



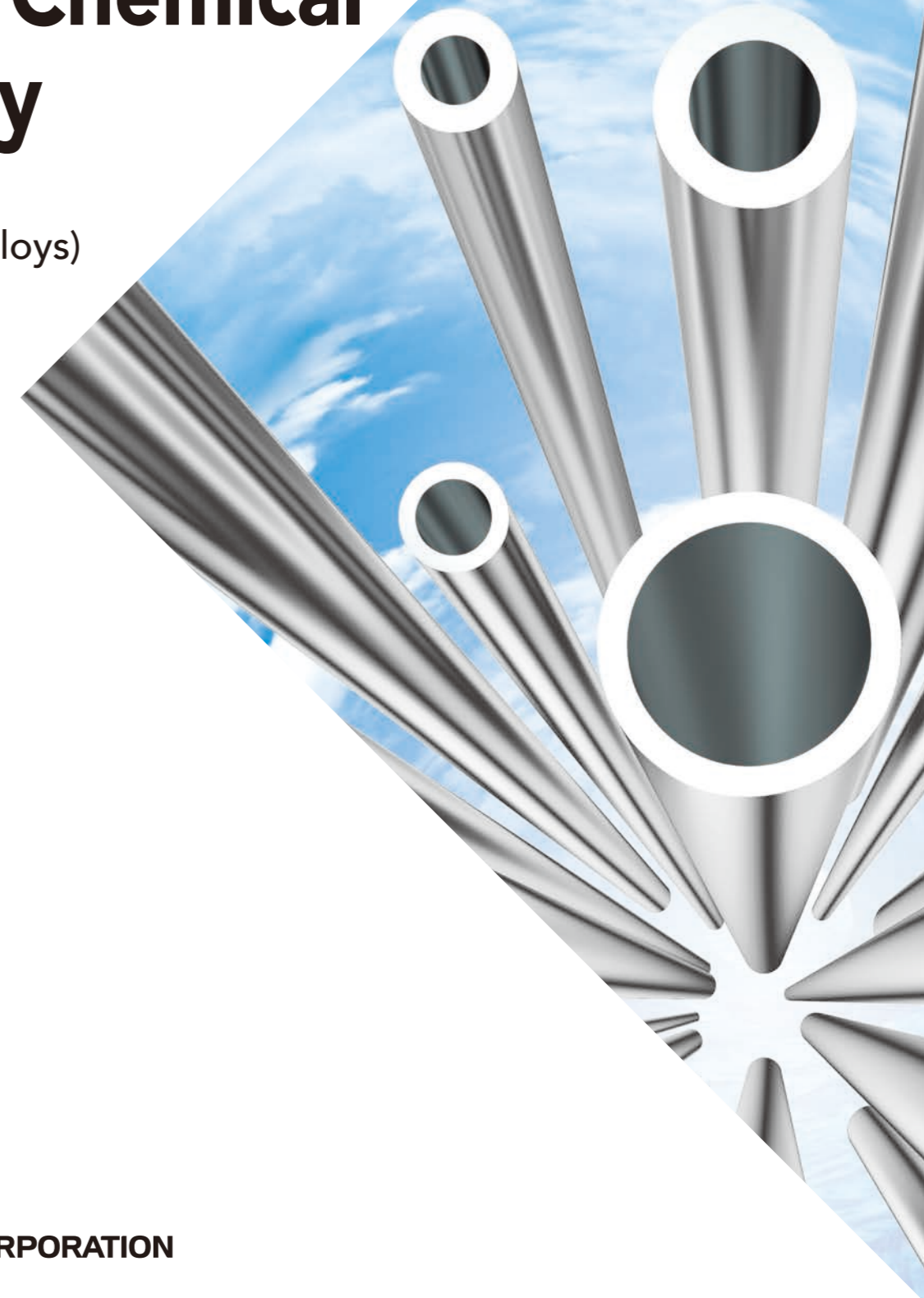
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Seamless Pipes and Tubes for the Chemical Industry

(Stainless Steel
and Ni-based Alloys)

Pipes
& Tubes



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(Stainless Steel and Ni-based Alloys)
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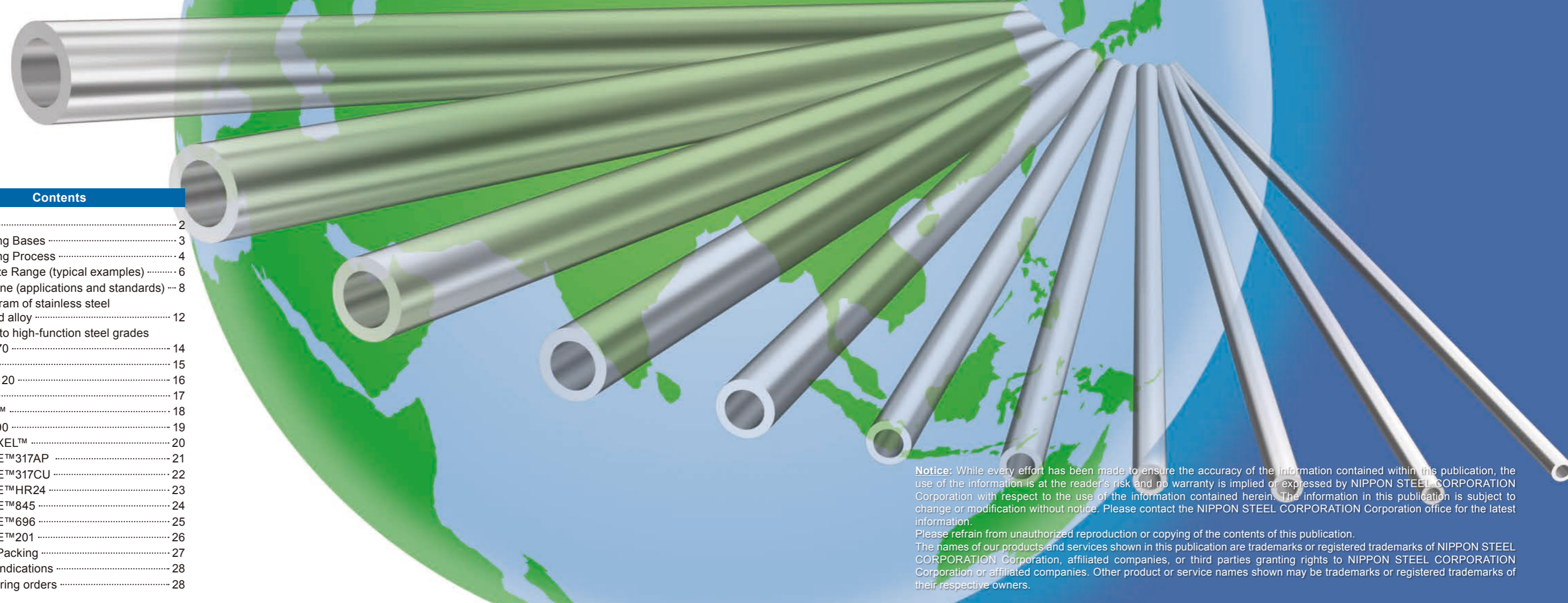
NIPPON STEEL CORPORATION

Seamless Pipes and Tubes for the Chemical Industry

(Stainless Steel and Ni-based Alloys)

Stainless steel and Ni-based alloy pipes and tubes have superior corrosion resistance, heat resistance, and low-temperature properties, and have been used as raw materials that can withstand harsh environments as seen in petroleum refining, petroleum chemistry, and energy fields, such as power and gas. Recently, they have proliferated in fields for building construction applications with their high aesthetic quality advantages, as well as in fields of new demand including semiconductor and liquid-crystal manufacturing equipment applications requiring a high level of cleanliness.

Our stainless steel and Ni-based alloy pipes and tubes have been manufactured based on excellent technology and strict quality control, from raw materials to final products, and have gained a favorable reputation from various fields. Without remaining complacent with the status quo, we will continue to research and develop improved products and will strive to meet the demands of the industry — which is undergoing remarkable technological innovation — and so we hope you will continue to do business with us.



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Features



Consistent quality control

Consistent control is performed from the material design stage, in order to deliver materials that meet customer needs. Strict quality control is performed from the raw material processing and steel-making stages to deliver high quality materials.



Abundant steel grades

In addition to the steel grades specified in the JIS and ASTM standards, our proprietary characteristic steel grades are also available.



Numerous acquired certifications

Many JIS, TÜV, and ship-class standard certifications and approvals have been acquired.



Substantial process control and service organization

Production is based on rational process control to ensure that you are satisfied about the delivery date. Appropriate technical services are also provided based on state-of-art research, experience, and track records.

Main production specifications

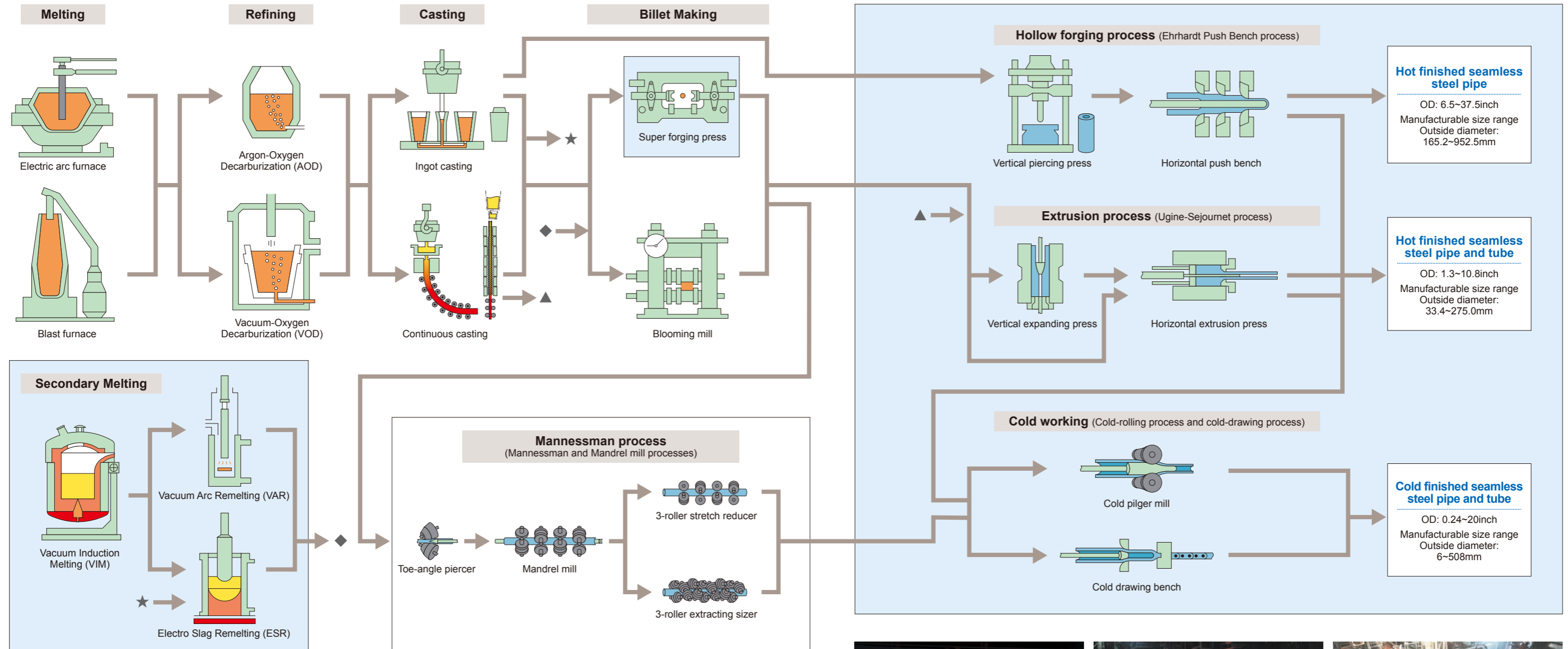
	Standard No.	Title
ASTM/ASME	A182/SA-182	Forged or Rolled Alloy and Stainless Steel Flanges, Forged fittings, and Valves and Parts for High Temperature Service
	A213/SA-213	Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater and Heat-Exchanger Tubes
	A268/SA-268	Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
	A312/SA-312	Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes
	A335/SA-335	Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
	A376/SA-376	Seamless Austenitic Steel Pipe for High-Temperature Service
	A403/SA-403	Wrought Austenitic Stainless Steel Piping Fittings
	A789/SA-789	Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service
	A790/SA-790	Seamless and Welded Ferritic/Austenitic Stainless Steel Pipes
	B161/SB-161	Nickel Seamless Pipes and Tubes
	B163/SB-163	Seamless Nickel and Nickel Alloy Condenser and Heat Exchanger Tubes
	B167/SB-167	Nickel-Chromium-Iron Alloys and Nickel-Chromium-Cobalt-Molybdenum Alloy Nickel-Iron-Chromium-Tungsten Alloy Seamless Pipes and Tubes
	B407/SB-407	Standard Specification for Nickel-Iron-Chromium Alloy Seamless Pipe and Tube
	B423/SB-423	Standard Specification for Nickel-Iron-Chromium-Molybdenum-Copper Alloy (UNS N08825, N08221, and N06845) Seamless Pipe and Tube
	B444/SB-444	Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloys (UNS N06625 and UNS N06852) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219) Pipe and Tube
	B622/SB-622	Standard Specification for Seamless Nickel and Nickel-Cobalt Alloy Pipe and Tube
	B668/SB-668	Standard Specification for UNS N08028 and N08029 Seamless Pipe and Tube
	B729/SB-729	Standard Specification for Seamless UNS N08020, UNS N08026, and UNS N08024 Nickel-Alloy Pipe and Tube
EN	10216-5	Seamless Steel Tubes for Pressure Purposes, Technical Delivery Conditions, Stainless Steel Tubes
JIS	G 3446	Stainless steel pipes for machine and structural purposes
	G 3459	Stainless steel pipes
	G 3463	Stainless steel boiler and heat exchanger tubes
	G 3467	Steel tubes for fired heater
	G 4903	Seamless nickel-chromium-iron alloy pipes
	G 4904	Seamless nickel-chromium-iron alloy heat exchanger tubes

