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What's Inside

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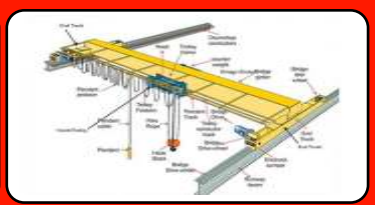

EOT Crane

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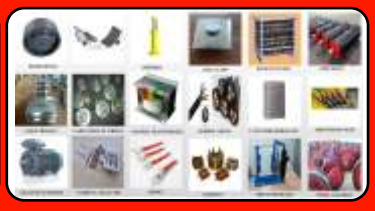

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Importance of Standard & Specification in Steel Industry

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Abstract

Steel is the only material having unique combination of properties producing versatile products used almost in all the manufacturing and construction sector/ subsectors. Steel standards provide a universal technical communication that promotes mutual understanding between the producer, customer and user industries. Unambiguous established test methods after researches ensure standards of product consistency and uniformity, which help businesses to establish and meet quality objectives making a significant contribution to the development and production of industrial and consumer items, equipment, and machineries.

Introduction: In the current fierce competitive global market particularly in alloy & special steel products where resources are limited and scarce, production complying with national or inter-national standard & specifications can only improve the quality and consistency in producing steel products for various application. The ability to purchase steel products with defined properties at recognized level of quality reduces the risk of incompatibility or failure, which will ensures that products perform as intended. Steel businesses can be assured that products and components supplied by different companies will be mutually compatible. Using standards also helps businesses demonstrate to regulators and customers that their products and services meeting defined product safety, quality, and environmental standards.

Having standards for any process not only helps to have bigger acceptance but also improves interoperability to build up an ecosystem in processing activities. Standards came into existence, being a technology obsessed industry in the world always encouraged to be in all activities. An acceptable standard not only helps developers *(One of the strongest stakeholders in the ecosystem with who has the responsibility to provide workable solutions by using available technology)* to build the ecosystem leading to minimal changes for implementing interoperability. In today's world, there is no proper system in existence which does not raise any error /failure in real time usage, Using global standards provides us another vital advantage of finding resolution to process in future.

Steel Classification Criteria and Application Areas: A standard is a document that specifies requirements for products, services and/or processes. This helps ensure the free movement of goods and encourages exports. Standardization supports efficiency and quality assurance in industry, technology, science and the public sector. It serves to safeguard people and property and to improve quality in all areas of life.

Every application area for steel will need to meet the strength, and other essential properties as stated in specification during service. For this different specifications for steels are created so that they will help the users to determine the appropriate steel grade for proposed applications. For this purpose, the specifications and standard for steel products are indispensable.

Steel Standards and Specification are classification, evaluation, and systems for criteria like chemical composition, mechanical, and metallurgical characteristics which are the deciding factors for achieving quality and useful life. While there are thousands of different types of steel which are generally bucketed into four categories: carbon steel, alloy steel, stainless steel, and tool steel.

However, there is no universally accepted steel standard or classification system. Instead, there are a variety of approved and widely used classification and identification systems that are established and standardized either nationally and globally by Standards Development Organizations (SDOs) or by certain vertical sectors or suppliers.

International Steel Standard & Classification systems: In the entire steel making, shaping, treating industries in the world strictly follow the standards and specification which are helpful in guiding metallurgical laboratories, manufacturers, designers, processors, fabricators and end-users in producing original equipment, machines, components/ parts maintain quality following specification in international standards like AISI/ ASTM, En/ BS, JIS,SUS, Gost, Din, AFNOR, SUS etc..

1. AISI/ SAE (American Iron and Steel Institute/ Society of Automotive Engineers): Steel standards are used in the United States and in many countries in the world since 1941 for the classification of steel materials. The steelmaking process is denoted by a letter prefix in the AISI system. Steels made in an open-hearth furnace, electric arc furnace, or basic oxygen furnace are designated by the prefix “C,” whereas steels made in an electric arc furnace are designated by the prefix “E.” The letter “L” in the grade name denotes the presence of lead as an additional component. Although this standard is no longer maintained and has been largely supplanted by SAE,

ASTM: The other American standards, it is still widely used to classify, evaluate the material, mechanical, and metallurgical properties of various types of steels, which are mainly used in the manufacturing of mechanical components, industrial parts, and construction elements, as well as many other associated equipment. Carbon, structural, stainless, ferritic, austenitic, and alloy steels are among the options. These steel standards help metallurgical laboratories and refineries, product makers, and other end-users of steel and its variations in ensuring quality and safe usage through correct processing and application processes. The ASTM standard is a commonly used material specification that focuses on product features and performance.

