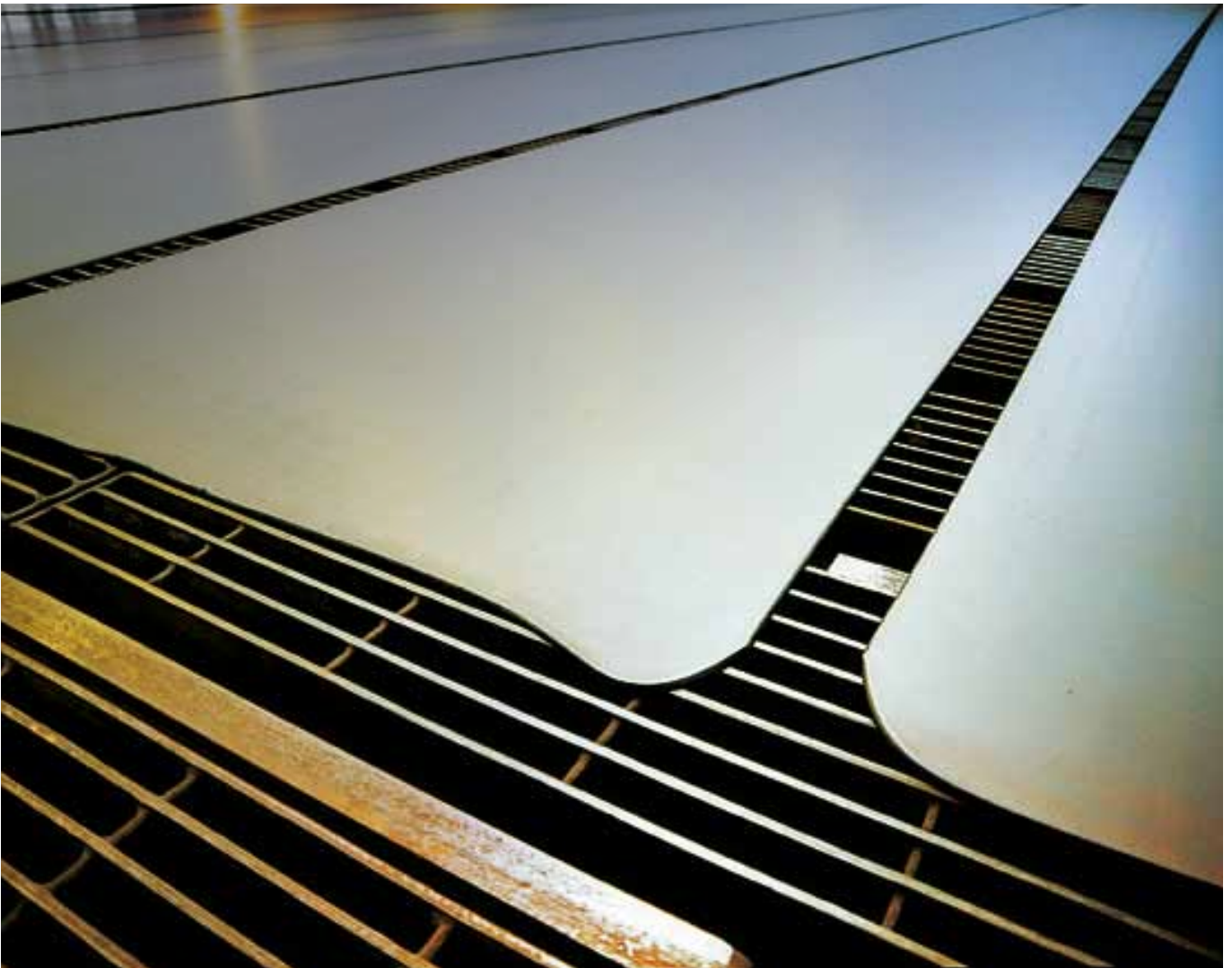


STEEL PLATES





Contents

Introduction: Pohang, Gwangyang Works	4
POSCO Profile	6
R&D System	8
Manufacturing Process	10
Quality Management System	12
Shipbuilding	
Approved Steel Grades	15
Chemical Composition & Mechanical Properties	16
Development of New Products	17
Offshore	
Available Steel Grades	20
Mechanical Properties - CTOD	21
Mechanical Properties - Others	22
Guaranteed Supplementary Requirement	24
Main Supply Records	25
API Steels for Line Pipe	
Available Sizes : HRC Products	27
Available Sizes : Plate Products	28
Main Supply Records	29
Testing and Evaluation Methods	30
Pressure Vessel	
Available Steel Grades	33
Characteristics (non-HIC guaranteed)	34
Characteristics (HIC guaranteed)	35
Supplementary Requirement	36
9%Ni Steel	37
High Mn Cryogenic Steel	38
Testing and Evaluation Methods	42
Structure & Construction	
Available Steel Grades	45
Steel Plate for Construction Structure	46
SN Steel for Building Structure	47
PILAC Steel for Building Structure	49
HSB Steel for Bridge Structure	50
Additional Guaranteed Quality	51
EN10025 Structural Steel	52
Steel Plate for Mechanical Structure	53
Abrasion-Resistant Steel	54
High Strength Steel for Welded Structure (POSTEN)	55
TMCP Steel	56
List of Mechanical Test	58
Marking	59
Mill Test Certificate	60
Available Dimensions	62
Global Sales Network	72

STEEL PLATES

Introduction: Pohang, Gwangyang Works



Pohang Works

MAJOR PRODUCTS

Hot-Rolled Products

automobile frames and wheels, shipping containers, steel pipes

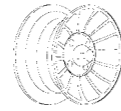


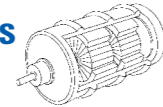
Plate Products

marine vessels and structures, bridges, building structures



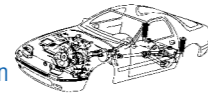
Electrical Steel Products

electric motors and transformer cores



Cold-Rolled Products

automobiles, home appliances, machinery, construction



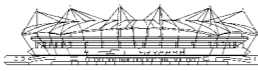
Wire Rod Products

fasteners, wire ropes, undersea cables



Stainless Steel Products

automobile exhaust systems, kitchenwares, walls/roofings



POHANG WORKS

Major Products: Hot-rolled steel, plate, cold-rolled steel, wire rod, electrical steel, STS, API steel, etc.

Crude Steel Production: 16,185,000 tons (2013)

Manufacturing Focus: Flexible short-run.

GWANGYANG WORKS

Major Products: Hot-rolled steel, cold-rolled steel, automotive steel, API steel, plate, etc.

Crude Steel Production: 20,231,000 tons (2013)

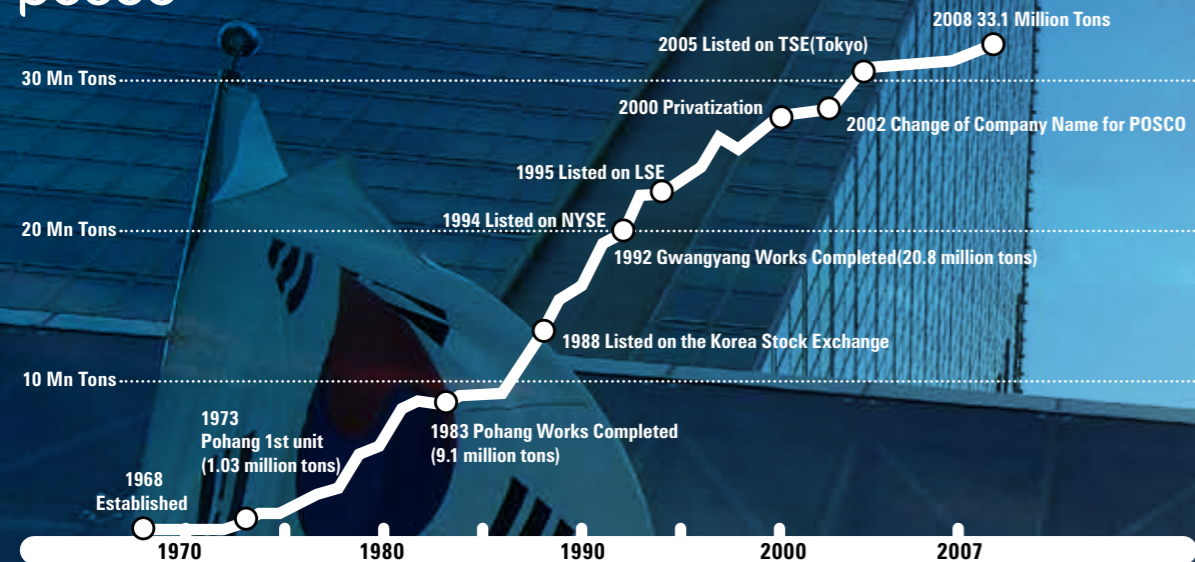
Manufacturing Focus: Dedicated long-run



Gwangyang Works

POSCO is a leading global steel company

posco Brief History



RANKED 1ST IN COMPETITIVENESS (WORLD STEEL DYNAMICS, FEB 2013)

Rank	Company	Score	Production (mn ton)	Criteria
1	POSCO	7.76	39.9	Tech. Innovation, Conversion Cost
2	NLMK	7.33	14.9	High Growth Market, Raw Material
3	Severstal	7.32	15.1	Raw Material, Labor Costs
4	JSW Steel	7.23	8.5	Expanding Capacity, Labor Costs
5	Nippon Sumitomo	7.15	47.9	Value-added product mix, Conversion cost; yields

* Weighted-Average Score based

2011 MOST ADMIRABLE METALS COMPANY (FORTUNE, MAR 2011)

GLOBAL OPERATIONS

USA	JV with US Steel in 1.5mtpa CR mill JV with US Steel and SeAH to produce API pipes
Mexico	New automotive steel sheet plant in June 2009
China	82.5% interest in ZPSS with a capacity of 0.8mtpa(STS) 80.0% interest in QPSS with a capacity of 0.2mtpa(STS)
India	Construction of integrated steel mill and iron ore mines in Orissa State CR mill with a capacity of 1.8mtpa CGL mill with a capacity of 0.3mtpa
Indonesia	JV with Krakatau Steel Construction of Integrated steel mill with a capacity of 6mtpa
Vietnam	CR mills with a capacity of 1.2mtpa
Turkey	Construction of STS CR mill a with capacity of 0.2mtpa
Korea	<Pohang Works> Capacity of 15.0mtpa <Gwangyang Works> Capacity of 18.0mtpa

STEEL PLATE HISTORY

POHANG WORKS

Jul. 1972	Plate Mill 1 / Pohang Works completed
Feb. 1978	Plate Mill 2 / Pohang Works completed
Nov. 1988	Plate Mill 2 Accelerated Cooling Control Facilities completed
Jun. 1990	Production of STS plate began
Sep. 1997	Plate Mill 3 / Pohang Works completed
Jul. 2001	ERP(Enterprise Resource Planning) introduced
Nov. 2003	Plate Mill 3 Accelerated Cooling Control Facilities completed
Jun. 2005	Revamping of Plate Mill 2 completed

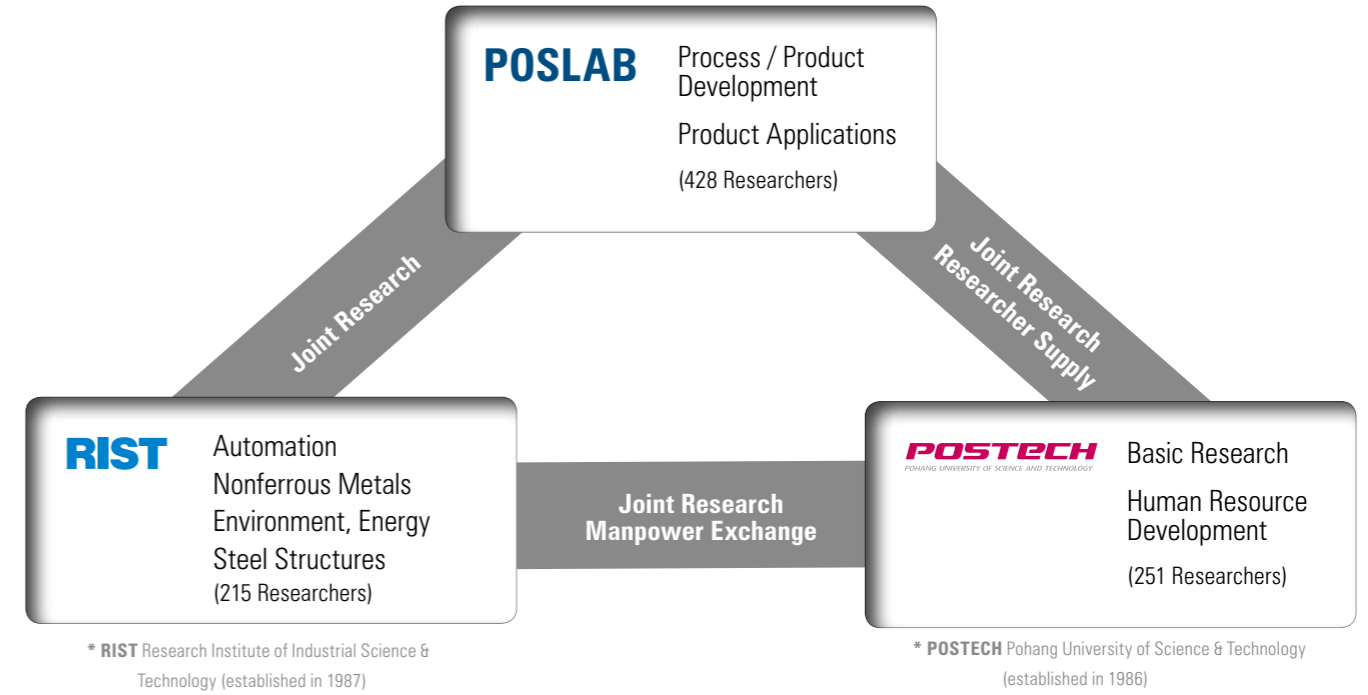
GWANGYANG WORKS

Aug. 2010	Plate Mill completed
Jul. 2011	Heat Treatment Equipment completed

During the period of economic downturn, POSCO increased its R&D investments to enhance its competitiveness of key products in preparation for business recovery in the global market



Organization



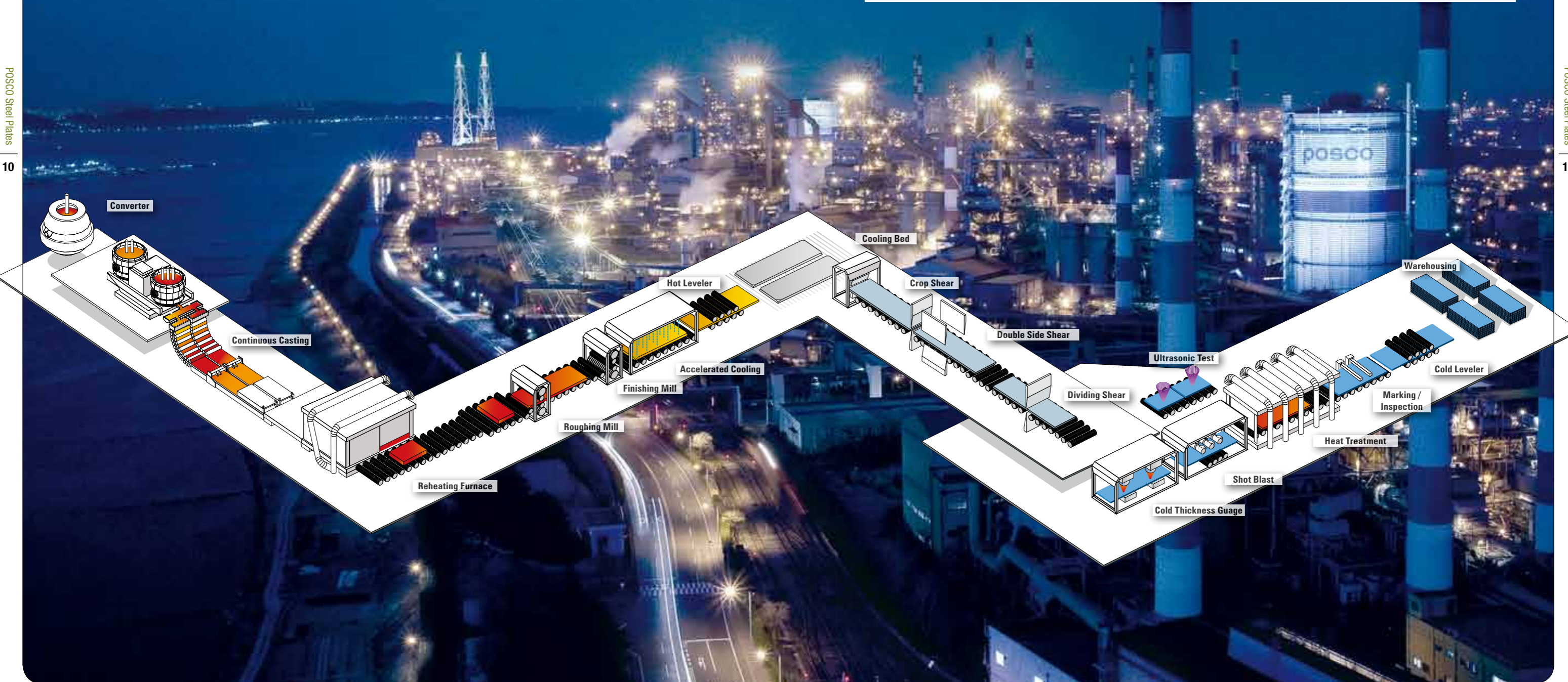
Goal : Joint research and nurturing of outstanding researchers based on industry-university-institute collaboration

