

**GERDAU**  
SUMMIT



# WE SHAPE THE FUTURE

The life asks for more than steel, asks for new ways of living, building, planting or generating energy. And Gerdau Summit is connected with all those changes and constantly adapting itself to keep up with such trends while contributing to the construction of the future

Gerdau Summit is the largest open-die press in Latin America, possesses technical expertise and invests in high technology towards the production of specialty forged and cast products. Our market focus allows for a closer proximity to customers, while generating customized solutions and a distinguished technical support.



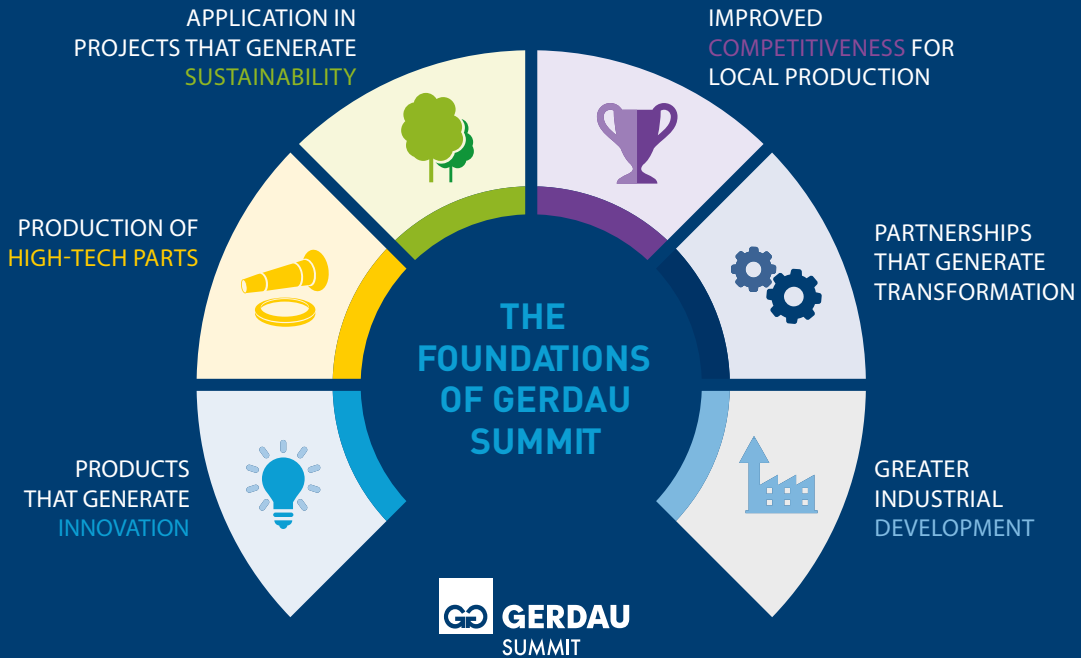
# WE ARE MADE BY THE UNIFICATION OF KNOWLEDGE

Gerdau Summit was created in 2017 after the Joint Venture between Gerdau, Sumitomo Corporation and The Japan Steel Works (JSW), combining industrial expertise, market knowledge and technological advances into the production of parts for various industries such as oil and gas, wind power, power generation, steel, mining, aluminum, sugar and alcohol. In addition, special focus was placed on the enhancement of its current line of rolling-mill rolls in Pindamonhangaba, São Paulo.

The merger of Gerdau's efforts with these two consolidated companies allowed for the production of Made-in-Brazil components for new wind farms, taking into account current market needs for forged and cast parts of this kind, as well as expanding investment technologies in rolling mill rolls.



## OUR FOCUS IS INNOVATION



## New Markets



### AGRICULTURE SUGARCANE

- Finished forged shafts, rough bars and Cast Sleeves for sugarcane mills



### INDUSTRY MINING

- Forged Sleeve and Shafts for mining equipments.



### ENERGY WIND, ELECTRIC MOTORS

- Finished forged shafts and rough bars for motors
- Forged rings for bearing





# Work Rolls for HOT STRIP MILLS

A broad range of products are available on Villares Rolls portfolio to attend the diverse properties required in rolling mill rolls applications. These work rolls are manufactured by spin cast processes. The roll's external layer (working layer) provides wear resistance while the subsequent layers (core) provide a combination between toughness and mechanical resistance, which is required to withstand the rolling strains.