For steel products, ASTM standards are typically used to differentiate the steel grade and chemical composition of the material, as well test results and finishing services. ASTM A36 steel has a low carbon content and other properties that are kept in a tight tolerance. Which include its density (7,800 kg/m^3), Poisson's ratio (0.32), and ultimate tensile strength (58,000-80,000 psi).. ASTM designations for testing would be E23 (which falls under “Miscellaneous subjects”), the standard for Charpy V-Notch Tests that perform. It specifies the dimensions of the sample, the steps that need to be taken, among other factors.

2. Euronorm (EN): Euro norm (also known as the European Standard) is an international technical standard that has been accepted as applicable throughout the European Union for a wide range of commercial and industrial operations. The standards may be identical to ISO or IEC worldwide standards developed by a European standards organization. Despite the fact that it is widely acknowledged and effective in many European nations, “obsolete” national systems like German DIN, British BS, French AFNOR, and Italian UNI are still widely utilized and frequently seen in many places.

The creation of the EEC (European Economic Community) has made it necessary to establish common standards named "European Norms" (EN), therefore standardizing the common language across Europe. Since 1988 a new series of 'mandatory' European standards (EN) has been created, to replace national standards, such as BS, DIN, SS and NF, throughout 18 countries of Western Europe.

The European (EN) standards include of specifications for delivery conditions, properties, quality, dimensions and definitions of all products, raw materials and processes of the iron and steel industry. Among others, Euronorm standards cover a large variety of structural and constructional steels, from hot and cold rolled steels, plates, forgings, sheets/ plates and strips, heat treatable steels, castings, stainless and heat resisting steels, electrical steels etc.

The International Organization for Standardization updated this in Euronorm 27-74 in 1974. Letters and numbers are used to classify things. The letters denote the steel type, smelting technique, alloy materials, and processing condition, while the numerals denote the steel material, carbon content, tensile strength, and element fixed-point number of the primary alloy.

3. Japanese Steel Standards (JIS): JIS steel standards are widely used throughout Asia and the Pacific. Other national systems, such as Korean, Chinese, and Taiwanese standards, have frequently adopted JIS steel requirements as a foundation. For the steel material number, the Japanese Industrial Standard (JIS) is separated into two types viz. (1) Structural Steel: The material number is the same as with CNS. Example: S30C means carbon content 0.30% of structural steel.(2) Other use of carbon steel and alloy steel: This kind of material code is divided into three parts. The first part denotes material. The second part denotes steel specification or use and the third part denotes type of steel material.

JIS standards are developed by the Japanese Industrial Standards Committee (JISC) in Tokyo with an aim to promote the industrial standards of Japan. The specifications begin with the prefix JIS, followed by a letter, where the letter denotes the area of division, followed by four digits. Divisions of JIS and significant standards are: A-Civil Engg & Architecture, B. Mechanical Engineering, C. Electronic & Electrical Engg, D. Automotive Engineering, E. Railway, F. Ship Building, G. Ferrous, Minerals & Metallurgy. H. Non Ferrous & Metallurgy, K. Chemical & petr-Chemical etc.

Japanese JIS standards are widely used in Asia and the Pacific areas. JIS steel specifications have also often been used as a base for other national systems, such as Korean, Chinese, and Taiwanese.

Example 1 : **JIS G3445 STKM11A** is a low-carbon tube steel containing 0.12%C, 0.35%Si, 0.60%Mn, 0.04%P, 0.04%S;

Example 2 : **JIS G4403 SKH2 (AISI T1Grade)** is a tungsten high-speed tool steel containing 0.73-0.83%C, 3.8-4.5%Cr, 0.4%Mn, 0.4%Si, 0.8-1.2%V and 17-19%W.

Regarding stainless steels, Japan has generally adopted the AISI numbering system within the Japanese system i.e. SUS 304 corresponds to Type 304 stainless steel. SUH numbers serve to designate the heat-resistant alloys such a SUH 310. SCS and SCH numbers are used for stainless steel castings. Generally, the first "S" in SUS stands for Steel, "U" is "Use" (= for special uses) and the second "S" denotes "Stainless".

4. Deutsches Institute fur Normung e.V (DIN): DIN, the German Institute for Standardization, is the independent platform for standardization in Germany and worldwide. As a partner for industry, research and society as a whole, DIN plays a major role in helping innovations to reach the market within the framework of research projects DIN was founded in 1917 and celebrated its 100 year anniversary in 2017. DIN used to stand for Deutsch Industrienorm (German Industry Standard), but it now stands for Deutsches Institut für Normung. More than **36,000 experts** from industry, research, consumer protection and the public sector bring their expertise to work on standardization projects managed by DIN. The result of these efforts are market-oriented standards and specifications that promote global trade, and encourage rationalization, quality assurance, and the protection of society and the environment, as well as improving security and communication.

