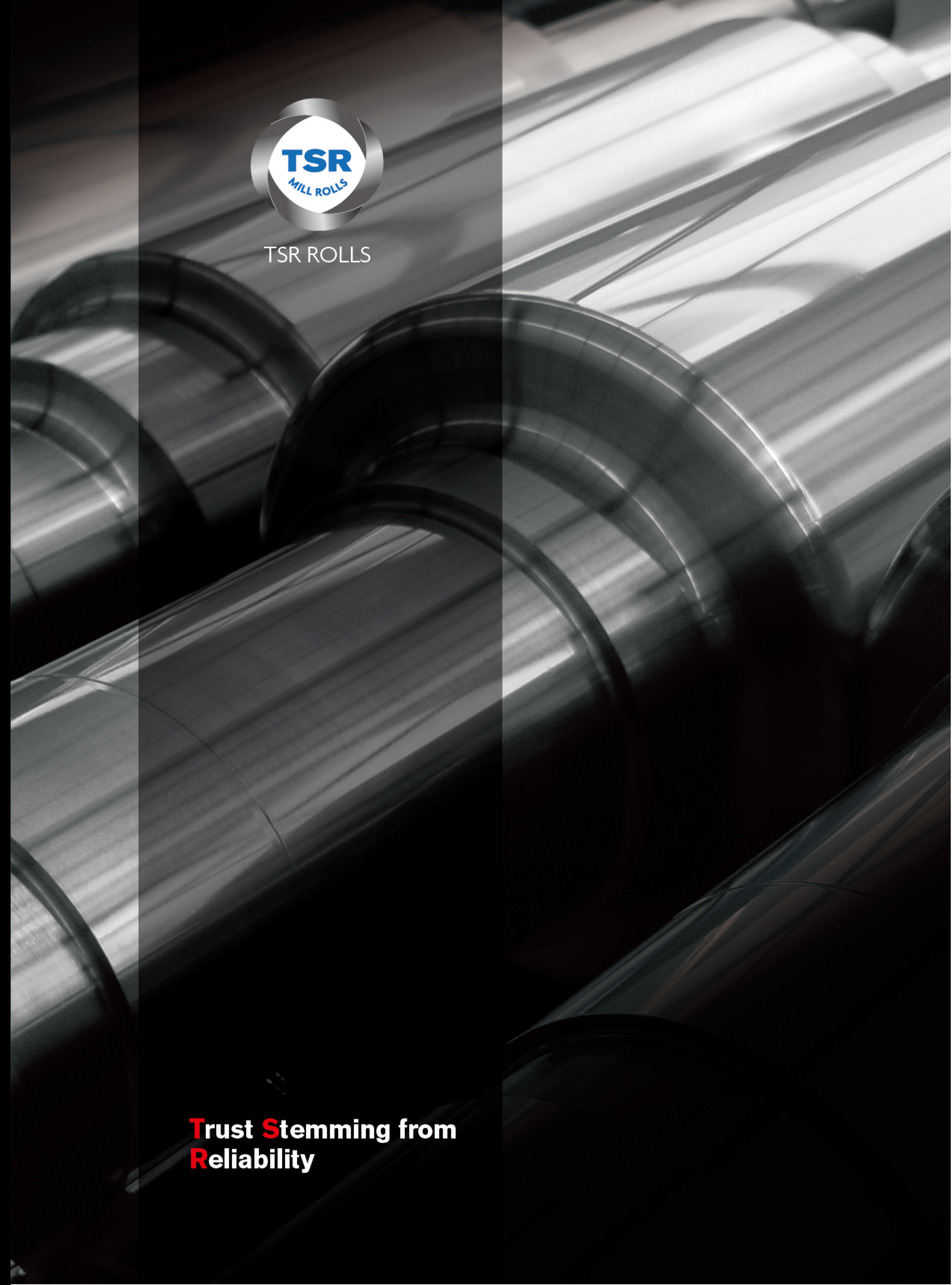
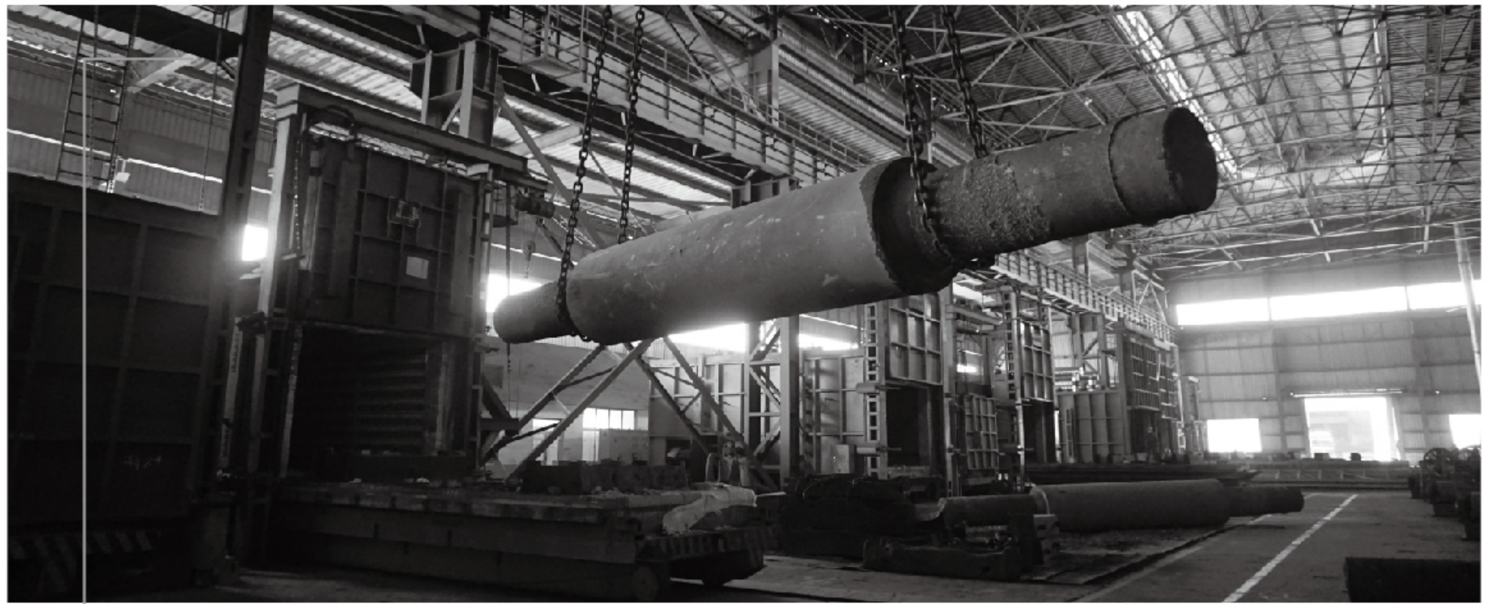
TSR ROLLS

Shanghai Tangshan Heavy Machinery International Co., Ltd.
Tangshan Iron & Steel Group Heavy Machinery Equipment Co., Ltd.