Manufacturing Bases

Facilities	
①	Muroran Works
②	Kamaishi Works
③	Kashima Works: Hot electric resistance-welded steel pipes UO steel pipes
④	Kimitsu Works Kimitzu Area: Electric resistance-welded steel pipes Spiral steel pipes, UO steel pipes
⑤	// Tokyo Area: Seamless steel pipes (Mannesmann process)
⑥	Naoetsu Works
⑦	Nagoya Works: Electric resistance-welded steel pipes
⑧	Wakayama Works Wakayama Area: Seamless steel pipes (Mannesmann process)
⑨	// Kainan Area: Seamless steel pipes (Mannesmann process)
⑩	// Sakai Area
⑪	Osaka Steel Works
⑫	Amagasaki Works: Seamless steel pipes (Ugine process)
⑬	Hirohata Works
⑭	Yawata Works Yawata Area
⑮	// Tobata Area: Spiral steel pipes
⑯	// Kokura Area
⑰	Oita Works Oita Area
⑱	// Hikari Area: Electric resistance-welded steel pipes Seamless steel pipes (Ugine process)



Manufacturing Process



Item	Main Facilities
Steel Making Facilities	Electric arc furnace, AOD (Argon Oxygen Decarburizing) equipment VOD (Vacuum Oxygen Decarburizing) equipment, VIM (Vacuum Induction Melting) furnace VAR (Vacuum Arc Remelting) furnace, ESR (Electro-Slag Remelting) equipment
Forging Facilities	Super forging press, Blooming mill
Hot Finished Pipe and Tube-Making Facilities	(Toe-angle piercing type tube making mill) Extrusion tube mill, Hollow forging pipe mill (Vertical press, Horizontal press) Boring and trepanning machines, Lathes for OD machine
Cold Finished Pipe and Tube-Making Facilities	Hydraulic cold drawing bench, Oil hydraulic drawing bench Chain type cold drawing bench, High pressure drawing bench Cold pilger mill
Heat Treatment Furnaces	Continuous type/ Batch type/ Barrel type, Atmosphere controlled type/ Vacuum annealing type



Electric arc furnace



Horizontal push bench



Horizontal extrusion press



Cold pilger mill



Cold drawing bench



Heat treatment furnace

Available Size Range (typical examples)

Hot-finished seamless pipes and tubes

Nominal diameter	Outside diameter	Wall Thickness (mm)																		Outside diameter						
		(mm)	2.8	3	3.5	4	5	6	7	8	9	10	11	12	13	14	15	17	20		25	30	35	40	45	(mm)
25	1	34.0																								34.0
		38.1																								38.1
40	1½	48.6																								48.6
50	2	60.5																								60.5
65	2½	76.3																								76.3
		82.6																								82.6
80	3	89.1																								89.1
90	3½	101.6																								101.6
100	4	114.3																								114.3
		(120.0)																								(120.0)
		130.0																								130.0
125	5	139.8																								139.8
		(150.0)																								(150.0)
150	6	165.2																								165.2
		(170.0)																								(170.0)
	7	190.7																								190.7
200	8	216.3																								216.3
250	10	267.4																								267.4
300	12	318.5																								318.5
350	14	355.6																								355.6
400	16	406.4																								406.4
(A)	(B)	(mm)	2.8	3	3.5	4	5	6	7	8	9	10	11	12	13	14	15	17	20	25	30	35	40	45	(mm)	
Nominal diameter	Outside diameter	Wall Thickness (mm)																		Outside diameter						

Remarks 1. Notice-there is a range where available size can be difficult, depending on the material properties.
 2. Consult with us about ultra-thin items near the available size limit beforehand.
 3. Consultation regarding size for anything not in this table is also available.

Cold-finished seamless pipes and tubes

Nominal diameter	Outside diameter	Wall Thickness (mm)																		Outside diameter						
		(mm)	1.2	1.6	2	2.6	3.2	4	4.5	5	6	7	8	9	10	11	12	13	14		15	17	20	25	30	35
		6.0																								6.0
		8.0																								8.0
6	1/8	10.5																								10.5
10	3/8	17.3																								17.3
15	1/2	21.7																								21.7
20	3/4	27.2																								27.2
25	1	34.0																								34.0
		38.1																								38.1
32	1¼	42.7																								42.7
40	1½	48.6																								48.6
50	2	60.5																								60.5
65	2½	76.3																								76.3
		82.6																								82.6
80	3	89.1																								89.1
90	3½	101.6																								101.6
100	4	114.3																								114.3
		120.0																								120.0
		130.0																								130.0
125	5	139.8																								139.8
		150.0																								150.0
150	6	165.2																								165.2
		170.0																								170.0
	7	190.7																								190.7
200	8	216.3																								216.3
250	10	267.4																								267.4
300	12	318.5																								318.5
350	14	355.6																								355.6
400	16	406.4																								406.4
(A)	(B)	(mm)	1.2	1.6	2	2.6	3.2	4	4.5	5	6	7	8	9	10	11	12	13	14	15	17	20	25	30	35	(mm)
Nominal diameter	Outside diameter	Wall Thickness (mm)																		Outside diameter						

Remarks Consultation about size regarding that other than this table is also offered.

Product outline (applications and standards)

