posco VIETNAM

Cold Rolled Steel

Cold Rolled Steel

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Cold Rolled Steel

Cold rolled steel sheets (CR) have fine surface and excellent workability. They are used for various purposes including automobiles, home appliances, furniture, office equipments, industrial machines and constructional materials. Due to the economic development and the advancement in consumers' level, the customers are gradually requiring high quality of diversified and functionalized products. We, POSCO-VIETNAM are making our best efforts to satisfy the customers with the optimum quality and continuous improvement in our products.

HISTORY

15.11.2006 : Got approval Investment License from Vietnam government
30.03.2007 : Finish ground leveling for CR Mill (21ha)
18.04.2007 : Got approval captive port establishment
01.08.2007 : Ground Breaking Ceremony
31.09.2009 : Completion (FH 500,000 ton/year, CR 700,000 ton/year)
08.10.2010 : ISO 9001: 2008/ISO 14001:2004 Certified

Contents

MANUFACTURING EQUIPMENT

Pickling

The hot-rolled coil passes through pickling line, where hydrochloric acid solution is used to remove surface scales for its smooth surface finish before further processing.

Cold-Rolling

Pickling coils are rolled in the tandem cold rolled mill where they are processed into specified thickness. The critical point at this stage is to maintain uniform and precise flatness throughout the entire length of the coil. The rolling process is automatically controlled by the latest computer technology.

Electrolytic Cleaning

The main purpose of electrolytic cleaning is to remove the lubricant oil and dirt left on the cold rolled strip before annealing. Every trace of surface oil is removed by using the mechanical and chemical reactions while the cold rolled coil passes through alkaline solution.

Annealing

After cold-rolling, the steel strip is hard and brittle with its grains elongated in the rolling direction. To obtain the mechanical properties, the strip is passed through the furnace, the heating, soaking and cooling sections. By various heat cycles, extra deep drawing quality and high tensile strengthen steel can also be produced. There are normally two annealing types, that is batch and continuous annealing line has superior productivity.

Skin Pass Rolling

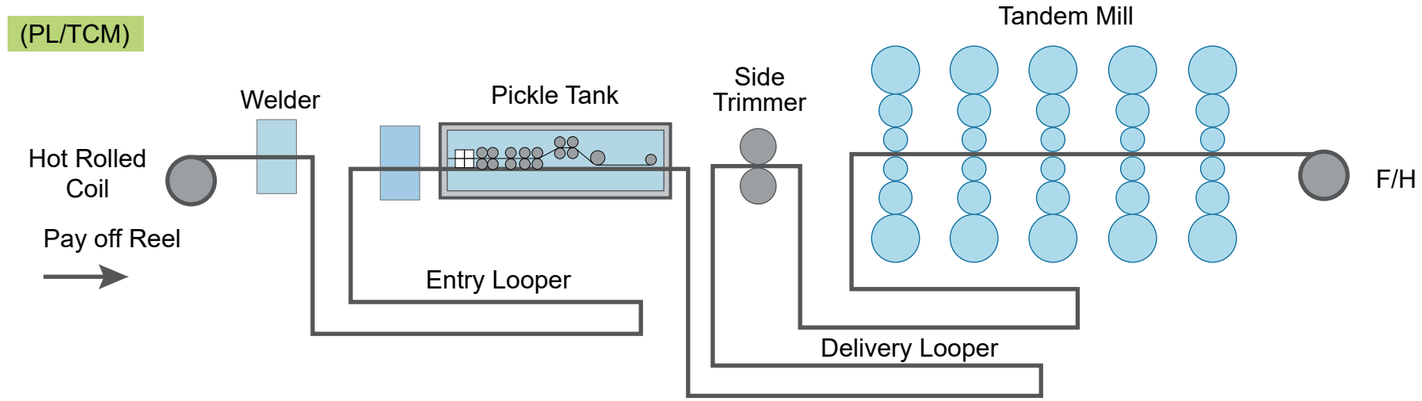
Skin pass rolling slightly reduces the size of the annealed coil to provide a degree of surface to remove some defects like stretcher strains which is easily generated on the strip passed an annealing process.

Finishing and Inspection

Production thickness, width and surface quality are checked during this stage. Product samples are also sent to the laboratory to test for mechanical properties, etc,…Oil is also applied to the product to prevent rust and they are packed for shipment.