Address:1st Floor, Building 2, 38 Debao Road, Pilot Free Trade Zone, Shanghai, China
Post Code: 200131 Website: www.tsroll.com Email: service@tsroll.com





ABOUT TSR

TSR is a professional company supplying the roll as well as the technical services. It has an expert team consisting of doctors majoring in material and metallurgical industry. Its aim is to develop into a world level supplier of roll technology and services.

Ever since its establishment, oriented by the customers' satisfaction, TSR has been continuously engaged in renovation and pursuit of perfection.

Thanks to years' exploration, TSR has developed series of products which are sold to over 30 countries and regions, including rolls and sleeves for hot rolling mills, forged steel rolls, and rolls of continuous casting.

TSR is supplying various cast rolls for global steel companies. Undertaking the professional manufacturing capabilities of TSME(Tangshan Iron&Steel Group Heavy Machinery Equipment Co., Ltd), TSR shows a superior cost performance ratio in exporting the rolls to the overseas market, gaining a universal preference in those overseas steel-makers.

Covering an area of over 300000m2, TSME is producing more than 20000tons of rolls and sleeves of various dimensions, among which 12000tons for big and medium size casting, 60000tons ingots, 30000tons machining. It is the roll enterprise with the largest annual machining ability and the highest profession in its location. Its products fall into hundreds of types, certified by ISO9001:2008.

ISO9001:2008 Quality Management System Certificate

Currently we have 500 employees, including 8 senior engineers, 11 intermediate engineers, and other 28 technical staff. We are strong in the areas of production, R&D, and quality assurance. With acquired European roll technology, we focus on the roll market and develop other related areas, aiming to build the company as the roll production base in the Northern China. It is our persistent orientation to develop the company into a modern roll manufacturing group with international level and global competition ideology.

MELTING

TSR Rolls factory is equipped with a variety of smelting equipments, such as EBT electric arc furnace, LF double-bit refining furnace, VD-VOD vacuum furnaces and etc. Advanced smelting equipment supplemented by temperature control, component analysis and other testing equipment ensure that each furnace is in line with the requirements of molten steel.

Steel Foundry	• EBT Arc Furnace; Capacity 55T
	• Ladle Furnace, Double position; Capacity 55 T Each
	• Vacuum Degassing VD + VOD, 9 units; Capacity 90 T Each
	• Medium Frequency Induction Furnaces, 2 sets; Capacity 20 T Each
Large Rolls Foundry	• 2 x 20 T Medium Frequency Induction Furnaces
	• 2 x 10 T Medium Frequency Induction Furnaces
	• 2 x 7 T Medium Frequency Induction Furnaces
	• 2 x 3 T Medium Frequency Induction Furnaces
Small Rolls Foundry	• 2 x 3 T Medium Frequency Induction Furnaces
	• 2 x 1.5 T Medium Frequency Induction Furnaces
	• 2 x 1 T Medium Frequency Induction Furnaces

CASTING

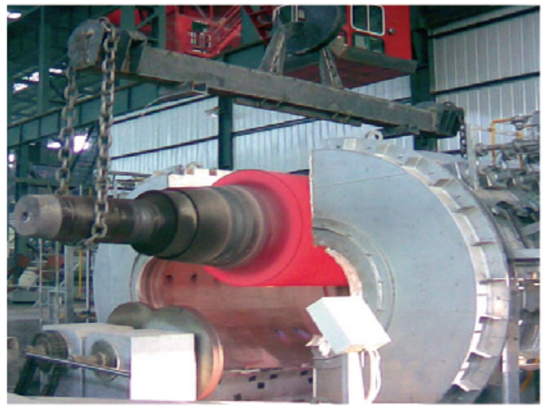
TSR Rolls applies advanced roll casting technology to first-class foundry equipment. Our main production processes use computers to control and select parameters automatically. So we can ensure that each batch of rolls has consistent production process control. Every step is traceable by our Electronic recording system. Whether it is static casting or centrifugal casting, our products have excellent performance.

7 Horizontal Spin Casters (Centrifugal Machines)

- 1 Unit Ø 1.600 mm x 4.500 mm B.L.
- 1 Unit Ø 1.400 mm x 3.000 mm B.L.
- 2 Units Ø 800 mm x 2.600 mm B.L.
- 1 Unit Ø 500 mm
- 2 Units Ø 300 mm

Plus a complete set of chills, chillers and moulding tackle to cast all kind of rolls including big section rolls with the barrel shaped with grooves and collars in as-cast condition.





HEAT TREATMENT

During the manufacturing process of rolls, many materials need to pass one or more heat treatment to further achieve the most appropriate mechanical properties and good microstructure. The resistance furnace of TSR Rolls can achieve multi-point precise temperature control to ensure uniformity of the furnace temperature. Between different furnaces, we use a unified computer control to achieve the furnace heating and cooling consistency in order to ensure the rolls from different furnaces with same microstructure and performance.

- Electrical furnaces, Maximum capacity: 200T 18 sets -bogie type
  7 sets - low-temperature
  11 sets – high temperature
- Differential Heat Treatment Furnace Ø 1.600 mm x 2.800 mm B.L.
- Spray quenching machine, Maximum capacity: Ø1800mm rolls

MACHINING

TSR Rolls has a machining shop of more than 15.000 square meters, including the lathe, boring machine, grinding machine and other modern processing equipment for rolls. Thanks for the first-class operator working on high-precision CNC equipment, it is easy to produce the rolls with various kinds of grooves and precise tolerances.

- CK61160 CNC Lathe, Maximum capacity: 32T
- MK84200 CNC Grinding machine, Maximum capacity 50T
- C9125*6/63 Turing and Boring machine, Maximum capacity: 63T
- T6920D Boring machine



QUALITY ASSURANCE

The high performance requirements of today's mills require reliable rolls capable of remaining in the production cycle longer than ever while still assuring a high quality of the rolled products.TSR Rolls has built a consistent quality control throughout the manufacturing process. Our aim is supplying the customer with reliable rolls capable to perform better, contributing to customer benefit, cost reduction and satisfaction.