Developed seamless steel pipes and tubes for the chemical industry

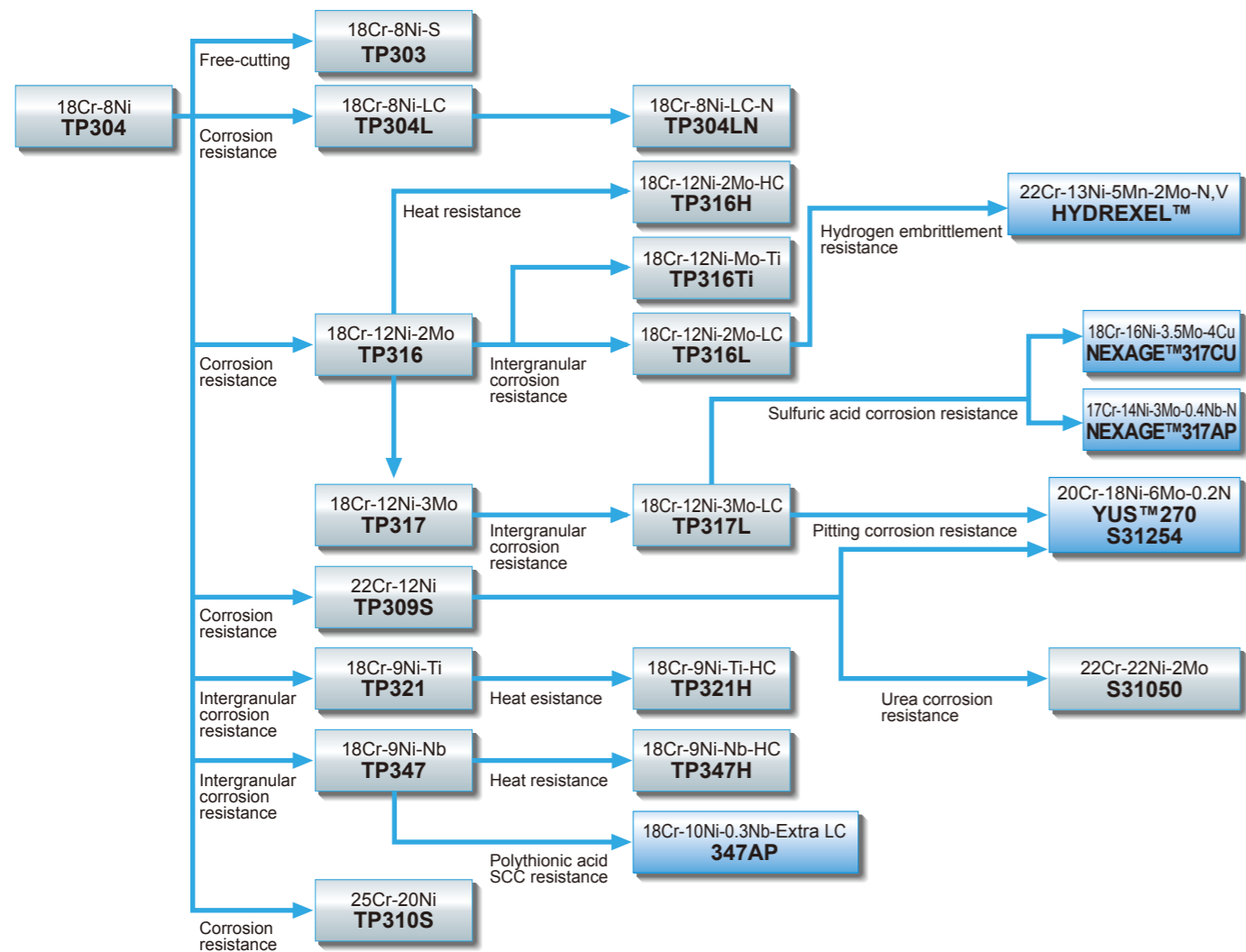
Classification	Grade	Composition	Applicable standard			Characteristics ● Example of an application	Chemical compositions (mass%)										Room-temperature tensile property		
			ASTM/ASME (example of a standard)	EN, etc.	JIS		C	Si	Mn	P	S	Ni	Cr	Mo	N	Others	TS, min. MPa	0.2% PS, min. MPa	EL, min. %
Austenitic stainless steel	YUS™ 270	20Cr-18Ni-6Mo-0.7Cu-0.2N-LC	S31254 (ASTM A312)	1.4547	JIS G3463 SUS312L TB	High corrosion resistance (pitting corrosion resistance, seawater resistance and acid resistance): ● Heat exchanger pipes and tubes for seawater desalination plants ● Seawater heat exchanger pipes and tubes for various chemical plants ● Food plant pipes handling high salinity	0.020max.	0.80max.	1.00max.	0.030max.	0.015max.	17.50~19.50	19.00~21.00	6.00~7.00	0.16~0.25	Cu:0.50~1.00	650	300	35
	347AP	18Cr-10Ni-0.3Nb-LC	S34751 (ASTM A312) ASME CC2196			Polythionic acid stress corrosion crack resistance and weld crack resistance: ● Petroleum refining plant furnace tubes	0.005~0.020	1.00max.	2.00max.	0.045max.	0.030max.	9.0~13.0	17.0~20.0	—	0.06~0.10	Nb:0.20~0.50 Nb ≥ 15C	515	205	35
	NEXAGE™ 317CU	18Cr-16Ni-3.5Mo-4Cu	S31730 (ASTM A312)			Sulfuric and hydrochloric acid dew point corrosion resistance (comparable to Ni-based alloy): ● Exhaust gas pipes and heat exchanger tubes for sulfur fuel boilers	0.030max.	1.00max.	2.00max.	0.040max.	0.010max.	15.10~16.50	17.00~19.00	3.10~4.00	0.045max.	Cu:4.0~5.0	480	175	35
	NEXAGE™ 317AP	17Cr-14Ni-3Mo-0.3Nb-N				Polythionic acid stress corrosion crack resistance weld crack resistance Naphthenic acid corrosion resistance ● Petroleum refining plant furnace tubes	0.020max.	1.00max.	2.00max.	0.045max.	0.030max.	11.0~15.0	16.5~20.0	3.0~4.5	0.06~0.15	Nb:0.20~0.50	515	205	35
	HYDREXEL™	22Cr-13Ni-5Mn-2Mo-0.3N	ASME TPXM-19			Hydrogen embrittlement resistance, High strength ● High pressure gaseous hydrogen supply tubes for hydrogen stations	0.005~0.060	0.20~1.00	4.30~6.00	0.030max.	0.010max.	12.00~13.50	21.50~23.50	1.50~3.00	0.25~0.40	Nb:0.15~0.30 V:0.15~0.30	800	430	35
Duplex stainless steel	YUS™ 2120	21Cr-2Ni-3Mn-Cu-N			JIS G3459 SUS821L1TP	High corrosion resistance (stress corrosion crack, general corrosion and crevice corrosion resistance): ● Heat exchanger pipes and tubes for various chemical plants	0.030max.	0.75max.	2.00~4.00	0.040max.	0.020max.	1.50~2.50	20.5~21.50	0.60max.	0.15~0.20	Cu:0.50~1.50	600	400	20
	YUS™ DX1	22Cr-5Ni-3Mo-0.13Cu-LC	S31803 (ASTM A789)	1.4462	JIS G3463 SUS329J3L TB		0.030max.	1.00max.	2.00max.	0.030max.	0.020max.	4.50~6.50	21.00~23.00	2.50~3.50	0.08~0.20	—	620	450	18
	DP11A	24Cr-4Ni-Mo-Cu-N					0.030max.	1.5max.	2.00max.	0.040max.	0.015max.	3.0~5.0	22.0~25.0	0.15~0.50	0.05~0.25	Cu:1.0~2.0	600	400	25
	DP12	25Cr-7Ni-2.7Mo-W-N	S31260 (ASTM A789)		JIS G3463 SUS329J4L TB	High corrosion resistance (urea corrosion and stress corrosion crack resistance): ● Urea reactor tubes	0.030max.	1.00max.	1.50max.	0.040max.	0.030max.	5.5~7.5	24.00~26.00	2.50~3.50	0.08~0.30	—	620	450	18
	DP3 DP3N	25Cr-7Ni-3.3Mo-N-W	S31260 (ASTM A789)		JIS G3463 SUS329J4L TB	High corrosion resistance (pitting corrosion, seawater and crevice corrosion resistance): ● Seawater heat exchanger tubes for various chemical plants	0.030max.	1.00max.	1.50max.	0.040max.	0.030max.	5.5~7.5	24.00~26.00	2.50~3.50	0.08~0.30	—	620	450	18
	DP3W	25Cr-7Ni-3.2Mo-2W-N	S39274 (ASTM A789) ASME CC2427	NORSOK M-630/M-650		High corrosion resistance (pitting corrosion, seawater and crevice corrosion resistance): ● Umbilical tubes and seawater heat exchanger tubes	0.030max.	0.80max.	1.00max.	0.030max.	0.020max.	6.0~8.0	24.0~26.0	2.5~3.5	0.24~0.32	Cu:0.20~0.80 W:1.50~2.50	800	550	15
	DP28W™	27.5Cr-7.7Ni-2.2W-Mo-N	S32808 (ASTM A789) ASME CC2496			High corrosion resistance (urea corrosion and stress corrosion crack resistance): ● Urea reactor tubes	0.030max.	0.50max.	1.10max.	0.030max.	0.010max.	7.00~8.20	27.00~27.90	0.80~1.20	0.30~0.40	W:2.10~2.50	800	550	15
Ferritic stainless steel	YUS™ 190	19Cr-2Mo-Ti-Nb-ULC-LN	S44400 (ASTM A268)	1.4521	JIS G3463 SUS444TB	Stress corrosion crack resistance (general corrosion resistance at SUS304 or higher): ● Heat exchanger pipes and tubes for various chemical plants ● Small hot-water/steam boilers	0.015max.	0.50max.	0.50max.	0.040max.	0.030max.	—	18.00~20.00	1.75~2.25	0.025max.	(Ti+Nb) ≥ 16 (C+N)	410	245	20
High Ni alloy	HK4M	25Cr-25Ni				Oxidation resistance, carburization resistance, and high-temperature strength (700 to 1,100°C) ● Cracking tubes for ethylene plants	0.2~0.3	0.75max.	1.50max.	0.020max.	0.030max.	24.0~26.0	24.0~26.0	—	—	Ti:0.20~0.60 Al:0.20~0.60 B:0.002~0.007	520	235	25
	NEXAGE™ HR24	25Cr-38Ni-Mo-Si				● Furnace pipes for hydrogen refineries ● Example of use: HK4M to 1,050°C and HPM to 1,100°C	0.10~0.20	1.40~2.00	1.50max.	0.020max.	0.030max.	37.0~40.0	23.0~26.0	1.00~3.00	—	Ti:0.20~0.60 B:0.010max. Zr:0.050max.	520	206	25
Ni-based alloy	NEXAGE™ 845	22.5Cr-47Ni-3Cu-6Mo-3.5W	N06845 (ASTM B423) ASME CC2794			Pitting corrosion resistance and acid resistance (sulfuric acid, hydrochloric acid, nitric acid, formic acid, etc.) ● Highly corrosion-resistant pipes and heat exchanger tubes for the chemical industry	0.05max.	0.50max.	0.5max.	—	0.010max.	44.0~55.0	20.0~25.0	5.0~7.0	—	Cu:2.0~4.0 W:2.00~5.00	690	276	30
	NEXAGE™ 696	30Cr-60Ni-2Cu-1.5Si	N06696 (ASTM B167) ASME CC2652			Metal dusting corrosion resistance, carburization resistance, and high-temperature strength ● Heating furnace pipes for synthetic gas plants ● High-temperature pipes for direct reduction iron plants	0.15max.	1.0~2.5	1.0max.	—	0.010max.	Remnant	28.0~32.0	1.0~3.0	—	Fe:2.0~6.0 Cu:1.5~3.0 Ti:1.0max.	586	240	30
	NEXAGE™ 201	Ni-Low C-Nb	N02201 (ASTM B161)	2.4068		Easy handling Ni ● Heat exchanger tube for caustic soda and hydrogen chloride plants	0.02max.	0.3max.	0.3max.	—	0.010max.	99.0min	—	—	—	Fe:0.4max. Cu:0.2max. Nb:Added	345	85	35

Note 1: DP28W™ is steel developed jointly with Toyo Engineering Corporation.

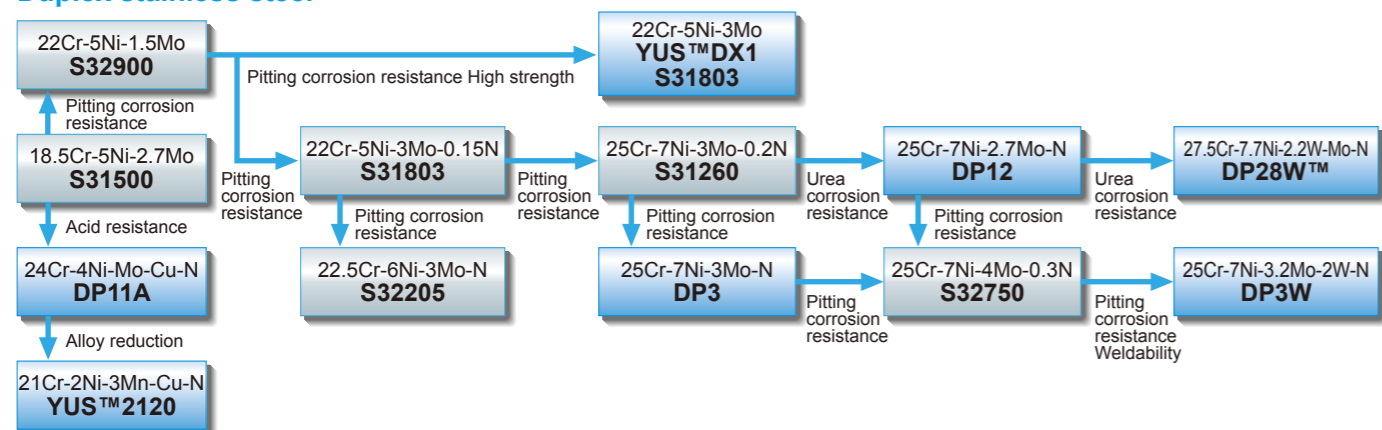
UNS No.

System diagram of stainless steel and Ni-based alloy

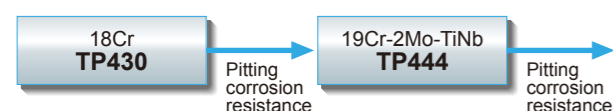
Austenitic stainless steel



Duplex stainless steel



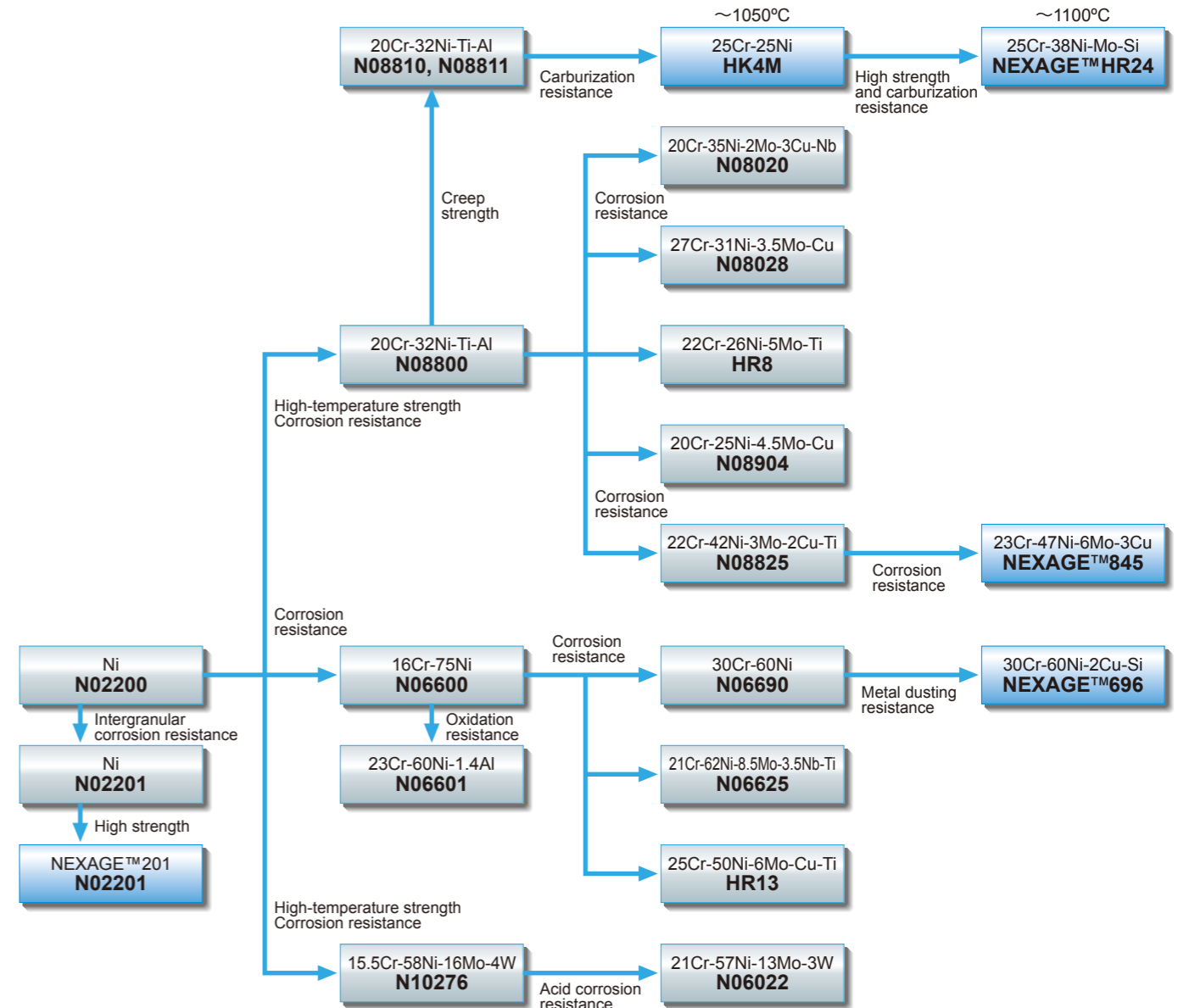
Ferritic stainless steel



Martensitic stainless steel



Ni, high Ni alloy and Ni-based alloy



YUS™270 Austenitic stainless steel pipes and tubes with seawater-resistance

20Cr-18Ni-6Mo-0.7Cu-0.2N-LC / Equivalent steel grades : ASTM S31254, JIS G3463 SUS312LTB

- Features**
- ① Superior corrosion resistance against chlorides, such as seawater.
 - ② Favorable corrosion resistance against hydrochloric acid and organic acid.
 - ③ Superior stress corrosion crack resistance to Type316 and 25Cr duplex stainless steel.
 - ④ Equivalent weldability to common austenitic stainless steel using 625 welding consumable.