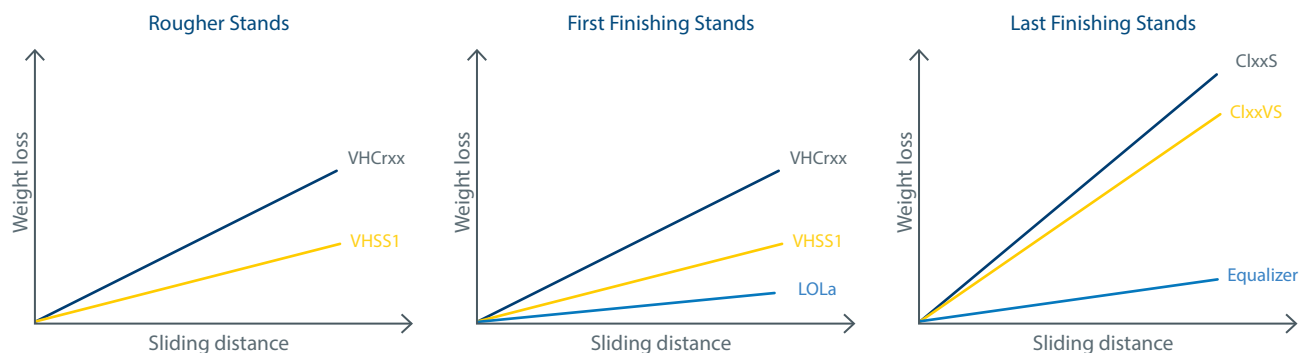
## PRODUCTS

Nominal chemical composition (% in weight; Fe balance), hardness and comparison of the Villares Rolls work rolls for hot strip mills.

Stands Type	Roll Type	Roll Grade	Chemical Composition (%wt)									Properties				Hardness (LD)	
			C	Si	Mn	Cr	Ni	Mo	V	W	Nb + Ti	Oxidation Resistance	Wear Resistance	Thermal Fatigue Resistance	Toughness		
Rougher Stands	High Chromium Iron	VHCrx	Min.	2.10	0.45	0.80	14.00	0.90	0.90	-	-	-	↑↑↑	↑	↑	↑	735/810
		HCI type	Max.	3.00	0.95	1.30	18.00	1.90	1.90	0.40	-	-	↑↑↑	↑	↑	↑	
	High Chrome Steel	VHCr11	Min.	1.00	0.45	0.50	8.00	0.50	0.90	-	-	-	↑↑↑	↑	↑	↑	735/785
		HCS type	Max.	2.50	1.00	1.50	16.00	2.00	3.00	0.50	0.50	0.50	↑↑↑	↑	↑	↑	
	High Speed Steel	VHSS1	Min.	1.00	0.10	0.10	3.50	0.50	0.50	2.00	1.50	-	↑↑	↑↑	↑↑	↑↑	780/810
		HSS type	Max.	2.00	1.50	1.00	8.00	2.00	2.50	6.00	4.50	0.40	↑↑	↑↑	↑↑	↑↑	
First Finishing Stands	High Chromium Iron	VHCrx	Min.	2.10	0.45	0.80	14.00	0.90	0.90	-	-	-	↑↑↑	↑	↑	↑	735/810
		HCI type	Max.	3.00	0.95	1.30	18.00	1.90	1.90	0.40	-	-	↑↑↑	↑	↑	↑	
	High Speed Steel	VHSS1	Min.	1.00	0.10	0.10	3.50	0.50	0.50	2.00	1.50	-	↑↑	↑↑	↑↑	↑↑	780/810
		HSS type	Max.	2.00	1.50	1.00	8.00	2.00	2.50	6.00	4.50	0.40	↑↑	↑↑	↑↑	↑↑	
		LOLa	Min.	1.00	0.10	0.10	3.50	0.50	0.50	2.00	1.50	-	↑↑↑↑	↑↑↑	↑↑	↑↑	
		HSS type	Max.	2.00	1.50	1.00	8.00	2.00	2.50	6.00	4.50	0.40	↑↑↑↑	↑↑↑	↑↑	↑↑	
High Speed Steel	Equalizer	Min.	1.00	0.10	0.10	3.00	0.50	2.50	2.00	-	-	↑↑	↑↑	↑↑	↑↑	780/810	
	HSS type	Max.	2.00	1.50	1.00	6.00	2.00	5.00	5.00	2.50	2.50	↑↑	↑↑	↑↑	↑↑		
Last Finishing Stands	Indefinite Chill Cast Iron	ClxxS	Min.	3.00	0.55	0.45	1.40	4.10	0.25	-	-	-	↑	↑	↑	↑↑	750/810
		IC type	Max.	3.60	1.25	1.30	2.10	4.80	0.70	1.50	1.50	3.00	↑	↑	↑	↑↑	
	Microalloyed Indefinite Chill	ClxxVS	Min.	2.50	1.00	0.50	1.00	3.00	0.25	-	-	-	↑	↑↑	↑	↑	750/810
ECl type	Max.	3.60	3.00	1.50	2.50	5.00	1.00	1.50	1.50	3.00	↑	↑↑	↑	↑			