Since the beginning TSR Rolls obtained the ISO 9001:2008 Quality Management System Certification. Based on our consistent adherence to the quality management, TSR Rolls products quality has been universally acclaimed by dozens of customers worldwide.

- Emission Spectrometer ARL – 3460; Two sets
- Carbon & Sulphur Analyzer CS-80
- Hydrogen & Oxygen Analyzers
- Thermal Analyzer
- Hardness Testers (Portable and Laboratory sets)
- Ultrasonic Testing Equipments (Several units)
- Material Testing Machine WAW-600
- Charpy Impact Test Machine JSB-300

SERVICE & SUPPORT

At TSR Rolls we are focused on the roll service. Our Technical Service will help you to solve questions about roll maintenance, roll wear, roll damages, roll configuration, shape of the roll, surface hardness, roughness, temperature distribution and damage inspection among others. The aim is reducing the Total Cost of Operation for the customer by supplying reliable rolls and advanced roll service always with strict adherence to the delivery time.

HICR STEEL

Symbol
HiCr Steel
Cast Steel

HiCr Steel is characterized by excellent fire crack resistance and very good oxidation behaviour at rolling temperature. Very good wear resistance and constant material properties throughout the shell layer.

HiCr Steel is manufactured by horizontal spin casting. No retained Austenite and the right structure and properties are obtained through the chemical composition, high temperature quenching and tempering cycles.

Core material: Nodular Iron

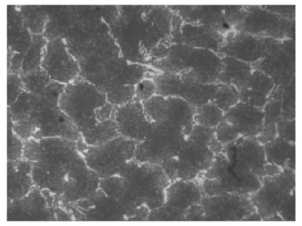
Application:

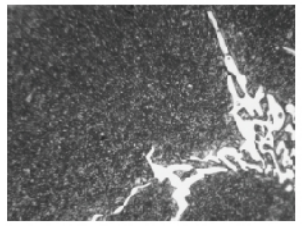
Work Rolls for Roughing Stands of conventional HSM
Early Stands of CSP Mill

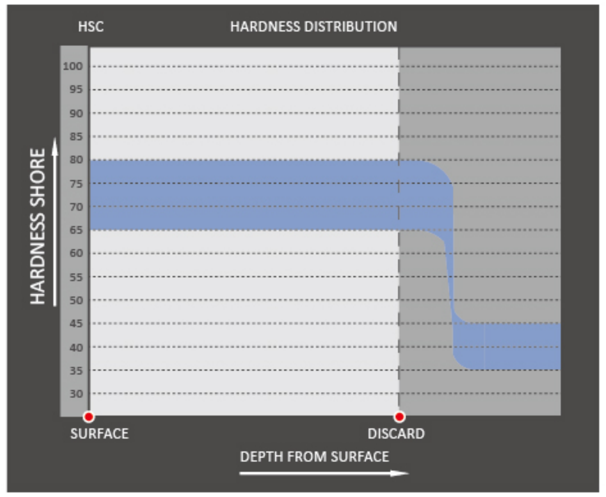
MATERIAL	CHEMISTRY							BARREL HARDNESS (HSC)
	C	Si	Mn	Cr	Ni	Mo	V	
HiCr Steel	0.90-2.00	0.40-1.40	0.40-1.40	9.0-15.0	0.60-1.60	1.00-2.00	≤1.00	65-80

	TYPICAL PHYSICAL PROPERTIES		
Neck Hardness (HSC)	Tensile Strength (N/mm²)	Unevenness of Barrel Surface Hardness (HSC)	Difference of Shell Thickness
35-45	shell ≥750 core & necks ≥400	＜3	＜10

HARDNESS DISTRIBUTION


Microstructure (100X)


Microstructure (500X)



EN-HICR IRON

Symbol
EN-HiCr-Iron
Cast Steel

Enhanced High Chromium Iron is widely used in early finishing stands of hot strip mills.The microstructure consists of a tempered bainitic / martensitic matrix with Cr_7C_3 carbides and MC type carbides homogeneously distributed in the matrix.

Core material: Nodular Iron

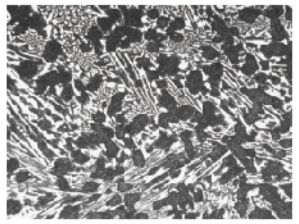
Application:

Work Rolls for early finishing stands (F1-F4) of HSM and early stands of CSP Mill.
Work Rolls for Heavy Plate mills and Temper mills

MATERIAL	CHEMISTRY							BARREL HARDNESS (HSC)
	C	Si	Mn	Cr	Ni	Mo	V	
HiCr Iron	2.60-3.20	0.40-1.20	0.30-1.20	16.0-22.0	1.00-2.00	1.00-3.00	≤1.5	70-85

	TYPICAL PHYSICAL PROPERTIES		
Neck Hardness (HSC)	Tensile Strength (N/mm²)	Unevenness of Barrel Surface Hardness (HSC)	Difference of Shell Thickness
35-45	shell ≥650 core & necks ≥400	＜3	＜10

HARDNESS DISTRIBUTION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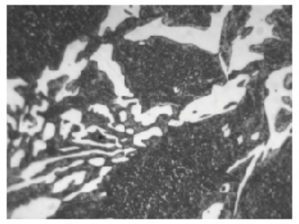
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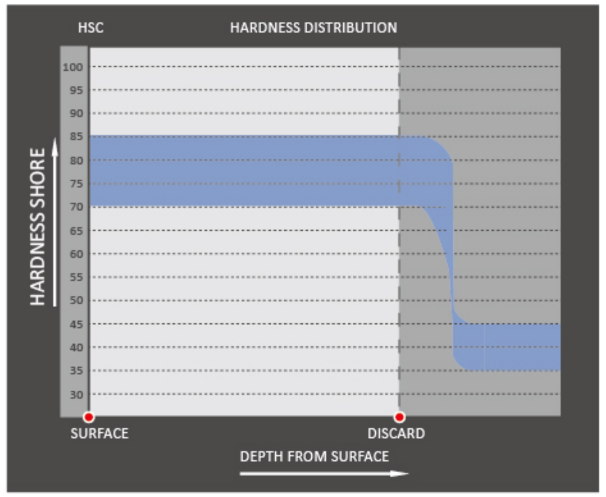


ROLL FOR HOT STRIP AND PLATE MILL

ENHANCED -ICDP

Symbol
EN-ICDP
Cast Iron

The enhanced ICDP is developed based on the classic Indefinite Chill Double Poured Cast Iron.The microstructure consists of a bainitic / martensitic matrix with Fe_3C and MC carbides homogeneously distributed and a certain amount of free graphite fine and also well distributed in the matrix.The rolls are double tempered to avoid retained Austenite and to obtain the right hardness level and the optimum residual stress level.