5. GOST (Standard for Russian Federation): The specification came from Soviet Union period. Creation and promotion of the Union Standards began in 1918 after introduction of the international systems of weights and measures. The first body for standardization was created by the Council of Labor and Defense in 1925 and was named the Committee for Standardization. Its main objective was development and introduction of the Union standards as GOST standards. The first standards gave the requirements for iron and ferrous metals. Until 1940, People's Commissariats had approved the standards. But in that year the Union Standardization Committee was founded and the standardization was redirected to creation of GOST standards.

In 1968 the state system of standardization (SSS) as the first in the world practice. It included creating and developing five standards: GOST – State Standard of the Soviet Union, RST – Republican standard. Steel standards from recently industrialized nations, such as Chinese, GB and YB, Indian IS, and Brazilian NBR, are currently being recognized due to global procurement, despite being less established and comprehensive at times. The same may be said about Russian GOST, which is the de facto standard for the entire Commonwealth of Independent States.

Vertical industrial steel standards include SAE for automotive, aerospace and more; ASME for pressure vessels and many other applications; AWS for welding consumables and related materials. Shipbuilding specifications are covered by the American ABS, British Lloyds, Italian RINA and others.

BS	DIN	IS	EN	SAE/AISI
150M36	36Mn5	37Mn2, 37C15	EN158	1536
-	CK15	C14	EN328	1015, 1016, 1018
-	CK38	-	-	1038
-	-	C50	EN436	1050
-	CK45	45C8	1045	-
070M55	CK55	C55	EN9	1055

BS	DIN	IS	EN	SAE/AISI
- C35	35C8, C35Mn75	-	1035	
-	CK75	80C6	EN42	1074
-	C67	65C6	EN428	1065
080M50	C55	60C6	EN45	1055
080A47	CK45	-	EN438	1045
150M36	36Mn7	37C15	EN15, 15A	SAE1541
080A40	CK45	45C8	EN8	1040, 1045
080A40	CK45	45C8	EN8A	1040, 1045
080A40	CK45	45C8	4SC8	1040, 1045
080A40	CK45	45C8	EN8C	1040, 1045
080A40	CK45	45C8	EN8D	1040, 1045

Carbon Steel - Related Standard

Numerous steel producers and suppliers have created their own unique, commercial designations for distinguishing steels in addition to the many standards listed above. After years and decades of usage, several of these identifiers have become extensively used within the industrial world, and are frequently referred to as common names or trade names without really referring to the specific provider. Because these “common” names are rarely standardized, and their characteristics can vary greatly, their use in formal technical publications should be avoided.

Chinese Steel Standard; The group of Chinese (GB) standard specifications covers carbon and alloy steel within different delivery conditions such as flat and long products, plates/ sheets, strips, bars, wires, castings, forgings etc. All character set standards that originate in the PRC have designations that begin with "GB". GB is an abbreviation of Guojia Biaozhun, meaning "National Standard". It is thee Chinese national standards issued by the Standardization Administration of China (SAC), the Chinese National Committee of the ISO and the IEC. All character set standards that originate in the PRC have designations that begin with "GB". GB is an abbreviation of Guojia Biaozhun, meaning "national standard". Recommended steel standards are constructed from a numerical code which follows "GB" or "GB/T".

The GB designations for non-alloy common steels and HSLA steels use the prefix letter Q, followed by the yield strength value (Mpa). For example, Q235, Q345, Q390 denote non-alloy common steels and HSLA steels with a yield strength of 235, 345, and 390 MPa, respectively. Non-alloy structural steels and alloy structural steels are represented by numerical codes, which represent the average carbon content to a multiple of 100. For example, numeric code 45 shows a steel containing 0.45% C. Alloy elements in steel use the descriptive code with chemical symbols, followed by its average content.

History of Steel standard:– In the areas of steel in construction, American Institute of Steel Construction develop standard, the major areas of development in past were - Activities started beginning in 1923 continued in 1936 to 1949, Radical change taken place in 1961/1963 continued also in 1969-78, Beginning of Stress Era in 1986, End of Stress Era in 1989..

The ASTM originated in 1898 as the American Section of the International Association for Testing

Materials (IATM). BSI originated in 1901, DIN in 1917 and AFNOR in 1926. The international ISO originated in 1947."

A group of scientists and engineers, led by Charles Dudley, formed ASTM in 1898 to address the frequent rail breaks affecting the fast-growing railroad industry. The group developed a standard for the steel used to shape and fabricate rails. Originally called the "American Society for Testing Materials" In 1902, it became the "American Society for Testing And Materials" in 1961. In 2001, ASTM officially changed its name to "ASTM International" and added the tagline "Standards Worldwide". In 2014, it changed the tagline to "Helping World Steel Industry for better Work". Now, ASTM International has offices in Belgium, Canada, China, Peru, Washington, D.C., and West Conshohocken, PA.