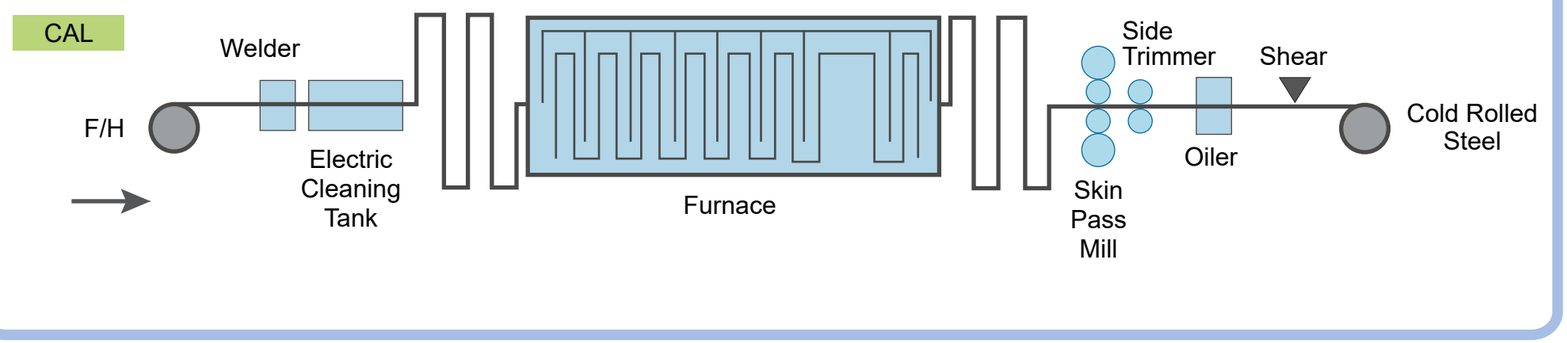
PRODUCTION FACILITIES

Cold Rolling Process



Description		PL/TCM
Capacity(Mill.ton/y)		1.2
TCM (Mill)		6Hi x 5Std
Product size	THK (mm) WTH (mm) Weight (Ton)	0.125 ~ 2.0 700 ~ 1,570 Max.35

Continuous Annealing Process



Description		CAL
Capacity(Mill.ton/y)		0.7
Product size	THK (mm) WTH (mm) Weight (Ton)	0.30 ~ 2.0 700 ~ 1,570 Max.35

MAIN USES

The usage presented in this section reflects the general use and shall be used as a reference. Please be sure to consult with our associates when making orders for specific usage.

Mild Cold Rolled Steel

This type of steel is used for general purposes. In particular, it is appropriate for manufacturing refrigerator doors, drums and furniture as well as for automobile roofs, fenders, hoods, quarters, oil pans and spring houses.

Steel for Structural Use

This structural steel does not need drawability but require high strength.

Steel for Porcelain Enameling

This product has two features as porcelain enameling such as heat resistance, corrosion resistance and surface gloss as well as steel product such as impact resistance, high ductility and formability. It is used for some components of home appliances, construction materials, kitchen appliances and bathtubs, etc.

High Tensile Strength Steel

This type of steel can be divided into commercial, drawing, deep drawing and TRIP steels, depending on manufacturing methods and final usages. In general, commercial steel is used for automobile seats, rail levers and parking brakes. Deep drawing steel is appropriate for outer panels of an automobile, including fenders and hoods. TRIP steel is used for car doors and bumpers.

PROPERTIES

Mild Cold Rolled Steel

Classification	Specifications	Properties	Applications
Class 1	SPCC	Use for the parts requiring bending, forming, light processing and welding, etc.	Refrigerator Doors, Drum, Furniture
Class 2	SPCD	Used for drawing parts where more drawability than SPCC	Filter Housing
Class 3	SPCE	Used for deep drawing parts where more drawability than SPCD	Roofs, Fenders and Hoods of Automobiles
	SPCEN	Guaranteed for non-aging deep drawing in which such properties do not change even after a long time has passed.	
	*CSP3E	Used for deep drawing parts of automobiles where more drawability than SPCEN.	Deep Drawing Part
	*CSP3X	Used for super deep drawing parts of automobiles which reguire more drawability than CSP3E	Side Panel of Automobiles Fuel Tanks of Motorcycles

Note * POSCO Specifications

Steel for Structures & Hard Materials

Classification	Specifications	Properties	Applications
Structural Quality	CSP30 CSP32 CSP34 CSP37 CSP37P CSP58	Used in structural materials that strength is needed instead of draw ability (The minimum value of tensile strength is guaranteed)	Structural Materials for Construction
Hard quality	CSP1-H CSP1-4H CSP1-8H	The hardness of strip is guaranteed when a customer requests	Plating, Piping, Motor core Materials, etc.

Steel for Porcelain Enameling

Classification	Specifications	Properties	Applications
Porcelain Enameling	CESP-C	This product has superior workability, but no defects on the forcelain enameled surface, such as fish scales and blisters, etc.., This product does not twist (called as 'sag') after baking at high temperature.	Washing machines, ovens, porcelain enameled bathtubs & tableware, pans, construction materials etc.,

High Strength Cold Rolled Steel

Classification	Specifications	Properties	Applications
Commercial (Precipitation Strengthened steel)	CHSP45C	Adding hardening elements, such as Nb, Cr and V, to low carbon steel enhances its strength and yield point. It has excellent crack resistance and is used for structural purposes where strength is needed.	Seat, Rail levers, and Parking Brackets of automobiles
Drawing (Solid Solution Strengthened Steel)	CHSP35R CHSP40R CHSP45R	This is high strength steel with solid solution hardening elements, such as phosphate (P). It is used in automobile panels for its increased strength.	Center floor and brackets, etc.
Deep Drawing (Soild Solution Strengthened Steel)	CHSP35E CHSP40E CHSP45E	This is ultra-low carbon steel with special elements added. It has a high elongation rate and is used in deep draw parts of automobiles outer panels.	Outer panels of Doors and Fenders, ect.
Extra Deep Drawing (Solid Solution Strengthened Steel)	CHSP35ES CHSP40ES	As the ultra carbon steel added with some special elements, this product has superior high strength and elongation. It is possible to lighten an automobile by applying it to the parts for deep drawing.	Inner and Outer Materials of Roofs, Hood Members, etc.
Steel with Guaranteed YS (Yield Strength)	CHSP260Y CHSP340Y CHSP380Y	This product has a very high yield strength compared to the existing high strength steel types since it is manufactured with its ultra fine ferric structure by using some special chemical elements.	Kinds of Member-re-inforcing Materials

SPECIFICATIONS

The product standards are subject to change.
Please be sure to confirm the recent standards when making orders or to consult our associates.

