NIPPON STEEL

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Seamless Pipes and Tubes for the Chemical Industry
(Stainless Steel and Ni-based Alloys)
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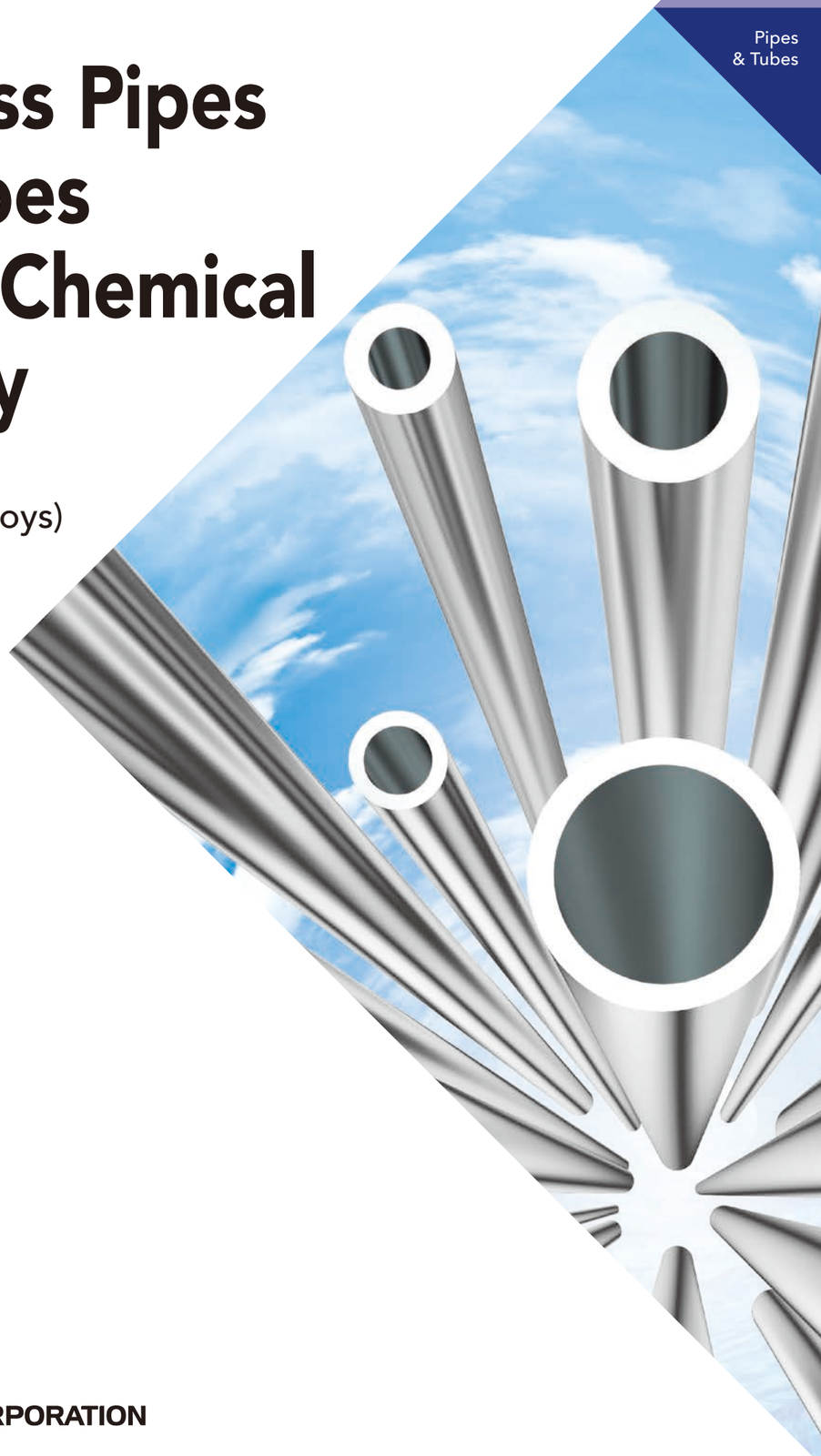
Pipes
& Tubes

Seamless Pipes and Tubes for the Chemical Industry

(Stainless Steel
and Ni-based Alloys)



NET ZERO
NIPPON STEEL
Green Transformation
initiative

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.

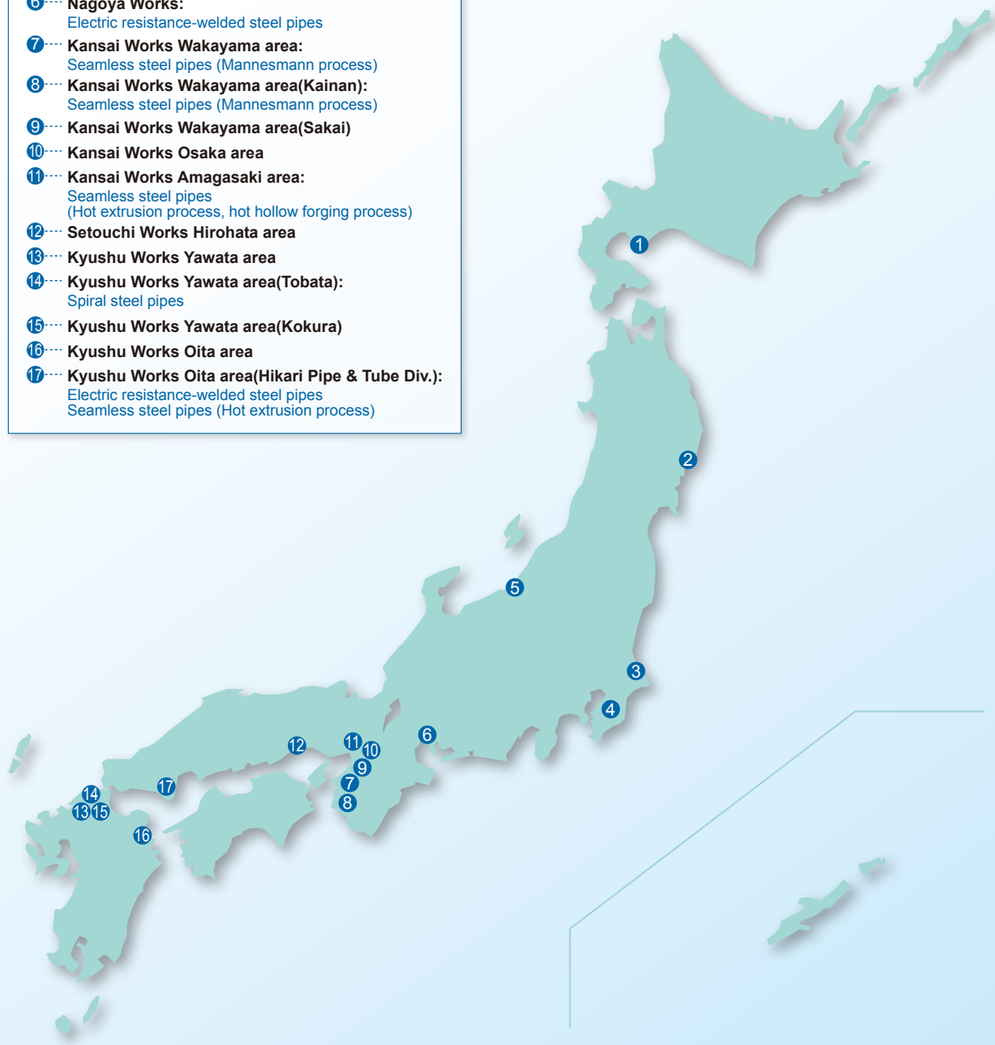
Main production specifications

	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

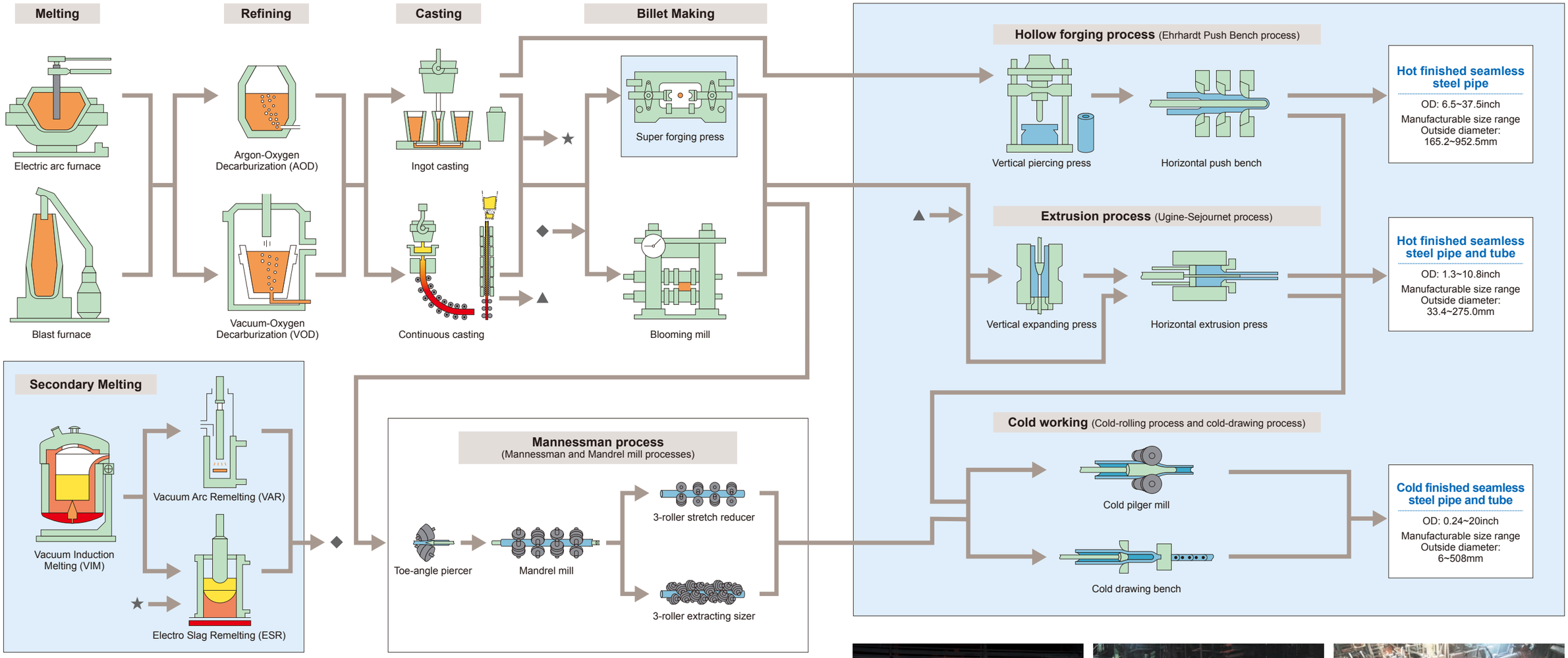
Manufacturing Bases

Facilities

1. **North Nippon Works Muroran area**
2. **North Nippon Works Kamaishi area**
3. **East Nippon Works Kashima area:**
   Hot electric resistance-welded steel pipes
4. **East Nippon Works Kimitsu area:**
   Electric resistance-welded steel pipes
   Spiral steel pipes
5. **East Nippon Works Naoetsu area**
6. **Nagoya Works:**
   Electric resistance-welded steel pipes
7. **Kansai Works Wakayama area:**
   Seamless steel pipes (Mannesmann process)
8. **Kansai Works Wakayama area(Kainan):**
   Seamless steel pipes (Mannesmann process)
9. **Kansai Works Wakayama area(Sakai)**
10. **Kansai Works Osaka area**
11. **Kansai Works Amagasaki area:**
    Seamless steel pipes
    (Hot extrusion process, hot hollow forging process)
12. **Setouchi Works Hirohata area**
13. **Kyushu Works Yawata area**
14. **Kyushu Works Yawata area(Tobata):**
    Spiral steel pipes
15. **Kyushu Works Yawata area(Kokura)**
16. **Kyushu Works Oita area**
17. **Kyushu Works Oita area(Hikari Pipe & Tube Div.):**
    Electric resistance-welded steel pipes
    Seamless steel pipes (Hot extrusion process)

