

# Solution for Offshore Oil and Gas



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NIPPON STEEL Group has various supply records of developing and supplying high-performance / high quality materials for offshore oil and gas development.

NIPPON STEEL group provides solutions based on the reliability and know-how that precisely matches the needs of the market.

Furthermore, we look to further contribute by leveraging the highest technological development capabilities in the world.

NIPPON STEEL

**Steelmaking**

**Engineering**  
(NIPPON STEEL ENGINEERING CO., LTD.)

**Welding**  
(NIPPON STEEL WELDING & ENGINEERING CO.,LTD.)

**Chemicals**  
(NIPPON STEEL Chemical & Material Co., Ltd.)

**New Materials**  
(NIPPON STEEL Chemical & Material Co., Ltd.)

**System Solutions**  
(NS Solutions Corporation)

**PLATE UNIT**

**BAR & WIRE ROD UNIT**

**CONSTRUCTION PRODUCTS UNIT**

**PIPE & TUBE UNIT**  
(SEAMLESS ERW UO)

**FLAT PRODUCTS UNIT**

**RAILWAY, AUTOMOTIVE & MACHINERY PARTS UNIT**

**TITANIUM & SPECIALTY STAINLESS STEEL UNIT**

**STAINLESS STEEL UNIT**

**Technical Research & Development Bureau**

Research & Engineering Center (Futtsu) Amagasaki R&D Center Hasaki R&D Center

**Promote technology development -key driver for innovation**

Electric Vehicles Lightweight cars COURSE50 Carbon dioxide capture, storage, and utilization

Develop high-performing products and solutions that meet customer's changing needs

Contribution for sustainability CO2 emission reduction, recycling

Oil well pipe with high corrosion resistance Hydrogen community

Process innovation ICT and AI

Low quality raw materials Maximize use of scraps Scheduling Sensing automation

About 800 steel researchers R&D spending ¥220bn/3years (+¥10bn/3years vs. 2017 Plan)

**Derwent Top 100 Global Innovator 2020**

Clarivate Analytics

NIPPON STEEL was Awarded [Derwent Top 100 Global Innovator 2019-20] -Selected for the Top 100

**Global Supply Network (Steel Plates, Pipe and Tubes, Spiral-weld Pipes)**

Seamless pipe production capacity

Approx. **1.6 million tons per year**  
(1 million tons in Japan plus 0.6 million ton overseas)  
(Based on VSB at full-scale production)

**SAUDI ARABIA**  
National Pipe Company

**INDIA**  
ArcelorMittal Nippon Steel India

**CHINA**  
Baoji-SMI Petroleum Steel Pipe

**VIETNAM**  
NIPPON STEEL SPIRAL PIPE VIETNAM CO.,LTD

**U.S.A.**  
Pennsylvania Extruded Tube Company (PEXCO)

**BRAZIL**  
USIMINAS  
Vallourec & Sumitomo Tubos do Brasil (VSB)

**NIPPON STEEL's huge experience of supplying highend materials for world offshore projects will be able to make solutions.**

**High End Plate Supply Record for Offshore Structure**

**High-Strength : YP460, 500, 550**

No.	Year	Area	MAX / YP	Type
1	2014	North Sea	YP500	Fixed
2	2014	-	YP460	Vessel
3	2013	North Sea	YP460	SPAR
4	2012	Gulf of Mexico	YP550	TLP
5	2011	North Sea	YP500	Fixed
6	2006	North Sea	YP500	Drill Ship
7	2005	Asia	YP460	Fixed
8	2003	West Africa	YP460	FPSO

**ARCTIC : Low-Temperature HAZ-Toughness**

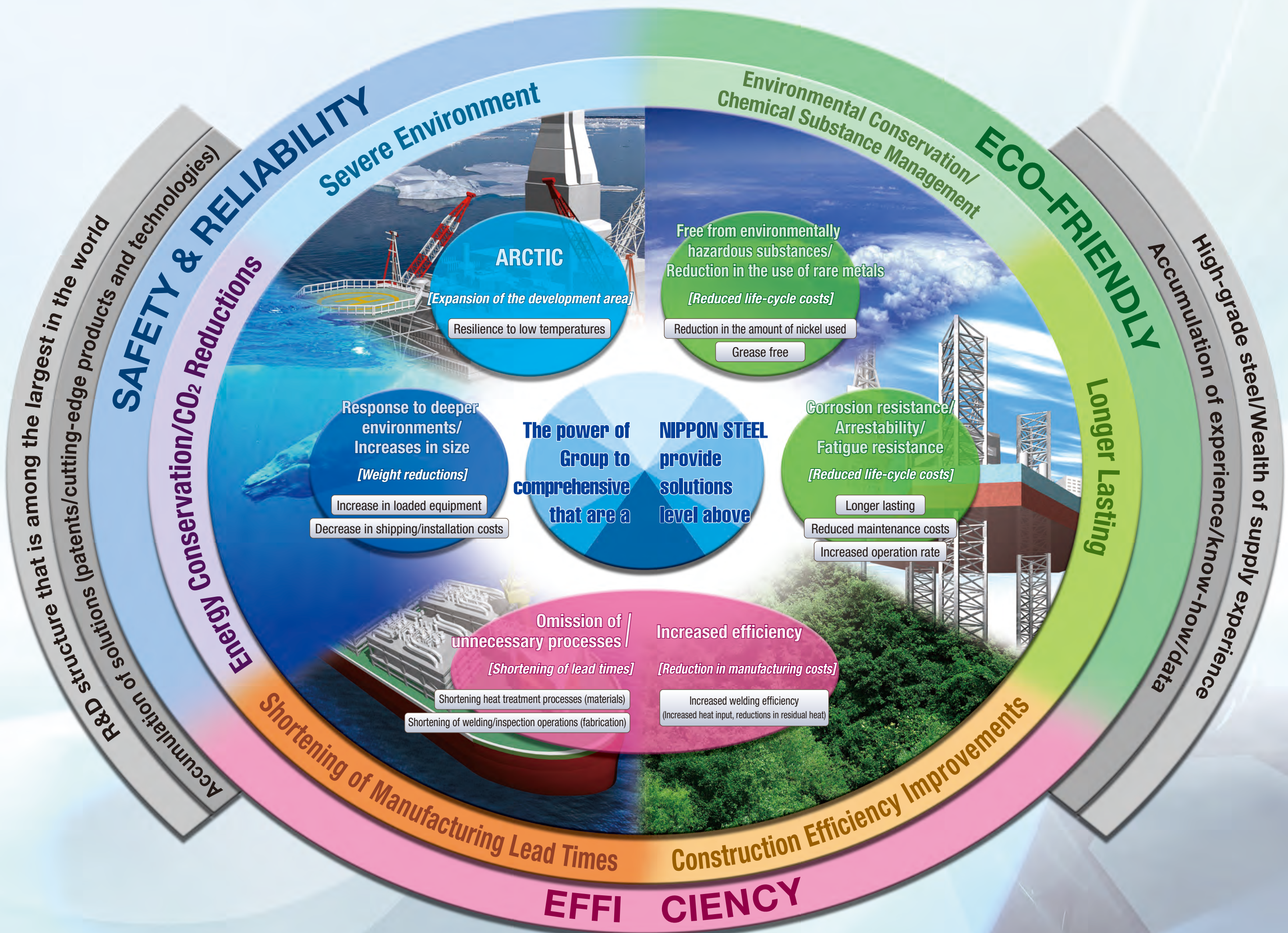
No.	Year	Area	MAX / YP	Design Temp.	Type
1	2012	North Sea	YP355	-20°C	FPSO
2	2012	North Sea	YP420	-20°C	Fixed
3	2011	Russia	YP355	-40°C	GBS
4	2011	North Sea	YP355	-20°C	FPSO
5	2004	Caspian Sea	YP355	-40°C	Fixed
6	2003	Russia	YP460	-40°C	Fixed
7	2002	Russia	YP420	-40°C	Fixed

**Supply Record for TLP's**

★:Plate Supply 16/28 DSAW Supply 17/28  
Total 24/28 All of The World

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1st Oil Year	1984 (RETIRED)	2007	1992	1995	2001	2007	1998	1989	2001 (RETIRED)	2015	2003	1994	1996	2001	2015	1997	1998	1999	2003	1993	2004	2005	2013	2008	2004	2009	2005	2014
Site	UK	Equadral Guinea	Norway	Norway	GoM	Equadral Guinea	GoM	GoM	GoM	Congo	GoM	GoM	GoM	GoM	GoM	GoM	GoM	GoM	Indonesia	GoM	Angola	Angola	Brazil	GoM	GoM	GoM	GoM	GoM
Water Depht (m)	147	271	335	345	454	503	518	536	639	780	859	873	894	910	914	980	987	1009	1021	1159	1178	1178	1180	1280	1311	1333	1425	1581
★ Plate		●		●		●				●			●	●	●	●			●	●	●	●	●		●		●	●
NIPPON STEEL Supply		●			●	●	●	●	●			●	●	●	●	●	●	●			●	●				●		●







## Solution

Expansion of the development area

Weight reductions

Reduced life-cycle costs

Shortening of lead times/Reduction in manufacturing costs

### High Strength Thick Steel Plates for RACK & CHORD (YP690)

Extra thick high strength steel plates with high toughness that meet classification society requirements.

[Plate Unit]



### For Cantilevers/TMCP-type/ EQ51 Steel Plates

High strength steel plates with shortened manufacturing lead times made possible through adopting the TMCP.

[Plate Unit]



### For Jacking System/High Tensile Strength Steel Plates for Cantilevers (YP500-690)

A wide range of high strength steel plates with high toughness that meet classification society requirements.

[Plate Unit]

### Low Temperature High Strength Tough Steel Plates for FLOATING/HULL Use (F-grade steel/YP355-420)

Steel plates that meet classification society requirements and impact test standards at -60°C.

[Plate Unit]

### High Strength Pipe for Bracing

High strength material for bracing (Jack Up Rig).

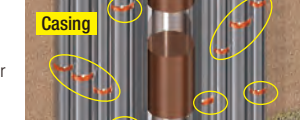
[Pipe & Tube Unit]



### SM125S Casing

High strength material for mild sour environments.

[Pipe & Tube Unit]



### VAM® Premium Connection

World leader for premium connection.

[Pipe & Tube Unit]



### CLEANWELL® DRY

Dope free dry solution developed to satisfy strict environmental regulations related to discharge into the sea.

[Pipe & Tube Unit]



### High Alloy OCTG

Corrosion resistance alloy for oil & gas development.

[Pipe & Tube Unit]

## Provision of high-performance items for all products, from those used for development, to production and transport

### Development / Drilling Rig

#### Fixed

#### Jack Up Rig

#### Floating

#### Semi-submersible

### Production

#### Fixed

#### Fixed Platform

#### TLP

#### Floating

#### FLNG

#### FPSO

#### SPAR

### Transport

#### Vessel

#### Linepipe

### 3.5% Ni, 5% Ni Steel Plates for Ship Tanks

The optimal steel grade (amount of nickel contained) can be selected based on tank contents.

[Plate Unit]



### A841 Grade G for Land LNG Storage Tanks (Ni: 6.0-7.5%)

Steel plates that reduce the amount of nickel used (Ni 6.0-7.5%) while having an equal or improved level of performance as that found with 9% Ni steel.

[Plate Unit]



Storage

### Tendon Pipe

Tendon pipe for tension leg platform.

[Pipe & Tube Unit]



### Corrosion-resistant Steel Plates for Crude Oil Tanker/FPSO Tanks [NSGP™]

Having non-coating specifications makes it possible to reduce coating costs during construction and repairs.

[Plate Unit]



### Duplex Umbilical Tube

DP3W, super duplex stainless steel for umbilical tube.

[Pipe & Tube Unit]



### Wire Rope

High strength wire rope that uses hypereutectoid high strength wire rod.

