



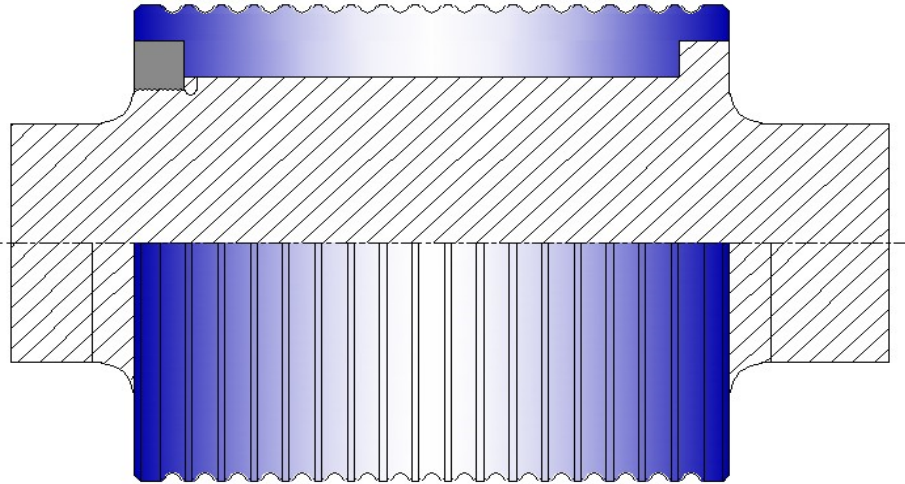
# Hybrid Roll

An Innovative CPM-9V® Solution

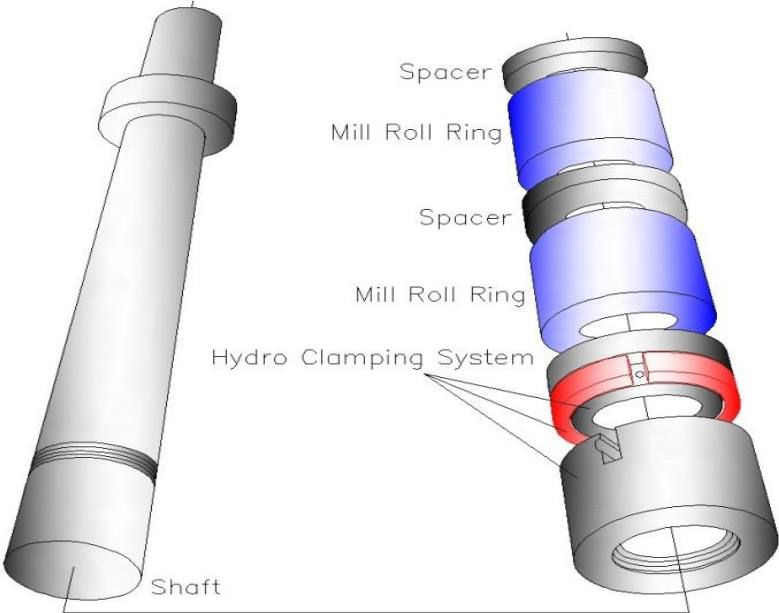
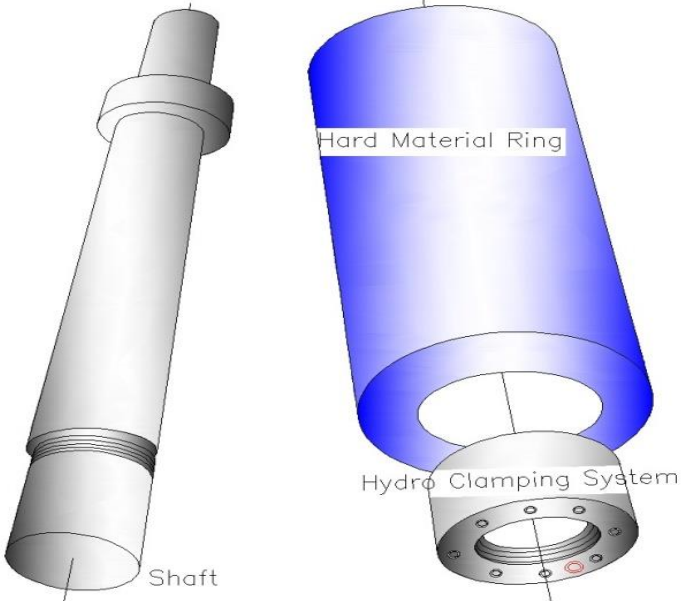
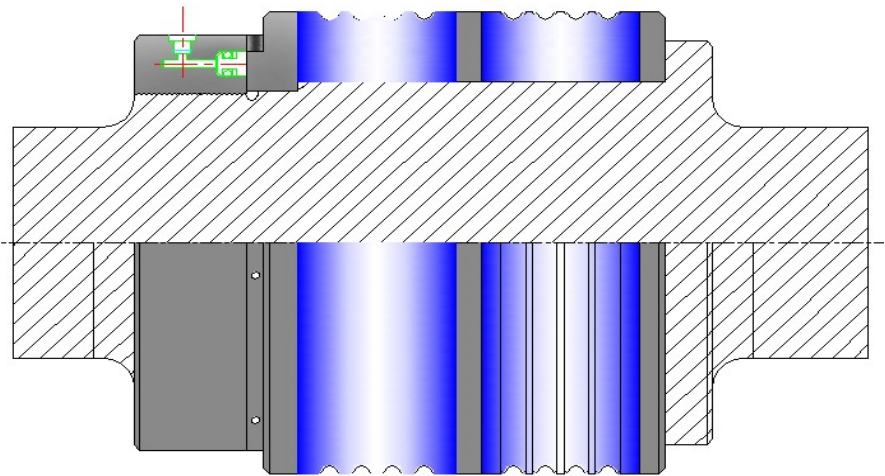
**XT Mill Rolls North America  
International Material Technology Co., Ltd.**