On June 9th, 2022, it was announced that the European Committee for Standardization (CEN) and ASTM International have agreed to extend and expand a Technical Cooperation Agreement from 2019. In India, both steel manufacturing and processing industries use AISI/ASTM standard and British Standard EN (BS). Also, cross-reference tables are utilized in order to figure out which steel grade standard is equivalent to another one. Few Defence production units in India use Russian GOST specification.

Major Classification of Steel grades: Generally, carbon is the most important in the steel specification, increasing carbon content increases hardness and strength, improves hardenability. But carbon at higher level also increases brittleness reducing weldability because of its tendency to form martensite. This means carbon content can be both a blessing and a curse when it comes to commercial steel for various construction purposes. Most commercial steels are classified into one of three groups:

Plain Carbon Steels - These steels usually are iron with less than 1 percent carbon, plus small amounts of manganese, phosphorus, sulfur, and silicon mostly termed as constructional grade steel. The weldability and other characteristics of these steels are primarily a product of carbon content, although the alloying and residual elements do have a minor influence.

Carbon Constructional – Carbon steel used in various construction and manufacturing are classified as carbon construction group, a combination of several types of elements e.g. iron, carbon, and trace elements. It has a number of advantages for construction applications due to the fact that it's fairly inexpensive to manufacture and has a very high tensile strength. What determines the type of steel is the ratio of elements used to produce it, and it's the magic formula of the carbon steel alloy created that makes it preferred for many projects. Copper content must be a minimum of 0.4% and no more than a maximum of 0.6%.Manganese content must not exceed 1.65%.Silicon content must not exceed 0.6%.Within the category of carbon steel, there are the subgroups of high carbon steel (0.60% or higher carbon content) and low carbon steel (up to 0.30% carbon content). In between carbon range is termed as medium carbon steel.

Plain carbon i.e. carbon constructional steels are further subdivided into four groups:

1. Low - Often called mild steels, low-carbon steels have less than 0.30 percent carbon and are the most commonly used grades. They machine and weld nicely and are more ductile than higher-carbon steels.

2. Medium - Medium-carbon steels have from 0.30 to 0.45 percent carbon. Increased carbon means increased hardness and tensile strength, decreased ductility, and more difficult machining

3. High - With 0.45 to 0.75 percent carbon, these

steels can be challenging to weld. Preheating, postheating (to control cooling rate), and sometimes even heating during welding become necessary to produce acceptable welds and to control the mechanical properties of the steel after welding.

4. Very High - With up to 1.50 percent carbon content, very high-carbon steels are used for hard steel products such as metal cutting tools and truck springs. Like high-carbon steels, they require heat treating before, during, and after welding to maintain their mechanical properties.In the Table below, shown Steel Types and Classes against the AISI steel Designation .

Steel Quality & Property: Quality and Property of steel products depend mostly on Composition; Manufacturing Process Routes e.g. BOF or EAF or EIF, Secondary Refining Process e.g. Vacuum Degassing, Ladle Refining etc., Primary Shaping as Ingot Casting or Continuous Casting and then Hot Working - Rolled or Forged Products, Heat Treatment Methods – Normalize, Anneal, Hardening & Tempering , Inspection & Testing..

Stainless Steel in Category of High-alloy Steels: For the most part in the industrial application, stainless steel is considered as the most important commercial high-alloy steel. Stainless steels are at least 12 percent chromium and many have high nickel contents..

Three basic stainless steels are:

Austenitic - Austenitic stainless steels offer excellent weldability, but austenite isn't stable at room temperature. Consequently, specific alloys must be added to stabilize austenite. The most important austenite stabilizer is nickel, and others include carbon, manganese, and nitrogen.

Special properties, including corrosion resistance, oxidation resistance, and strength at high temperatures, can be incorporated into austenitic stainless steels by adding certain alloys like chromium, nickel, molybdenum, nitrogen, titanium, and columbium. And while carbon can add strength at high temperatures, it can also reduce corrosion resistance by forming a compound with chromium. It's important to note that austenitic alloys can't be hardened by heat treatment. That means they don't harden in the welding HAZ

Ferritic - Ferritic stainless steels have 12 to 27 percent chromium with small amounts of austenite-forming alloys.

Martensitic- Martensitic stainless steels, initially, was termed as the cutlery grades, but same now used in many industrial applications. They have the least amount of chromium, offer high hardenability, and require both pre- and post heating in welding operation to prevent cracking in the heat-affected zone (HAZ).

Alloy Steels: Addition of other elements to the carbon steel form alloy steel have variety of properties in environmental, chemical and property wise. The proportion of alloying elements here can provide different mechanical properties.