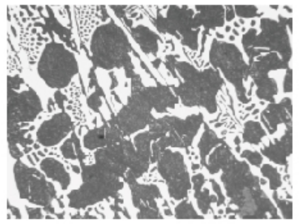
Core material: Nodular Iron or Grey Iron depending on the mill or customer's requirements

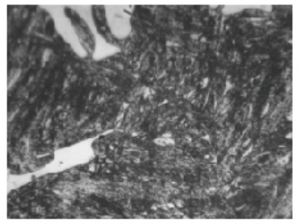
Application:

Late finishing stands (F4 – F7) of hot strip mills
Steckel mills, Heavy Plate mills and finishing stand of section mills

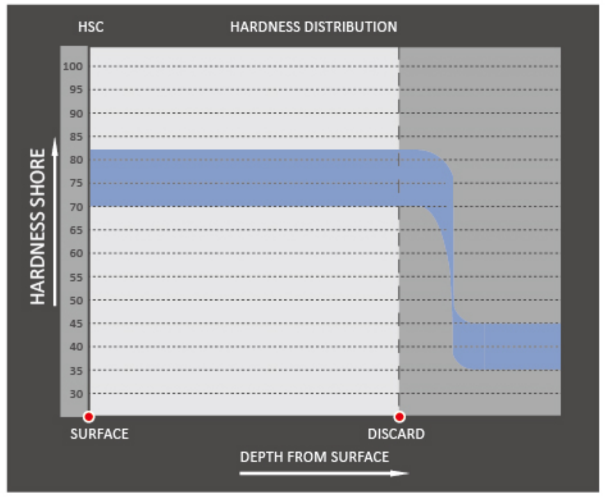
MATERIAL	CHEMISTRY							BARREL HARDNESS (HSC)
	C	Si	Mn	Cr	Ni	Mo	V+W+Ti+Nb	
EN-ICDP	2.90-3.40	0.60-1.60	0.50-1.50	1.20-2.00	3.50-5.00	0.20-1.00	≤2.5	70-82

TYPICAL PHYSICAL PROPERTIES			
Neck Hardness (HSC)	Tensile Strength (N/mm²)	Unevenness of Barrel Surface Hardness (HSC)	Difference of Shell Thickness
35-45	≥400	<3	<10


Microstructure (100X)


Microstructure (500X)

HARDNESS DISTRIBUTION



HIGH SPEED STEEL

Symbol
HSS
Cast Steel

The microstructure consists of tempered bainitic / martensitic matrix with primary and secondary carbides. Primary carbides MC, M_7C_3, M_6C and M_2C are originated during the eutectic solidification. Secondary carbides are precipitated during the High Temperature quench and tempering. The rolls are cast with the right structure to undergo the High Temperature quenching to promote the right precipitation of secondary carbides and optimum material properties. Excellent wear resistance and fire crack resistance and very good oxidation behaviour at rolling temperatures under the adequate rolling conditions are the main features of this grade.

Core material: Nodular Iron

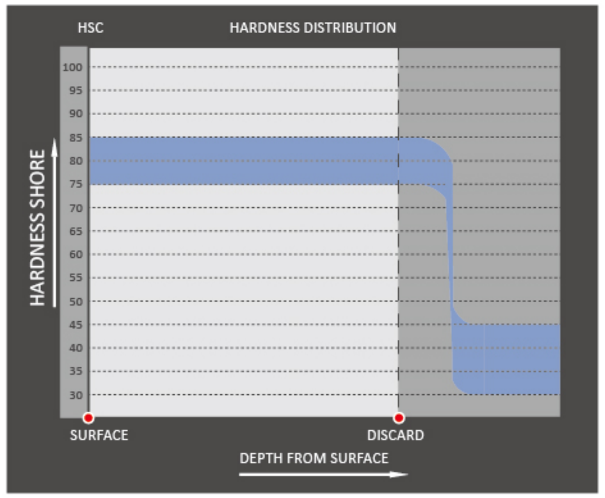
Application:

Work Rolls for early finishing stands (F1-F4) of HSM and early stands of CSP Mill.
Work Rolls for finishing stands of bar mills

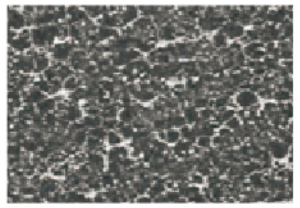
MATERIAL	CHEMISTRY								BARREL HARDNESS (HSC)
	C	Si	Mn	Cr	Ni	Mo	V	W	
HSS	1.50-2.20	0.30-1.00	0.40-1.20	3.00-8.00	0.50-1.50	2.00-8.00	2.00-9.00	0.00-8.00	75-85

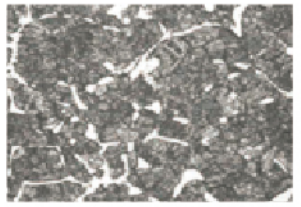
TYPICAL PHYSICAL PROPERTIES			
Neck Hardness (HSC)	Tensile Strength (N/mm²)	Unevenness of Barrel Surface Hardness (HSC)	Difference of Shell Thickness
30-45	shell ≥800 core & necks ≥400	<3	<10

HARDNESS DISTRIBUTION



Material		Characteristics	Disadvantages
Shell	core		
High Carbon & High Vanadium HSS	Nodular Cast Iron	• With high alloy element, good quenching degree and hardenability, small hardness drop. Carbide is MC type granular and M6C strip, high micro hardness, low crack propagation • In high temperature rolling, barrel surface is easy to form compact oxidization film with strong adhesion.	• High coefficient of linear expansion. Easy to cause roll shape change in rolling, thus to affect precision of rolled material. • Wear resistance is depending on the time, thickness and completeness of the oxidization film. • For some thin material and low rolling temperature, it is hard to form good oxidization film. Thus, the wear resistance can't be sufficiently realized.