Application Seawater heat exchanger tubes and seawater desalination plant pipes

Chemical compositions (mass%)

	C	Si	Mn	P	S	Ni	Cr	Mo	N	Cu
Specification	0.020max.	0.80max.	1.00max.	0.030max.	0.015max.	17.50~19.50	19.00~21.00	6.00~7.00	0.16~0.25	0.50~1.00

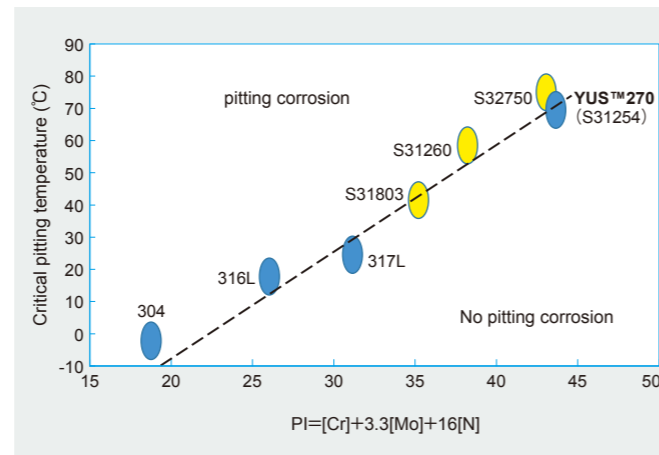
Quality property

● Mechanical property

	Tensile strength (MPa)	0.2% proof stress (MPa)	Elongation (%)
Specification	650min.	300min.	35min.
Typical example	712	348	61

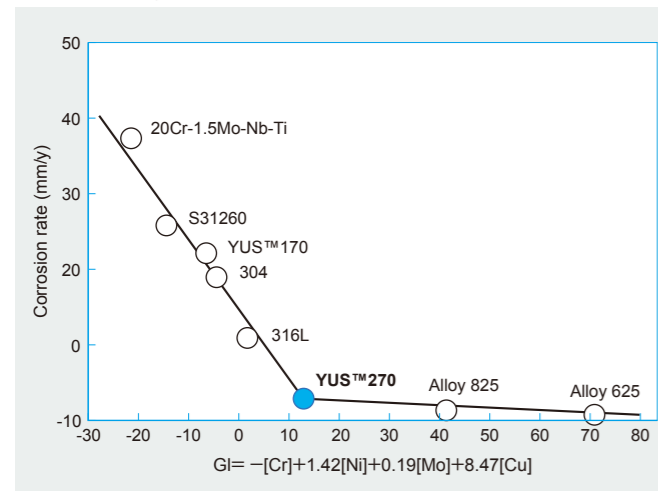
● Pitting corrosion resistance

JIS G 0578: 6%FeCl₃ + N/20 HCl, 24h



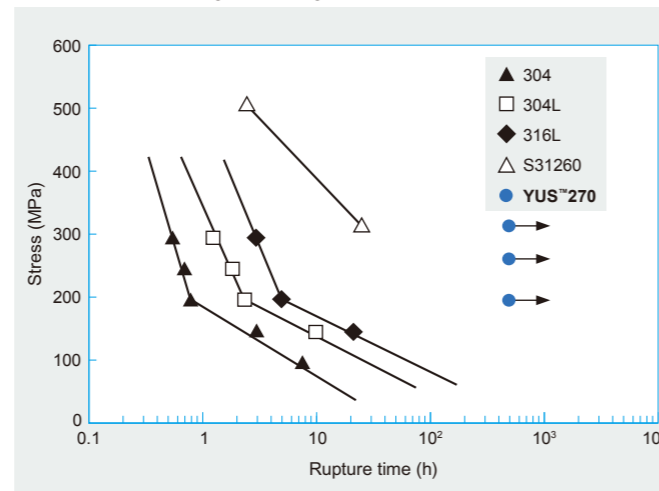
● General corrosion resistance (hydrochloric acid)

10.42% HCl, pH0.61, 50°C, 6h



● Stress corrosion cracking resistance

JIS G0576 : 42% MgCl₂, Boiling (143°C)



347AP Austenitic stainless steel pipes and tubes against polythionic acid stress corrosion cracking

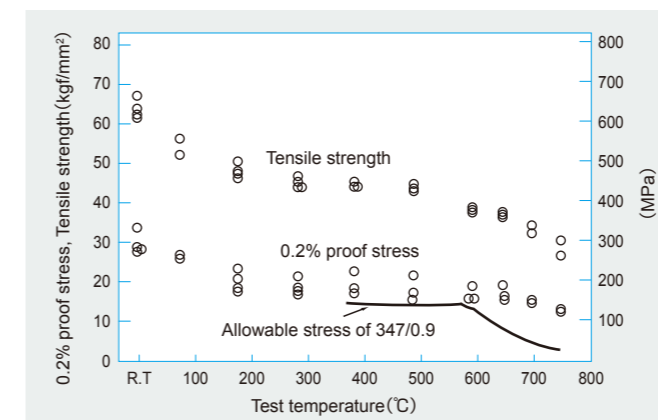
18Cr-10Ni-0.3Nb / Equivalent steel grades : ASTM S34751, ASME Code Case 2196

- Features**
- ① Excellent polythionic acid SCC resistance with no PWHT (post-weld heat treatment).
 - ② Equivalent weldability to Type304 and superior one to Type347.
 - ③ Equivalent high-temperature strength to Type347.

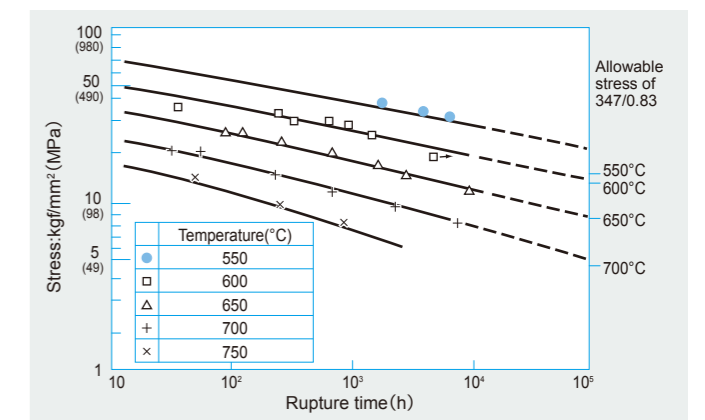
Chemical compositions (mass%)

	C	Mn	P	S	Si	Cr	Ni	N	Nb	Nb/C
Specification	0.005~0.020	2.00max.	0.045max.	0.030max.	1.00max.	17.0~20.0	9.0~13.0	0.06~0.10	0.20~0.50	15min.

Tensile property

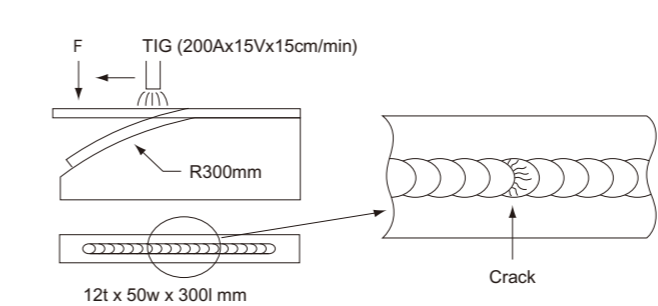


Creep rupture property

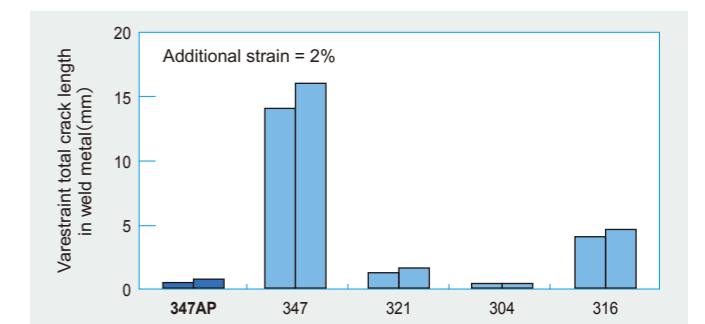


Weldability (Hot weld cracking)

● Vareststraint test

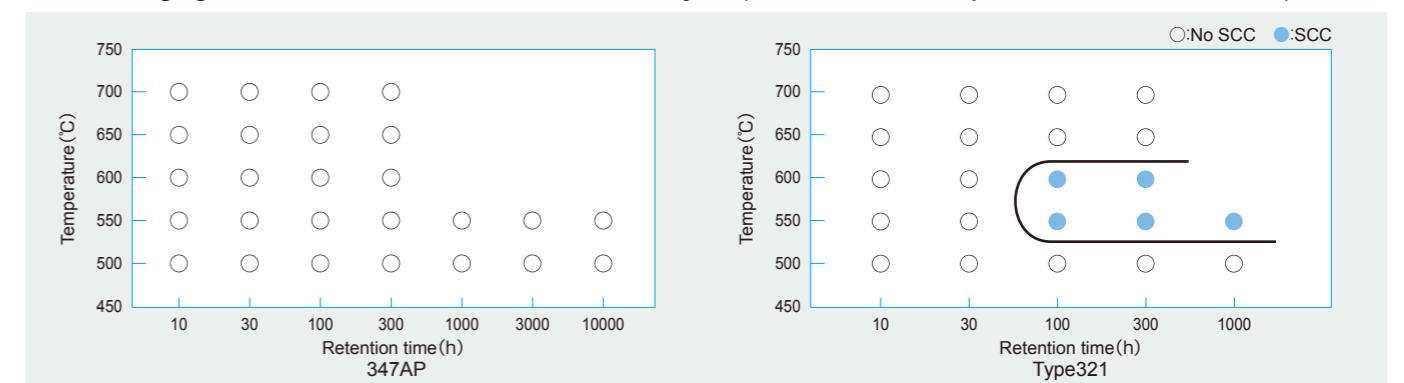


● Vareststraint test result



Corrosion resistance of a GTAW weld joint without PWHT

● Effect of aging condition on the SCC resistance of a weld joint (ASTM G35, U-bent specimen, 720 hrs immersion)



YUS™2120 Duplex stainless steel pipes and tubes with high strength

- Features**
- ① Lean duplex stainless steel pipe and tubes
 - ② Equal or higher pitting corrosion resistance than Type304
 - ③ About twice the yield strength as Type304 and Type316 at room temperature

Application Pipes for various chemical plants

Chemical compositions (mass%)

	C	Si	Mn	P	S	Ni	Cr	Mo	N	Cu
Specification	≤ 0.030	≤ 0.75	2.00~4.00	≤ 0.040	≤ 0.020	1.50~2.50	20.50~21.50	≤ 0.60	0.15~0.20	0.50~1.50

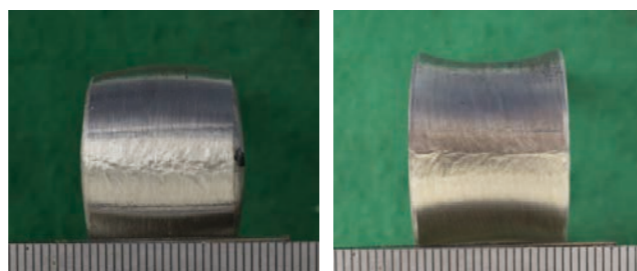
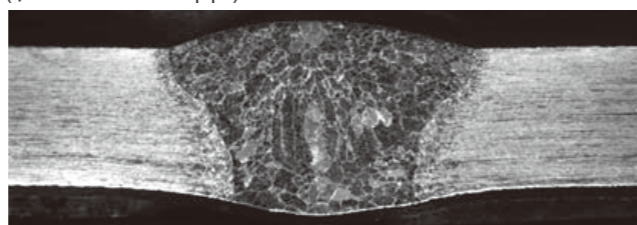
Quality property

●Mechanical property

	Tensile strength (MPa)	0.2% proof stress (MPa)	Elongation (%)
Specification	≥ 600	≥ 400	≥ 20
Typical example	706	606	37

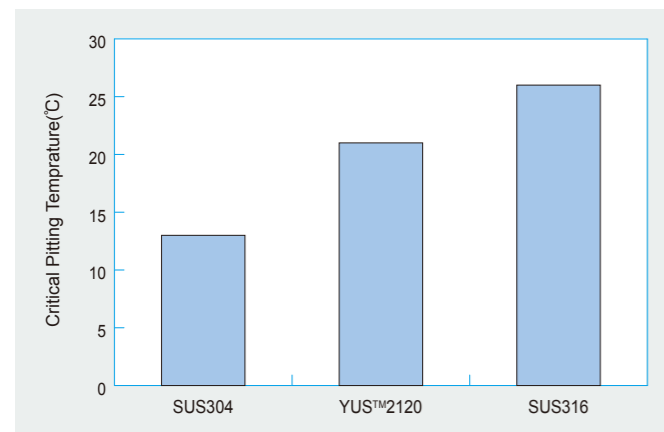
●Weldability

Macro structure observation and bend test at welded points (φ 60.5mm x 3.9mm pipe)



●Pitting corrosion resistance

JIS G0590-Modified(※) : 1kmol/m³ NaCl aqueous solution
※ Without surface grinding on test pieces



<Introduction of related products>

NIPPON STEEL Stainless Steel Corporation sells equivalent products(coils, sheets, heavy plates, wire rods and bars) as NSSC®2120.

