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# SEAMLESS STEEL LINE PIPE

Pipes  
& Tubes



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SEAMLESS STEEL LINE PIPE  
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**NIPPON STEEL CORPORATION**

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# INTRODUCTION

For more than five decades, NIPPON STEEL has been serving the needs of the oil and gas industries. All the supply records for most of the severe environment of pipe line project indicate that NIPPON STEEL is the leader in line pipe technologies. We have been supplying high quality SEAMLESS STEEL LINE PIPE with most advanced technology and with most reliable quality. Our fully automated mill equipment ensures the high and stable quality of NIPPON STEEL SEAMLESS STEEL LINE PIPE. Research and development are being made in constant pursuit of technical innovation in all areas of SEAMLESS STEEL LINE PIPE product and production.

# Principle of NIPPON STEEL SEAMLESS STEEL LINE PIPE

**Quality**  
Quality is the most fundamental element of our SEAMLESS STEEL LINE PIPE business. We understand that quality leads to product reliability, which in turn leads to customer trust and that in the end, quality is the basis of our reputation. We will continue to be dedicated to maintaining and improving our quality standard.

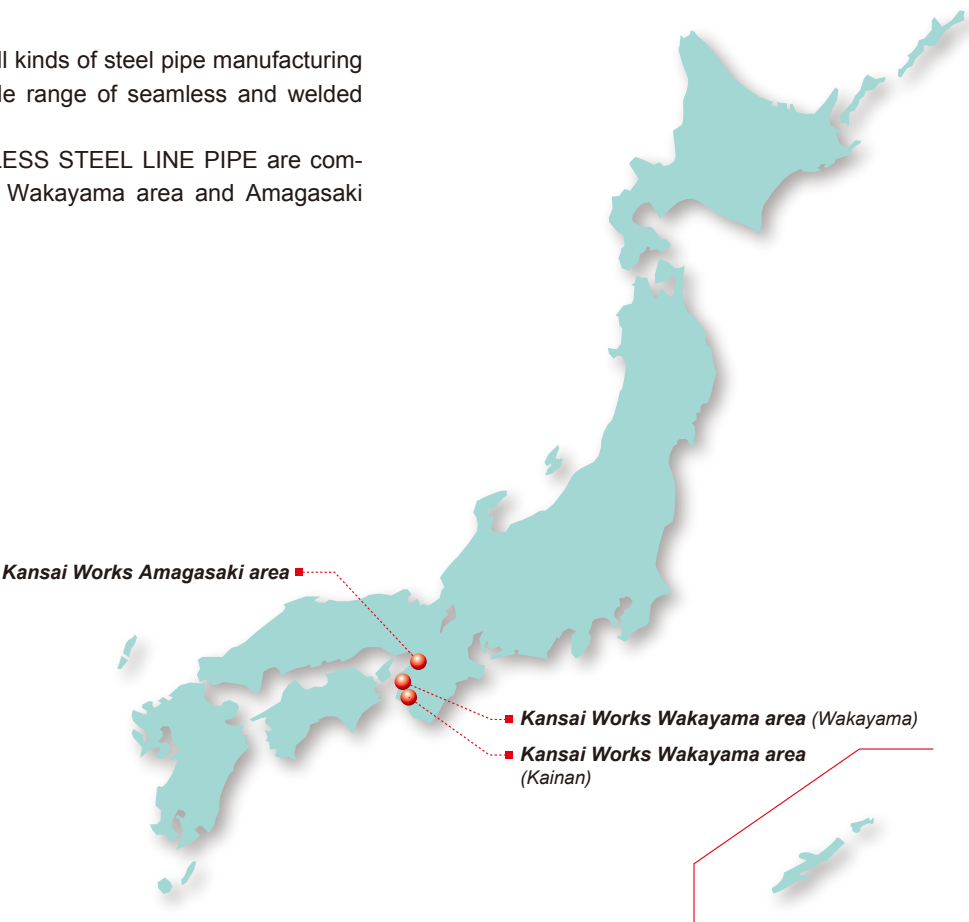
**Technology**  
We understand that customers rely on the technology of our products when they plan pipe line project in severe environment, and we are proud of our No.1 technical position. We will continue to work through our R&D activities to develop high-end products for the future.