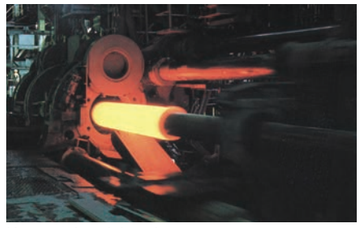


Manufacturing Process



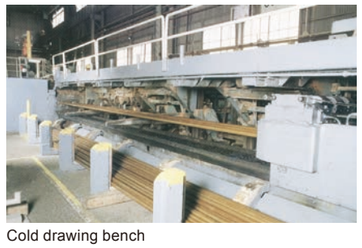
Item	Main Facillities
Steel Making Facilities	Electric arc furnace, AOD (Argon Oxygen Decarburizing) equipment VOD (Vacuum Oxygen Decarburizing) equipment, VIM (Vacuum Induction Melting) furnace VAR (Vacuum Arc Remelting) furnace, ESR (Electro-Slag Remelting) equipment
Forging Facilities	Super forging 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, Atomsphere controlled type/Vacuum annealing type

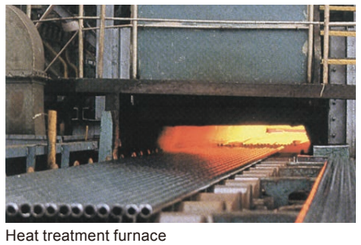
Electric arc furnace


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 (A)	Nominal diameter (B)	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	Outside diameter (mm)
25	1	34.0																							34.0
		38.1																							38.1
40	1 1/2	48.6																							48.6
50	2	60.5																							60.5
65	2 1/2	76.3																							76.3
		82.6																							82.6
80	3	89.1																							89.1
90	3 1/2	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 (A)	Nominal diameter (B)	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	Outside diameter (mm)
		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	1 1/4	42.7																								42.7
40	1 1/2	48.6																								48.6
50	2	60.5																								60.5
65	2 1/2	76.3																								76.3
		82.6																								82.6
80	3	89.1																								89.1
90	3 1/2	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)

Common grade seamless pipes and tubes for the chemical industry

Classification	Grade	Component	Applicable standard			Characteristics ●Example of an application	Chemical compositions (mass%)										Room-temperature tensile property		
			ASTM/ASME (example of a standard)	EN, etc.	JIS (example of a standard)		C	Si	Mn	P	S	Ni	Cr	Mo	N	Others	TS, min. MPa	YS, min. MPa	EL, min. %
Austenitic stainless steel	303	18Cr-8Ni-S	S30300	1.4305	SUS303	Free cutting steel	0.15max.	1.00max.	2.00max.	0.20max.	0.15min.	8.0～10.0	17.0～19.0	0.60max.	—	—	515	210	35
	304	18Cr-8Ni	S30400	1.4301	SUS304	Basic steel grade:	0.08max.	1.00max.	2.00max.	0.045max.	0.030max.	8.0～11.0	18.0～20.0	—	—	—	515	205	35
	304H	18Cr-8Ni-High C	S30409	1.4948	SUS304H	●General-purpose steel for numerous applications in many fields	0.04～0.10	1.00max.	2.00max.	0.045max.	0.030max.	8.0～11.0	18.0～20.0	—	—	—	515	205	35
	304L	18Cr-8Ni-Low C	S30403	1.4307	SUS304L		0.035max.	1.00max.	2.00max.	0.045max.	0.030max.	8.0～12.0	18.0～20.0	—	—	—	485	170	35
	304N	18Cr-8Ni-N	S30451 (ASTM A213 TP304N)	1.4315	(SUS304N1)	High strength	0.08max.	1.00max.	2.00max.	0.045max.	0.030max.	8.0～11.0	18.0～20.0	—	0.10～0.16	—	550	240	35
	304LN	18Cr-8Ni-Low C-N	S30453 (ASTM A213 TP304LN)	1.4311	(SUS304LN)	Intergranular corrosion resistance	0.035max.	1.00max.	2.00max.	0.045max.	0.030max.	8.0～11.0	18.0～20.0	—	0.10～0.16	—	515	205	35
	309H	22Cr-12Ni	S30909	1.4829	SUS309	Oxidation resistance: ●Chemical plant pipes and tubes ●Radiant tubes ●Thermocouple protection tubes	0.04～0.10	1.00max.	2.00max.	0.045max.	0.030max.	12.0～15.0	22.0～24.0	—	—	—	515	205	35
	309S	22Cr-12Ni	S30908		SUS309S		0.08max.	1.00max.	2.00max.	0.045max.	0.030max.	12.0～15.0	22.0～24.0	—	—	—	515	205	35
	310H	25Cr-20Ni	S31009	1.4842	SUS310		0.04～0.10	1.00max.	2.00max.	0.045max.	0.030max.	19.0～22.0	24.0～26.0	—	—	—	515	205	35
	310S	25Cr-20Ni	S31008		SUS310S		0.08max.	1.00max.	2.00max.	0.045max.	0.030max.	19.0～22.0	24.0～26.0	—	—	—	515	205	35
	312L	20Cr-18Ni-6Mo-0.2N	S31254	1.4547	SUS312L (JIS G3463)	Seawater resistance: ●Seawater desalination plant pipes	0.020max.	0.80max.	1.00max.	0.030max.	0.010max.	17.5～18.5	19.5～20.5	6.0～6.5	0.18～0.25	Cu:0.50～1.00	655*1	310	35
	316	18Cr-12Ni-2Mo	S31600	1.4401	SUS316	Corrosion resistance: ●LNG plant pipes ●Boilers, nuclear power and chemical industry pipes and tubes	0.08max.	1.00max.	2.00max.	0.045max.	0.030max.	10.0～14.0	16.0～18.0	2.00～3.00	—	—	515	205	35
	316H	18Cr-12Ni-2Mo-High C	S31609	1.4918	SUS316H		0.04～0.10	1.00max.	2.00max.	0.045max.	0.030max.	11.0～14.0	16.0～18.0	2.00～3.00	—	—	515	205	35
	316L	18Cr-12Ni-2Mo-Low C	S31603	1.4404	SUS316L		0.035max.	1.00max.	2.00max.	0.045max.	0.030max.	10.0～14.0	16.0～18.0	2.00～3.00	—	—	485	170	35
	316Ti	18Cr-12Ni-Mo-Ti	S31635 (ASTM A213 TP316Ti)	1.4571 1.4573	SUS316Ti (JIS G3463)	Intergranular corrosion resistance	0.08max.	0.75max.	2.00max.	0.045max.	0.030max.	10.0～14.0	16.0～18.0	2.00～3.00	0.10max.	Ti:5 (C%+N%) ～0.70	515	205	35
	317	18Cr-12Ni-3Mo	S31700		SUS317	Pitting corrosion resistance:	0.08max.	1.00max.	2.00max.	0.045max.	0.030max.	11.0～15.0	18.0～20.0	3.0～4.0	—	—	515	205	34
	317L	18Cr-12Ni-3Mo-Low C	S31703	1.4438	SUS317L	●Chemical tanker pipes	0.035max.	1.00max.	2.00max.	0.045max.	0.030max.	11.0～15.0	18.0～20.0	3.0～4.0	—	—	515	205	35
	321	18Cr-9Ni-Ti	S32100	1.4541	SUS321	Intergranular corrosion resistance: ●Chemical plant pipes	0.08max.	1.00max.	2.00max.	0.045max.	0.030max.	9.0～12.0	17.0～19.0	—	—	Ti:5 (C%+N%) ～0.70	515	205	35
	321H	18Cr-9Ni-Ti-High C	S32109	1.4940	SUS321H	High-temperature strength: ●Boiler heater tubes and reheater tubes	0.04～0.10	1.00max.	2.00max.	0.045max.	0.030max.	9.0～12.0	17.0～19.0	—	—	Ti:4 (C+N) ～0.70	515	205	35
	347	18Cr-9Ni-Nb	S34700	1.4550	SUS347	Intergranular corrosion resistance: ●Chemical plant pipes and tubes	0.08max.	1.00max.	2.00max.	0.045max.	0.030max.	9.0～13.0	17.0～20.0	—	—	Nb:10×C%～1.10	515	205	35
	347H	18Cr-9Ni-Nb-High C	S34709	1.4942	SUS347H	High-temperature strength: ●Boiler heater tubes and reheater tubes	0.04～0.10	1.00max.	2.00max.	0.045max.	0.030max.	9.0～13.0	17.0～19.0	—	—	Nb:8×C%～1.10	515	205	35
	254SMO	20Cr-18Ni-6Mo-Cu-N	S31254 (ASTM A312)	1.4547		High pitting corrosion resistance: ●Seawater heat exchanger tubes	0.020max.	0.80max.	1.00max.	0.030max.	0.010max.	17.5～18.5	19.5～20.5	6.0～6.5	0.18～0.25	Cu:0.50～1.00	655*3	310	35
	310MoLN	25Cr-22Ni-2Mo-N	S31050 (ASTM A213)	1.4466		Intergranular corrosion resistance: ●Urea reactor tubes	0.025max.	0.40max.	2.00max.	0.020max.	0.030max.	21.0～23.0	24.0～26.0	2.00～3.00	0.10～0.16		540*2	255*2	25*2
Duplex stainless steel	329J3L	22Cr-5Ni-3Mo-0.15N	S31803 (ASTM A789)	1.4462 NORSOK M-630/M-650	SUS329J3L	High strength, high corrosion resistance: ●Various heat exchanger tubes	0.030max.	1.00max.	2.00max.	0.030max.	0.020max.	4.5～6.5	21.0～23.0	2.5～3.5	0.08～0.20	—	620	450	25
	329J4L	25Cr-7Ni-3Mo-0.2N	S31260 (ASTM A789)		SUS329J4L		0.030max.	0.75max.	1.00max.	0.030max.	0.030max.	5.5～7.5	24.0～26.0	2.5～3.5	0.10～0.30	Cu:0.20～0.80 W:0.10～0.50	690	450	25
	S31500	18.5Cr-5Ni-2.7Mo	S31500 (ASTM A789)				0.030max.	1.40～2.00	1.20～2.00	0.030max.	0.030max.	4.3～5.2	18.0～19.0	2.50～3.00	0.05～0.1	—	630	440	30
	S32205	22.5Cr-6Ni-3Mo-0.2N	S32205 (ASTM A789)	1.4462 NORSOK M-630/M-650			0.030max.	1.00max.	2.00max.	0.030max.	0.020max.	4.5～6.5	22.0～23.0	3.0～3.5	0.14～0.20	—	655	485	25
	S32750	25Cr-7Ni-4Mo-0.3N	S32750 (ASTM A789)	1.4410 NORSOK M-630/M-650		High strength, high corrosion resistance: ●Seawater desalination plant pipes	0.030max.	0.80max.	1.20max.	0.035max.	0.020max.	6.0～8.0	24.0～26.0	3.0～5.0	0.24～0.32	Cu:0.50max. Cr%+3.3×Mo%+16×N%≥41	800	550	15
Martensitic stainless steel	405	13Cr-Al	S40500 (ASTM A268 TP405)	1.4002	SUS405 (JIS G3463)	Low thermal expansion: ●Automotive exhaust system pipes	0.08max.	1.00max.	1.00max.	0.040max.	0.030max.	0.50max.	11.5～14.5	—	—	Al:0.10～0.30	415	205	20
	410	13Cr	S41000 (ASTM A268 TP410)	1.4006	SUS410 (JIS G3463)		0.15max.	1.00max.	1.00max.	0.040max.	0.030max.	—	11.5～13.5	—	—	—	415	205	20
Ferritic stainless steel	430	18Cr	S43000 (ASTM A268 TP430)	1.4016	SUS430 (JIS G3463)	Chloride corrosion resistance and stress corrosion crack resistance: ●Water heater pipes	0.12max.	1.00max.	1.00max.	0.040max.	0.030max.	—	16.0～18.0	—	—	—	415	240	20
	444	19Cr-2Mo-Ti/Nb	S44400 (ASTM A213 TP444)	1.4521	SUS444 (JIS G3463)		0.03max.	1.00max.	1.00max.	0.040max.	0.030max.	—	17.5～19.5	1.75～2.50	0.035max.	Ti+Nb:0.20+4 (C%+N%) ～0.80 Ni+Cu:1.00max.	415	275	20
	446	25Cr-N	S44600 (ASTM A268 TP446-1)				0.20max.	1.00max.	1.50max.	0.040max.	0.030max.	0.75max.	23.0～27.0	—	0.25max.		485	275	18
High Ni alloy	800	20Cr-30Ni-Ti	N08800 (ASTM B163)	1.4558	NCF800 (JIS G4904)	High corrosion resistance	0.10max.	1.0max.	1.5max.	0.045max.	0.015max.	30.0～35.0	19.0～23.0	—	—	Cu:0.75max. Al:0.15～0.60 Ti:0.15～0.60 Fe:39.5min.	517	207	30
	800H	20Cr-30Ni-Ti-High C	N08810 (ASTM B163)	1.4876	NCF800H (JIS G4904)	High strength, high corrosion resistance: ●Chemical plant heater tubes and reheater tubes	0.05～0.10	1.0max.	1.5max.	0.045max	0.015max.	30.0～35.0	19.0～23.0	—	—	Cu:0.75max. Al:0.15～0.60 Ti:0.15～0.60 Fe:39.5min.	448	172	30
	904L	20Cr-25Ni-4.5Mo-Cu	N08904 (ASTM A312)	1.4539	SUS890L (JIS G3463)	High corrosion resistance: ●Various heat exchanger tubes	0.020max.	1.00max.	2.00max.	0.040max.	0.030max.	23.0～28.0	19.0～23.0	4.0～5.0	0.10max.	Cu:1.00～2.00	490	215	35
	28	27Cr-31Ni-3.5Mo-Cu	N08028 (ASTM B668)	1.4563			0.030max.	1.0max.	2.50max.	0.030max.	0.030max.	30.0～34.0	26.0～28.0	3.0～4.0	—	Cu:0.6～1.4	500	214	40
	20	20Cr-35Ni-2Mo-3Cu-Nb	N08020 (ASTM B729)	2.4660		High corrosion resistance	0.07max.	1.00max.	2.00max.	0.045max.	0.035max.	32.00～38.00	19.00～21.00	2.00～3.00	—	Cu:3.00～4.00 Nb+Ta:8×C～1.00	550	240	30
	825	20Cr-42Ni-3Mo-2Cu-Ti	N08825 (ASTM B163)	2.4858	NCF825 (JIS G4904)	High corrosion resistance and stress corrosion crack resistance: ●Heat exchanger tubes for petroleum refining	0.05max.	0.5max.	1.00max.	—	0.03max.	38.0～46.0	19.5～23.5	2.5～3.5	—	Cu:1.5～3.0 Al:0.2max. Ti:0.6～1.2 Fe:22.0min.	586	241	30
Ni-based alloy	600	15Cr-8Fe-Ni base	N06600 (ASTM B163)	2.4816	NCF600 (JIS G4904)	Oxidation resistance: ●Thermocouple protection tubes	0.15max.	0.5max.	1.0max.	0.030max.	0.015max.	72.0min.	14.0～17.0	—	—	Fe:6.00～10.0 Cu:0.50max.	552	241	30
	601	23Cr-1.4Al-Ni base	N06601 (ASTM B163)	2.4581		Oxidation resistance and carburization resistance	0.10max.	0.5max.	1.0max.	—	0.015max.	58.0～63.0	21.0～25.0	—	—	Al:1.0～1.7 Cu:1.0max.	552	207	30
	625	22Cr-9Mo-Ni base	N06625 (ASTM B444)	2.4856	NCF625 (JIS G4904)	High corrosion resistance and stress corrosion crack resistance: ●Seawater heat exchanger tubes	0.10max.	0.50max.	0.50max.	0.015max.	0.015max.	58.0min.	20.0～23.0	8.0～10.0	—	Fe:5.0max. Co:1.0max. Al:0.40max. Ti:0.40max. Nb+Ta:3.15～4.15	690 Solution	276 Solution	30
	690	29Cr-9Fe-Ni base	N06690 (ASTM B163)	2.4642	NCF690 (JIS G4904)	High corrosion resistance	0.05max.	0.5max.	0.5max.	0.030max.	0.015max.	58.0min.	27.0～31.0	—	—	Fe:7.0～11.0 Cu:0.5max.	586	241	30
	C22	21Cr-13Mo-3W-Ni base	N06022 (ASTM B622)	2.4602		High acid resistance: ●Heat exchanger tubes for chemical plants	0.015max.	0.08max.	0.50max.	0.02max.	0.02max.	Remnant	20.0～22.5	12.5～14.5	—	Fe:2.0～6.0 Co:2.5max. W:2.5～3.5 V:0.35max.	690	310	45
	276	15.5Cr-16Mo-5Fe-Ni base	N10276 (ASTM B622)	2.4819			0.010max.	0.08max.	1.0max.	0.04max.	0.03max.	Remnant	14.5～16.5	15.0～17.0	—	Fe:4.0～7.0 Co:2.5max. W:3.0～4.5 V:0.35max.	690	283	40
	200	Ni (Annealed)	N02200 (ASTM B161)	2.4066		High corrosion resistance: ●Heat exchanger tube for caustic soda and hydrogen chloride plants	0.15max.	0.35max.	0.35max.	—	0.01max.	99.0min.	—	—	—	Fe:0.40max. Cu:0.25max.	380*4	105*4	35*4
	201	Ni-Low C (Annealed)	N02201 (ASTM B161)	2.4068			0.02max.	0.35max.	0.35max.	—	0.01max.	99.0min.	—	—	—	Fe:0.40max. Cu:0.25max.	345*4	80*4	35*4