[Bar & Wire Rod Unit]



### Flat Wire with High Corrosion Resistance

Flat wire with excellent HIC-resistance properties.

[Bar & Wire Rod Unit]



### High Strength Line Pipe

High strength line pipe for flowline, riser and export line.

### Weldable 13Cr Line Pipe and Welding Consumables

Stainless line pipe for CO<sub>2</sub> and H<sub>2</sub>S applications in small quantities (super duplex welding consumable).

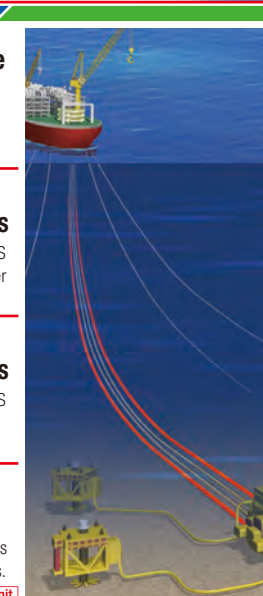
### Duplex Line Pipe and Welding Consumables

Stainless line pipe for CO<sub>2</sub> and H<sub>2</sub>S applications.

### New Duplex DP25U Line Pipe

Newly developed duplex phase stainless steel line pipe for mild sour applications.

[Pipe & Tube Unit]



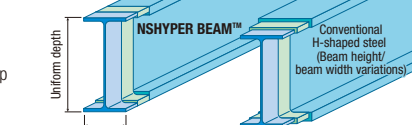
Under Sea

Fixed Platform

### NSHYPER BEAM™

Save fabrication cost and time to build up beam.

[Construction Products Unit]



### Low Temperature CVN H-shapes

Up to -40°C/50J.

[Construction Products Unit]



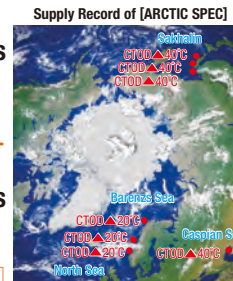
### Steel Plates for -40°C (ARCTIC) Usage Environments

YP420 grade steel plates suited for use in -40°C (ARCTIC) environments/maximum plate thickness of 4" (world first).

### Steel Plates for -20°C (ARCTIC) Usage Environments

YP420 grade steel plates suited for use in -20°C (ARCTIC) environments.

[Plate Unit]



### For Primary Steel/ YP460, 500 Steel Plates

High tensile strength steel plates that guarantee HAZ toughness. (First in the world) YP500

### For Primary Steel/ YP550 Steel Plates

High tensile strength steel plates that guarantee HAZ toughness (world's first application of its kind).

### Concept of Toughness Improvement in HAZ



### Ni Base Alloy for Heat Exchanger Tubes and Piping

Alloy 625, alloy C276, NEXAGE™845, alloy 825 with excellent corrosion resistance to sea water and sour gas.

[Pipe & Tube Unit]



### High Corrosion Resistant Alloy for Heat Exchanger Tube and Piping

S31254, YUS270, super austenitic stainless steel with excellent corrosion resistance to sea water.

[Pipe & Tube Unit]

### Duplex Stainless Steel for Heat Exchanger Tube and Piping

DP3W, S32750, super duplex stainless steel with excellent corrosion resistance to sea water.

[Pipe & Tube Unit]



### A841 Grade G for Ship LNG Storage Tanks (Ni: 6.0-7.5%)

Steel plates that reduce the amount of nickel used (Ni 6.0-7.5%) while having an equal or improved level of performance as that found with 9% Ni steel.

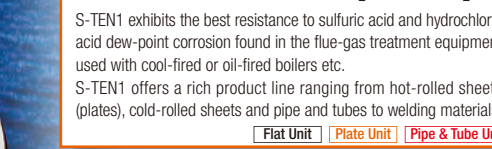
[Plate Unit]



### Steel Resistant to Sulfuric Acid and Hydrochloric Acid Dew-point Corrosion for TOPSIDE MODULE Use [S-TEN™1]

S-TEN1 exhibits the best resistance to sulfuric acid and hydrochloric acid dew-point corrosion found in the flue-gas treatment equipment used with cool-fired or oil-fired boilers etc. S-TEN1 offers a rich product line ranging from hot-rolled sheets (plates), cold-rolled sheets and pipe and tubes to welding materials.

[Flat Unit] [Plate Unit] [Pipe & Tube Unit]



### Mariloy™

Excellent corrosion resistance to seawater and equal weldability to carbon steel.

[Pipe & Tube Unit]



Welding

#### Welding Consumables for Offshore

Welding consumables for offshore use.

#### Seamless Flux Cored Wire

High quality of weldment and easy storage due to excellent resistance to hygroscopicity and rust.

#### Large Heat Input Submerged Arc Welding Consumable

High welding efficiency.

#### Low Temperature Transformed Welding Consumable

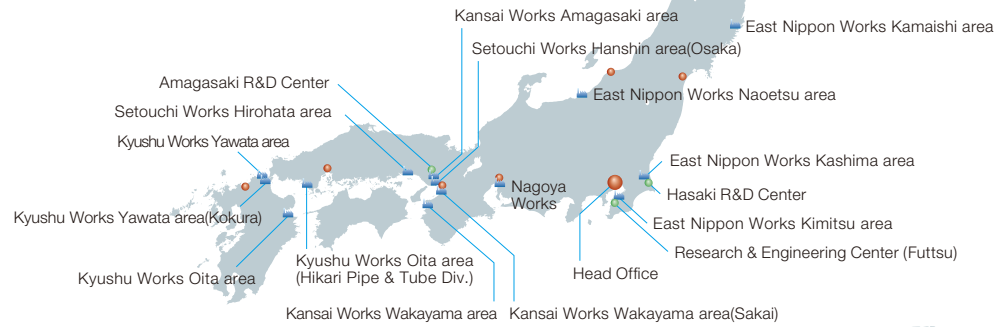
Improving fatigue by compression stress caused by the transformation of welding metals at low temperatures.

NIPPON STEEL WELDING & ENGINEERING CO.,LTD.



## Bases in Japan

- Sales Offices
- Steelworks
- Research Laboratories



## Overseas Offices and Branches



### NIPPON STEEL NORTH AMERICA, INC.

New York Office  
1251 Avenue of the Americas, Suite 2320, New York, N.Y. 10020, U.S.A.  
Tel: 1-212-486-7150 / Fax: 1-212-593-3049

### NIPPON STEEL NORTH AMERICA, INC.

Chicago Office  
900 North Michigan Avenue, Suite 1820, Chicago, Illinois 60611, U.S.A.  
Tel: 1-312-751-0800 / Fax: 1-312-751-0345

### NIPPON STEEL NORTH AMERICA, INC.

Houston Office  
945 Bunker Hill, Suite 600, Houston, Texas 77024, U.S.A.  
Tel: 1-713-654-7111 / Fax: 1-713-654-1261

### NIPPON STEEL NORTH AMERICA, INC.

Mexico Representative Office  
Calle de Ruben Dario 281 No. 2101, Colonia Bosque de Chapultepec, Mexico, D.F. 11580, Mexico  
Tel: 52-55-5281-6123 / Fax: 52-55-5280-0501

### NIPPON STEEL AMÉRICA DO SUL LTDA.

São Paulo Office  
Av. Paulista 2300, 18º andar conj. 181 e 183 Bela Vista, São Paulo, SP CEP 01310-300, Brasil  
Tel: 55-11-3563-1900 / Fax: 55-11-3563-1901

### NIPPON STEEL AMÉRICA DO SUL LTDA.

Belo Horizonte Office  
Av. do Contorno, 6594-13º andar-Sala 1302, Belo Horizonte-MG, CEP 30110-044, Brasil  
Tel: 55-31-2191-4000 / Fax: 55-31-2191-4880

### NIPPON STEEL CORPORATION European Office

Am Seestern 8, 40547 Düsseldorf Federal Republic of Germany  
Tel: 49-211-5306680 / Fax: 49-211-5961163  
E-mail: info@de.nipponsteel.com

### NIPPON STEEL CORPORATION Dubai Office

(PO Box : 18347) JAFZA16, Office No.613 Jebel Ali Free Zone, Dubai, U.A.E.  
Tel: 971-4-887-6020 / Fax: 971-4-887-0206

### NIPPON STEEL AUSTRALIA PTY. LIMITED

Sydney Office  
Level 5, 20 Hunter Street, Sydney, N.S.W. 2000, Australia  
Tel: 61-2-8036-6600 / Fax: 61-2-9221-5277

### NIPPON STEEL CONSULTING (BEIJING) CO.,LTD.

Beijing Office  
Room No.5002, Chang Fu Gong Center, Jian Guo Men Wai Da Jie 26, Chaoyang District, 100022 Beijing, P.R. China  
Tel: 86-10-6513-8593 / Fax: 86-10-6513-7197

### NIPPON STEEL CONSULTING (BEIJING) CO.,LTD.

Shanghai Office  
Room No.808, UNITED PLAZA, 1468 Nanjing Road West, Jingan District, 200040 Shanghai, P.R. China  
Tel: 86-21-6247-9900 / Fax: 86-21-6247-1858

### NIPPON STEEL CONSULTING (BEIJING) CO.,LTD.

Guangzhou Office  
Room 1402, G.T. Land Plaza, D, No.8 Zhujiang West Road, Zhujiang New Town, Guangzhou, 510623, P.R. China  
Tel: 86-20-8386-8178 / Fax: 86-20-8386-7066

### NIPPON STEEL SOUTHEAST ASIA PTE. LTD.

16 Raffles Quay #17-01  
Hong Leong Building, Singapore 048581  
Tel: 65-6223-6777 / Fax: 65-6224-4207  
E-mail: nssm.s3a.sg@sg.nipponsteel.com

### PT. NIPPON STEEL INDONESIA

Jakarta Representative Office  
Sentral Senayan II 201-2C Ground Floor, Jl. Asia Afrika No.8, Gelora Bung Karno-Senayan, Jakarta Pusat 10270, Indonesia  
Tel: 62-21-290-39210 / Fax: 62-21-290-39211

### NIPPON STEEL (THAILAND) CO., LTD.

Bangkok Office  
909 Ample Tower 14th, Debaratana Road, Khwang Bangna-Nuea, Khet Bangna, Bangkok. 10260, Thailand  
Tel: 66-2-744-1480 / Fax: 66-2-744-1485

### NIPPON STEEL VIETNAM COMPANY LIMITED

Ho Chi Minh City Office  
Room 2001, 20th Floor, SUNWAH TOWER, 115 Nguyen Hue Blvd, Ben Nghe Ward, Dist.1, Ho Chi Minh City, Vietnam  
Tel: 84-28-3914-7016 / Fax:84-28-3914-7018