Testing Facilities

Instrumented Charpy Impact Tester	Evaluation of Brittle Crack Initiation Resistance
Instrumented DWTT Tester (Drop Weight Tear Test)	Evaluation of Brittle Crack Propagation Resistance
Large Tensile Test Machine	Large Scale Tension or Compression Test
Automatic Macro Etching System	Evaluation of Internal Defects of Cast Products
High Temp. High Pressure Corrosion Test System	Qualifying of CO ₂ or H ₂ S Corrosion Properties of Linepipe Steel under HT/ HP
Ultrasonic Test System	Non-destructive Detection of Defects and Flaws in Metal
Hydrogen Induced Cracking Test System	Evaluation of the Hydrogen Induced Cracking Resistance of Plate/Pipe
Sulfide Stress Corrosion Cracking Test System	Evaluation of the Sulfide Stress Corrosion Cracking Resistance of Plate/Pipe

POSCO produces a variety of steel plates with the state-of-the-art facilities

Facilities	Pohang Works			Gwangyang Works
	Plate Mill 1	Plate Mill 2	Plate Mill 3	Plate Mill 4
Operation	Jul. 1972	Feb. 1978	Nov. 1997	Aug. 2010
Capa'(ton/y)	620,000	2,700,000	1,180,000	2,500,000
Thickness(mm)	6~120	6~200	4.5~200	8~200
Max. Width(mm)	3,100	4,500	4,000	5,300
Max. Length(mm)	15,500	25,000	25,000	25,000
Max.(Net Weight)	-	25ton	-	28ton
Mill Power	3,600ton X 1	7,200ton x 1(RM) 9,000ton x 1(FM)	8,000ton X 1	12,000ton X 2
Accelerated Cooling Control System	-	Multi Jet Type (4.7m x 28m)	Multi Jet Type (4.2m x 24m)	Multi Laminar Jet Type (5.5m x 24m)
Mechanical Shear	-	50mmt	-	50mmt/Slitter
UT	Transverse Tester(SMT)	Transverse Tester(SMT)	Transverse Tester(SMT)	Longitudinal Tester (NDT)
Heat Treatment Equipment	-	NQT x 1, Nor' Only x 1 (400,000ton) Batch(30,000ton)	Nor' Only x 1 (200,000ton)	NQT x 1 (200,000ton, Oct. 2011) Batch(30,000ton)
Main Product	Mild Steel	High Strength Steel (TMCP, Nor', QT)	High Strength Steel (TMCP, Nor')	High Strength Steel (TMCP, Nor', QT)





POSCO guarantees quality products under its well-organized production system

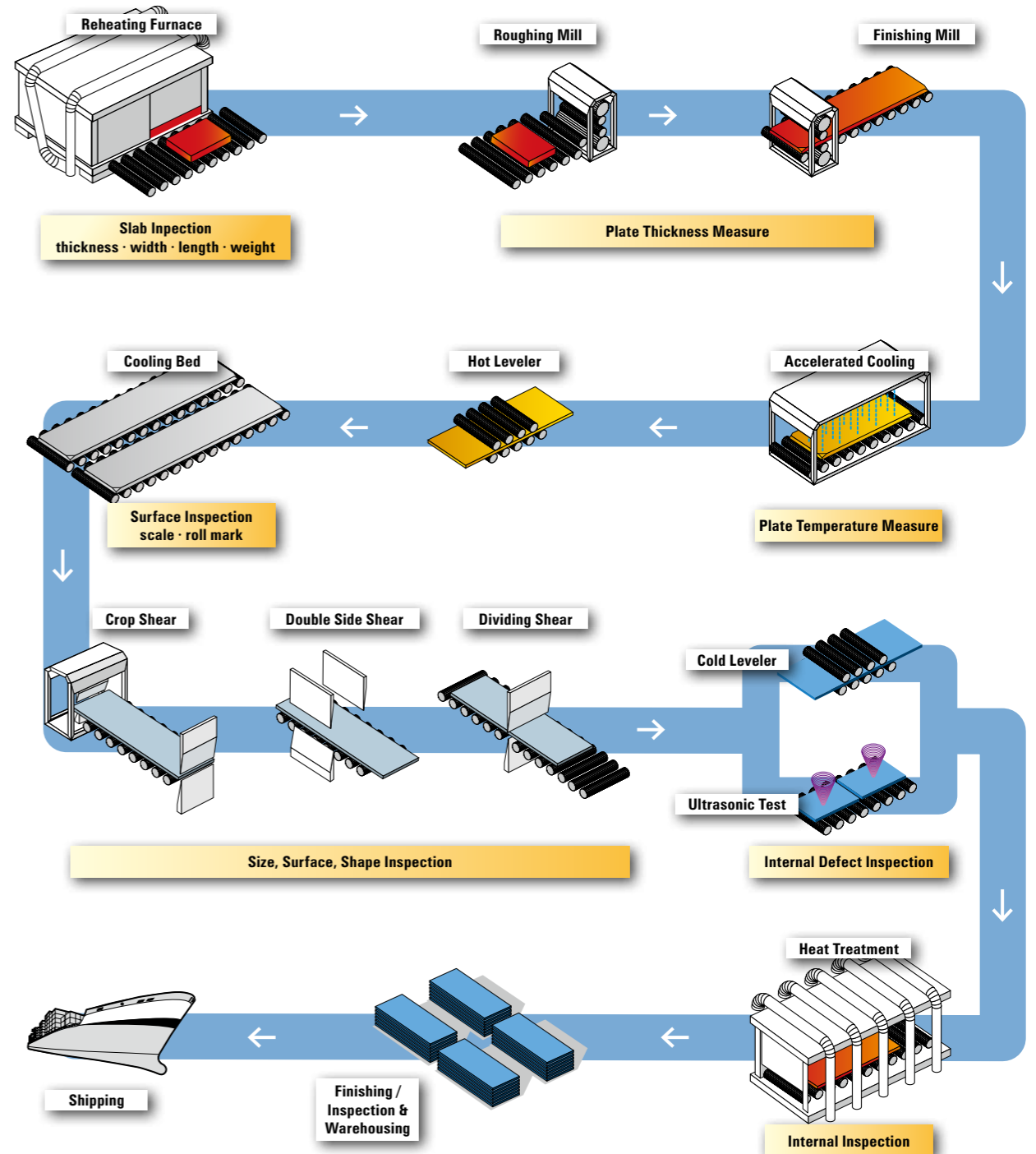
Certification of Quality Management System

	Application Product	Institute	Renewal
ISO9001	Flat Product	LRQA(UK)	Every year Regular Inspection Every 3 years, Certificate renewal
ISO14001	Environmental Management System	LRQA(UK)	Every year Regular Inspection Every 3 years, Certificate renewal

Certification of compliance of the quality system with ISO 9001, 14001



Inspection Flow of Steel Plate





Steel Plate for Shipbuilding

POSCO produces mild and high strength steel approved by 11 classification societies

POSCO has provided the global Big 3 shipyards with all the required steel as main supplier

Approved Steel Grades

Unit: max. thickness(mm)

Grade Classification Society	Non-TMCP		TMCP				Low Temperature Service Different Standards per CS
	Normal Strength	High Strength	Normal Strength	High Strength		Low Temperature Service	
	A,B,D,E	AH32~EH32 AH36~EH36	A,B,D,E	AH32~EH32 AH36~EH36	AH40~EH40		
KR(Korea)	100	83	100	100	100	80	RL37 (50)
ABS(USA)	100	83	100	100	100	80	VH-060 (50)
LR(UK)	100	90	100	100	100	80	LTFH36 (50)
DNV(Norway)	100	90	100	100	100	80	NV4-4 (50)
NK(Japan)	100	83	100	100	100	80	KL37 (40)
GL(Germany)	100	90	100	100	100	80	-
BV(France)	100	90	100	100	100	80	510LF (40)
CR(Taiwan)	100	90	100	100	100	-	-
RINA(Italy)	100	90	100	100	100	-	460LE/LF (40)
CCS(China)	100	90	100	100	100	-	-
RS(Russia)	100	100	100	100	100	-	-

Please contact us for more details before ordering EH47 or steel for low temperature service.

Chemical Composition & Mechanical Properties

Unit: weight percent(%)

Grade	Normal Strength				High Strength	
	A	B	D	E	AH~EH32~40	EH47
C	≤ 0.21	≤ 0.21	≤ 0.21	≤ 0.18	≤ 0.18	≤ 0.10
Mn	> 2.5xC	> 0.80	> 0.60	> 0.70	0.90~1.60	≤ 2.00
Si	≤ 0.50	≤ 0.35	≤ 0.35	≤ 0.35	≤ 0.50	≤ 0.55
P	≤ 0.035	≤ 0.035	≤ 0.035	≤ 0.035	≤ 0.035	≤ 0.030
S	≤ 0.035	≤ 0.035	≤ 0.035	≤ 0.035	≤ 0.035	≤ 0.030
Cu	-	-	-	-	≤ 0.35	≤ 0.35
etc ¹⁾	Cr, Ni, Mo, S-Al, Nb, V, Ti Added					

1) One or more grain refining elements should be added(Al, Nb, V and others)
Ceq AH32~EH32 ≤ 0.38, AH36~EH36 ≤ 0.40, AH40~EH40 ≤ 0.42

Grade	Yield Point (MPa)	Tensile Strength (MPa)	Elongation(%) 5.65√S ₀	Average Absorbed Energy Longitudinal(Joule)		
				t ≤ 50	50 < t ≤ 70	70 < t ≤ 100
A, B, D, E	≥ 235	400~520	≥ 22	≥ 27	≥ 34	≥ 41
AH~EH32	≥ 315	440~570 (440~590) ¹⁾	≥ 22	≥ 31	≥ 38	≥ 46
AH~EH36	≥ 355	490~630	≥ 21	≥ 34	≥ 41	≥ 50
AH~EH40	≥ 390	510~660	≥ 20	≥ 39	≥ 46	≥ 55
EH47	≥ 460	570~720	≥ 17	≥ 64		

1) ABS, CCS, LR, NK

Development of New Product

Development of High Strength Steel

■ **Background** : As the size of containership has been increased, high strength steel is required to obtain structural integrity and weight reduction.

■ Target

Products	Thickness(mm)	Requirements
EH47-TM	80	-10°C CTOD, -40°C HAZ toughness, high strength
EH40-TM for high heat input welding	80	Tandem EG welding over 500KJ/cm
AH40-TM for high strength stiffener	80	Distortion after cutting (≤ 1mm/m, ≤ 10mm in whole length)

■ Mechanical Properties

EH47-TM		Specification
Plate	Yield Strength(MPa)	≥ 460
	Impact Toughness(J)	≥ 54
	CTOD(mm)	≥ 0.38
	Kca(N/mm ^{1.5})	≥ 6,000
Welded Joint	Tensile Strength(MPa)	≥ 570~720
	HAZ Toughness(J, -40°C)	≥ 54
	Preheating Temperature(y-groove, °C)	≤ 75
	HAZ CTOD(mm)	≥ 0.38

EH40-TM for high heat input welding		Specification
Plate	Yield Strength(MPa)	≥ 390
	Tensile Strength(MPa)	510~660
	Impact Toughness(J, -40°C)	≥ 55
Welded Joint	Tensile Strength(MPa)	510~660
	HAZ Toughness(J, -40°C)	≥ 47

AH40-TM for high strength stiffener		Specification
Plate	Yield Strength(MPa)	≥ 390
	Tensile Strength(MPa)	510~660
	Impact Toughness(J, 0°C)	≥ 55
Distortion	50t×3000W×15000L (Cutting Width 500mm, mm)	≤ 10
Characteristic	80t×2500W×10000L (Cutting Width 800mm, mm)	≤ 10

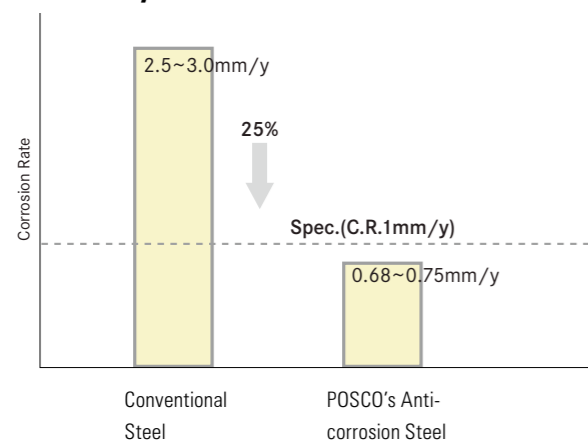
Please contact us for more details.

Development of New Products

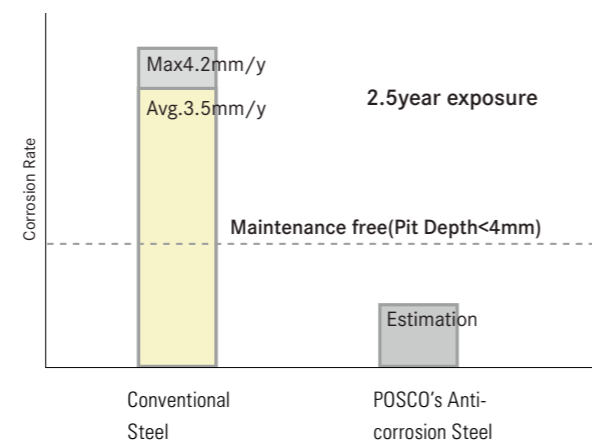
Corrosion resistant steel

- **Overview :** Maintenance and repair is not required for this corrosion resistant steel, even though it is applied to the bottom and deck plate of cargo oil tanker without coating.
(An alternative to coating process omission)
- **Concept :** Enhancement of corrosion resistance by optimization of alloy composition.
- **Corrosion Properties (10%NaCl Solution, pH0.85, 30°C, 144 hours digestion)**

■ Laboratory Test



■ On Board Test



■ Welded Joint

Welding condition and consumable : Equivalent to general AH32 grade steel

■ On-board test

Ship : 157,000 DWT Cargo Oil Tanker

Participants : POSCO, DSME, SOVCOMFLOT, DNV

Test Schedule : Start on Sep. 11th, 2009. Analyze 1st specimen 3 years later / Analyze 2nd specimen 5 years later.

Steel Plate for Offshore Structure

Steel plates for offshore structure are used to manufacture facilities for exploration, drilling, production and storage of crude oil and natural gas and marine structures such as offshore windmill, tide power plan and pipe laying vessel



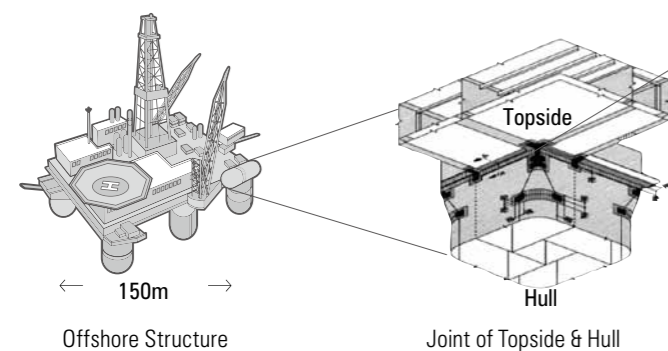
Offshore structure has been used for over 30 years without repair, so one brittle crack can be a significant threat to the structure. Hence steel plate used in offshore structure must have high toughness against fracture. Especially joints of topside and hull, the two most critical parts in structure, require excellent strength.

POSCO has developed high quality and excellent steel plates guaranteeing superb performance and weldability. Due to the outstanding quality and performance of the API 2W Gr. 50/60 steel plates, POSCO has been nominated as an official vendor for API 2W Gr. 50/60 steel plates from major oil companies including ExxonMobil, Shell, BP, Total, etc.

