Hot Rolled Coils and Sheets

Rourkela Steel Plant

Rationalised sizes of Hot Rolled Coils

Thickness (mm)	Width (mm)
2.0, 2.1, 2.2, 2.3	910, 920, 930, 1010, 1020, 1025, 1030, 1040, 1060
2.5, 2.6	910, 920, 930, 1010, 1020, 1025, 1030, 1040 1060, 1130
2.7, 2.8	910, 920, 930, 1010, 1020, 1025, 1030, 1040, 1060, 1130, 1250
2.9	1125, 1150, 1155, 1160, 1220
3.1, 3.5	910, 920, 930, 1010, 1020, 1025, 1030, 1040, 1060, 1130, 1250, 1310
3.7	910, 920, 930, 1010, 1020, 1025, 1030, 1040, 1060, 1130, 1250, 1310, 1410
3.8	910, 920, 930, 1010, 1020, 1025, 1030, 1040, 1060, 1130, 1250, 1310, 1400, 1410
4.0	910, 920, 930, 1010, 1020, 1025, 1030, 1040, 1060, 1130, 1220, 1250, 1310, 1400, 1410
4.1, 4.3, 4.5, 4.6, 4.8, 5.0, 5.6, 5.8, 6.0, 6.6, 7.0, 7.4, 7.8, 8.0, 9.0, 9.8, 10.0	910, 920, 930, 1010, 1020, 1025, 1030, 1040, 1060, 1130, 1220, 1250, 1310, 1400, 1410, 1420

Coils can also be supplied in other width/thickness combination, as per mutual agreement.

Inner diameter of coils : 760 mm. **Coil weight :** 8 -17 tonnes

Bokaro Steel Plant

Rationalised sizes of Hot Rolled Coils

Thickness (mm)	Width (mm)
2	1030, 1070, 1250, 1270, 1310, 1400
2.1, 2.2	1030, 1070, 1250, 1270, 1310, 1400
2.3, 2.37	1030, 1250, 1270, 1305, 1400
2.5	1030, 1070, 1130, 1250, 1270, 1310, 1400, 1420
2.6	1030, 1100, 1250, 1270, 1310, 1400, 1420
2.7, 2.8	1030, 1070, 1250, 1270, 1310, 1400, 1420
2.9	1030, 1090, 1130, 1150, 1155, 1160, 1250, 1270, 1280, 1310, 1400, 1420, 1680, 1685
2.95, 3.0, 3.10, 3.15 3.2	1030, 1130, 1250, 1270, 1310, 1400, 1420
3.35	1030, 1250, 1270, 1310, 1385, 1400, 1420, 1500, 1550
3.5, 3.55, 3.6	1030, 1250, 1270, 1310, 1360, 1400, 1420, 1500, 1550
3.65	1030, 1250, 1270, 1310, 1385, 1400, 1420, 1500, 1550
3.8, 3.9, 3.95	1030, 1250, 1270, 1310, 1400, 1420, 1500, 1550
4	1030, 1250, 1270, 1310, 1400, 1420, 1500, 1550
4.10	1030, 1250, 1270, 1310, 1385, 1400, 1420, 1500, 1550
4.3	1030, 1250, 1270, 1310, 1350, 1360, 1400, 1420, 1500, 1550, 1730
4.50	1030, 1100, 1250, 1270, 1310, 1360, 1400, 1420, 1500, 1550, 1730
4.8, 4.9	1030, 1250, 1270, 1310, 1360, 1385, 1400, 1420, 1500, 1550, 1730
5	1030, 1250, 1310, 1400, 1420, 1500, 1550, 1730, 1830
5.30, 5.4, 5.6	1030, 1060, 1310, 1360, 1400, 1420, 1500, 1550, 1730
5.8	1030, 1250, 1310, 1360, 1400, 1420, 1500, 1550, 1730
6	1030, 1250, 1310, 1360, 1400, 1420, 1500, 1550, 1730, 1830
6.3, 6.6	1030, 1130, 1250, 1310, 1360, 1400, 1420, 1500, 1550, 1730
7	1030, 1250, 1310, 1360, 1400, 1420, 1500, 1550, 1730, 1830
7.2, 7.3, 7.5, 7.8	1030, 1130, 1150, 1250, 1310, 1360, 1400, 1420, 1500, 1550, 1730
8.0, 8.7	1030, 1250, 1310, 1360, 1400, 1420, 1500, 1550, 1730, 1830
9.2, 9.8, 10, 11.8, 12	1030, 1150, 1250, 1310, 1400, 1420, 1500, 1550, 1730, 1830
16	1250, 1310, 1400, 1420, 1500, 1550, 1730, 1830

– 1100 mm width as already indicated will be through concast route for which sequential order will be required.

