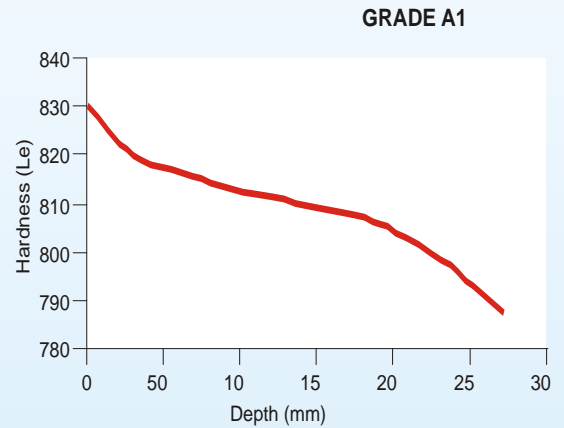




FORGED STEEL ROLLS GRADE : A1

FEATURES

A1 grade is most commonly used for work roll and intermediate roll being used in cold rolling mills. It gives adequate depth of hardness along with required toughness at the core. Depth of hardness can be varied by adopting different hardening parameters depending on customer requirement. This grade is also used for back up rolls of smaller diameter (< 840 mm). This grade of roll can be produced through single coil or double coil progressive hardening method at Tayo. Hardened layer primarily consists of Martensite along with carbides. Carbide hardness is almost equal to matrix hardness for this grade.



AIM CHEMISTRY (WT%)

	C	Si	Mn	P	S	Cr	Mo	Ni	Al	Cu	Sn	AIM H2
Min	0.77	0.25	0.30			3.00	0.22					Max PPM
Max	0.83	0.40	0.40	0.020	0.01	3.20	0.27	0.50	0.01	0.40	0.030	2

CARBIDE ANALYSIS (ON BARREL IN HARDENED LAYER)

Carbide Type	Carbide Hardness (HV)	Surface Area (%)	Average Diameter (μ)	Carbide Density (Carbide/mm ²)	Retained Austenite (%)
M ₃ C	850 - 1100	6 - 7	0.6	3.0 x 10 ⁵	< 4

TYPICAL MECHANICAL PROPERTIES (ON JOURNALS)

U.T.S. Mpa	Fatigue Strength Mpa	Bending Strength Mpa	Torsional Strength Mpa	Elongation %
940	460	345	570	16



MICROSTRUCTURE (Hardened Layer of Barrel)

Well Tempered Martensite with uniformly distributed fine Carbides and minimum amount of Retained Austenite

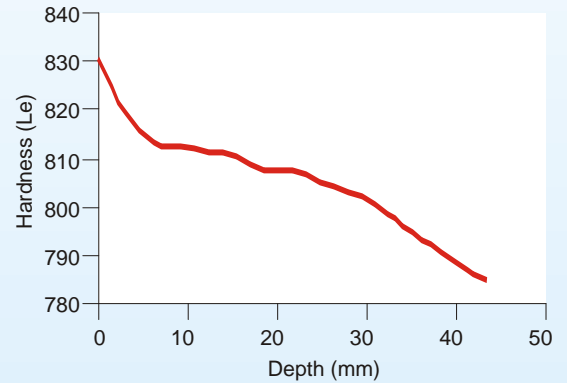


FORGED STEEL ROLLS GRADE : A2

FEATURES

A2 grade is generally used for work roll and intermediate roll with greater hardening depth requirement. It gives more depth of hardness than A1 grade along with required toughness at the core. Depth of hardness can be varied by adopting different hardening parameters depending on customer requirement. This grade is can be used for back up rolls of smaller diameter (< 840 mm). This grade of rolls are produced through single coil or double coil progressive hardening method at Tayo. Hardened layer primarily consists of Martensite along with carbides. Carbide hardness is almost equal to matrix hardness for this grade. This grade of rolls undergo higher tempering temperature after hardening compared to A1 grade for same final hardness.

GRADE A2



AIM CHEMISTRY (WT%)

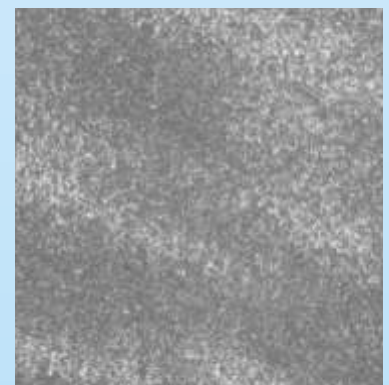
	C	Si	Mn	P	S	Cr	Mo	Ni	Al	Cu	Sn	AIM H2
Min	0.77	0.60	0.20			3.00	0.30					Max PPM
Max	0.83	0.80	0.30	0.020	0.010	3.20	0.35	0.50	0.010	0.40	0.030	2

CARBIDE ANALYSIS (ON BARREL IN HARDENED LAYER)