Available Steel Grades

(max. thickness)

YS Class	TMCP Steel		Normalized Steel
	CTOD	Non-CTOD	(Non-CTOD)
YS 355	API-2W-50(-10°C, 100mm)	API-2W-50(120mm)	API-2H-50(100mm)
	API-2W-50(-40°C, 100mm)	EN-S355G10+M(100mm)	EN-S355G10+N(100mm)
	EN-S355G10+M(-10°C, 100mm)	EN-S355ML(100mm)	EN-S355NL(100mm)
	EN-S355G10+M(-20°C, 100mm)	TOTAL S355KT-40(100mm)	PTS-355EMZ(70mm)
YS 420	API-2W-60(-10°C, 100mm)	API-2W-60(100mm)	API-2Y-60(150mm)
	API-2W-60(-20°C, 100mm)	EN-S420G2+M(100mm)	
	API-2W-60(-40°C, 100mm)	EN-S420ML(100mm)	
	EN-S420G2+M(-10°C, 100mm)	TOTAL S420KT-40(125mm)	
	EN-S420G2+M(-20°C, 100mm)	NV-EW420(100mm)	
YS 460	EN-S460G2+M(-20°C, 100mm)	EN-S460G2+M(100mm)	-
		EN-S460ML(120mm)	

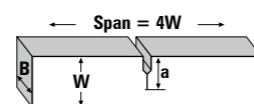


Critical Part(within 10% of total volume)

Even a local damage can be fatal to the entire structure
Thick plates(60~100mm) are applied for critical part

Fracture Resistance Evaluation Method

CTOD Test Required



Mechanical Properties - CTOD

Lowest Anticipated Service Temperature(LAST) -10°C

Grade	Base metal				Welded Joint(HAZ)		
	Strength(MPa)		Toughness	CTOD (-30°C,mm)	Heat Input (kJ/mm)	CTOD(-10°C,mm)	
	YS	TS	vE(J, -40°C)			CGHAZ	SCHAZ
API-2W-50(100mm)	Spec.	345 ≤	448 ≤	41 ≤	0.25 ≤	0.7	1.71 ≤ 1.89 ≤
	Avg.	374	491	377	1.76 ≤	3.0	0.80 ≤ 1.48 ≤
API-2W-60(100mm)	Spec.	414 ≤	517 ≤	48 ≤	-	0.8	0.98 ≤ 0.73 ≤
	Avg.	444	557	309	-	3.0	2.57 ≤ 1.74 ≤
						4.5	2.83 ≤ 2.79 ≤

Lowest Anticipated Service Temperature(LAST) -40°C

Grade	Base metal				Welded Joint(HAZ)		
	Strength(MPa)		Toughness	CTOD (-60°C,mm)	Heat Input (kJ/mm)	CTOD(-40°C,mm)	
	YS	TS	vE(J, -60°C)			CGHAZ	SCHAZ
API-2W-50(100mm)	Spec.	345 ≤	448 ≤	41 ≤	0.38 ≤	0.8	2.36 ≤ 0.54 ≤
	Avg.	387	492	383	2.52 ≤	3.0	1.33 ≤ 2.19 ≤
API-2W-60(100mm)	Spec.	414 ≤	517 ≤	48 ≤	To be agreed	0.8	0.13 0.12
	Avg.	435	538	314	0.9	3.0	0.51 0.55
						4.5	1.06 0.16

Mechanical Properties - Others

Steel Grades	Supplementary Requirement	Thickness (mm)	Chemical Composition	Mechanical Properties		
				Tensile Test	YS(MPa)	TS(MPa)
API-2H-50	CTOD no-guarantee	≤ 100	Ceq ≤ 0.43 Pcm ≤ 0.27	YS(MPa)	345~420	
				TS(MPa)	490~620	
				EL(%), GL50	23	
				YR(%)	≤ 80	
				Charpy Test(J) (-40°C, Transverse)		≥ 50
API-2W-50	CTOD no-guarantee	≤ 100	Ceq ≤ 0.36 Pcm ≤ 0.19	YS(MPa)	345~483	
				TS(MPa)	485~630	
				EL(%), GL50	23	
				YR(%)	≤ 90	
				Charpy Test(J) (-40°C, Transverse)		≥ 50
API-2W-60	CTOD no-guarantee	≤ 75	Ceq ≤ 0.41 Pcm ≤ 0.20	YS(MPa)	414~586	
				TS(MPa)	517~660	
				EL(%), GL50	22	
				YR(%)	≤ 90	
				Charpy Test(J) (-40°C, Transverse)		≥ 80
API-2W-50	CTOD (-10°C)	≤ 90	Ceq ≤ 0.39 Pcm ≤ 0.19	YS(MPa)	345~483	
				TS(MPa)	485~630	
				EL(%), GL50	23	
				YR(%)	≤ 90	
				Charpy Test(J) (-40°C, Transverse)		≥ 50

$$Ceq = C + Mn/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15$$

$$Pcm = C + Si/30 + (Mn+Cu+Cr)/20 + Ni/60 + Mo/15 + V/10 + 5B$$

Mechanical Properties - Others

Steel Grades	Supplementary Requirement	Thickness (mm)	Chemical Composition	Mechanical Properties		
				Tensile Test	YP(MPa)	TS(MPa)
API-2W-60	CTOD (-10°C)	≤ 100	Ceq ≤ 0.42 Pcm ≤ 0.21	YP(MPa)	414~586	
				TS(MPa)	520~665	
				EL(%),GL50	22	
				YR(%)	≤ 90	
				Charpy Test(J) (-40°C, Transverse)		≥ 60
EN-S355G8+M	CTOD no-guarantee	≤ 100	Ceq ≤ 0.36 Pcm ≤ 0.19	YP(MPa)	345~520	
				TS(MPa)	480~620	
				EL(%),GL50	22	
				YR(%)	≤ 90	
				Charpy Test(J) (-40°C, Transverse)		≥ 50
EN-S355ML	CTOD no-guarantee	≤ 100	Ceq ≤ 0.36 Pcm ≤ 0.19	YP(MPa)	345~520	
				TS(MPa)	480~620	
				EL(%),GL50	22	
				YR(%)	≤ 90	
				Charpy Test(J) (-50°C, Longitudinal)		≥ 50
TOTAL S355KT-40	CTOD no-guarantee	≤ 100	Ceq ≤ 0.36 Pcm ≤ 0.19	YP(MPa)	345~520	
				TS(MPa)	480~620	
				EL(%),GL50	22	
				YR(%)	≤ 90	
				Charpy Test(J) (-40°C, Transverse)		≥ 60

$$Ceq = C + Mn/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15$$

$$Pcm = C + Si/30 + (Mn+Cu+Cr)/20 + Ni/60 + Mo/15 + V/10 + 5B$$

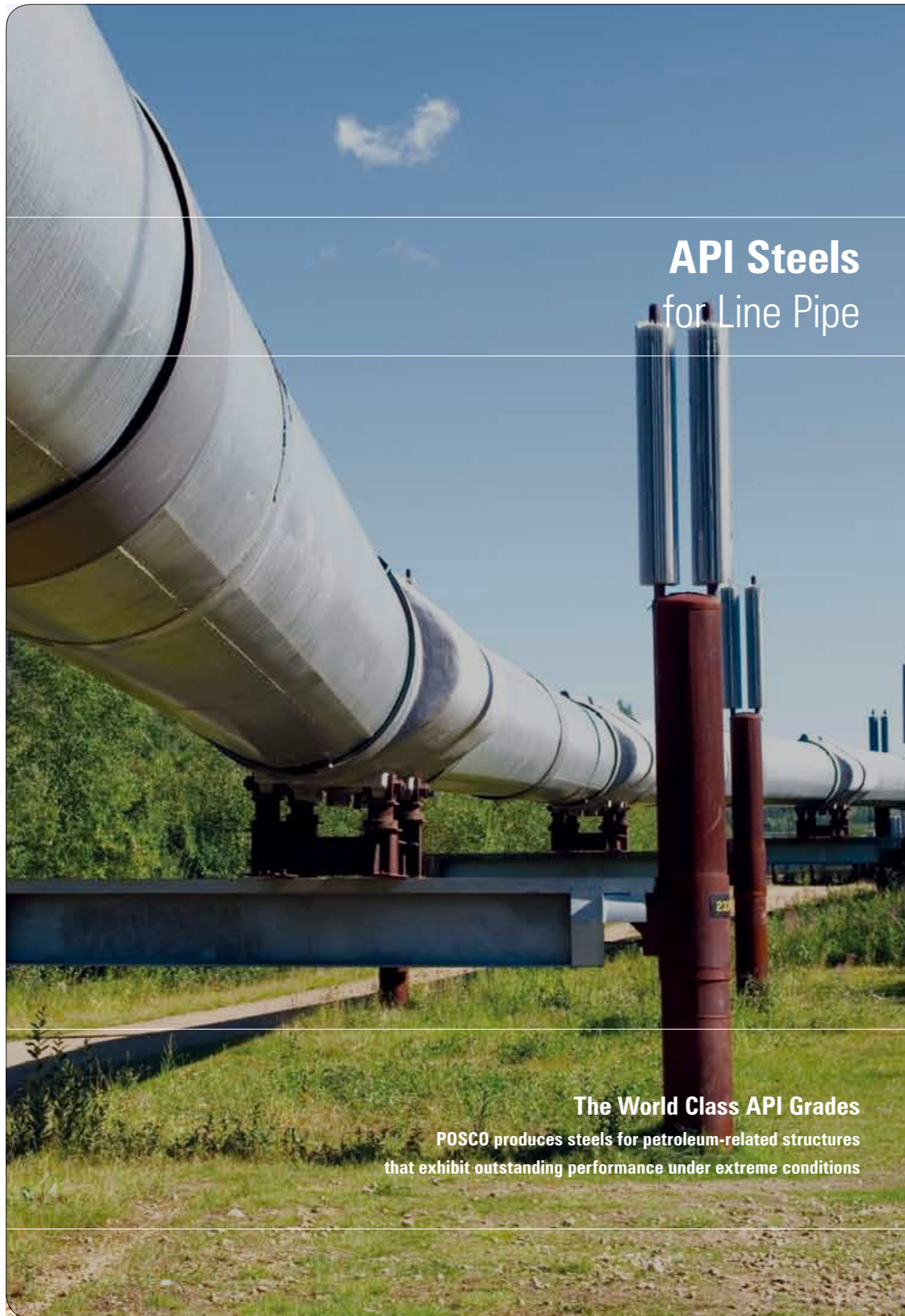
Guaranteed Supplementary Requirement

Supplementary Requirement	CTOD(-10°C)		Non-CTOD		
	YS355-TM	YS420-TM	YS355-TM	YS420-TM	YS355-N
S1 : UT(ASTM A578Level C)	Available	Available	Available	Available	Available
S2 : Impact Test at Low Temp(-60°C)	Available	Available	Available	Available	Available
S3 : Additional Tension Test	Available	Available	Available	Available	Available
S4 : Through Thickness Test	Min. 35%	Min. 35%	Min. 35%	Min. 35%	Min. 35%
S5 : Low Sulfur(Max. 0.006%)	Max. 0.005	Max. 0.005	Max. 0.005	Max. 0.005	Max. 0.005
S7 : Low Nitrogen(Max. 0.0009%)	Max. 0.0007	Max. 0.0007	Max. 0.0007	Max. 0.0007	Max. 0.0007
S8 : Strain-Aged Impact Test (250°C, 1 Hour, Strain : 5%)	Available	Available	Available	Available	Available
S9 : PWHT(600±20°C, 240minutes)	Available	Available	Available	Available	Available
S11 : Pre-Qualification(CTOD)	Max. 100t	Max. 100t	-	-	-
S12 : Drop-Weight Test(-35°C)	Available	Available	Available	Available	-
S91 : Fine Austenitic Grain Size	Grain Size Index above "7"(ASTM E112)				

* Please contact us for details before ordering supplementary requirement

Main Supply Records

Year	Project Name	Client	Fabricator	Grade (Parathe : CTOD Temp)	
2002	Donghae-1 Gas Field	KNOC, Korea	Hyundai Heavy Industries	API 2H Gr.50	
2003	Huizhou	ACTOG, China	Hyundai Heavy Industries	API 2H Gr.50	
2004	South Angsi	PETRONAS, Malaysia	EEW Korea	BS7191 355C	
	9 Well Platform	ONGC, India	EEW Korea	API 2H Gr.50	
	APN Project	BP, UK	EEW Korea	API 2H Gr.50	
	TUNU 10	TotalFinaElf, France	EEW Korea	S355	
	ARTHIT Campaign 1	PTTEP, Thailand	Steel Flower	API 2H Gr.50	
2005	Oveng & Okume	MODEC, USA	Samsung Heavy Industries	API 2W Gr.50T	
	PANNA Field	BG, UK	Steel Flower	API 2H Gr.50	
	KIKEH	MURPHY, USA	EEW Korea	API 2W Gr.50Z	
	Qatar Gas 3+4	ConocoPhillips, USA	EEW Korea	BS7191 355EM, BS7191 355EMZ	
	SISI-NUBI	TotalFinaElf, France	EEW Korea	S355KT-40	
2006	9 WELLHEAD	ONGC, India	EEW Korea	API 2H Gr.50	
	B&S-NH4	NPCC, UAE	EEW Korea	API 2H Gr.50, S355K2G3	
	SHENZI	MODEC, USA	Samsung Heavy Industries	API 2W Gr.50T	
	Vasai East Mosbold	Petronet	Samsung Heavy Industries	API 2W Gr.50	
	Pecikot	Total E&P, Indonesia	Sam Kang	API 2W Gr.50	
2007	NCP-8335	British Petroleum	Steel Flower	S355 G8M, S355 G7M	
	Al Shaheen	NPCC, UAE	EEW Korea	API 2H Gr.50,	
	Bohai Phase II	Conocophillips, UK	EEW Korea	API 2H Gr.50,	
	Northern Arthit	PTTEP	Steel Flower, Sam Kang	API 2H Gr.50, API 2W Gr.50Z	
	Tombua Landana	Chevron	DSME	API 2W Gr.60	
2008	Umm Shaif	ADMA-OPCO, UAE	Hyundai Heavy Industries	API 2W Gr.50T	
	Pazflor	Total	DSME	API 2W Gr.50, API 2W Gr.60	
2009	DAIHUNG	PETROVIETNAM	Steel Flower	API 2H Gr.50	
	Kipper Tuna Turrum	ExxonMobil	J.Ray McDermott, Sam Kang	API 2W Gr.50, 60, -10°C	
	Gumusut-Kakap	Shell	MMHE	API 2W Gr.50, 60, -10°C	
2010/2011	Platong Gas II	Chevron	J.Ray McDermott	API 2W Gr.50, API 2W Gr.60	
	CLOV	Total	DSME	API 2W Gr.50, 60, -10°C	
	JSM	Chevron	Samsung Heavy Industries	API 2W Gr.50 -10°C	
	Mars B	Shell	Samsung Heavy Industries	API 2W Gr.50,60 -10°C	
	SHWE	Daewoo International	Hyundai Heavy Industries	API 2W Gr.50,60 -10°C	
	Gorgon	Chevron	Hyundai Heavy Industries	API 2W Gr.50T -10°C	
	Goliat	ENI Norge	Hyundai Heavy Industries	EN-S355G9+M(-20°C)	
	Teekay	Teekay Petrozarl	Samsung Heavy Industries	EN-S355G9/10+M(-20°C)	
	Arkutun-Dagi	Exxon-mobil	DSME	API 2W Gr.50,60	
	Osprey	Brunei Shell	BSP, EEW	EN-S355G7,8+M(-10°C)	
	Bulan Bulan	Brunei Shell	BSP, EEW	EN-S355G7,8+M(-10°C)	
	2012	B-23	Brunei Shell	BSP, EEW	EN-S355G7,8+M(-10°C)
		OFON2	Total	Nigerdock	EN-S355/S420
		FLNG1	SBM OFFSHORE	DRYDOCK	S355G10+M(-10°C)
		FLNG	Shell	Samsung Heavy Industries	EN-S420G1,2+M(-10°C)
Yadana		Total	Steel Flower	S355,S420	
Wheatstone		Chevron	DSME	API 2W Gr.50/60(-10°C)	
B-23		Brunei Shell	BLNG/EEW	S355G7,8+M(-10°C)	
MALAMPAYA		Shell PHILIPPINES	FLUOR	S355G7,8+M(-10°C)	
2013	MALIKAI	PETRONAS	TECHNIP/MMHE	GR345, GR414(-10°C)	
	Heborn	Exxon-mobil	Hyundai Heavy Ind.	API-2W-60(-20°C)	
	Ichthys	INPEX	Samsung Heavy Ind.	EN-S460G2M(-10°C)	
	Ichthys	INPEX	Mcdermott	API-2W-60(-10°C)	
	Ichthys	INPEX	DSME	S355	
	Point thomson	Exxon-mobil	Hyundai Heavy Ind.	API-2W-50(-10°C)	
	SK316	Petronas	MMHE/EEWM	EN-S460G2M(-10°C)	



API Steels for Line Pipe

The World Class API Grades
 POSCO produces steels for petroleum-related structures
 that exhibit outstanding performance under extreme conditions

Available Sizes : HRC Products

■ Sweet Service Material

Unit: mm

Thickness Steel Grade	5 ≤ T < 7	7 ≤ T < 9	9 ≤ T < 18.5
B, X42~X56	880 ≤ W ≤ 1750	880 ≤ W ≤ 1945	880 ≤ W ≤ 1945
X60	880 ≤ W ≤ 1750	880 ≤ W ≤ 1945	880 ≤ W ≤ 1945
X65	880 ≤ W ≤ 1750	880 ≤ W ≤ 1945	880 ≤ W ≤ 1945
X70	880 ≤ W ≤ 1600	880 ≤ W ≤ 1945	880 ≤ W ≤ 1945
X80	-	880 ≤ W ≤ 1600	880 ≤ W ≤ 1750

T : Thickness, W : Width, "-" : Not-Available
 Over 18.5mm in thickness (T > 18.5) should be discussed before ordering.