– Coils can also be supplied in other sizes, as per mutual agreement.

Inner diameter of coils : 850 mm

Outer diameter of coils : 2300 mm (max)

Coil weight : 29 tonnes max.

Bokaro Steel Plant

Rationalised sizes of Hot Rolled Sheets

Thickness, mm (gauge)	Width (mm)	Length (mm)
2 (14)	930, 1000, 1030, 1100, 1130, 1250, 1310	2500
2.50 (12)	930, 1000, 1030, 1100, 1130, 1250, 1310, 1400	2500
2.9	1000, 1100, 1250, 1400	2500, 4000, 4500
3.15 (10)	1000, 1100, 1250, 1400	2500, 4000, 4500
3.55 (9)	1000, 1100, 1250, 1400	2500, 4000, 4500
4 (8)	1000, 1100, 1250, 1400	2500, 4000, 4500

Thickness and width tolerances are as per IS: 1852/2003. Closer tolerances can also be supplied on demand.

Packaging : Bare bundles with cross-wise steel strip. Packet weight : 7 - 18 tonnes. Marking : Paint marked on the top sheet of the bundle OR Sticker/label on top sheet of bundle with required details.

Common grades for Hot Rolled Coils and Sheets : IS 10748/2009 grades I-V, API 5L Grades A, B, X42, X46, X52, X56, X60, SAIL-WTCR, IS: 11513/2011 grades O, D, DD, EDD, IS: 1079/ 1994 grades O, D, DD, EDD, Medium Carbon Strapping Steel, HCRS, SAE-1040, SAE – 1055, C 30, 40, 50, Medium Silicon Electrical Steel, IS: 6240/2008, SAIL HS LPG, SAILMA, IS: 2062/2011, IS: 5986/2011 Fe 330, 360, 410, 510, SAILRIM, IS: 2062/2011 Grade with copper, SAILCOR/IRSM-41, SAE 1012, SAE 1541 Auto Chassis Grade: E 34 / E38 / 46 & SAPH 45.

Materials are also available in the following foreign specifications : For structural and general purposes- ASTM-A 36/A 569/A 570 Grades 33/40, JISG 3101 SS400, JISG 3131 SPHC, DIN 17100 ST 37.2/ST 44.2, BS 4360 Grades 40/43A, EN 10025; For Tube-making and other grades : JISG 3132 SPHT 1/2, DIN 1614 Pt. 1/2 ST 22/23/24, SAE 1006, SAE 1018 or equivalents, if sufficient orders are available.

HR Sheets for Conventional LPG Cylinders

Thickness (mm)	Width (mm)	Length (mm)
2.9	1240	2480
2.8	1250	2500

Sheets can also be supplied in the following sizes on mutual agreement : 2.9 x 1360 x 2720 mm, 2.9 x 1270 x 2540 mm, 3.0 x 1360 x 2700 mm

Other sizes of hot rolled coils and sheets can be supplied as per mutual agreement.

HR Coils for LPG Cylinders

Grade	Thickness (mm)	Width (mm)
Conventional (IS: 6240/2008)	2.9	1090, 1160, 1250, 1685
SAIL HS LPG (JISG 3116/EN10120/ IS 15914)	2.2 - 4.0	1090, 1160, 1250

Applications (Hot Rolled Coils and Sheets)