**Customer Satisfaction**  
Our goal is to be more than just a superior product supplier. We intend to also be a superior solutions provider for our line pipe products customers. We place importance not just on managing material sales, but also on “before” and “after service”. Customer satisfaction drives our constant and growing commitment to the oil and gas industries.

# FACILITIES AND LOCATIONS

NIPPON STEEL has almost all kinds of steel pipe manufacturing facilities which produce a wide range of seamless and welded steel pipe and tubes.

The main facilities for SEAMLESS STEEL LINE PIPE are composed of our Kansai Works Wakayama area and Amagasaki area.



NIPPON STEEL Tube Making Equipment and Available Sizes

Tube Mills		Location of Works	Outside Diameter in Inches																							
			1	2	3	4	5	6	7	8	9	10	15	20	25	30	35	40	45	50	60					
Seamless (Hot Finished)	Mannesmann (2 sets)	Kainan			2 <sup>3</sup> / <sub>8</sub>			7																		
	Mannesmann	Wakayama						5 <sup>1</sup> / <sub>2</sub>				16 <sup>3</sup> / <sub>4</sub>														
	Extrusion	Amagasaki			2 <sup>3</sup> / <sub>8</sub>								9 <sup>5</sup> / <sub>8</sub>													
	Hollow Forging	Amagasaki								8					28											
Cold Finished	Cold Drawn	Kainan	0.625				5																			
	Cold Drawn	Amagasaki			2 <sup>3</sup> / <sub>8</sub>									20												

# MANUFACTURING SITES

## Kansai Works Wakayama area

Kansai Works Wakayama area is the integrated supply center for seamless pipes. The steel billets are produced by a blast furnace, converter, continuous-casting machine. Then, three seamless pipe mills roll the billets into seamless pipes. Above all, the medium-size seamless mill is the most advanced in the world that is directly connected to a round CCM, combined with a cone-type piercer with high cross angle, a mandrel mill and an in-line heat treatment furnace.



(Wakayama)