▶ POSCO Specifications

Mild Cold Rolled Steel

: Thickness (mm)

Classification		Specifications	Temper Classifications		Tensile Strength (Mpa)	Elongation, Min.(%)					Hardness	
						0.25 ~ 0.4	0.4 ~ 0.6	0.6 ~ 1.0	1.0 ~ 1.6	1.6 ~ 2.0	HRB	HV
Class 1	Commercial Quality	CSP1	Annealing Standard	A S	(275 ≤)	(32)	(34)	(36)	(37)	(38)	-	-
			1/8 Full Hard	8H		-					50 ~ 71	95 ~ 130
			Full Hard	H	-						85 ≤	170 ≤
	Light Drawing Quality	CSP1D	Annealing Standard	A S	(275 ≤)	33	35	37	38	39	-	-
Class 2	Drawing Quality	CSP2	Annealing Standard	A S	275 ≤	34	36	38	39	40	-	-
Class 3	Deep Drawing Quality	CSP3	Annealing Standard	A S	275 ≤	36	38	40	41	42	-	-
	Non-Aging Deep Drawing Quality	CSP3N	Annealing Standard	A S	275 ≤	36	38	40	41	42	-	-
	Non-Aging Super Deep Drawing Quality	CSP3E	Standard	S	275 ≤	44	45	46	48	-	-	-
		CSP3X*	Standard	S	265 ≤	46	47	48	50	-	-	-
		CSP3Z*	Standard	S	255 ≤	-	52	52	52	-	-	-

Note.

1. Annealed and normal tempered CSP1 class steel is to be CSP1T in case that each or both of the values of the tensile test and Erichsen test are guaranteed according to customers requirements.
2. In case that surface quality is strictly require, “E” will be attached at the end of the specification. Ex CSP1D-E
3. [ ] is only for reference.
4. In case of CSP3N and CSP3E, non-aging property is guaranteed for six months after shipment.
5. For steel less than 0.6mm in thickness, the tensile test shall generally be omited.
6. The specification with “*” require prior negotiation before ordering.
7. The tensile test: JIS No. 5 test pieces Rolling Direction. Bending test: No.3 test pieces Rolling Direction

SPECIFICATIONS

POSCO Specifications

Steel for Porcelain Enameling

: Thickness (mm)

Classification	Specifications	Thickness (mm)	Chemical Composition (wt %)			
			C	Mn	P	S
Porcelain Enameling	CESP - C	0.4 ~ 2.0	≤ 0.008	≤ 0.50	≤ 0.04	≤ 0.04

Elongation, Min. (%)				Test Piece
0.4 ~ 0.6	0.6 ~ 1.0	1.0 ~ 1.6	1.6 ~ 2.0	
38	40	41	42	JIS No.5 Rolling Direction

High Strength Cold Rolled Steel

: Thickness (mm)

Classification	Specifications	Thickness (mm)	Yield Point Min. (Mpa)	Tensile Strength Min. (Mpa)	Elongation, Min. (%)		
					0.4 ~ 0.6	0.6 ~ 1.0	1.0 ~ 1.6
Cold Rolled High Strength Steel Sheets and Coils	CHSP45C	0.4 ~ 2.0 mm	275	440	22	23	24
	CHSP35R		187	340	32	34	35
	CHSP40R		236	390	29	31	32
	CHSP38R		220	372	32	32	32
	CHSP45R		275	440	15	15	15
	CHSP35E-E		167	340	33	35	36
	CHSP38E-E		155	370	33	34	36
	CHSP38		155	370	35	37	37
	CHSP40E		206	390	30	32	33
	CHSP40E-E		206	392	30	32	33
	CHSP35E		245	440	-	29	31
	CHSP35ES		167	340	33	35	36
	CHSP35ES-E		167	340	33	35	36
	CHSP40ES		200	390	32	32	32
	CHSP220Y		220	340	28	28	28
	CHSP260Y		260	350	28	28	28
	CHSP300Y		300	380	22	22	22
	CHSP340Y		340	410	18	18	18
	CHSP380Y		380	460	18	18	18

Note

1. In case that surface rigid materials are being required on CHSP35E, CHSP40E. CHSP35E-E, CHSP40E-E are to be replaced instead of CHSP35E and CHSP40E
2. Chemical composition is subject to the agreement between manufacturer and customer.
3. If not specified, surface finishing shall be treated in dull finishing
4. Please enquire to technical staffs if you need other properties information such as bend ability, n, r, etc.

SPECIFICATIONS

JIS Specifications

JIS G 3141 Cold Rolled Steel Sheets.

Classification	Specifications	Temper Classifications		Chemical Composition (wt %) C	Mn	P	S	Tensile Strength (Mpa)
Commercial Quality (Class 1)	SPCC	Annealing Standard	A S	≤ 0.15*	≤ 0.60*	≤ 0.10*	≤ 0.05*	(270 ≤)
		1/8 Hard	8					-
		Hard	1					
Drawing Quality (Class 2)	SPCD	Annealing Standard	A S	≤ 0.12*	≤ 0.50*	≤ 0.040*	≤ 0.50*	≤ 0.12*
Deep Drawing Quality (Class 3)	SPCE	Annealing Standard	A S	≤ 0.12*	≤ 0.45*	≤ 0.030*	≤ 0.30*	≤ 0.12*
	SPCF	Annealing Standard	A S	≤ 0.08*	≤ 0.45*	≤ 0.030*	≤ 0.30*	≤ 0.08*
	SPCG	Annealing Standard	A S	≤ 0.02*	≤ 0.25*	≤ 0.020*	≤ 0.20*	≤ 0.02*