Specification	Application
IS 10748/2004, Grades I, II, III, IV, V	Tube making
SAIL-WTCR, IS 11513/2011 Grades CR1, CR2, CR3, CR4, SAIL DRAW (EDD with CBT)	Cold reducing segment
IS 1079/2009 Grades HR1, HR2, HR3, HR4	General structural applications
SAILRIM	Manufacture of cycle rims
SAE 1012	Manufacture of wheel disc and cold formed products
SAIL PROP (SAE 1020) SAIL PREFAB (SAE 1020 Spl.)	Manufacture of propeller shaft Manufacture of Prefabricated structures
IS 2062/2011, Grade B with Copper SAILCOR/IRSM-41/HCRS	Manufacture of corrosion resistant engineering products
SAILMA, IS 2062/2011, Grades A, B, C, IS 5986/2011	Fabrication of engineering structurals Manufacture of Hamilton and other poles, flanging applications
Strapping quality (IRS P 41)	Strapping for packaging
SAE 1541	Manufacture of fork and spokes for two wheelers
Medium Carbon Grades (SAIL MC 40/45/50/55/60 SAE 1040, SAE 1045, SAE 1055)	Chains, hair clip, sprocket, clutch plate, hacksaw blade etc.
Medium silicon electrical steel	Manufacture of electrical equipment
IS 6240/2008	Domestic/Auto LPG Cylinders
SAIL HS LPG (JISG 3116, EN 10120)	Export quality LPG Cylinders
SAIL FORM 34, 38, 46 (E 34, E 38, E 46/ BSK 46)	Fabrication of long & cross members for LCV, MCV and HCV
SAIL SUPER FORM 45 HSFQ, SAIL FORMING, IS: 11513-2011, JISG 3113, SAPH 440	Long and cross member of LCV & MCV, wheel disc, wheel rim and other structural components of passenger car
HSFQ 250/350/450/500/550 (Thickness $<$ 8 mm)	Auto Components & Pre Engineered Building (PEB) Sections (For forming at ambient temperature)
SAIL FORMING 250/350/450/550	Auto components (For forming at high temperature – Hot forming)
MnB Steel	Crash Resistant Auto Components (For Simultaneous Forming & Quenching in Die - Hot Stamping)
API 5L, Grades A, B, X42, X46, X52, X56, X60, X65, X70	Manufacture of tubes & pipes mostly for oil and gas sector
IS 15962/2012	Seismic resistant application
IS 15914/2011	Lighter (thinner) cylinder

Rolling and Cutting Tolerance as per IS:1852 - 1985 (Reaffirmed 2003)

Tolerance on Width of Strip Supplied with as Rolled Edges

Width (mm)	Tolerance (mm)
Up to 250	+ 4, - 0
> 250 to 600	+ 6, - 0
> 600 to 800	+ 10, - 0
> 800 to 1250	+ 30, - 0
> 1250 to 1550	+ 35, - 0
> 1550 to 1850	+ 40, - 0

Tolerance on Thickness of Strip up to and including 500 mm width

Width (mm)	Tolerance on thickness (mm)
Upto 200	± 0.20
> 200 to 320	± 0.23
>320 to 400	± 0.25
> 400 to 500	± 0.30

Tolerance on Thickness for Strip above 500 mm width

Width (mm)	Tolerance on thickness (mm)				
	> 1.6 to 2	> 2 to 3	> 3 to 5	> 5 to 8	> 8 to 10
500 to 1250	± 0.18	± 0.20	± 0.25	± 0.30	± 0.35
1250 to 1550	± 0.20	± 0.25	± 0.30	± 0.35	± 0.40
1550 to 1850	± 0.22	± 0.28	± 0.35	± 0.40	± 0.40

Rolling and Cutting Tolerance for HR Sheets
as per IS: 1852 - 1985 (Reaffirmed 2003)

Width (mm)	Tolerance (mm)	Length (mm)	Tolerance
Up to 1250	+ 6 , - 0	Up to 2500	+ 25 mm, - 0 mm
> 1250 to 1550	+ 0.5%, - 0	Over 2500	+ 1% of the length (max 70 mm), - 0 mm

Thickness tolerance for sheets as per table of HR Coils

Note : Cutting tolerance for all lengths for all products except plate, strip and sheet shall be + 100 mm, - 0 mm.

Closer tolerances can be supplied on mutual agreement.