### Ha Noi Office

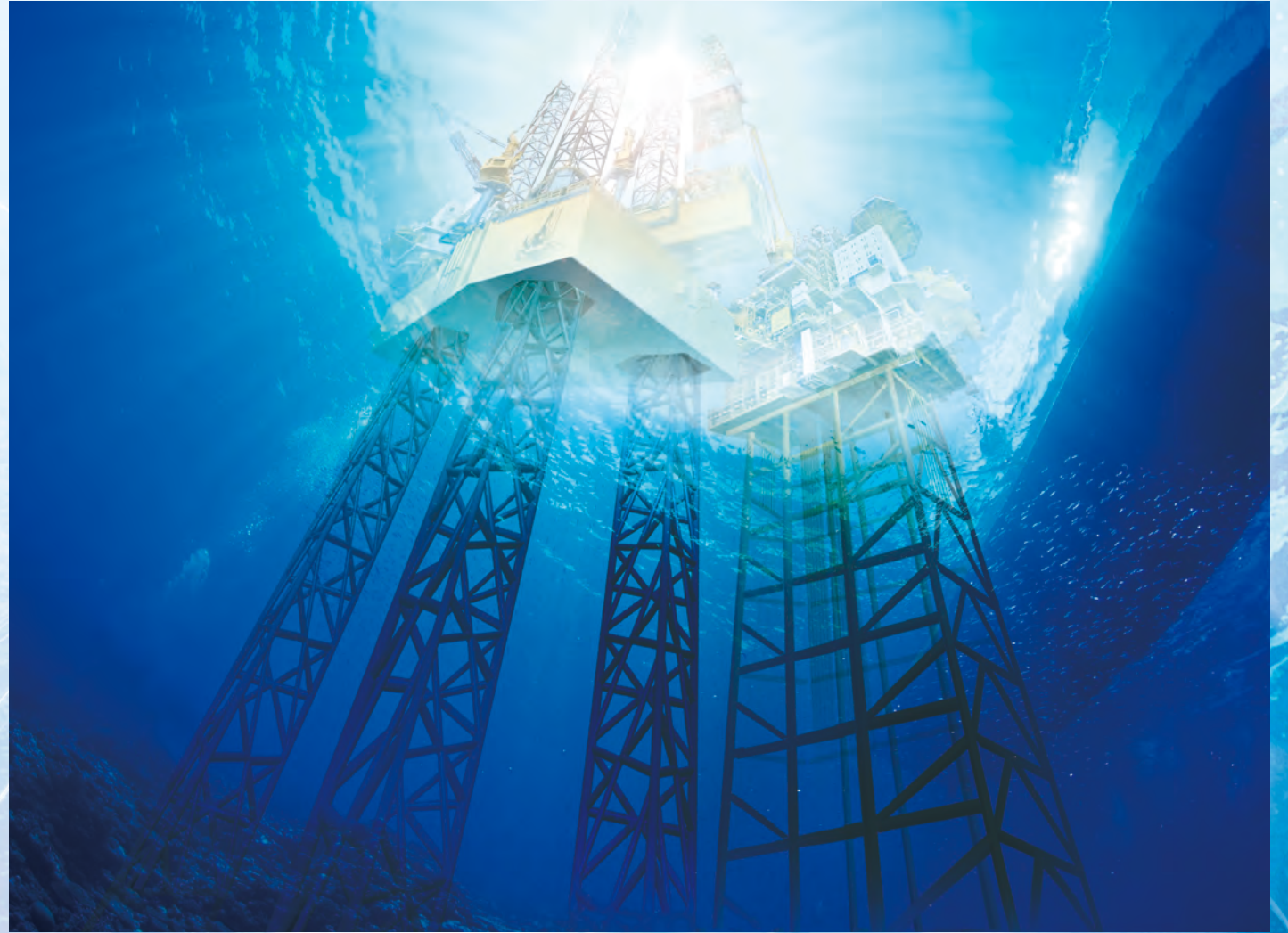
Room 402, 4th floor, Corner Stone Building, 16 Phan Chu Trinh, Hoan Kiem, Ha Noi, Vietnam  
Tel: 84-24-3633-2029

### NIPPON STEEL INDIA PRIVATE LIMITED

Prius Platinum, A Wing, Ground Floor, D-3, Dist. Centre, Saket, New Delhi -110017, INDIA  
Tel: 91-11-4763-0000 / Fax: 91-11-4763-0001

*If you have any questions please contact below.*

[Mail GR\\_J\\_01\\_energy@jp.nipponsteel.com](mailto:GR_J_01_energy@jp.nipponsteel.com)





# High-tensile / Excellent Quality HAZ Toughness Plate

Weight reductions

Reduced life-cycle costs

Shortening of lead times/  
Reduction in manufacturing costs

- The needs of high tensile steel are growing up as the size of facility increases.
- NIPPON STEEL has wide range Pre-Qualification material with high toughness for offshore structure using advanced technology.
- NIPPON STEEL has supplied offshore structural steel for various projects all over the world.
- NIPPON STEEL has applied the TMCP<sup>(1)</sup> process to offshore structural high tensile steel with excellent weldability and HAZ<sup>(2)</sup> toughness for the first time in the world.  
(\*1:Thermo Mechanical Control Process. \*2:Heat Affected Zone)
- The shift to high tensile steel leads the reduction in the size and weight of steel structure.  
As the result, it is possible to reduce “Distribution and installation cost” while mounting equipment.

## Benefits of use

- 1 Compatible with the needs in place for high strength structures
  - In addition to Gr50 and Gr60 steel plates specified by API standards, we have newly developed Gr80 steel plates, being the first in the world to put it into practical use.
- 2 Weight reductions
  - Allows for capacity in TOPSIDE-loaded equipment.

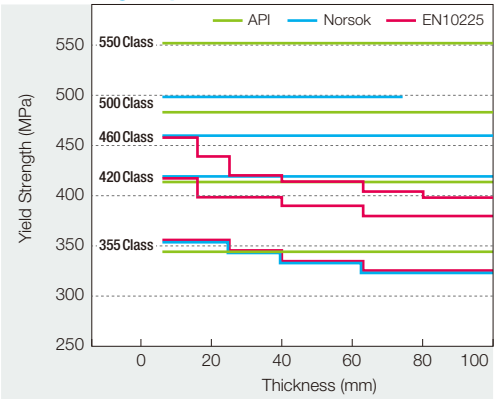
## Features

- 1 Excellent TMCP technology
- 2 Improvement of HAZ toughness
- 3 Good weldability
- 4 World-class product lineup

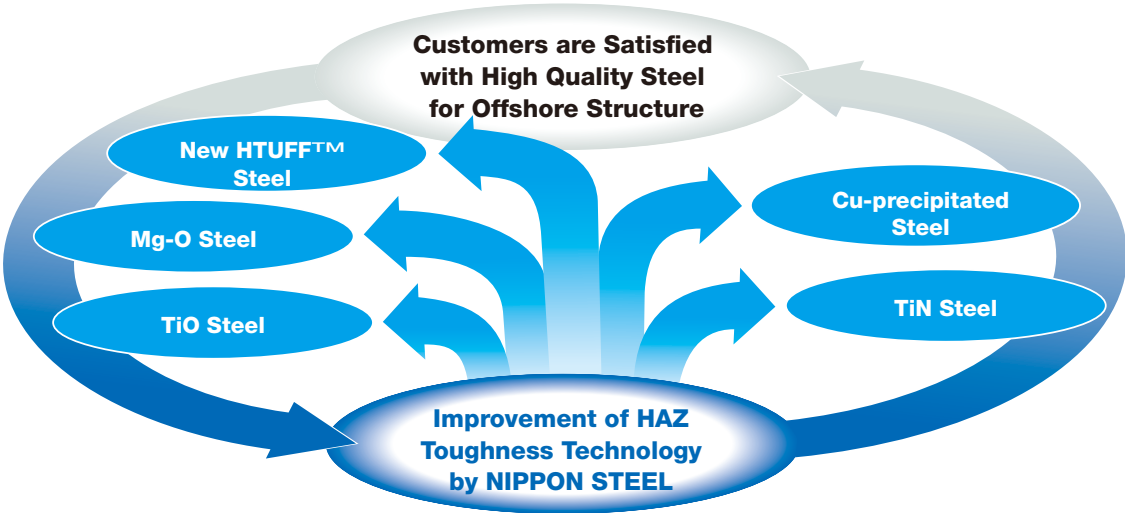
Steel Grade	API 2W	EN10225	NORSOK
355	GR50	S355G 7+M	MDS-Y20 MDS-Y25
		S355G 8+M	
		S355G 9+M	
		S355G10+M	
420	GR60	S420G1+M S420G2+M	MDS-Y30 MDS-Y35
460		S460G1+M S460G2+M	MDS-Y40 MDS-Y45
500	GR70	(S500G1+M) (S500G2+M)	MDS-Y50 MDS-Y55
550	GR80	(S550M3)	(MDS-Y60) (MDS-Y65)

Required Plate Thicknesses *YP Design Example Used		
150 mm	100 %	—
124 mm	83 %	-17 %
112 mm	75 %	-25 %
103 mm	69 %	-31 %
93 mm	62 %	-38 %