: Thickness (mm)

Elongation, Min (%) 0.25 ~ 0.30	0.30 ~ 0.40	0.40 ~ 0.60	0.60 ~ 1.0	1.0 ~ 1.6	1.6 ~ 2.0	Hardness HRB	HV
(28)	(31)	(34)	(36)	(37)	(38)	-	-
-						50 ~ 71	95 ~ 130
						85 ≤	170 ≤
30	33	36	38	39	40	-	-
32	35	38	40	41	42	-	-
-	-	40	42	43	44	-	-
-	-	42	44	-	-	-	-

Note:

1. Among the Class 1, the steel in annealed and normal tempering state is not applied to the value of tensile test. But if specified by customers [SPCCT], the value within [ ] can be applied.
2. The value with "*" are only for reference.
3. Normal tempering among Class 3, if guaranteed non-aging property by specification, shall be written as SPCEN by adding "N" at the end of the specification.
4. Tensile test is applied to steel more than 30mm in width.
5. For steel less than 0.6mm in thickness, the tensile test shall generally be omitted.
6. When the normal tempering steel in Class 3 are specified as "non-aging", they will have a six month "non-aging" guarantee after shipment
7. The Tensile test pieces: JIS: No.5 Rolling Direction. Bending test: No.3 Test pieces Rolling Direction.

SPECIFICATIONS

▶ ASTM A1008 Standards

ASTM Cold Roll Steel Sheets

Classification	Specifications	Chemical Composition (wt %)															Mechanical Properties * (Nonmadatory)**			
		C(%)	Mn(%)	P(%)	S(%)	Si(%)	Al(%)	Cu(%)	Ni(%)	Cr(%)	Mo(%)	V(%)	Cb(%)	Ti(%)	N(%)	B(%)	Yield Strength (Mpa)	Elongation Min (%)	r_m value	n value
Commercial Quality	A1008 CS Type A	≤ 0.1	≤ 0.6	≤ 0.025	≤ 0.035	-	-	≤ 0.2	≤ 0.2	≤ 0.15	≤ 0.06	≤ 0.008	≤ 0.008	≤ 0.025	-	-	140~275	30	-	-
	A1008 CS Type B	0.02~0.15	0.6	≤ 0.025	≤ 0.035	-	-	≤ 0.2	≤ 0.2	≤ 0.15	≤ 0.06	≤ 0.008	≤ 0.008	≤ 0.025	-	-	140~275	30	-	-
	A1008 CS Type C	≤ 0.08	0.6	≤ 0.1	≤ 0.035	-	-	≤ 0.2	≤ 0.2	≤ 0.15	≤ 0.06	≤ 0.008	≤ 0.008	≤ 0.025	-	-	140~275	30	-	-
Drawing Quality	A1008 DS Type A	≤ 0.08	0.5	≤ 0.02	≤ 0.02	-	0.01 ≤	≤ 0.2	≤ 0.2	≤ 0.15	≤ 0.06	≤ 0.008	≤ 0.008	≤ 0.025	-	-	150~240	36	1.3~1.7	0.17~0.22
	A1008 DS Type B	0.02~0.08	0.5	≤ 0.02	≤ 0.02	-	0.02 ≤	≤ 0.2	≤ 0.2	≤ 0.15	≤ 0.06	≤ 0.008	≤ 0.008	≤ 0.025	-	-	150~240	36	1.3~1.7	0.17~0.22
Deep Drawing Quality	A1008 DDS	≤ 0.06	0.5	≤ 0.02	≤ 0.02	-	0.01 ≤	≤ 0.2	≤ 0.2	≤ 0.15	≤ 0.06	≤ 0.008	≤ 0.008	≤ 0.025	-	-	115~200	38	1.4~1.8	0.20~0.25
Extra Deep Drawing Quality	A1008 EDDS	≤ 0.02	0.4	≤ 0.02	≤ 0.02	-	0.01 ≤	≤ 0.1	≤ 0.1	≤ 0.15	≤ 0.03	≤ 0.1	≤ 0.1	≤ 0.15	-	-	105~170	40	1.7~2.1	0.23~0.27

Note:

Where an ellipsis (-) appears in the table, there is no requirement, but the analysis result shall be reported

* These typical mechanical properties apply to the full range of steel sheet thicknesses. The yield strength tends to increase, the elongation decrease and some of the formability values tend to decrease as the sheet thickness decreases.

** The typical mechanical property values presented here are nonmandatory. They are provided to assist the purchaser in specifying a suitable steel for a given application. Values outside of these ranges are to be expected.

SIZE TOLERANCE

Thickness Tolerance

POSCO Specifications

Unit(mm)

Thickness \ Width	250 and over under 400	400 and over under 630	630 and over under 1,000	1,000 and over under 1,250	1,250 and over under 1,570
Under 0.25	± 0.030	± 0.030	± 0.030	± 0.030	-
0.25 and over under 0.40	± 0.035	± 0.035	± 0.040	± 0.040	-
0.40 and over under 0.60	± 0.040	± 0.040	± 0.050	± 0.050	± 0.060
0.60 and over under 0.80	± 0.045	± 0.045	± 0.060	± 0.060	± 0.060
0.80 and over under 1.00	± 0.050	± 0.050	± 0.060	± 0.070	± 0.080
1.00 and over under 1.25	± 0.050	± 0.060	± 0.070	± 0.080	± 0.090
1.25 and over under 1.60	± 0.060	± 0.060	± 0.090	± 0.100	± 0.110

