

**THINK RAILWAYS.  
THINK JINDAL STAINLESS.**

**OVER 5 DECADES OF INNOVATIVE  
STAINLESS STEEL SOLUTIONS**

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## A STAINLESS LEGACY

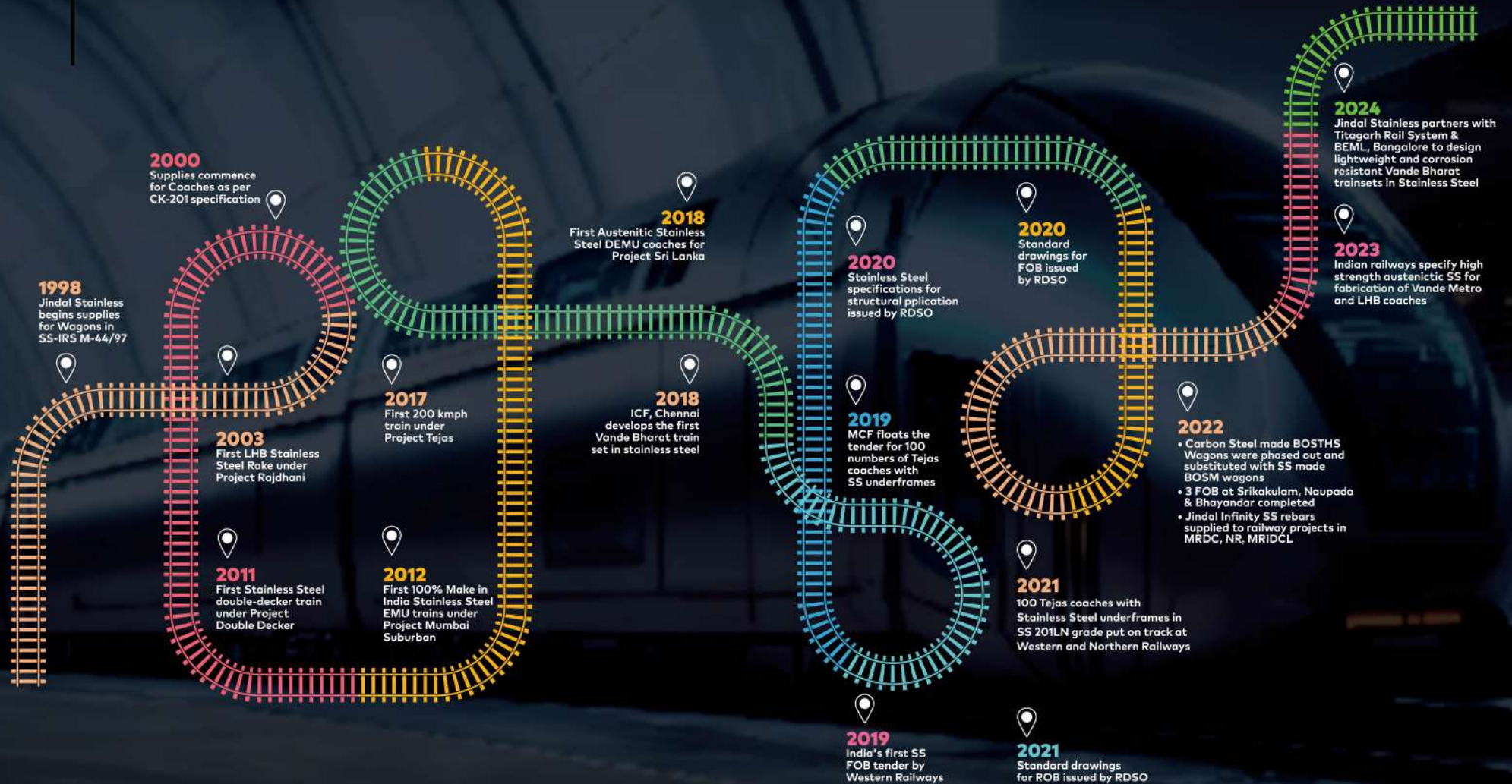
India's leading stainless steel manufacturer, Jindal Stainless, achieved a consolidated annual turnover of INR 38,562 crore (USD 4.7 billion) in FY24. The company is expanding its facilities to reach 4.2 million tonnes of annual melt capacity by 2026. Jindal Stainless operates 16 manufacturing and processing facilities across India, Spain, and Indonesia, with a global network of 12 locations as of March 2024.