■ Sour Service Material

Spiral Type

Unit: mm

Grade	Thickness	Width
X52	7~19	880~1930
X56~X65	9~14	880~1600

ERW Type

Unit: mm

Grade	Thickness	Width
X52	7~19	880~1930
X56/X60/X65	7~22	

T : Thickness, W : Width



Available Sizes : Plate Products

■ Non Sour Service Material (DWTT, 0°C, TMCP Delivery)

Unit: mm

Thickness Steel Grade	Thickness				
	12.7 ≤ T < 15.9	15.9 ≤ T < 17.5	17.5 ≤ T < 25.4	25.4 ≤ T < 32.5	32.5 ≤ T < 41
B	W ≤ 4800	W ≤ 4800	W ≤ 4800	W ≤ 4500	W ≤ 4000
X52M	W ≤ 4800	W ≤ 4800	W ≤ 4800	W ≤ 4500	W ≤ 4000
X56M	W ≤ 4800	W ≤ 4800	W ≤ 4800	W ≤ 4500	W ≤ 4000
X60M	W ≤ 4800	W ≤ 4800	W ≤ 4800	W ≤ 4500	W ≤ 4000
X65M	W ≤ 4800	W ≤ 4800	W ≤ 4800	W ≤ 4500	W ≤ 4000
X70M	W ≤ 4800	W ≤ 4800	W ≤ 4800	W ≤ 4500	W ≤ 4000
X80M	W ≤ 4000	W ≤ 4800	W ≤ 4800	W ≤ 4500	W ≤ 4000

T : Thickness, W : Width, "-" : Not-Available

Low temperature (Below 0°C) assurance should be discussed before ordering.

Below 12.7mm in thickness (t<12.7) should be discussed before ordering.

■ Sour Service Material (DWTT, 0°C, TMCP Delivery)

Unit: mm

Thickness Steel Grade	Thickness				
	14.3 ≤ T < 17.5	17.5 ≤ T < 22.2	22.2 ≤ T < 25.4	25.4 ≤ T < 32.5	32.5 ≤ T < 39
X52MS	W ≤ 4100	W ≤ 4400	W ≤ 4000	-	-
X56MS	W ≤ 4100	W ≤ 4400	W ≤ 4000	W ≤ 3200	W ≤ 2400
X60MS	W ≤ 4100	W ≤ 4400	W ≤ 4000	W ≤ 3200	W ≤ 2400
X65MS	W ≤ 4100	W ≤ 4400	W ≤ 4000	W ≤ 3200	W ≤ 2400
X70MS	W ≤ 4100	W ≤ 4400	W ≤ 4000	W ≤ 3200	W ≤ 2400

T : Thickness, W : Width, "-" : Not-Available

Low temperature (Below 0°C) assurance should be discussed before ordering.

Below 14.3mm in thickness (t<14.3mm) should be discussed before ordering.

Over 32.5mm in thickness (t<32.5mm) should be discussed ordering.

Main Supply Records

■ HRC Products

Unit : Thousand tons

Spec	Size(mm)	Piping Type	Quantity	Period
Non Sour Service				
X80	11/14.45*1530	Spiral (42")	13	'07
X70	22.22*1530	Spiral (42")	10	'08
X70	12.91~22.22*1645	Spiral (48")	47	'09~'10
X80	17.5*1500	Spiral (48")	73	'10
X70	14.1~19.7*1500	Spiral (48")	164	'11
X70	17.5*1450	Spiral (48")	10	'11
X70	13.08~19.56*1800	Spiral (36")	38	'11
X70	22.2*1600	Spiral (20")	3	'12
Sour Service				
X60	6.35~15.88* 851~1710	ERW	107	'06~'09
X52	7.1*1595	ERW	21	'08~'09
X52	11.1~15.9*1500 / 11.1*1865	Spiral	70	'10
X60	17.5*1210	LSAW(JCO)	7	'10
X65	19.1*1539	LSAW(JCO)	2	'11
X60	17.5/20.6*1214/1519	LSAW(JCO)	6	'11
X60	17.5*1211	Spiral	8	'12
X60	14.3*1868	Spiral	9	'12

■ Plate Products

Unit : Thousand tons

Spec	Size(mm)	Piping Type	Quantity	Period
Non Sour Service				
X70M	26.4*4338	JCO	20	'08
X80M	21.0*3295	JCO	3	'08
X70M	19.8*4382	JCO	58	'09~'10
X70M	26.4*4332	JCO	9	'10
X65M	20.6~30.2*2477	JCO	47	'10~'11
X80M	23.0*4343	JCO	20	'11
X80M	22.2*1361	UOE	7	'11
X60M	14.3*3275	R/B	75	'11
X65M(offshore)	25.4*1663	JCO	10	'12
X70M(offshore)	31*2235 / 27.4*2226	JCO	23	'13
Sour Service				
X65MS	22.2*4369	R/B	5	'07
X65MS	25.4*2305	JCO	6	'08
X65MS	19.1~24.03*3775	JCO	34	'08
X60MS	15.9/19.1*2800	R/B	7	'08~'09
X52MS	14.3*1860	R/B	41	'10
X60MS	11.4*2024	UOE	3	'11
X65MS	14.3~22.2*2145~2753	JCO	59	'11
X65MS	23.8~28.5*2845	UOE	3	'12
X65MS	11.13*1546	JCO	18	'13

Testing and Evaluation Methods

UOE Simulator

Test Features

Integrated Simulator for U-O Forming + Expanding

Test Equipment Specifications

Press Capacity	· 4,000 Ton
System Overview	· Full Automation system (U→O Forming)
Others	· Expander can be installed at O die position

Pipe Making Capability

Grade	API X70~X120
Pipe length	1m
Pipe diameter	20"~56"
Pipe thickness	Max. 35mmt (@70)



ERW Simulator

ERW Mechanism

Sweeping distance vs. Narrow gap length
Bridge sweeping velocity
Arcing frequency

Test Equipment Specifications

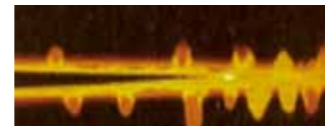
Material	<ul style="list-style-type: none"> · Strength: T. S. \leq 800 MPa · Thickness: 1.5 ~ 16 mm · Skelp width: 80 ~ 100mm
ERW power	<ul style="list-style-type: none"> · Power: Max. 475 kW · Frequency: 150 ~ 350 kHz
Welding point adjustment	<ul style="list-style-type: none"> · V-angle: 2 ~ 8° · Tilting angle: -5 ~ +10° · Pull-out speed: 4 ~ 40 m/min



Low heat input



Moderate heat input



High heat input

Testing and Evaluation Methods

Drop Weight Tear Test (DWTT)

Test Features

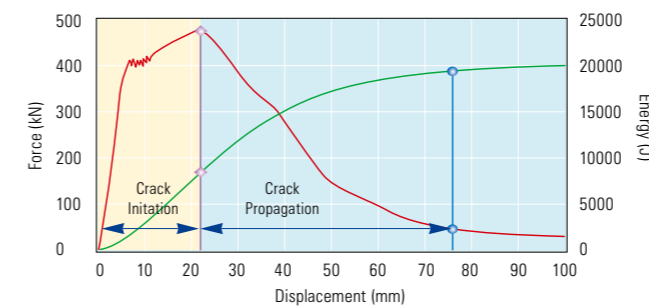
Test the resistance to brittle fracture propagation with the same specimen thickness as in the actual pipe

Test Equipment Specifications

Capacity	<ul style="list-style-type: none"> · Impact Energy: 10,000J ~ 100,000J · Load Cell: 1,500kN
Temperature Control	<ul style="list-style-type: none"> · Cooling Media: Gaseous / Liquid Nitrogen · Temperature Range: -196°C ~ 100°C
Specimen Loading	<ul style="list-style-type: none"> · Weight Capacity Robot: 90Kgf · Specimen Thickness: 6mm ~ 50mm

Test Results

Load-Displacement: Fracture Energy

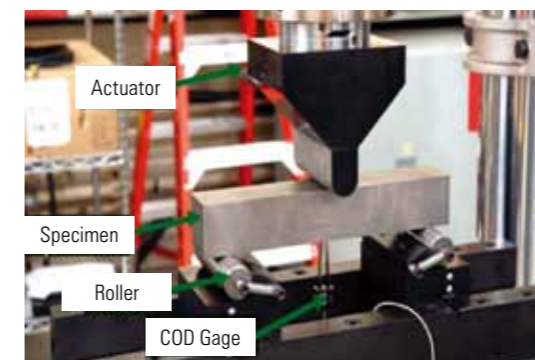


Model: DWTT-100 (IMATEK, UK)

Crack Tip Opening Displacement (CTOD)

Test Features

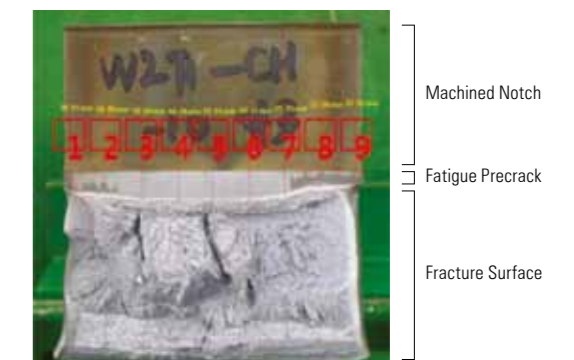
Test measures the resistance of a material to the propagation of a crack. It is used on materials that can show some plastic deformation before failure occurs causing the tip to stretch opening.



Instrumented CTOD Tester

Quality Assessment Method

ASTM E1290, BS7448



Machined Notch
Fatigue Precrack
Fracture Surface

Steel Plate for Pressure Vessel

POSCO produces various kinds of steel plates for pressure vessels such as LNG storage tank, boiler, heat exchanger and reactor

POSCO steel plate for pressure vessel shows excellent cold and hot formability and guarantees mechanical properties after post welding heat treatment(PWHT)

	Standard Abbreviation	Standard
Low Temperature	A516-55, 60, 65, 70 SA516-55, 60, 65, 70, A537-1.2	KS-SB410, 450, 480 / JS-SB410, 450, 480
Extreme Low Temperature	A553-TY1(9%Ni), A203-D,E JS-SLA235A,B	JS-SL2N255, SL3N255, SL3N275, SL9N520
Vessel	A537-1,2 / A204-A,B	JS-SPV235, 315, 355, 450, 490 / STH750Q, STH890CM, 34CRMO4
Intermediate Temperature	A515-55, 60, 65, 70 / SA515-55, 60, 65, 70, A204-A,B, A285-A,B,C	JS-SB450M, 480M, JS-SGV410, 450, 480
High Temperature	A387-11-C1, C2, A387-12-C1, C2, A387-22-C1, C2, SA387-11 (12, 22)-C1,C2	JIS G 4109(SCMV), G 4110(SCMQ)

Available Steel Grades

Grades	Requirement		
	ASME	ASTM	JIS
YS 220	SA516-60 (T ≤ 133t)	A516-60 (T ≤ 133t)	JS-SB410 (T ≤ 93t)
	SA387-22-C1 (T ≤ 65t)	A387-22-C1 (T ≤ 65t)	
YS 240	SA516-65 (T ≤ 133t)	A516-65 (T ≤ 133t)	JS-SB450 (T ≤ 93t)
	SA387-11-C1 (T ≤ 133:NACT Type)	A387-11-C1 (T ≤ 133:NACT Type)	JS-SB450M (T ≤ 90t)
	SA387-12-C1 (T ≤ 65t)	A387-12-C1 (T ≤ 65t)	
YS 260	SA516-70 (T ≤ 133t)	A516-70 (T ≤ 133t)	JS-SB480 (T ≤ 60t)
	SA387-12-C2 (T ≤ 65t)	SA387-12-C2 (T ≤ 65t)	JS-SB480M (T ≤ 70t)
YS 310	SA387-11-C2 (T ≤ 100t : NACT Type)	A387-11-C2 (T ≤ 100t : NACT Type)	
	(T ≤ 65t : NT Type)	(T ≤ 65t : NT Type)	
	SA387-22-C2 (T ≤ 133t : NACT Type)	A387-22-C2 (T ≤ 133t : NACT Type)	
	(T ≤ 65t : NT Type)	(T ≤ 65t : NT Type)	
YS 345	SA537 Class 1 (T ≤ 100t)	A537 Class 1 (T ≤ 100t)	JS-SLA365 (T ≤ 38t)
			JS-SLA365TM (T ≤ 38t)
YS 415	SA537 Class 2 (T ≤ 100t)	A537 Class 2 (T ≤ 100t)	-
YS 450~			JS-SPV450 (T ≤ 70t)
			JS-SPV490 (T ≤ 70t)

Characteristics (non-HIC guaranteed)

Steel Grades	Elements	Mechanical Properties		Thickness (Max. mm)	Additional Service
		YS(MPa, Min.)	TS(MPa)		
(S)A516-60	C,Ni,Nb,V	220	415~550	133	Ceq 0.43% (0.45%)
(S)A516-65		240	450~585	133	SR 6~15hrs.
(S)A516-70		260	485~620	133	Impact Test at -45~-49°C
(S)A537-1		355	485~620	100	SR 3~7hrs.
(S)A537-2		415	550~690	100	Impact Test at -46~-49°C
(S)A515-60	C,Mn	220	415~550	93	SR 3hrs.
(S)A515-65		240	450~585	93	
(S)A515-70		260	485~620	93	
(S)A387-11-C1	Cr,Mo,Mn	240	415~585	65(NT) 133(NACT)	SR 3~20hrs.
(S)A387-11-C2		310	515~690	65(NT) 100(NACT)	J-Factor ¹⁾
(S)A387-22-C1		205	415~585	65	
(S)A387-22-C2		310	515~690	65(NT) 133(NACT)	
(S)A299-B ²⁾	Cu,Ni,Cr,Mo	325	550~690	150	SR 10hrs.
(S)A302-C	Ni,Mo	345	550~690	133	SR 10hrs.

¹⁾ J-Factor=(Si+Mn)x(P+Sn)x10⁴ ≤ 150 (Si,Mn,P and Sn in wt %)

²⁾ 150mm: Possible only when the Rolling Reduction Ratio is 2:1

Characteristics (HIC guaranteed)

Unit: max. percent(%)

Steel Grades	Chemical composition			Thickness(mm)	CLR	Additional Service
	P	S	Ceq(G) t ≤ 40t	NACE TM0177 pH ≤ 4.5		
(S)A516-60	≤ 0.01	≤ 0.002	≤ 0.43	≤ 133	≤ 5~15%	SR: 620±20°C, 3Hr/inch
(S)A516-65						Impact Energy: 27J(Avg., Min.)/24J at -46°C
(S)A516-70				≤ 133		Delivery Condition : NACT or Nor

HIC Test Standards

Test Standards	Test Solution	Terminal pH	Test Conditions
NACE TM0284-sB	Artificial Seawater	8.1~8.3	25°C, 96 hrs.
NACE TM0177(Low pH)	Acid NaCl	≤ 4.5	25°C, 96 hrs.