Yield strength specification v.s. thickness



## Improvement of HAZ toughness technology

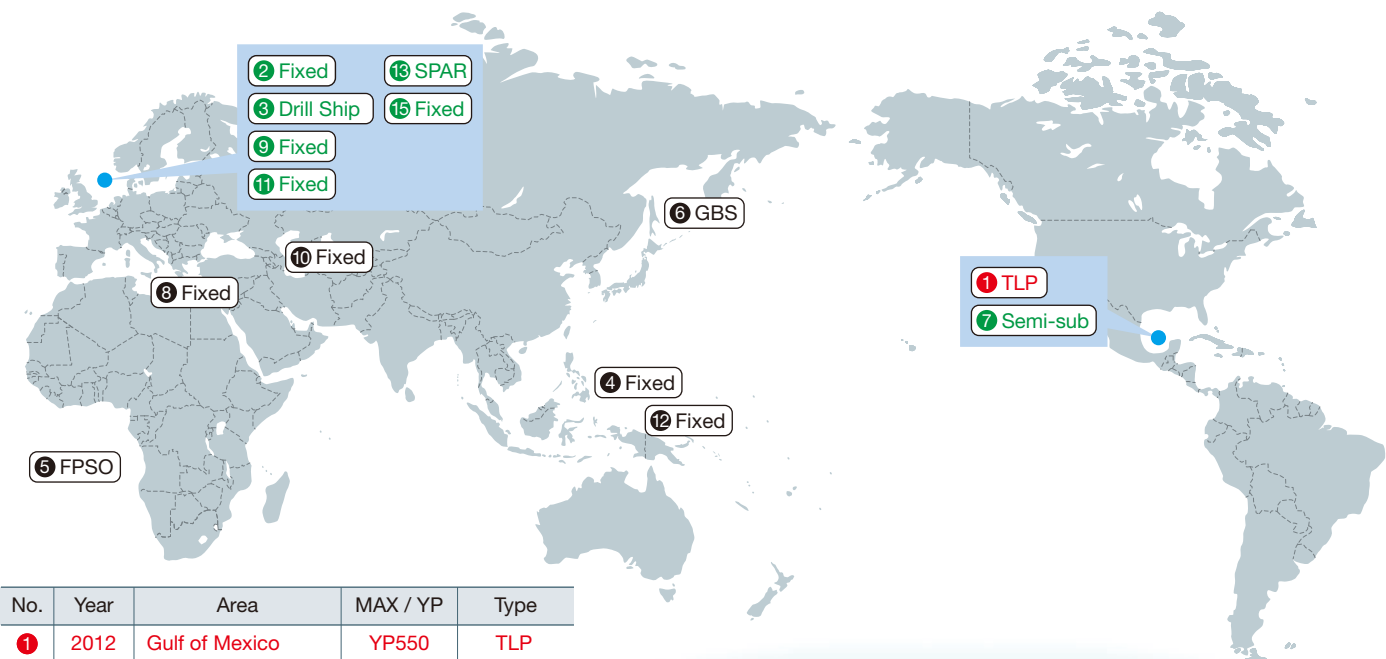


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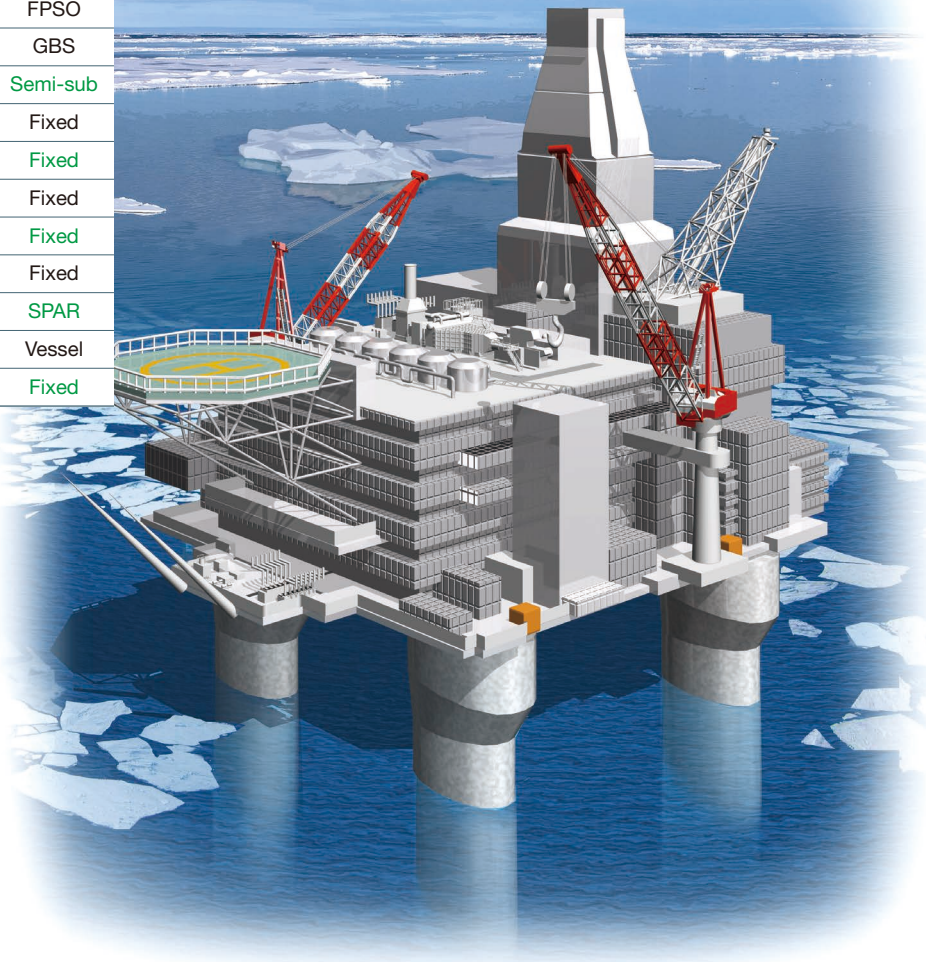


Areas of use

Reliability backed up by a wealth of experience in supplying projects the world over.



No.	Year	Area	MAX / YP	Type
1	2012	Gulf of Mexico	YP550	TLP
2	2011	North Sea	YP500	Fixed
3	2006	North Sea	YP500	Drill Ship
4	2005	Asia	YP460	Fixed
5	2003	West Africa	YP460	FPSO
6	2003	Russia	YP460	GBS
7	2003	Gulf of Mexico	YP500	Semi-sub
8	2002	Mediterranean Sea	YP460	Fixed
9	2001	North Sea	YP500	Fixed
10	2001	Caspian Sea	YP460	Fixed
11	2000	North Sea	YP500	Fixed
12	2000	Timor Sea	YP460	Fixed
13	2013	North Sea	YP460	SPAR
14	2014	-	YP460	Vessel
15	2014	North Sea	YP500	Fixed





# TMCP-type Steel Plates for LNG Storage Tanks

## A841Gr-G (Ni Reduction of Over 20%)

Reduced life-cycle costs

- New development of 6-7% Ni steel for LNG storage tanks has an equal or improved performance compared with conventional 9% Ni steel.
- TMCP technology reduced the amount of nickel and improved strength compared with 9% Ni steel.
- Up to 4,500 mm width is available.
- Supple Record ; approximately 19,000tons for 6 LNG storage tanks.

### Advantages

#### A841 Grade G steel for LNG storage tanks

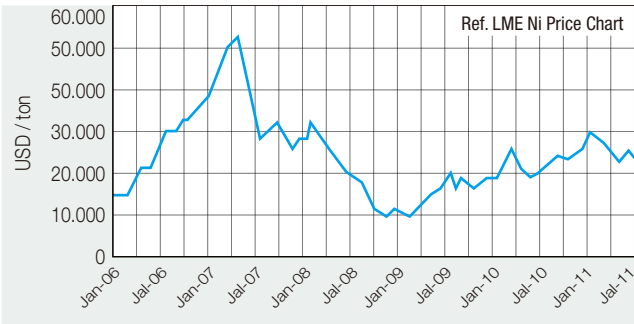
Preservation  
of valuable rare metal “Nickel”

Mitigation  
to the price fluctuation risk  
of nickel

Construction cost reduction  
of LNG tank

Fracture toughness equivalent to 9%Ni steel plate

### Price fluctuation of Ni



### Advantage of A841 Grade G

Item		Reduction	Compare With	Remark
A841 Grade G	Nickel Cost [Ni:6.0–7.5%]↔(8.5–9.5%)	Over 20%	A553	Class 10 Use
	wall thickness (Material Cost)	9%		
	(Transportation Cost)	9%		

	Class 9	Class 10
Yield Strength (0.2% offset), MPa, min	585	620
Tensile Strength, MPa	690—825	750—855
El in 50mm, min, %	20	20

### Deposits share of Ni (2011)



Over 75% from  
only 6 countries

Ref. Mineral Commodity  
Summaries

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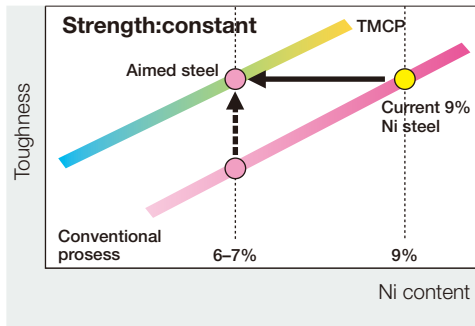
## Key technologies

Refined Microstructure produced by  
**Thermo-Mechanical Control Process (TMCP)**

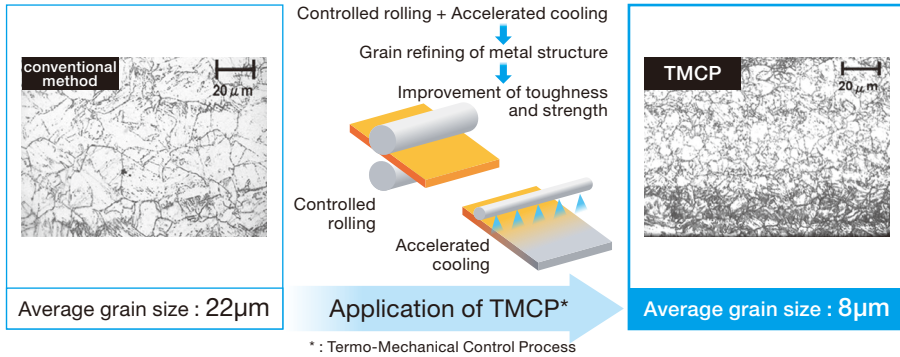
Improvement of HAZ Toughness obtained by  
**Optimize Chemical Composition**

**Over 20% Nickel reduction  
with equivalent or superior properties to 9% Ni steel plate**

### Concept of development



### Key technology : Refinement of microstructure by TMCP



\* : Thermo-Mechanical Control Process

### Code registration in international standards

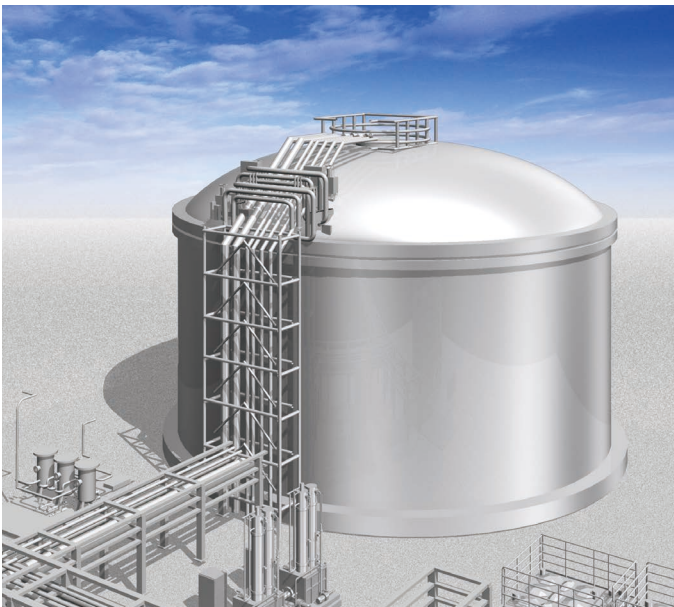
	Organization	Designation	Incorporation
Design	ASME	Code Case 2736 for Div.1 Code Case 2737 for Div.2	August, 2013
	API	620 Appendix. Q	April, 2018
	EN	14620	Under preparation for proposal
	Japanese Government	Gas Business act	March, 2011
Material	ASTM	A841 grade G	Oct, 2013
	EN	10028	Under preparation for proposal
	JIS	SL7N590	March, 2013
	Class NK	KL7N590	May, 2014
	DNV	NV5Ni - MOD	Feb, 2014

### Supply record

Country	Owner	Tank Capacity	Supply Record	Remark
Japan	Osaka Gas	230,000m <sup>3</sup>	3,700MT	Aboveground Tank
	Chita	220,000m <sup>3</sup>	450MT	Underground Tank
	Fukushima	230,000m <sup>3</sup>	3,500MT	Aboveground Tank
	Fukushima	230,000m <sup>3</sup>	3,700MT	Aboveground Tank
	Hitachi	230,000m <sup>3</sup>	3,700MT	Aboveground Tank
	Nihama	230,000m <sup>3</sup>	3,700MT	Aboveground Tank

### Welding consumables for A841Gr-G & 9% Ni steel

Welding Method	Brand Name	AWS
SMAW	YAWATA WELD B(M)	A5.11 ENiCrFe-4
	NITTETSU WELD 196	A5.11 ENiMo-9
GTAW	NITTETSU FILLER 196	A5.14 ERNiMo-9
SAW	NITTETSU FLUX 10H x NITTETSU FILLER 196	A5.14 ERNiMo-9 Modify



## NIPPON STEEL CORPORATION

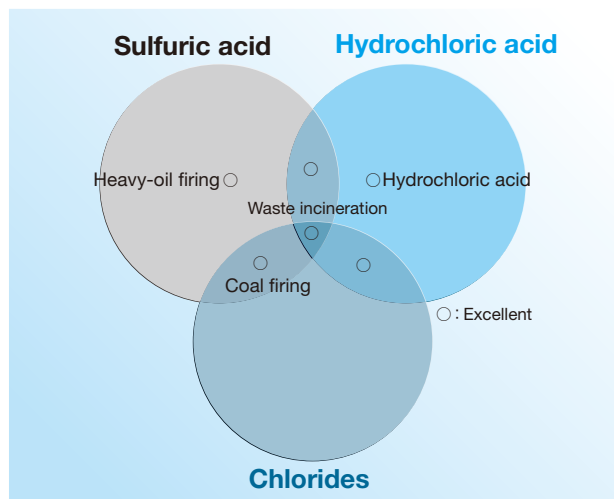
2-6-1 Marunouchi, Chiyoda-ku, Tokyo 100-8071 Japan  
Mail: GR\_J\_01\_energy@jp.nipponsteel.com  
www.nipponsteel.com

TMCP-type thick steel plates for LNG storage tanks  
A841Gr-G (Ni reduction of over 20%) Rod  
E202en-02\_02\_202004f  
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## S-TEN1 is a sulfuric acid and hydrochloric acid dew-point corrosion-resistant steel developed by NIPPON STEEL using proprietary technology.