KS, JIS Specifications

Unit(mm)

Thickness \ Width	Under 630	630 and over under 1,000	1,000 and over under 1,250	1,250 and over under 1,570
Under 0.25	± 0.030	± 0.030	± 0.030	-
0.25 and over under 0.40	± 0.040	± 0.040	± 0.040	-
0.40 and over under 0.60	± 0.050	± 0.050	± 0.050	± 0.060
0.60 and over under 0.80	± 0.060	± 0.060	± 0.060	± 0.070
0.80 and over under 1.00	± 0.070	± 0.070	± 0.080	± 0.090
1.00 and over under 1.25	± 0.080	± 0.080	± 0.090	± 0.100
1.25 and over under 1.60	± 0.090	± 0.090	± 0.110	± 0.120

Width Tolerance

POSCO Specifications, KS, JIS, Specifications

Unit(mm)

EDGE TYPE	Width	Tolerance
MILL EDGE	Under 1,250	+ 7.0
	1,250 and over	+10.0
SLIT EDGE	Under 1,250	+ 3.0
	1,250 and over	+ 4.0

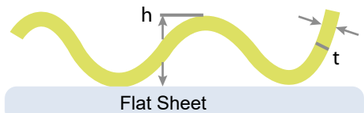
Note: F/H – Only Mill Edge possible

Maximum Flatness

POSCO Specification, KS, JIS Specification

Unit(mm)

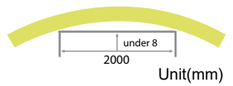
Width \ Classification	WAVE	EDGE	CENTER
Under 1,000	12(2)	8(2)	6(2)
1,000 and over under 1,250	15(3)	10(2)	8(2)
1,250 and over under 1,570	15(4)	12(3)	9(2)



*Flatness = h-t

Note:
1. In principle, the value within [ ] are applied to steel drawn by stretcher leveler.
2. Flatness is measured on a flat table. Flatness is the value except thickness of the steel from the maximum value of transformation.

Maximum Camber



POSCO Specifications

Unit(mm)

Width \ Classification	Coil
under 600	4/2000 for arbitrary length
600 and over	2/2000 for arbitrary length

Note: It is not applicable to abnormal parts of steel.

KS, JIS Specifications

Unit(mm)

Width \ Classification	Coil
30 and over	8/2000 for arbitrary length
60 and over 600	4/2000 for arbitrary length
600 and above	2/2000 for arbitrary length

Note:
1. It is not applicable to abnormal parts of steel.
2. Camber means bending from right and left against rolling direction and is estimated as show above.

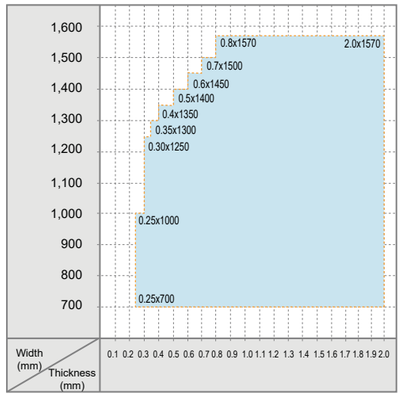
AVAILABLE DIMENSIONS

The available sizes are subject to change.
Please consult with POSCO-VIETNAM contact person before ordering.

Mild Cold Rolled

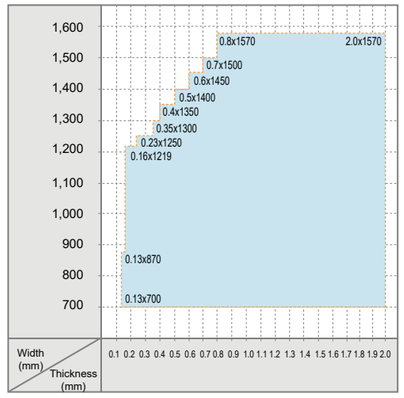
CR

CQ, DQ

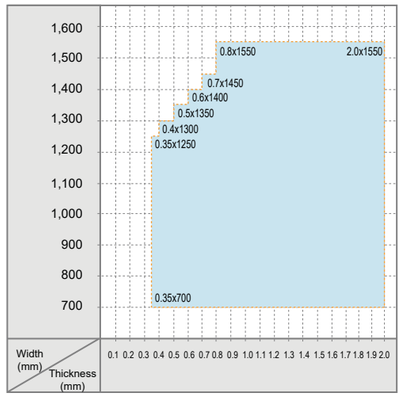


FH

CQ (Full Hard)

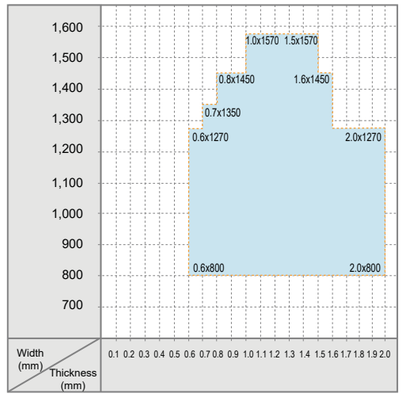


DDQ, EDDQ

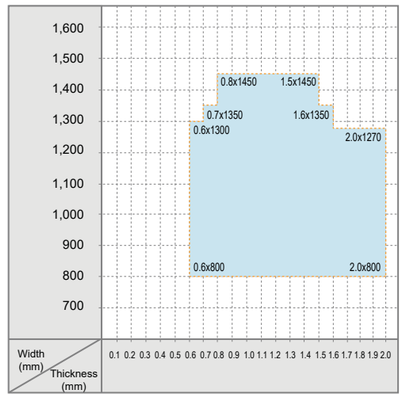


High Strength Cold Rolled Steel

HSS 40C,R,E



HSS 35YS



SURFACE FINISHES AND OILING

Surface Finishes DULL

Dull finish, which is attained by attaching numerous fine grains onto the steel surface, is often called pear-skin finish or ‘ egg-shell texture’.