* NACE:National Association of Corrosion Engineers

** HIC Test frequency: per heat on the same thickness plate

Supplementary Requirement

Supplementary Requirement	SA516-60 / 65 / 70	SA387-11-C1/C2	SA387-22-C1/C2	SA537-1	SA537-2
S1 : Vacuum degassed	0	0	0	0	0
S2 : Product Analysis	0	0	0	0	0
S3 : Simulated PWHT of Test Coupons(1Hr/inch, T>2inches each inch plus 15minutes)	15Hr	3Hr C2: 20Hr(NACT)	3Hr C2: 20Hr(NACT)	7Hr	3Hr
S4 : Additional Tension Test	Not Required	Not Required	Not Required	Not Required	Deviation Need
S5 : CVN Impact Test(-46°C)	0	0	0	0	0
S7 : High Temperature Tension Tests	Reference Data Available	Reference Data Available	Reference Data Available	Reference Data Available	Reference Data Available
S22 : Through Thickness Tension Tests (A770 or EN 10164)	Min. 35%	Min. 35%	Min. 35%	Min. 35%	Min. 35%
Fine Austenitic Grain Size	Grain Size Index above "7"	-	-	Grain Size Index above "7"	Grain Size Index above "7"
Low Phosphorous	Max. 0.01	Max. 0.012	Max. 0.012	Max. 0.012	Max. 0.012
HIC (Total average of 3 specimens)CTR 1.5% CSR 0.5%	CLR 5% Not Required	Not Required	Not Required	Not Required	

9%Ni Steel

Material Characteristics

Low temperature toughness : $\geq 70\text{J @-196}^\circ\text{C}$

High tensile strength $\geq 690\text{MPa}$

Residual magnetization : Flux Density ≤ 50 Gauss

Usage

Liquefied Natural Gas(LNG) Storage Tank

Standard Abbreviation : A553-TY1

Chemical Composition

	C	Si	Mn	P	S	Sol-Al	Cu	Ni
Spec.	≤ 0.08	0.15~0.40	≤ 0.90	≤ 0.008	≤ 0.005	0.005~0.04	≤ 0.10	8.50~9.50
Result	0.04~0.08	0.20~0.30	0.60~0.70	0.005	0.002	0.005~0.040	0~0.10	8.90~9.30

Mechanical Properties

	Yield Strength	Tensile Strength	Impact @ -196°C	CTOD @ -164°C
Spec.	$\geq 585\text{MPa}$	690~825MPa	70Joules \leq	$> 0.17\text{mm}$
Result	657MPa	707MPa	207Joules	0.28~1.29mm

Supply Records (Last 4 years)

Year	Project Name	Client	Construction	Thickness
2008	Tongyeong LNG Terminal(#13, #14)	KOGAS	Daewoo E&C, Hyundai E&C	6~32.9mm
	Pyeongtaek LNG Terminal(#15, #16, #17)	KOGAS	Samsung C&T	6~32.9mm
2009	Gwangyang LNG Terminal(#3)	POSCO	POSCO E&C	6~32.9mm
	Tongyeong LNG Terminal(#15, #16)	KOGAS	Doosan HI&C	6~20mm
	Pyeongtaek LNG Terminal(#18, #19)	KOGAS	Doosan HI&C	6~32.9mm
	Pyeongtaek LNG Terminal(#20, #21)	KOGAS	Hyundai E&C	10~29.5mm
2010	Pyeongtaek LNG Terminal(#22, #23)	KOGAS	Daewoo E&C, Samsung C&T	10~32.9mm
2011	Gwangyang LNG Terminal(#4)	POSCO	POSCO E&C	6~32.9mm
2013	Samcheok LNG Terminal(#8, #9)	KOGAS	Doosan HI&C	6~32.9mm

High Mn Cryogenic Steel

Recently, the new high manganese austenitic steel plate and welding consumables with an excellent combination of strength and cryogenic toughness were developed without additional costly element, Ni, and they offer an attractive alternative for cryogenic applications.

Chemical Composition and Mechanical Properties of Plate

Chemical Composition

Unit: wt.%

C	Si	Mn	P	S	Others
0.2~0.6	0.1~1.0	22.0~26.0	≤0.03	≤0.01	Cr equiv. 0~20.0 Ni equiv. 28.0~48.0

1) Cr equivalent = Cr + 1.5Si + Mo + 5V + 3Al + 0.5Nb + 1.5Ti

2) Ni equivalent = Ni + 0.87Mn + 0.33Cu + 30C + 30(N-0.045) when N is 0~0.2

Note : Alloying elements in Cr equivalent and Ni equivalent can be added to ensure austenite stability.

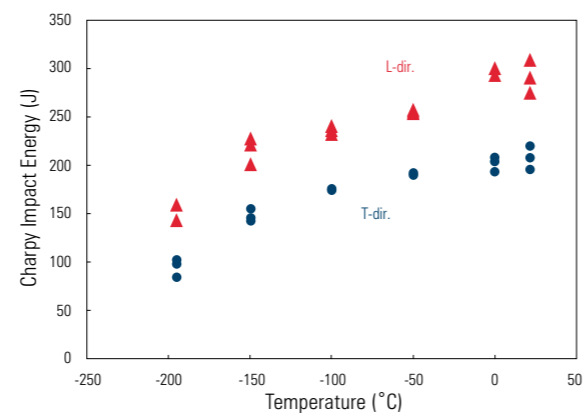
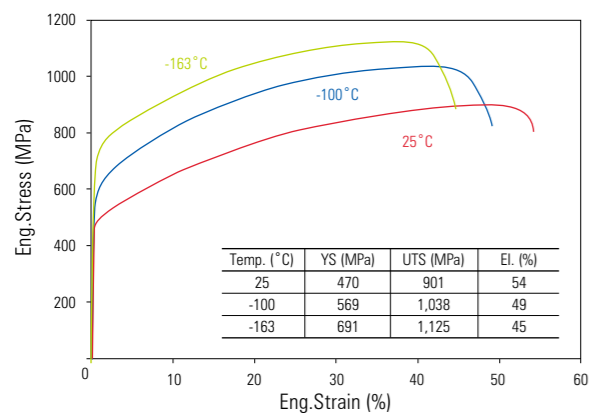
Mechanical Properties

YS (MPa)	UTS (MPa)	El. (%)	Charpy Impact Energy @ -196°C (J)	
			Transverse	Longitudinal
≥360	TS : ≥560	≥22	≥27	≥41

Cryogenic Properties of Plate

Strength and Toughness

The high manganese steel is designed to have high strength and toughness at cryogenic temperature by appropriate strengthening mechanisms and controlled manufacturing processes.

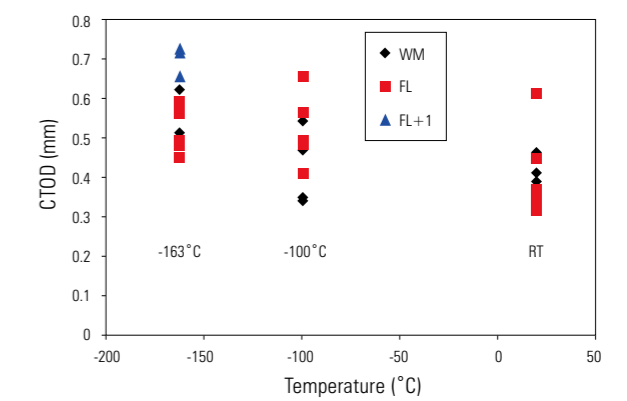
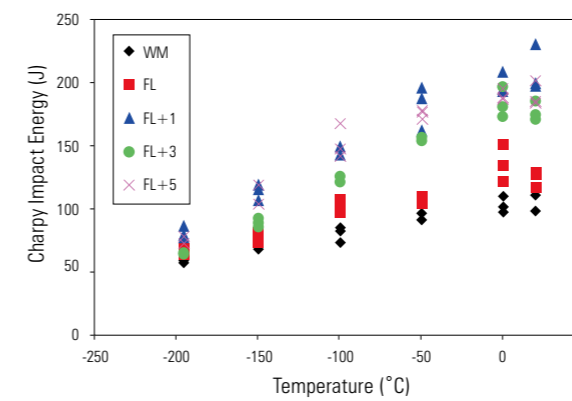


Cryogenic Properties of Welded Joint

Welding Condition

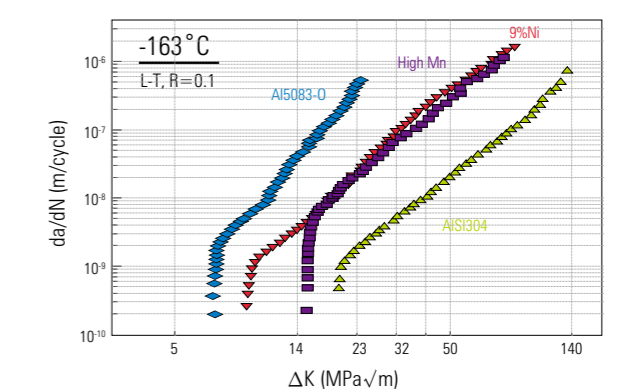
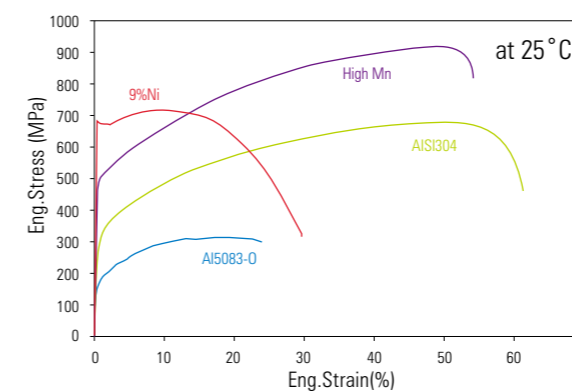
Welding Process	Groove	Current (A)	Voltage (V)	Speed (cpm)	Heat Input (kJ/cm)	Shielding Gas
GMAW		280	28	25	18.8	Ar-20% CO ₂ 20 l/min

Toughness and CTOD

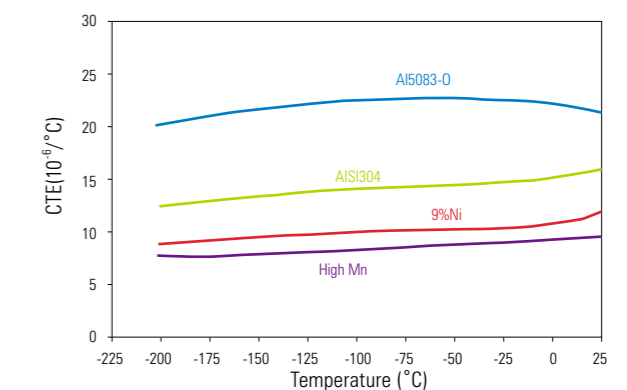
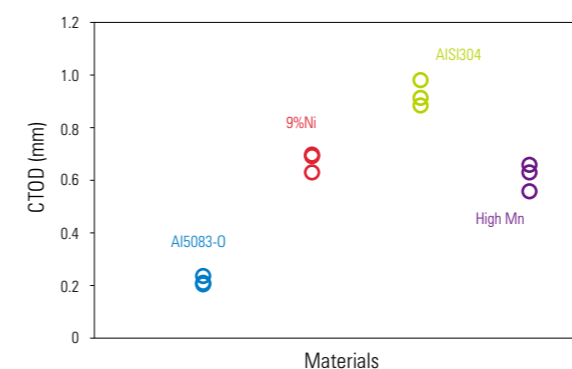


Comparison with Conventional Materials for Cryogenic Applications

Strength and Toughness



CTOD



High Mn Cryogenic Steel

Flux-cored Arc Welding Consumable for High Mn Steel (PT-400MTM)

■ Description and Application

PT-400M™ is an Fe-Ni-Mn based flux-cored wire for welding high Mn steel and Ni-Cr-Mo alloys.

Satisfies stringent toughness requirement at cryogenic temperature

Stable arc with minimal spatter

No need to pre-heat and control maximum interpass temperature at 150°C or lower

■ Welding Position



■ Polarity and Shielding Gas

DCEP (DC+)

100% CO₂

■ Chemical Composition of Wire (wt. %)

Ni equiv.	Cr equiv.
35.0~55.0	≤20.0

■ Mechanical Properties of All-Weld Metal

YS (MPa)	UTS (MPa)	El. (%)	Charpy Impact Energy @ -196°C (J)
≥360	≥600	≥22.0	≥27

■ Packing

Diameter (mm)	1.2	1.4	1.6
Weight (kg)	5, 12.5, 15, 20		



Submerged Arc Welding Consumable for High Mn Steel (PC-400MTM)

■ Description and Application

PC-400M™ is a high Mn based metal-cored wire for welding high Mn steel and Ni-Cr-Mo alloys.

POS-CF1™ is an agglomerated and slightly Mn-alloyed aluminated-basic flux for single/multipass welding.

Satisfies the stringent toughness requirement at cryogenic temperature

Good arc stability and bead appearance with high travel speed

No need to pre-heat and control maximum interpass temperature at 150°C or lower

■ Welding Position



■ Polarity

DC, AC

■ Chemical Composition of Wire (wt. %)

Ni equiv.	Cr equiv.
28.0~48.0	≤20.0

■ Mechanical Properties of All-Weld Metal

YS (MPa)	UTS (MPa)	El. (%)	Charpy Impact Energy @ -196°C (J)
≥360	≥660	≥22.0	≥27

■ Packing (Wire)

Diameter (mm)	3.2	4	4.8
Weight (kg)	25, 50, 100, 200		

■ Packing (Flux)

Type	Can	Bag
Weight (kg)	20, 25	

Testing and Evaluation Methods

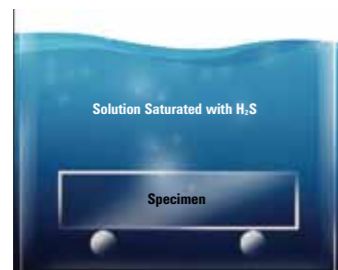
Sour Resistance

Sour Resistance (Resistance to HIC and SSCC)

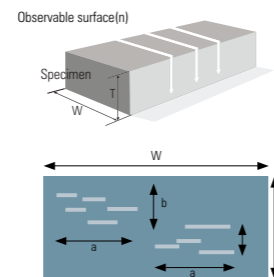
A way to evaluate quality and resistance to hydrogen induced cracking (HIC)

Cracks occur in line pipe steel used in sour gas environment without exterior forces on it.

Quality Assessment Method: NACE TM 0284



Immersed for 96 hours at 25°C



Solution A (strong acid)

5% NaCl + 0.5% CH₃COOH

The pH is 2.7 at first and 4.0 or lower by the end.

Solution B (weak acid)

synthetic seawater

The pH is 8.2 at first and 4.8~5.4 by the end.

$$\text{Crack length ratio (CLR)} = \frac{\sum a}{W} \times 100\%$$

$$\text{Crack thickness ratio (CTR)} = \frac{\sum b}{T} \times 100\%$$

$$\text{Crack sensitivity ratio (CSR)} = \frac{\sum (a \times b)}{W \times T} \times 100\%$$

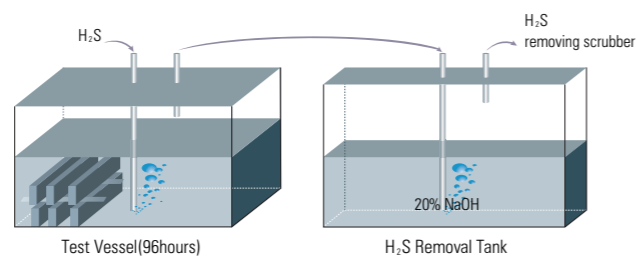
HIC



Hydrogen Induced Cracking Test System

Test Equipment Specifications

Test Method (Standard)	NACE TM0284 or EFC16
Capability	Vessel : 15liter x 20ea 20 specimens/vessel
Test Solution	H ₂ S saturated acidic solution
Others	Temperature control : ±1°C



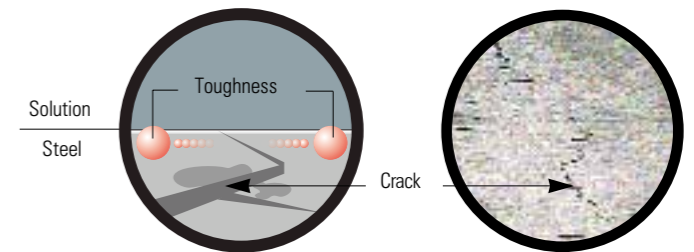
Sulfide Stress Corrosion Cracking(SSCC):R&D



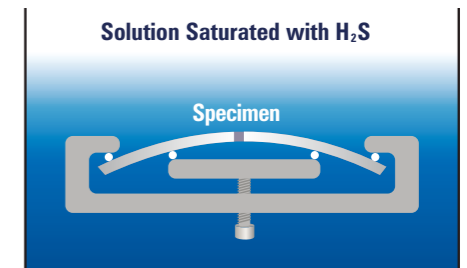
Static load method : proof ring type

Quality Assessment Method : NACE TM 0177

Test for 720 hours at 25°C : static load and bending deformation are typical methods.