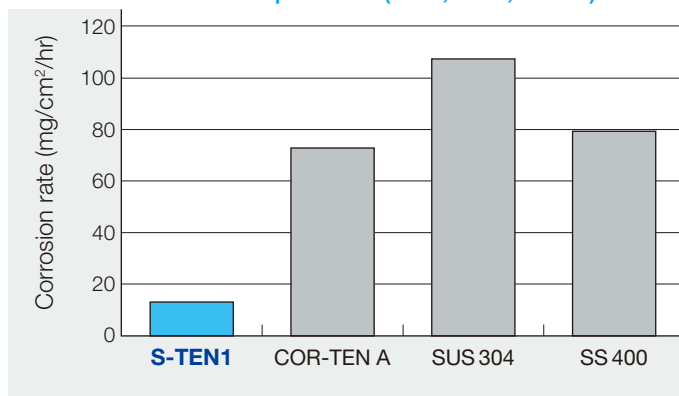
- S-TEN1 exhibits the best resistance to sulfuric acid and hydrochloric acid dew-point corrosion found in the flue-gas treatment equipment used with coal-fired boilers, waste incineration plants, etc. (This steel has the finest application record in the field of thermal power generation and waste incineration plants, according to surveys conducted by NIPPON STEEL)
- S-TEN1 exhibits the best resistance to sulfuric acid and hydrochloric acid dew-point corrosion found in hydrochloric acid pickling, industrial sulfuric acid and other tanks.
- S-TEN was awarded the Ichimura Industrial Award Achievement Award in 2007.



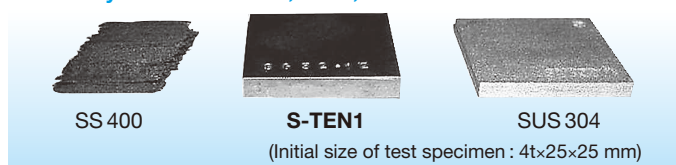
### Advantages

- Displays around 5 to 10 times the corrosion resistance of regular steel and stainless steel against high-temperature, high-concentration sulfuric acid and high-temperature, high-concentration hydrochloric acid.
- Offers economic benefits over stainless steel.
- Wide lineup that encompasses everything from hot-rolled and cold-rolled steel sheets to steel piping and welding materials.
- Features a lineup of dedicated welding materials, making welding possible under the same conditions as ordinary steel of the same strength.

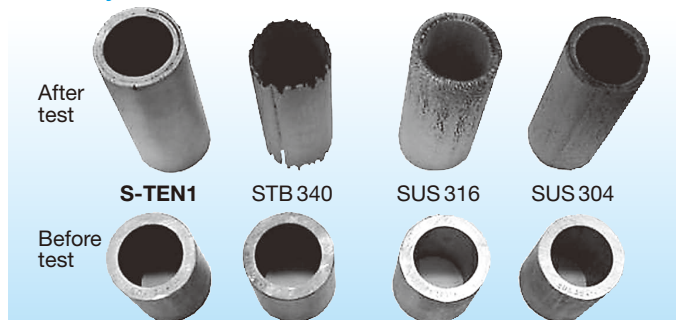
**Sulfuric acid resistance**  
of various steel products (50%, 70°C, H<sub>2</sub>SO<sub>4</sub>)



**10.5% Hydrochloric acid, 60°C, 72 Hrs**



**10.5% Hydrochloric acid, 80°C, 144 Hrs**

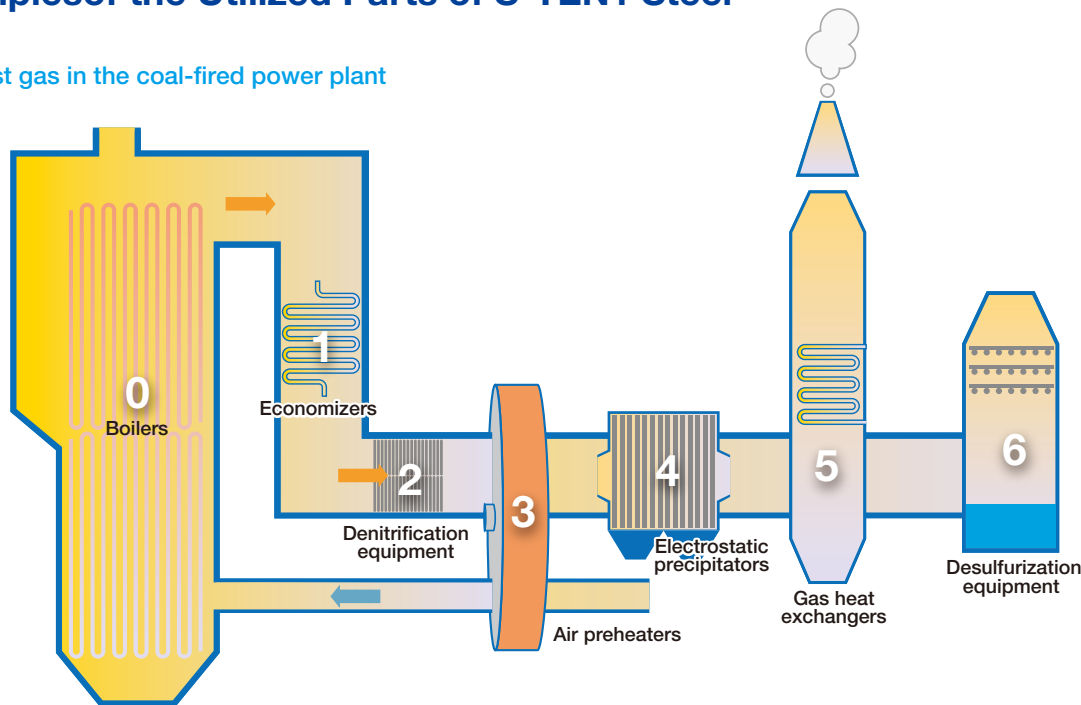


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Flow of exhaust gas in the coal-fired power plant  
and examples of the Utilized Parts of S-TEN1 Steel

Flow of exhaust gas in the coal-fired power plant



			Steel Pipes	Steel Plates	Steel Sheets	
			Welded		Hot-rolled	Cold-rolled
0	Boilers	Boiler Tube				
1	Economizers	Boiler Tube	○	(○)		
		Fin				○
2	Denitrification Equipment	Casing		(○)	○	
3	Air Preheaters	Boiler Tube	○	(○)		
		Element				○
4	Electrostatic Precipitators	Casing		(○)	○	
5	Gas Heat Exchangers	Boiler Tube	○	(○)		
		Fin				○
		Element				○
6	Desulfurization Equipment	Casing		(○)	○	

Welding materials

As the welding material for exclusive use for S-TEN1,  
NIPPON STEEL WELDING & ENGINEERING CO.,LTD.\* supplies the following products.

\*Inquiry: NIPPON STEEL WELDING & ENGINEERING CO.,LTD.  
Shingu Bldg.,2-4-2 Toyo, Koto-ku,Tokyo 135-0016  
Tel: +81-3-6388-9000 Fax: +81-3-6388-9160

Grade	Kind of Shielding Material			
	Shielded Metal Arc Welding (SMAW)	Gas Shielded Metal Arc Welding		Submerged Arc Welding (SAW)
		MAG Welding (FCAW)	TIG Welding (GTAW)	
S-TEN1	ST-16M <sup>1)</sup> (☆JIS Z 3211 E4916G)	SF-1ST (☆JIS Z 3313 T49J0T1-1CA-UH5)	YT-1ST (☆JIS Z 3313 T49J0TG-1GA-U)	Y-1ST × NB-1ST (☆JIS Z 3183 S502-H)

Notes: 1) Low-hydrogen type

Mark "☆" means that the product meets the classification requirements but that the JIS mark system is not applicable to the classification.



# NIPPON STEEL's High Grade H-Shapes

Expansion of the development area

Shortening of lead times/Reduction in manufacturing costs

The NIPPON STEEL began producing and selling H-shapes in 1959. Since then, it has consistently produced high quality H-shapes and it is used in structures all over the world. With the recent increase in world energy demand, the company has been activity in also focusing its attention to fields relating to energy development for the sale of its products.

## Characteristic of our H-shapes

### Availability of various size

- ~W40, ~UB1016, ~HE1000, ~JIS H1000
- NSHYPER BEAM™ (47 series and 611 size)
- Taylor made sizes  
ex. 1000×400×25/55  
920×430×30/50 used for HRSG Column.

### Availability of various steel grades

- Standards : ASTM, BS, EN, JIS, AS
- CVN : Up to -40°C/50J at tf≤40mm  
(-40°F/37ft-lbf at tf≤1.5inch)
- Steel grade : ~YP355

## Feature of NSHYPER BEAM™

NSHYPER BEAM is a high quality rolled H-shapes which acts as an alternative to welded H-shapes from the sheer variation in sizes available. The benefits of non-welded steel (no need to fabri-

cate / no need welding inspections / high quality) have received much praise, and this has been widely adopted in the form of H-shaps for steel frames in the natural resource and energy fields.

## Advantages of NSHYPER BEAM™

### Saving cost on steel work

- Without built-H process

### Wider size availabilities

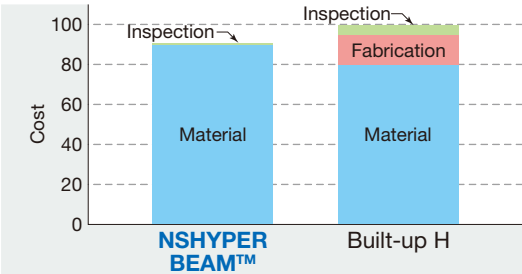
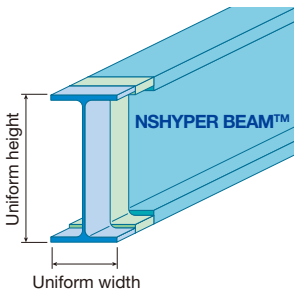
- 47 series and 611 size
- Uniform height and width within a same size series.

### Shortened fabrication term

- Cutting the welding and inspection processes
- Free from critical path on the built-H process

### Quality improvement because of no welding process

- Free from heat damage and fatigue problems caused by welding



H-shapes	Size	Fabrication
Rolled H	LIMITED	FREE
Built-up H	FREE	NEEDED
NSHYPER BEAM™		

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NSHYPER BEAM™ series

		Flange Width (mm)				
		200	250	300	350	400
Web Height (mm)	1000		○	○	○	○
	950		○	○	○	○
	900		○	○	○	○
	850		○	○	○	○
	800		○	○	○	○
	750		○	○	○	○
	700	○	○	○	○	○
	650	○	○	○		
	600	○	○	○		
	550	○	○	○		
	500	○	○	○		
	450	○	○	○		
	400	○	○	○		

CVN Availability

Test Condition of CVN			Availability [Case≥WF16(400mm) ]				
Location of Test Piece	Test Temperature	Minimum Average Energy	CE (%)	Pcm (%)	Flange Thickness [Unit:inch(mm)]		
					Ft ≤ 1 (25)	1 ≤ Ft ≤ 1.75 (25) (40)	1.75 ≤ Ft ≤ 1.97 (40) (40)
Longitudinal (Location:1/6F)	32°F (0°C)	37ft-lbf (50J)	≤0.43*	≤0.24*	○	○	○
	-4°F (-20°C)				○	○	○
	-40°F (-40°C)				○	○	NA
Transverse (Location:1/6F)	-4°F (-20°C)				○	NA	NA
	-40°F (-40°C)				○	NA	NA

CE = C+Mn/6+(Cu+Ni)/15+(Cr+Mo+V)/5  
Pcm = C+Si/30+(Mn+Cu+Cr)/20+Ni/60+Mo/15+V/10+5B

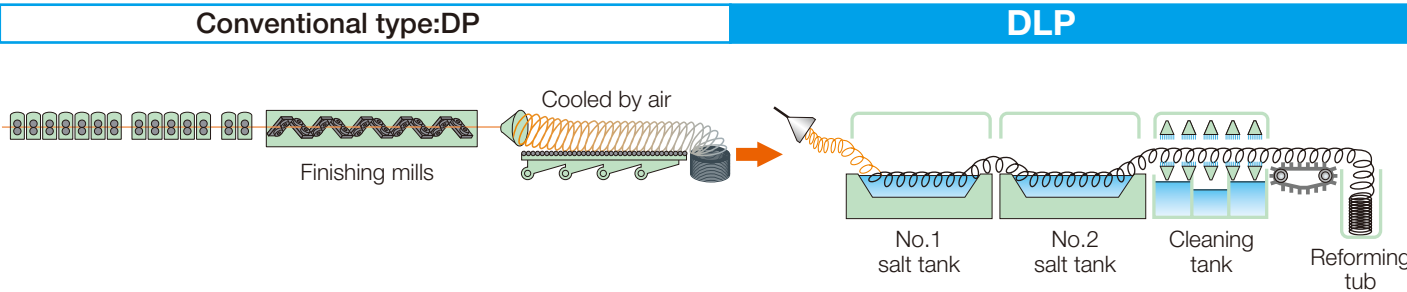
\*:Please ask us.