Chemical Composition: IS 1079/2009

Quality			Constituent, Percent, Max			
Designation nation	Old Designation	Name	Carbon	Manganese	Phosphorus	Sulphur
HR0	(New)	Ordinary	0.25	1.70	0.05	0.045
HR1	O	Commercial	0.15	0.60	0.05	0.035
HR2	D	Drawing	0.10	0.45	0.040	0.035
HR3	DD	Deep Drawing	0.08	0.40	0.035	0.030
HR4	EDD	Extra Deep Drawing	0.08	0.35	0.030	0.030
HR5	(New)	Micro-alloyed	0.16	1.6	0.020	0.020

NOTES:

1. Steel of these grades can be supplied with the addition of micro-alloying elements like Boron, Titanium, Niobium and Vanadium. The micro-alloying elements shall not exceed 0.008 percent in case of Boron and 0.20 percent in case of other elements.
2. The Nitrogen content of the steel shall not be more than 0.007 percent. For Aluminium killed or Silicon-Aluminium killed, the Nitrogen content shall not exceed 0.012 percent. This has to be ensured by the manufacturer by occasional check analysis.
3. Grade HR4 and HR5 shall be supplied in fully Aluminium killed condition or Aluminium with stabilising elements.
4. When the steel is Aluminium killed, the total Aluminium content shall not be less than 0.02 percent. When the steel is Silicon killed, the Silicon content shall not be less than 0.10 percent. When the steel is Aluminium-Silicon killed, the Silicon content shall not be less than 0.03 percent and total Aluminium content shall not be less than 0.01 percent.
5. When Copper bearing steel is required the Copper content shall be between 0.20 and 0.35 percent. In case of product analysis, the Copper content shall be between 0.17 and 0.38 percent.
6. Restricted chemistry may be mutually agreed to between the purchaser and the supplier.

Specification	Grade	C % max	Mn % max	P % max	S % max	Si % max
SAIL DRAW	EDD (CBT)	0.04	0.15	0.015	0.015	0.03 Al:Si 0.025-0.06
SAIL RIM		0.07-0.11	0.30-0.45	0.040	0.040	
SAE 1012		0.10-0.15	0.30-0.60	0.030	0.035	0.10 max
SAIL PROP	SAE 1020	0.17-0.23	0.32-0.6	0.04	0.03	
SAIL PREFAB	SAE 1020 spl	0.23 max	1.35 max	0.04	0.03	Nb: 0.005-0.05

Chemical Composition: IS 2062/2011

Grade Designation	Quality	Ladle Analysis, Percent, Max					Carbon Equivalent (CE), Max	Method of Deoxidation
		C	Mn	S	P	Si		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
E 250	A	0.23	1.50	0.045	0.045	0.40	0.42	Semi killed/killed
	BR	0.22	1.50	0.045	0.045	0.40	0.41	Killed
	B0							
	C	0.20	1.50	0.040	0.040	0.40	0.39	Killed
E 300	A	0.20	1.50	0.045	0.045	0.45	0.44	Semi Killed/Killed
	BR							Killed
	B0							
	C	0.20	1.50	0.040	0.040	0.45	0.44	
E 350	A	0.20	1.55	0.045	0.045	0.45	0.47	Semi Killed/Killed
	BR							Killed
	B0							
	C	0.20	1.55	0.040	0.040	0.45	0.45	
E 410	A	0.20	1.60	0.045	0.045	0.45	0.50	Semi Killed/Killed
	BR							Killed
	B0							
	C	0.20	1.60	0.040	0.040	0.45	0.50	
E 450	A	0.22	1.65	0.045	0.045	0.45	0.52	Semi Killed/Killed
	BR							Killed
E 550	A	0.22	1.65	0.020	0.025	0.50	0.54	Semi Killed/Killed
	BR							Killed
E 600	A	0.22	1.70	0.020	0.025	0.50	0.54	Semi Killed/Killed
	BR							Killed
E 650	A	0.22	1.70	0.015	0.025	0.50	0.55	Semi Killed/Killed
	BR							Killed

Specification	Grade	C % max	Mn % max	P % max	S % max	Si % max
SAIL COR	IRSM 41	0.10	0.25-0.45	0.075-0.140	0.030	0.28-0.72
	Cr 0.35-0.60, Ni 0.20-0.47, Cu 0.30-0.60, Al 0.03 max					
HCRS (Cu-P)		0.15	0.25-0.8	0.07-0.15	0.03	0.28-0.50 (Cu 0.20 min)