Committed to a greener future, Jindal Stainless Steel scrap in electric arc furnaces, reducing greenhouse gas emissions and ensuring high recyclability without quality loss. The company targets a 50% reduction in carbon emission intensity before FY35 and aims for Net Zero by 2050.



# WORLD'S LEADING RAILWAY NETWORK TRUSTS JINDAL STAINLESS

5 DECADES OF INNOVATIVE STAINLESS STEEL SOLUTIONS





## STATE-OF-THE-ART MATERIALS FOR NEW AGE RAILWAYS



Advisory



Customization



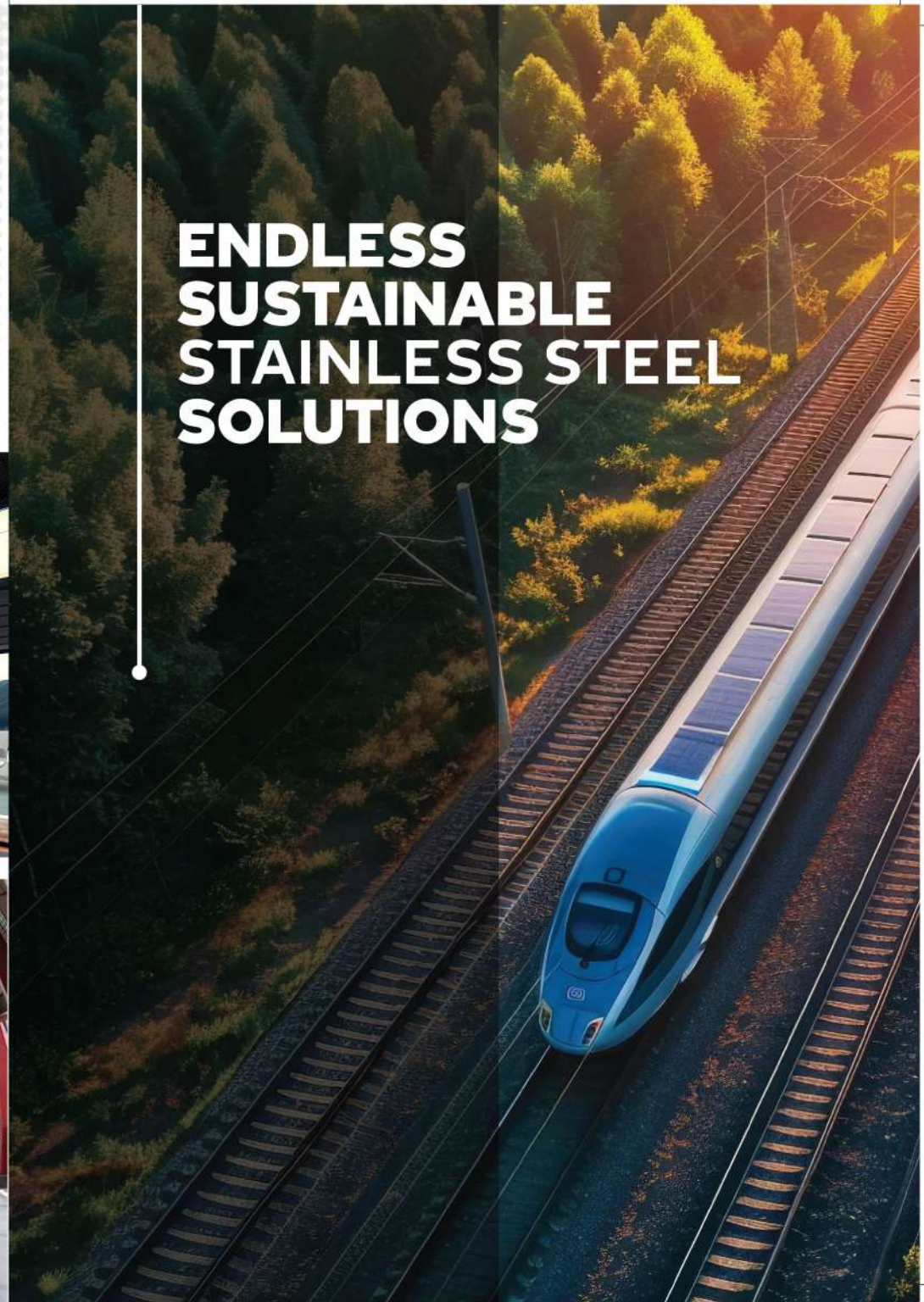
Raw Material  
Supplier



Fabricated  
Components



# ENDLESS SUSTAINABLE STAINLESS STEEL SOLUTIONS





# BEYOND. SAFETY.

## UNPARALLELED PASSENGER PROTECTION



- > 2.0-2.5x more crash resistant than carbon steel and aluminium
- > SS can withstand temperatures upto 1000 °C while carbon steel starts degrading at 300-400 °C and aluminium at 120-150 °C



## STAINLESS STEEL COACHES IN INDIAN RAILWAYS

HIGH SPEED BULLET TRAIN



VANDE BHARAT



VANDE METRO



RAJDHANI



DURONTO



SHATABDI



TEJAS



EMU/MEMU