The grains are made by EDT method (Electro Discharge Texturing). The dull finish is useful in drawing because lubricant oil can be evenly spread over the entire surface, thereby reducing the possibility of friction. The fine grains also help boost paint adherence and extend the steel life span.

Dull Finish Ra (μm)		
E5	E7	E9
1.00 ~ 1.80	0.70 ~ 1.30	0.40 ~ 0.80

Note: We do not guarantee in F/H Product

Oiling

It is recommended that customers use product promptly to avoid the possibility of rusting during storage or shipment. Customers can choose kind of oil and quantity.

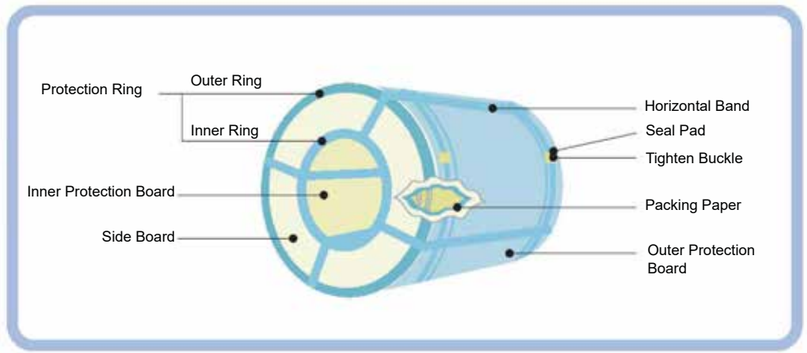
Oiling improves corrosion resistance but cannot be perfect way to protect products from rust. Also, non-oiled and DOS oiled products are easy to rusting so., POSCO strongly recommend to apply with general oil and use the products as soon as possible.

Classification	CODE	Oiling weight (mg/m^2), both sides standard
Normal, HEAVY	AH	3,000 ~ 4,500
Normal, GENERAL	AG	1,800 ~ 3,000
Normal, LIGHT	AL	800 ~ 1,800
DOS-A	BD	80 ~ 140
DOS-A	BS	40 ~ 80
DOS-A	BU	10 ~ 25

Note: We do not guarantee in F/H Product

PACKING / MARKING

Coil



Precautions in Use

Please be cautious of the following matters while using cold rolled steel sheets in oder to maintain the characteristics as they are.

- Keep products away from moist or wet places and where and there is sharp fluctuations in temperature. Store products in a well-ventilated place and repair packing if broken or damaged while storing.
- Dry the storing place immediately in case that moisture or water smeared in it.
- Be careful not to damage surface while transporting or working.
- Pay attention to working environments. Workability may not be good under environments of high temperatures, strong sulfuric acid gas or extreme smoke.
- Product quality may change and the period or product durability may be shortened if they are worked near a stove pipe where the temperature is very high. Such place of high temperatures should be avoided.
- Maintain the shortest stocking period as possible.

※ We POSCO-VIETNAM have various packing type. So, please consult with POSCO-VIETNAM contact person before ordering.

Marking

Label


FULL HARD COIL
FH
CUSTOMER
LILAMA HANOI JSC COMPANY
SPEC
JIS G3141 SPCC-1
SIZE
0.47X1142XC
NET WT 22000 Kg
GR WT 22036 Kg
PROD. NO.
97A00103
FINAL DESTINATION
HAIPHONG
PO NO.
GRADE 1
DATE 2009.02.05
DCB3A
POSCO-VIETNAM.CO
Made in Vietnam
posco

Marking Label


FULL HARD COIL
JIS G3141 SPCC-1
0.47X1142XC
22000 Kg
22036 Kg
Made in Vietnam
posco

Inspection Card


INSPECTION CARD
COMMODITY FULL HARD COIL
SPEC JIS G3141 SPCC-1
SIZE 0.47X1142XC
NET WT 22000 Kg
INSP.NO. 97A00103
DATE 2009.02.05 DCB3A
PO NO.
LENG 6562 M
WELD.P. NO WELD
OILING YY POST.T
COAT.WT
GRADE 1
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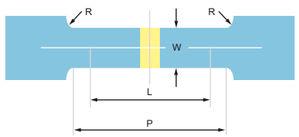
TESTING METHODS



P=Parallel Body Length=around 60mm
L= Gauge Length
W=Width
R= Shoulder Radius=15mm

Tensile Test

A tensile test is a basic testing method to measure the yield point, the tensile strength and the elongation of a steel sheet. In case of a usual tensile test, some load is increased until the test piece is broken while some load is added to a fixed test piece.

Test Piece

The kind and sizes, etc. of test pieces are specified in all of the specifications, such as KS, JIS and ASTM, etc. in order for you to prepare for test a tensile test. In case of a cold-rolled steel sheet, a way of selecting a test piece, which is specified in KS B 0801 No.5, is generally used.

Results from a Tensile Test

The results from a tensile test are used as the most basic standards to judge the workability and formability.