Specification	Grade	C% max	Mn% max	P% max	S% max	CE
IS : 5986/2011	165	0.12	0.60	0.040	0.040	–
	205	0.15	0.80	0.040	0.040	–
	235	0.17	1.00	0.040	0.040	–
	255	0.20	1.30	0.040	0.040	0.42
	325	0.20	1.30	0.040	0.040	0.42
	355	0.20	1.50	0.035	0.035	0.45
	420	0.20	1.50	0.035	0.035	0.45
	490	0.20	1.50	0.035	0.030	0.45
	560	0.20	1.50	0.035	0.030	0.45

Chemical Composition

Grade	C max.	Mn max.	S max.	P max.	Al min.	Si max.	CE max.	MAE (Nb+V+Ti) max.
SAILMA 300	0.20	1.50	0.045	0.045	0.02	0.45	0.44	≤ 0.25
SAILMA 300 HI	0.20	1.50	0.040	0.040	0.02	0.45	0.43	≤ 0.25
SAILMA 350	0.20	1.55	0.045	0.045	0.02	0.45	0.46	≤ 0.25
SAILMA 350 HI	0.20	1.55	0.040	0.040	0.02	0.45	0.45	≤ 0.25
SAILMA 410	0.20	1.60	0.045	0.045	0.02	0.45	0.48	≤ 0.25
SAILMA 410 HI	0.20	1.60	0.040	0.040	0.02	0.45	0.48	≤ 0.25
SAILMA 450	0.20	1.65	0.045	0.045	0.02	0.45	0.50	≤ 0.25
SAILMA 450HI	0.20	1.65	0.040	0.040	0.02	0.45	0.50	≤ 0.25
SAILMA 550	0.20	1.65	0.020	0.025	0.02	0.50	0.54	≤ 0.25
SAILMA 550HI	0.20	1.65	0.015	0.025	0.02	0.50	0.54	≤ 0.25
SAILMA 600	0.22	1.70	0.015	0.025	0.02	0.50	0.54	≤ 0.25

For Hot Rolled coils, S is maintained below 0.030%

Specification	Grade	C % max	Mn % max	P % max	S % max	Si % max	Al % min
Strapping Quality	IRS P 41	0.25-0.45	1.20-1.45	0.040	0.040	0.15-0.35	
	SAE 1541	0.36-0.44	1.30-1.60	0.030	0.030	0.15-0.35	
	SAIL MC 30	0.26-0.35	0.60-0.90	0.04	0.04	0.15-0.35	0.02
	SAIL MC 40	0.36-0.45	0.60-0.90	0.04	0.04	0.15-0.35	0.02
	SAIL MC 45	0.41-0.50	0.60-0.90	0.04	0.04	0.15-0.35	0.02
	SAIL MC 50	0.46-0.55	0.60-0.90	0.40	0.04	0.15-0.35	0.02
	SAIL MC 55	0.51-0.60	0.60-0.90	0.04	0.04	0.15-0.35	0.02
	SAIL MC 60	0.56-0.65	0.60-0.90	0.04	0.04	0.15-0.35	0.02
Medium Si Electrical Steel		0.05	0.40	0.025	0.025	0.30 - 1.50	
IS 6240		0.16	0.30 min	0.025	0.025	0.25 Al	0.02 min MAE, 0.1% (Nb, Ti, B) N<90 ppm
SAIL HS LPG JISG 3116	SG 255	0.20 max	0.30 min	0.04	0.040	-	
	SG 295	0.20 max	1.00 max	0.04	0.040	0.35	
SAIL HS LPG EN 10120	P245NB	0.16 max	0.30 min	0.025	0.015	0.25	
	P265NB	0.19 max	0.40 min	0.025	0.015	0.25	
	P310NB	0.20 max	0.70 min	0.025	0.015	0.50	
	Nb 0.05 max Ti 0.03 max for EN 10120						

Chemical Composition

Specification	Grade	C % max	Mn % max	P % max	S % max	Si % max
E-34	SAIL FORM 34	0.10	0.70	0.030	0.030	0.20
E-38	SAIL FORM 38	0.10	1.00	0.030	0.030	0.40
E-46/BSK-46	SAIL FORM 45	0.12	1.20	0.025	0.025	0.40
JISG 3113 SAPH 440	SAIL SUPER FORM	0.14	1.2	S&P < 0.04%		0.15
Nb + Ti 0.10 max for SAIL FORM Grade						
API 5 L	A	0.22	0.9	0.030	0.030	
	B	0.26	1.20	0.030	0.030	
	X42	0.26	1.30	0.030	0.030	
	X46	0.26	1.40	0.030	0.030	
	X52	0.26	1.40	0.030	0.030	
	X56	0.26	1.40	0.030	0.030	
	X60	0.26	1.40	0.030	0.030	
	X65	0.26	1.45	0.030	0.030	
	X70	0.26	1.65	0.030	0.030	
	Nb +V + Ti < 0.15%					