Sudden fracture when subjected to tensile stress in a corrosive environment that contains H₂S



Immersion for 720hours at 25°C

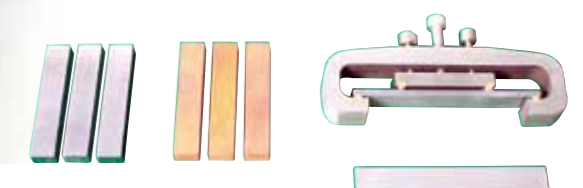
ASTM G39(Four Point Load Test)

Many customers require this method for determining SSCC resistance

SSCC Test System

Test Equipment Specifications

Method(Standard)	NACE TM0177 or EFC16
Characteristics	Loading type: dead weight Maximum applied load: 3tons 44 testers
Test Solution	H ₂ S saturated acidic solution
Others	Temperature control: ±1°C



Steel Plate for Structure & Construction

Available Steel Grades

Usage	JIS	KS	ASTM	EN10025	Others	POSCO standards
Structural Steel	SS330, 400, 490, 540	SS330, 400, 490, 540	A36 A283-A,B,C,D A570 Gr.40,50 A572-42,50,60,65 A573 Gr.70	S235 Series S275 Series S355 Series S420 Series E295,355	BS 4360 Gr40A, B, C, D, E Gr.50A, B, C, D, E	
Welding Structural Steel	SM400, 490, 490Y, 520, 570	SM400, 490, 490Y, 520, 570				
Building Structure	SN400,490	SN400,490	-	-	-	PILAC- BT33,36,45
Bridge Structure	-	HSB500,600 800	A709-36 A709-50 A709-50W	-	-	-
Weather Resistant Steel	SMA400, 490, 570	SMA400, 490, 570	A588	-	-	-
Mechanical Structure	S20C~S55C SCM440	-	-	-	SAE 1020, 1022 1030, 1035, 1040 1045, 1049, 4150	POSMOLD1,2
Abrasion Resistant Steel	-	-	-	-	-	POS AR 320, 360, 360LC, 400, 500, 500LC
High Strength Steel	-	-	A514-F A573 Gr. 70	S460 Series	-	POSTEN 55H~100

Steel Plate for Construction Structure

Introduction

Steel plates for construction structure have 300~1000MPa strength.
Generally high tensile strength of higher than 500MPa is produced by TMCP method.

In structures with high occurrence of lamella tear, lamella tear resistance steel is used,
in which sulfur is lowered and Z-direction resistant stress by controlling non-metallic inclusions.

Grade	Standards	Remark
40kg	SN400B/C	PILAC-BT33: SM490TMC
50kg	SN490B/C, PILAC-BT33/36, HSB500	
60kg	PILAC-BT45, HSB600	
80kg	HSB800, HSA800	PILAC-BT66: KS-HSA800

Designation

SS : Steel Structure
SM : Steel Marine
SN : Steel New
SMA : Steel Marine Atmosphere

CVN Grade

- A: No Limits
- B: $\geq 27J(0^\circ C)$
- C: $\geq 47J(0^\circ C)$
- No Designation : A Grade

S M A 4 9 0 B W N Z C

Tensile Strength

400 : 400MPa(41kg/mm²)
490 : 490MPa(50kg/mm²)
520 : 520MPa(53kg/mm²)
570 : 570MPa(58kg/mm²)

Weathering Grade

W: used as-rolled or after rust stabilization
P: used after general painting

Heat Treatment

N: Normalizing
QT: Quenching & Tempering
TMC: Thermo-Mechanical Control
As-Rolled: No Designation

Lamellar Tear Grade

ZA : $S \leq 0.008\%$
ZB : $S \leq 0.008\%$, $RA_{av} \geq 15\%$, $RA_{min} \geq 10\%$
ZC : $S \leq 0.006\%$, $RA_{av} \geq 25\%$, $RA_{min} \geq 15\%$
ZD : Customer's Requirements

SN Steel for Building Structure

Chemical Composition

Grade	Thickness (mm)	Element(% ,Max.)					Ceq (% ,Max.)	Pcm (% ,Max.)	
		C	Si	Mn	P	S			
SN400	A	6 ≤ t ≤ 100	0.24	-	-	0.05	0.05	-	-
	B	6 ≤ t ≤ 50	0.20	0.35	0.60~1.40	0.03	0.015	0.36	0.26
		50 < t ≤ 100	0.22						
C	16 ≤ t ≤ 50	0.20	0.35	0.60~1.40	0.02	0.008	0.36	0.26	
	50 < t ≤ 100	0.22							
	SN490	B	6 ≤ t ≤ 40	0.18	0.55	1.60	0.03	0.015	0.44
40 < t ≤ 50			0.18	0.55	1.60	0.03	0.015	0.44	0.29
50 < t ≤ 100			0.20	0.55	1.60	0.03	0.015	0.46	0.29
C		16 ≤ t ≤ 100	0.18	0.55	1.60	0.02	0.008	0.44	0.29
		40 < t ≤ 50	0.18	0.55	1.60	0.02	0.008	0.44	0.29
		50 < t ≤ 100	0.20	0.55	1.60	0.02	0.46	0.44	0.29

Ceq(%): $C + Mn/6 + Si/24 + Ni/40 + Cr/5 + Mo/4 + V/14$

Pcm(%): $C + Si/30 + Mn/20 + Cu/20 + Ni/60 + Cr/20 + Mo/15 + V/10 + 5B$

Mechanical Properties

Grade	Thickness (mm)	Tensile Test				Impact Test (0°C, J)	
		YS(MPa, Min.)	TS(MPa)	EL(% ,Min.)	YR(% ,Max.)		
SN400	A	6 ≤ t ≤ 16	235	400~510	17	-	-
		16 < t ≤ 40	235	400~510	21	-	-
		40 < t ≤ 100	215	400~510	23	-	-
	B	6 ≤ t < 12	235	400~510	18	-	-
		12 ≤ t ≤ 16	235~355	400~510	18	80	27
		16 < t ≤ 40	235~355	400~510	22	80	27
		40 < t ≤ 100	215~335	400~510	24	80	27
	C	6 ≤ t < 12	235	400~510	18	80	27
		16 ≤ t ≤ 40	235~355	400~510	18	80	27
SN490	B	6 ≤ t < 12	325	490~610	17	-	-
		12 ≤ t ≤ 16	325~445	490~610	17	80	27
		16 < t ≤ 40	325~415	490~610	21	80	27
	C	40 < t ≤ 100	295~415	490~610	23	80	27
		T=16	325	490~610	17	80	27
		16 < t ≤ 40	325~445	490~610	21	80	27
40 < t ≤ 100	295~415	490~610	23	80	27		

SN Steel for Building Structure

Comparison with Conventional Steels

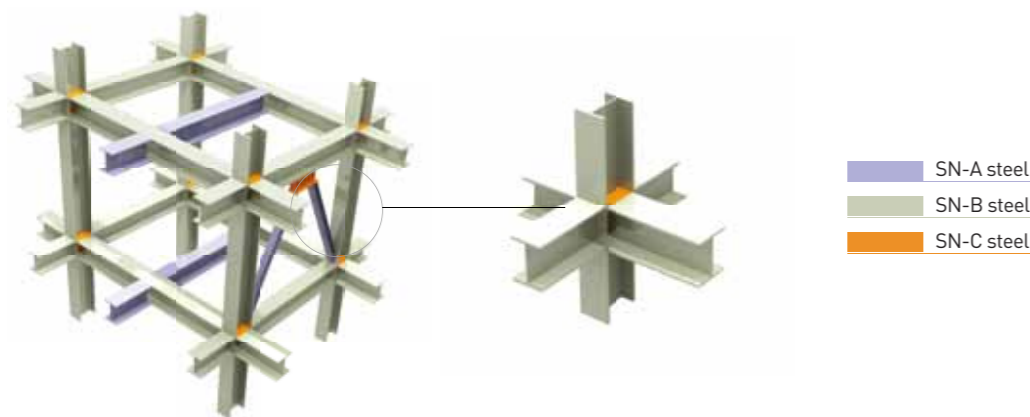
Grade	Struc. Calculation	Quality of Weldment				Plastic Deformation		Through Thickness Quality		
		Upper C	Charpy	P _{≤0.030%} S _{≤0.015%}	Ceq, P _{CM}	Yield Ratio	Upper Y.S.	P _{≤0.030%} S _{≤0.015%}	Reduction of Area	UT
SS400	-	-	-	-	-	-	-	-	-	-
SM400A, SM490A	-	●	-	-	-	-	-	-	-	▲
SM400B, SM490B	-	●	●	-	-	-	-	-	-	▲
SM400A	●	●	-	-	-	-	-	-	-	-
SN400B, SN490B	●	●	●	●	●	●	●	-	-	▲
SN400C, SN490C	●	●	●	●	●	●	●	●	●	●

1) ● = OK, ▲ = not satisfied, - = indefinite

2) SN400B, SN490B yield Point : 120N/mm² at over 12mm thick

SN Steel Usage : Structural Steel for Building

Type A (SN400A)	Applicable for structural members and parts that do not exhibit plastic behavior, such as beam, in-fill beam, roof frame. applicable for, even if limited, structurally significant members welded in field.
Type B (SN400B, 490B)	Applicable for general structural members and connections, except for the members where SN400C and SN490C are utilized.
Type C (SN400C, 490C)	Applicable for skip plates of built-up box columns and structural parts subjected to high-heat-input-welding and high tension force to the direction of thickness, such as diaphragm.



B-H columns with Damper

Details of beam-column Connection

PILAC Steel for Building Structure

PILAC-BT (Posco In Line Accelerated Cooling-Building high Tensile)

Pilac-BT is used primarily in making H-Beam and Box column, which have high yield strength and weldability.

Chemical Composition

Grade	Thickness	Element(%Max.)					Ceq (%Max.)	Pcm (%Max.)
		C	Si	Mn	P	S		
PILAC-BT33(SM490TMC)	6 ≤ t ≤ 50	0.18	0.55	1.60	0.020	0.010	0.38	-
	50 < t ≤ 80	0.20	0.55	1.60	0.020	0.010	0.40	-
PILAC-BT36(SM520TMC)	9 ≤ t ≤ 50	0.18	0.55	1.60	0.020	0.010	0.40	0.26
	50 < t ≤ 80	0.20	0.55	1.60	0.020	0.010	0.42	0.27
PILAC-BT45(SM570TMC)	12 ≤ t ≤ 100	0.18	0.55	1.60	0.020	0.010	0.44	0.28
PILAC-BT66(HSA800)	16 ≤ t ≤ 80	0.20	0.55	3.0	0.015	0.006	0.60	0.30

Ceq(%) = C+Mn/6+Si/24+Ni/40+Cr/5+Mo/4+V/14

Pcm(%) = C+Si/30+(Mn+Cu+Cr)/20+Ni/60+Mo/15 + V/10+5B

Mechanical Properties

Grade	Tensile Test						Impact Test(longitudinal)	Tensile Test Z-Direction		
	YS (Min.,MPa)	TS (MPa)	YR (Max.,%)	Elongation(Min.)				Absorbed Energy	Reduction of Area(Min.)	
				Thickness	Test Piece	%	Thickness		Avg	Individual
PILAC-BT33 (SM490TMC)	325	490~610	80	6 ≤ t ≤ 16	No.1A	≥ 17	≥ 47J@0°C	16 ≤ t ≤ 80	25	15
				16 < t ≤ 40	No.1A	≥ 21				
				40 < t ≤ 80	No.4	≥ 23				
PILAC-BT36 (SM520TMC)	355	520~640	85	9 ≤ t ≤ 16	No.1A	≥ 15	≥ 47J@0°C			
				16 < t ≤ 40	No.1A	≥ 19				
				40 < t ≤ 80	No.4	≥ 21				
PILAC-BT45 (SM570TMC)	440	570~720	85	12 ≤ t ≤ 16	No.5	≥ 19	≥ 47J@-5°C			
				16 < t ≤ 20	No.5	≥ 26				
				20 < t ≤ 80	No.4	≥ 20				
PILAC-BT66 (HSA800)	650~770	850~950	85	t ≤ 16	No. 5	≥ 15	≥ 47J @ -5°C			
				16 < t ≤ 20	No. 5	≥ 22				
				t > 20	No. 4	≥ 16				

HSB Steel for Bridge Structure

HSB (High-performance Steel for Bridge structure)

HSB, customized plate for bridge structures has excellent weldability, strength, toughness compared to previous bridge structure steel.

Chemical Composition

Grade	Thickness (mm)	Element(% ,Max.)								Ceq (% ,Max.)	Pcm (% ,Max.)
		C	Si	Mn	P	S	Cu	Cr	Ni		
HSB500,500L	≤ 100mm	0.18	0.55	1.80	0.020	0.006	-	-	-	0.40	0.20
HSB500W	≤ 100mm	0.18	0.55	1.80	0.020	0.006	0.10~0.50	0.45~0.75	0.05~0.80	0.47	0.22
HSB600,600L	≤ 100mm	0.10	0.55	1.80	0.020	0.006	-	-	-	0.42	0.20
HSB600W	≤ 100mm	0.10	0.65	1.80	0.020	0.006	0.10~0.50	0.45~0.75	0.05~0.80	0.47	0.22
HSB800,800L	≤ 50mm	0.10	0.55	2.20	0.015	0.006	-	-	-	0.55	0.25
HSB800W	≤ 50mm	0.10	0.65	2.20	0.015	-	0.10~0.50	0.45~0.75	0.05~0.80	0.60	0.27
HSA800	≤ 60mm	0.20	0.55	3.0	0.015	0.006	-	-	-	0.60	0.30

Ceq(%) = C+Mn/6+Si/24+Ni/40+Cr/5+Mo/4+V/14

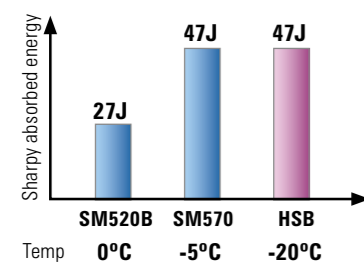
Pcm(%) = C+Si/30+Mn/20+Cu/20+Ni/60+Cr/20+Mo/15+V/10+5B

* L : Low Temperature, W: Weathering

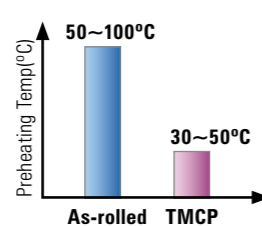
Mechanical Properties

Grade	Thickness (mm)	Tensile Test					Impact Test (longitudinal)	
		YS (Min.,MPa)	TS (MPa)	Elongation(Min.)			Absorbed Energy	
				Thickness	Test Piece	%		
HSB500	t ≤ 100	≥ 380	≥ 500	t ≤ 16	1A	≥ 15	≥ 47J @-5°C	
HSB500L				16 < t ≤ 40	1A	≥ 19	≥ 47J @-20°C(Low Temp)	
HSB500W				t > 40	No. 4	≥ 21	≥ 47J @-5°C	
HSB600	t ≤ 100	≥ 450	≥ 600	t ≤ 16	No. 5	≥ 19	≥ 47J @-5°C	
HSB600L				16 < t ≤ 20	No. 5	≥ 26	≥ 47J @-20°C(Low Temp)	
HSB600W				t > 20	No. 4	≥ 20	≥ 47J @-5°C	
HSB800	t ≤ 50	≥ 690	≥ 800	t ≤ 16	No. 5	≥ 15	≥ 47J @-20°C	
HSB800L				16 < t ≤ 20	No. 5	≥ 22	≥ 47J @-40°C(Low Temp)	
HSB800W				t > 20	No. 4	≥ 16	≥ 47J @-20°C	
HSA800	t ≤ 60	650~770	800~950	t ≤ 60	No. 4	≥ 16	≥ 47J @-5°C	

Charpy Test



Weldability



* More than TMCP 600MPa grade high strength materials must conform y-groove test results.