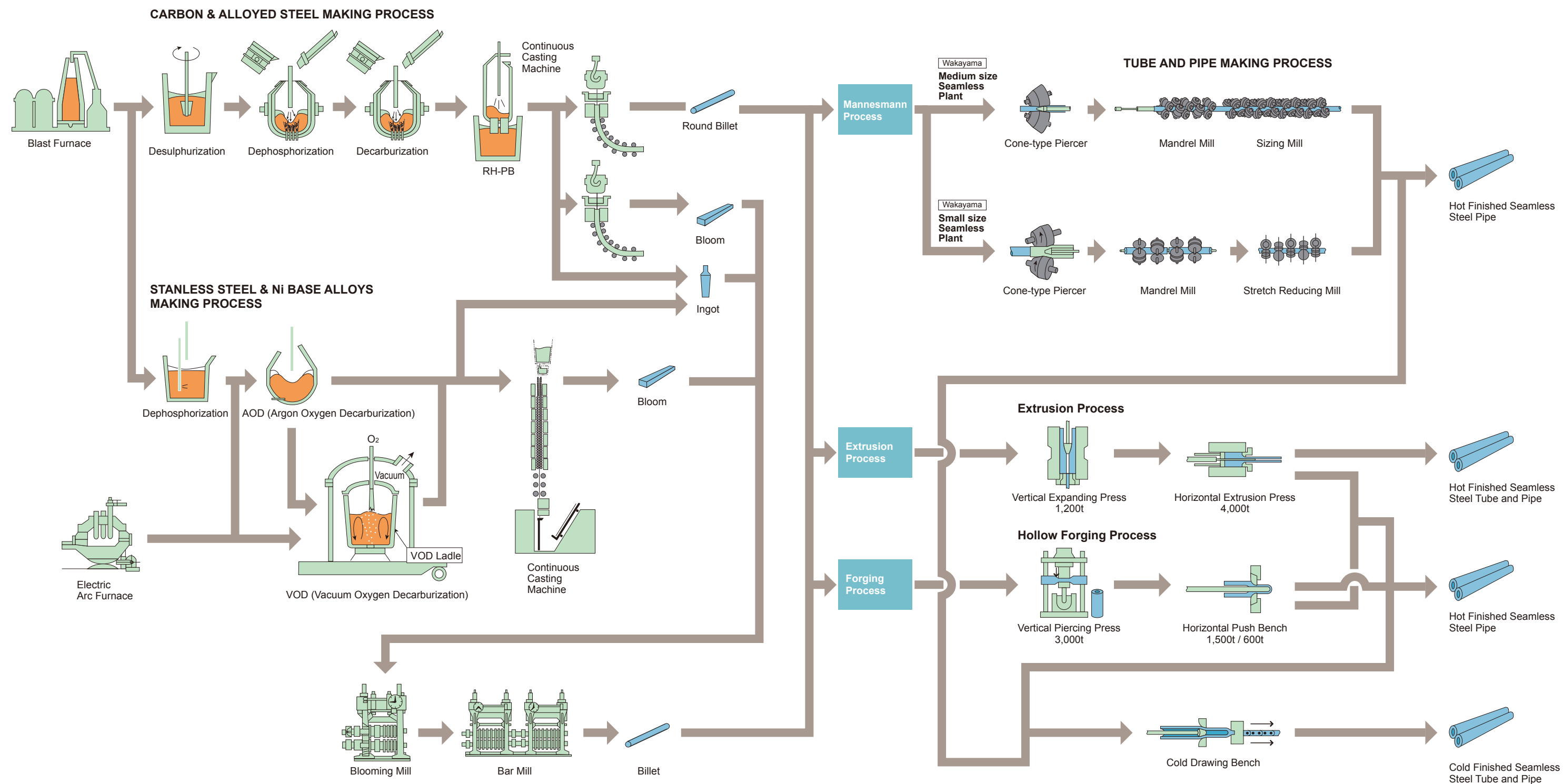
(Kainan)



## Kansai Works Amagasaki area

The Steel Tube Works was established in 1919 as the first integrated mill in Japan for the production of high quality seamless steel tubes and pipe. Since then, the Works has specialized in high quality steel tubes and pipes. The company is committed to ongoing research to improve manufacturing methods and to upgrade quality.

# MANUFACTURING PROCESS OF STEEL TUBES AND PIPES





# APPLICABLE SPECIFICATION

## 1. Line Pipes (Carbon Steel)

API 5L	Line Pipe (Grade B, X42, X46, X52, X56, X60, X65, X70, X80, X90, X100)
ISO 3183	Petroleum and natural gas industries -Steel Pipe for Pipelines-
DNVGL-ST-F101	Submarine Pipeline Systems (Applicable Design Code)
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Seamless
ASTM A106	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A333	Seamless Steel Pipe for Low-Temperature Service
CSA Z245.1	Steel Line Pipe
JIS G3454	Carbon Steel Pipes for Pressure Service (STPG)
JIS G3455	Carbon Steel Pipes for high Pressure Service (STS)

## 2. Line Pipes (Corrosion Resistant Alloy)

API 5LC	CRA Line Pipe
DNVGL-ST-F101	Submarine Pipeline Systems (Applicable Design Code)
ASTM A790	(S31803) Seamless Ferritic / Austenitic Stainless Steel Pipe
ASTM A790	(S31260) seamless Ferritic / Austenitic Stainless Steel Pipe

# MATERIAL DESIGN TECHNOLOGY

## 1. NIPPON STEEL MATERIAL DESIGN CONCEPT FOR SOUR SERVICE

### Performance



### Performance Requirements

Strength

Toughness

Weldability

HIC

### Design Concept

Strength Control by  
Q&T Heat Treatment

#### Clean steel

- Fully killed and fine grained
- Low P, S, N, O, H
- Inclusion shape control
- Low segregation