## NEW POSSIBILITIES: STAINLESS STEEL UNDERFRAME

### ADDED ADVANTAGES



#### Corrosion Resistance

Better Corrosion Resistance & Maintenance Free Life For 30-40 Years

#### SS GRADES

#### Proposed SS Grades

201LN, 301LN as specified by RDSO, Lucknow

## NEW POSSIBILITIES: STAINLESS STEEL BOGIE FRAME

### ADDED ADVANTAGES



#### Corrosion Resistance

Better Corrosion Resistance & Maintenance Free Life For 30-40 Years

#### SS GRADES

#### Proposed SS Grades

201LN, Lean Duplex 2101

## CHEMICAL COMPOSITION OF PROPOSED SS GRADES:

Grade	% C (max)	% Mn (max)	% Si (max)	% S (max)	% P (max)	% Cr (max)	% Ni (max)	N (max)	Others
201LN	0.030	6.4-7.5	0.75	0.015	0.045	16.0-17.50	4.0-5.0	0.1-0.25	Cu=1.0 max
301LN	0.030	2.00	1.00	0.03	0.045	16.0-18.0	0.07-0.20	0.03	

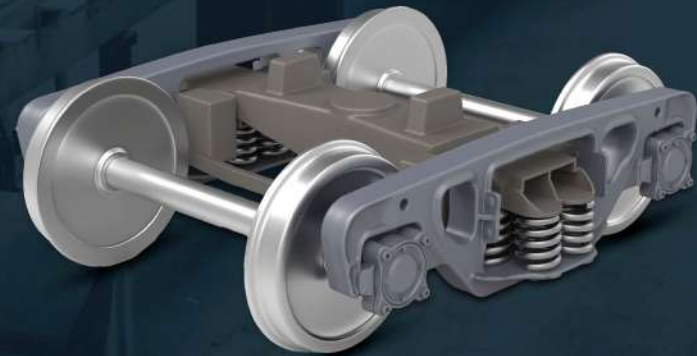
## CHEMICAL COMPOSITION OF PROPOSED SS GRADES:

Grade	% C (max)	% Mn (max)	% Si (max)	% S (max)	% P (max)	% Cr (max)	% Ni (max)	N (max)	Others
201LN	0.030	6.4-7.5	0.75	0.015	0.045	16.0-17.50	4.0-5.0	0.1-0.25	Cu=1.0 max
Lean Duplex 2101	0.040	4.00-6.00	1.00	0.030	0.040	21.0-22.0	1.35-1.70	0.2-0.25	Cu=0.10-0.80



Tender for 100 numbers of Tejas Coaches with SS 201LN underframes was published in 2019.