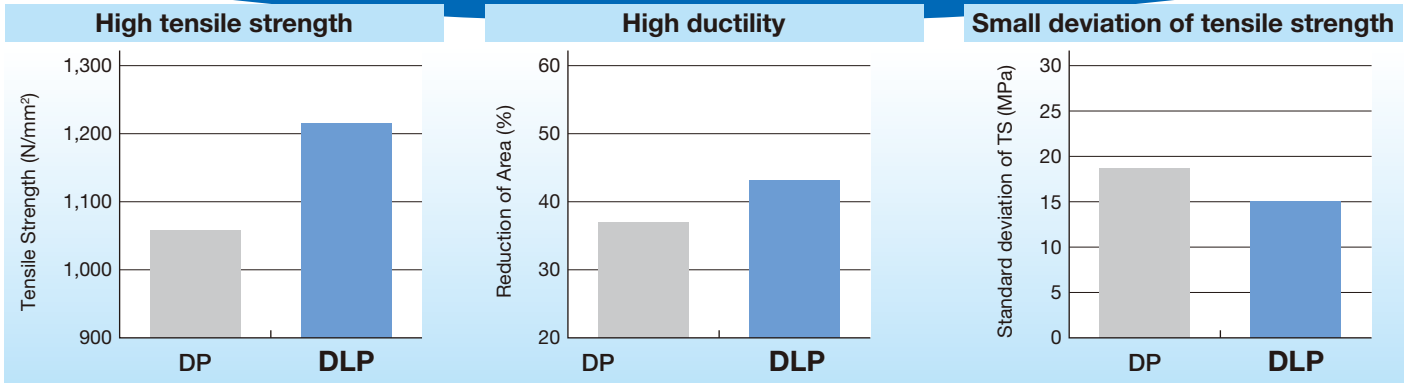
# High Tensile Wire Rod for Rope

Reduced life-cycle costs

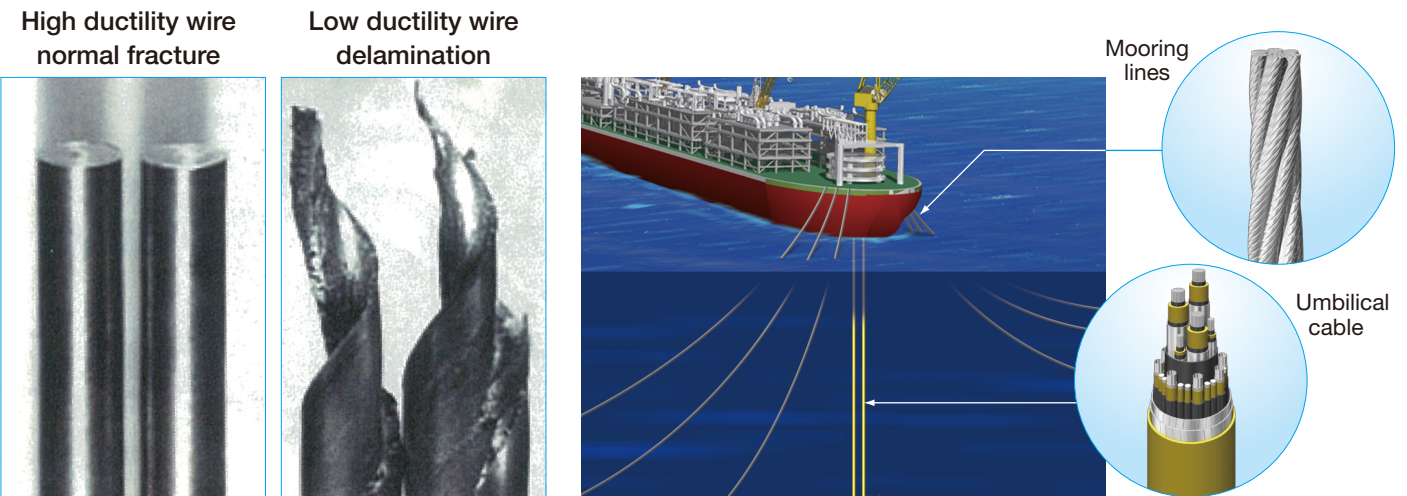
## Lead-free In-line heat treatment (World First)



**DLP wire rod is suitable for high quality wire products which need high performance.**



**High strength, high ductility DLP wire materials** → **Development of high strength, high ductility wire**



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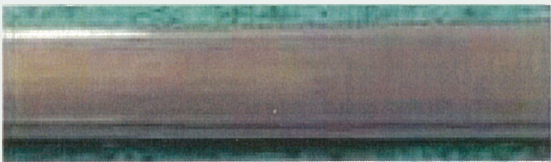
# Resin Coated Flat Wire for Extra Flexibility

Reduced life-cycle costs

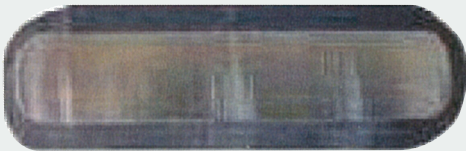
## Test sample of flat wire

Result							
Grade	Size	T.S.	E.L.	Torsion	HIC test (96h)	SSC Test (720h)	Preform Test (Bending, Torsion)
TARGET	3 × 11	2000MPa 以上	2.5% ≤	5% ≤	No Cracking	No Cracking	No Cracking No Breakung
Data	3 × 11	2018	5.1	18.6	No Cracking	No Cracking	No Cracking No Breakung
Result	○	○	○	○	○	○	○

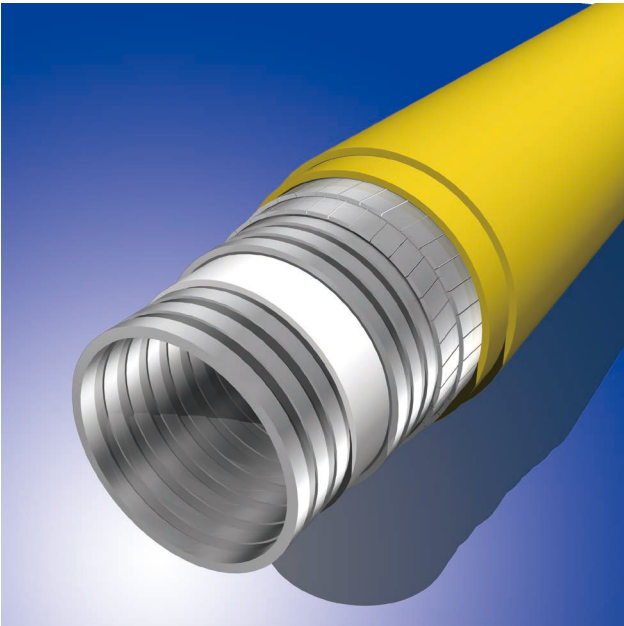
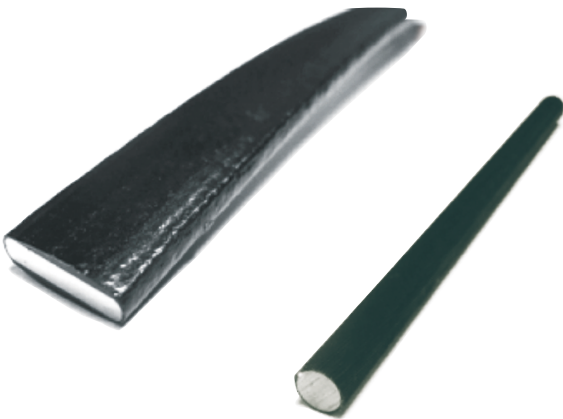
Appearance



Cross-section (Resin coating 0.5mm)



## Resin coating products



# Welding Consumables for Offshore

Expansion of the development area

Weight reductions

## Characteristics

Deposited metal shows excellent strength and toughness at low temperatures.  
Crack resistance is extremely high.

## Applications

Welding of high tensile strength steel for offshore structure.

### Jack-up Rigs

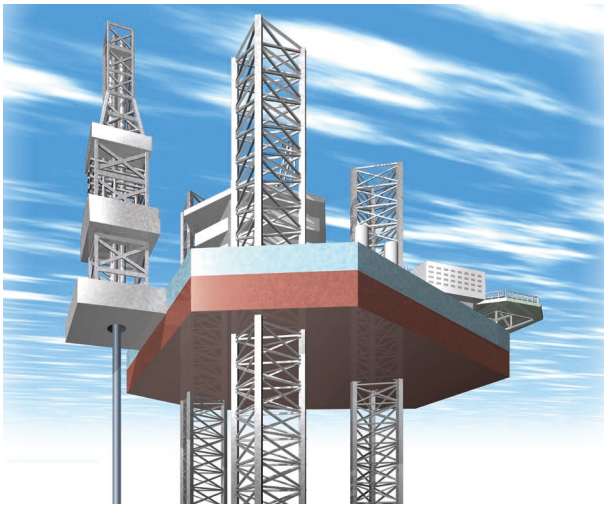
Steel Grade	Welding Process	Brand Name	AWS Classification	Polarity, Shielding gas	Approvals	
					ABS	DNV GL
YS690	SMAW	L-80SN	A5.5 E11016-G	AC, DCEP	5Y690MW	V Y69H15
	SAW	NB-250J (Flux) & Y-80J (Wire)	A5.23 F11A10-EG-M3	AC, DCEP	5YQ690M	IV Y69M*
	GMAW	YM-80A	A5.28 ER110S-G	Ar+20%CO <sub>2</sub>	4YQ690SA	IV Y69MS
		YM-69F	A5.28 ER110S-G	Ar+10%CO <sub>2</sub>	5YQ690SA	V Y69MS

\*Plus manuf's spec. (vE-60°C≥47J)