Pcm Control Weldability

## Manufacturing Available Size Range (Carbon Steel Pipes)

### Available size range for seamless pipe

OD (mm)	Wall thickness (mm)																		Wall thickness (mm)																						OD (mm)							
	2.5	3.0	3.2	3.5	4.0	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10	11	12	13	14	15	16	17	18		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33		34	35	36	37	38	39	40
(26.7)																			Cold finished condition																						(26.7)							
33.4																																									33.4							
42.2																																									42.2							
48.3																																									48.3							
60.3																																									60.3							
73.0																																									73.0							
(76.3)																																									(76.3)							
88.9																																									88.9							
89.1																																									89.1							
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339.7																																									339.7							
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355.6																																									355.6							
(365.1)																																									(365.1)							
(377.0)																																									(377.0)							
(381.0)																																									(381.0)							
406.4																																									406.4							
426.0																																									426.0							
OD (mm)	Wall thickness (mm)																		Wall thickness (mm)																						OD (mm)							

OD in parentheses : Please contact us in advance

— : Available size range for seamless pipe

---: Permissible specified size range of API 5L

# CARBON STEEL LINE PIPE

NIPPON STEEL has supplied Carbon Steel Line pipe with low carbon and low Pcm material. And we can provide tighter ID tolerance at pipe end.

## NIPPON STEEL MATERIAL DESIGN CONCEPT FOR CARBON STEEL

- To Prevent HAZ Hardening in Field Girth Welding, our carbon steel is low carbon and low Pcm.

Table Chemical composition Nippon Steel compared to others

	Size (mm)	C	Si	Mn	P	S	Others	Ceq (IIW)	Pcm
Nippon Steel	355.6OD x 25.4WT	0.05/ 0.07	0.05/ 0.15	1.05/ 1.40	max. 0.015	max. 0.002	Cr, Mo, Ti, and V	0.39	0.17
	406.4OD x 25.4WT						Cr, Mo, Ti, and V	0.39	0.16
Others	355.6OD x 25.4WT	0.10/ 0.12	0.20/ 0.30	1.05/ 1.40	max. 0.015	max. 0.002	Cr, Mo, Ti, V and Nb	0.37	0.20
	406.4OD x 25.4WT						Cu, Ni, Cr, Mo and Nb	0.37	0.19

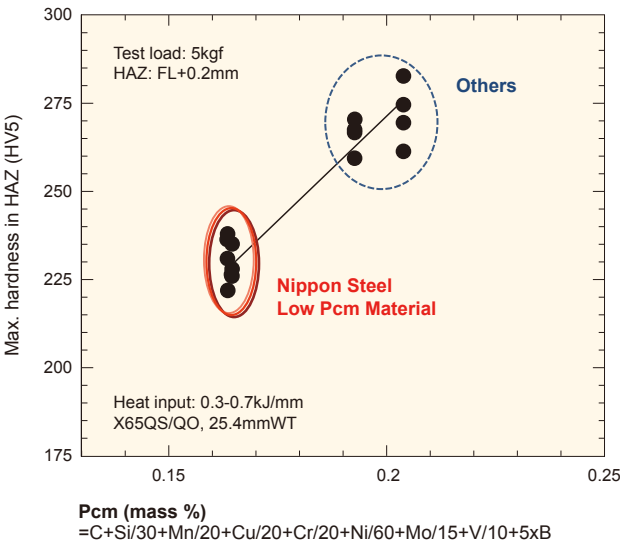
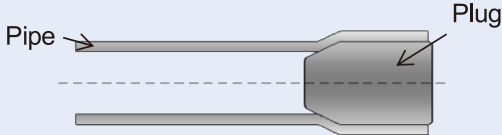
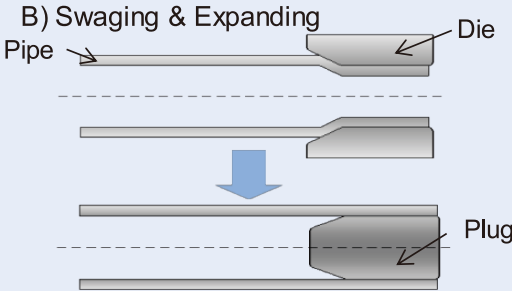
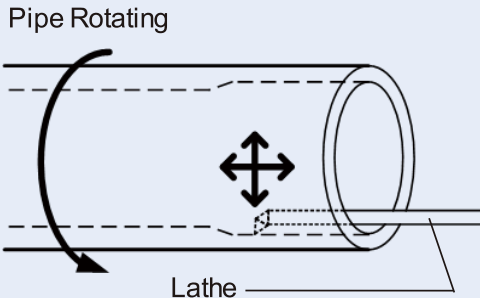