Carbide Type	Carbide Hardness (HV)	Surface Area (%)	Average Diameter (μ)	Carbide Density (Carbide/mm ²)	Retained Austenite (%)
M ₃ C	850 - 1100	6 - 7	0.6	3.0 x 10 ⁵	< 4

TYPICAL MECHANICAL PROPERTIES (ON JOURNALS)

U.T.S. Mpa	Fatigue Strength Mpa	Bending Strength Mpa	Tortional Strength Mpa	Elongation %
940	460	345	570	16



MICROSTRUCTURE (Hardened Layer of Barrel)

Well Tempered Martensite with uniformly distributed fine Carbides and minimum amount of Retained Austenite

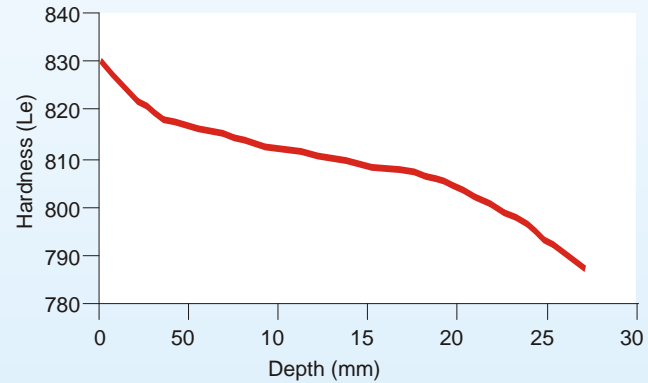


FORGED STEEL ROLLS GRADE : B1

FEATURES

B1 grade is some sort of compromise between 3% Cr and 5% Cr grade. It has better wear resistance properties compared to A1 & A2 grade where as not mill incidence sensitive as C1 & C2 grade. Generally Tayo offers this grade of work roll and intermediate roll on Customer's demand and also where this grade is stabilised in the mill. Depth of hardness is comparable with other grades manufactured at Tayo. Depth of hardness can be varied by adopting different hardening parameters depending on customer requirement. This grade of rolls are produced through single coil or double coil progressive hardening method at Tayo. Hardened layer primarily consists of Martensite along with carbides. Carbide hardness is higher than matrix hardness thereby contributing more in wear resistance properties.

GRADE B1



AIM CHEMISTRY (WT%)

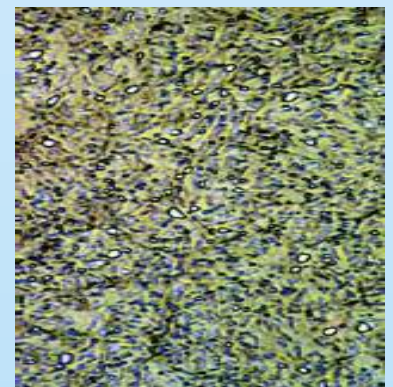
	C	Si	Mn	P	S	Cr	Mo	Ni	Al	Cu	Sn	AIM H2
Min	0.77	0.35	0.30			3.95	0.50					Max PPM
Max	0.83	0.45	0.40	0.020	0.010	4.10	0.55	0.50	0.010	0.40	0.030	2

CARBIDE ANALYSIS (ON BARREL IN HARDENED LAYER)

Carbide Type	Carbide Hardness (HV)	Surface Area (%)	Average Diameter (μ)	Carbide Density (Carbide/mm ²)	Retained Austenite (%)
M ₃ C/M ₇ C ₃	(850 - 1100)/ (1200 - 1600)	7 - 8	0.7	2.4 x 10 ⁵	< 4

TYPICAL MECHANICAL PROPERTIES (ON JOURNALS)

U.T.S. Mpa	Fatigue Strength Mpa	Bending Strength Mpa	Tortional Strength Mpa	Elongation %
940	460	345	570	16



MICROSTRUCTURE (Hardened Layer of Barrel)

Well Tempered Martensite with uniformly distributed fine Carbides and minimum amount of Retained Austenite

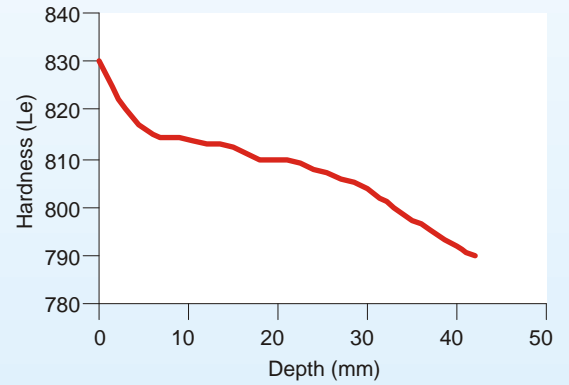


FORGED STEEL ROLLS GRADE : C1

FEATURES

C1 grade is highly alloyed grade and offer very high wear resistance properties with a higher degree of risk against mill incidence. Work rolls and intermediate rolls of this grade have higher hardenability and demand more mill discipline to extract best output from this grade of rolls. Tayo can produce this grade on demand and after thorough mill study. Depth of hardness is comparable with other grades manufactured at Tayo. Depth of hardness can be varied by adopting different hardening parameters depending on customer requirement. This grade of rolls are produced through single coil if diameter is less than 410 mm or double coil for diameter greater than 410 mm progressive hardening method at Tayo. Hardened layer primarily consists of Martensite along with carbides. Carbide hardness is significantly higher than matrix hardness thereby contributing much in wear resistance properties.