Alloying elements can change carbon steel in a number of ways. Alloying affects microstructure, heat treatment conditions and mechanical properties. Today's high-speed computer technology can predict the properties and micro-structure of steel during cold forming, heat treatment, hot rolling or alloying. For example, if steel requires properties such as high strength and weldability in certain applications, the use of carbon steel alone will not achieve as the inherent brittleness of carbon can make the weld as brittle. The solution is to reduce carbon and add other elements such as manganese or nickel. This is one way to make high strength steel with the required weldability. There are two types of alloy steels - low alloy steel and high alloy steel.

Series Designation	Types and Classes
10xx	Nonresulfurized carbon steel grades (plain carbon steel)
11xx	Resulfurized carbon steel grades (free-cutting carbon steel)
13xx	Manganese 1.75%
20xx	Nickel steels
23xx	Nickel 3.50%
25xx	Nickel 5.00%
30xx	Nickel chromium steels
31xx	Nickel 125%, chromium 065% or 080%
33xx	Nickel 3.50%, chromium 155%
40xx	Molybdenum 025%
41xx	Chromium 0.50-0.95%, molybdenum 0.12% o r02036
43xx	Nickel 1.80%, chromium 0.50% or 080% molybdenum 025%
46xx	Nickel 1.55% or 1.80%, molybdenum 020% or 025%
47xx	Nickel 1.05%, chromium 0.45%, molybdenum 025961
48xx	Nickel 3.50%, molybdenum 025%
50xx	Chromium 028% or 0.4CR6
51xx	Chromium 0.80%, 090%, 095%, 1 CO36, or 1.05%
5xxxx	Carbon 1.00%, chromium 050%, 1 C096, or 1.45%
60xx	Chrome-vanadium steels
61xx	Chromium 0.80% or 095%, vanadium 0.10% or 0.15% min.
70xx	Heat-resisting casting alloys
80xx	Nickel-chrome-molybdenum steels
86xx	Nickel 055%, chromium 050% or 065%, molybdenum 0.2036
87xx	Nickel 0.55%, chromium 050%, molybdenum 0.25%
90xx	Silicon-manganese steels
92xx	Manganese 085%, silicon 200%
93xx	Nickel 3.25%, chromium 120%, molybdenum 0.12%
94xx	Manganese 10096, nickel 0.45%, chromium 040%, molybdenum 0.12%
97xx	Nickel 0.55%, chromium 0.1796, molybdenum 020%
98xx	Nickel 1.00%, chromium 0.50%, molybdenum 0.25%

AISI Steel Classification

As mentioned earlier, the composition and proportion of the alloying elements determine the various properties of the alloy steel. Low alloy steel is steel with up to 8% alloying elements, while high alloy steel contains more than 8% alloying elements.

About 20 alloying elements can be added to carbon steel to produce various grades of alloy steel. They provide different types of attributes. Some of the elements used and their effects include:

Effects of Alloying Elements

Al - steel that removes phosphorus, sulfur and oxygen

Cr - can increase toughness, hardness and wear resistance

Cu - can increase corrosion resistance and wiring harness

Mn - can improve high temperature strength, wear resistance, ductility and hardenability

Ni - can increase corrosion, oxidation and strength

Mo - Molybdenum, like chromium, has an effect on the corrosion resistance of steel, can also increase the hardenability, toughness, and tensile strength of steel.

Si - can increase magnetic force and strength

W - can increase strength and hardness

V - can increase corrosion, impact resistance, strength and toughness

Nb - Improved mechanical properties, grain structure.

These alloying elements may be used singly or in various combinations depending on the desired properties.

Alloy steel products and their applications

Hundreds of products can be made from alloy steels with different compositions. These include alloy steel pipes and tubes, alloy steel plates, plates and coils, alloy steel bars, rods and wires, alloy steel forged parts, alloy steel butt welds, alloy steel flanges, fasteners, etc. Alloy steels have many uses in various industries, such as automotive, mining, machinery and equipment, railways, road construction, buildings, electrical and marine applications.

Advantages of Use of Carbon & Alloy Steels: The advantages of using carbon & alloy steels for construction & manufacturing applications refor the properties- Durability The biggest benefit of carbon steel is its durability. It is strong and shock resistant, which is why it makes such a beneficial material for construction projects. Business places, government buildings, and residences constructed with steel materials are more resistant to natural disasters such as earthquakes and tornadoes. Carbon steel is sustainable and easy to recycle and reuse.

Affordability. It's far cheaper to manufacture certain products out of carbon steel than other metals. Its durability means less metal can be used while still performing the same function as materials – such as piping – that may be made of another metal like copper. Safety. Steel is relatively easy and safe to handle and also commonly used in cookware because it does not shed potentially harmful chemicals into food

Because of its lower carbon content in low carbon steel, it has a lower cost than high carbon or medium carbon steel. However, low carbon steel is not near as strong or durable like medium or high carbon steel. The number of construction projects uses for various types of carbon steel are virtually limitless, without the carbon steel, production or construction activities in modern world wouldn't be possible..