Additional Guaranteed Quality

Grade	Z-direction Characteristics(Z-RA, %)			Ultrasonic Test Thickness Test Method* (mm)	Additional Guarantee	Manufacturing Method
	Thickness (mm)	Individual Min.	Average Min.			
SS490	Not evaluated			Upon customer's request	-	As-Rolled
SM490	Upon customer's request			Upon customer's request	-	As-Rolled
SM520(B,C)	Upon customer's request			Upon customer's request	-	As-Rolled(Nor')
PILAC-BT33	16 ≤	15	25	Upon customer's request	YR,Ceq	TMCP
PILAC-BT36	16 ≤	15	25	Upon customer's request	YR,Ceq	TMCP
SN490 B	16 ≤	15	25	13~100 KS D 0040 Upon customer's request	YR,Ceq	As-Rolled
SN490 C	16 ≤	15	25	16~100 KS D 0040(mandatory)	YR,Ceq	(B,C Nor')
HSB500	Upon customer's request			Upon customer's request	-	TMCP
HSB500L	Upon customer's request			Upon customer's request	-	TMCP
SS540	Not evaluated			Upon customer's request	-	As-Rolled
SM570(QT)	Upon customer's request			Upon customer's request	-	QT
PILAC-BT45	16 ≤	15	25	Upon customer's request	Ceq	TMCP
HSB600 HSB600L	Upon customer's request			Upon customer's request	-	TMCP
HSB800 HSB800L	Upon customer's request			Upon customer's request	-	TMCP
PILAC-BT66 HSA800	16 ≤	15	25	Upon customer's request	YR,Ceq	TMCP

KS D0040 is equivalent to JIS G 0901.

EN10025 Structural Steel

Chemical Composition

Grade	Element (max., %)										CEV (Max.,%) t=30t
	C			Si	Mn	P	S	N	Cu	Others	
	16 ≤ t	16 < t ≤ 40	40 < t								
S235JR	0.17	0.17	0.20	-	1.40	0.035	0.035	0.012	0.55	-	0.35
S235J0	0.17	0.17	0.17	-	1.40	0.030	0.030	0.012	0.55	-	0.35
S235J2	0.17	0.17	0.17	-	1.40	0.025	0.025	-	0.55	-	0.35
S275JR	0.21	0.21	0.22	-	1.50	0.035	0.035	0.012	0.55	-	0.40
S275J0	0.18	0.18	0.18	-	1.50	0.030	0.030	0.012	0.55	-	0.40
S275J2	0.18	0.18	0.18	-	-	0.025	0.025	-	0.55	-	0.40
S355JR	0.24	0.24	0.24	0.55	1.60	0.035	0.035	0.012	0.55	-	0.45
S355J0	0.20	0.20	0.22	0.55	1.60	0.030	0.030	0.012	0.55	-	0.45
S355J2	0.20	0.20	0.22	0.55	1.60	0.025	0.025	-	0.55	-	0.45
S355K2	0.20	0.20	0.22	0.55	1.60	0.025	0.025	-	0.55	-	0.45
S355NL	0.18	0.18	0.18	0.50	0.90~1.65	0.025	0.02	0.015	0.55	Ti,Al,V,Nb	0.45
S355ML	0.14	0.14	0.14	0.50	1.60	0.025	0.02	0.015	0.55	Ti,Al,V,Nb	0.45
S420ML	0.16	0.16	0.16	0.50	1.70	0.025	0.02	0.025	0.55	Al,Nb,Ni,Cr,Ti	0.45
S450J0	0.20	0.20	0.22	0.55	1.70	0.030	0.030	0.025	0.55	-	0.47
S460ML	0.16	0.16	0.16	0.60	1.70	0.025	0.02	0.025	0.55	Al,Nb,Ni,Cr,Ti	0.46

Mechanical Properties

Grade	Strength at t=16t		Charpy V-Notch longitudinal		Elongation (L ₀ =5.65√S ₀)			EN10025 :1993	BS4360 :1990			
	YP(Reh) (MPa)	TS(Rm) (MPa)	Temp (°C)	Absorbed Energy(J)	Position	L ₀ =5.65√S ₀		Grade	Grade			
						t≤40	40<t≤63					
S235JR	235	360/510	20	27	L	26	25	S235JR(G1/G2/AR)	40B			
S235J0			0	27				T	24	23	S235J0(AR)	40C
S235J2			-20	27							S235J2(G3/G4/AR)	40D
S275JR	275	410/560	20	27	L	23	22	S275JR	43B			
S275J0			0	27				T	21	20	S275J0	43C
S275J2			-20	27							S275J2G3/G4	43D
S355JR	355	470/630	20	27	L	22	21	S355JR	50B			
S355J0			0	27				T	20	19	S355J0	50C
S355J2			-20	27							S355J2G3/G4	50D
S355K2			-20	40							S355K2G3/G4	50DD
S355NL	355	470/630	-50	27	T	22	22	S355NL	-			
S355ML			-50	27				S355ML	-			
S420ML	420	520/680	-50	27	T	19	19	-	-			
S450J0	450	550/720	0	27	L	17	17	-	-			
S460ML	460	540/720	-50	27	T	17	17	-	-			

Steel Plate for Mechanical Structure

Usage	Spec	Thickness	Manufacturing method
Mechanical Structure	S10C	≤ 105t	As-rolled
	S20C	≤ 100t	
	S30C	≤ 70t	
	S40C, S50C	≤ 105t	
	S40C, S45C, S55C	≤ 200t * Strict internal quality assurance : ≤ 150t	
	SCM440	≤ 80t	As-rolled
Mold	POSMOLD1	≤ 70t	Normalized
	POSMOLD2	≤ 80t	

[POSMOLD] Steel for Mold

Grade	Element (%Max.)					Remark (POSMOLD)
	C	Si	Mn	P	S	
POSMOLD1	0.47~0.53	0.15~0.35	0.60~0.90	0.030	0.020	POSCO MOLDBASE
POSMOLD2	0.38~0.43	0.15~0.35	0.60~0.85	0.030	0.020	

[POS-AG] Steel Plate for Zinc Pot

Grade	Thickness(mm)	Element (%Max.)				
		C	Si	Mn	P	S
POS-AG	6~80	0.20	0.05	0.20~0.40	0.010	0.010

Abrasion-Resistant Steel

Chemical Composition

Grade	Thickness(mm)	Element(% Max.)								Ceq (% Max.)
		C	Si	Mn	P	S	Cu	Cr	Others	
POS-AR320	9~50	0.20	0.5	1.5	0.025	0.015	0.5	0.8	Mo, Ni, Cu, V, Ti, B Added	0.56
POS-AR360LC	12~40 (6~10T)	0.18	0.5	1.4	0.025	0.015	0.1	0.8		0.53
POS-AR400	12~50	0.25	0.5	1.5	0.025	0.015	-	0.8		0.58
POS-AR500LC	12~50	0.35	0.5	1.4	0.025	0.015	0.1	0.8		0.65

*Ceq(%) : C+Mn/6+(Cu+Ni)/15+(Cr+Mo+V)/5

Mechanical Properties

Grade	Tensile Test			Impact Test	Surface Hardness(HB)	Bendability	Heat Treatment
	YS(Min., MPa)	TS(MPa)	El(%)	CVN@-40°C(J)			
AR360LC	≥ 1000	≥ 1200	≥ 15	≥ 27(reference)	360~440	180°, r=3.0t	Q

Equivalent Standard

Company	Spec	Thickness(mm)	POSCO Equivalent Spec
SSAB (Sweden)	HARDOX 400	3~130	POS AR360LC

High Strength Steel for Welded Structure (POSTEN)

Chemical Composition

Grade	Thickness(mm)	Element(% Max.)								Ceq (% Max.)
		C	Si	Mn	P	S	Cr	Others		
POSTEN55H	9~17	0.18	0.55	1.6	0.035	0.035	-	-	0.47	
POSTEN60	6~80	0.16	0.15~0.55	1.50	0.030	0.025	0.30	Ni,Mo,V Added	(t ≤ 50) 0.44 (T > 50) 0.47	
POSTEN60RE	6~25	0.12	0.15~0.55	2.0	0.030	0.030	-	Ti,Nb,V Added	0.45	
POSTEN60FW	6~40	0.08	0.15~0.55	1.60	0.030	0.030	0.25	Ni,Mo,V,Ti Added	0.43	
POSTEN70TM	10.01~40	0.1	0.5	2.8	0.025	0.030	-	Nb,Ni,Ti,Cr Added	0.60	
POSTEN80	8~70	0.16	0.15~0.35	1.20	0.030	0.030	0.4~0.8	Cu,Ni,Mo, V Added	0.60	
POSTEN80TM	16~60	0.10	0~0.55	2.2	0.030	0.030	0.8	Cu,Nb,Ni,Mo, V,Ti Added	0.55	
POSTEN100	10~50	0.16	0.15~0.35	1.20	0.030	0.030	0.4~0.8	Cu,Nb,B,Ni,Mo, Ti,V Added	0.70	
POSTEN100TM	8~70	0.16	0.15~0.35	1.20	0.030	0.030	0.4~0.8	Cu,Nb,Ni,Cr, Mo,Ti,V Added	0.60	

Ceq(%)=C+Mn/6+Si/24+Ni/40+Cr/5+Mo/4+V/14

Pcm(%)=C+Si/30+Mn/20+Cu/20+Ni/60+Cr/20+Mo/15+V/10+5B

Mechanical Properties

Grade	Tensile Test					Impact Test		Heat Treatment
	YS (Min., MPa)	TS (MPa)	EL			Temp (°C)	Energy (J)	
			Thickness	TestPiece	%			
POSTEN55H	393	540(Min.)	t ≤ 16	No.4	19	-5	49(>12t)	TMCP
			16 < t	No.4	26			
POSTEN60	450	590/710	t ≤ 16	No.4	20	-5	47(>12t)	QT/DQT
			16 < t ≤ 20	No.4	28			
			20 < t	No.4	20			
POSTEN60RE	450	590/710	t ≤ 16	No.4	20	-5	47(>12t)	TMCP
			16 < t	No.4	20			
			t ≤ 16	No.4	18			
POSTEN60FW	491	609/735	16 < t ≤ 20	No.4	25	-10	47(>12t)	QT
			20 < t	No.4	19			
			6 ≤ t ≤ 16	No.4	11			
POSTEN70TM	550	550(Min.)	16 < t ≤ 20	No.4	16	-40	10	TMCP
			20 < t ≤ 40	No.4	12			
			t ≤ 16	No.4	16			
POSTEN80	686	785/930	16 < t ≤ 20	No.4	24	-20	36	QT/DQT
			20 < t ≤ 65	No.4	16			
			65 < t	No.13	16			
			t ≤ 16	No.4	16			
POSTEN80TM	690	795/930	16 < t ≤ 20	No.4	16	-20	36	TMCP
			20 < t	No.13	16			
POSTEN100	885	950/1130	6 ≤ t ≤ 16	No.4	14	-20	27	QT
			16 < t ≤ 20	No.4	22			
			20 < t ≤ 50	No.4	14			
POSTEN100TM	885	950/1130	10 ≤ t ≤ 16	No.4	11	-20	27	TMCP
			16 < t ≤ 20	No.4	16			
			20 < t ≤ 35	No.13	12			

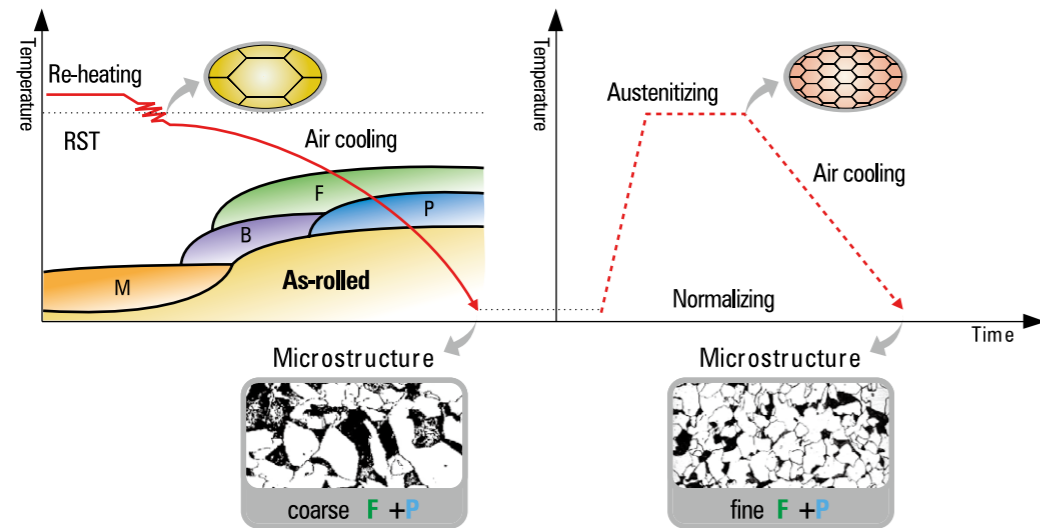
TMCP Steel

Introduction

TMCP(Thermo-Mechanical Control Process) Steel for construction and shipbuilding is manufactured by controlled rolling and subsequent rapid cooling with low alloy contents.

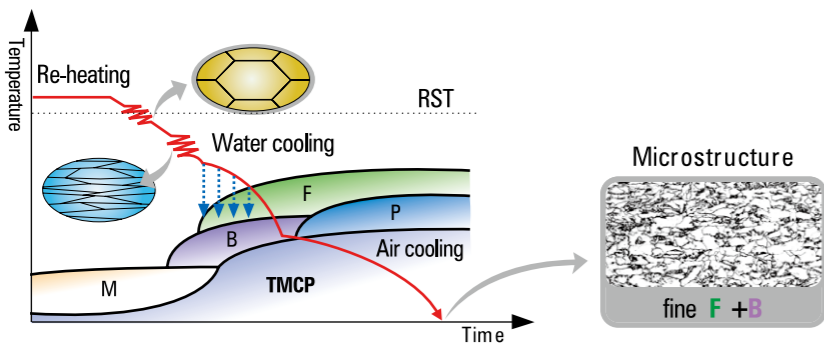
TMCP steel shows excellent strength, toughness and weldability superior to conventional high strength steels produced by heat treatment(normalizing).

Conventional Process (Normalizing)



* RST: Recrystallization Stop Temperature F Ferrite P Pearlite B Bainite M Martensite

TMCP

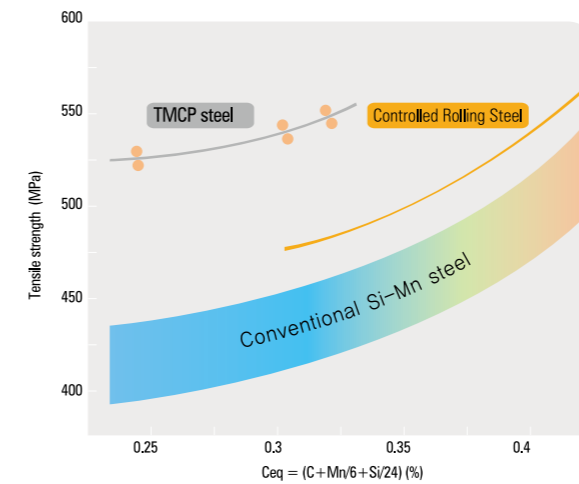


Controlled rolling and cooling processes enable TMCP steel to improve both strength and toughness effectively by refining the microstructures.

Advantages

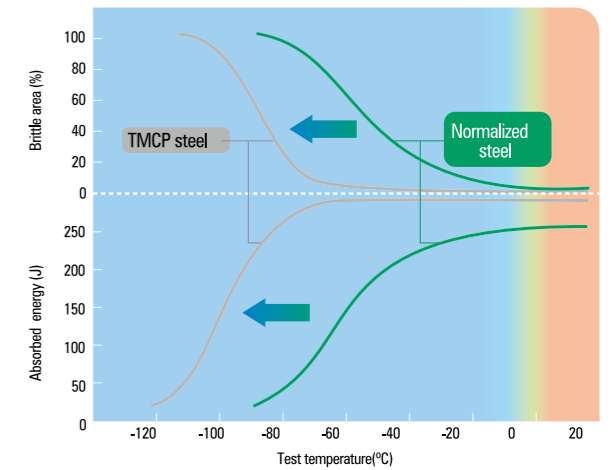
Advantages for manufacturer(shipbuilders) include the lower production costs, higher productivity and shorter project period.

Increased strength by controlled rolling and cooling



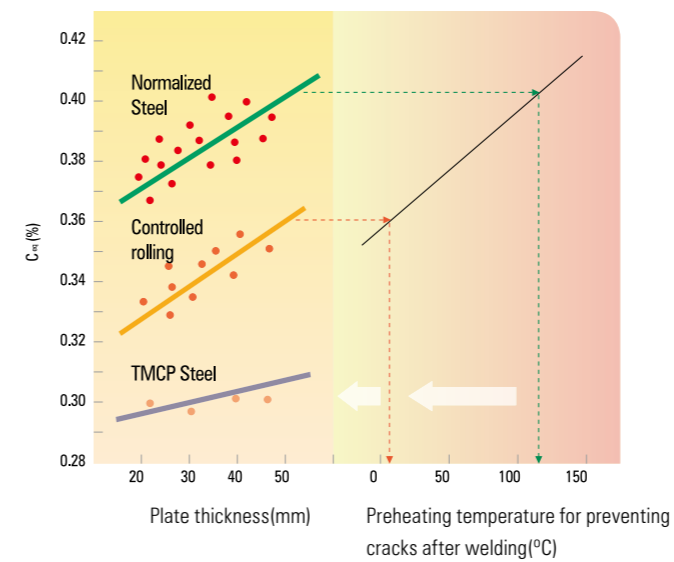
Relation between carbon equivalent and strength by production process.

