Steel 101:

Flat Rolled Low Carbon Sheet

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Overview of Presentation

- Methods of steel production
- Types of low carbon steel
- Steel grades, chemistries, and strengths
- Steel supply chain

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Steel Definition

Webster Definition :

steel \ˈstēl\

A generally hard, strong, durable, malleable alloy of iron and carbon, usually containing between 0.2 and 1.5 percent carbon.

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Steel Mill Types

There are different types of flat rolled steel mills:

Integrated Mills

Mini Mills

Conversion Mills

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Steel Mill Types

Integrated Mills: The principal raw materials for an integrated mill are iron ore, limestone, scrap, and coal (or coke). These materials are charged in batches in a blast furnace where the raw materials are converted to liquid iron (also called pig iron). The material is then moved to a basic oxygen furnace (BOF) for final chemistry refinement. Material is poured into a thick slab and is cooled for future rolling. Slabs must be reheated in ovens to be rolled down to a final thickness.

- Advantages: generally produces broader grades and types of steel than mini mills.

- Examples:
  - Arcelor Mittal
  - AK Steel
  - US Steel
  - Essar Algoma

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Steel Mill Types

Mini Mills: Obtains most of its iron from scrap steel recycled from used automobiles and equipment or by-products of manufacturing. Material is melted in an Electric Arc Furnace (EAF). Material is continuously cast from the laddle into a slab form and while still heated is rolled to a final sheet product.

- Advantages:
  - Newer and efficient infrastructure
  - Uses recycled material- more Eco friendly
  - Reduced energy costs than other types of mills
  - Less labor required
  - Produces less pollution
  - Reduced leadtimes
  - Improved gauge control

- Examples:
  - Steel Dynamics (SDI)
  - Nucor
  - North Star BlueScope Steel
  - Big River
  - NLMK Indiana

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Steel Mill Types

Conversion Mills: Convert slabs into flat rolled coils by heating them up and reducing gauge through rolling mills.

- Advantages:
  - Leadtimes
  - Smaller min order quantity
  - Flexibility on size / width of coils

- Examples:
  - NLMK PA
  - Wheeling Nisshin
  - AM/NS-Calvert (Arcelor Mittal / Nippon Steel)
  - CSN

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Common Steel Types

Hot Rolled (Hot Rolled Black) :

molten steel that is cooled and formed into coils while steel is red hot (approx. 1,700°). Product has scale , which is a oxide coating that is formed at high temperatures. Rust forms on unprotected metal and is often stored outside.

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Common Steel Types

Hot Rolled Pickled & Oiled (HR P&O):

Hot rolled black is uncoiled and sent through a series of hydrochloric baths that removes scale, rust, and unwanted debris. The coil is then lightly oiled for temporary rust prevention.

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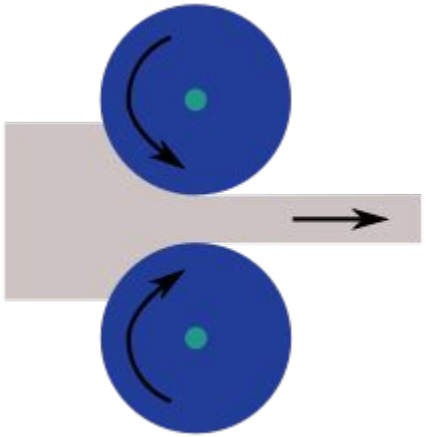
Common Steel Types

Cold Rolled Steel (CR):

Is produced by running HRP&O steel through a series of rollers at room temperature to reduce thickness. The rolling process can increase strength and improve surface finish.

When reducing gauge by a large percentage the material becomes brittle and hard and must go through an annealing (baking) and tempering process to regain formability and required hardness.



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Common Steel Types

Common Types of Coated Steels:

Electro-Galvanized (EG/EL)

Galvanized (GA)

Galvanneal (GN)

Aluminized (AZ)

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Common Steel Types

Electro-Galvanized (EG/EL):

Zinc plating process whereby the molecules on the positively charged zinc anode attach to the negatively charged sheet steel. Thickness of coating can be readily controlled by electric charge or changing the speed of operation.