Microstructure (100X)


Microstructure (500X)

ROLL FOR HOT STRIP AND PLATE MILL

CAST BACK-UP ROLLS

TSR Rolls Cast Back Up Rolls are produced to a high hardness level of up to 75 HSC through a Differential Hardening process. The superior wear and mechanical hardening resistance are related to the bainitic / martensitic matrix and complex carbides finely distributed. In the Differential Hardening process the monoblock rolls are first heat treated to produce a fine pearlite necks and core structure followed by the differential hardening of the working layer (Austenitize, water quench and double tempering) to develop the optimum microstructure in the working layer.

The rolls are monoblock cast so no shell / core interface problems

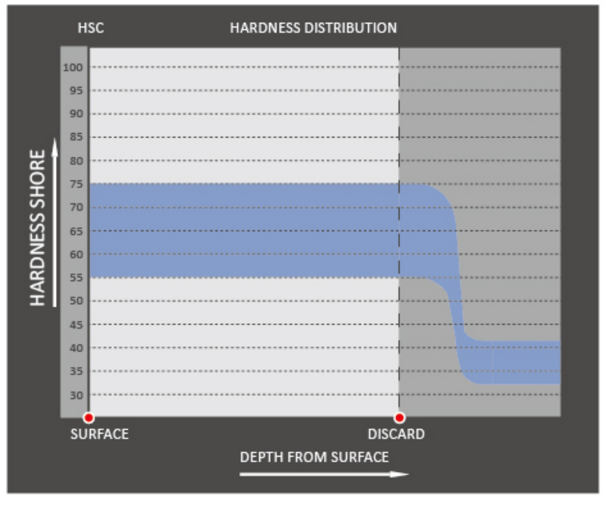
Application:

Back Up Rolls for 4-Hi Stands of Hot and Cold Strip mills and CSP Mills.
Work Rolls for 2-Hi roughing Stands of Hot Strip Mills (3 % Cr)

MATERIAL	GRADE	CHEMISTRY						BARREL HARDNESS (HSC)
		C	Si	Mn	Cr	Ni	Mo	
Cast Back-up Roll	3%Cr	0.30-0.50	0.30-0.60	0.40-1.0	2.50-3.50	0.60-1.50	0.30-0.60	55-62
	4%Cr	0.30-0.50	0.30-0.60	0.40-1.0	3.50-4.50	0.60-1.50	0.30-0.60	60-65
	5%Cr	0.30-0.50	0.30-0.60	0.40-1.0	4.50-5.50	0.60-1.50	0.50-0.80	65-75

TYPICAL PHYSICAL PROPERTIES			
Neck Hardness (HSC)	Tensile Strength (N/mm²)	Unevenness of Barrel Surface Hardness (HSC)	Difference of Shell Thickness
≤42	shell ≥1500 core & necks ≥750	<3	<10

HARDNESS DISTRIBUTION



ALLOY CAST STEEL

Symbol
AS
Cast Steel

Carbon contents of Alloyed Cast Steel range between 0.4 to 1.4 % depending of the hardness level. Additions of Cr, Ni, Mo and other alloying elements and the right heat treatment will develop a pearlitic or sorbitic structure.

In case of deep channels and grooves, we recommend a pre-machining of the grooves before the final heat treatment allowing the hardness to penetrate down to the bottom of the grooves and developing a uniform hardness along the barrel

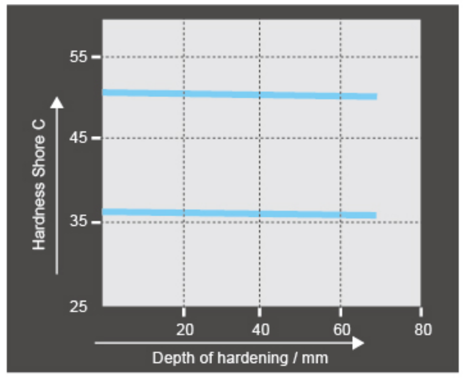
Application:

Roughing and BD stands of heavy section and medium section mills.

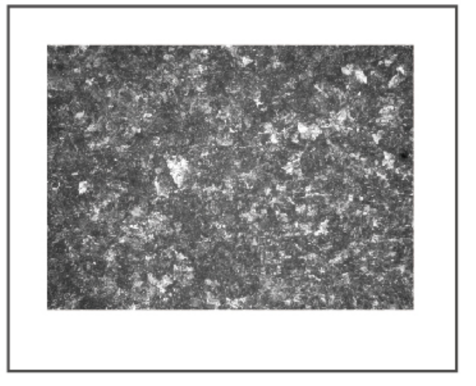
MATERIAL	GRADE	CHEMISTRY						BARREL HARDNESS (HSC)
		C	Si	Mn	Cr	Ni	Mo	
Alloy Steel	AS60	0.55-0.65	0.20-0.45	0.90-1.20	0.80-1.20		0.20-0.45	35-50
	AS65 I	0.55-0.65	0.20-0.60	0.50-1.00	0.80-1.20	0.20-1.50	0.20-0.60	35-45
	AS70	0.65-0.75	0.20-0.45	0.90-1.20				32-42
	AS70 I	0.65-0.75	0.20-0.45	1.40-1.80				35-45
	AS70 II	0.65-0.75	0.20-0.45	1.40-1.80			0.20-0.45	35-45
	AS75	0.70-0.80	0.20-0.45	0.60-0.90	0.75-1.00		0.20-0.45	35-50
	AS75 I	0.70-0.80	0.20-0.70	0.70-1.10	0.80-1.50	≥0.20	0.20-0.60	35-50

GRADE	TYPICAL PHYSICAL PROPERTIES		
	Neck Hardness (HSC)	Tensile Strength (N/mm²)	Unevenness of Barrel Surface Hardness (HSC)
AS60	≤45	≥650	<5
AS65 I	≤45	≥650	<5
AS70	≤45	≥600	<5
AS70 I	≤45	≥600	<5
AS70 II	≤45	≥680	<5
AS75	≤45	≥680	<5
AS75 I	≤45	≥700	<5

HARDNESS CURVE



MICROSTRUCTURE 100X



ADAMITE

Symbol
AD
Cast Steel

Adamite or Steel Base is a material with Carbon content and mechanical properties between Steel and Iron.The addition of Cr, Ni, Mo and other elements and a special heat treatment process will develop a high wear and fire cracking resistance together with a constant hardness along the working layer.