## WEAR BEHAVIOR

Schematic representation of the wear behavior for Villares Rolls products.



The main test used for such evaluations in work rolls for hot strip mills consists in the "pin-on-disc" test.



# Work Rolls for COLD STRIP MILLS

Three types of grades for cold strip mills work rolls are currently available on Villares Rolls portfolio. The main difference between these is the chromium content in their chemical composition. To define a product specification it is necessary to analyze the rolling process characteristics and the value given by the user to the performance requirements (i.e. mechanical resistance and wear resistance). These requirements are usually conflicting with each other in the rolling process perspective. For rolling mills with high stability (meaning low accident rates), it is recommended to use products with 5%Cr. On the other hand, if the accident rate is high, it is recommended to use products with 3%Cr.

## PRODUCTS

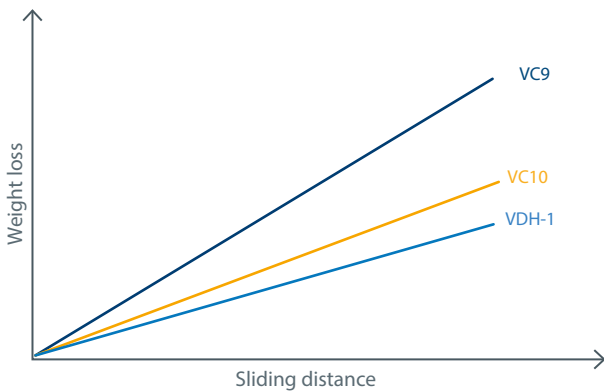
Nominal chemical composition (% in weight; Fe balance), mechanical properties and hardness features of the three grades of Villares Rolls work rolls for cold strip mills.

Roll Type	Roll Grade		Chemical Composition (%wt)						Mechanical Properties		Hardness Features		
			C	Si	Mn	Cr	Mo	V	Yield Limit (MPa)	Resistance Limit (MPa)	Hardness Range (LD)	Maximum Depth of Layer (mm)*	Drop in Hardness (LD)
3% Cr	VC9	Min.	0.70	0.10	-	3.00	0.20	0.04	600 - 800	800 - 1000	730 - 900	30	25
		Max.	0.95	0.70	0.70	4.00	0.55	0.15					
5% Cr	VC10	Min.	0.80	0.10	0.50	4.00	0.10	0.04	800 - 900	900 - 1000	800 - 900	40	40
		Max.	0.95	0.70	0.80	5.00	0.40	0.15					
5% Cr deep hardness	VDH-1	Min.	0.85	0.15	0.20	4.00	0.10	0.04	700 - 900	900 - 1100	800 - 900	60	110
		Max.	1.00	0.70	0.80	6.00	0.45	0.15					

\* Depth associated to the barrel's radius.

## WEAR BEHAVIOR

Schematic representation of the wear behavior for the three grades of Villares Rolls products.



