors, generators etc
Sintering	A process in which fine materials (typically iron ore fines and coke breeze) are combined into a porous mass that can be used in the blast furnace
Skelp	Narrow or medium-width hot rolled strip (generally 200-700mm in width) commonly used for the production of welded tube
Sponge iron	A metallic product made by direct reduction of iron, via the removal of oxygen from iron ore. Sponge iron is also known as DRI, or direct reduced iron
Slab	Semi-finished steel product - the main intermediate material in the production of flat rolled steel. Slab, typically ~150-400 mm thick, is usually hot rolled into plate or into hot rolled coil

SSC	Steel service centre. A typical SSC in the industrialised world may offer customers mechanical services (e.g. cutting, slitting, sawing, shearing, grinding, polishing,
	drilling, corrugating, edge-shaping, pressing, blanking), advisory services (CAD, material selection, testing, expert technical support) and / or inventory support (bar-coding, storage, JIT, etc)
Stainless	An alloy of carbon and iron that has a minimum chromium content of 10.5 percent
Steckel Mill	Sheet rolling mill that reduces steel gauge by repeated reversal of rolling action. Heated coil boxes at each end allow the steel to be reheated prior to each reversing pass through the Steckel mill's stands
Strand	A combination of individual steel wires that are specially twisted together. Individual strands are often combined in the manufacture of steel rope
Strip mill products	Hot and cold rolled steel coil, sheet and / or strip
Teeming	The pouring of molten metal from a ladle into an ingot mould. The economic advantages of continuous casting over ingot casting mean that the ingot-route process has largely been superseded for high volume production of steel
Terne coated	Cold rolled steel that has been hot dip coated with a lead coating (usually >90% lead). The most common application of terne coated steel is car petrol tanks
Thin slab casting	Production of a slab approx 50 mm - 75 mm thick in a process that is integrated with hot strip casting. The thin slab casting process requires much less gauge reduction of the slab (otherwise undertaken in roughing mills starting with perhaps 250mm thick slab) and the integration with strip rolling means much reduced reheat needs (saving time and energy cost)
TMT	Thermomechanical treatment
Toll rolling	Also refered to as hire rolling this glossary term refers to the practice of rolling steel as a service - typically by a firm that does not have ownership of the steel
Tonne	Unit of weight commonly used outside the USA, which refers to a metric tonne. A tonne is 1000 kilograms or ~2204.6 pounds

Tool steel	Carbon and alloy steels that have high resistance to abrasion. As the name suggests this product group is especially well suited to the manufacture of tools (including stamping dies, shear blades, and hand tools such as spanners, machine tool bit holders etc)
Tpt	Tonnes per tonne - refers to process charge as the inverse of yield loss. Thus a charge of 1.05 tpt is the starting weight for a manufacturing step with ~95% through yield
Tundish	A reservoir for holding liquid steel and feeding the steel in a controlled manner into a continuous casting machine
Turnings	Metal shavings formed during the course of metalworking. Also know as swarf
ULCOS	Ultra Low CO2 Steelmaking
ULSAB	Ultra Light Steel Auto Body - a joint initiative undertaken by vehicle designers and steelmakers to create a lighter stronger autobody, improve vehicle fuel efficiency and improve emission performance
White goods	Reference to refrigerators, freezers, ovens, washing machines, tumble driers [often painted white] which make up a distinct steel-consuming segment (especially significant in flat products)
Wire drawing	Operation that produces steel wire by passing ('drawing') a steel rod through a series of progressively smaller dies
Wrought iron	Iron that has a low carbon content (usually les than 0.15 per cent). Many traditional applications of wrought iron now use low carbon steel instead
Yellow goods	Reference to fork lift trucks, bulldozers, earth-moving equipment etc [typically painted yellow] which represent a distinct steel-consuming segment
Yield	Measure of efficiency of a steelmaking process stage, often expressed as a percentage. Typically calculated as the weight of steel produced in a given manufacturing step relative to the quantity charged