For more information, please visit NIPPON STEEL Stainless Steel Corporation's website.

Contact detail : (NIPPON STEEL Stainless Steel Corporation) Products development division Tel:+81-3-6841-5290

<Precautions>

Recommended use environment

- ① Temperature : -50°C~+300°C (Prevention of embrittlement)
- ② Cl-concentration : Less than 500ppm at water environment (Always touching brackish water or seawater can cause rapid corrosion)

DP3W Super duplex stainless steel pipes and tubes

25Cr-7Ni-3.2Mo-2W-N / Equivalent steel grades : ASTM S39274, ASME Code Case 2427, NORSOK M-630/M-650

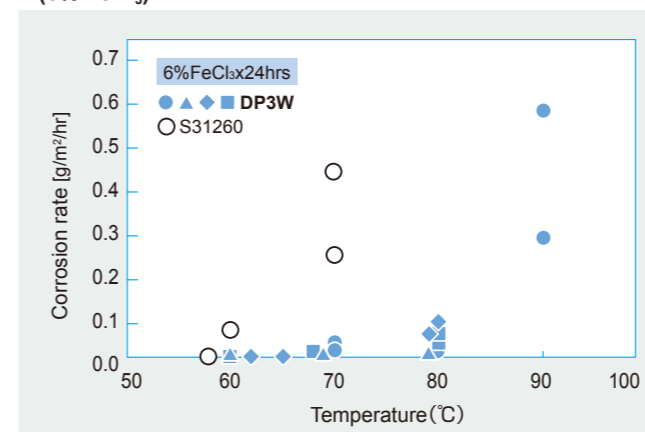
- Features**
- ① Excellent resistance to localized corrosion.
 - ② High resistance to general corrosion (especially in a sour environment).
 - ③ Excellent mechanical properties.
 - ④ Good weldability.
 - ⑤ Low sensitivity to sigma phase precipitation.

Chemical compositions (mass%)

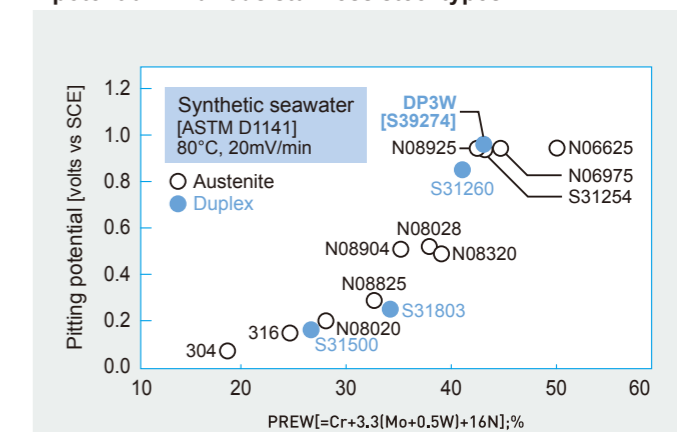
	C	Si	Mn	P	S	Ni	Cr	Mo	N	Cu	W
Specification	0.030max.	0.80max.	1.00max.	0.030max.	0.020max.	6.0~8.0	24.0~26.0	2.5~3.5	0.24~0.32	0.20~0.80	1.50~2.50

Pitting corrosion resistance

●Pitting corrosion rate in an ASTM G48 solution (6% FeCl₃)

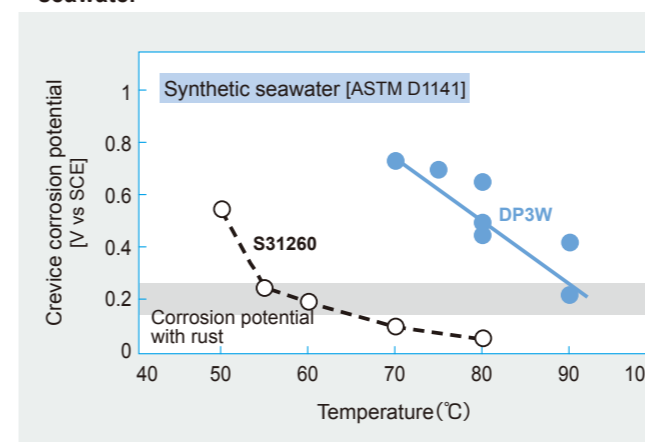


●Relationship between the PREW value and pitting potential in various stainless steel types



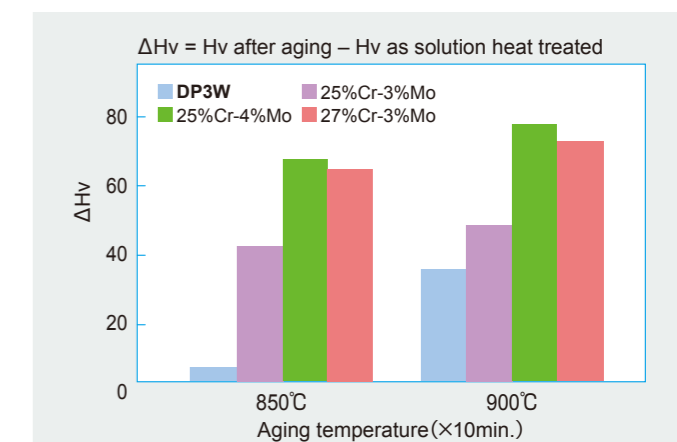
Crevice corrosion resistance

●Crevice corrosion potential for DP3W in synthetic seawater



Phase stability

●Hardness increase due to sigma phase precipitation

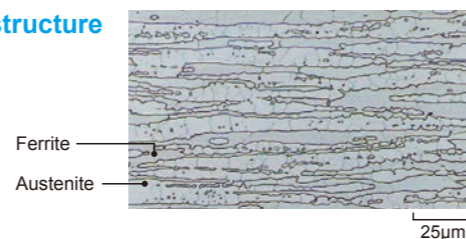


DP28W™ Duplex stainless steel pipes and tubes for urea plants

27.5Cr-7.7Ni-2.2W-Mo-N / Equivalent steel grades : ASTM S32808, ASME Code Case 2496

- Features**
- ① Excellent corrosion resistance in urea- carbamate solution.
 - ② High resistance to SCC.
 - ③ Very high mechanical strength.
 - ④ Good weldability.
 - ⑤ Good formability.

Microstructure

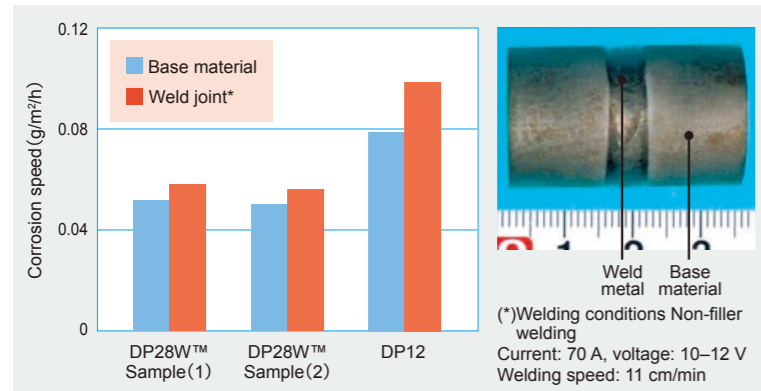


Chemical compositions (mass%)

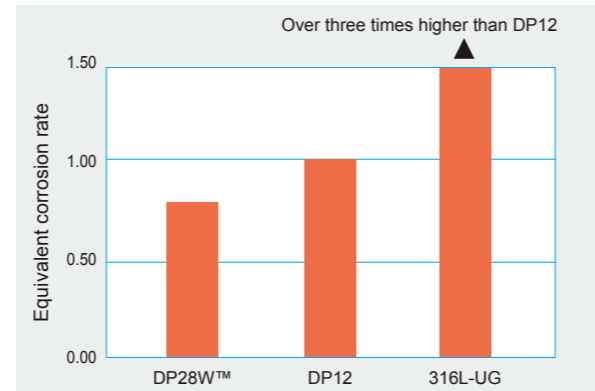
	C	Si	Mn	P	S	Ni	Cr	Mo	N	W
Specification	0.030max.	0.50max.	1.10max.	0.030max.	0.010max.	7.0~8.2	27.0~27.9	0.80~1.20	0.30~0.40	2.10~2.50

Corrosion resistance

● Result of a corrosion test in boiling 65% nitric acid



● Result of a corrosion test in a synthetic urea-carbamate solution

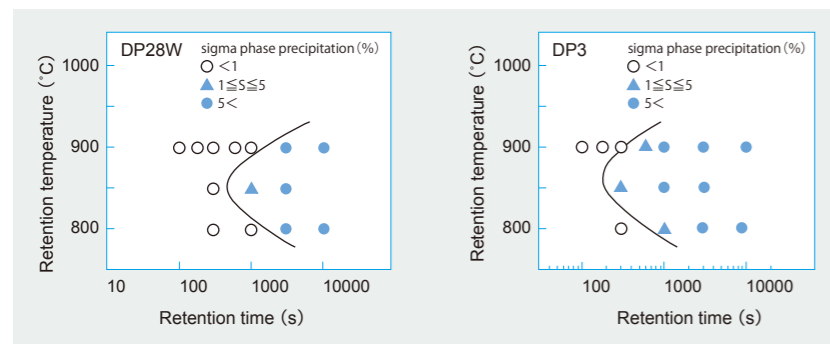


Mechanical property (example)

Grade	Tensile strength (MPa)	0.2% proof stress (MPa)	Elongation (%)	Hardness (Hv)
DP28W™	934	647	42	281
DP12	822	610	42	251
25-22-2(S31050)	676	352	50	173
316L	518	234	52	144

Weldability

● Comparison of sigma phase precipitation



Formability

● Appearance of U-bent tube



YUS™190 Ferritic stainless steel pipes and tubes with high corrosion resistance

19Cr-2Mo-Ti-Nb-ULC-LN / Equivalent steel grades : ASTM TP444, JIS G3463 SUS444TB

- Features**
- This is a ferrite stainless steel pipe and tube that delivers superior performance regarding stress corrosion cracking, which is the disadvantage of austenite stainless steel, and also has intergranular corrosion resistance, pitting corrosion resistance, and crevice corrosion resistance that have been significantly enhanced.
- ① Superior stress corrosion crack resistance and intergranular corrosion resistance.
 - ② Even or better pitting corrosion resistance and crevice corrosion resistance than TP304.
 - ③ Good formability and weldability.

Application Water heater pipes and seawater heater exchanger tubes

Chemical compositions (mass%)

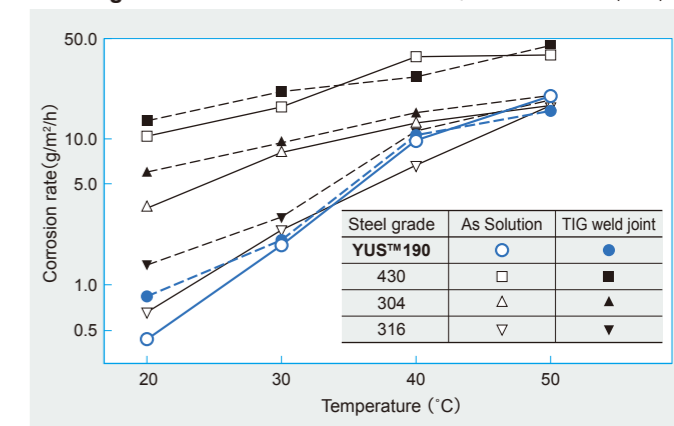
	C	Si	Mn	P	S	Cr	Mo	N	Ti + Nb
Specification	0.015max.	0.50max.	0.50max.	0.040max.	0.030max.	18.00~20.00	1.75~2.25	0.025max.	16 (C+N) min.