Permissible level of trace elements in steel: Residual elements (Cu, Ni, As, Pb, Sn, Sb, Mo, Cr, etc.) are defined as elements which are not added on purpose to steel and which cannot be removed by simple metallurgical processes. The presence of residual elements in steel can have strong effects on mechanical properties. There is therefore clearly the need to identify and to quantify the effects of residual elements in order to keep these effects within acceptable limits. Residual elements, or at least some of them, have an influence on processing conditions and regimes, from casting to the final annealing, and possibly on all mechanical properties. Residual elements, or at least some of them, have an influence on processing conditions and regimes, from casting, hot working to heat treatment.

A clear distinction has to be made between those residual elements which have an effect due to their presence in solid solution, such as **Mo, Cr, Ni,** and **Cu,** and those which have an effect due to their segregation at interfaces (surface and grain boundaries), such as **Sn, As,** and **Sb.** The following non exhaustive list gives some possible metallurgical effects of residual elements on processing conditions and properties of steel products. Residuals may influence:1. The processing conditions in terms of: Recrystallisation and rolling forces in the hot strip mill: Residual elements enter steel from impurities in ore, coke, flux and scrap; from these, scrap is considered to be the main source of residuals. The most commonly found residuals are **Cu, Ni, Cr, Mo,** and **Sn.**

Technical Delivery Condition: Steel makers are not always aware about the end use and further processing at customer or processor end, Therefore purpose of use of steel mainly Composition, Properties, End Use etc. should be known to steel makers.

The acceptance limits of these residuals depend mainly on product requirements. A major problem of the recycling process is to control the level of undesirable elements or residuals elements in order to ensure the steel cleanness required by the product performance. The most of steels used today are low carbon/low alloy and extra deep drawing grades of steel. The properties of these steels are very sensitive to the residual elements content and to the thermomechanical processing. As far as flat products and reinforcing bars are concerned, Table 1 shows typical values of main residual elements for the EAF route, in wt%. Mean Residual Element Levels in EAF/IF Produced Steels.

Products	Cu	Ni	Cr	Mo	Sn
Flat	0.050-0.2000	0.050-0.2000	0.025-0.1000	0.010-0.0300	0.010-0.0300
Rebar	max 0.48	max 0.08	max 0.24	max 0.06	max 0.08

The two basic types of competitive advantage combined with the scope of activities for which a plant seeks to achieve them, lead to three generic strategies for achieving above average performance in the steel industry: cost leadership, differentiation, and focus. The variants of focusing strategy are cost focus, quality focus and differentiation focus.

Responsibility of Steel Fabrication Units: Steel fabrication industries should provide steel making industry following information for producing output related to standard and specification for performing products. Numerous chemical elements are now controlled or eliminated at levels of 50 ppm and below by EIF/EAFs which have led to improvements in quality and properties of specific steel grades. However, details will mutually help each other.

1. Mechanical characteristics at room and elevated temperatures, as well as creep resistance.
2. Toughness and fracture mechanics at low temperature,.
3. Practical Weldabiiity & Carbon Equivalent (CE) – Very Good to Poor

Carbon	Weldability
0.36-0.40	Very Good
0.41-0.45	Good
0.46-0.50	Fair
Over 0.50	Poor

4. Hot and cold formability
5. Corrosion resistance in numerous media.
6. he ability of a metal to be formed, cast, welded, or machined is called its fabricating characteristic.
7. Machinability refers to the ease with which a metal may be machined, i.e., the forces acting on the cutting tool are low, chips are easily broken up, good finish produced, longer tool life between two sharpening. The machinability of metals is improved by uniform microstructure, small and undistorted grains, spheroidal structure in high carbon steels, lamellar structure in low- and medium-carbon steels.
8. It is also improved by hot working of medium- and high-carbon steels, cold working of low-carbon steels and heat treatments (annealing, normalising, tempering. The addition of small amounts of lead, manganese, sulphur and phosphorus and absence of abrasive inclusions (Al2O3) also improve the machinability of metals.
9. Ferrite being too soft does not produce good shearing action. Lead (0.15 to 0.35%>), or manganese sulphides help break up the ferrite structure. Leaded steels are known as free-machining steels and can be used at 50% higher cutting speeds than corresponding plain carbon steels. Small amounts of carbon improve the machinability of plain carbon steels upto around 180 BHN, but beyond this further carbon increases hardness and decreases machinability.