Improvement of base metal toughness



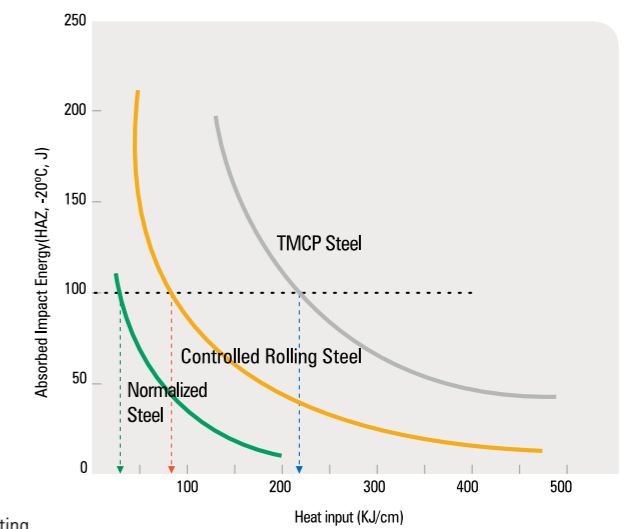
Toughness comparison between TMCP and normalizing process.

No preheating required in welding



HAZ : Heat Affected Zone

Improved HAZ toughness for high heat input welding



List of Mechanical Tests

List	Test	Guaranteed				Reference (R&D Lab's Test)	
		Ship	Offshore	Line Pipe	Pressure Vessel		
Material	Strength, Ductility	Tensile Test	○	○	○	○	-
		Large Scale Tensile Test	-	-	-	-	○
	Formability	UOE Forming Simulator	-	-	-	-	○
	Toughness	Charpy Impact Test	○	○	○	○	-
		Strain Aging Impact Test	○	○	△	-	-
		DWTT(Drop Weight Tear Test)	-	-	△	-	-
		NRL Drop Weight Test	○	○	-	-	-
	Resistance to Lamellar Tear	Through Thickness Tensile Test	○	○	-	○	-
	Abrasion Resistant	Hardness Test	○	○	○	○	-
	Resistance to HIC	Hydrogen Induced Cracking Test	-	-	○	○	-
	SSCC	Sulfide Stress Corrosion Cracking Test	-	-	△	△	○
	High Temperature Strength	High Temperature Tensile Test	○	○	○	○	-
	Creep Characteristic	Creep Test	-	-	-	-	○
	Fracture Toughness	CTOD Test	-	○	○	-	○
		Deep Notch Test	-	-	-	-	○
ESSO Test(Kca)		-	-	-	-	○	
Fatigue Strength & Life	Fatigue Test(S-N curve)	-	-	-	-	○	
Internal Soundness	Internal Defect	Ultrasonic Test(UST)	○	○	○	○	-
	Inclusion	Micrographs	○	○	○	○	○
	Segregation	S-print	-	-	-	-	○
Macro Etching Test		-	△	△	△	○	
Weldability	Welding Hardness	Welding HAZ's Max. Hardness	-	-	-	-	○
		Taper Test	-	-	-	-	○
	Welding Crack	Hardness γ-groove	-	-	-	-	○
	Susceptibility	Weld Bead Bend Test	-	○	-	-	-
Specimen Simulated Heat Treatment	PWHT, SR, HF, Nor'	-	○	△	○	○	

○ Available △ Further Discussion Required

Marking

Marking

Starting Position : 100mm, 360mm or 1,000mm

Marking	Size(mm)	No. of Characters	No. of Lines
Small	34 x 24	24	12
Medium	49 x 34	16	9
Large	69 x 49	12	6
Special	79 x 79	8	6

Side Label Contents

Mandatory : Plate No. + Order No. + Specification + Size

Optional : Stock Lot No., Marking PO, Customer Code, Destination Code, POSCO, Heat No., Net Weight

Color Stroke Method

Color : Yellow, White, Red

Number of Lines : Max. 3 Lines/color

Die Stamping Contents

Mandatory : Plate No.

Optional : Heat No., Classification Society Mark, Grade, POSCO

* Grade marking is available only for Shipbuilding Steel




Unit mm

POSCO Mill Test Certificate

POSCO guarantees to provide mill test certificate to its customers.

The original copy of mill test certificate is available at www.steel-N.com



Mill Test Certificate/검사증명서

Order No./계약번호 : *****
 Supplier /수입사 : *****
 Customer /고객사 : *****

Certificate No./증명서번호 : *****
 Date of Issue/발령일자 : *****

PO No./주문번호 : *****
 Commodity : STEEL PLATES
 Spec & Type : TOTAL S355KT-40 Z35

POSCO

Order No./계약번호 : *****
 Supplier /수입사 : *****
 Customer /고객사 : *****

Spec/과구	Product No. 제품번호	Quantity 수량	Weight 중량 (kg)	Heat No. 재열번호	Position	Tensile Test 인장시험				Z-Direction Tensile Test			Impact Test 충격시험 V Notch -40°C Energy (Joules)	U.S.T	Division	Chemical Composition/화합성분 (%)										
						YP (MPa)	TS (%)	EL (%)	YR (%)	TS (MPa)	RA (%)	1				2	3	Avg	C	Si	Mn	P	S	Cr	Ni	B
403050000	*****	1	9,194	SJ06289	I	495	568	25	87.1	537.9	74	75	74	75	1.314	Good	L	0.0788	0.291	1.554	0.0065	0.0214	0.014	0.011	3	0.012
<p>*** Specimen No: Tension => KP03083603 Z-Tension => KP03083603 Impact => KP03083603</p> <p>*** Sub Total (kg) *** 1 9,194 (kg)</p> <p>*** Heat Treatment *** Thermo Mechanical Rolling + Accelerated Cooling</p> <p>*** Lot Total *** 1 9,194 (kg)</p> <p>*** Grade Total *** 1 9,194 (kg)</p> <p>*** Grand Total *** 1 9,194 (kg)</p>																										
<p>Sample</p> <p>CRD (C) = C + Mn/6 + (Ni + Cu)/15 + (Cr + Mo + V)/5 PCM (B) = C + Si/30 + (Mn + Cu + Cr)/20 + Ni/10 + Mo/15 + W/10 + S/5</p>																										

This Mill Test Certificate can be used only for reference.

본 문서는 견본문서로서 용도 외 사용을 엄격히 금합니다.

Surveyor To : BV(INDUSTRY)


Lee, Yong-Heon

POSCO

Gwangyang Works, 20-26, Pokpocwang-gil, Gwangyang-si, Jeollanam-do, 545-711, Korea

POSCO

Gwangyang Works, 20-26, Pokpocwang-gil, Gwangyang-si, Jeollanam-do, 545-711, Korea



Mill Test Certificate/검사증명서

Order No./계약번호 : *****
 Supplier /수입사 : *****
 Customer /고객사 : *****

Certificate No./증명서번호 : *****
 Date of Issue/발령일자 : *****

PO No./주문번호 : *****
 Commodity : STEEL PLATES
 Spec & Type : TOTAL S355KT-40 Z35

POSCO

Order No./계약번호 : *****
 Supplier /수입사 : *****
 Customer /고객사 : *****

Product No. 제품번호	Division	Mo	N	Nb	Ti	V	Total-N	ClO	PCM	Chemical Composition/화합성분 (%)	
										C	Si
*****	L	0.021	0.002	0.005	0.0109	0.002	0.026	0.393	0.170	0.0788	0.291
*****	P	0.002	0.019	0.0108	0.002	0.026	0.160			0.0788	0.291
<p>*** Sub Total (kg) *** 1 9,194 (kg)</p> <p>*** Lot Total *** 1 9,194 (kg)</p> <p>*** Grade Total *** 1 9,194 (kg)</p> <p>*** Grand Total *** 1 9,194 (kg)</p>											
<p>Sample</p> <p>CRD (C) = C + Mn/6 + (Ni + Cu)/15 + (Cr + Mo + V)/5 PCM (B) = C + Si/30 + (Mn + Cu + Cr)/20 + Ni/10 + Mo/15 + W/10 + S/5</p>											

This Mill Test Certificate can be used only for reference.

본 문서는 견본문서로서 용도 외 사용을 엄격히 금합니다.

Surveyor To : BV(INDUSTRY)

Lee, Yong-Heon

POSCO

Gwangyang Works, 20-26, Pokpocwang-gil, Gwangyang-si, Jeollanam-do, 545-711, Korea

POSCO

Gwangyang Works, 20-26, Pokpocwang-gil, Gwangyang-si, Jeollanam-do, 545-711, Korea

Global Sales Network (Plate)

We designate one trading company per customer.

● POSCO Sales Corp.

POSCO-China	Beijing	+86-10-5166-6677
	Shanghai	+86-21-6091-2788(ext200)
	Qingdao	+86-532-8683-8362
	Guangzhou	+86-2-3891-1630
POSCO-CDPPC	Dalian	+86-411-3911-3601
POSCO-Asia	Hongkong	+852-9469-4546
POSCO-Japan	Osaka	+81-6-6214-1622
	Tokyo	+81-3-3546-1234
	Nagoya	+81-52-219-9231
POSCO-America	New Jersey	+201-585-3064
POSCO Southasia	Bangkok	+66-2-654-3600
	Jakarta	+62-21-3000-3809
	Kuala Lumpur	+603-2260-3226
	Delhi	+91-12-4476-7500
	Chennai	+91-98400-50545
	Hanoi	+84-4-3771-3208

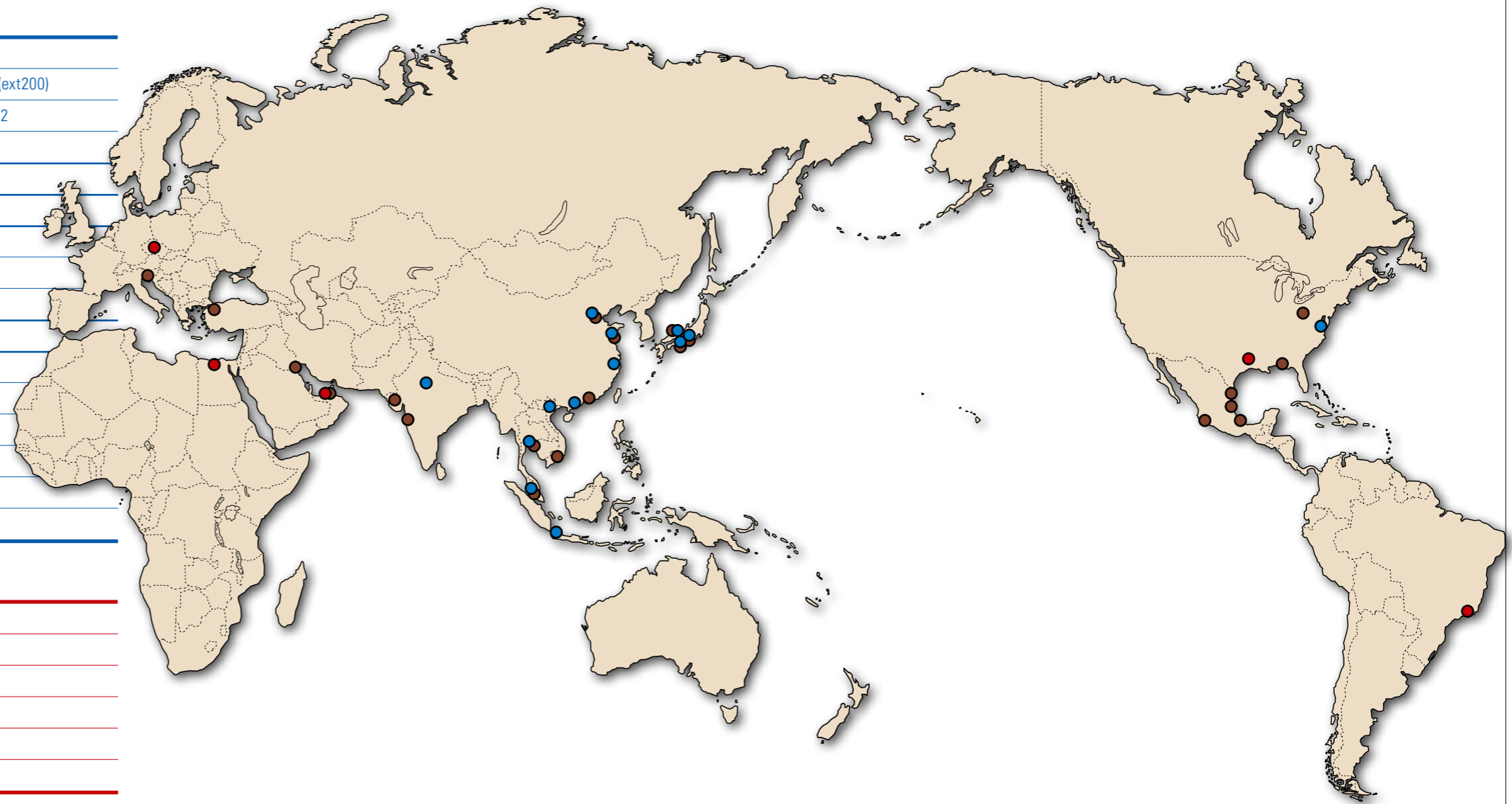
● POSCO Overseas Office

	EU	+49-211-435-300
	Prague	+420-246-088-360
	Dubai	+971-4-221-8280
	Cairo	+20-2-2750-7436
	Rio de Janeiro	+55-21-2543-6132
	Houston	+1-713-979-3946

Providing technical services only

Trading Corp.

POSCO P&S	+82-2-3469-6214
Daewoo International	+82-2-759-2847, 2312
Samsung Corporation	+82-2-2145-3280
Hyosung	+82-2-707-8631
SK Networks	+82-70-7800-2325
Hyundai Corporation	+82-2-390-1677
GS Global	+82-2-2005-5202
LG International Corp.	+82-2-3773-5417
Trans-Pacific Resource Ltd.	+82-2-773-9210(209)
Yoosung Corp.	+82-2-756-6573
KS International	+82-2-551-2803
Steel N People	+82-2-508-5157



● Allocation Pattern by Export Region(CNF)

Region	Main Port	Allocation Cycle	Vessel Size(DWT-base)
China	Beijing, Shanghai, Hong Kong	3times/month	3~5 thousand tons
Japan	Osaka, Tokyo, Nagoya	3times/month	2~3 thousand tons
Southeast	Vung Tau, Laem Cha Bang, Port Kelang	1~3times/month	25~30 thousand tons
Southwest	Bombay, Kandla, Mundra, Chennai	2 times/month	20~30 thousand tons
Middle-east	Kuwait, Dubai	once/month	40~50 thousand tons
Europe	Koper, Ravenna, Gemlik	once/month	40~50 thousand tons
North America	Mobile, Pittsburgh, Brownsville	once/month	40~50 thousand tons
Latin America	Manzanillo, Veracruz, Altamira	2 times/month	40~50 thousand tons

Negotiation with POSCO Salesman is needed regarding discharging port and maritime transportation terms.

Freight rate : Quarter-based rate reflecting oil price and shipping market conditions

STEEL PLATES

Copyright © 2014 by POSCO
All rights reserved

Contact Us

POSCO Center 440, Teheran-ro,
Gangnam-gu, Seoul, Korea
Global Technical Center
TEL 82-2-3457-1586, 0740
FAX 82-2-3457-1980

Headquarters

6261, Donghaean-ro, Nam-gu, Pohang-si,
Gyeongsangbuk-do 790-300, Korea
TEL 82-54-220-0114
FAX 82-54-220-6000

Seoul Office

POSCO Center, 440, Teheran-ro,
Gangnam-gu, Seoul 135-777, Korea
TEL 82-2-3457-0114
FAX 82-2-3457-6000

Pohang Works

6261, Donghaean-ro, Nam-gu, Pohang-si,
Gyeongsangbuk-do 790-785, Korea
TEL 82-54-220-0114
FAX 82-54-220-6000

Gwangyang Works

20-26, Pokposarang-gil, Gwangyang-si,
Jeollanam-do 545-711, Korea
TEL 061) 790-0114
FAX 061) 790-7000

posco

www.posco.com

www.steel-n.com