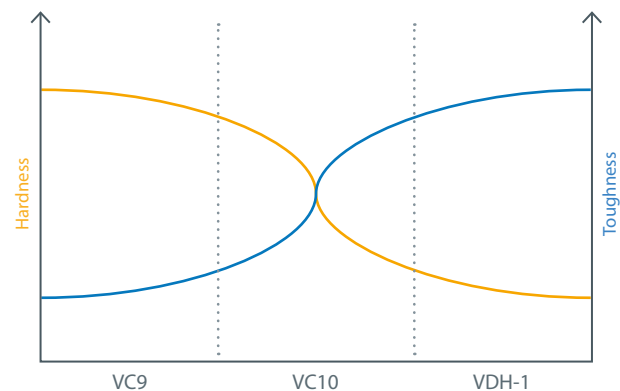
The main test used for such evaluations in work rolls for cold strip mills consists in the "pin-on-disc" test.

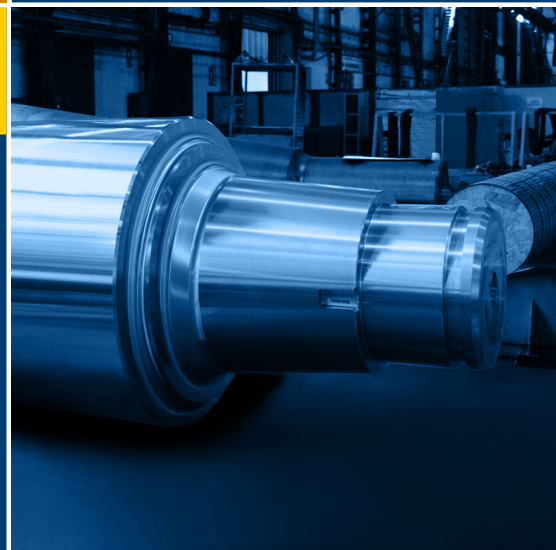


Work Roll for Cold Strip Mill

## MECHANICAL PROPERTIES

Schematic representation of the variation of hardness and toughness for the three grades of Villares Rolls products. The three grades in Villares Rolls portfolio for this application present their own combination of hardness and resistance to accidents. In general, as the hardness increases, the wear resistance also increases, but the resistance to accidents during the rolling process decreases.





# BACK-UP ROLLS

Back-up rolls are available on Villares Rolls portfolio in three product grades. These grades are defined according to the required properties and application during the rolling process. The specification of a product is closely related to the analysis of the rolling process characteristics. In back-up rolls applications these characteristics will demand requirements such as: wear resistance and contact fatigue resistance. For hot strip mills in which the demand for wear resistance on a back-up roll is high, it is recommended to use products VC4HM-1 or VC4TS. For cold strip mills, the recommendation will depend on the typical roll wear of the mill (VC4A or VC4HM-1 may be used).



## PRODUCTS

Nominal chemical composition (% in weight; Fe balance) and mechanical properties of the three grades of Villares Rolls back-up rolls.

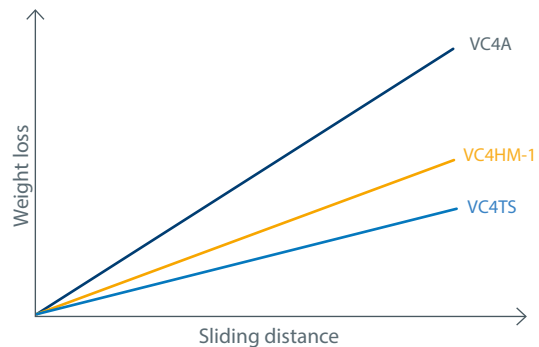
Roll Type	Roll Grade	Chemical Composition (%wt)						Mechanical Properties			
		C	Si	Mn	Cr	Mo	V	Yield Limit (MPa)	Resistance Limit (MPa)	Hardness Range (LD)	
3% Cr	VC4	Min.	0.40	0.10	0.50	2.60	0.40	-	1100 - 1400	1200 - 1500	655 - 735
		Max.	0.50	0.45	0.90	3.10	1.10	0.15			
5% Cr	VC4HM-1	Min.	0.40	0.10	0.40	4.00	0.20	-	1200 - 1550	1250 - 1600	655 - 760
		Max.	0.70	0.60	0.80	5.00	1.00	0.30			
5% Cr enhanced	VC4TS	Min.	0.40	0.20	0.40	4.00	1.00	0.20	1200 - 1550	1250 - 1600	730 - 800
		Max.	0.50	0.50	0.80	5.50	2.50	0.40			