# Comparison of Hybrid Roll with Composite Roll

Hybrid Roll

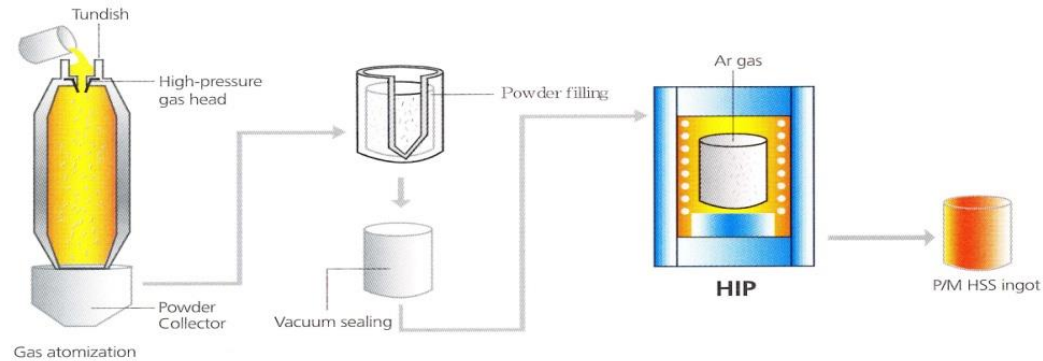


Composite Roll



# Powder Metallurgy Process

## Powder Metallurgy Process



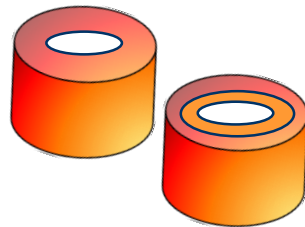
Atomization

Canning, Degassing

H.I.P

Powder Metallurgy Alloy Steel

## The shapes of materials by Canning H.I.P



Single Ring Material

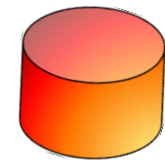
Powder Metal + Steel Bonding



Single Square Material



Single Rods Material



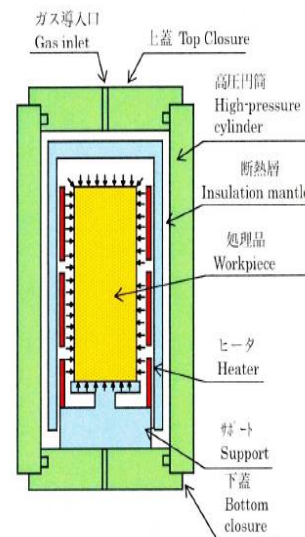
# H.I.P. (Hot Isostatic Pressing)