Basic Differences between Carbon and Alloy Steel	
Carbon Steel Structure	**Alloy Steel Product**
	

A worldwide oversupply of carbon and alloy constructional grade steel particularly from China has led to increased competition in the market, requiring developing countries like India to function on the same level as developed countries. Since energy use contributes between 20 and 40% of steel production costs, a reduction in energy consumption likely to result in decreased production costs, and increased competitiveness.

Low-carbon steel is the choice for building frames in commercial, government, and residential buildings, infrastructure and construction projects. Bridges, steel piping, and many automotive parts are also made from low-carbon steel. Smaller products made of low-carbon steel include nails, wires, pipes, and chain.

High-carbon steel, with its even greater durability, is often used in cutting tools, springs, coils, wrenches, hammers, and other types of tools and equipment used in the building process.

Alloy Constructional - Alloy constructional grades steels are known for their enhanced properties compared to plain-carbon steel becase of effects of alloying elements which improve: corrosion resistance, hardness, strength, wear resistance, and toughness. Steels are used to make fabrication tooling and end products across just about all industries. The most commonly used grades of Alloy construction in AISI specification are Grade 4140 – Cr- Mo,l.Grade 4340 – Ni-Cr-Mo,.Grade 6150 – Cr-V Steel., Grade 8620 – HSLA -Nil-Cr-Mo Steel.

Tool steel. General purpose grades of tool steel standards are **O-1, A-2, and D-2.** These standard grade steels are considered "cold-working steels," that can hold their cutting edge at temperatures up to about 400°C. This specification covers the chemical, mechanical, and physical requirements for available wrought alloy tool steel products which include hot or cold finished bar, plate, sheet, strip, rod, wire, or forgings, are normally fabricated into tools, dies, or fixtures. The selection of a material for a particular application will depend upon design, service conditions, and desired properties. The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

Standard for Heat Treatment of Steel:

Heat treatment may be defined as an operation or combination of operations that involves the heating and cooling of steel products for the purpose of obtaining certain desirable conditions or properties. It is usually desired to preserve, as nearly as possible, the form/ shape/, dimensions, and m surface of the piece being treated. Steels are essentially alloys of carbon, modified by the presence of other m elements as alloy. Steels may be broadly classified into two types, (1) carbon and (2) alloy. Carbon steels owe their properties chiefly to the carbon. They are fre- quently called straight or plain carbon steels. Alloy steels are those to which one or more alloying elements are added in sufficient amounts to modify certain properties

Common Heat treatment process followed for Steel Products:

Normalizing- Heating to a suitable temperature, between 800-930 degrees Celsius, dependent on steel specification, holding at temperature followed by cooling in still air

Annealing.- Process is performed for steel products by heating the material (generally until glowing) for a while and then slowly letting it cool to room temperature in still air.

Stress Relieving - The stress relieving temperature is normally between 550 and 650°C for steel parts. Soaking time is about one to two hours. After the soaking time the components should be cooled down slowly in the furnace or in air..

Hardening &.Tempering - Steels are heated to their appropriate hardening temperature {usually between 800-900°C), held at temperature, then "quenched" (rapidly cooled), often in oil or water. This is followed by tempering (a soak at a lower temperature) which develops the final mechanical properties and relieves stresses

Nitriding - A heat treating process that diffuses nitrogen into the surface of a metal to create a case-hardened surface. .

Carburising – Carburising or carburisation is a heat treatment process in which iron or steel absorbs carbon while the metal is heated in the presence of a carbon-bearing material, such as charcoal or carbon monoxide. The intent is to make the metal harder..

Induction Hardening - Induction hardening is a process used for the surface hardening of steel and other alloy components. The parts to be heat treated are placed inside a copper coil and then heated above their transformation temperature by applying an alternating current to the coil.

Steel product properties depend on

- Steel composition; carbon, low-alloy, or stainless steel,
- Manufacturing method; basic oxygen process, or electric arc / induction furnace methods etc,Finishing methods; cold or hot rolling and various surface finishing and platting techniques
- Final Product; sheet, structural shape, bar, wire, plate, strip, tubing
- Microstructure; ferritic, pearlitic or martensitic
- Heat treatment method; tempering, annealing and quenching.

The chemical composition is fundamental to the mechanical properties of steel. Adding alloys such as Carbon, Manganese, Niobium and Vanadium can increase the strength. However, such alloy additions increase the cost of the steel, and can adversely affect other properties (i.e. ductility, toughness and weldability). Keeping the sulphur level low can enhance the ductility, and the toughness can be improved by the addition of Nickel. Hence, the chemical composition for each steel specification has been carefully chosen to achieve the required properties.

Role & Responsibilities of Mini Steel Industry :

Improved ability to meet legislative and regulatory requirements enables steel making industries to develop competitive manufacturing capabilities expanding their market reach by ensuring conformity with specified standards in various industries, armament, aerospace, and automotive standards. Several widely recognized organizations set standards that specify the material, chemical, mechanical, and metallurgical properties of materials. These standards are widely used by refineries, Heavy Electrical industries, seamless tubing manufacturers and provide a means of assuring a consistent grade of alloy from producer and a uniform methodology for quality and integrity testing.