Great surface for painting and precise coating thicknesses

Applications: Automotive (electrical components, body panels) and Appliance (dishwashers/ stoves etc.)

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Common Steel Types

Galvanized (GA):

Hot dipped galvanized is manufactured by passing steel through a molten bath of zinc to form a thin layer of corrosion resistance. Leaves a crystallization pattern on surface called spangle.

Uses: HVAC & Construction

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Common Steel Types

Galvanneal (GN):

Is produced by taking a hot dipped galvanized coil and passing it through a series of furnaces that raise the temperature so that iron atoms from the sheet move into the zinc coating to form a zinc-iron layer.

Great surface for painting and a lower cost alternative to Electro- Galvanized.

Applications: Mainly automotive (Hoods, Doors, and Body Panels)

Common Steel Types

Aluminized (AZ):

Steel that has been hot-dip coated with aluminum-silicon alloy (T1) or pure aluminum (T2).

Type 1 (T1): Heat Resistant, better formability than T2, generally thinner coating thicknesses than T2.

Uses: automotive exhaust systems and ovens

Type 2 (T2): High Corrosion Resistance

Uses: construction (Example- Road Culvert Pipe)

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Steel Chemistry: Low Carbon

Chemistry: primary elements added to Iron, below are percentages

SAE Certs	Carbon	Manganese	Phosphorous	Sulfur
1006	0-.08	0-.45	0-.03	0-.035
1008	0-.10	0-.50	0-.03	0-.035
1008/1010	0-.13	0-.60	0-.03	0-.035
1010	.08-.13	.30 -.60	0-.03	0-.035
1018	.14-.20	.60-.90	0-.03	0-.035
1018/1020	.14-.23	.30-.90	0-.03	0-.035
1020	.17-.23	.30-.60	0-.03	0-.035

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Steel Grades and Hardness

Steel Grades:

CS (CQ): Commercial Steel

DS (DQ) or FS: Drawing Steel or Forming Steel (Coated Products)

DDS (DDQ): Deep Drawing Steel

EDDS: Extra Deep Drawing Steel

SS: Structural Steels

HSLA: High Strength Low Alloy Steels

Rockwell B Scale (Rb):

is a hardness scale based on the surface hardness of a material. Scale is 0 to 100, higher the Rb harder the material. Used for Aluminum, brass, and soft steels.

(Rockwell C Scale is used for harder steels)

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Steel Grades and Hardness

ASTM Guidelines for Grades of Steel**

COMMONLY USED STEEL TYPES							
Cold Rolled (CR) A1008							
		Rb max	C	Mn	P	S	Al
CS	Type A	65	0-.10	0-.60	0-.03	0-.035	-
CS	Type B	65	.02-.15	0-.60	0-.03	0-.035	-
DS	Type A	55	0-.08	0-.50	0-.02	0-.03	.01 min
DS	Type B	55	.02-.08	0-.50	0-.02	0-.03	.02 min
DDS		50	0-.06	0-.50	0-.02	0-.025	.01 min
EDDS		45	0-.02	0-.40	0-.02	0-.02	.01 min
Hot Rolled Pickled & Oiled A1011							
		Rb max	C	Mn	P	S	Al
CS	Type A	75	0-.10	0-.60	0-.03	0-.035	
CS	Type B	75	.02-.15	0-.60	0-.03	0-.035	
DS	Type A	60	0-.08	0-.50	0-.02	0-.03	.01 min
DS	Type B	65	.02-.08	0-.50	0-.02	0-.03	.01 min
Galvanized Coated (GA) A653							
		Rb max	C	Mn	P	S	Al
CS	Type A	65	0-.10	0-.60	0-.03	0-.035	
CS	Type B	65	.02-.15	0-.60	0-.03	0-.035	
FS (DS)	Type A	55	0-.10	0-.50	0-.02	0-.035	
FS (DS)	Type B	55	.2-.10	0-.50	0-.02	0-.03	
DDS	Type A	50	0-.06	0-.50	0-.02	0-.025	.01 min
EDDS		45	0-.02	0-.40	0-.02	0-.02	.01 min

FOR REFERENCE ONLY

** for maximum amounts of: Cu, Ni, Cr, Mo, V, Cb, Ti, N, B please reference specific ASTM Specification.

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Steel Strength (Mechanical Properties)

TYE or YTE:

Yield Strength:

The stress at which a material is permanently deformed.