Chemical Composition

Grade	C max	Mn max	S max	P max	Al min	Si max	MAE max
HSFQ 250	0.12	1.00	0.020	0.025	0.02	0.25	-
HSFQ 350	0.12	1.20	0.020	0.025	0.02	0.25	0.03
HSFQ 450	0.12	1.40	0.020	0.025	0.02	0.40	0.05
HSFQ 500	0.12	1.50	0.020	0.025	0.02	0.50	0.10
HSFQ 550	0.12	1.60	0.020	0.025	0.02	0.50	0.15

Grade	C max	Mn max	S max	P max	Al min	Si max	MAE max
SAIL FORMING 250	0.12	1.40	0.025	0.030	0.02	0.30	0.04
SAIL FORMING 350	0.12	1.50	0.025	0.030	0.02	0.40	0.08
SAIL FORMING 450	0.12	1.60	0.025	0.030	0.02	0.50	0.12
MnB Steel	0.25	1.50	0.025	0.030	0.02	0.40	0.40

Chemical Composition

Specification	Grade	C % max	Mn % max	P % max	S % max	Si % max
IS: 10748/2004	1	0.10	0.50	0.040	0.040	For semi killed Quality Si content shall be 0.08% max
	II	0.12	0.60	0.040	0.040	
	III	0.16	1.20	0.040	0.040	
	IV	0.20	1.30	0.040	0.040	
	V	0.25	1.30	0.040	0.040	
	CE: 0.45 max for grades IV and V					
SAIL WTCR	-	0.06	0.25	0.025	0.025	0.04
SAIL SOFT	-	0.06	0.25	0.025	0.04	0.05

Chemical Composition of Seismic Resistant Structural Steel IS 15962:2012

Grade	C max	Mn max	P max	S max	Simax	CE* max	Mode of Deoxidation
E250S	0.20	1.50	0.035	0.045	0.40	0.39	Semi-killed/Killed
E300S	0.20	1.50	0.035	0.045	0.45	0.40	Semi/killed/Killed
E350S	0.20	1.60	0.035	0.045	0.45	0.42	Semi/killed/Killed
E450S	0.22	1.60	0.035	0.045	0.45	0.47	Semi/killed/Killed

- Microalloying elements (MAE) like Nb, V and Ti may be added singly or in combination. Total MAE shall not be more than 0.15%.
- Cr, Ni, Mo may be added but not more then 0.60% singly or in combination.
- Cu may be present between 0.20 and 0.35%.
- Nitrogen content shall not be more then 0.012%.

Chemical Composition for high tensile flat rolled steel for lighter cylinder IS 15914:2011

Grade	Constituent, Percent					
	Carbon Max	Manganese Min	Silicon Max	Sulphur Max	Phosphorus Max	Alluminium Min
HS 235	0.16	0.30	0.25	0.025	0.025	0.015
HS 265	0.18	0.40	0.30	0.025	0.025	0.015
HS 295	0.19	0.50	0.35	0.025	0.025	0.015
HS 345	0.20	0.70	0.45	0.025	0.025	0.015

NOTES:

1. Elements not listed in this table may not be added to the steel. All suitable arrangements are to be made to prevent such elements being added from scrap or other materials used during manufacture, which impair the mechanical properties and usability.
2. Steel may be supplied with the addition of micro alloying elements like niobium, titanium, vanadiam and boron. The micro-alloying elements shall not exceed 0.10% when added individually or in combination.
3. The nitrogen content of the steel shall not be more than 0.009%. This has to be ensured by the manfacturer by occasional check analysis.