## HIP ?

熱間等方圧加圧法 (Hot Isostatic Pressing、以下 HIP と略す) は、アルゴンなどのガスを圧力媒体とし、通常 100MPa (1020kgf/cm<sup>2</sup>) 以上の圧力と 1000℃以上の温度との相乗効果を利用して加圧処理する技術です。

HIP は、高い等方圧力 (あらゆる方向から均等に加わる圧力) と高温の相乗効果を利用する原理的にすぐれた方法で、従来不可能とされていた鋳物の巣の除去など種々の技術問題の解決が可能です。



▲HIP 概念図 Schematic view of HIP

Hot Isostatic Pressing is a method by which a workpiece is processed under the simultaneous application of high-pressure gas and high temperature.

HIP can solve many technical problems which were impossible to solve by conventional processes. One example is the elimination of casting defects.

## Specification

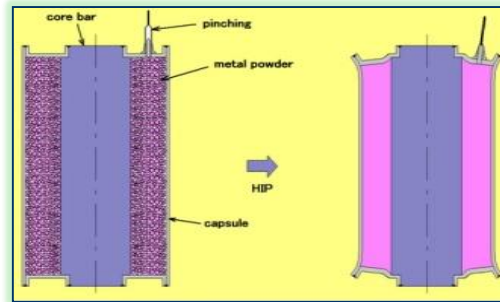
Press Proper Type	Press frame type Multiple steel plate yoke type
Maximum working pressure	118MPa(17,155Psi)
Loading style	Bottom loading
Furnace Type	Graphite, three zone
Maximum working Temperature	1500℃
Process gas	Argon
Furnace size	Φ600mm × 1,300mm
Product / Product basket (Crucible) size	Φ550mm × 1,300mm



# H.I.P.



Example of Hipped Products



SH3 Sleeve



Hybrid Roll

## TITAMAX® SH3 (CPM-9V Equivalent )

- Extremely high wear resistance compared to tool steel
- Longer life : 3~5 times longer than tool steel.
- Extremely high toughness and ductility due to controlled microstructure

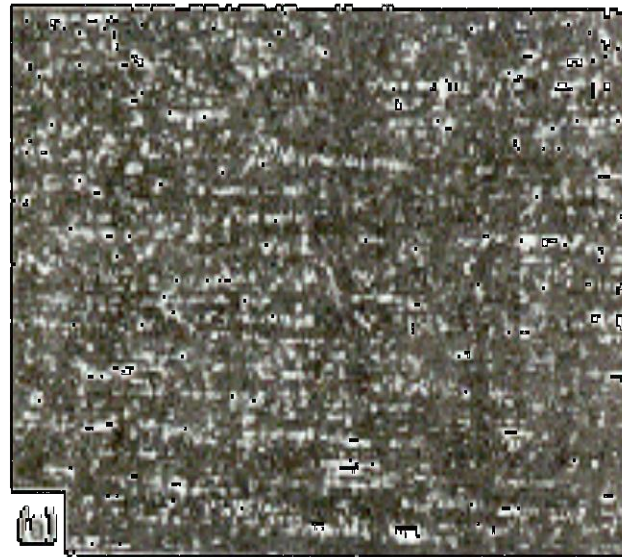
Factor \ Material	TITAMAX®SH3	NCI	TC
Hardness(HRC)	49~62	37~58	75~80
Density(g/cm <sup>3</sup> )	8.2	7.2~7.5	12.8~14.4
Life(times)	6 ~7	1	7~8
Cost(times)	0.4~0.6	-	1