Tensile (Ultimate Strength):

The maximum stress that a material can withstand without fracture

Elongation %:

Total amount of elongation (stretch) until fracture

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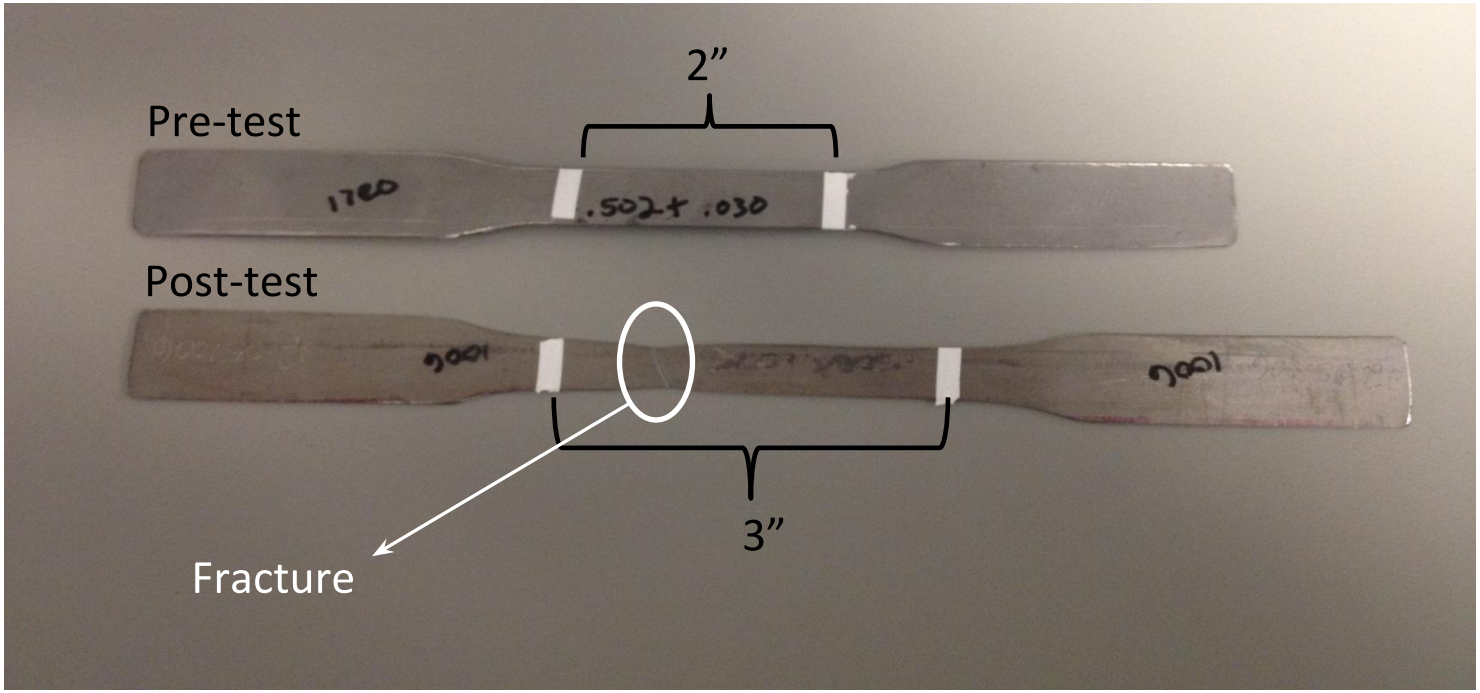
Steel Strength (Mechanical Properties)

"Dog Bone" samples showing results of TYE testing



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Logistics through the Supply Chain

Why is a Steel Service Center Needed?

- Buys in bulk and can offer end user smaller quantities and cost savings.
- Converts master coils into precise widths and lengths needed by end user.
- Timely / JIT deliveries: 3-7 day turn around compared to 4-8 week mill leadtime.

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Conclusion

Questions?

If you have any questions, please feel free to access our resources page, call, or email:

www.miamivalleysteel.com/resources

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