Application:

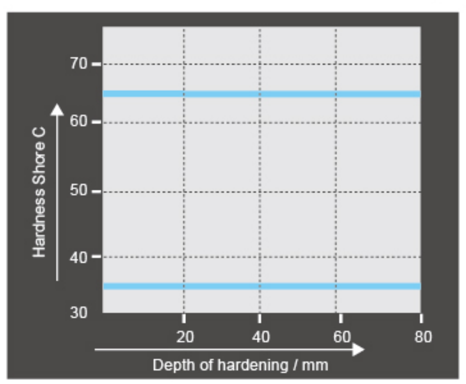
Intermediate and finishing stands of section mills.
Intermediate stands of bar mills.
Sleeves for Universal stands of heavy section mills.
Vertical Edgers of hot strip mills
Work Rolls for roughing stands of heavy plate mills.

MATERIAL	GRADE	CHEMISTRY						BARREL HARDNESS (HSD)
		C	Si	Mn	Cr	Ni	Mo	
Adamite	AD140	1.30-1.50	0.30-0.60	0.70-1.40	0.80-1.60		0.20-0.60	38-55
	AD140 I	1.30-1.50	0.30-0.60	0.70-1.10	0.80-1.20	0.50-1.20	0.20-0.60	35-50
	AD160	1.50-1.70	0.30-0.60	0.70-1.10	0.80-1.20		0.20-0.60	40-50
	AD160 I	1.50-1.70	0.30-0.60	0.80-1.30	0.80-2.00	≥0.20	0.20-0.60	40-60
	AD180	1.70-1.90	0.30-0.80	0.60-1.10	0.80-1.50	0.50-2.00	0.20-0.60	45-60
	AD190	1.80-2.00	0.30-0.80	0.60-1.20	1.50-3.50	1.00-2.00	0.20-0.60	55-65
	AD200	1.90-2.10	0.30-0.80	0.80-1.20	0.60-2.00	0.60-2.50	0.20-0.80	50-65

	TYPICAL PHYSICAL PROPERTIES		
Material	Neck Hardness (HSC)	Tensile Strength (N/mm²)	Unevenness of Barrel Surface Hardness (HSC)
AD140	≤45	≥590	<5
AD140 I	≤45	≥590	<5
AD160	≤50	≥490	<5
AD160 I	≤50	≥490	<5
AD180	≤50	≥490	<5
AD190	≤50	≥490	<5
AD200	≤50	≥490	<5

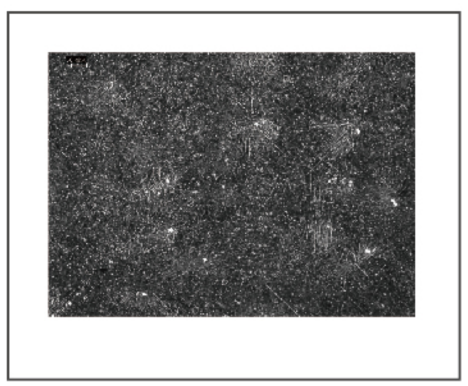
HARDNESS CURVE

CC Duplex



MICROSTRUCTURE

100X



GRAPHITIC STEEL

Symbol
GS
Cast Steel

The carbon content and matrix of graphite steel rolls are similar to those of adamite rolls. Its main character is that it contains a small amount of fine graphite in its microstructure, which will increase its resistance to fire crack and prevent oxidized scales from adhering.

Application:

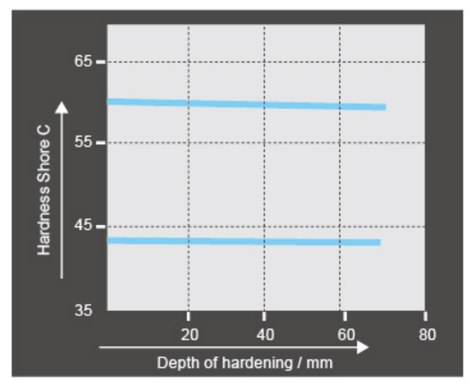
Intermediate and finishing stands of heavy section mills.
Finishing stands of rails
Pilger mills.
Vertical Edgers of hot strip mills

MATERIAL	GRADE	CHEMISTRY						BARREL HARDNESS (HSC)
		C	Si	Mn	Cr	Ni	Mo	
Graphite Steel	GS 140	1.30-1.50	1.30-1.60	0.50-1.00	0.40-1.00		0.20-0.50	36-46
	GS 160	1.50-1.70	0.80-1.50	0.60-1.00	0.50-1.50	0.20-1.00	0.20-0.60	40-60
	GS190	1.80-2.00	0.80-1.50	0.60-1.00	0.50-2.00	0.60-2.20	0.20-0.80	55-65

	TYPICAL PHYSICAL PROPERTIES		
Material	Tensile Strength (N/mm²)	Bending Strength(N/mm²)	Elongation (%)
Graphite Steel	≥450	650-1000	0.2-0.6

HARDNESS CURVE

Static



MICROSTRUCTURE

100X

PEARLITIC NODULAR CAST IRON

Symbol
SGP
Cast Iron

Pearlitic and Pearlitic / Sorbitic Nodular Iron are nodular grades alloyed with Cr, Ni, and Mo with Ni ranging between 1.50 % in the softer grades and 4 % in the harder grades. The right balance of Si and Cr will help to develop the adequate hardness level. The rolls can be cast static or spun cast depending of the size of the working layer and the mill conditions.

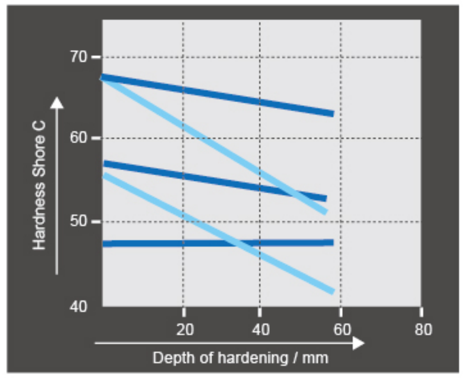
Application:

Roughing stands of bar, wire rod and medium section mills.
Intermediate stands of bar mills.
Sleeves of Universal stands