UNS No.

*1：t＞0.18in (5mm)　*2：t＞0.25in (6mm)　*3：t＞0.187in (15mm)　*4：OD≤5in (127mm)

Product outline (applications and standards)

Developed seamless steel pipes and tubes for the chemical industry

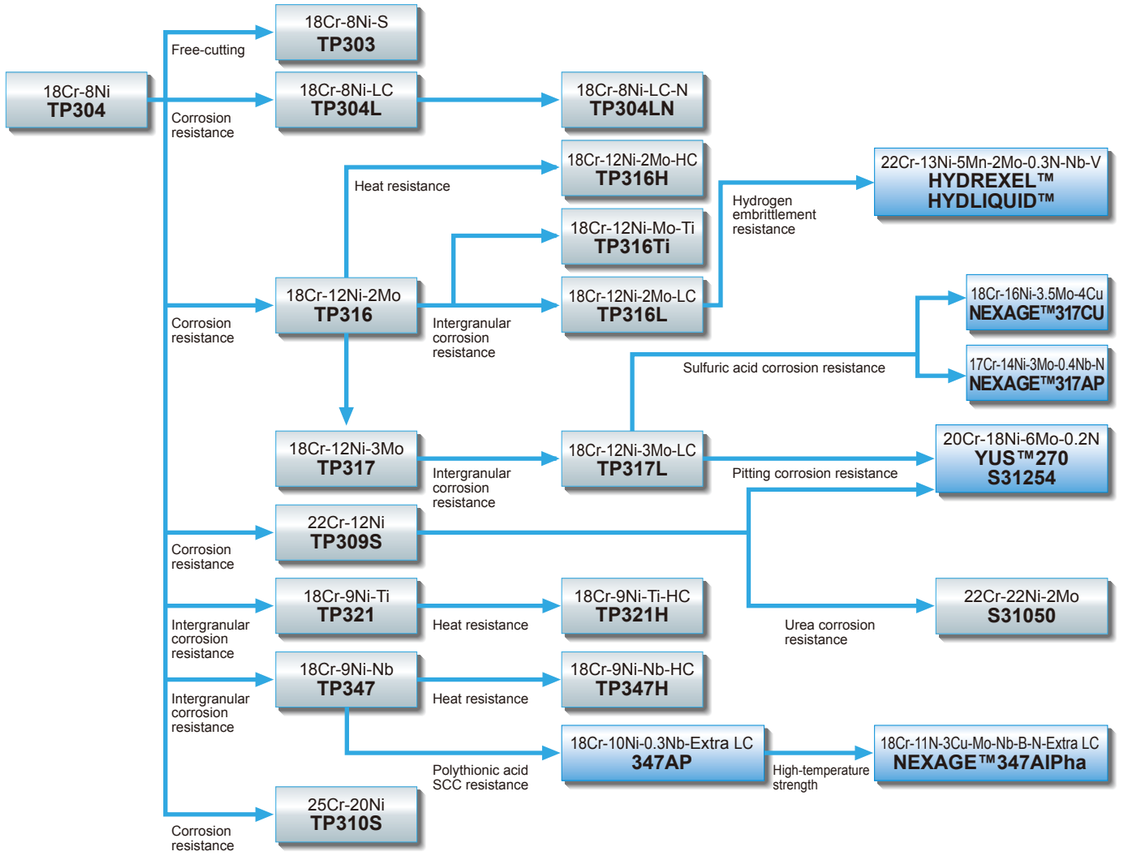
Classification	Grade	Composition	Applicable standard			Characteristics ●Example of an application	Chemical compositions (mass%)										Room-temperature tensile property		
			ASTM/ASME (example of a standard)	EN, etc.	JIS		C	Si	Mn	P	S	Ni	Cr	Mo	N	Others	TS, min. MPa	0.2% PS,min. MPa	EL, min. %
Austenitic stainless steel	YUS™270	20Cr-18Ni-6Mo-0.7Cu-0.2N-LC	ASTM S31254	1.4547	JIS G3463 SUS312LTB	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-Extra LC	ASTM S34751 ASME CC2196			Polythionic acid stress corrosion crack resistance, weld crack resistance and stress relaxation crack resistance: ●Petroleum refining plant furnace tubes	0.005～0.020	1.00max.	2.00max.	0.045max.	0.030max.	9.0～13.0	17.0～19.0	—	0.06～0.10	Nb:0.20～0.50 Nb ≧ 15C	515	205	35
	NEXAGE™ 347AlPha	18Cr-11N-3Cu-Mo-Nb-B-N-Extra LC	ASTM S34752 ASME CC2984			Polythionic acid stress corrosion crack resistance, weld crack resistance and stress relaxation crack resistance High-temperature strength ●Petroleum refining plant furnace tubes	0.005～0.020	0.60max.	2.00max.	0.035max.	0.010max.	10.0～13.0	17.0～19.0	0.20～1.20	0.06～0.12	Cu:2.50～3.50 B:0.001～0.005 Nb:0.20～0.50 Nb ≧ 15C	515	205	35
	NEXAGE™ 317CU	18Cr-16Ni-3.5Mo-4Cu	ASTM S31730			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.	15.0～16.5	17.0～19.0	3.0～4.0	0.045max.	Cu:4.0～5.0	480	175	35
	NEXAGE™ 317AP	17Cr-14Ni-3Mo-0.3Nb-N	ASTM S31740 ASME CC3038			Polythionic acid stress corrosion crack resistance, weld crack resistance and stress relaxation crack resistance Naphthenic acid corrosion resistance ●Petroleum refining plant furnace tubes	0.005～0.020	1.00max	2.00max.	0.045max.	0.030max.	11.0～15.0	17.0～19.0	3.0～4.5	0.06～0.15	Nb:0.20～0.50 Nb ≧ 15C	515	205	35
	HYDREXEL™	22Cr-13Ni-5Mn-2Mo-0.3N-Nb-V	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.	0.001max.	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
	HYDLIQUID™	22Cr-13Ni-5Mn-2Mo-0.3N-Nb-V	ASME TPXM-19			Hydrogen embrittlement resistance, high cryogenic toughness： ●liquefied hydrogen, LNG plant pipes	0.005～0.060	0.20～1.00	4.30～6.00	0.030max.	0.001max.	12.00～13.50	21.50～23.50	1.50～3.00	0.20～0.40	Nb:0.10～0.20 V:0.10～0.20	690	380	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	20.50～21.50	0.60max.	0.15～0.20	Cu:0.50～1.50	600	400	20
	YUS™2351	23Cr-5Ni-1Mo			JIS G3459 SUS329J1TP		0.080max.	1.00max.	1.50max.	0.040max.	0.030max.	3.00～6.00	23.00～28.00	1.00～3.00	—	—	600	400	20
	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 SUS329J4LTB	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 SUS329J4LTB	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.	7.0～8.2	27.0～27.9	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	ASTM TP444	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 1,100ºC) ●Cracking tubes for ethylene plants ●Furnace pipes for hydrogen refineries ●Example of use: HK4M to 1,050ºC and HPM to 1,100ºC	0.20～0.30	0.75max.	1.50max.	0.020max.	0.030max.	24.00～26.00	24.00～26.00	—	—	Ti:0.20～0.60 Al:0.20～0.60 B:0.002～0.007	520	235	25
	NEXAGE™ HR24	25Cr-38Ni-Mo-Si					0.10～0.20	1.40～2.00	1.50max.	0.020max.	0.030max.	37.00～40.00	23.00～26.00	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.	0.5max.	0.5max.	—	0.010max.	44.0～50.0	20.0～25.0	5.0～7.0	—	Cu:2.0～4.0 W:2.0～5.0	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 B163)	2.4068		Easy handling Ni ●Heat exchanger tube forcaustic soda and hydrogen chloride plants	0.02max.	0.35max.	0.35max.	—	0.01max.	99.0min.	—	—	—	Fe:0.40max. Cu:0.25max Nb:Added	345	83	40