Back-Up Roll

## WEAR BEHAVIOR

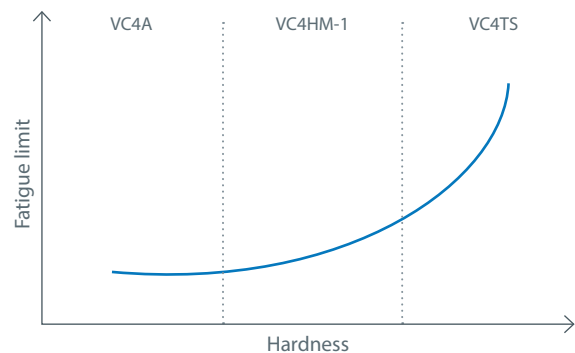
Schematic representation of the wear behavior for the three grades of Villares Rolls products.

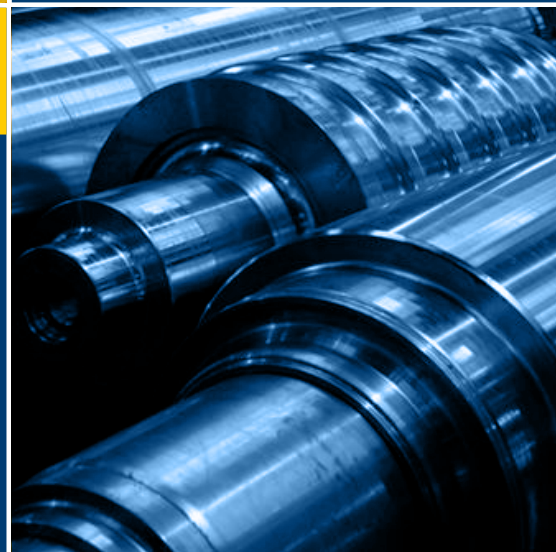
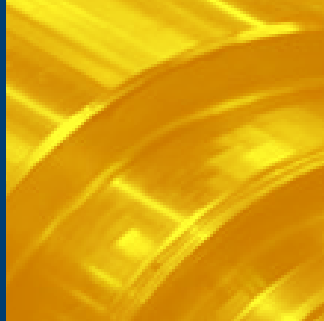


The main test used for such evaluations in back-up rolls consists in the "pin-on-disc" test.

## MECHANICAL PROPERTIES

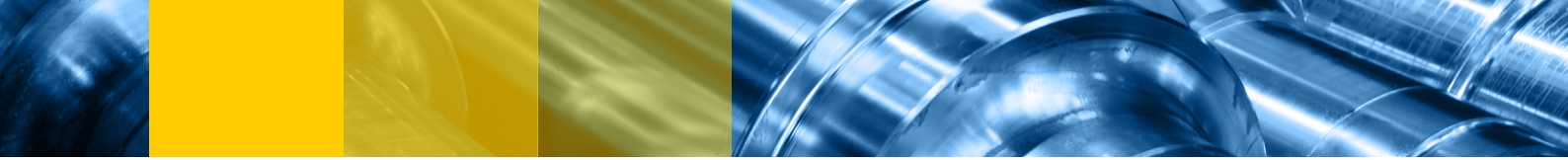
Schematic representation of the variation of fatigue limit due to the hardness for the three grades of materials of Villares Rolls back-up rolls. The three grades of products in Gerdau Summit's portfolio related to this application present their own hardness and fatigue limit characteristics. As a general rule, increases in hardness leads to subsequent increases in the fatigue limit.





# Rolls for LONG PRODUCTS MILL

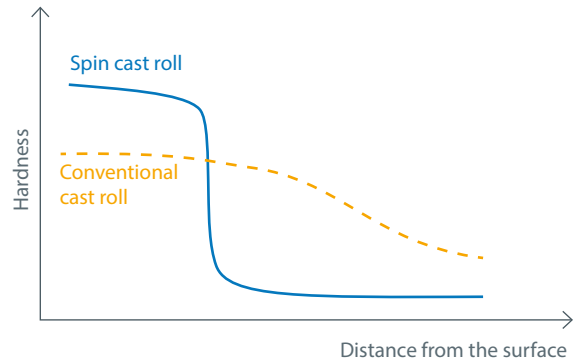
There is a great variety of products available on Gerdau Summit portfolio for long-product applications. These rolls can be manufactured by conventional or static casting, process in which rolls are made up of a single material; or through spin casting in which the roll's work layer provides wear resistance and the core provides a combination between toughness and mechanical resistance. The main difference between those two processes is the hardness characteristic as shown in figure 1.