Mechanical Properties

IS: 1079/2009

Quality			Tensile Strength Rm2 max MPa	Percentage Elongation after Fracture A, min			
				t≤3		t>3	
Desig-nation	Old Desig-nation	Name		Gauge length Lo=80 mm	Gauge length Lo=50 mm	Gauge length Lo=5.65√So mm	Gauge length Lo=50 mm
HR0	(New)	Ordinary	*	*	*	*	*
HR1	O	Commercial	440	23	24	28	29
HR2	D	Drawing	420	25	26	30	31
HR3	DD	Deep Drawing	400	28	29	33	34
HR4	EDD	Extra Deep Drawing	380	31	32	36	37
HR5	SAILFORM 34	YS 340	400-500	*	*	26	27
	SAILFORM 38	YS 380	450-570	*	*	24	25
	SAILFORM 45	YS 450	500-620	*	*	20	21

NOTES:

1. 1 MPa = 1N/mm^2
2. Minimum tensile strength for qualities HR1, HR2, HR3 and HR4 would normally be expected to be 270 MPa. Where minimum tensile strength is required, the value of 270 MPa may be specified. All tensile strength values are determined to the nearest 10 MPa.
3. The non proportional test piece with a fixed original gauge length (50 mm) up to 6 mm thick sheet can be used in conjunction with a conversion table. In case of dispute, however, only the results obtained on a proportional test piece will be valid for material 3 mm and over in thickness.
4. HR5 grade is for cold rolling only, therefore mechanical properties are not applicable.
5. Where "t" is thickness of steel sheet, in mm.
6. Tensile testing is not mandatory for HR1, unless agreed to between the purchaser and manufacturer.

* Properties on mutual agreement between the purchaser and manufacturer.

Mechanical Properties

Specification	Grade	Yield Strength	Ultimate Tensile Strength	Elongation % Std GL	Internal diameter of bend
		MPa min	MPa min		
SAILCOR		340	480	22	
SAIL PROP	SAE 1020	310-320	440		15
SAIL PRE FAB	SAE 1020 spl.	345 min	450 min		21

Mechanical Properties

IS: 2062/2011

Grade Designation	Quality	Tensile Strength Rm Min MPa	Yield Stress Min Mpa			Percentage Elongation A, at Gauge Length, L=5.65 √S Min	Internal Bend Diameter Min (See Note 2)		Charpy Impact Test (See Note 3 & 4)	
			<20	20-40	>40		≤25	>25	Temp °C	J, Min
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
E-250	A	410	250	240	230	23	2t	3t	–	–
	BR								RT	27
	B0								0	27
	C								(-) 20	27
E-300	A	440	300	290	280	22	2t	–	–	–
	BR								RT	27
	B0								0	27
	C								(-) 20	27
E-350	A	490	350	330	320	22	2t	–	–	–
	BR								RT	27
	B0								0	27
	C								(-) 20	27
E-410	A	540	410	390	380	20	2t	–	–	–
	BR								RT	25
	B0								0	25
	C								(-) 20	25
E-450	A	570	450	430	420	20	2.5t	–	–	–
	BR								RT	20
	B0									
	C									
E-550	A	650	550	530	520	12	3t	–	–	–
	BR								RT	15
E 600	A	730	600	580	570	12	3.5t	–	–	–
	BR								RT	15
E 650	A	780	650	630	620	12	4t	–	–	–
	BR								RT	15

- For sub-quality BR, Impact test is optional.
- Impact test shall normally be carried out on products having thickness greater than or equal to 12 mm.

Mechanical Properties - SAILMA grades

Grade	YS, MPa, min			UTS, MPa, min	% El min Std GL	Internal Bend Diameter, min		Charpy Impact Test	
						≤25 mm	>25 mm	Temp ^{o}C	J, min
	<25 mm	25-40 mm	>40 mm						
SAILMA 300	300	290	280	440	24	2t	-	-	-
SAILMA 300 HI	300	290	280	440	24	2t		0	40
SAILMA 350	350	330	320	490	24	2t	-	-	-
SAILMA 350 HI	350	330	320	490	24	2t	-	0 -20	40 30
SAILMA 410	410	390	380	540	22	2t	-	-	-
SAILMA 410 HI	410	390	380	540	22	2t	-	0 -20	35 25
SAILMA 450	450	430	420	570	22	2.5t	-	-	-
SAILMA 450 HI	450	430	420	570	22	2.5t	-	0 -20	30 20
SAILMA 550	550	530	520	650	14	3t	-	-	-
SAILMA 550 HI	550	530	520	650	14	3t	-	0 -20	25 15
SAILMA 600	600	580	570	730	14	3.5t	-	-	-

Impact will be given for any one temperature. For 450 HI & above impact is for >10 mm. For <12 mm impact to be given only if specified.