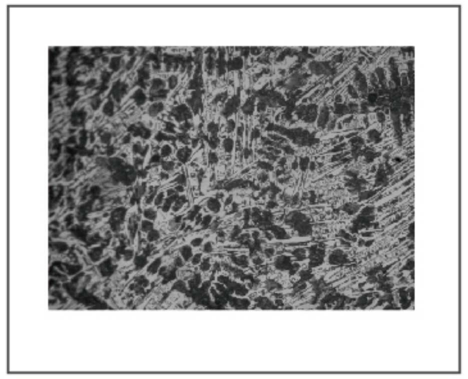
MATERIAL	GRADE	CHEMISTRY						BARREL HARDNESS (HSC)
		C	Si	Mn	Cr	Ni	Mo	
Pearlite (SGP)	Pearlite I	2.90-3.60	1.40-2.20	0.40-1.00	0.10-0.60	1.50-2.00	0.20-0.80	45-55
	Pearlite II	2.90-3.60	1.20-2.00	0.40-1.00	0.20-1.00	2.01-2.50	0.20-0.80	50-60
	Pearlite III	2.90-3.60	1.00-2.00	0.40-1.00	0.20-1.00	2.51-3.00	0.20-0.80	60-70

TYPICAL PHYSICAL PROPERTIES		
Neck Hardness (HSC)	Tensile Strength (N/mm²)	Unevenness of Barrel Surface Hardness (HSC)
35-55	≥350	<5

HARDNESS CURVE



MICROSTRUCTURE 100 X



BAINITIC NODULAR CAST IRON

Symbol
SGA
Cast Iron

Bainitic and bainitic / martensitic nodular iron are nodular grades alloyed with Cr, Ni, and Mo with higher Cr and Ni contents. Compared to pearlitic irons, acicular irons show higher strength, toughness and wear resistance.
The rolls can be cast static or spun cast depending of the size of the working layer and the mill conditions.

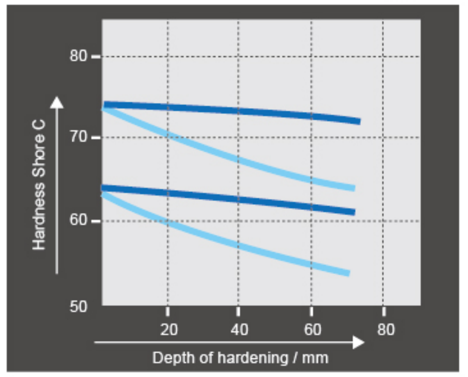
Application:

Intermediate and finishing stands of bar, wire rod and medium section mills.
Forming, sizing, reducing and straightening rolls for pipe and tube mills
Sleeves for Universal finishing stands (Horizontal & Vertical)

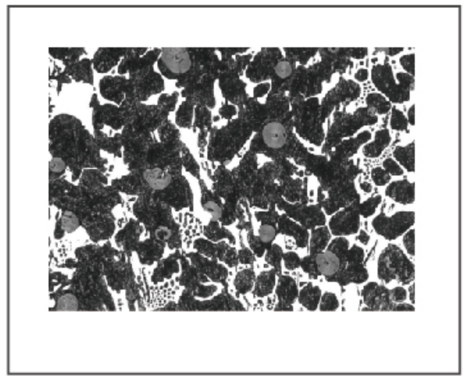
MATERIAL	GRADE	CHEMISTRY					BARREL HARDNESS (HSC)
		C	Si	Mn	Ni	Cr	
Bainite(SGA)	Bainite I	2.90-3.60	1.20-2.20	0.20-0.80	3.01-3.50	0.50-1.00	55-65
	Bainite II	2.90-3.60	1.00-2.00	0.20-0.80	3.51-4.50	0.50-1.00	65-75

TYPICAL PHYSICAL PROPERTIES		
Neck Hardness (HSC)	Tensile Strength (N/mm²)	Unevenness of Barrel Surface Hardness (HSC)
32-45	≥350	<5

HARDNESS CURVE



MICROSTRUCTURE 100 X

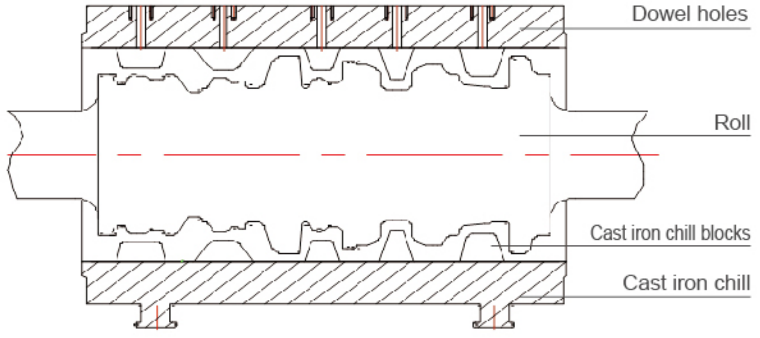


CAST ROLL WITH GROOVES

When rolls are deeply grooved as in Heavy Section mill rolls, it is necessary to produce a roll with a similar hardness at the top of the collar and at the bottom of the groove. A significant hardness fall off along the groove will lead to an uneven wearing behaviour and a rapid deterioration of the dimensional stability and tolerances of the rolled section. This will require frequent roll changes, redressings and a significant increase of the operational cost.
In the case of steel rolls, since the hardness and the microstructure are adjusted by the heat treatment, it is relatively easy to premachine the grooves before the heat treatment in order to have the same hardness at the top of the collars than at the bottom of the grooves.
In the case of cast iron rolls, where the microstructure and the hardness are basically obtained in as-cast condition, it is a distinct advantage to shape the mould of the roll with a contour as close as possible to the shape of the finished roll.
At TSR Rolls we have developed a moulding technique using a solid chill for the outer contour of the roll barrel and shaped cast iron chills bolted to the outer chill to produce the grooves promoting rapid solidification in the working area of the roll. This minimizes the appearance of solidification defects and produces a fine grained wear resistant structure which results in enhanced mill performance.

• Material: SGP • Maximum weight: 32T • Patent has been authorized

The grooved cast roll in as-cast condition



A basic sketch of the grooved mould.

ROLLS FOR LONG PRODUCTS

ALLOY INDEFINITE CHILLED CAST IRON

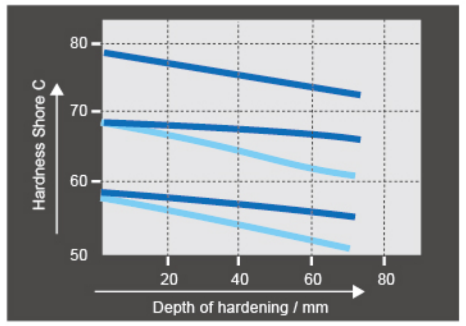
Symbol
IC
Cast Iron

Alloy Indefinite Chilled Cast Iron is a material between chill cast iron and grey cast iron. The sizes, shapes and distributions of graphite and carbide are controlled by the chilling effect and the contents of alloy elements. The addition of alloy elements such as Manganese, Nickel, Chromium, and Molybdenum changes the matrix microstructure from pearlite, bainite to martensite. The presence of small amount of fine graphite enhances the roll's resistance to spallling, thermal crack and wearability. This roll has small hardness gradient in the working layer of roll barrel and is suitable to medium and finishing stands for bar, wire and section mills.