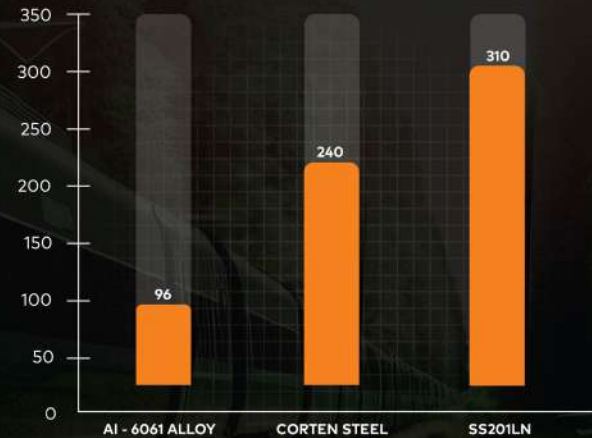
- > These coaches were put on track at Western Railways in 2020-2021
- > Till date, no corrosion has been observed on SS 201LN underframes





## FATIGUE STRENGTH IS A MAJOR CRITERION FOR DESIGNING OF UNDERFRAMES AND BOGIE FRAMES

Fatigue strength (MPa)



With the onset of corrosion, the fatigue strength of corten steel reduces to **140 MPa**

# VANDE BHARAT CASE STUDY

## VANDE BHARAT : WEIGHT REDUCTION WITH AUSTENITIC & LEAN DUPLEX STAINLESS STEEL

COMPONENT	CURRENT MATERIAL	CURRENT WEIGHT (KG)	PROPOSED MATERIAL	PROPOSED WEIGHT (KG)	WT. REDUCTION (KG)
ROOF	X5CrNi1810 & X2CrNi12	1,771	1/2 hard SS 201LN / 301LN	1,311	460
END WALLS	X2CrNi12	741	1/2 hard SS 201LN / 301LN	421	320
SIDE WALLS	X2CrNi12	3,690	1/2 hard SS 201LN / 301LN	2,128	1,562
UNDERFRAME	Corten Steel	7,543	SS 2101; hot rolled & annealed	5,607	1,936
BOGIE (FRAME-1)	S355	2,558	SS 2101; hot rolled & annealed	2,220	338
BOGIE (FRAME-2)	S355	2,558	SS 2101; hot rolled & annealed	2,220	338
		18,861		13,907	4,954

ESTIMATED WT REDN  
BY 5.0 MT





# BEYOND. LIGHTWEIGHT. HIGHER STRENGTH WITH STAINLESS STEEL



Lightweight



Corrosion Resistant



Lower Lifecycle Cost



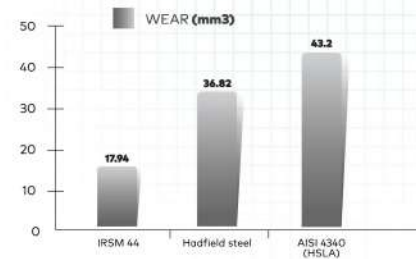
Lower Carbon Footprint

## MECHANICAL PROPERTIES

PROPERTY	IRSM44
YIELD STRENGTH (MPa)	350-450 MPa
ULTIMATE TENSILE STRENGTH (MPa)	500 MPa min
PERCENTAGE ELONGATION	25% min