- **Elongation (El)**
  The higher the elongation is, the better the formability is

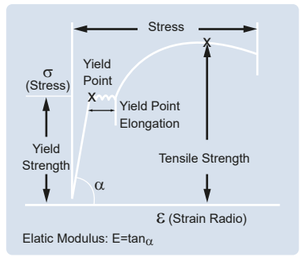
- **Yield Point (YP)**
  The lower the yield point is, the better the shape of a final product is.

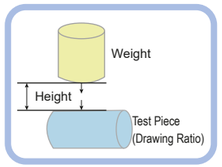
- **Yield Ratio (Yield Point/Tensile Strength, YR)**
  The lower the yield ratio is, the wider the gap between the yield point and the tensile strength is, and the wider the gap is, the better the shape freezing property of a steel sheet is when it is processed at the same strength level.

- **Elastic Modulus (E)**
  An elastic modulus is inversely proportional to the inverse elasticity of a steel sheet. The lower the inverse elasticity is, the better the shape of a final product is.

- **Working Hardening Exponent (n)**
  When some stress is put onto materials, a deformed part becomes hard in order for it to be constrained not to be deformed more and the force of deformation is spread to the other un-deformed parts in order for the whole parts of a material to be deformed evenly. Since the bigger the work hardening exponent is, the quicker and the evener the spread of deformation becomes, such kind of material is considered as the one with a good formability.

- **Plastic Deformation Factor(r) :** $\frac{\ln w_o/w}{\ln t_o/t}$ (wo, w=width before or after a test; to, t=thickness before or after a test)
  The reduction ratio of the part in the thickness-wise direction is inversely proportional to the r_{value} , and the reduction ratio of the part in the width-wise direction is proportional to the r_{value} if the material has big r_{value} it is strong against crack and good drawing.





DBTT (Ductile to Brittle Transition Test) Method

- Test flow: Cup forming (Blanking, Punching) → test temperature variety → drop weight test → Slit ruin observation (transition temperature is the temperature that slit ruin is not occurred)
- DBTT Rating Test Condition

Classification	Detail	Test Condition	Classification	Detail	Test Condition
Forming Condition	Blank Dia.(mm) Punch Dia. (mm) Punch Type Drawing Ratio	96 50 Flat Cup 1,92	Drop Weight Test	Load(kgf) Drop Height(m) Weight Type Test Pieces Position	4.44 0.99 Cylinder Type Laid on to the Side

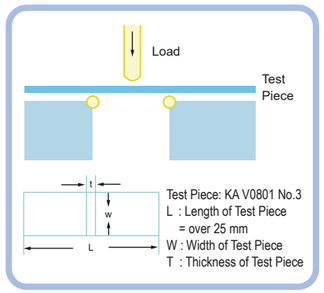
※ Drawing Ratio Range [1.7~2.16]: Blank Dia 85mm (1,7) ~ 108mm (2.16).

Bending Test

The bend test is used judging the deformability [ductility] of the steel sheet, and is primarily conducted as follow: KS B 080 No.3 test specimens are used in the bend test for cold rolled steel sheet. In the bend test, the specimen is bent through a specified angle with a mandrel or a specified radius. Then the ductility of the sheet is judged by whether or not the specimen cracks on the outside of the bent portion. In the case of cold rolled sheet, the specimen is to be bent flat on itself through 180 degree.

Hardness Test

The hardness of steel bears a certain relation to its other properties such as strength, wear resistance and drawability. Therefore, the hardness test often employed to judge those other properties because measures the characteristics of given steel sample comparatively.



Rockwell Hardness Test

In this test, a hard steel ball is forced into surface of the test specimen, first under a fixed minor load and than under a major load. On remove the major load, the permanent depth of impression is measure, and a number derived form the net increase in the depth of impression in the two operations is read directly on the Rockwell hardness B- scale and Rockwell superficial hardness 30T-scale. The B-scale is based on a steel ball 1/16 in. [1.558 mm] in diameter and a 100kg test-load. The 30T-scale consists of a 30kg test load and a steel ball of the same diameter. The B-scale is highly dependable when the test specimen is 0.762mm [0.030in] or thicker. For thicknesses less than 0.762mm, therefore, use of the 30T-scale is recommended.

APPENDIX

Cold Rolled Weight Table [unit: kg]