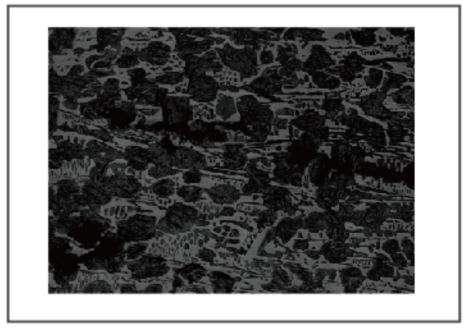
MATERIAL	GRADE	CHEMISTRY									BARREL HARDNESS (HSC)
		C	Si	Mn	Cr	Ni	Mo	V	W	Nb	
Indefinite Chilled (IC)	IC III	2.90-3.60	0.60-1.20	0.40-1.20	0.70-1.20	2.01-3.00	0.20-1.00				38-55
	IC IV	2.90-3.60	0.60-1.50	0.40-1.20	1.00-2.00	3.01-4.00	0.20-1.00				35-50
	IC V	2.90-3.60	0.60-1.50	0.40-1.20	1.00-2.00	3.01-4.80	0.20-2.00	0.20-2.00	0.00-2.00	0.00-2.00	40-50

	TYPICAL PHYSICAL PROPERTIES		
Material	Tensile Strength (N/mm²)	Bending Strength(N/mm²)	Elongation (%)
IC	400-500	700-1000	0.2-0.5

HARDNESS CURVE



MICROSTRUCTURE 100 X



HIGH SPEED STEEL

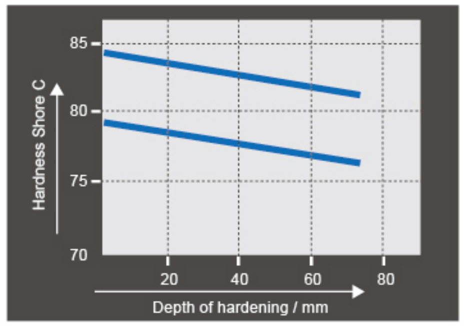
Symbol
HSS
Cast Steel

High-speed steel rolls are manufactured by centrifugal casting, the core material as spheroidal graphite cast iron. By adding vanadium, tungsten, niobium and other alloying elements and special heat treatment, the distribution of this material becomes martensite with good uniformity to ensure high hardness and hardness uniformity of Shell. High-speed steel materials deliver high hardness and wear resistance at high temperature. It can be used for finishing stand to increase the operating time and improve the quality of the surface of rolling material.

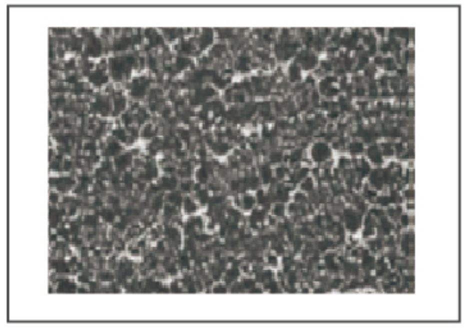
MATEAIAL	CHEMISTRY										BARREL HARDNESS (HSC)
	C	Si	Mn	p	s	Cr	Ni	Mo	V	W	
High Speed Steel	1.50-2.20	0.30-1.00	0.40-1.20	≤0.030	≤0.025	3.00-8.00	0.00-1.50	2.00-8.00	2.00-9.00	0.00-8.00	75-95

	TYPICAL PHYSICAL PROPERTIES		
Material	Neck Hardness (HSC)	Tensile Strength (N/mm²)	Unevenness of Barrel Surface Hardness (HSC)
High Speed Steel	30-45	≥350	＜5

HARDNESS CURVE



MICROSTRUCTURE 100 X



ROLLS FOR LONG PRODUCTS

SLEEVE AND ROLL SHAFT

We produce various grades of sleeves and shafts or arbors for universal mills (Horizontal and Vertical Stands) in SGP, SGA, Adamite, Hi Cr Iron… The standard manufacturing method for the universal sleeves is double poured centrifugal casting with the outer shell made of high hardness and high alloy material and the core (central bore) made out of softer materials.

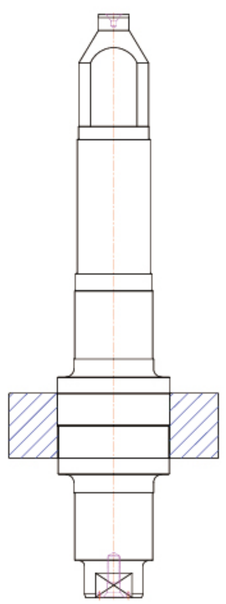
The shafts or arbors are made of low carbon alloy steel either cast or forged, Upon customer request we can assemble the sleeves and arbors by shrink fitting to form the whole roll.

SLEEVES

MATERIAL	CHEMISTRY						Hardness HSC	Tensile Strength
	C	Si	Mn	Cr	Ni	Mo		
SGP	2.90-3.60	1.00-2.20	0.40-1.00	0.20-1.20	1.50-3.00	0.20-0.80	55-70	≥450
SGA	2.90-3.60	1.00-2.20	0.20-0.80	0.20-1.50	3.0-4.50	0.50-1.00	60-75	≥450
Adamite	1.50-2.10	0.30-0.80	0.60-1.30	0.80-3.50	0.50-2.50	0.20-0.80	60-65	≥600
GS	1.60-2.20	1.20-2.00	0.50-1.50	1.00-3.00	1.00-3.00	0.40-0.80	60-65	≥700

SHAFTS

MATERIAL	CHEMISTRY					Tensile Strength (N/mm^2)
	C	Si	Mn	Cr	Mo	
42CrMo	0.38-0.45	0.17-0.37	0.50-0.80	0.90-1.20	0.15-0.30	≥800



TSR ROLLS

Trust Stemming from Reliability