Mechanical Properties

Specification	Grade	Yield Strength	Ultimate Tensile Strength	Elongation %		Internal diameter of bend
		MPa min	MPa	Up to 3 mm	Above 3 mm	
Strapping Quality						
SAE 1541						
Medium Carbon	C 30	55% of UTS	500-600	21		
	C 40		580-680	18		
	C 50		660-780	13		
Med Si Elec						
IS 6240/2008		240	350-450	25 GL=5.65√So		t - Thickness of test piece
SAIL HS LPG	SG 255	255	400	28 GL=50 mm		
JISG 3116	SG 295	295	440	26 GL=50 mm		
SAIL HS LPG	P245	245	360-450	26	34	
	P265NB	265	410-500	24	32	
EN 10120	P310NB	310	460-550	21	28	
SAIL SUPER FORM SAPH 45	JISG 3113 SAPH 440	305 (t<6 mm) 295 (t:6 to 8 mm)	440	GL: 50 mm 345 (t <6 mm) 32% (t:6-8 mm)		
APL-5L	A	207	331	% elongation 1.944A $^{0.2}$/U 0.9 (GL : 50.8 mm) for all API Grades A : Cross sectional area in mm² U: Minimum UTS in MPa		
	B	241-418	414-758			
	X42	290-496	414-758			
	X46	317-524	434-758			
	X52	359-531	455-758			
	X56	386-544	490-758			
	X60	414-565	517-758			
	X65	448-600	531-758			
	X70	483-621	565-758			

NOTES : These are pipe properties. Hot rolled plate/coil properties are to be mutually agreed upon by producer and pipe manufacturers.

Mechanical Properties

Grade	YS, MPa, min	UTS, MPa, min	% El min (Std GL)
HSFQ 250	250	380	30
HSFQ 350	350	400	28
HSFQ 450	450	520	25
HSFQ 500	500	560	22
HSFQ 550	550	620	18

Grade	YS, MPa, min	UTS, MPa, min	% El min (Std GL)
SAIL FORMING 250	250	410	26
SAIL FORMING 350	350	490	24
SAIL FORMING 450	450	550	22

Specification	Grade	Yield Strength	Ultimate Tensile Strength	Elongation % GL=5.65√So	Internal diameter of bend
		MPa min	MPa min		
IS:10748/2004*	I	170	290	30	T
	II	210	330	28	2T
	III	240	410	25	2T
	IV	275	430	20	3T
	V	310	490	15	3T
SAIL WTCR				35	65 HRB max
SAIL SOFT				38	55 HRB max

T=Normal thickness of test piece

* Supplied on basis of chemical composition for IS10748/2004, SAIL WTCR and SAIL SOFT.

Mechanical Properties of Seismic Resistant Structural Steel (IS 15962:2012)

Grade	UTS (MPa, min.)	Yield Strength (MPa, min.)			% El min. GL=5.65√A0	Charpy Impact (J at 0°C) min.	YS/UTS max.
		<20 mm	20-40 mm	>40 mm			
E250S	410	250	240	230	23	27	0.80
E300S	440	300	290	280	22	27	0.80
E350S	490	350	330	320	22	27	0.85
E450S	570	450	430	420	20	27	0.88

Mechanical Properties of high tensile flat rolled steel for lighter cylinder (IS 15914:2011)

Grade	Tensile Strength MPa	Yield Stress MPa Min	Percentage Elongation at Gauge Length = 5.65√So Min		Reference Heat Treatment Austenitizing Temperature °C
			<3 mm³	3 to 5 mm³	
HS 235	360-460	235	25	32	920-960
HS 265	410-510	265	22	30	890-930
HS 295	450-560	295	20	28	890-930
HS 345	490-610	345	18	24	880-920

The above properties are specified for cold formed and normalized cylinder. However tensile properties of hot rolled plate/sheet/strip are to be mutually agreed upon by the producer and by the cylinder manufacturer.