### Top-side

Steel Grade	Welding Process	Brand Name	AWS Classification	Polarity, Shielding gas	Applicable Temp.		Approvals
					vET ≥47J	CTOD* ≥0.25mm	
YS355	FCAW	SF-36E <i>Seamless</i>	A5.36 E81T1-C1A8-K2-H4 (A5.29 E81T1-GC)	CO <sub>2</sub>	-60°C	-20°C	ABS, LR, DNV GL, BV, RS, NK
	SAW	NB-55 & Y-DS	A5.17 F7A8-EH14 F7P8-EH14	DCEP/AC	-60°C	-40°C	ABS, LR, DNV GL, BV, NK
YS420 YS460	FCAW	SF-47E <i>Seamless</i>	A5.36 E81T1-C1A8-Ni1-H4 (A5.29 E81T1-Ni1C-J)	CO <sub>2</sub>	-60°C	-20°C	ABS, LR, DNV GL, NK
		SF-3AM <i>Seamless</i>	A5.36 E81T1-M21A8-Ni1-H4 (A5.29 E81T1-GM)	80%Ar+20%CO <sub>2</sub>	-60°C	-40°C	ABS, LR, DNV GL
	SAW	NB-55 & Y-CMS	A5.23 F8A8-EA4-A4 F8P8-EA4-A4	DCEP/AC	-60°C	-40°C	ABS, LR, DNV GL, NK
YS500	FCAW	SF-50E <i>Seamless</i>	A5.36 E91T1-C1A8-Ni2-H4 (A5.29 E91T1-Ni2C-J)	CO <sub>2</sub>	-60°C	-40°C	ABS, DNV GL, BV
		SF-50A <i>Seamless</i>	A5.36 E91T1-M21A4-K2-H4 (A5.29 E91T1-GM)	80%Ar+20%CO <sub>2</sub>	-40°C	-10°C	LR, DNV GL
	SAW	NB-250H & Y-204B	A5.23 F9A8-EG-G F9P8-EG-G	DCEP/AC	-60°C	-10°C	ABS, DNV GL, BV

\*Information only





## Mechanical property

### Mechanical properties of weld metal (YS690 class)

Process	Brand Name (Dia.)	Test Plate (Thk)	Welding Position	Examples of Mechanical Properties of Weld Metal				
				Location	0.2% PS (MPa)	T.S (MPa)	EL. (%)	vE (J)
SMAW	L-80SN (4.0ø, 5.0ø)	HT780 (75mm)	Flat	1/4t	817	840	21	47, 65, 46 Avg.53
				1/2t	839	851	20	50, 52, 58 Avg.53
		HT780 (75mm)	Horizontal	1/4t	800	819	22	95, 97, 104 Avg.99
				1/2t	830	858	20	85, 85, 93 Avg.88
		HT780 (75mm)	Vertical-up	1/4t	735	783	23	78, 70, 68 Avg.72
SAW	NB-250J × YM-80J (4.0ø)	HT780 (75mm)	Flat	1/4t	742	814	23	148, 119,145 Avg.138
					744	818	23	
				1/4t	738	804	24	147, 167, 152 Avg.155
					734	807	23	
GMAW	YM-80A (1.2ø) × Ar-20%CO <sub>2</sub>	HT780 (75mm)	Vertical-up	1/4t	698	898	22	73, 76, 74 Avg.74
					690	893	21	
	YM-69F (1.2ø) × Ar-10%CO <sub>2</sub>	HT780 (75mm)	Flat	3/4t	—	806	—	76, 92, 106 Avg.91
			Vertical-up	3/4t	815	910	23	103, 95, 103 Avg.100

Process	Brand Name	Steel	Welding Position	Heat Input (kJ/cm)	Examples of Mechanical Properties of Weld Metal			
					0.2% PS (MPa)	T.S (MPa)	vET (J)	
SMAW	L-80SN	WELTEN780 (T=75mm)	Horizontal	20.5 (AC)	830	858	−60°C	85, 85, 93 Avg.88
			Vertical-up	32.6 (AC)	735	783	−60°C	78, 70, 68 Avg.72
SAW	NB-250H & Y-80M	WELTEN780 (T=75mm)	Flat	39.6 (AC)	744	818	−40°C	148, 119, 145 Avg.138
	NB-250J & Y-80J	WELTEN780 (T=38mm)	Flat	45.3 (DCEP)	785	851	−40°C	103,59,87 Avg. 87
							−60°C	59, 61, 59 Avg. 60
GMAW (Ar+20%CO <sub>2</sub> )	YM-80A	WELTEN780 (T=75mm)	Vertical-up	30.0	698	898	−40°C	73, 76, 74 Avg. 74
	YM-69F	WELTEN780 (T=75mm)	Vertical-up	30.0	815	910	−60°C	103,95,103 Avg. 100



#### Warning !

Fumes and gas may be hazardous to your health. Please take appropriate preventive measures such as the implementation of ventilation as well as wearing a protector for breathing. Arc light is harmful to the eyes and skin. Please use appropriate shielding measures. Please do not touch anything where electricity is activated. It may cause death.

#### Request to Customers

- 1 Various data of distinctive features such as welding materials, deposited metal, weld metal, etc. shown in this catalog are meant to explain the representative properties and performance of the products and are not to be taken as a guarantee except those which are specified clearly as "Specification".
- 2 In regard to the properties of welded structures, please be careful since design of structures, chemical compositions of steel plates, construction method, welding conditions, ability of constructor, etc. will affect the results.
- 3 Please understand that we are not able to take responsibility for damages caused by the misuse of the technical information written in this catalog.

## NIPPON STEEL WELDING & ENGINEERING CO.,LTD.

2-4-2 Touyou, Koutou-ku,Tokyo 135-0016 Japan

Tel: +81-3-6388-9000

www.weld.nipponsteel.com

Welding consumables for Offshore

E202en-06\_02\_202004f

# Superiority of Seamless Flux Cored Wires (NSWE's SFW)

to conventional flux cored wires & conventional seamless FCW (Filling by vibration)

Expansion of the development area

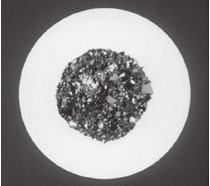
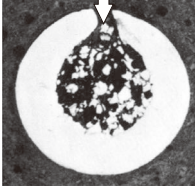

Weight reductions

Reduced life-cycle costs

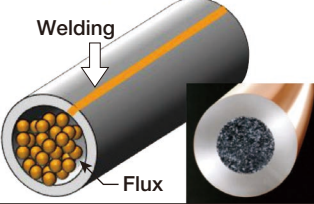
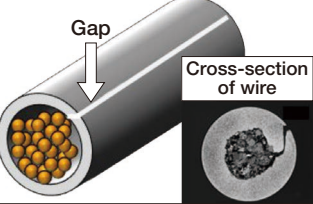
Shortening of lead times/  
Reduction in manufacturing costs

## Difference between NSWE's SFW and conventional fold type

### 1. No seam in outer layer

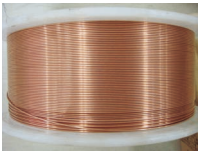
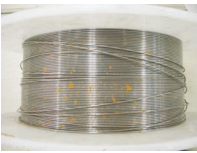
NSWE's Seamless FCW	Conventional Fold Type (↓:Seam)	
		

### 2. Copper plated surface

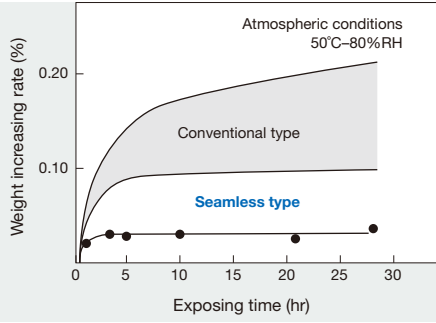
	NSWE's Seamless FCW	Conventional Fold Type
Cross sectional shape	Outer skin without seam metal 	Outer skin metal with seam (gap) 
Merit	Applied annealing in process, It means decreasing hydrogen. No absorption of moisture .	Not applied an annealing because of oxidation in inner flux. Absorption of moisture is occurred.

## Superiority of NSWE's SFW to conventional fold type

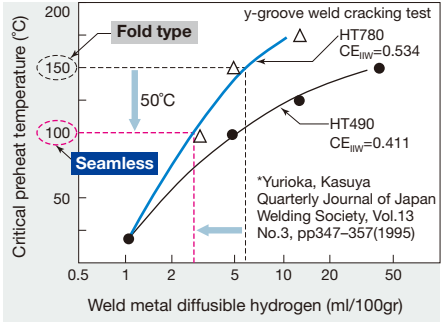
### 1. Excellent rust prevention

NSWE's Seamless FCW (Copper coating)	Conventional Fold Type
	

### 2. Excellent hygroscopic resistance

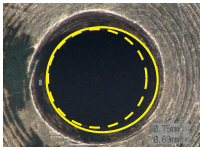
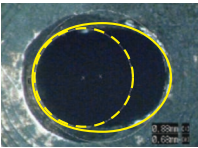


### 3. Can decrease preheat temp.



- Customers can store for extended periods of time.
- Can decrease preheat temp.
- There is no need for rework of weld defects like the wormhole porosity or pit.

### 4. Excellent tip abrasion resistance

Conditions	NSWE's Seamless FCW	Conventional Type
Continuous welding 10min ×10times (Accumulating Total 100min) Wire Dia.:1.2mm Welding Current:270A		
Abrasion Amount of Top of The Tip*	0.13mm	0.45mm

\* : (Circumscribed circle of tip hole after welding)  
— (Diameter of the tip hole before welding)

When NSWE's SFW is used, the life of the tip is about 3.5 times as long as instances where the conventional fold type is used. (When NSWE's SFW is used, the abrasion of the tip is about 1/3.5.)

- Reasons the life of the tip is so long are as follows:
- a) The surface of NSWE's SFW is plated with copper and, therefore, friction is small.
  - b) The cross-sectional shape of NSWE's SFW is one of point symmetry. Therefore, the wire is fed out straight.

- Can reduce usage of tip



## NSWE's SFW lineup

Welding Process	Shielding Gas	Polarity	Brand Name	AWS Classification	Heat Input, Typical (kJ/cm)	Applicable YS Grade (MPa)	Applicable Temp. (°C)		Chemical Compositions of Deposited Metal (wt%) <Typical>			
							CVN≥47J, δ≥0.25mm					
							CVN	CTOD (δ)	C	Si	Mn	Ni
FCAW-G	100% CO <sub>2</sub>	DCEP	SF-1	A5.20 E71T-1C A5.36 E71T1-C1A0-CS1	F, H: 7-20  V-up, OH: 10-25	375	0	—	0.06	0.50	1.40	—
			SF-1E	A5.20 E71T-1C A5.36 E71T1-C1A2-CS1		375	−20	—	0.06	0.50	1.29	0.30
			SF-3	A5.20 E71T-12C A5.36 E71T12-C1A2-CS2		375	−30	—	0.04	0.37	1.22	0.35
			SF-3M	A5.20 E71T-9C-J A5.36 E71T1-C1A4-CS1		400	−40	−10	0.04	0.41	1.27	0.36
			SF-3E	A5.29 E81T1-GC A5.36 E81T1-C1A4-CS1		420	−40	−10	0.05	0.44	1.33	0.39
			SF-36E	A5.29 E81T1-GC A5.36 E81T1-C1A8-K2-H4		400	−60	−20	0.06	0.40	1.60	1.40
			SF-47E	A5.29 E81T1-Ni1C-J A5.36 E81T1-C1A8-Ni1-H4		460	−60	−30	0.05	0.49	1.42	1.03
			SF-50E	A5.29 E91T1-Ni2C-J A5.36 E91T1-C1A8-Ni2-H4		500	−60	−40	0.05	0.33	1.41	2.42
	80%Ar+ 20%CO <sub>2</sub>	DCEP	SF-1A	A5.20 E71T-1M A5.36 E71T1-M21A2-CS1	F, H: 7-20  V-up, OH: 10-25	375	−20	—	0.05	0.52	1.22	—
			SF-3A	A5.20 E71T-9M-J A5.36 E71T1-M21A4-CS1		420	−40	−10	0.06	0.48	1.54	0.35
			SM-3A	A5.18 E70C-GM A5.36 E71T15-M21A4-CS1		375	−40	—	0.05	0.66	1.69	—
			SF-3AMSR	A5.29 E71T1-GM A5.36 E71T1-M21A6-K6-H4 E71T1-M21P6-K6-H4		420	−40	−10 (SR: 620°C, 4hr)	0.05	0.30	1.20	0.96
			SF-3AM	A5.29 E81T1-GM A5.36 E81T1-M21A8-Ni1-H4		460	−60	−40	0.06	0.33	1.26	1.00
			SF-36EA	A5.29 E81T1-GM A5.36 E81T1-M21A6-K6-H4 E81T1-M21P6-K6-H4		400	−60	−10 (SR: 580°C, 4hr)	0.05	0.33	1.17	0.85
			SF-50A	A5.29 E91T1-GM A5.36 E91T1-M21A4-K2-H4		500	−40	−10	0.05	0.44	1.15	1.72
			SF-70A	A5.29 E101T1-GM-H4 A5.36 E101T1-M21A4-K2-H4		620	−51	−20	0.07	0.40	1.68	1.65



### Warning!

Fumes and gas may be hazardous to your health. Please take appropriate preventive measures such as the implementation of ventilation as well as wearing a protector for breathing. Arc light is harmful to the eyes and skin. Please use appropriate shielding measures. Please do not touch anything where electricity is activated. It may cause death.