□ Figure 1

Hardness variation as a function of the distance from the roll surface for Gerdau Summit products produced by conventional cast or spin cast process.

The properties required in the roll depend on typical features of the rolling process such as the product's reduction rate, dimensions of the billet, cooling efficiency, type of stand, as well as the diameter of the roll and stand at which the roll operates.

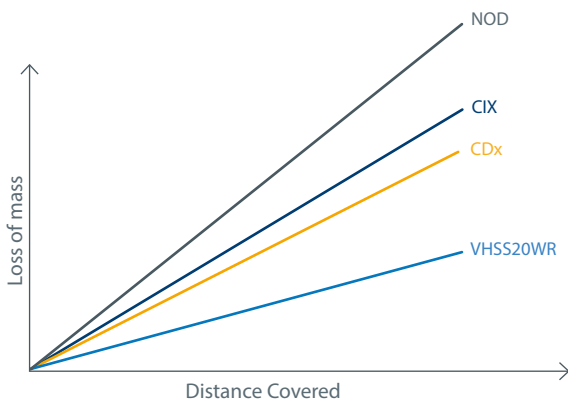


□ WEAR BEHAVIOR

Laboratory studies are carried out to assess the performance of the roll products under set conditions. The main tests implemented for this purpose are: i) "pin-on-disc" type test (figure 2), ii) thermal fatigue test, and iii) oxidation test.

□ Figure 2

Schematic representation of the wear behavior for the various groups of materials.



Product	Tenacity	Thermal Fatigue Resistance	Wear Resistance
Forged Steel	↑↑↑↑↑	↑↑↑↑↑	↑
Adamite Steel	↑↑↑↑	↑↑↑↑	↑↑
Cast Iron (Nodular)	↑↑↑	↑↑↑	↑↑
Indefinite Cast Iron	↑↑	↑↑	↑↑↑
Definite Cast Iron	↑↑	↑↑	↑↑↑
High Speed Steel	↑↑	↑↑	↑↑↑↑

Comparative properties of the materials of the rolls for long products mills.

□ PRODUCTS

Nominal chemical composition (% in weight; Fe balance) and mechanical properties of Gerdau Summit's products.