Quality property

● Mechanical property

	Tensile strength (MPa)	0.2% proof stress (MPa)	Elongation (%)
Specification	410min.	245min.	20min.
Typical example	531	357	42

● Pitting corrosion resistance 5% FeCl₃ + N/20 HCl test (48 h)



● Stress corrosion crack resistance

- ① 42%MgCl₂
Heat treatment condition : YUS™190 1200°C 5min AC
Type304 650°C 2h AC
Type316 650°C 2h AC
- ② High temperature chloride
Test condition: Pure water + NaCl(Cl⁻: 30 to 600 ppm) is used for adjustment.
300°C, 9.5MPa, ~300h

Grade	Heat treatment	Load stress (MPa)	Rupture time
YUS™190	Anneal	265	Not ruptured after 1,000 hrs
		294	//
	Sens	265	//
		314	//
304	Anneal	147	Ruptured in 3 hrs
		196	Ruptured in 1 hr
316	Anneal	147	Ruptured in 7 hrs
		196	Ruptured in 4 hrs

Test specimen: 1 mm × 15 mm × 100 mm 10R U-bent specimen

Grade	Heat treatment	Cl ⁻ concentration	Occurrence of crack		
			100h	200h	300h
YUS™190	Anneal	30	○	○	○
		600	○	○	○
	Sens	30	○	○	○
		600	○	○	○
304	Anneal	30	○	○	○
		600	○	×	×
	Sens	30	○	○	×
		600	○	×	×
316	Anneal	30	○	○	○
		600	×	×	—
	Sens	30	○	○	○
		600	—	—	—

○ : No crack, × : Crack, — : Not tested

Introduction to high-function steel grades

HYDREXEL™ New stainless steel for high pressure gaseous Hydrogen environments

22Cr-13Ni-5Mn-2Mo-0.3N / NIPPON STEEL Standard (According to ASME SA-312 TPXM-19)

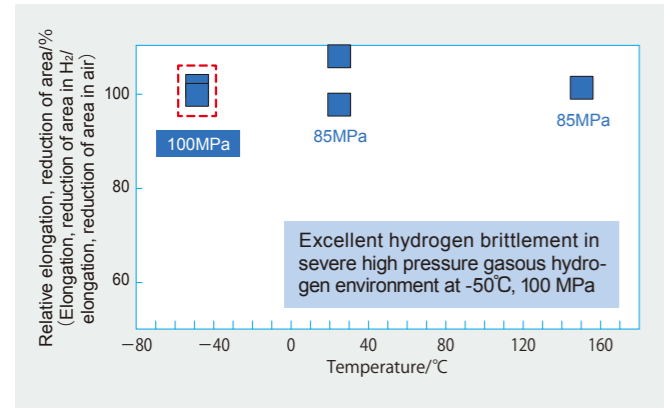
- Features**
- ① Highest level of resistance to hydrogen embrittlement in the world under high pressure gaseous hydrogen environment.
 - ② High strength over wide temperature range from room temperature to high temperature.
 - ③ Good weldability with high strength and resistance to hydrogen embrittlement equal to base metal.

Chemical compositions (mass%)

	C	Si	Mn	Ni	Cr	Mo	V	Nb	N
Specification	0.005~0.06	0.2~1.0	4.3~6.0	12.0~13.5	21.5~23.5	1.5~3.0	0.15~0.30	0.15~0.30	0.25~0.4

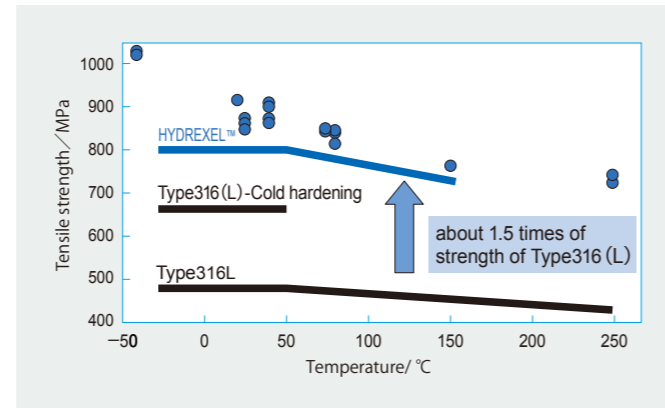
Hydrogen embrittlement

● SSRT (Slow Strain Rate Test)



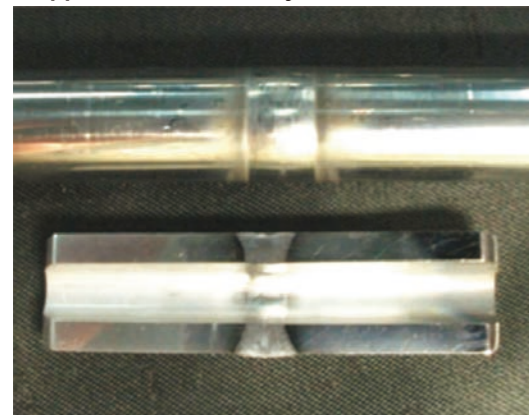
Mechanical property

● Mechanical property

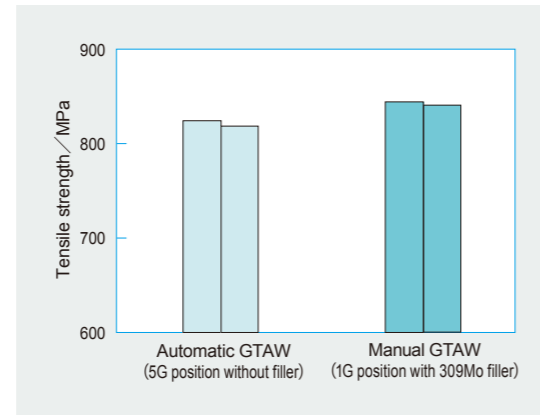


Weldability

● Appearance of welded joint



● Mechanical property of welded joints



Introduction to high-function steel grades

NEXAGE™ 317AP Austenitic stainless steel pipes and tubes against Polythionic acid stress corrosion cracking and Napthenic acid corrosion

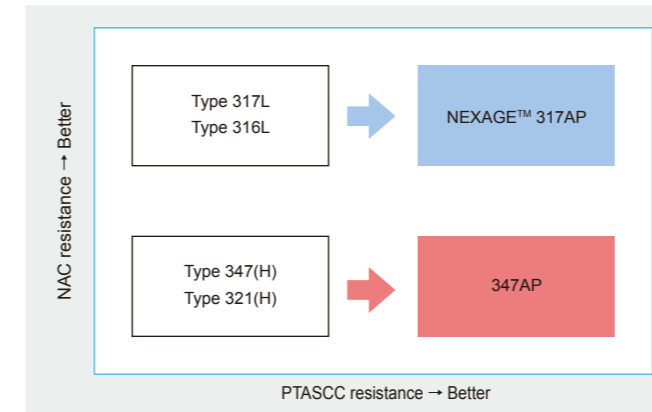
17Cr-14Ni-3Mo-0.3Nb-N

- Features**
- ① Excellent naphthenic acid and polythionic acid corrosion resistance without PWHT and thermal stabilization.
 - ② Better phase stability at high temperature as compared with type 317L.
 - ③ Equivalent mechanical property to type 317L.
 - ④ High Mo bearing Ni-based welding consumable such as 617 or 625 filler are available.

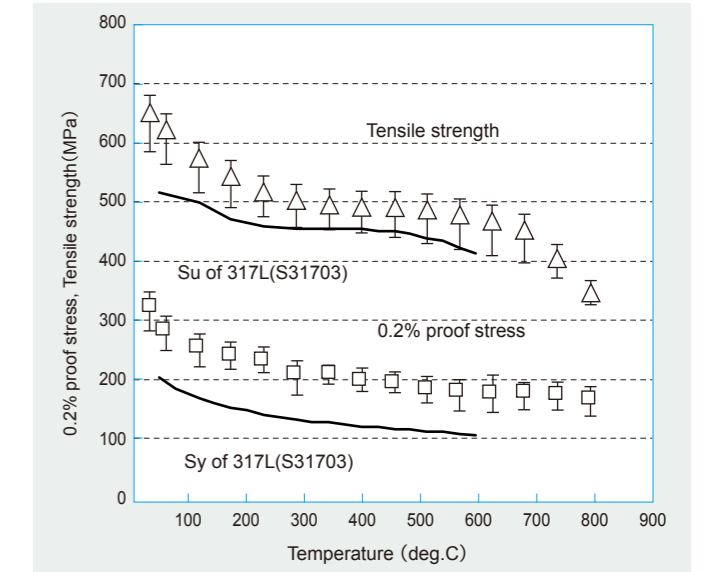
Chemical compositions (mass%)

	C	Mn	P	S	Si	Cr	Ni	Mo	N	Nb
Specification	max. 0.020	max. 2.00	max. 0.045	max. 0.030	max. 1.00	16.50~20.00	11.00~15.00	3.00~4.50	0.06~0.15	0.20~0.50

Target of Development

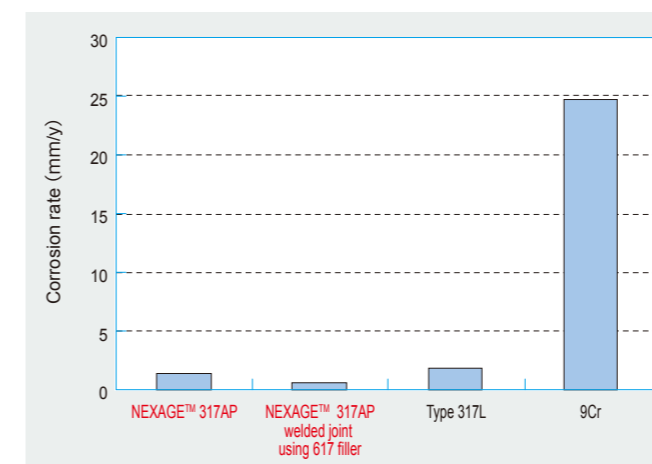


● High-temperature tensile property



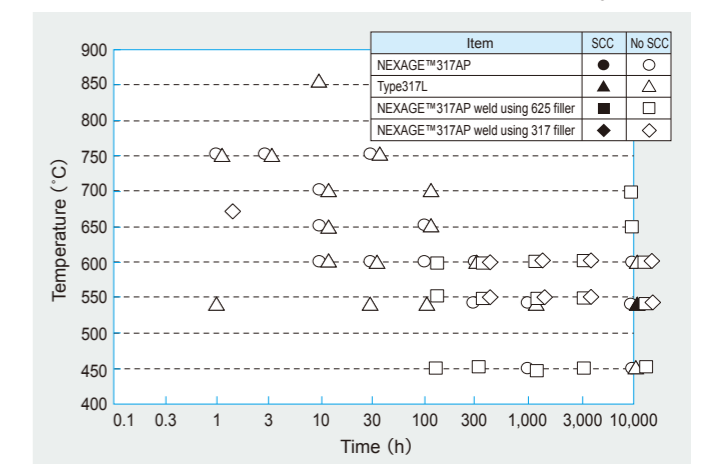
● Napthenic acid corrosion resistance

Crude oil fraction	Temperature	Test duration	Pressure relief valve setting	Wall shear stress by impeller	TAN
Process oil + Cyclohexylacetic acid	350°C (662F)	24h. X2 times	125psig (N2 purge)	135Pa	6mg KOH/g



● Polythionic acid SCC resistance

Test Solution	pH	Immersion Time(h)	Temperature (deg.C)
1% K ₂ S ₂ O ₈	2.0	100	20



NEXAGE™ 317CU

Austenitic stainless steel pipes and tubes with sulfuric acid dew point corrosion resistance

18Cr-16Ni-3.5Mo-4Cu / Equivalent steel grades : ASTM S31730

- Features**
- ① Superior corrosion resistance in sulfuric acid and hydrochloric acid than conventional austenitic stainless steels.
 - ② Equivalent localized corrosion resistance to Type316L.
 - ③ Equivalent weldability to Type316L using commercially available Ni-based welding consumable.