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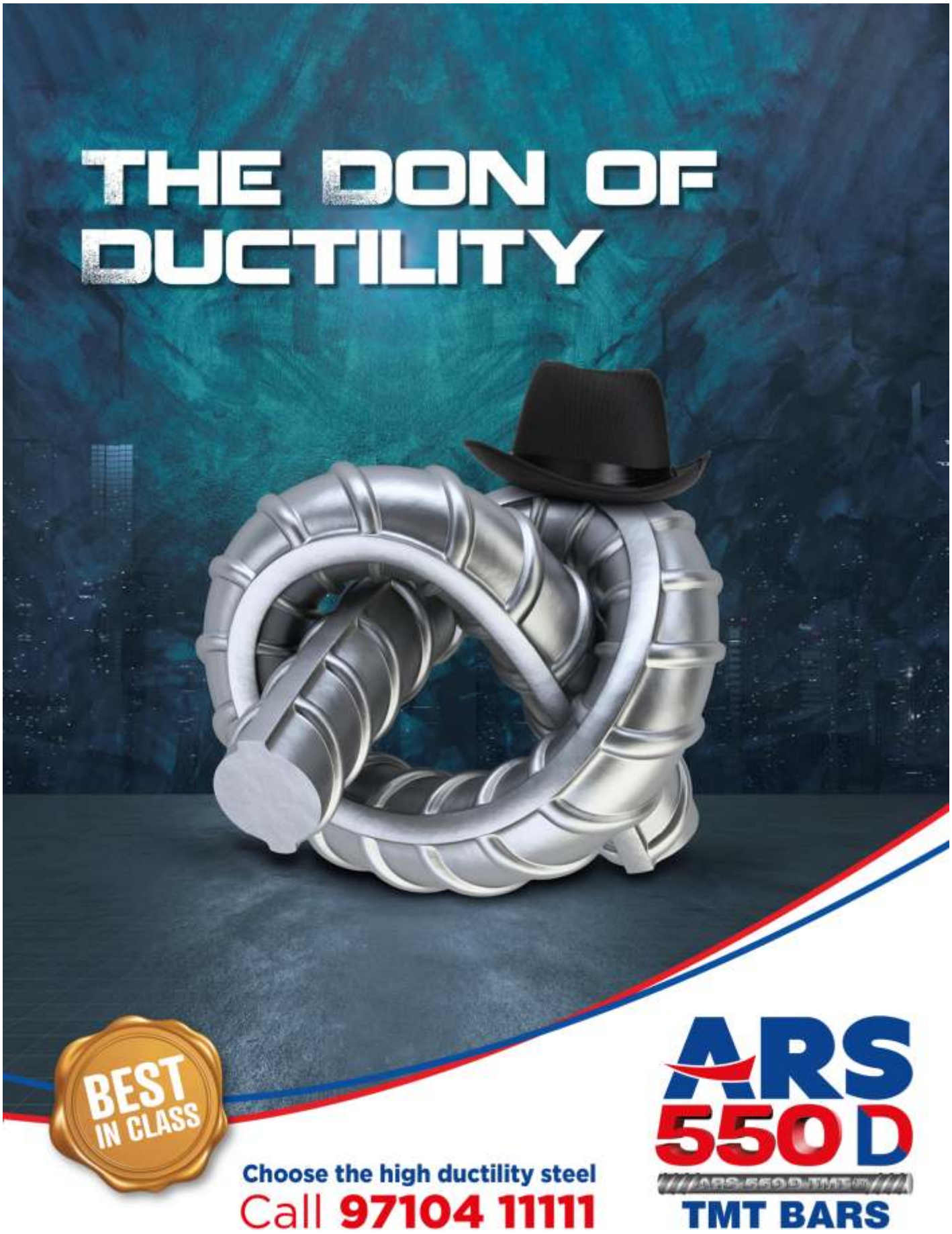
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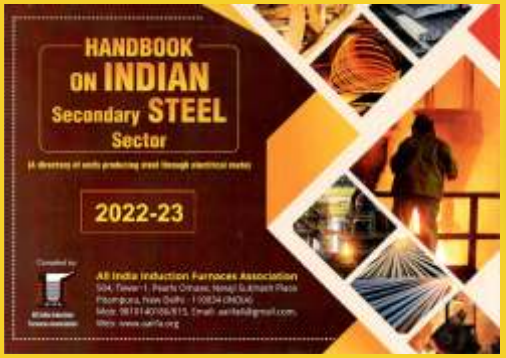

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