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

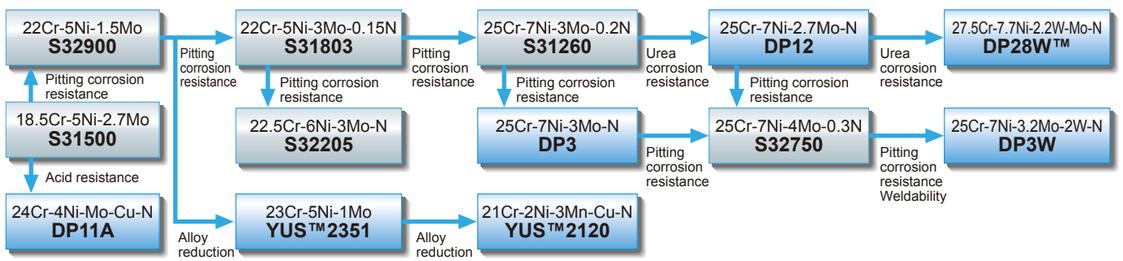
UNS No.

System diagram of stainless steel and Ni-based alloy

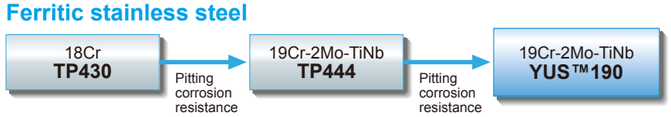
Austenitic stainless steel



Duplex stainless steel

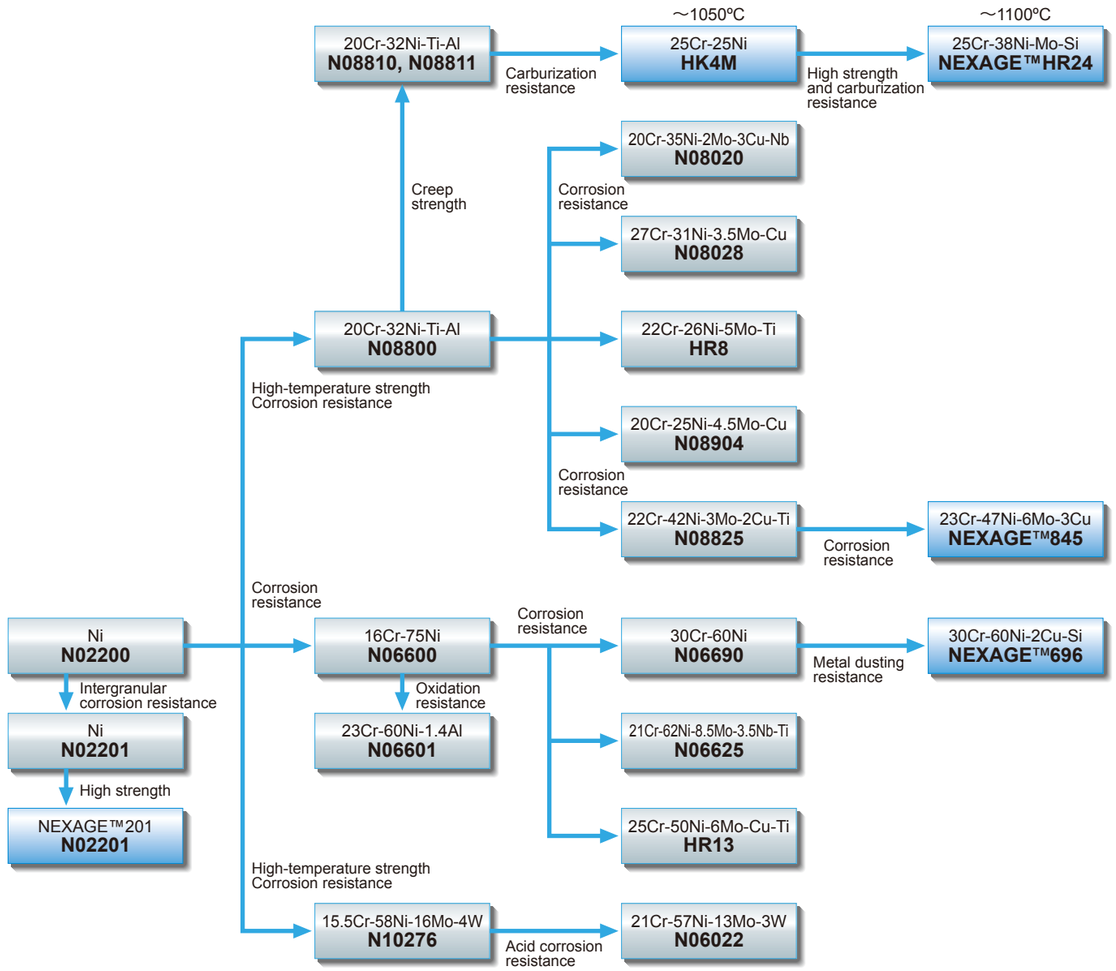


Ferritic stainless steel



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

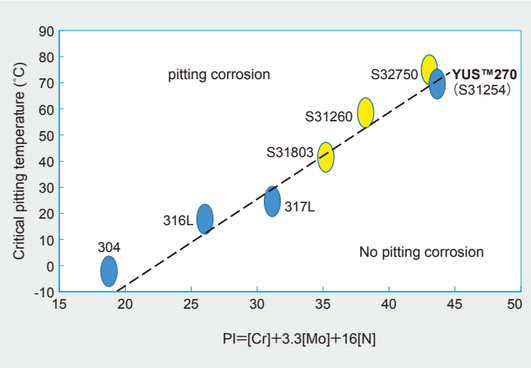
Quality property

●Mechanical property

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

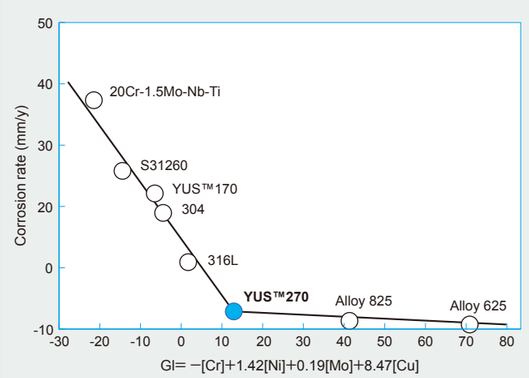
●Pitting corrosion resistance

JIS G 0578: 6%$FeCl_3$ + N/20 HCl, 24h



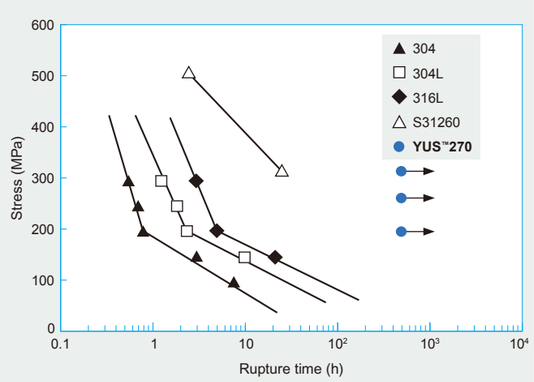
●General corrosion resistance (hydrochloric acid)

10.42% HCl, ph0.61, 50°C, 6h



●Stress corrosion cracking resistance

JIS G0576：42% $MgCl_2$, 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

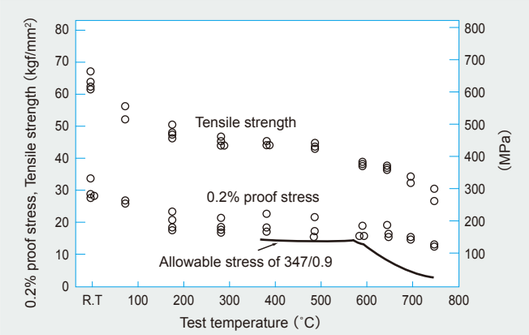
Features

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

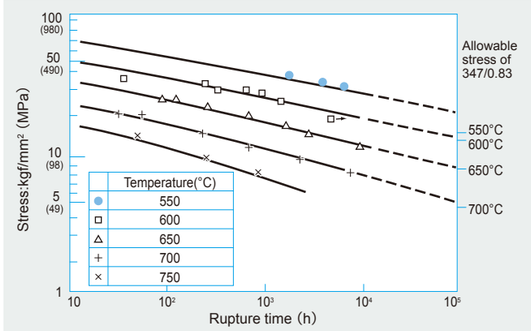
Chemical compositions (mass%)

	C	Mn	P	S	Si	Cr	Ni	N	Nb	Nb/C
Specification	0.005～0.020	2.00max.	0.045max.	0.030max.	1.00max.	17.0～19.0	9.0～13.0	0.06～0.10	0.20～0.50	15min.