Chemical compositions (mass%)

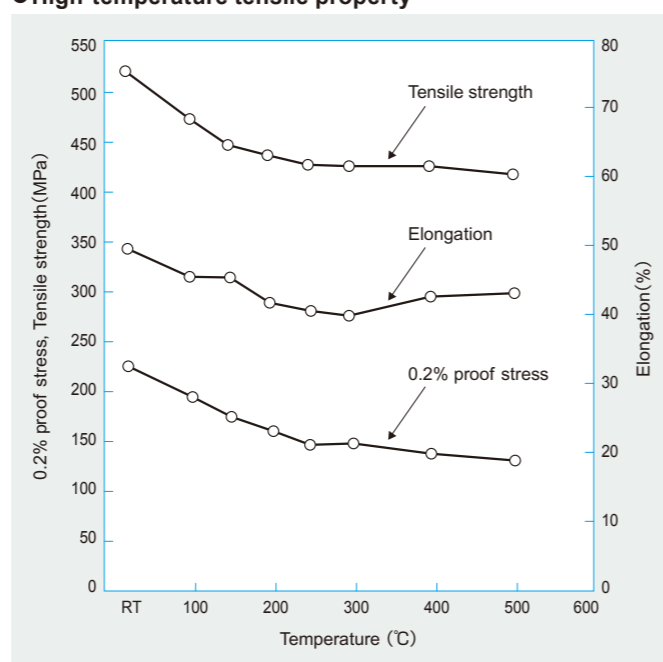
	C	Si	Mn	P	S	Ni	Cr	Mo	N	Cu
Specification	0.030max.	1.00max.	2.00max.	0.040max.	0.010max.	15.10~16.50	17.00~19.00	3.10~4.00	0.045max.	4.0~5.0

Quality property

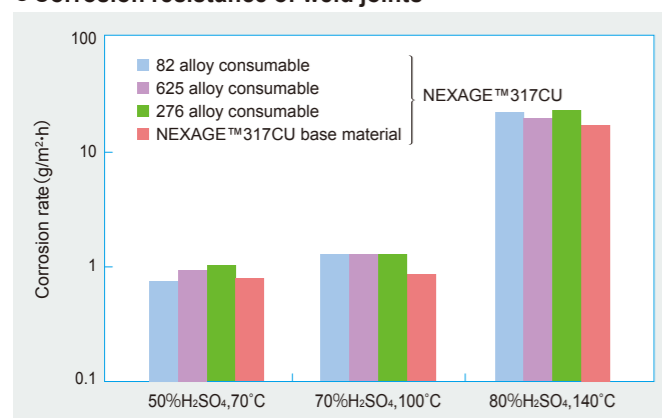
● Mechanical property

	Tensile strength (MPa)	0.2% proof stress (MPa)	Elongation (%)
Specification	480min.	175min.	35min.
Typical example	520	225	50

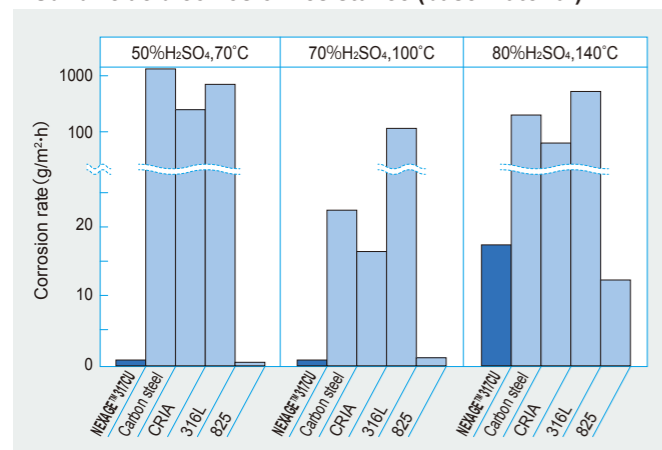
● High-temperature tensile property



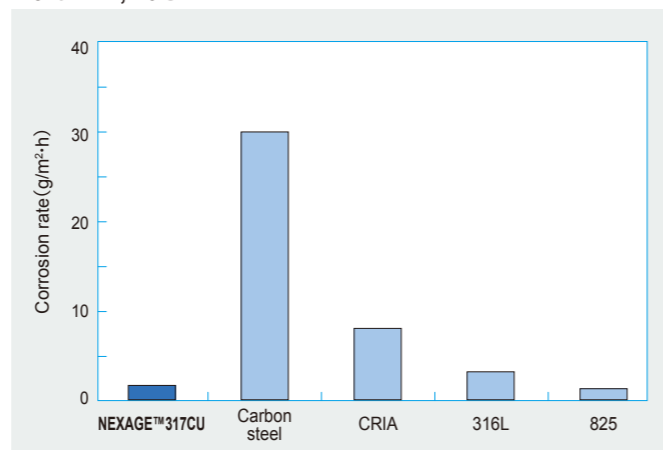
● Corrosion resistance of weld joints



● Sulfuric acid corrosion resistance (base material)



● Hydrochloric acid corrosion resistance (base material) 5% HCL, 40°C



NEXAGE™ HR24

Austenitic stainless (high Ni) alloy pipes and tubes for ethylene plants

25Cr-38Ni-Mo-Si

- Features**
- ① Long unit length more than 13m with small diameter.
 - ② Internal finned tubes are available.
 - ③ Excellent elevated temperature strength and carburization resistance.
 - ④ Excellent ductility.
 - ⑤ Easy repair of welds.



Characteristics

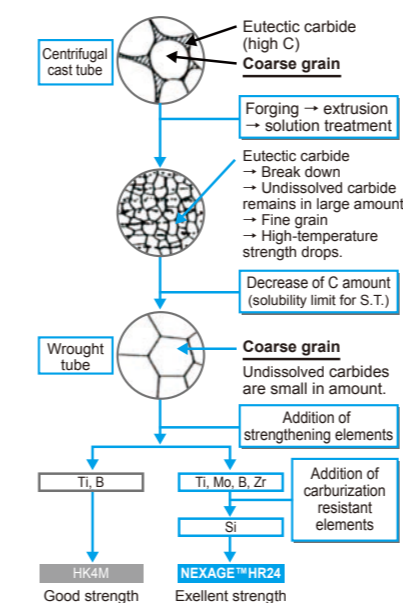
Grade	Basic composition	Oxidation	Carburization	Creep strength
800H	0.08C-20Cr-30Ni	●	●	●
HK4M	0.2C-25Cr-25Ni-Ti, B	★★	★★	★
NEXAGE™ HR24	0.14C-25Cr-38Ni-Mo, Si	★★★	★★★	★★

● Reference level ★ Superior

Chemical compositions (mass%)

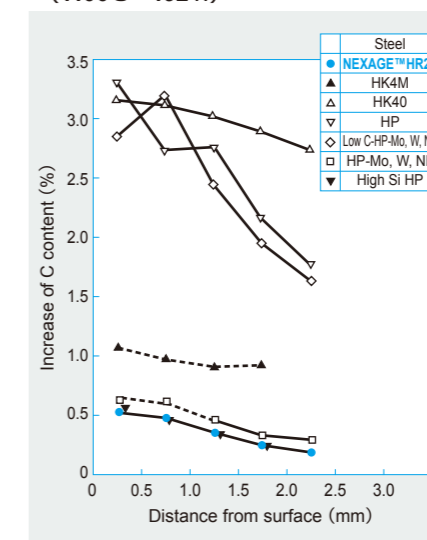
	C	Si	Mn	P	S	Ni	Cr	Mo	Ti	B	Zr
Specification	0.10~0.20	1.4~2.0	1.5max.	0.02max.	0.03max.	37~40	23~26	1.0~3.0	0.2~0.6	0.01max.	0.05max.

Development philosophy of NEXAGE™ HR24

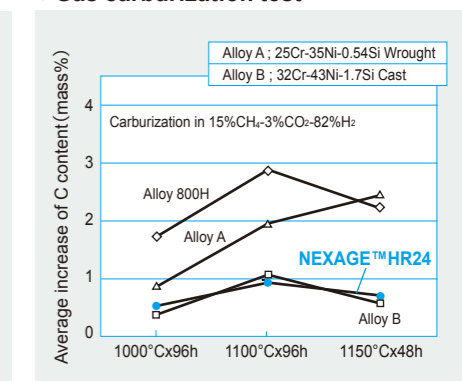


Corrosion resistance

● Pack carburization test (1100°C × 192 h)



● Gas carburization test



NEXAGE™ 845 New Ni-based alloy with best-balanced performances

23Cr-47Ni-6Mo-3Cu / Equivalent alloy grades : ASTM N06845, ASME Code Case 2794

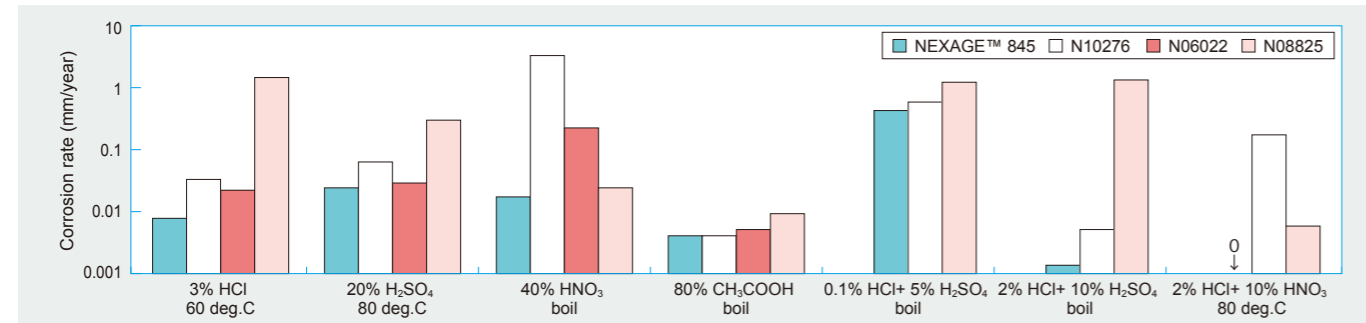
- Features**
- ① Excellent corrosion resistance for both oxidizing and reducing environment.
 - ② More cost-effective than conventional alloys.
 - ③ Good formability and weldability.

Chemical compositions (mass%)

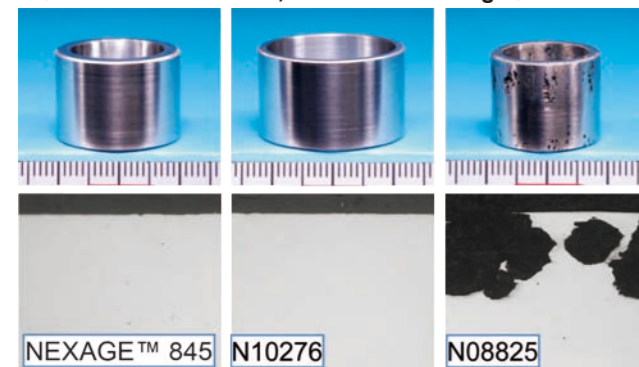
	C	Si	Mn	S	Cu	Ni	Cr	Mo	W	Fe
Specification	max.0.05	max.0.5	max.0.5	max.0.010	2.0~4.0	44.0~50.0	20.0~25.0	5.0~7.0	2.0~5.0	Remainder

Corrosion resistance

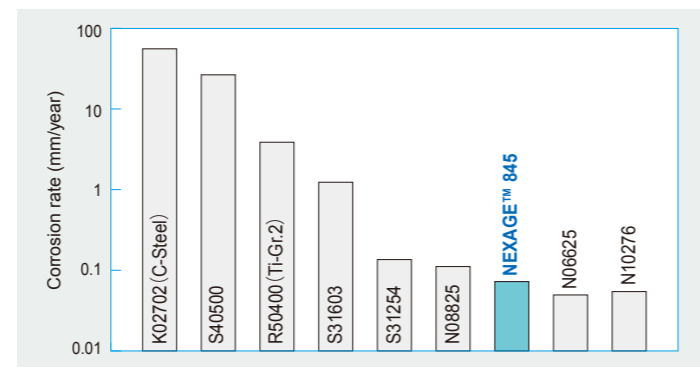
● Resistance to acid corrosion



● Resistance to local corrosion (ASTM G48 Method A, 6% FeCl₃ at 85 deg.C)