Fig. Hardness test results on typical field girth welds (Mechanized PGMAW)

Low Pcm material prevented HAZ hardening

## NIPPON STEEL PIPE END AVAILABLE ID TOLERANCE

Table Available ID Tolerance and control method

Available ID tolerance	End Sizing	End Machining
	+/- 1.0mm	+/- 0.25mm
ID control method	<div><p>A) Expanding</p></div> <div><p>B) Swaging &amp; Expanding</p></div>	

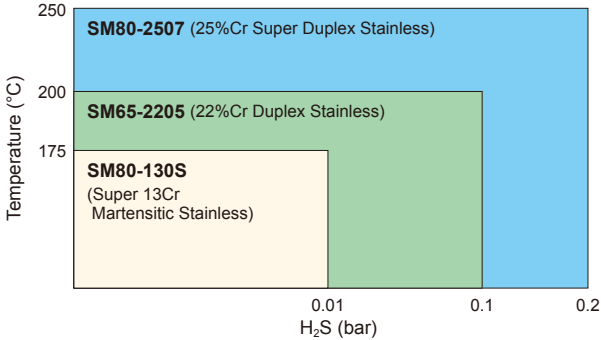
# CORROSION RESISTANT ALLOY LINE PIPES

NIPPON STEEL has supplied Corrosion Resistant Alloy pipes in a wide range of sizes and material grades. In the area of flow lines, Corrosion Resistant Alloy line pipes are used under hostile environmental conditions including CO<sub>2</sub>, Cl<sup>-</sup> and H<sub>2</sub>S.

Material Selection Guideline for Weldable 13Cr and Duplex Stainless Steel Line Pipe

For CO<sub>2</sub> : Superior CO<sub>2</sub> corrosion resistance at elevated temp.  
Beyond the limitation of C-steel + inhibitor system,  
Merit for lower life-cycle-cost and less environmental impact.

For H<sub>2</sub>S : Applicable up to following sour condition



Chemical Composition

Material		Chemical Composition (mass%)								
		C	Cr	Ni	Mo	Cu	Ti	N	W	PREW
SM80-130S <13CrS> (UNS S41525)	Martensitic Stainless	max.0.03	11.5-13.5	4.5-7.0	2.0-3.0	—	0.01-0.50	—	—	—
SM65-2505 <DP8> (UNS S31803)	Duplex Stainless	max.0.03	21.0-23.0	4.5-6.5	2.5-3.5	—	—	0.08-0.20	—	min.34
SM80-2507 <DP3W> (UNS S39274)		max.0.03	24.0-26.0	6.0-8.0	2.5-3.5	0.20-0.80	—	0.24-0.32	1.5-2.5	min.40
SM65-2505 SM70-2505 <DP25U> (UNS S82551)		max.0.03	24.5-26.5	4.5-6.5	0.75-2.00	2.0-3.0	—	0.10-0.35	—	min.30