# Microstructure

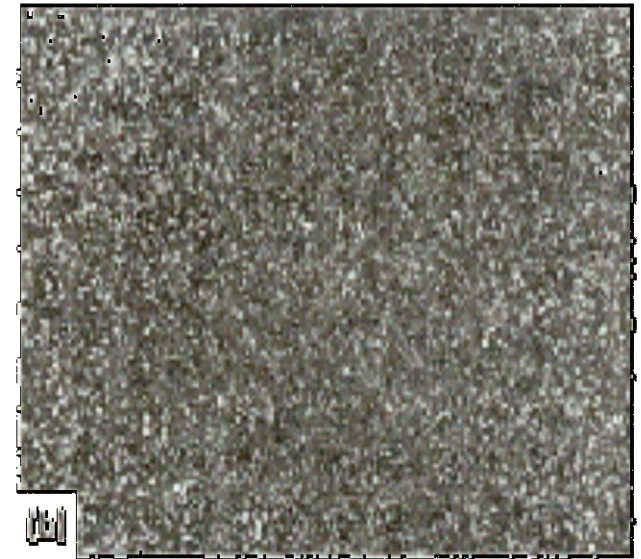
SH3 is Powder Metallurgy Alloy Steel made by our Powder Metallurgy Process (Canning HIP). It provides **superior wear resistance** while maintaining **toughness** and **fabrication characteristics** comparable to Rolling Steel such as D2, M2.

**SH3 Mill Roll** is superior to general rolling and casting steels in improving wear resistance for above products. Presently, It is widely used in domestic and overseas markets.

Comparison  
Of  
Carbide  
Structures



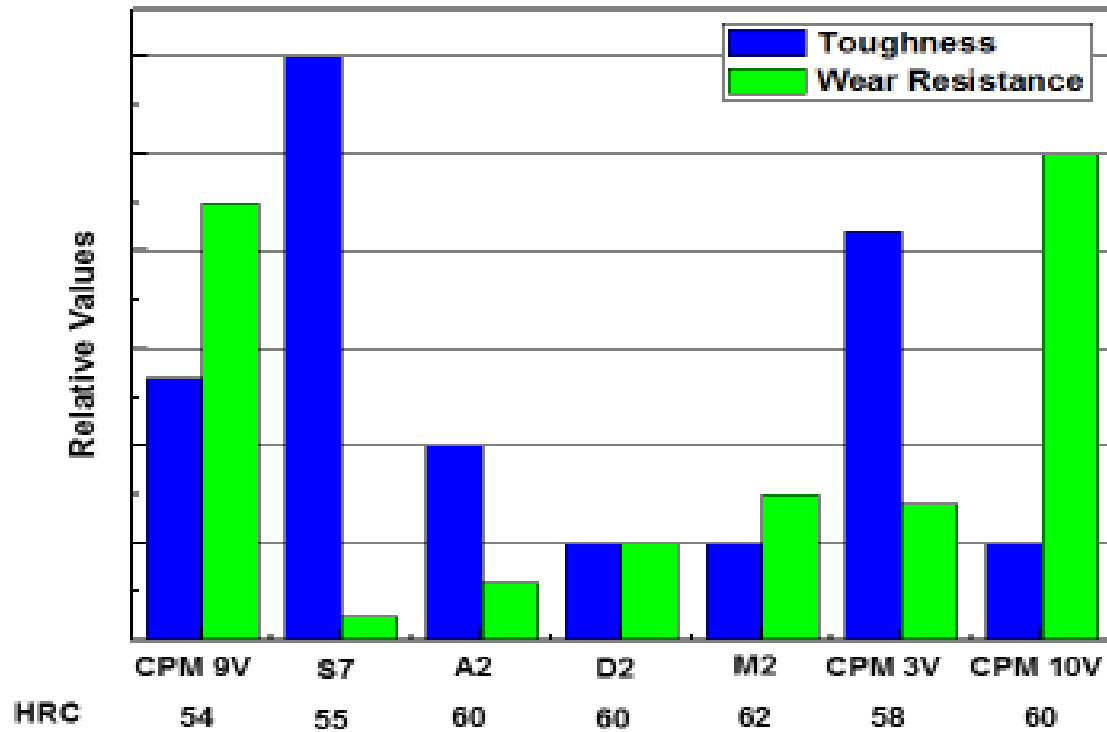
Tool Steel



SH 3

# Wear Resistance and Toughness

## Tool Steel Comparagraph





# Heat Check Resistance

Heat Check Resistance (Warm Work Applications)		
Grade	Hardness HRC	Number of Cycles*
D2	50	3,000
10V	51	5,000
9V	48	15,000
H13	48	20,000
H19	50	60,000