Tensile property

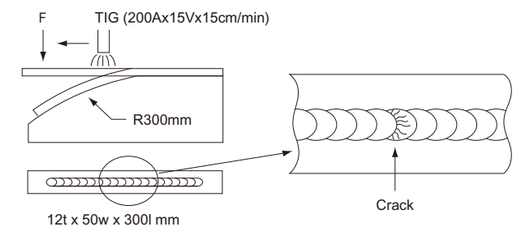


Creep rupture property

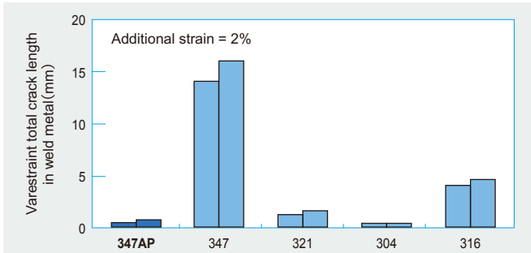


Weldability (Hot weld cracking)

●Varestraint test

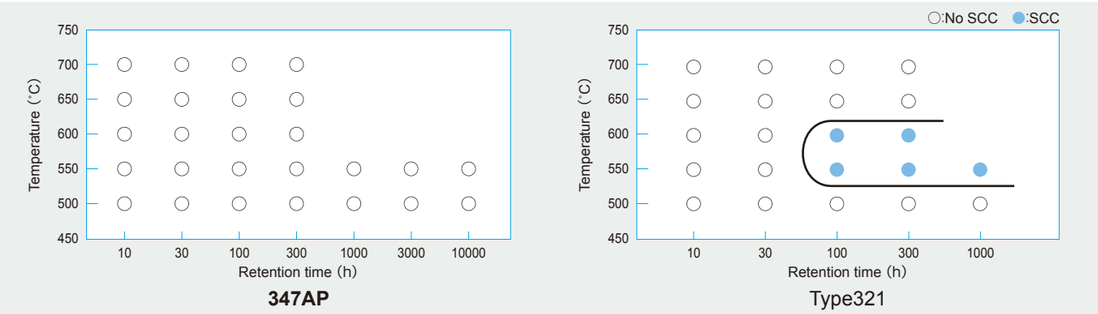


●Varestraint test result



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)



NEXAGE™347AIPha

Austenitic stainless steel pipes and tubes against polythionic acid SCC and stress relaxation cracking

18Cr-11Ni-3Cu-Mo-Nb-B-N/Equivalent steel grades: ASTM S34752、ASME Code Case 2984

Features

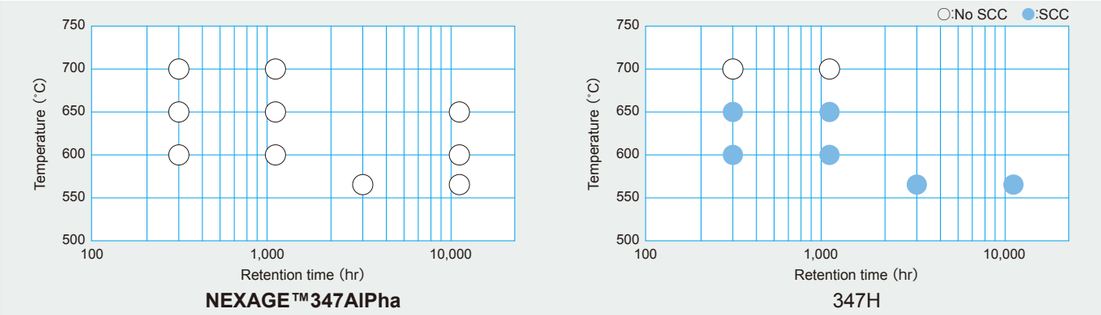
① Excellent polythionic acid SCC resistance and stress relaxation cracking with no PWHT (post-weld heat treatment)
② Superior high-temperature strength to type347H
③ Equivalent weldability Type304 and superior one to Type347

Chemical compositions (mass%)

	C	Mn	P	S	Si	Cr	Ni	Mo	Cu	N	B	Nb	Nb/C
Specification	0.005～0.020	2.00max.	0.035max.	0.010max.	0.60max.	17.0～19.0	10.0～13.0	0.20～1.20	2.50～3.50	0.06～0.12	0.001～0.005	0.20～0.50	15min.

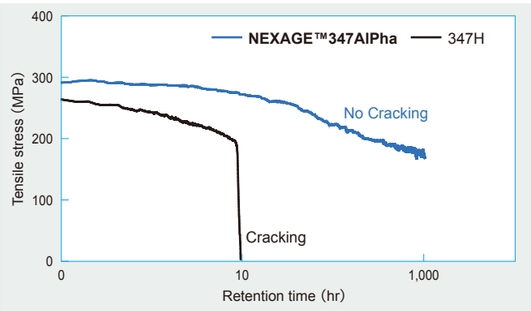
Polythionic acid SCC resistance

• Test piece : U-bent plate • Test solution : 1% $K_2S_4O_6$ (pH=2.0) • No stabilization heat treatment

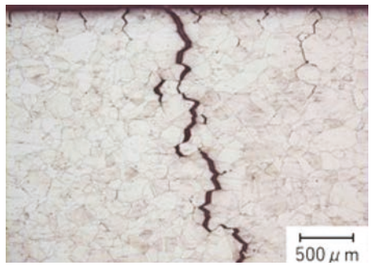


Stress relaxation cracking resistance

• Test temperature : 650˚C

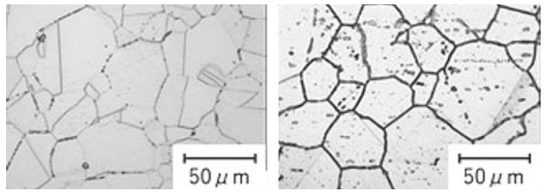


●Stress relaxation cracking (347H)



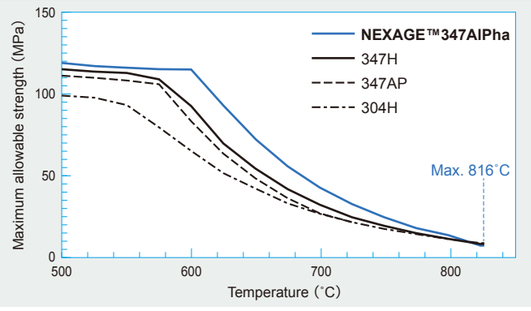
Sensitization resistance (Microstructure after heat treatment)

• Heat treatment Condition : 650˚C×1,000˚C
• Test method:ASTM A262 Practice-A (Susceptibility to intergranular attack)



NEXAGE™ 347AIPha 347H

Maximum allowable strength (ASME)



NEXAGE™317AP

Austenitic stainless steel pipes and tubes against Polythionic acid stress corrosion cracking and Naphthenic acid corrosion

17Cr-14Ni-3Mo-0.3Nb-N／Equivalent steel grades: ASTM S31740、ASME Code Case 3038

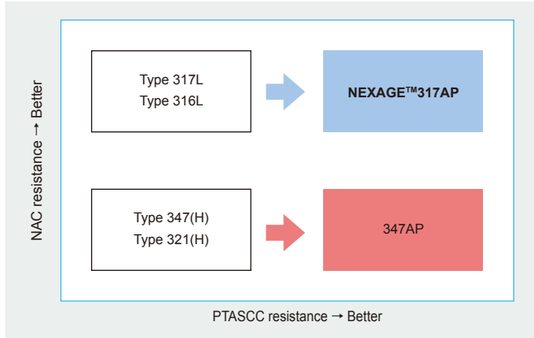
Features

①Excellent naphthenic acid and polythionic acid corrosion resistance without PWHT and thermal stabilization.
②Better phase stability at high temperature as compared with type317L.
③Equivalent mechanical property to type317L.
④High Mo bearing Ni-based welding consumable such as 617 or 625 filler are available.

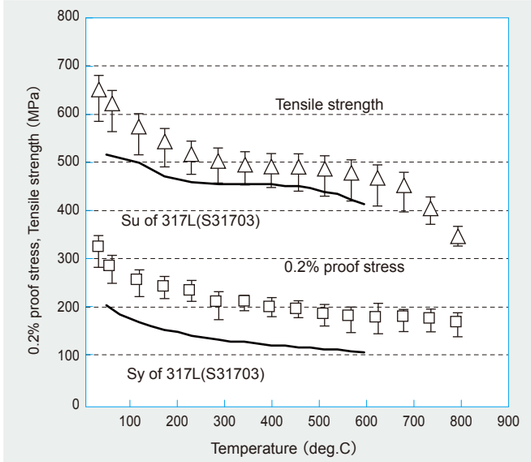
Chemical compositions (mass%)

	C	Mn	P	S	Si	Cr	Ni	Mo	N	Nb	Nb/C
Specification	0.005～0.020	2.00max.	0.045max.	0.030max.	1.00max.	17.0～19.0	11.0～15.0	3.0～4.5	0.06～0.15	0.20～0.50	15min.

Target of Depelopment

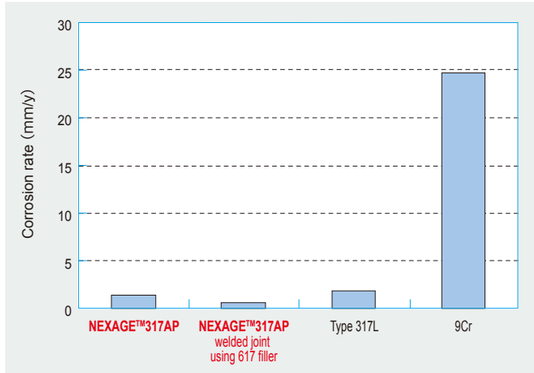


●High-temperature tensile property



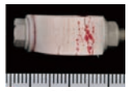
●Napthenic acid corrosion resistance

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

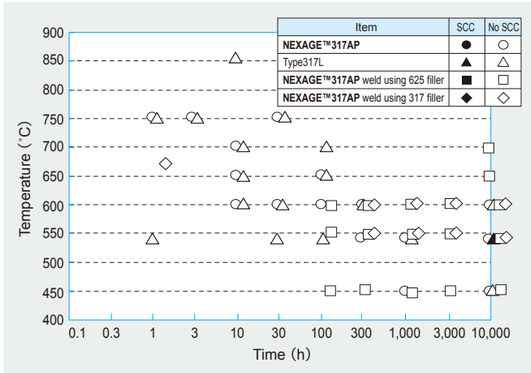


●Polythionic acid SCC resistance

Test Solution	pH	Immersion Time(h)	Temperature (deg.C)
1% $K_2S_4O_6$	2.0	100	20



317L



HYDREXEL™、HYDLIQUID™

New stainless steel for high pressure gaseous Hydrogen environments

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

Features

●HYDREXEL™

① Highest level resistance to hydrogen embrittlement due to higher Ni equivalent design