### Request to Customers

- Various data of distinctive features such as welding materials, deposited metal, weld metal, etc. shown in this catalog are meant to explain the representative properties and performance of the products and are not to be taken as a guarantee except those which are specified clearly as "Specification".
- In regard to the properties of welded structures, please be careful since design of structures, chemical compositions of steel plates, construction method, welding conditions, ability of constructor, etc. will affect the results.
- Please understand that we are not able to take responsibility for damages caused by the misuse of the technical information written in this catalog.

## NIPPON STEEL WELDING & ENGINEERING CO.,LTD.

2-4-2 Touyou, Koutou-ku,Tokyo 135-0016 Japan

Tel: +81-3-6388-9000

www.weld.nipponsteel.com

Superiority of Seamless Flux Cored Wires (NSWE's SFW)

E202en-07\_02\_202004f



# NIPPON STEEL's Duplex Stainless Steel Seamless Pipe & Tube

Expansion of the development area

Shortening of lead times/Reduction in manufacturing costs

Grade	UNS or NEXAGE™ Designation	Chemical Composition (%)	Features Application
Low alloy	S31500	18.5Cr - 5Ni - 2.7Mo	Heat exchanger
	DP11A	24Cr - 4Ni - Mo - Cu - N	Even pitting resistance with 316L
Standard	S31803	22.5Cr - 5Ni - 3Mo - N	Good pitting resistance
	S32205	22.7Cr - 6Ni - 3.4Mo - N	S31803 with controlled Mo, N
High alloy	S31260	25Cr - 7Ni - 3Mo - N - W	Better pitting resistance
	DP3N (S31260)	25.5Cr - 7Ni - 3.3Mo - N - W	Superior pitting resistance
Super	S32750	25Cr - 7Ni - 4Mo - N	Superior pitting resistance
	DP3W (S39274)	25Cr - 7Ni - 3.2Mo - 2W - N	Heat exchanger, Umbilical tube
Urea	DP12 (S31260)	25Cr - 7Ni - 2.7Mo - N - W	Optimized S31260 for urea
	DP28W™ (S32808)	27.5Cr - 7.7Ni - Mo - 2.2W - N	Best material for urea

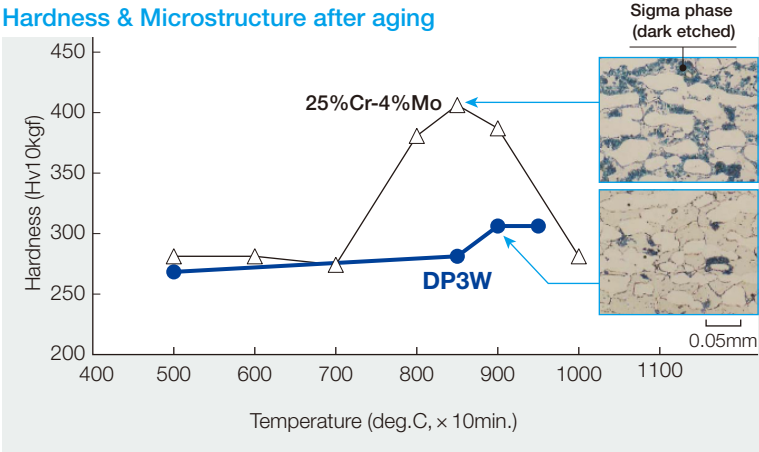
## Main features of DP3W

- Excellent resistance to localized corrosion
- High resistance to general corrosion, especially in sour environment
- Excellent mechanical and physical properties
- Good weldability
- Low sensitivity to sigma phase precipitation

## Standard

- UNS No.S39274
- ASTM A789/A789M, A790/A790M, A240/A240M, A480/A480M
- NACE MR0175
- NORSOK M-630

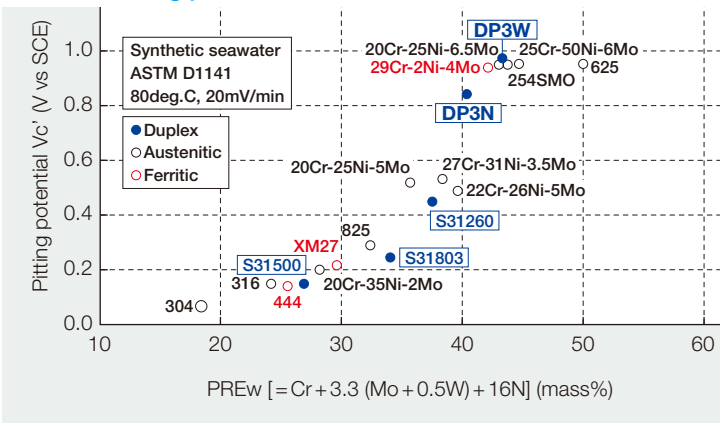
## Hardness & Microstructure after aging



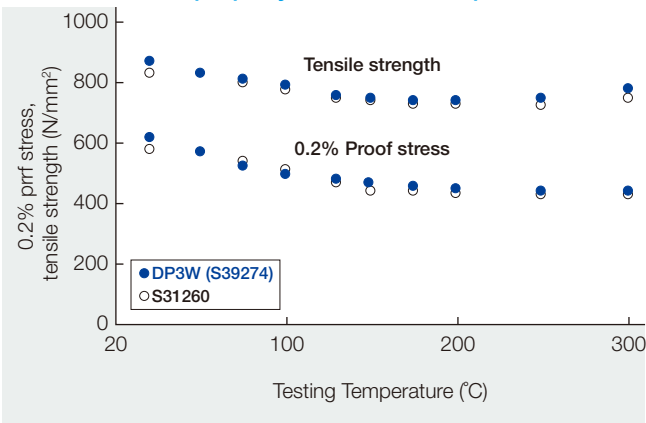
## Chemical contents

C	Si	Mn	P	S	Ni	Cr	Mo	N	Cu	W
Max. 0.030	Max. 0.80	Max. 1.00	Max. 0.030	Max. 0.020	6.0 – 8.0	24.0 – 26.0	2.5 – 3.5	0.24 – 0.32	0.20 – 0.80	1.50 – 2.50

## PREw vs Pitting potential



## Excellent tensile property at elevated temperature



# NIPPON STEEL’s Corrosion Resistant Alloy Seamless Pipe & Tube

Expansion of the development area

Shortening of lead times/Reduction in manufacturing costs

Grade	UNS or NEXAGE™ Designation	Chemical Composition (%)	Features Application
6%Mo+N	<span style="color: #e91e63;">■</span> <b>S31254</b>	20Cr - 18Ni - 6Mo - Cu - 0.20N	High pitting resistance: Seawater heat exchanger tubes
High Ni	<span style="color: #ffeb3b;">■</span> <b>N08825</b>	22Cr - 42Ni - 3Mo - 2Cu - Ti	High corrosion resistance & stress corrosion resistance: Heat exchanger tubes for petroleum refining
Ni base	<b>NEXAGE™ 845</b> <span style="color: #8bc34a;">■</span> <b>N06845</b>	22.5Cr - 47Ni - 3Cu - 6Mo - 3.5W	Pitting corrosion & acid resistance: Highly corrosion-resistant pipe and heat exchanger tubes for chemical industry
	<b>NEXAGE™ 696</b> <span style="color: #8bc34a;">■</span> <b>N06696</b>	30Cr - 60Ni - 2Cu - 1.5Si	Metal dusting corrosion and carburization resistance with high temp. strength: Heating furnace pipes for synthetic gas plants
Ni base High Mo	<span style="color: #ff9800;">■</span> <b>N06625</b>	22Cr - 9Mo - Ni base	High corrosion resistance and stress corrosion cracking: Seawater heat exchanger tubes
	<span style="color: #ff9800;">■</span> <b>N10276</b>	15.5Cr - 16Mo - 5Fe - Ni base	High acid resistance: Heat exchanger tubes for chemical plants

### ■ Main features of N08825

N08825 offers optimum resistance to environments where reducing and oxidizing conditions are encountered in process streams. Alloying Nickel content to 40mass% exhibits proven resistance to chloride stress corrosion cracking. It also resist to intergranular attack caused by welding, and to pitting / crevice corrosion caused by chloride with hostile sour gas condition.

### ■ Main features of N06625

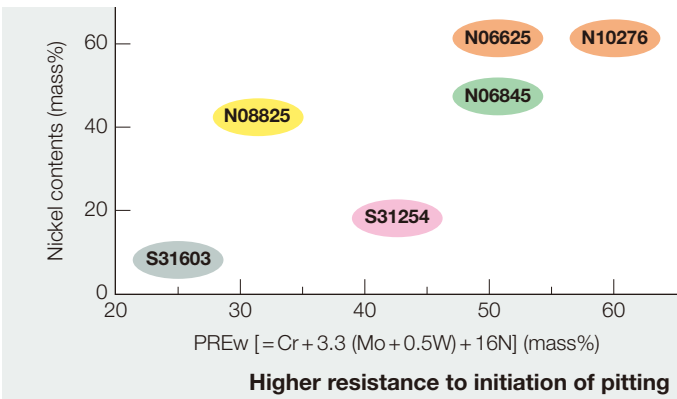
N06625 is a high Molybdenum, Niobium stabilized Nickel base super alloy with excellent resistance to localized corrosion, high temperature oxidation resistance and high strength. It resists stress corrosion cracking due to 62mass% nickel with outstanding resistance to pitting / crevice corrosion owing to 9mass% molybdenum.

### ■ Main features of N10276

N10276 is an extra low carbon-nickel base super alloy with high 15mass% molybdenum. It has superior corrosion resistance to a wide variety of environments, especially reducing media. It is widely used in hostile sour gas processing and production.

#### Comparison of Ni contents & pitting resistance

Higher resistance to propagation of SCC



#### Tensile properties at room temperature

UNS designation	TS, min. (MPa)	0.2%PS, min. (MPa)	EL, min. (%)
<span style="color: #e91e63;">■</span> <b>S31254</b>	675	310	35
<span style="color: #ffeb3b;">■</span> <b>N08825</b>	586	241	30
<b>NEXAGE™ 845</b> <span style="color: #8bc34a;">■</span> <b>N06845</b>	690	276	30
<b>NEXAGE™ 696</b> <span style="color: #8bc34a;">■</span> <b>N06696</b>	586	240	30
<span style="color: #ff9800;">■</span> <b>N06625</b>	690 (Solution)	276 (Solution)	30
<span style="color: #ff9800;">■</span> <b>N10276</b>	690	283	40

#### Available Size Range

- NPS1/2~38
- SCH10~160

## NIPPON STEEL CORPORATION

2-6-1 Marunouchi, Chiyoda-ku,Tokyo 100-8071 Japan  
Mail: GR\_J\_01\_energy@jp.nipponsteel.com  
www.nipponsteel.com

NIPPON STEEL’s Corrosion Resistant Alloy Seamless Pipe & Tube  
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