**\*One cycle consists of immersing the test specimen in 1250°F molten lead for 4 sec., cooling in 180°F water for 2 sec. followed by 8 sec. of air cooling**

# Heat Treat Response

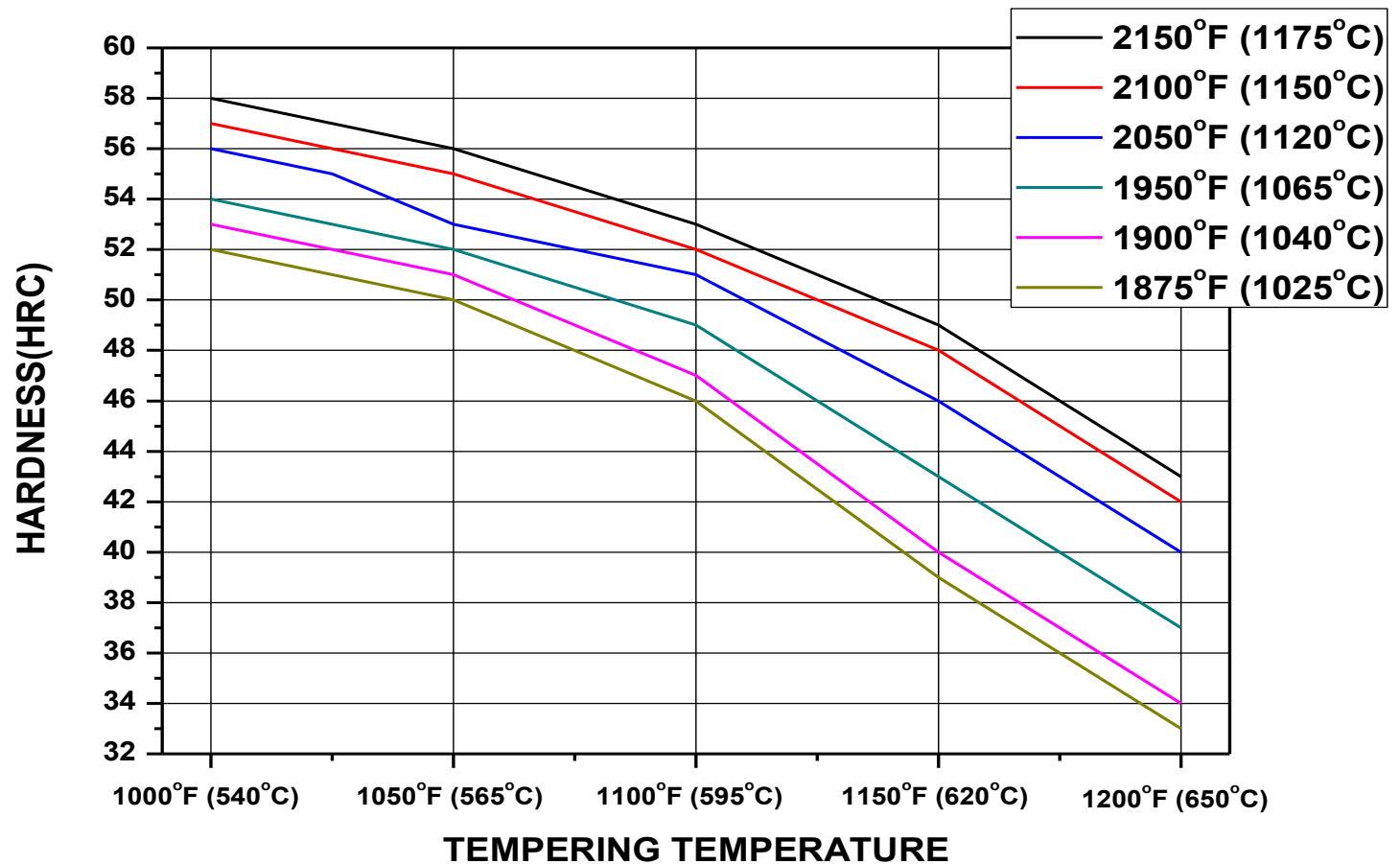
## Heat Treat Response

Hardness HRC						
Austenitizing Temperature						
Tempering Temperature	1875°F	1900°F	1950°F	2050°F	2100°F	2150°F
	(1025°C)	(1040°C)	(1065°C)	(1120°C)	(1150°C)	(1175°C)
As Quenched 1000°F (540°C)	53	54	56	58	59	61
	52	53	54	56	57	58
Optimum for Maximum Toughness and Effective Stress Relieving						
1025°F (550°C)	51	52	53	55	56	57
1050°F (565°C)	50	51	52	53	55	56