② About 15 and 50% higher strength than TPXM-19 and TP316L by adjusting manufacturing process and chemical composition within ASME TPXM-19 standard

③ Good weldability with strength and resistance to hydrogen embrittlement equal to base metal

●HYDLIQUID™

① Optimized ranges of V, Nb and N so that it can be used for low-temperature piping portion such as liquefied hydrogen usage

② Both base metal & welded joint achieved lateral expansion ≧0.46mm* at -196˚C
*ASME Section VIII Division 1 (1998) part UHA requirement

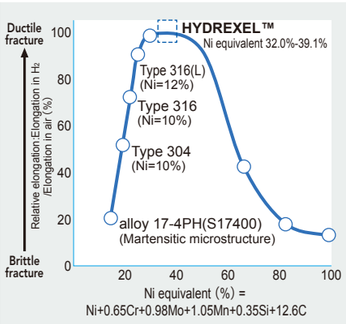
③ Strength satisfied with ASME TPXM-19 requirement

	Tensile strength	Cryogenic toughness	Hydrogen brittleness	Welding
HYDREXEL™	**Excellent** (800MPa min.)	Good	Excellent (Ni eq. 32.09 % min.)	Available
HYDLIQUID™	Good (690MPa min.)	**Excellent** Absorbed energy 27J min. ※ Lateral expansion 0.46mm min. ※		

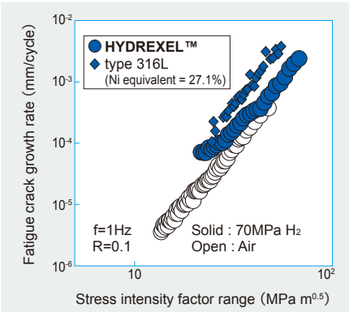
※Guaranteed at -196˚C for steel bars only

Hydrogen resistance

●Ni equivalent

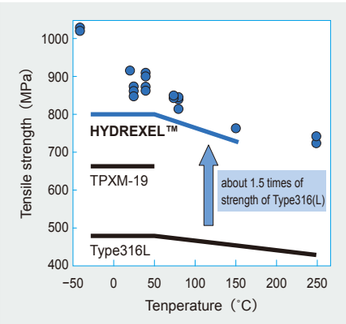


●Fatigue crack growth rate



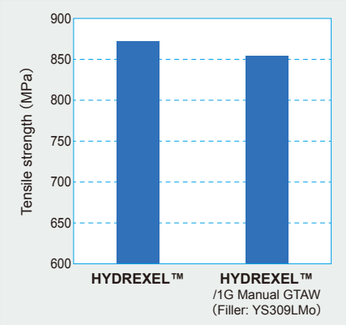
Mechanical property

●Tensile strength (Base metal)

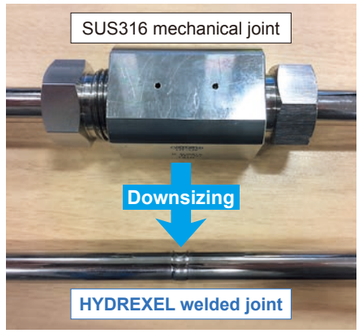


Weldability

●Tensile strength (Welded joint)

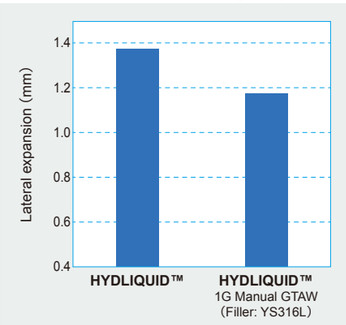


●Appearances



Toughness

●Lateral expansion at -196˚C (Base metal and welded joint)



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 corrsion resistance in sulfuric acid and hydrochloride 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%)

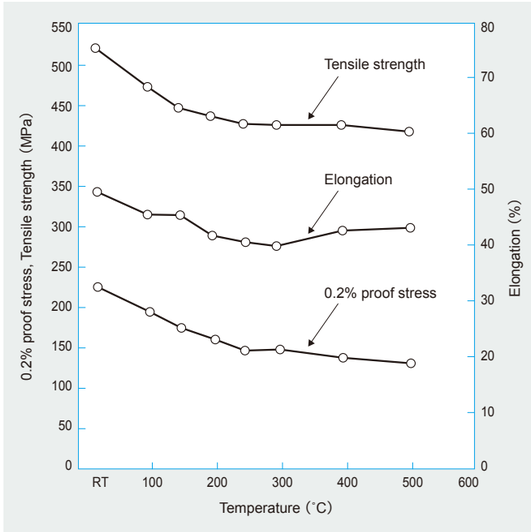
	C	Si	Mn	P	S	Ni	Cr	Mo	N	Cu
Specification	0.030max.	1.00max.	2.00max.	0.040max.	0.010max.	15.0～16.5	17.0～19.0	3.0～4.0	0.045max.	4.0～5.0

Quality property

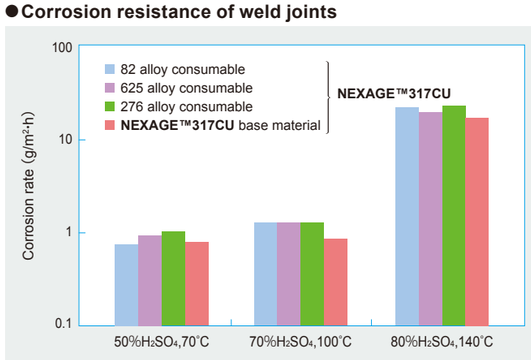
●Mechanical property

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

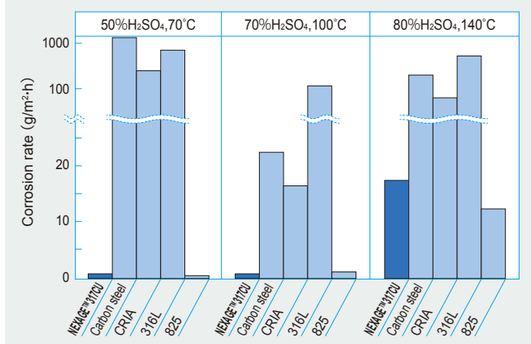
●High-temperature tensile property



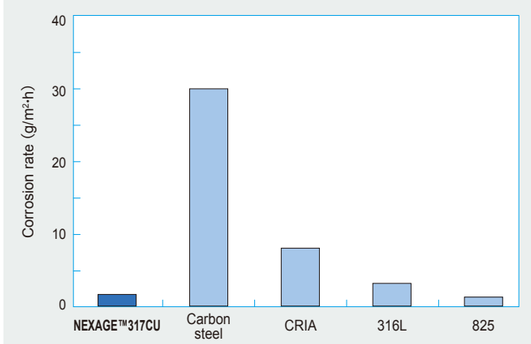
●Corrosion resistance of weld joints



●Sulfuric acid corrosion resistance (base material)



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



YUS™2120、YUS™2351 Duplex stainless steel pipes and tubes with high strength

YUS™2120：21Cr-2Ni-3Mn-Cu-N /Equivalent steel grades: JIS G3459 SUS821L1TP, G3446 SUS821L1 TKA, G 3463 SUS821L1TB
YUS™2351：23Cr-5Ni-1Mo /Equivalent steel grades: JIS G3459 SUS329J1TP, G3446 SUS329J1 TKA, G 3463 SUS329J1TB

Features

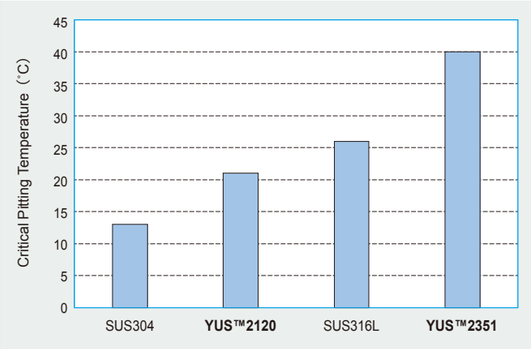
① Lean duplex stainpess steel pipes and tubes
② Equal or higher pitting corrosion resistance than Type 304 and Type 316L
③ About twice the yeild strength as Type 304 and 316 at room temperature

Chemical compositions(Mass%)

	C	Si	Mn	P	S	Ni	Cr	Mo	N	Cu
YUS™2120	0.030max.	0.75max.	2.00～4.00	0.040max.	0.020max.	1.50～2.50	20.50～21.50	0.60max.	0.15～0.20	0.50～1.50
YUS™2351	0.080max.	1.00max.	1.50max.	0.040max.	0.030max.	3.00～6.00	23.00～28.00	1.00～3.00	—	—

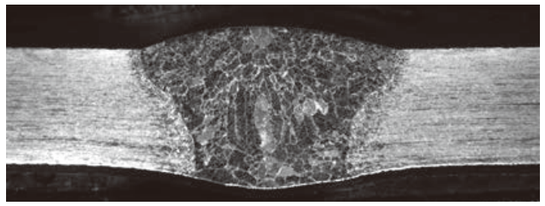
Pitting corrosion resistance

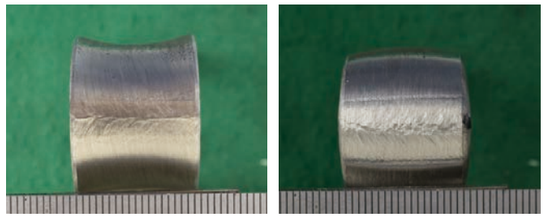
●**JIS G0590-Modified (※): 1kmol/m^3_NaCl aqueous solution**
※Without surface grinding on test pieces



Weldability

●**Macro structure observation and bend test at welded points (φ60.5mm × t3.9mm pipe, YUS™2120)**





Mechanical property

		Tensile Strength (MPa)	0.2% proof (MPa)	Elongation (%)
Specification		min. 600	min. 400	min. 20
Typical example	**YUS™2120**	706	606	37
	YUS™2351	766	557	36

<Introducion of related products>

NIPPON STEEL Stainless Steel Corporaton sells equivalent products (coils,sheets,heavy plates, wire rods and bars) as NSSC2120™ and NSSC™2351.
For more information, please visit NIPPO STEEL Stainless Steel Corporation's website.
Contact detail：(NIPPON STEEL Stainless Steel Corporaton) Products development dvision Tel:+81-3-6841-5290

<Precausions>

Rcommended use environmet
① Temperature：-50˚C～+300˚C(Prevention of embrittlement)
② Water environment：YUS™2120 / Flesh water (Cl-concentration is less than 500ppm)
YUS™2351 / Flesh water or brackish water (Cl-concentration is less than 10,000ppm)

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

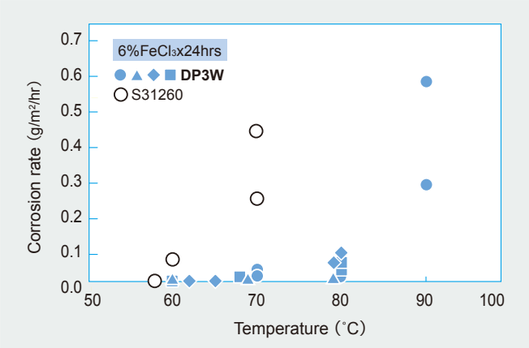
① Excellent resistance to localized corrosion.
② High resistance to general corrosion (especially in a sour environment).
③ Excellent mechanical properties.
④ Good weldability.
⑤ Low sensitivity to sigma phase precipitation.