## WHY IRSM44?

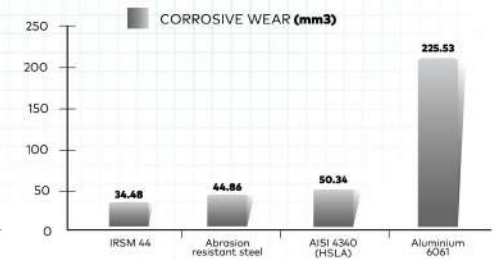
### 1. CORROSION RESISTANCE



CORROSION WEAR RESISTANCE IN WET CONDITION

#### CONCLUSION

IRSM 44 is 2.06 times better than Hadfield steel  
IRSM 44 is 2.41 times better than HSLA steel



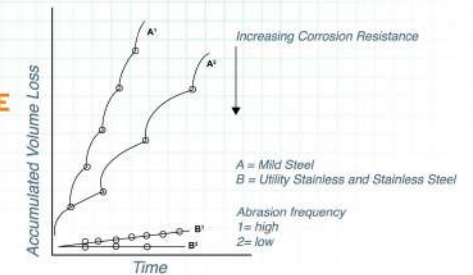
ABRASIVE WEAR RESISTANCE IN WET CONDITION

#### CONCLUSION

IRSM 44 is 1.30 times better than abrasion resistant steel  
IRSM 44 is 1.46 times better than HSLA steel  
IRSM 44 is 6.54 times better than aluminum alloy

### 2. CORROSION-WEAR RESISTANCE

#### SYNERGISTIC EFFECT OF ABRASION ON CORROSION RESISTANCE





## PERFORMANCE OF **BOXNHL** WAGONS IN STAINLESS STEEL



Almost NIL corrosion observed in **BOXNHL** wagons with Stainless Steel (IRSM 44) underframes even after 12 years of use.

## ENDORSEMENT FROM **RAIPUR WAGON REPAIR WORKSHOP**

WAGON No. 21071158346 BOSTHS, Mfg Year; 2011



Carbon steel wagons experience heavy corrosion after 10-11 years of use.

WAGON No. 22101126281 BOXNHL, Mfg Year; 2011



No corrosion observed on Stainless Steel wagons (IRSM 44) even after 10-11 years of use.



## STAINLESS STEEL WAGONS IN INDIAN RAILWAYS



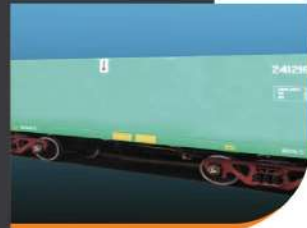
- BOXXNHL
- Coal / Cement Transportation
- Grade: IRSM 44
- Axle Load: 22.9T

- BOXXNHL
- Coal / Cement Transportation
- Grade: IRSM 44
- Axle Load: 25 T



- BRN 22.9
- Steel Transportation
- Grade: IRSM 44
- Axle Load: 22.9 T

- BOXNS 25
- Coal Transportation
- Grade: IRSM 44
- Axle Load: 25 T



- BOBSN Wagon
- Ore Transportation
- Grade: IRSM 44
- Axle Load: 22.9 T

- Special Purpose Wagon
- Milk Transportation
- Grade: 304L
- Axle Load: 22.9 T



## CURRENT SS GRADES USED FOR FABRICATION OF WAGONS & COACHES

### STEEL GRADES & THEIR CHEMICAL COMPOSITION AS DETERMINED BY LADLE ANALYSIS

Material	C %	Mn %	Si %	S %	P %	Cr %	Mo %	Ni %	Others
Designation/Grade									

### FERRITIC STEELS

X2 Cr Ti 12 (409)	≤ 0.03	1.0 max	1.0 max	0.030 max	0.040 max	10.5 to 12.5	-	-	Ti 6 x % C min upto 1.0 max
X2 Cr Ni 12 (409M) (TRSM 44)	≤ 0.03	0.5 to 1.5	1.0 max	0.030 max	0.040 max	10.5 to 12.5	-	0.3 to 1.0	N-0.03 max
X6 Cr 17 (430)	≤ 0.08	1.0 max	1.0 max	0.030 max	0.040 max	16 to 18	-	-	-