1100°F (595°C)	46	47	49	51	52	53
1150°F (620°C)	39	40	43	46	48	49
1200°F (650°C)	33	34	37	40	42	43

Results may vary with hardening method and section size. Salt or oil quenching will give maximum response. Vacuum or atmosphere cooling may result in up to 1-2 HRC points lower.

Minimum Time at Aust. Temp.	60min.	45min.	30min.	20min.	15min.	10min.
Minimum Number of Tempers	2	2	2	2	3	3

# Hardness Profile



# Toughness

## Toughness

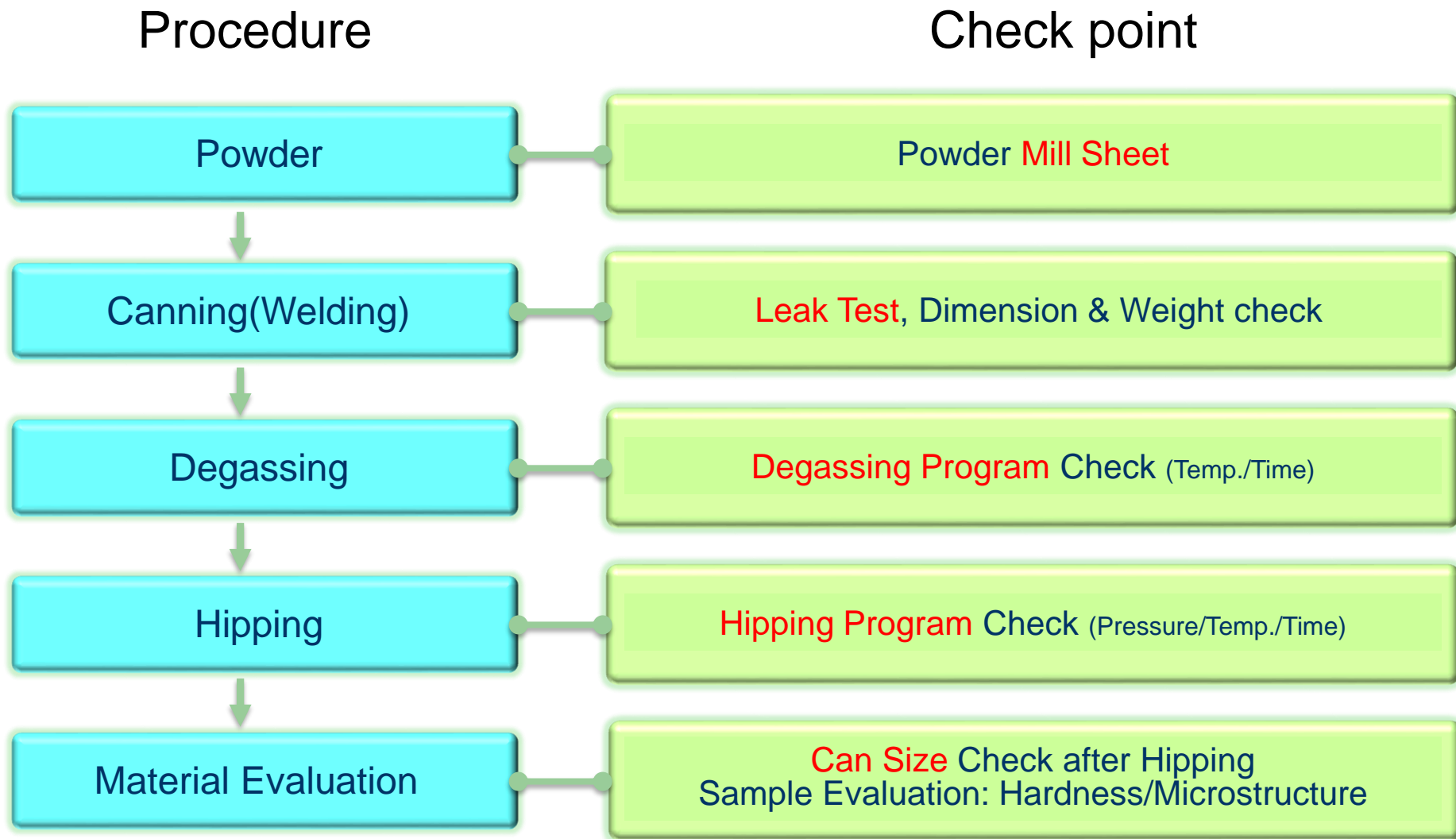
Depending on the hardness requirement, lowering the hardening temperature (underhardening) increases toughness.

