

Free Cutting Steels



**SUN FLAG
STEEL**

ISO-9001 & ISO/TS-16949 Co.

NABL Accredited

AD 2000 - Merkblatt W0 certified from TUEV Nord

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FREE CUTTING STEELS



What is Free Cutting Steels?

Free Cutting or Free Machining Steels are those with enhanced machinability.

The term machinability is manifested by following main characteristics:

- Speed of machining
- Surface finish of the machined components
- Tool life of the cutting tools employed for machining operation

In any commercial machining operation an optimum performance of a free cutting steel in relation to above three parameters is highly desirable.

Metallurgy of Free Cutting Steels

Presence of elements such as Sulphur (S), Lead (Pb), Tellurium (Te), Selenium (Se), Bismuth (Bi) in steel, impart the properties necessary for free machining. The presence of these elements basically ensures easy dispersal of chips

during machining, thereby reducing the machining force, and improving tool life and surface finish of the machined component.

Sulphur and sulphur+lead bearing free cutting steels are widely used in engineering industry where the criteria for free machining have to be necessarily satisfied.

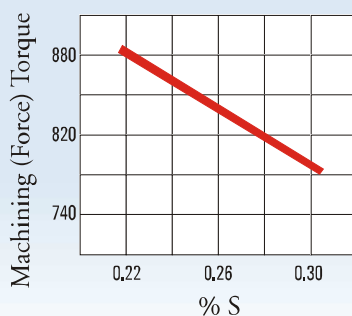
Presence of sulphur in steel leads to formation of manganese sulphides which are basically responsible for free machining properties.

Manganese is an essential alloying element in Free Cutting Steel apart from sulphur. It is the composition and morphology of manganese sulphides which decides the machining performance of a Free Cutting Steel.

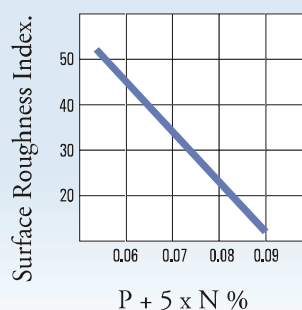
The composition of Manganese Sulphides (MnS) is controlled by the individual levels of manganese and sulphur, Mn/S ratio and the deoxidation practice employed in the manufacture of steel.

The morphology of MnS is defined by the parameter length/width ratio, popularly known as L/W ratio for sulphides. Other elements such as phosphorous, nitrogen, oxygen also play a supplementary role in deciding the overall machining performance of free cutting steel.

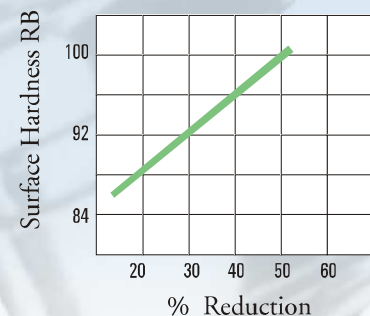
Typical Co-relation of Machining Parameters with Elemental Levels



It is observed that in a certain (Machining) drilling operation, the level of sulphur has a direct relation with the machining force.



The surface finish of a component is dependent upon the combined levels of phosphorous and nitrogen. A significant improvement results by close control of their levels.