Mechanical Properties

Material		Temperature (deg.C)	Yield Strength (MPa)	Tensile Strength (MPa)	Hardness (Hv10)
SM80-130S <13CrS> (UNS S41525)	Martensitic Stainless	25	min.550	min.750	max.310
		100	min.540	min.690	—
SM65-2505 <DP8> (UNS S31803)	Duplex Stainless	25	min.450	min.640	max.290
		100	min.380	min.575	—
25		min.550	min.800	max.330	
100		min.480	min.725	—	
25		min.450	min.620	max.290	
100		min.380	min.575	—	
25		min.485	min.660	max.305	
100		min.415	min.595	—	

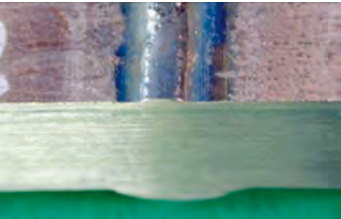
Technical Data for SM80-130S

PWHT is recommendable after GMAW for SM80-130S  
<SCC Resistance at elevated temperature condition>

PWHT is effective to improve SCC resistance of GMAW.

↓

NIPPON STEEL recommends the PWHT of 650°C × 5 minutes.



(root bead of GMAW – as weld)

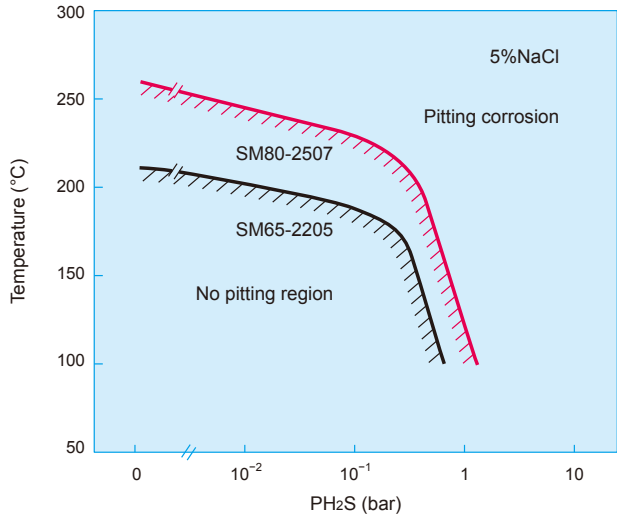
Table. Summary of 4PB test (25%NaCl. 10barCO<sub>2</sub>. 110°C. 720h)

No.	Welding process		PWHT	SCC test results		
				Batch-A	Batch-B	Batch-C
1	GMAW	5G	No	SCC	SCC	SCC
2			650°C × 5min.	No SCC	No SCC	No SCC

[NACE 2008 Paper No.08100]

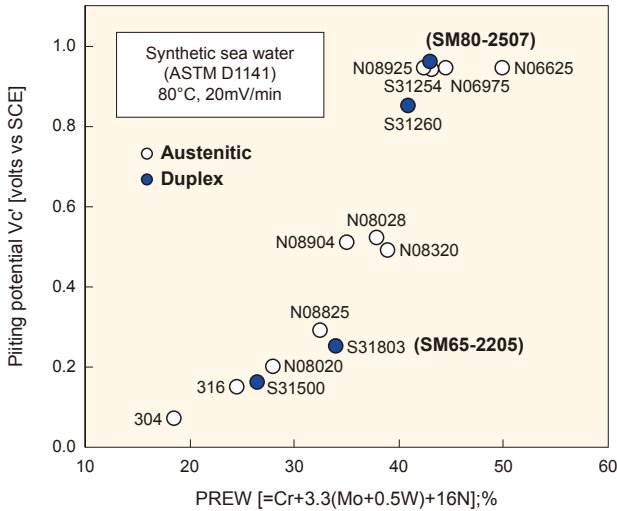
Technical Data for SM65-2205 and SM80-2507

<Corrosion Resistance at elevated temperature condition>



Effect of temperature and partial pressure of H<sub>2</sub>S (PH<sub>2</sub>S) on the susceptibilities of SM80-2507 and SM65-2205 to pitting corrosion in 5%NaCl solution.