Hardening Temperature	Tempering Temperature	Hardness	Charpy C-Notch		Bend Fracture Strength	
			HRC	Ft-lb	(J)	ksi
2150°F(1175°C)	1025°F(550°C)	57	26	35	606	4177
2100°F(1150°C)	1025°F(550°C)	56	36	48	-	-
2050°F(1120°C)	1000°F(540°C)	56	47	63	600	4136
1950°F(1065°C)	1100°F(595°C)	49	74	99	-	-

Note: Properties show throughout this data sheet are typical values. Normal variations in chemistry, size and heat treat conditions may cause deviations from these values. For additional data or metallurgical engineering assistance, consult your local Crucible Service Center.



# Quality Control System / Material



# Performance of TITAMAX® SH3 (CPM-9V Equivalent)

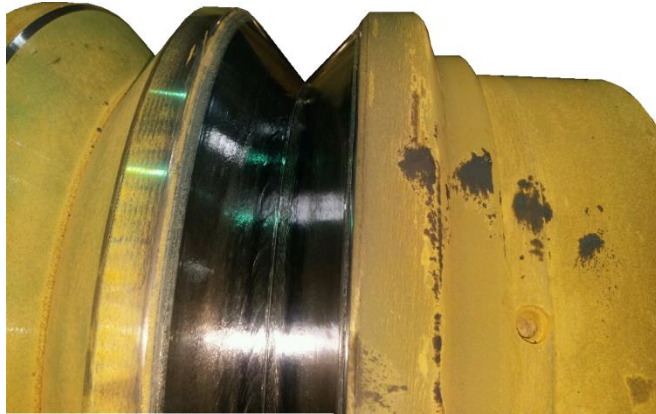
## Performance Comparison

Material	Customer	Item Stand	Original Dia. (in MM)	Scrap Dia. (in MM)	Regrinding (times)	Production (avg.ton/caliber)	Total Production (ton)	Life (times)
<b>SH3</b>	Samho Steel	Angle Finishing	<b>400</b>	<b>350</b>	<b>13</b>	<b>1,700</b>	<b>22,100</b>	<b>6.1</b>
DCI			400	350	9	400	3,600	<b>1.0</b>
<b>SH3</b>	Daehan Steel	D16 Oval	<b>370</b>	<b>330</b>	<b>9</b>	<b>6,800</b>	<b>61,200</b>	<b>6.2</b>
DCI			370	330	7	1,400	9,800	<b>1.0</b>
<b>SH3</b>	Hyundai Steel	D10 Slitting	<b>350</b>	<b>310</b>	<b>10</b>	<b>4,500</b>	<b>45,000</b>	<b>7.0</b>
DCI			350	310	8	800	6,400	<b>1.0</b>
<b>SH3</b>	YK Steel	D10 Slitting	<b>440</b>	<b>390</b>	<b>22</b>	<b>3,300</b>	<b>72,600</b>	<b>2.9</b>
HSS			440	390	19	1,300	24,700	<b>1.0</b>
<b>SH3</b>	Samho Steel	Flat Bar Finishing	<b>367</b>	<b>330</b>	<b>15</b>	<b>800</b>	<b>12,000</b>	<b>0.6</b>
TC			367	330	17	1,200	20,400	<b>1.0</b>