: mm : feet

Thickness (mm)	Width*Length / Unit Weight (kg/m²)	762x1829	762x2438	762x3048	914x1829	914x2438	1219x3048	1219x1829	1219x2438	1219x3048
		2.5x6	2.5x8	2.5x10	3x6	3x8	3x10	4x6	4x8	4x10
0.23	1.806	2.52	3.36	4.20	3.02	4.02	5.03	4.06	5.37	6.71
0.25	1.963	2.74	3.65	4.56	3.28	4.37	5.47	4.38	5.83	7.29
0.26	2.041	2.85	3.79	4.74	3.41	4.55	5.69	4.55	6.07	7.58
0.29	2.276	3.17	4.23	5.29	3.81	5.07	6.34	5.08	6.76	8.46
0.30	2.355	3.28	4.38	5.47	3.94	5.25	6.56	5.25	7.00	8.75
0.32	2.512	3.50	4.67	5.84	4.20	5.60	7.00	5.60	7.47	9.33
0.35	2.748	3.83	5.11	6.38	4.59	6.12	7.66	6.13	8.47	10.2
0.40	3.140	4.38	5.85	7.29	5.25	7.00	8.75	7.00	9.33	11.7
0.45	3.532	4.92	6.56	8.20	5.91	7.87	9.84	7.88	10.5	13.1
0.50	3.926	5.47	7.29	9.12	6.56	8.74	10.9	8.75	11.7	14.6
0.55	4.318	6.02	8.02	10.0	7.22	9.62	12.0	9.63	12.8	16.0
0.60	4.710	6.57	8.75	10.9	7.88	10.5	13.1	10.5	14.0	17.5
0.70	5.120	7.11	9.48	11.9	8.53	11.4	14.2	11.4	15.2	19.0
0.75	5.495	7.66	10.2	12.8	9.19	12.2	15.3	12.3	16.3	20.4
0.80	5.888	8.21	10.9	13.7	9.84	13.1	16.4	13.1	17.5	21.9
0.80	6.280	8.75	11.9	14.6	10.5	14.0	17.5	14.0	18.7	23.3
0.85	6.672	9.30	12.4	15.5	11.2	14.9	18.6	14.9	19.8	24.8
0.90	7.065	9.85	13.1	16.4	11.8	15.7	19.7	15.8	21.0	26.3
0.95	7.458	10.4	13.9	17.3	12.5	16.6	20.8	16.6	22.2	27.7
1.00	7.850	10.9	14.6	18.2	13.1	17.5	21.9	17.5	23.3	29.2
1.20	9.420	13.1	17.5	21.9	15.8	21.0	26.2	21.0	28.0	35.0
1.40	10.99	15.3	20.4	25.5	18.4	24.5	30.6	24.5	32.7	40.8
1.60	12.56	17.5	23.3	29.2	21.0	28.0	35.0	28.0	37.3	46.7
1.80	14.13	19.7	26.3	32.8	23.6	31.5	39.4	31.5	42.0	52.5
2.00	15.70	21.9	29.2	36.5	26.2	35.0	43.7	35.0	46.7	58.3

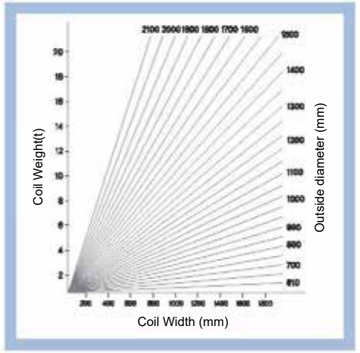


Diagram of relationship between Coil Widths, Outer Diameters and Weight

Note: this graph was determined by calculating the parameters of the steel in 20 inches [508mm] of length and having its main component at a space factor of 100%.

Hardness Conversion Table

Rockwell Hardness			Vickers Hardness HV	Brinell Hardness HB(10/500)	Rockwell Hardness			Vickers Hardness HV	Brinell Hardness HB(10/500)
B	F	30-T			B	F	30-T		
100	113.3	80.8	235	202	55	88.1	51.9	100	89
99	112.7	80.1	229	195	54	87.5	51.3	99	87
98	112.1	79.5	224	193	53	87.0	50.7	98	86
97	111.6	78.9	218	184	52	86.5	50.0	96	85
96	111.0	78.2	214	179	51	85.9	49.4	95	84
95	110.5	77.6	209	175	50	85.3	48.7	94	83
94	109.9	76.9	205	171	49	84.8	48.1	93	82
93	109.3	76.3	200	167	48	84.2	47.5	92	81
92	108.8	75.7	196	163	47	83.7	46.8	91	80
91	108.2	75.0	192	160	46	83.1	46.2	90	79
90	107.7	74.4	188	157	45	82.5	45.5	89	79
89	107.1	73.7	184	154	44	82.0	44.9	88	78
88	106.6	73.1	180	151	43	81.4	44.3	87	77
87	106.0	72.4	176	148	42	80.9	43.6	86	76
86	105.4	71.8	173	145	41	80.3	43.0	85	75
85	104.9	71.2	170	142	40	79.8	42.3	84	75
84	104.3	70.5	166	140	39	79.2	41.7	83	74
83	103.8	69.9	163	137	38	78.6	41.1	82	73
82	103.2	69.2	160	135	37	78.1	40.4	81	72
81	102.6	68.6	156	133	36	77.5	39.8	80	72
80	102.1	68.0	154	130	35	77.0	39.1	80	71
79	101.5	67.3	150	128	34	76.4	38.5	79	70
78	101.5	66.7	147	126	33	75.8	37.9	78	69
77	100.4	66.0	145	124	32	75.3	37.2	78	69
76	99.9	65.4	142	122	31	74.7	36.6	77	68
75	99.3	64.8	140	120	30	74.2	35.9	77	67
74	98.7	64.1	137	118	28	73.1	34.6		66
73	98.2	63.5	134	116	26	71.9	33.4		65
72	97.6	62.8	132	114	24	70.8	32.1		64
71	97.1	62.2	129	112	22	69.7	30.8		63
70	96.5	61.6	127	110	29	68.6	29.5		61
69	95.9	60.9	125	109	18	67.5	28.2		60
68	95.4	60.3	123	107	16	66.4	27.0		59
67	94.8	59.6	120	106	14	65.2	25.7		59
66	94.3	59.0	119	104	12	64.1	24.4		58
65	93.7	58.4	117	102	10	63.0	23.1		57
64	93.2	57.7	115	101	8	61.9	21.8		86
63	93.6	57.1	113	99	6	60.8	20.6		55
62	92.0	56.4	111	98	4	59.7	19.3		55
61	91.5	55.8	109	96	2	58.5	18.0		54
60	90.9	55.2	107	95	0	57.4	16.7		53
59	90.4	54.5	106	94					
58	89.8	53.9	104	92					
57	89.2	53.2	103	91					
56	88.7	52.6	102	90					

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