Chemical compositions (mass%)

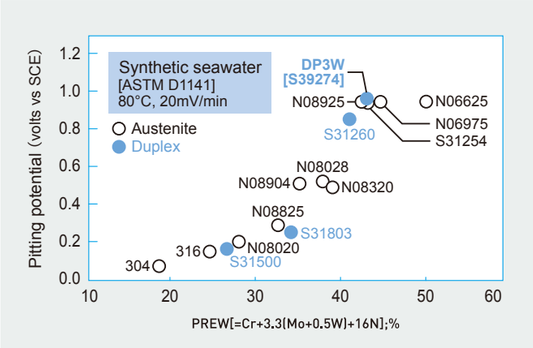
	C	Si	Mn	P	S	Ni	Cr	Mo	N	Cu	W
Specification	0.030max.	0.80max.	1.00max.	0.030max.	0.020max.	6.0～8.0	24.0～26.0	2.5～3.5	0.24～0.32	0.20～0.80	1.50～2.50

Pitting corrosion resistance

●**Pitting corrosion rate in an ASTM G48 solution (6% $FeCl_3$)**

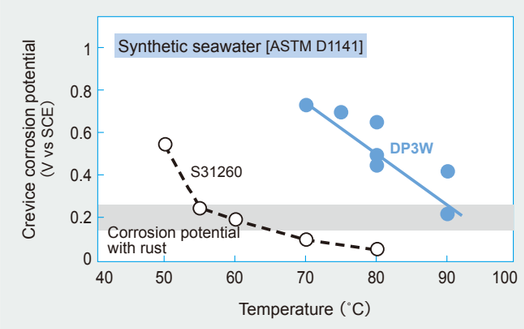


●**Relationship between the PREW value and pitting potential in various stainless steel types**



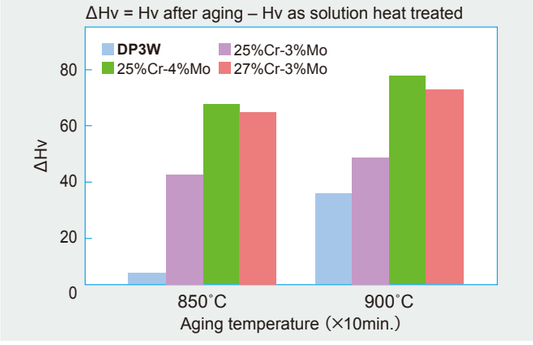
Crevice corrosion resistance

●**Crevice corrosion potential for DP3W in synthetic seawater**



Phase stability

●**Hardness increase due to sigma phase precipitation**



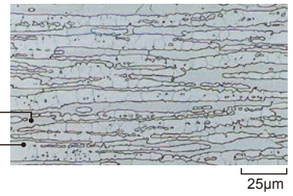
DP28W™ Duplex stainless steel pipes and tubes for urea plants

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

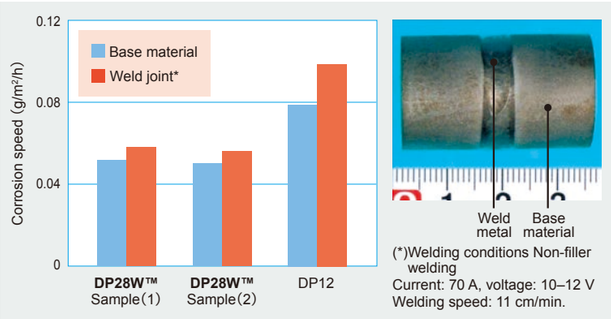


Chemical compositions (mass%)

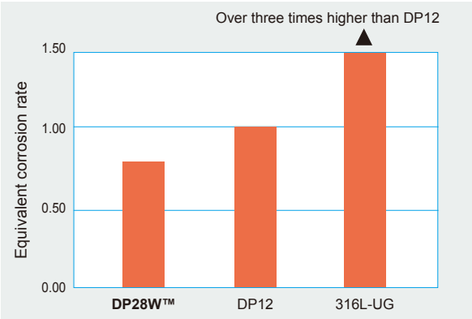
	C	Si	Mn	P	S	Ni	Cr	Mo	N	W
Specification	0.030max.	0.50max.	1.10max.	0.030max.	0.010max.	7.0～8.2	27.0～27.9	0.80～1.20	0.30～0.40	2.10～2.50

Corrosion resistance

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



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

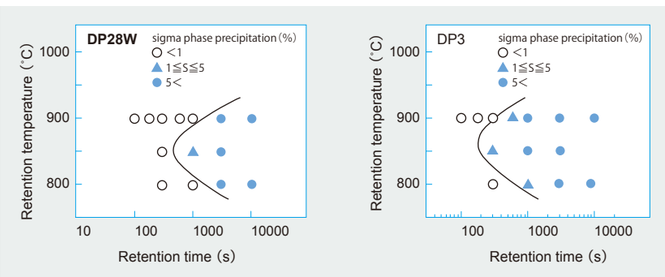


Mechanical property (example)

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 sigmaphase 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%)

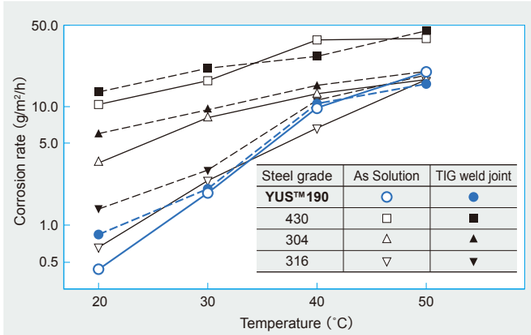
	C	Si	Mn	P	S	Cr	Mo	N	Ti + Nb
Specification	0.015max.	0.50max.	0.50max.	0.040max.	0.030max.	18.00～20.00	1.75～2.25	0.025max.	16(C+N) min.

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% $FeCl_3$ + N/20 HCl test (48 h)



●Stress corrosion crack resistance

❶ 42%$MgCl_2$
Heat treatment condition：YUS™190 1200°C 5min. AC
Type304 650°C 2h AC
Type316 650°C 2h AC

Grade	Heat treatment	Load stress (MPa)	Rupture time
YUS™190	Anneal	265	Not ruptured after 1,000 hrs
		294	//
		314	//
	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

❷ High temperature chloride
Test condition: Pure water + NaCl(Cl^-: 30 to 600 ppm) is used for adjustment.
300°C, 9.5MPa,～300h
Test specimen: 1 mmt × 15 mmw × 100 mmL 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

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

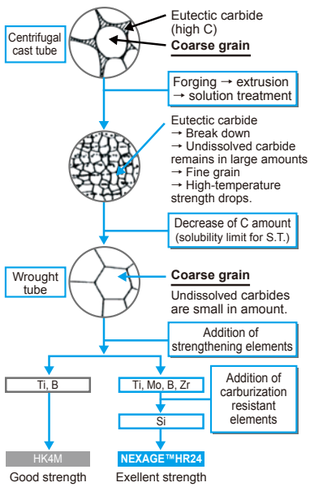
Grade	Basic composition	Oxidation	Carburization	Creep strength
800H	0.08C-20Cr-30Ni	●	●	●
HK4M	0.2C-25Cr-25Ni-Ti, B	★★	★★	★
NEXAGE™HR24	0.14C-25Cr-38Ni-Mo, Si	★★★	★★★	★★

● Reference level ★ Superior

Chemical compositions (mass%)

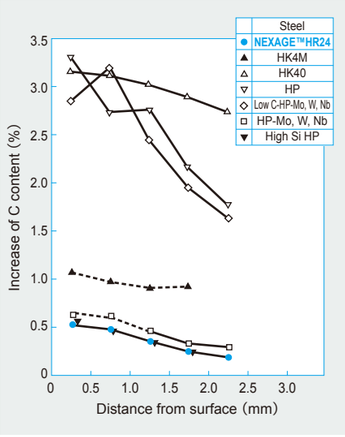
	C	Si	Mn	P	S	Ni	Cr	Mo	Ti	B	Zr
Specification	0.10～0.20	1.40～2.00	1.50max.	0.020max.	0.030max.	37.00～40.00	23.00～26.00	1.00～3.00	0.20～0.60	0.010max.	0.050max.

Development philosophy of NEXAGE™HR24

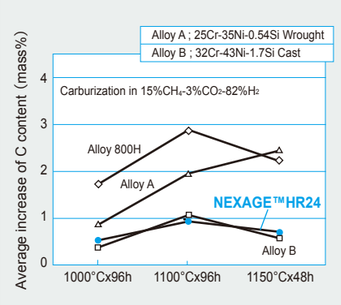


Corrosion resistance

●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

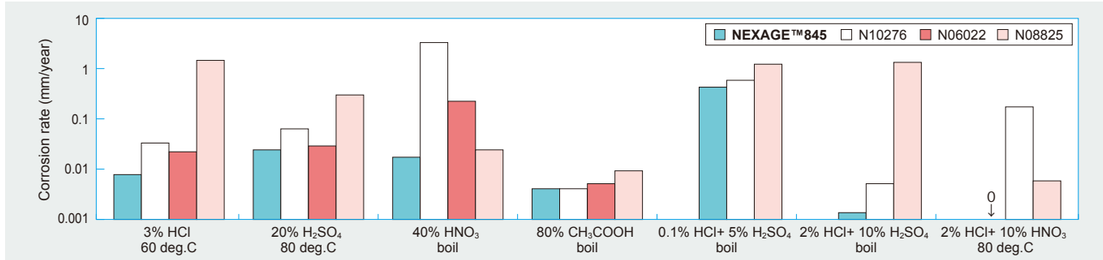
① Excellent corrosion resistance for both oxidizing and reducing environment.
② More cost-effective than conventional alloys.
③ Good formability and weldability.

Chemical compositions (mass%)

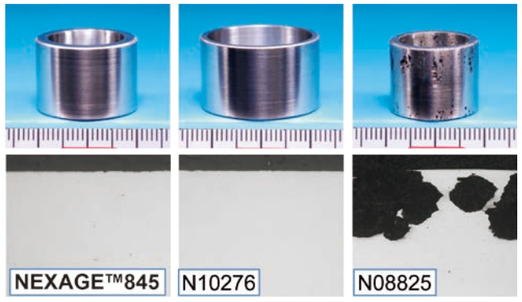
	C	Si	Mn	S	Cu	Ni	Cr	Mo	W	Fe
Specification	0.05max.	0.5max.	0.5max.	0.010max.	2.0～4.0	44.0～50.0	20.0～25.0	5.0～7.0	2.0～5.0	Remainder

Corrosion resistance

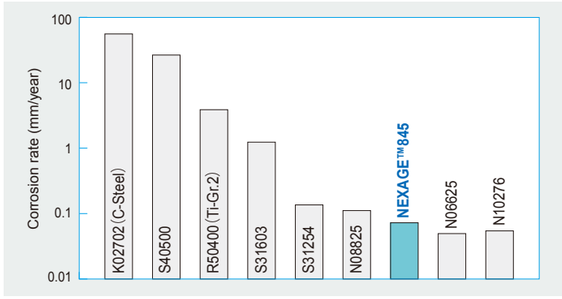
●Resistance to acid corrosion



●Resistance to local corrosion
（ASTM G48 Method A, 6% $FeCl_3$ at 85 deg.C）



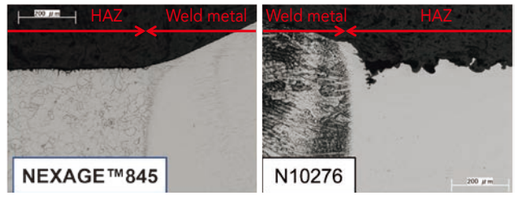
●Corrosion resistance to 40% NH_4Cl solution at 200˚C