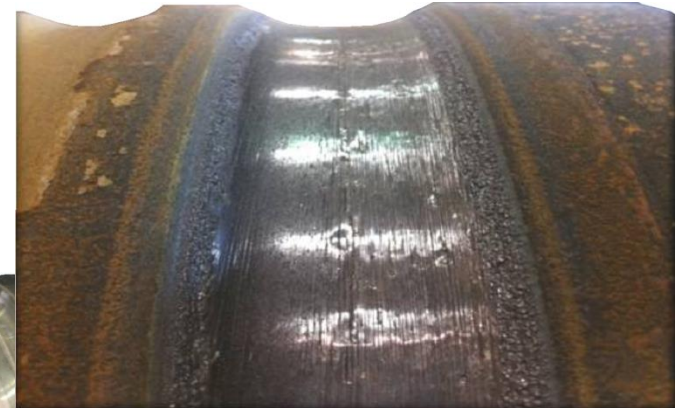
# Performance of TITAMAX<sup>®</sup> SH3 (CPM-9V Equivalent)

Surface of Titamax<sup>®</sup> SH3 After Rolling

50x50 Angle



D16 Oval



D10 Slitting  
after 4,500ton



D10 Slitting



Flat Bar



# Reference of TITAMAX® SH3 (CPM-9V Equivalent)

## Reference

Material		Customer	Item Stand	Shape	Original Dia. (in MM)	Scrap Dia. (in MM)
Current	Former					
SH3	DCI	Samho Steel	Angle Finishing	Anggle 50x50	400	350
SH3	DCI	Daehan Steel	Deformed bar Intermediate	Oval & Square	370	330
SH3	DCI	Hyundai Steel	Deformed bar Slitting	Slitting	350	310
SH3	High Speed Steel	YK Steel	Deformed bar Slitting	Slitting	440	390
SH3	TC	Samho Steel	Flat Bar Finishing	Flat	367	330
SH3	DCI	Hwhanyoung Steel	Deformed bar Slitting	Slitting	400	350
SH3	DCI	Hyundai Steel	Angle Finishing	Anggle 65x65	460	365
SH3	High Speed Steel	Hyundai Steel	Intermediate	Oval & Square	400	365
SH3	High Speed Steel	YK Steel	Deformed bar Intermediate	Square	385	350
SH3	DCI	Korea Iron & Steel	Deformed bar Slitting	Slitting	425	375



# Hybrid Roll Products in Mass Production



Product : Round Bar  
Detail : SCM Shaft + Titamax<sup>®</sup> SH3  
(CPM-9V Equivalent)



Product : Round Bar  
Detail : SCM Shaft + Titamax<sup>®</sup> SH3  
(CPM-9V Equivalent)

# Hybrid Roll Products in Mass Production



Product : 50 x 50 Angle

Detail : SCM Shaft + Titamax<sup>®</sup> SH3 (CPM-9V Equivalent)

# Advantages & Features of Hybrid Roll

- ◆ Combined advantage of clad (Double Poured HSS) and composite roll.
- ◆ Provide better performance than what clad roll or double cast roll does.
- ◆ Provide same numbers of passes as clad or double cast roll does.
- ◆ More cost efficiency - shaft can be reused.
- ◆ Lead time is dramatically shorten. Easy to repair or replacement
- ◆ Capable to offer multiple grade material including CPM, HSS and tool steels

Easy to Assembly

# ASSEMBLY DEMO



**THANK YOU**