GRADE C1



AIM CHEMISTRY (WT%)

	C	Si	Mn	P	S	Cr	Mo	Ni	Al	Cu	Sn	AIM H2
Min	0.77	0.25	0.30			4.60	0.22					Max PPM
Max	0.83	0.40	0.40	0.020	0.010	4.90	0.27	0.50	0.010	0.40	0.030	2

CARBIDE ANALYSIS (ON BARREL IN HARDENED LAYER)

Carbide Type	Carbide Hardness (HV)	Surface Area (%)	Average Diameter (μ)	Carbide Density (Carbide/mm ²)	Retained Austenite (%)
M ₇ C ₃	1200 - 1600	7 - 8	0.8	1.5 x 10 ⁵	< 4

TYPICAL MECHANICAL PROPERTIES (ON JOURNALS)

U.T.S. Mpa	Fatigue Strength Mpa	Bending Strength Mpa	Tortional Strength Mpa	Elongation %
940	460	345	570	16



MICROSTRUCTURE (Hardened Layer of Barrel)

Well Tempered Martensite with uniformly distributed fine Carbides and minimum amount of Retained Austenite

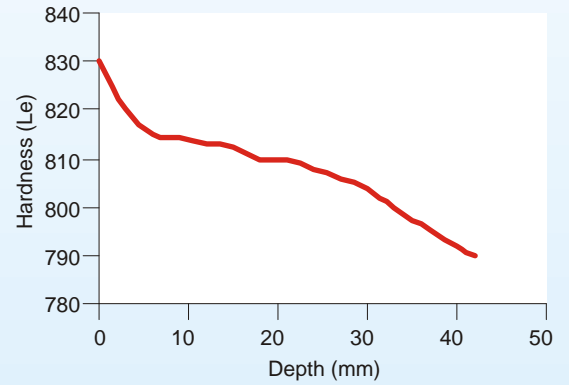


FORGED STEEL ROLLS GRADE : C2

FEATURES

These rolls C2 grade is highest alloyed grade and hence offer high wear resistance properties with a higher degree of risk against mill incidence. This grade has greater hardness depth compared to C1. Work rolls and intermediate rolls of this grade have higher hardenability and demand more mill discipline to extract best output from this grade of rolls. Tayo can produce this grade on demand and after through mill study. Depth of hardness is comparable with other grades manufactured at Tayo. Depth of hardness can be varied by adopting different hardening parameters depending on customer requirement. This grade of rolls are produced through single coil if diameter is less than 475 mm or double coil for diameter greater than 475 mm progressive hardening method at Tayo. Hardened layer primarily consists of Martensite along with carbides. Carbide hardness is significantly higher than matrix hardness thereby contributing much in wear resistance properties.

GRADE C2



AIM CHEMISTRY (WT%)

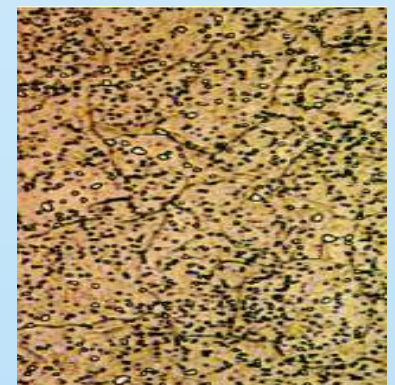
	C	Si	Mn	P	S	Cr	Mo	Ni	Al	Cu	Sn	AIM H2
Min	0.77	0.6	0.20			4.80	0.30					Max PPM
Max	0.83	0.80	0.30	0.020	0.010	5.00	0.35	0.50	0.010	0.40	0.030	2

CARBIDE ANALYSIS (ON BARREL IN HARDENED LAYER)

Carbide Type	Carbide Hardness (HV)	Surface Area (%)	Average Diameter (μ)	Carbide Density (Carbide/mm ²)	Retained Austenite (%)
M ₇ C ₃	1200 - 1600	10 - 11	0.6	4.3 x 10 ⁵	< 4

TYPICAL MECHANICAL PROPERTIES (ON JOURNALS)

U.T.S. Mpa	Fatigue Strength Mpa	Bending Strength Mpa	Tortional Strength Mpa	Elongation %
940	460	345	570	16



MICROSTRUCTURE (Hardened Layer of Barrel)

Well Tempered Martensite with uniformly distributed fine Carbides and minimum amount of Retained Austenite