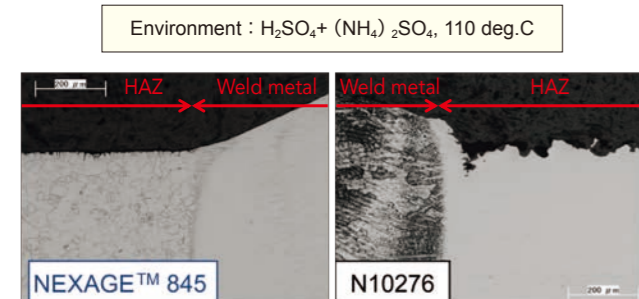


● Corrosion resistance to 40% NH₄Cl solution at 200°C



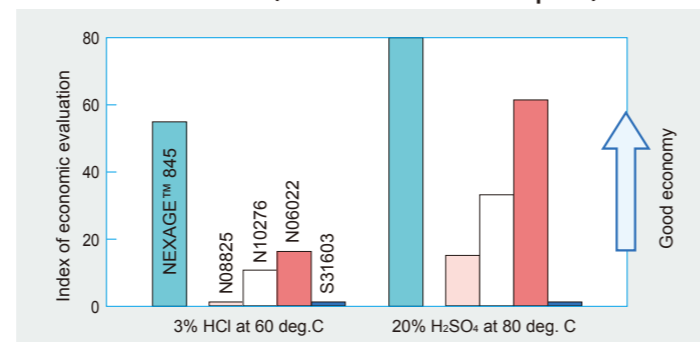
Field evaluation

● Microstructure of weldment after 1 year immersion in sulfuric acid tank



Economy

● Economic evaluation (= 1/corrosion rate/unit price)



NEXAGE™ 696 Ni-based alloy pipes and tubes with excellent metal dusting resistance

30Cr-60Ni-2Cu-1.5Si / Equivalent alloy grades : ASTM N06696, ASME Code Case 2652

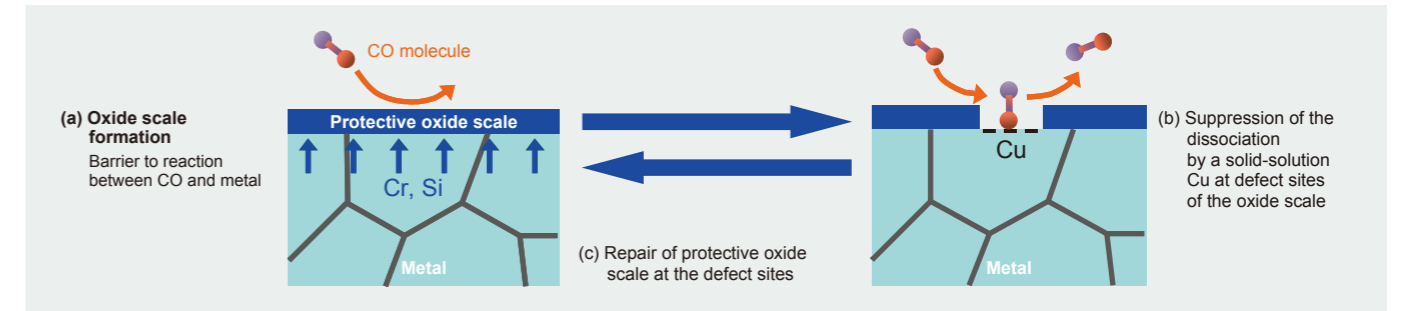
- Features**
- ① Excellent high-temperature corrosion resistance especially carburization and metal dusting.
 - ② High strength at elevated temperature.
 - ③ Excellent thermal stability.
 - ④ Good weldability.

Chemical compositions (mass%)

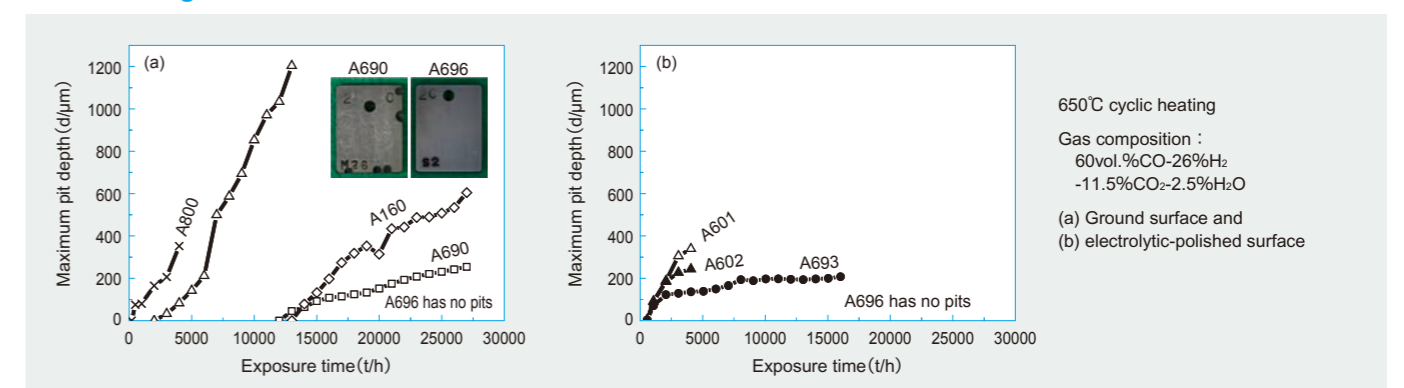
	C	Si	Mn	S	Cu	Ni	Cr	Mo	Ti	Fe
Specification	0.15max.	1.0~2.5	1.0max.	0.010max.	1.5~3.0	Remainder	28.0~32.0	1.0~3.0	1.0max.	2.0~6.0

Mechanism

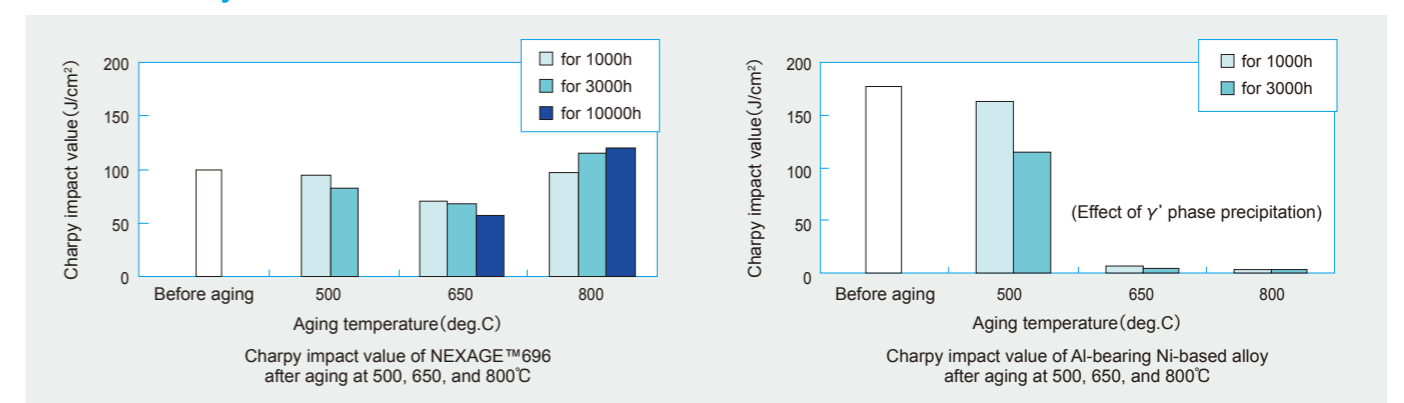
● Concept of new metal dusting prevention technology



Metal dusting resistance



Thermal stability



NEXAGE™ 201 Easy handling Ni by strengthening

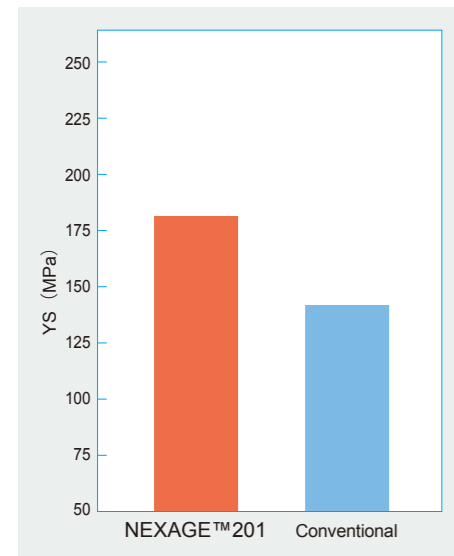
Equivalent steel grades : ASTM N02200, N02201(Low-C)

- Features**
- ① Improvement of handling ability by adding Nb within the range of the standard.
 - ② Improvement of corrosion resistance by reducing solute carbon.

Chemical compositions (mass%)

	Ni	Cu	Fe	Mn	C	Si	S	Nb
N02200	99.0min.	0.25max.	0.40max.	0.35max.	0.15max.	0.35max.	0.01max.	—
N02201	99.0min.	0.25max.	0.40max.	0.35max.	0.02max.	0.35max.	0.01max.	—
NEXAGE™ 201	99.0min.	0.25max.	0.40max.	0.35max.	0.02max.	0.35max.	0.01max.	Added

Mechanical property

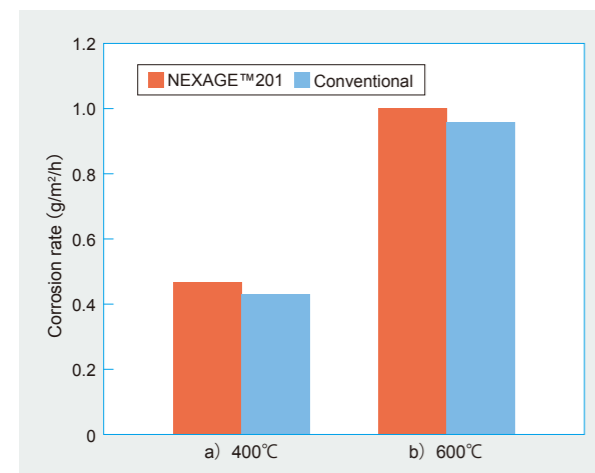


Workability

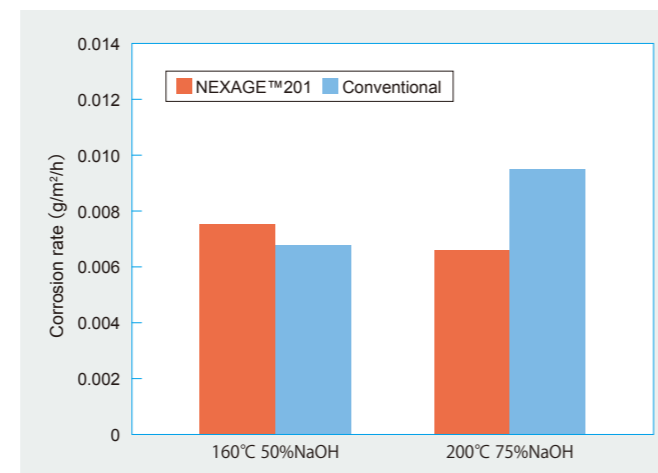
● Appearance after flaring and flattening test of ϕ 31.8mm x t1.6mm tube



Corrosion resistance in 30% HCl gas



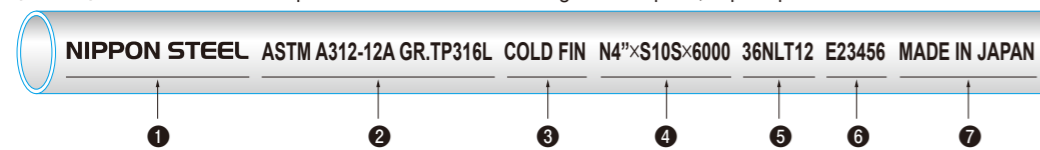
Corrosion resistance in NaOH



Example of Packing

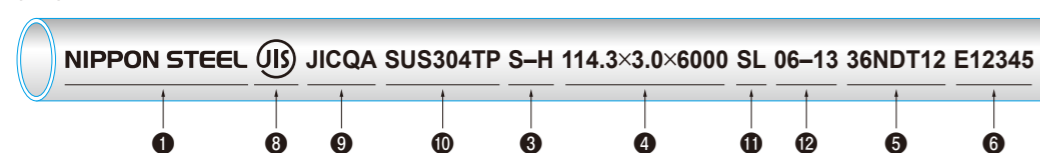
Example of Indications

<ASTM> ※This is an example. Indication is based on cargo mark reports, in principle.



①	Manufacturer's band or name
②	Standard abbreviation
③	Manufacturing method
④	Dimensions (outside diameter × thickness × length)
⑤	Inspection number (serial number)
⑥	Heat number (molten steel number)
⑦	Country of origin
⑧	JIS mark
⑨	Certification body code
⑩	Type code
⑪	Works abbreviation
⑫	Date of manufacture (month/two low-order digits for year)

<JIS>



Requests during orders

When ordering or inquiring about our stainless steel pipes and tubes, you are requested to inform us about the following items.

1. Steel pipe standard and type
2. Dimensions (outside diameter, thickness, and length)
3. Quantity
4. Delivery date and destination
5. Applications and usage condition
6. Packing type
7. Number of copies of the inspection certificate
8. With or without a witnessed inspection
9. Other and specially requested items

memo