<Pitting Resistance in Seawater Environment>



Relationship between pitting potential and PREW (Synthetic Seawater, 80°C)



DP25U

NIPPON STEEL have developed new alloy grade based on the applicability under as-welded condition(No PWHT). Because The PWHT is required for the welded super 13Cr stainless steel and PWHT might have the negative impact in the efficiency of laying operations.

Table Chemical composition of DP25U

Chemical Composition (mass %)							
C	Cr	Ni	Mo	Cu	N	W	PREW
max.0.03	24.5 - 26.5	4.5 - 6.5	0.75 - 2.00	2.0 - 3.0	0.10 - 0.35	-	min.30

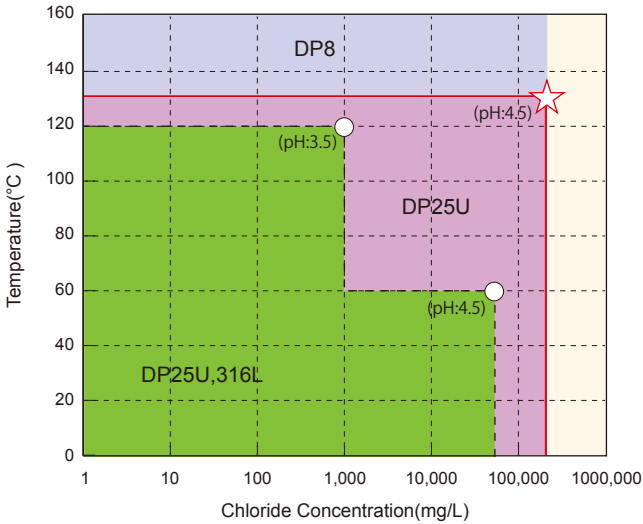
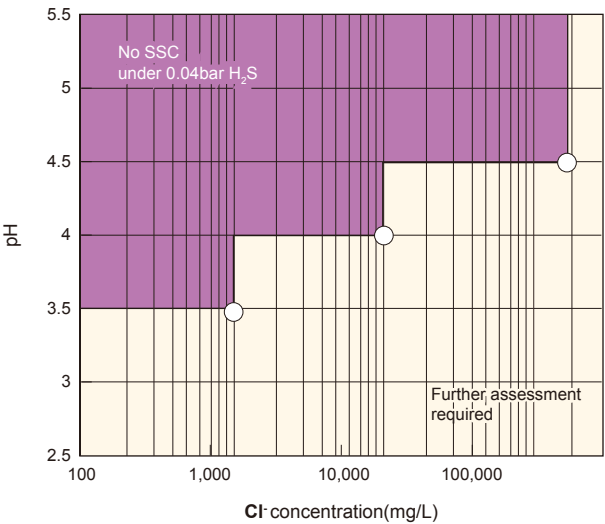
$PREW=Cr+3.3(Mo+1/2W)+16N$

Table Mechanical Properties of DP25U

Material	Grade	Yield Strength (MPa)	Tensile Strength (MPa)	Hardness (Hv10)
DP25U (UNS S82551)	SM65 - 2505	min.450	min.620	max.290
	SM70 - 2505	min.485	min.660	max.305

Corrosion resistance after welding (GMAW) of DP25U

- Welding condision; Consumable : 25Cr SDSS (AWS A5.9 ER2594)  
Heat input : 0.2-1.0 kJ/mm  
PWHT is not applied



★ No SSC on DP25U welded joint (0.04bar H<sub>2</sub>S)      — Recommendable domain of DP25U welded joint

○ - ISO 15156 ballot of 316L Clad <sup>1)</sup>

Reference document  
<sup>1)</sup> Briony K Holmes et al, Corrosion/2010, Paper No. 10308, NACE International(2010).

Fig. Corrosion resistance after welding (GMAW)

Available Size range of DP25U

OD (mm)	Wall thickness (mm)																			
	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
168.3																				
219.1																				
273.1																				
323.9																				
355.6																				
406.4																				

- :Available size
- :Please contact us in advance
- :Unavailable size

memo