### AUSTENITIC STEELS

X5 Cr Ni 18 10 (304)	≤ 0.07	2.0 max	1.0 max	0.030 max	0.045 max	17 to 19	-	8.5 to 10.5	-
X2 Cr Ni N 18 7 (301)	≤ 0.08	2.0 max	1.0 max	0.030 max	0.045 max	16 to 18	-	6 to 8	-
X6 Cr Ni Ti 18 10 (321)	≤ 0.08	2.0 max	1.0 max	0.030 max	0.045 max	17 to 19	-	9 to 12	Ti 5 x C% min upto 0.80 max
X5 Cr Ni Mo 17 12 2 (316)	≤ 0.07	2.0 max	1.0 max	0.030 max	0.045 max	16 to 18	2.0 to 2.5	0.5 to 13.5	-

### MECHANICAL PROPERTIES OF COLD ROLLED PRODUCTS (6 MM THICKNESS MAXIMUM)

Designation/ Grade	Condition	Min Yield Stress or 0.2% proof stress (N/mm <sup>2</sup> ) Transverse	Tensile Strength (N/mm <sup>2</sup> ) Transverse	Min Elongation at fracture (%) at 50 mm gauge length
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### FERRITIC STEELS

X2 Cr Ti 12(409)	2D/2B	220	390 to 560	20
X2 Cr Ni 12(409M)	2D/2B	320	450 to 650	20
X6 Cr 17(430)	2D/2B	270	450 to 600	20

### AUSTENITIC STEELS

X2 Cr Ti 12 (409)	2D/2B	235	550 to 750	40
	Work-hardened	350	700 min	25
X2 Cr Ni N 18 7 (301)	2D/2B	350	600 to 900	40
	Work-hardened	500	800 min	20
X6 Cr Ni Ti 18 10 (321)	2D/2B	245	540 to 740	40
X6 Cr Ni Mo 17 12 2 (316)	2D/2B	255	550 to 700	40

Note : If the fracture of the tensile test piece is outside gauge length, the test shall be discarded and retest conducted. To facilitate this, sufficient number of pieces shall be prepared





# BEYOND. STYLE. WORLD-CLASS SAFETY & STRENGTH

## THE SHEEN OF SUPERIORITY



### SAFETY AGAINST OVERCROWDING

Metro trains have higher "Super-dense Crush Load" i.e., 14 to 16 standing passengers per square meter of floor space. Under these overloading conditions, higher resistance to buckling plays a major role in selection of the material of construction. The buckling resistance of stainless steel is almost 3 times as compared to other materials, making it a metal of choice for constructing Metro Coaches.



### CRASH RESISTANCE

Stainless steel has a significantly higher impact resistance. Thus, during crash and accidents, coaches made of stainless steel offer maximum safety to passengers.



### FIRE RESISTANCE

Stainless steel can withstand temperatures in excess of 900°C. This fire resistance property makes stainless steel, a suitable metal for fabricating Metro Coaches.



### CORROSION RESISTANCE

Stainless steel has superior corrosion resistance than other materials, in diverse environments. Thus, the durability of stainless steel coaches is significantly higher as compared to other materials.



### HIGHER STRENGTH & LIGHTER CAR BODY

Stainless steel, owing to its higher strength-to-weight ratio, enables reduction in thickness of the components and makes the car body lighter, which translates to lesser energy consumption in propelling the train.



### FATIGUE RESISTANCE

Stainless steel, by virtue of higher strength, showcases double the fatigue resistance.



### ABRASION RESISTANCE

Stainless steel has higher hardness, which exhibits superior scratch, dent and abrasion resistance. For instance, coaches fabricated of stainless steel will incur lower maintenance cost in terms of dents & scratches for Indian Railways, which has a huge network of 64,600 KM spread over the country.



### WELDABILITY & REPAIRABILITY

Stainless steel is easier to weld and fabricate as compared to other materials. With the usage of optimum welding electrode, gas mixture and process parameters, Metro Coaches made of stainless steel have the finest weld quality at optimal.