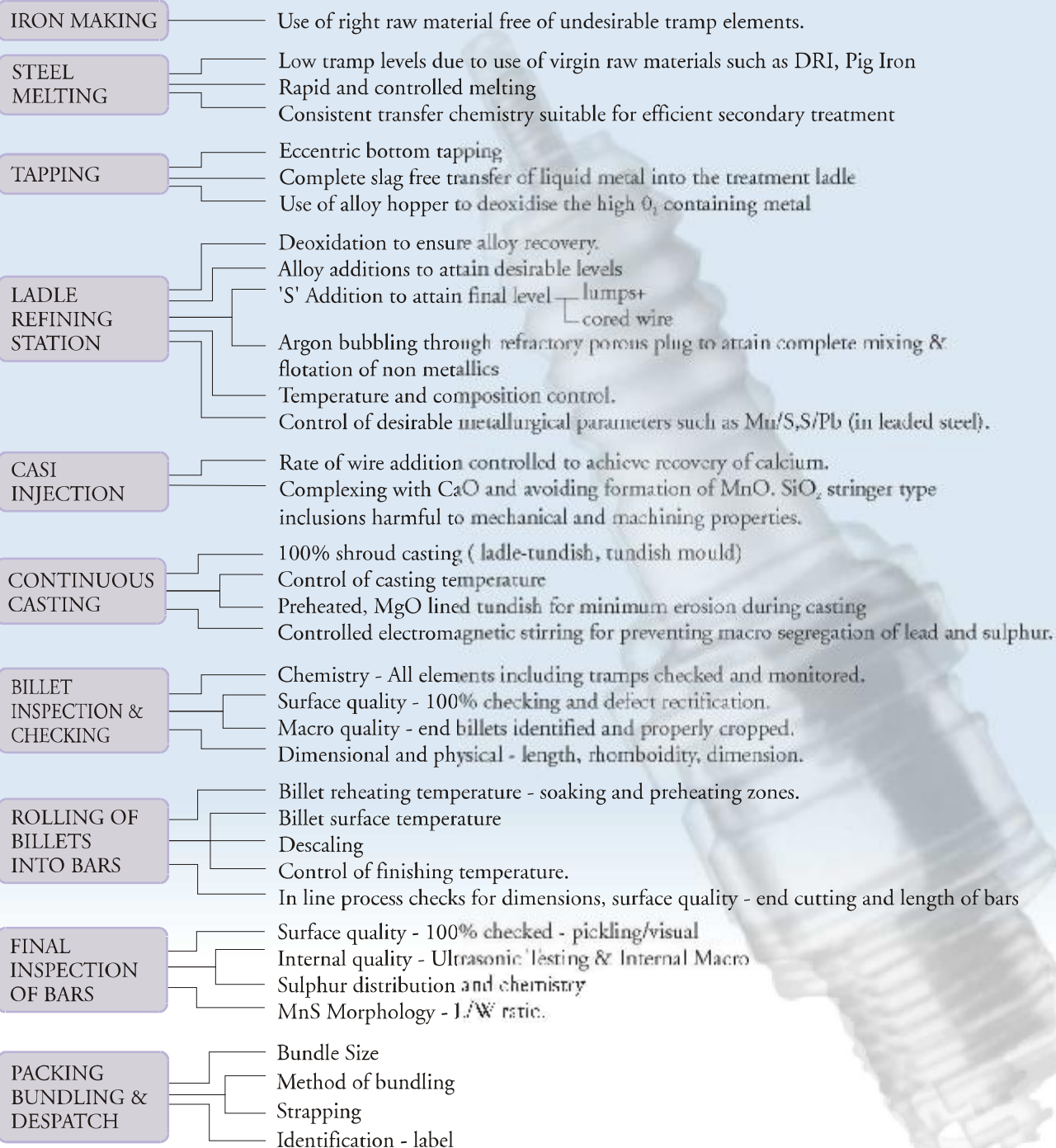
Free machining steels are generally used after cold processing such as drawing, peeling, grinding etc. The extent of cold work employed in converting black bar of free machining steel into bright bar, decides its surface hardness, which in turn is responsible for its machining performance.

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Process of manufacture

In order to achieve the desirable features of free machining steels, Sunflag have designed and implemented a manufacturing process. The outline and salient features of this process are as under



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Certification of quality

- Surface condition : Free from harmful defects.
- As rolled hardness - Free Cutting Steels \leq 150 Bhn
- Macro etch test - (ASTM-E-381) • Inclusion rating - (ASTM - E-45) 2.5 max each - B,C,D
- Spark/Spectral test - 100% bars
- Micro structure - Sulphide morphology (Aspect ratio)

International Specifications of Free Cutting Steels

Country	Grade	Chemistry						
			C	Mn	Si	P	S	Pb
IS (Indian)	11C10S25	Min	0.08	0.80	-	-	0.20	0.15
		Max	0.15	1.20	0.10	0.06	0.30	-
BS (British)	220M07	Min	-	0.90	-	-	0.20	0.20
		Max	0.15	1.30	-	0.07	0.30	-
EN (British)	ENIA-Pb	Min	0.07	0.80	-	-	0.20	0.20
		Max	0.15	1.20	0.10	0.07	0.30	-
AISI (American)	12L14	Min	-	0.85	-	0.04	0.26	0.15
		Max	0.15	1.15	-	0.09	0.35	0.35

DIN (German)	C	Mn	Si	P	S	Pb	Al
9SMn28K	-/0.15	0.90/1.30	-/0.05	-/0.100	0.27/0.33	-	-
9SMnPb28K	-/0.16	0.86/1.35	-/0.06	-/0.11	0.24/0.36	0.15/0.35	-
SUIA28	-/0.18	0.70/1.05	-/0.45	-/0.060	0.08/0.15	-	0.020/0.050
R10S10U	-/0.18	0.70/1.05	-/0.45	-/0.060	0.08/0.15	-	0.020/0.050
45S20U	0.39/0.53	0.66/1.15	0.07/0.33	-/0.065	0.15/0.28	-	-

Sizes and conditions of Supply

Condition of Supply	Shapes	Sizes
1. Black	Hex	15.5 mm - 38 mm A/F
	Round	5.5 mm - 100 mm dia
2. Drawn	Hex	14 mm - 36 mm A/F
	Round	10 mm - 50 mm dia
3. Peeled & Ground	Round	10 mm - 90 mm dia

Industry Serviced by Sunflag's Free Cutting Steels

- Automobile - through manufacture of various machined components
- Auto components and spares manufacturers
- Textile machinery manufacturers
- Engineering Industry - Viz. Manufacturers of machine tools
- Power production industry