Roll Type	Roll Grade		Chemical Composition (%wt)										Mechanical Properties	
			C	Ni	Mn	Si	Cr	Mo	P	S	V	W	Resistance Limit (MPa)	Hardness Range (LD)
Adamite Steel	VAF18	Min.	1,70	0,50	0,70	0,50	0,80	0,30	-	-	-	-	600	585 - 660
		Max.	2,00	0,70	1,10	1,00	1,20	0,70	0,40	0,015	-	-		
	VAF21	Min.	1,85	0,50	0,40	1,40	1,30	0,10	-	-	-	-	600	600 - 660
		Max.	2,30	0,70	0,70	1,90	1,70	0,40	0,04	0,015	-	-		
Cast Iron (Nodular)	NODAA	Min.	3,10	1,60	0,40	1,90	-	0,20	-	-	-	-	850	555 - 620
		Max.	3,50	2,20	0,90	2,50	0,20	1,00	0,09	0,025	-	-		
	NODE	Min.	3,10	1,50	0,80	2,10	-	0,70	-	-	-	-	550	635 - 685
		Max.	3,40	2,10	1,10	2,40	0,20	1,10	0,09	0,025	-	-		
	NODA	Min.	3,10	1,70	0,30	1,30	0,20	0,10	-	-	-	-	500	635 - 685
		Max.	3,40	2,30	0,60	2,10	0,80	0,50	0,09	0,025	-	-		
	NODB	Min.	3,10	1,30	0,30	1,90	0,30	0,10	-	-	-	-	500	670 - 715
		Max.	3,40	2,20	0,60	3,20	1,00	0,60	0,09	0,025	-	-		
	NODC	Min.	3,20	1,20	0,30	2,20	0,40	0,20	-	-	-	-	500	695 - 745
		Max.	3,50	1,90	0,60	3,40	1,10	0,60	0,09	0,025	-	-		
	NODD	Min.	3,20	1,40	0,40	3,30	0,40	0,40	-	-	-	-	500	735 - 785
		Max.	3,50	1,90	0,80	3,70	0,90	0,80	0,09	0,025	-	-		
Cast Iron (Acicular)	ACICx	Min.	3,10	1,10	0,30	3,40	-	0,50	-	-	-	-	500	680 - 750
		Max.	3,60	2,20	1,00	4,00	0,30	1,00	0,10	0,025	-	-		
Indefinite Cast Iron	CI6x	Min.	3,15	0,65	0,40	2,00	1,00	-	-	-	-	-	450	725 - 755
		Max.	3,45	1,05	0,75	2,60	1,45	0,45	-	-	-	-		
	CI7x	Min.	3,20	0,65	0,40	3,10	1,40	-	-	-	-	-	500	750 - 790
		Max.	3,50	1,05	0,75	4,20	2,00	0,45	-	-	-	-		
	CI8x	Min.	3,20	0,75	0,40	4,30	1,80	-	-	-	-	-	500	780 - 810
		Max.	3,55	1,10	0,75	4,80	2,20	0,45	-	-	-	-		
Definite Cast Iron	CD7x	Min.	3,15	0,70	0,40	2,00	1,00	-	-	-	0,50	-	450	770 - 800
		Max.	3,50	1,10	0,75	4,20	1,90	0,45	-	-	0,90	-		
	CD8x	Min.	3,25	0,80	0,40	3,80	1,60	-	-	-	0,50	-	450	800 - 830
		Max.	3,50	1,10	0,70	4,30	2,00	0,45	-	-	0,90	-		
High Speed Steel	VHSS20WR	Min.	1,20	0,10	0,10	-	5,00	0,50	-	-	2,00	1,00	1150	790 - 830
		Max.	2,50	1,50	1,00	2,00	15,00	2,50	-	-	10,00	3,00		
Forged Steel	VC8BL	Min.	0,50	0,10	0,20	0,10	1,00	0,20	-	-	-	-	1450	550 - 655
		Max.	1,00	0,30	0,50	0,40	2,00	0,60	0,02	0,020	0,015	-		



## □ PRODUCTS

Product specification depends on an analysis of the characteristics of the rolling process that will usually demand from the rolls the following requirements: i) mechanical resistance, ii) wear resistance, iii) thermal fatigue and oxidation resistance, and iv) adhesion resistance.

### □ Blooming Stands

- For stands with greater demands of mechanical resistance, forged rolls are recommended, VC8BL. These can be manufactured with rough drawn grooves obtained during the forging process, providing greater wear resistance of the rolls;
- On stands with smaller demands of mechanical resistance, it is recommended to implement products of the Nodular Cast Iron line such as NODAA and NODE;"

### □ Roughing Stands

- For rolling mills with lower stability, it is recommended to utilize VAF16, VAF18, and NODAA, which have a good compromise between thermal fatigue resistance and toughness;
- For rolling mills with high stability, efficient cooling, and low-risk operational conditions (lower reductions, smaller billets, and/or larger diameters of the rolls), it is recommended to implement NODE, NODA, and NODB;"

### □ Intermediate Stands

- For rolling mills with high stability and efficient cooling, the utilization of ACICx, which have high matrix hardness is recommended;
- For rolling mills with lower stability, it is recommended to utilize NODA, NODB, and NODC, which ensure a balance between wear resistance and toughness;"

### □ Finishing Stand - Wire Rod

- For rolling mills with high stability and efficient cooling, spin-cast products such as CI8x and VHSS20R are recommended;
- For rolling mills with lower stability, spin-cast products such as CI6x and CI7x, which show high wear resistance and preserve toughness are recommended;"

### □ Finishing Stands - Profile

- For rolling mills with high stability and efficient cooling, the utilization of ACICx, CD6x, CD7x, CI6x, CI7x and CI8x is recommended.
- For rolling mills with lower stability, it is recommended to use NODC.  
For rolling of large bars (greater than 4"), it is recommended to implement the line of Adamite rolls (VAF), which allow for greater mechanical requirements during the rolling process."





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