Field evaluation

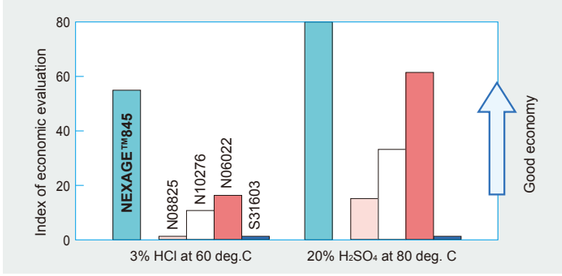
●Microstructure of weldment after 1year immersion in salfuric acid tank

Environment：H_2SO_4+ $(NH_4)_2SO_4$, 110 deg.C



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

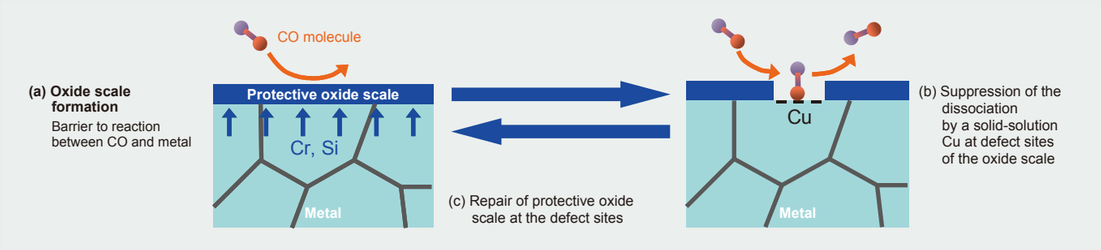
① Excellent high-temperature corrosion resistance especially carburization and metal dusting.
② High strength at elevated temprature.
③ Excellent thermal stability.
④ Good weldability.

Chemical compositions (mass%)

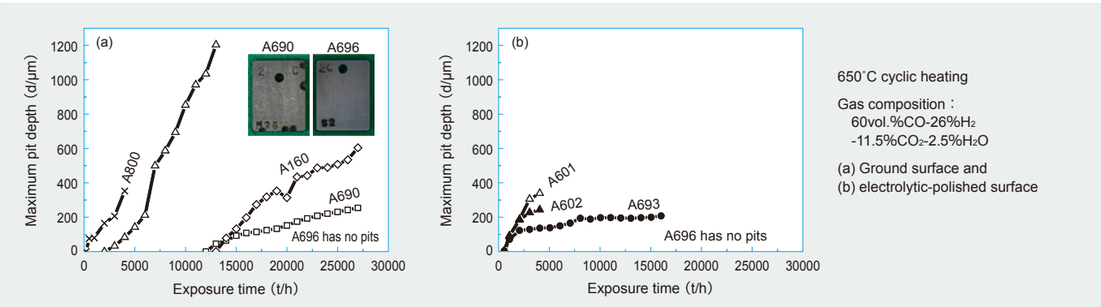
	C	Si	Mn	S	Cu	Ni	Cr	Mo	Ti	Fe
Specification	0.15max.	1.0～2.5	1.0max.	0.010max.	1.5～3.0	Remainder	28.0～32.0	1.0～3.0	1.0max.	2.0～6.0

Mechanism

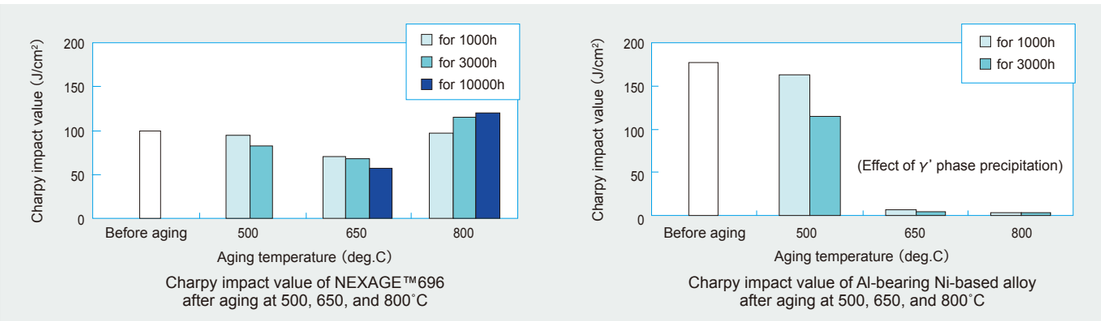
●Concept of new metal dusting prevention technology



Metal dusting resistance



Thermal stability



NEXAGE™201 Easy handling Ni by strengthening

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

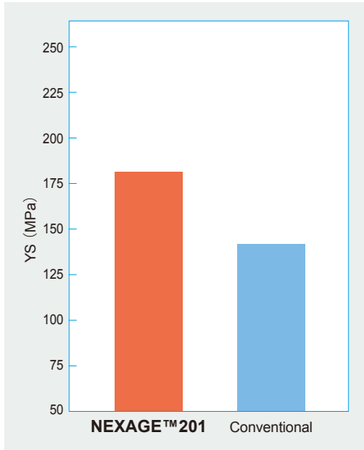
Features

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%)

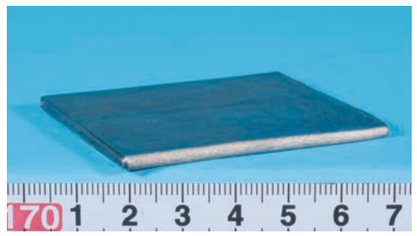
	Ni	Cu	Fe	Mn	C	Si	S	Nb
N02200	99.0min.	0.25max.	0.40max.	0.35max.	0.15max.	0.35max.	0.01max.	—
N02201	99.0min.	0.25max.	0.40max.	0.35max.	0.02max.	0.35max.	0.01max.	—
NEXAGE™201	99.0min.	0.25max.	0.40max.	0.35max.	0.02max.	0.35max.	0.01max.	Added

Mechanical property

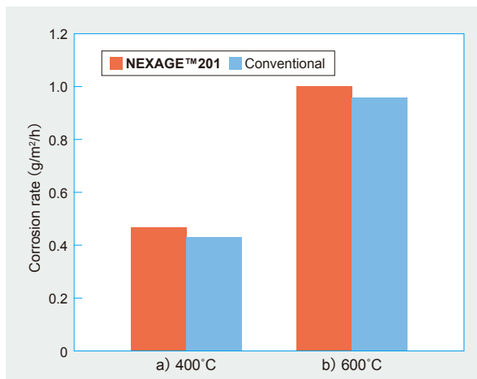


Workability

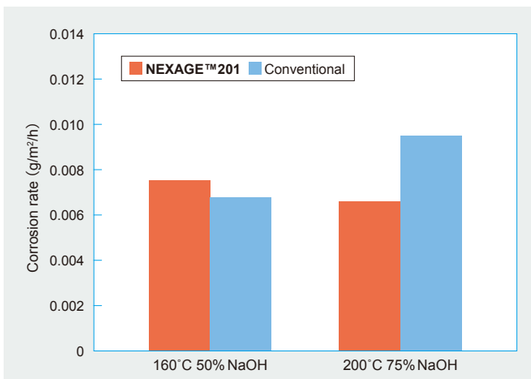
●Appearance after flaring and flattening test of φ31.8mm x t1.6mm tube



Corrosion resistance in 30% HCl gas

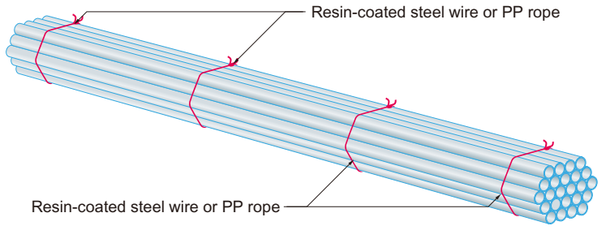


Corrosion resistance in NaOH

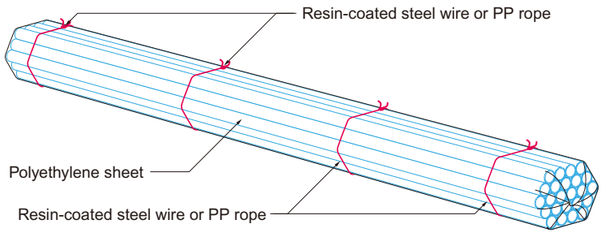


Example of Packing

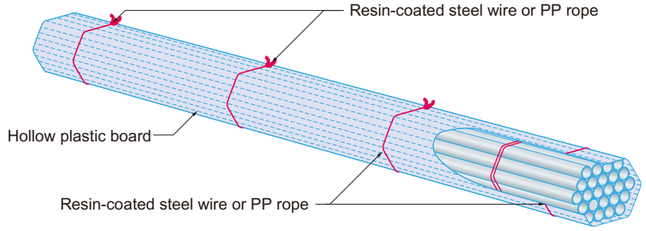
Bare packing



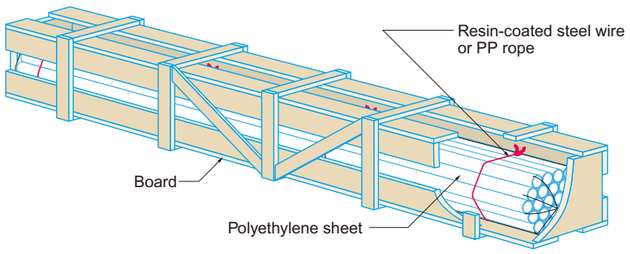
Polyethylene sheet packing



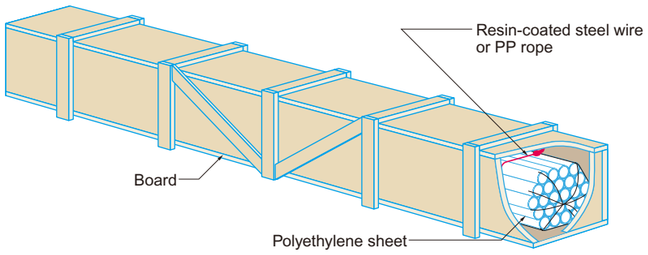
Hollow plastic board packing



Open wood box packing

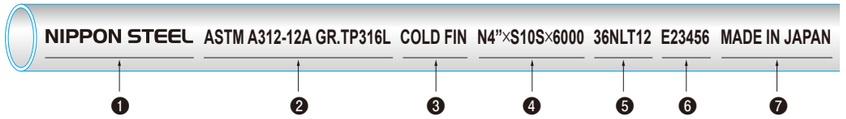


Closed wood box packing

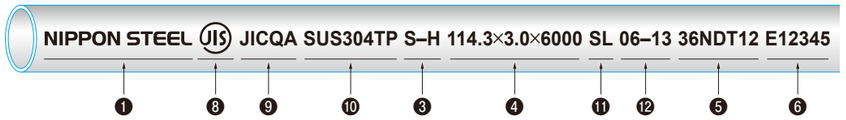


Example of Indications

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



〈JIS〉



❶	Manufacturer's band or name
❷	Standard abbreviation
❸	Manufacturing method
❹	Dimensions (outside diameter × thickness × length)
❺	Inspection number (serial number)
❻	Heat number (molten steel number)
❼	Country of origin
❽	JIS mark
❾	Certification body code
❿	Type code
⓫	Works abbreviation
⓬	Date of manufacture (month/two low-order digits for year)

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